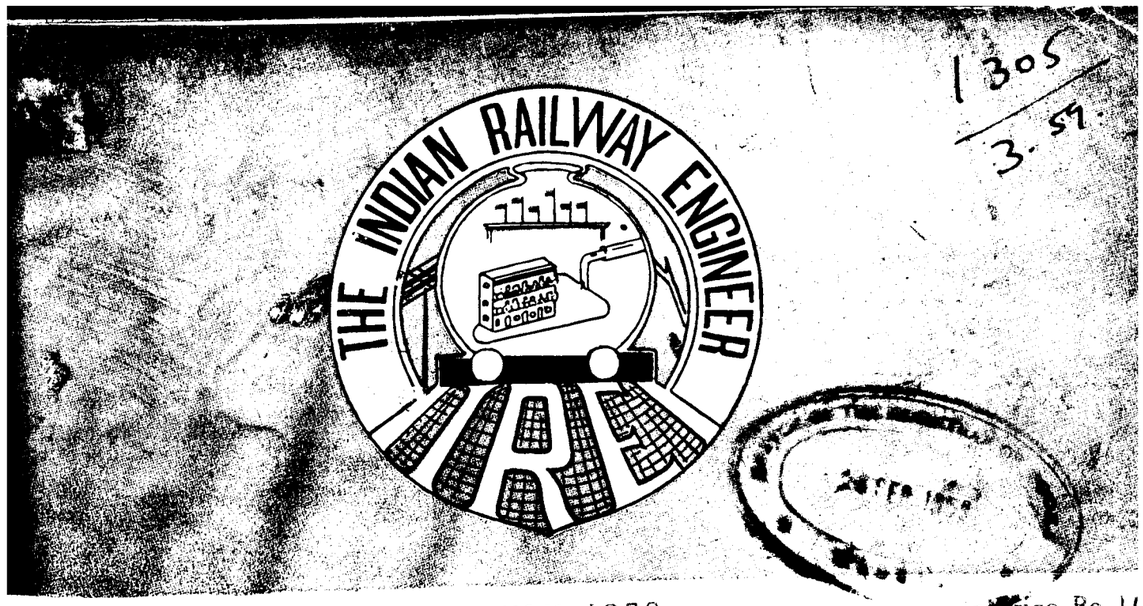
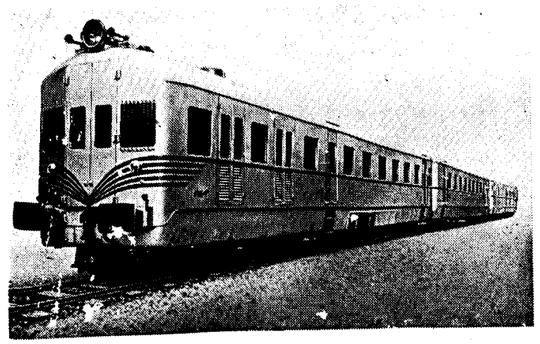


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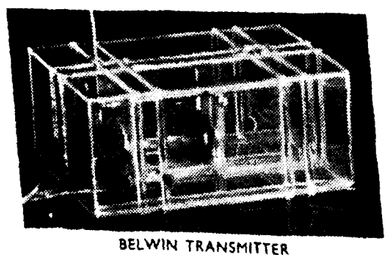
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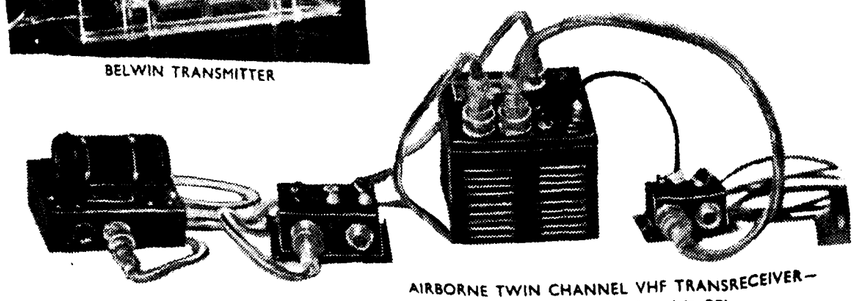


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Railway Workshops and the Young Generation

YOUTH is a period of activity and daring and for this reason we speak of the dynamism of youth. Young men generally want to be up and doing and nothing smothers and dampens their enthusiasm and initiative as inactivity. They often rebel and exhibit a spirit of intolerance if conditions are static for too long a period.

It is, therefore, good psychology and a matter of vital importance that young men in Railways whatever their status in their profession or trade, should be kept ever occupied doing something which will be profitable both to themselves and the Railway which they serve. Work only, with no play thrown in between can make Jack a dull boy and for this reason the Administration should encourage sports and games, technicians' associations, technical libraries, handicrafts and model making societies, which can divert in useful channels the energies of the young people.

It must be remembered that the young men of to-day are going to be the leaders of to-morrow, each in his respective field of work and on them will depend the future success or failure of our Railways.

It must be conceded that all young men who join the Railway service to-day come to it better qualified and better equipped to do the work imposed on them than their predecessors of 20 years ago. Inspite of their youth, they appear to be more intelligent, better informed on all matters and more worldly-wise than their colleagues of an earlier generation.

Taking the young Mechanical Engineers for a start in the official grade of the Railway Service, they are selected as a result of a competitive examination after they have passed their Inter-Science. They are then given a seven years training as Special Grade Apprentices, where both their theoretical and practical syllabus is laid down to fit them in every way for superior service in Railway Workshops. In addition, before they are confirmed in any working post, they have to show their intelligence and aptitude to do railway mechanical engineering work for a period of 2 to 3 years by being attached to Senior Officers in various posts. By this time, they must win their spurs if they are to be retained in Railway service.

Compared with this, their English predecessors in workshops, were mostly practical men with hardly any theoretical qualifications. Many of them had risen from the stage of workmen, who had worked on various trades with their own hands. They came out to man the Indian Railways because there were no Indians either theoretically or practically qualified to hold charge of posts which they held. These Englishmen generally worked by the rule of thumb method, but they were endowed with both common sense and engineering sense. Their knowledge of Mathematics or Applied Mechanics, never reached beyond the apprentice stage, so that they could never work out a design problem using first principles. They had a very poor idea of stresses and strains to which locomotive or carriage and wagon parts were subjected. If a loco-

motive piston rod or connecting road they increase the dimension by an eighth or a quarter of an inch without checking it for factor of safety theoretically. All they were concerned about was that the increase in dimension did not make the part foul any other.

It is reported in the annals of railway history that when a young theoretically well qualified Indian Officer was confronted with a failure of a locomotive detail, said to his Head of Department "but sir, I find that this particular part is weak in design working it out by the Euler Formula, it should be increased in diameter by 1/8th" he got the reply "sho is Euler anyway to give you these ideas, but you can increase the diameter by what you say provided that due to the increase the part will not foul anything else."

It must, however, be conceded that in spite of their lack of theoretical knowledge in engineering matters, these Englishmen, drew largely from their practical training and experience. It played the same role in their life as intuition is supposed to play in the life of a woman. They knew by a practical engineering sense, without being able to account for it by theoretical working that something was wrong and they knew what was to be done to put it right, although they could not give a theoretical explanation for their action.

They had a poor command of their own language and to write a coherent Report of more than 20 lines, on any aspect of railway working was to them really irksome and a severe penance.

Our young Engineers, when they reach the Official Grade of the railway ladder, do not suffer from the same disability and given the same opportunities, they would be able to outshine their English predecessors in all departments of railway mechanical engineering, except in the elusive faculty called 'engineering sense'.

It is because the young officers of to-day have such an excellent background of mechanical and mathematical knowledge they should be entrusted with greater engineering and management responsibility and it will be found that they can well shoulder it, as it was proved during the years of the 2nd World War. They should be given opportunities to gain practical knowledge and experience both in this country and abroad, so that with their basic engineering knowledge and training, they could observe and remember how things are done abroad and introduce suitable advance methods in their own workshops, where they hold certain charges. In this way they could rise to higher rungs of their departmental ladder of hierachy steadily and yet quickly.

So much for officers, but what about the men in the junior and senior supervisory grades? If a shopwise analysis is taken, it will be found that the old supervisors have developed certain fixed habits and find it difficult to contend with changes, modern supervision demands. Undoubtedly after years of working they know their jobs, but they have got into a rut of routine working and want to be left there in peace to pass the rest of their days. Some of them do not aspire to higher positions of responsibility and would be satisfied to retire from their present position with-

out any additional exertion. Expansion in the scope of their activities leaves them cold and the introduction of new and up-to-date methods to increase production puts them into a flat spin. They find it extremely difficult to meet changed conditions of working or altered methods. They would, if they could get all their benefits of Provident Fund and Gratuity and retire before their time and eke out a peaceful existance rather than face the present exigencies of a dynamic supervision.

No so the younger supervisors who show a better flexibility in working and have a better control of the men who work under them, provided they have been good tradesmen themselves. They are ready to adapt themselves to the changes for the better which may be introduced by an elightened management. They have the courage to face difficulties and overcome them rather than run away from them. They can be relied upon to give better production in spite of the many handicaps that may be imposed upon them. They are not overcome by fatigue by the end of the day as their older colleagues and what is more, after due rest they have wonderful powers or recuperation. It is for this reason that younger supervisors are earmarked for supervision on overtime or night shift.

The younger supervisors start their apprenticeship to-day after passing the S.S.C. or Inter Science, which is indeed a higher standard of education when compared with their colleagues of 20 years standing. Hence their minds work more quickly and they are able to grasp an order of understand instructions without loss of time and execute them speedily. Many of them dare do things in times of emergency which their older colleagues would shudder to think of and get away with it. As the saying goes, it is fortune which favours the brave. Because of their initiative and ability, they naturally receive recognition from the management and in due course receive or are earmarked for promotion to higher grades on merit, which is exactly as it should be in the selection grades.

Having examined the position of Supervisors, let us examine the conditions of the workmen in various trades of the workshop. When it is a question of increased production, it will be found that properly trained tradesmen can be expected to give a greater production or comparable machines or work done by hand. In the strenous trades like those of blacksmiths, boilermakers, they show a greater stamina and are capable of working for longer hours, more willingly than the older tradesmen, who work if they are obliged to do so, very reluctantly.

Their youth and their freedom from encumbrances give them a different outlook of life and they are therefore generally more cheerful and enthusiastic in what they do. If approached in the by the management or their own supervisors, they are prepared to accept orders and execute them more promptly than the older men. Not having got into a rut and with the optimism of youth, they work hard to see recognition and so earn their promotion more quickly. It is in the interest of management to spot these young men and recognise their ability when the time comes for making a selection to the supervisory grades.

Good young workers show a certain lack of responsibility and are not always loyal to the Administration which they serve and unless thoroughly satisfied with wages, conditions of service and chances of promotion are likely to seek employment by which they can better their prospects. This was forcibily brought to the notice of the Railway Administrators during the war years, when their best young tradesmen left the railway service and went into private industry, attracted by the higher emoluments offered there, even if conditions of working were harder and the amenities not so many.

Some of these young workers show early signs of leadership and should be picked up when opportunity offers to fill supervisory grades and it is incumbent for railways to realise in the best interest of work that all supervisors should be chosen by a definite act of selection. Promotion by recognition of merit to the supervisory grades will act as an inducement to work hard, intelligently and concientiously on tradesmen in general and improve the morale of railway working.

In times of strikes or labour disputes, it is the young men who create all the mischief and as they have nothing to lose, are more prone to hooliganism and intimidation of the older workers. The older workers, with much to lose, leave the workshops at the first sign of labour trouble and come back when a settlement is reached. The young workers do not act in a foolish manner because of malice, but by a sense of bravado where they want to show their antagonism to the management and defiance to railway authority. Here again the study of the psychological make up of these budding leaders and handling them in the right way in a firm but concialatory manner.

Before concluding, I must pay a tribute to the older Anglo-Indian Supervisors as one who has worked with them for many years. They were generally excellent tradesmen and may be because of their fairer skin, had a masterly control over their men. In the early days, they may have been a bit arrogant, but after the Indianisation of the official grades, they worked co-operatively with Indian Officers. They were both knowledgeable and obedient, without being subservient or psycophantic. They could be trusted to do a job on time if they gave their word. The information they supplied and the reports they submitted were reliable and could be acted upon with confidence. In loosing this class of Supervisors, India has lost quality workshop supervision which will take many years to build up.

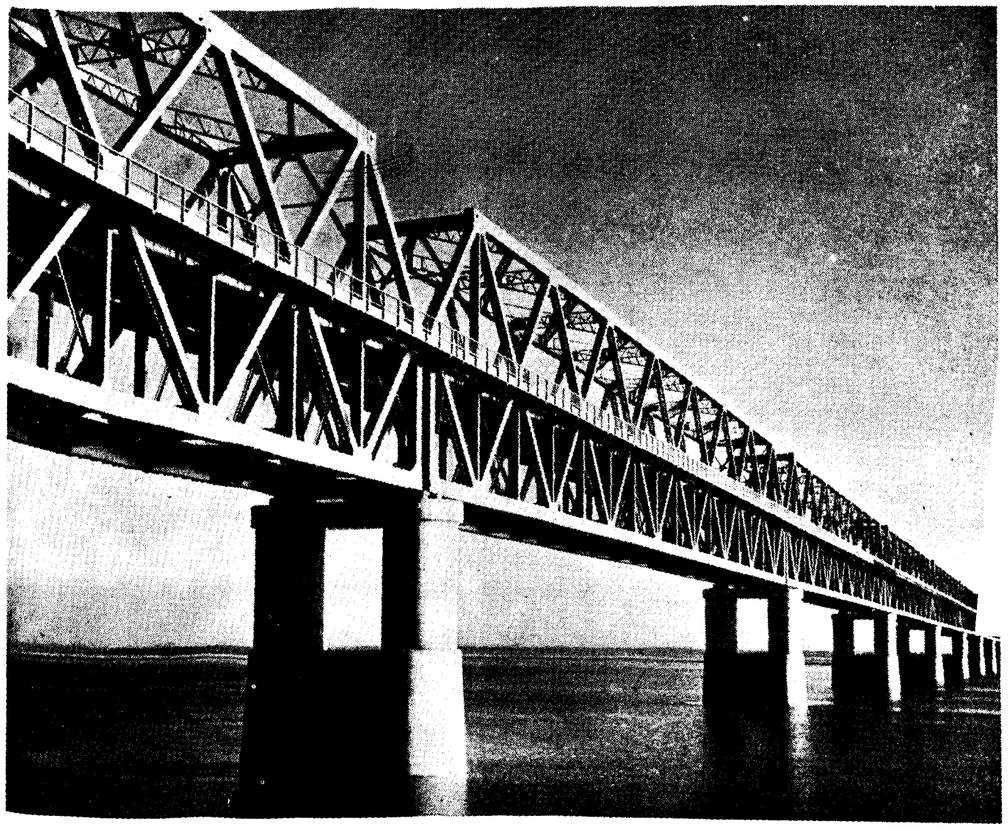
If the Railways of India are to progress and hold their own in the India of the future, it is necessary and incumbent that youth should be at the helm of affairs and for this reason, young men of promise should be watched, encouraged and given such positions in every rung of the ladder, which will test their initiative, ability, responsibility and sense of judgment, which will enable the Railways to undertake the enormous tasks which are likely to be imposed upon them when the country develops her resources in agriculture, industry and oil and mineral wealth.

GENERAL ENGINEERING SUPPLEMENT

Major Railway Bridges in Second Five-Year Plan

By H. K. L. Sethi
General Manager & Chief Engineer, Ganga Bridge Project, Mokameh.

THE Ministry of Railways, realising the importance of providing through communications across major rivers, planned a number of bridges for this purpose during the Second Five Year Plan. However, the most important of these bridges was started in the First Five Year Plan and completed in the Second Five Year Plan. This first bridge has been built across Ganga near Mokameh on which the field work was started in October, 1955, and the bridge was opened by the Prime Minister on 1st May, 1959. This Bridge has been rightly called as the gateway to the prosperity of the North Bihar and its opening has ushered a new era in the history of Bihar. It has attracted the location of an Oil Refinery and a



General view of "Rajendra Pul" on Ganga at Mokameh, Bihar.

big Thermal Power Station near Barauni, which is only 5 miles from the Bridge. The North Bihar is mainly an agricultural area; at present its principal industry is sugar, the annual production being about 200 thousand tons. After the partition the growth of Jute is also receiving considerable attention. There is no coal, cement or steel in North Bihar and all these materials have to be sent from South. The Ganga Bridge will lead not only to the agricultural & industrial development of North Bihar but will also greatly help in the movement of goods to & from Assam, Nepal and to parts of West Bengal north of the river.

2. The Bridge across Ganga built near Mokameh connects the B. G. system of the Eastern Railway on the south of the river with the M. G. system of the North Eastern Railway on the other side of the river. The Bridge comprises of 14 spans of 403 ft. 4½ inches centre to centre and 4 land spans, two at each end of the main bridge, 104 ft. 9 inches centre to centre of bearings. It carries a single BG railway line on the bottom floor and a 14 ft. wide road on the upper floor.

3. In 1949 when the work of the Ganga Bridge near Mokameh was first contemplated, there was a pressing demand from the Bihar State that the bridge should instead be built near Patna. The main engineering objections to the siting of a bridge at Patna were—

(a) Proximity of the confluence of the Sone & Gogra rivers.
It is not advisable to site a bridge near the confluence of a major tributary as varying directions of flow, discharge, velocities and silt carried are liable to affect the safety of the bridge.

(b) Poor soil conditions for the location of Guide Bund.
A guide bund built on soil with interspersed layers of sand & clay is not stable due to unpredictable conditions of scour.

(c) Difficulty in the alignment of the Guide Bund being made parallel to the South Bank.

& (d) Threat of river attack on the South Bank on which Patna is situated.

The question of building a road bridge across Ganga near Patna is now under examination. In view of the serious engineering objections stated above, most careful investigation of this problem would be essential.

4. After collecting sufficient quantity of stone for the river training works, their construction was started in November, 1955. At the same time, the work of foundations was also taken in hand. During



The Prime Minister depressing the miniature lever of a signal that shows the "line clear" for the rail track over the "Rajendra Pul"—Opening ceremony of the Ganga Bridge—on 1-5-59.

the first season of 200 working days, the Guide Bank and the North Approach Bank, involving closure of half of the river, was finished. In this 750 lakhs cft. of earthwork and 250 lakhs cft. of stone were used. Nearly 50% of the piers were also finished during the same period. During the second working season, i. e. 1956-57, the remaining piers were finished. The girder erection could not be started till October, 1957, due to delay in the supply of steel. However, once the erection was taken in hand, the progress was continued uninterrupted. The first material train was passed across the bridge on 23rd February, 1959.

5. Besides the main bridge and its training works, the Ganga Bridge Project had to construct a major BG/MG Transhipment & Marshalling Yard near Barauni to handle 350/500 BG wagons per day, BG/MG Locosheds, 1400 staff quarters, 17 miles of new BG line of main line standard for providing approaches to the bridge from Patna, Kiul and Barauni sides and 5 miles long direct MG link from Tilrath Station of the N. E. Railway to the new Yard. While the earthwork in this Yard was started in November, 1956, the important works were started in October, 1957, and completed by April, 1959.

6. The approaches to the bridge have involved the building up of high banks and approximately 21 crores cft. of earthwork were done departmentally by the Earthmoving Machinery.

7. The bridge, after being tested, was opened to goods traffic on 22nd April, 1959, and to passenger traffic on 1st May, 1959. The actual construction period for all the works including the bridge and its training works has been only 3½ years.

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8. The highlights of the construction of the Mokameh Bridge are :—

(i) Completion of the work nine months ahead of the schedule, and without exceeding the sanctioned estimate.

(ii) Closure of the North Channel of Ganga carrying a discharge of 7000 cusecs in winter.

(iii) Construction of a Guide Bund involving 750 lakhs cft. of earthwork in a concentrated area and the use of 250 lakhs cft. of pitching stone in about 150 working days of one season only.

(iv) Well foundations 190—200 feet below high flood level, the deepest for any railway bridge across a river in the world & finishing of all work in two working seasons only.

(v) Use of high tensile steel in the main girders and welded steel in the floor system resulting in considerable economy in the use of steel. The girders are nearly 25% lighter in weight than the girder for similar spans of orthodox design.

(vi) Erection by the cantilever process making it independent of the vagaries of the water level and the river course throughout the year.

(vii) Departmental working of the Earthmoving Plant, achieving an average availability of 75%, which has been achieved on very few Projects.

9. The other railway bridges included in the Second Five Year Plan are :—

(i) Across Gandak near Sonepore on the N. E. Railway. It consists of 8 spans of 250 feet each ; foundation work of this has already been finished and the N. E. Railway have taken the work of girder erection in hand.

This bridge will remove the present bottleneck, as speed on the old bridge is severely restricted and the number of trains that can be run across it is limited.

(ii) Bridge across Brahmaputra near Pandu (Assam), which will consist of 10 spans of 400 ft. each. The wrok of well foundation was commenced in the beginning of this year. It is expected to be ready by 1962. This bridge will replace the existing ferry, and will thus greatly help in accelerating movements to parts of Assam on the south of river Brah maputra.

(iii) The provision of a second bridge across Yamuna has also been approved of. It will consist of 12 spans of 150 feet each. All traffic from Bombay side to Ghaziabad, i. e. Western U. P., has at present to pass through the congested New Delhi & Delhi Yards. With the enormous increase in traffic it is necessary to find a by-pass for this traffic, so that goods trains can proceed to Ghaziabad without passing through the congested areas. The Railways are also constructing a big Marshalling & Sorting Yard near Tuglakabad, 12 miles away from Delhi in this connection.

Leclanche Type Inert Cells

It may be recalled that the Indian Standards Institution had issued, in 1951 Specification for Leclanche Type Inert Cells, currently used in India for tele-communication purposes. Since then, IEC has progressed considerably in its work on primary batteries. With a view to aligning the original standard with the IEC publication No. 86, Recommendations for Primary Cells and Batteries, the Indian Standards Institution has now issued a revised Specification for Leclanche Type Inert Cells (IS : 267–1958) which lays down the dimensions, tests and performance requirements of Leclanche type inert cells.

Certain important changes have been made in the revision. All references to internal constructional details of the cell have been deleted ; and the standard now deals only with the dimensional and performance requirements of the complete cell. Definitions of terms, originally included as part of IS : 267–1951, have also been deleted : as these have now been included in IS : 1025–1957 Glossary of Terms of Primary Cells and Batteries.

MATERIALS CONTROL

By D. R. Mukerjee, I.R.S.E.
Controller of Stores, South Eastern Railway, Calcutta

STORE-KEEPING is, by its very nature a negative art : negative in the sense that its real value and importance is realised only when the Stores Supply Organisation has failed or ceased to function. The Storeman's job is anything but spectacular. Unlike his brother executives in other departments, say, the Engineers, he has no solid or massive achievements to show. His work is silent but all-pervading. It is easily comparable to the job of the patient and disciplined souls steadily maintaining the Lines of Communication in rigorous monotony and against heavy odds, to keep their brethren at the front in fighting trim. A more appropriate and homely parallel is the selfless and unremitting toil of the good mother nurturing and rearing up, with infinite care, her young ones whose success in life is her only aim and real measure of her own success and glory.

Modern Scientific Store-keeping is based on experience, planning and method. Its development on scientific lines is comparatively recent and directly attributable to the growing 'Stores Consciousness' in men at the helm of affairs in Industry. Such a realisation of (i) the importance of Stores, in a manufacturing or Repairing Organisation and (ii) the essential need for a well managed Stores Department exercising proper control in the procurement, inspection, storage, issue and distribution of Stores is almost inevitable. With the monopolistic days of practically all industries left well in the past, proper application of 'materials control' which ensures smooth and economic supply of materials, economic production and maintenance of efficiency and standard and quality in production, is an essential requirement of modern planned management.

MATERIALS CONTROL

Materials Control can be defined as the care and control exercised at different stages of the stores-handling cycle, through well-tested methods and planned procedure to ensure timely and economic procurement of stores of proper standards and quality, timely recoupment of stocks, proper storage of materials and maintenance of adequate stocks with the least possible capital block and prevention of losses due to deterioration in stock, obsolescence or formation of surplus.

The principal aspects of 'Materials Control' can be broadly detailed as—

I. Inventory Planning and Control
II. Purchase Planning and Control
III. Stores or Stock Control
IV. Techniques used to prevent losses and periodic evaluation of stocks.

I. INVENTORY PLANNING AND CONTROL

Inventory Planning is designed to ensure continuous maintenance of adequate stocks of materials which are regularly in demand and prompt issue of such materials on demand.

As a rule, items of material to be brought on the Stock Lists are suggested by the Consuming Department under a formal official request from competent authority. Such requests have to be completed with all details viz. the items to be stocked, their complete standardised nomenclature, reference to Standard Specifications and/or drawings, justification for stocking the items and if these items are to replace old stock-items, how the present stocks of the latter are to be worked off. The Store-keeper also has to keep a close watch on the demands for non-stock items and properly examine those items frequently repeating themselves and take them on to his Stock Lists if sufficient justification exists. A new item is added to the List after great care and scrutiny have been exercised. The Indentor is invariably requested to make do with a near-size stock-item in place of the item of a particular size suggested by him or frequently demanded by him before the new item is put on the List. He has also to completely satisfy the Store-keeper about using up the current stocks of an outgoing standard before his suggestion for stocking a new standard is finally accepted.

To ensure correct indenting and prompt compliance with requisitions, Price Lists or Catalogues containing

the stock-items arranged in alphabetical order—and usually compiled on class-wise basis—are circulated to indentors. The essential features of the Price Lists or Catalogue are—

(i) Price List Number.

(ii) Standard nomenclature of stores (This has to be complete and unambiguous. As a standard practice, the order followed in the nomenclature is : Basic commodity, specific kind, use, peculiarity of size or shape and particular size or dimension e. g. Glass Sheet white, 32 ozs., 20"×18¼")

(iii) Specification or Drawing Reference

(iv) Unit of transaction

(v) Stocking Depot

& (vi) Book Rate.

The Book rate is of incalculable help to the Indentors in framing of their Estimates with reasonable accuracy. It is necessary, therefore, to amend these rates and issue Correction Slips whenever prices obtained on averaging prices according to entries in Accounts Priced Ledgers exceed a certain plus/minus limit compared to the published Book rates.

Price Lists to be of real value to all concerned have also to be reviewed from time to time and brought up-to-date after working out necessary modifications reflecting recent developments in Industry, new standards of machines and appliances introduced in the Indentor's Workshops and price variations.

The stocks in the storage Depots are, for convenience and proper control, kept in different groups or Wards each controlling a number of classes of stores on the basis of their nature and use.

Transactions of Stores in a Depot are recorded in Card Ledgers maintained by it. The accountal is only numerical and hence these Ledgers are called Numerical Card Ledgers as distinct from the Accounts Departments' Priced Ledgers which in addition to accounting for number or weight also show the priced valuation of the stocks on hand. The Depot Numerical Card Ledgers are used for recoupment of stock, disposal of surplus and periodical stock Verification, whereas the Accounts' Priced Ledgers are utilized for raising debits for issues made, affording credit to suppliers and finding out the Stores Balance i. e. the Capital at block. Revised Book rates—when such revisions are called for—are also worked out on the basis of average price of the current holding from the entries in the Priced Ledgers.

II. PURCHASE PLANNING AND CONTROL

Purchase planning is necessary for proper utilisation of the capacity of the Purchase Section as well as to ensure spreading of the load uniformly over the year not only on this Section but also on other nodal points viz. Receipts and Inspection Depot and the Accounts Department's Bill Section.

This planning in the case of the Indian Government Railways, is carried out, for different items of stores, in slightly different ways as briefly explained below—

(i) For Stores to be obtained through the agency of the D. G. S. & D., Indents are submitted strictly in accordance with his Time Table set for the purpose, several months ahead of the actual contract period.

(ii) Where direct purchases are to be made for more than one depot, annual Contract Statements are obtained from all depots according to a time table and final purchase arrangements are made after bulking the depots' requirements.

Where however only one Depot has to be fed as in the case of the S. E. Railway's Depot at Khargpur with as many as 22,000 stock items, a time table for recoupment is not necessary. Recoupments are made by such a Depot according to the normal Stock Control method—based on proper maximum and minimum limits and the work load is generally found to be evenly spread over the months.

Control in Purchase is exercised in a number of ways as detailed below :—

(A) CHECK ON DEMANDS OR REQUISITIONS

The following check is carried out on each requisition after it is registered—

(i) that the description of Stores required is clear.

(ii) that it shows the relevant Specification and/or drawing, reference and in case of certain special items it also shows the approved brands.

(iii) that dimensions or sizes, if necessary are clear.

(iv) If purchase is to be made according to a drawing whether copies thereof are readily available.

(v) that the allocation i. e. Accounting Head chargeable is clearly specified and certification of necessary fund is incorporated in the requisition.

(vi) that the requisition has been routed through the Stocking Depot concerned.

(vii) that it is signed by an Officer authorised for the purpose. (Different grades of Officers carry different authority for signing requisitions of different values).

& (viii) that in case of a proprietory item, necessary certificate from a competent authority is there.

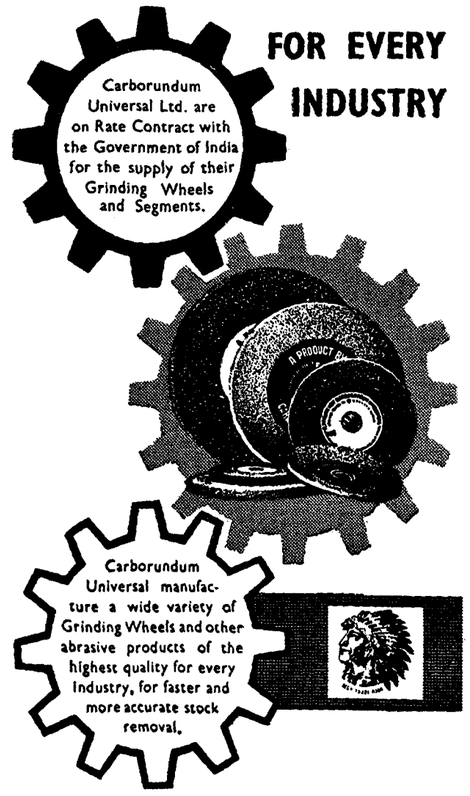
(B) ISSUE OF TENDER NOTICES

Tender Notices (usually called Tenders in common parlance) are issued on Single, Limited or Open Tender basis strictly according to rules prescribed in this connection.

As a rule, Open or Advertised Tenders are issued against requisition valued over a certain (estimated) value. For the Indian Government Railways this limit is Rs. 10,000/- at present. In case of urgency, limited tenders above this limit may be issued but only after obtaining sanction from competent authority.

Limited tenders are usually issued through periodical bulletins. In cases of urgency or stores of a highly specialised nature, special limited tenders are issued. In case of extreme urgency 'per bearer' tenders are issued under orders from a competent Officer. Single tenders are issued in case of proprietory items and against small demands (say Rs. 150/- or below) supplies generally are arranged through cash purchases.

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BOMAS CUZ-46

In case of an item for which there is a Rate or Running Contract let out by the D. G. S. & D., a Supply Order is placed against the Contract on receipt of the demand.

(C) ACCEPTANCE OF TENDERS

This responsibility has to be discharged with care and judgment by the Purchasing Officer acting within his specified range of power. Strict rules exist in all Purchase Officers for the opening, sorting and marking of Tenders and handling and keeping them. These must be observed rigidly and the entire work carried out in an atmosphere of fair and keen competition with the real interest of the organisation (or Company) always kept in view.

A careful check on a number of points has to be carried out before finally accepting a Tender and placing the Purchase Order.

Purchase Card Ledgers. For proper control of Purchases and expeditious work, the Purchase Office invariably maintains records of past purchases in Cards kept either in Loose Leaf system or in Card Index Cabinets. In a Card-Index Cabinet, usually two Cards are maintained for one item of Stores: one the Top Card for recording comparatively more permanent information e. g. Specification or Drawing References, Approved brands, previous years' consumption, List of Suppliers etc. and the other the Bottom Card for recording details of Purchase Orders placed.

Schedule of suppliers. To facilitate purchase through limited tenders which account for the bulk of purchases *at least* in number, a Schedule of Suppliers—both Stores-wise as well as Supplier-wise—is maintained. Care is taken to see that for each group or Class adequate numbers of Suppliers including as many leading firms in the line and especially as many manufacturers as possible, are borne on the Schedule. New Suppliers are taken on after proper enquiry in accordance with strict rules laid down for the purpose. The Schedule is kept up-to-date—by following a continuous process of eliminating unreliable firms on the basis of their performance and registering new firms with proper resources and capacity.

III. STORES OR STOCK CONTROL

For a Store-keeper this is the most important function. He is expected to carry, all the time, adequate stocks of widely differing range of materials, sometimes running into several thousands in number, look after them properly and make issues to the consuming departments *on* receipt of their demands without running out of stock and manage the whole affair with the least amount of Capital blocked in stores held in stock. The Capital block involved in the Stores Balances represents non-productive capital with corresponding loss of interest and liability for depreciation and obsolescence charges.

The responsibilities of a Store-keeper, therefore, are heavy, complicated and at the same time great and vitally important.

Thus, considering the responsible and pivotal position that he holds, a Store-keeper should be selected with the greatest of care and judgment. A wrong selection may mean, without anybody knowing it for months, considerable loss and lowering of the efficiency of the entire org anisation.

Actual Stores control is exercised by fixing proper Stocking Limits after careful study of a number of factors and considerations e.g. past consumption, time taken to obtain fresh supplies, storage capacity, economical batch for purchase and nature of the item etc. For past consumption usually the consumption during the last twelve months are taken into account. In some cases even a longer period is taken. Past consumption, however, is not a guide for certain items e. g. newly introduced items, items gradually becoming obsolete, items replacing old standards and items of a seasonal nature.

For a correct computation of consumption certain issues for obvious reasons, are not to be taken into account and these are issues on Capital account, issues against non-recurring revenue demands, issues made in lieu of the standard stock items, issues on transfer to sister depots. Stores drawn but subsequently returned by an indentor should not also be taken into account. In order to distinguish these issues from normal issues, usually such issues are posted in a different ink or entered in a bracket in the Depot Card ledgers.

RECOUPMENT

The principle followed for scientific stock control as followed on the Indian Government Railways, is asking for recoupment of stocks at the safe lowest level (known as the Minimum Stock or Stock Order Point) and obtaining the supply just before the old stocks are depleted. The maximum quantity that is normally asked for at a time is known as the *Maximum* Stock fixed on operational and economic considerations.

STOCKING LIMITS

The MINIMUM is thus fixed on a level equal to the consumption for the period taken by the replenishment to arrive from the date of recoupment. Thus arithmetically,

Minimum— Consumption for Unit-period (week or month) × No. of unit periods required to obtain replenishment supply.

Minimum for an item is actually fixed on experience and is solely determined by the nature of the item, market conditions and the situation of the depot in relation to the market or source of supply.

As can be guessed, an artificially higher minimum will result in temporary over-stocks and a lower minimum will mean no stocks for sometime.

The MAXIMUM fixed for a stock item is the maximum quantity that can be held in stock at any time under normal conditions. This, under ideal conditions, also denotes the maximum quantity of the item that the depot asks for in its recoupment demand.

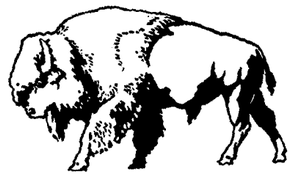
One can manage with a large maximum stock and make procurements at considerably large intervals of time or with a low maximum stock which means more frequent purchases. Both methods have their good and bad points. Obviously a large maximum will mean large Capital block with corresponding large interest, depreciation and obsolescence charges, larger storage accommodation with larger risks of deterioration in stock and formation of surplus and increased maintenance costs.

Whereas a low Maximum will result in proportionately increased work for Purchase Section and Receipts and Inspection Depot. In many cases it will inevitably mean less bargaining power and uneconomical purchases.

Thus the maximum level has to be fixed carefully and judiciously after considering all the factors involved. And these are :—

(i) Capital block (ii) Storage accommodation (iii) Load of work on Purchase Section and Receipts and

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Inspection Depot (iv) Nature of the item (e. g. pinchable stores, costly and non-ferrous metals, stores quickly deteriorating in stock) and (v) optimum quantity to ensure economical purchase.

EFFICIENCY OF OPERATION

To keep a check on the Stores Balances in relation to the consumption—usually a ceiling—expressed as a percentage of the total annual issues is fixed and the depot is expected to operate within this limit. For the Indian Government Railways, this limit for Stores Balance before the last War used to be 40% of annual issues but in view of the present market conditions it is not possible to work to this limit. On an average, Indian Government Railways individually are working with Stores Balance at 60 to 70% of their annual issues.

RECOUPMENT FORMULA

The depot has to religiously follow the procedure and formula prescribed for recoupment. The principle followed in this connection is to recoup one maximum when the stock reaches the minimum level so that the stock is about to go down to 'Nil' when the recoupment supply arrives.

Thus the quantity for recoupment should be one maximum, under ideal conditions. But ideal conditions are not always there. Sometimes the stock is below *minimum* or even 'Nil' when recoupment is made. At times it may be still worse i. e. there may be pending demands which will mean a minus figure for the current stocks. There may be also outstanding due or dues against previous recoupments. So, taking all these conditions into account, the formula for recoupment works out to :—

Q (Quantity for recoupment) = Maximum + Minimum + Pending demands — (Stock + Dues)

IV. TECHNIQUES USED TO PREVENT LOSSES AND PERIODIC EVALUATION OF STORES :—

(1) Proper Security arrangements : In addition to the essential basic security arrangements in the shape of proper storage godowns and compound walls for the Storage Depot, special arrangements in the shape of Watch & Ward staff and, where necessary, armed guards are provided according to the nature of the stores and value of stocks held.

(2) Gate Pass system for issued materials : A strict procedure has to be laid and strictly followed for passing out stores issued from the Depot. This procedure has essentially to include a proper Gate-pass system and necessary check at the gate by the Gate-clerk and Security staff posted there for the purpose.

(3) Prevention of leakage from stock : Continuous Stock-verification i. e. verification of the ground balance with the Depot Card Ledger balance, is carried out by departmental staff. In addition, a continuous and meticulous Stock-verification in respect of the stocks of all items stocked at the Depot, is carried out by Stock Verifiers of the Accounts Department, in accordance with a set time-table. Furthermore, the Depot Numerical Card Ledgers are also reconciled with the Accounts Department's Priced Ledgers—in convenient batches, right round the year.

At the time of entering new receipts in the Priced Ledger, the average price-rate is worked out after taking into account the balance already in stock and a revised book-rate is fixed, every time the average rate, on evaluation, is found to differ, by more than a fixed percentage (plus or minus) from the existing book-rate.

(4) Loss due to obsolescence and formation of surplus : A close and constant watch is kept on consumption and recoupment of stocks regulated carefully on its trend. Introduction of new types and standards is also carefully watched and as a rule new standards are introduced only after proper arrangements have been made for working off stocks in hand of old standards. Necessary notes are kept on Depot Numerical Card Ledgers for these purposes and timely warning is issued to consumers.

Stocks considered heavy compared to current consumption or moving slowly, are offered to other sister organisations and part of the stocks is disposed of to the best advantage of the organisation.

(5) Loss in storage : Apart from the general precautions taken to prevent any loss in storage due to insecure arrangements or defective ventilation or stacking, special precautions are taken for certain items requiring, by their very nature, special attention and care in storage such as :—

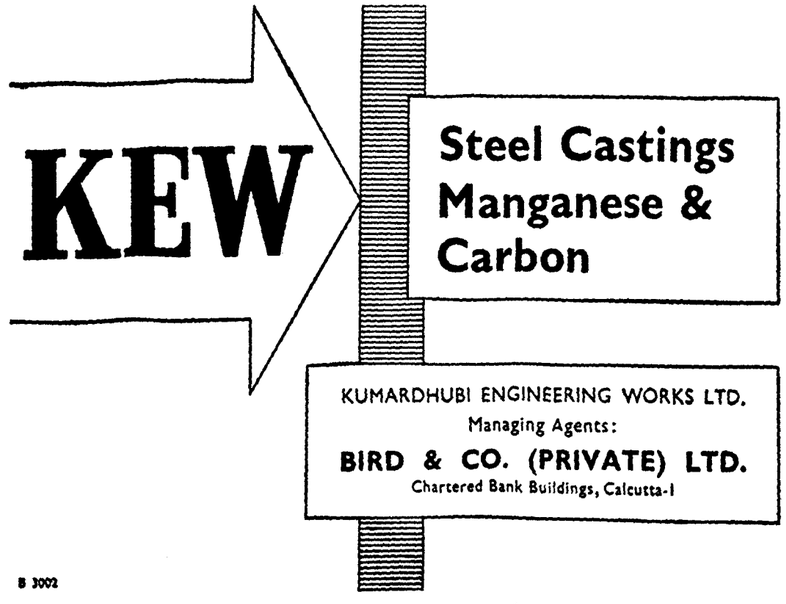
Textile materials, Sheet and Plate Glasses, Leather and Leather goods, Rubber Goods, Acids, Oils, Paints, Petrol, Grinding Wheels, Tools and bearings, Timber, Electrodes, Brushes etc.

(6) Loss due to breakage : Stores-handling appliances and gadgets—where their operation can be financially justified—are used for the efficient handling operations, stacking and transport to adjoining Workshops or Indentors at distant places.

Wrought Aluminium Alloys, Bolt and Screw Stock

An Indian Standard Specification for Wrought Aluminium Alloys, Bolt and Screw Stock, for General Engineering purposes, (IS : 1284–1958) covering the requirements of four wrought aluminium alloys in the form of bolt and screw stock, has just been issued by the Indian Standards Institution.

This standard is one of a series of 10 Indian Standards for wrought aluminium, in various forms for general engineering purposes. The standard is divided into two parts ; Part I gives general clauses for each type of material while Part II gives specific clauses applicable to it. Included in the standard, are a number of appendices covering the determination of 0.1 per cent proof stress ; heat treatment ; summary of mechanical properties, characteristics, forms and uses of some grades of wrought aluminium and aluminium alloys ; and summary of chemical compositions.



Progress of BEL in Retrospect

BHARAT Electronics Limited was set up by Government in the public sector to make the country self-sufficient in electronic equipment in the shortest possible time. Although we started production only by the end of 1956, we have kept up a steady progress since then and it is considered worthwhile giving a review of our activities during the last year.

Our major achievement during the year was the development of a Twin Channel VHF Trans-receiver for air to ground communication for the Indian Air Force. This set is primarily meant for fitment in the HT-2 Trainer aircraft and will satisfy a long felt need of the Air Force, as the aircraft has been without communication equipment all these years. The set was subjected to stringent tests and has been approved by I. A. F. It will shortly go into production. Modified version of the set for Single and Ten Channel operation are under development in our factory.

A Transistorised hearing aid has been constructed and tested in our factory. It has been found to be quite satisfactory, its performance being comparable to any imported equipment and cheaper in price. After further trials this will be put into mass production.

We have also developed a transistorised Loudhailer called "BELHAILER" during the current year. Large demand exists for this popular item throughout the country. It is an electronic megaphone with self-contained power supply and is required by Police, Fire Departments, Defence Establishments, Rail and Dockyards and a host of others as a handy public address system. When we shortly go into production, our output will completely meet the country's requirements.

For the India Meteorological Department, we manufactured 10,000 "BELWIN" Transmitters during the year for upper air observation. Efforts are being made to find foreign market for this equipment.

An agreement has been signed with PYE Telecommunications of Cambridge for the manufacture of their Wireless Set type 62 which is a high frequency mobile Trans-receiver for the Defence Services, who have been importing this set for the last several years. Our production of this set will completely meet the requirements of the services.

Another important agreement signed was with PHILLIPS of Holland for the manufacture of Valves. The Valves standardized by the Radio and Cable Board and accepted by the Radio Manufacturers' Association in India will be taken up for manufacture in the initial stages. The capacity of the plant will be 1.8 million Valves of the miniature type which can be substantially increased by double shift working, if the demands warrant such a step. The annual turnover will be in the order of Rs. 40—50 lakhs when full production is reached. It is expected that the Valves will be available for sale by January 1961.

An agreement is shortly to be signed with M/s. SIEMENS and HALSKE of Germany for the manufacture of high power Transmitters which will help to conserve our country's foreign exchange as there is an urgent need for such Transmitters in the Defence Services and other Government Departments.

Our Crystal Division now completely manufacture Piezo Electric Crystals which are critical components required to stabilize the frequency for all types of electronic equipment.

The Transformer section is well equipped for the design and manufacture of a wide range of high quality Transformers and Chokes including power transformers smoothing Chokes (sealed and oil filled types) suitable for a wide variety of electronic applications. All Transformers and Chokes required for our equipments are produced in our factory.

There has been a steady increase in production during the year under review which amounted to Rupees 65 lakhs as against Rupees 26 lakhs during the preceding year. For the year 1959-60, we have plans to produce equipment valued at over a crore of rupees.

SIGNALLING, INTERLOCKING & TELECOMMUNICATIONS SUPPLEMENT

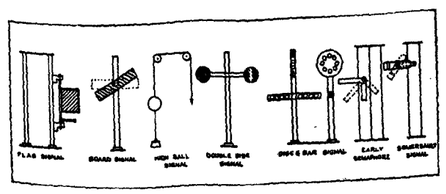
Signalling and Tele-communication Practices on Railways

By T. S. Parthasarathy
Divisional Superintendent, Southern Railway, Hubli

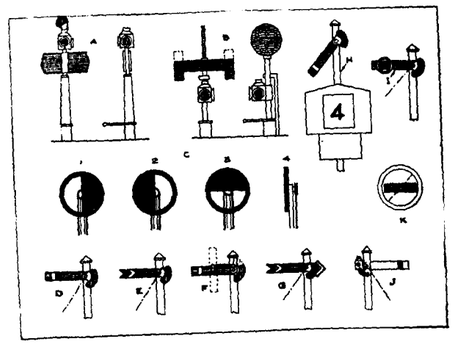
HISTORICAL

THE fundamental purpose of a signal is to convey a message to the driver. The semaphore signal, familiar on nearly every railway, is in effect a 'telegraph'. It conveys, by its position, messages and instructions to enginemen, thus serving the same purpose as the old semaphore telegraphs used to before the days of electricity for sending messages from hill to hill and so on, for hundreds of miles across country.

But the railways did not begin with the semaphore. Flags and lamps shown by 'policemen' in top hats were the signals and signalmen of early days, and later all sorts of queer contraptions were used, some of which are still employed, though in improved forms, in many countries. The illustrations appearing in this article show several examples of these. There were various shapes of boards; if they showed broadside, the driver interpreted it as indicating "danger"; if turned endwise, to be more or less out of sight, the signal was "clear". Another type had a big disc with openings and according to their position, a different meaning applied. The disc and cross-bar signals were, however, most generally employed. One of each was fitted at right angles, so that when the disc showed broadside and the cross-bar was seen endways, the indication was "clear"; the cross-bar showing and the disc endwise meant "danger". Lamps moved with these to show red or green



Early Signals

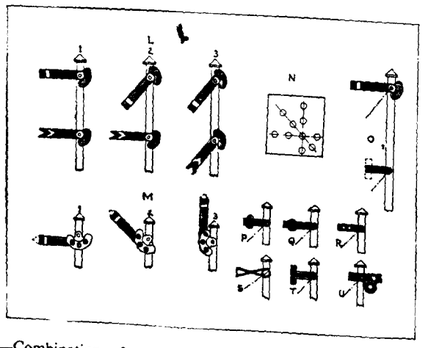


A, B, C—Early forms of signals, D—Ordinary Semaphore, E—Ordinary Warner Arm, F—Somersault Signal, G—Warner with Fish-Tail Reflector on Lamp, H—Route Indicating Signal, I—Slow Line Signal, J—Back View Signal, K—Banner Signal.

(or white) according to the way the signal was turned.

Most of these signals were worked independently and the "policemen" had to go to each to operate it. The approach was rather negative as the object was always to 'stop' a train from coming in. Usually trains ran on the "time interval" method. If a train had been gone ten minutes, the driver of the next train was warned to proceed carefully; if longer, he was told he could expect a clear run. Balls and baskets raised on poles were other devices used and arrow signals sometimes showed, by the way they pointed, the direction for which the lines were set at junctions.

The first semaphore signal was, naturally enough, introduced in Great Britain and for some time signals had three positions—horizontal meant "stop", inclined downwards indicated "caution" and dropped right down so that the arm disappeared into a slot in



L—Combination of outer and warner, M—Upper Quadrant Signals, N—Light Signal giving Semaphore Indications, O—Calling-on Arm, P, Q, R, S, T—Shunt Signal, U—Dwarf Signal.

the post and was out of sight showed "clear". A red light was used for stop, green for caution and white for clear. Hence the rhyme :

"White is right ;
Red is wrong ;
Green is gently go along."

Signals were still worked independently, but here and there several were grouped together and the "policeman", as he was called for several years, had a little hut on top of which the signals were placed. This was the origin of what are now called "cabins" or "signal boxes". But the grouping of signals suggested that they might be fitted with mechanism so that a signal could not be lowered if one which conflicted with it was off. This brought the first interlocking into existence so that incorrect signals could not be given and signals could only be lowered if the points were properly set.

All this may sound crude and primitive nowadays, but it must be remembered that trains were not frequent and a policeman had to depend very much upon his knowledge of the trains and his commonsense, while drivers had to be always on the look-out for possible danger. Moreover, there was no electric telegraph for sending messages.

PRINCIPLES OF SIGNALLING

Safety was undoubtedly the original purpose for which signals were installed and the fundamental principles were centred around this original purpose, although in actual application it is impracticable to separate the principles pertaining to safety from those pertaining to facility of train movement and since they are so inter-related, they will be stated below without regard to either safety of train movement or the facilitation thereof.

The principles given below are fundamentals of fixed signalling regardless of whether they be of the semaphore, colour light, position light and colour-position-light type.

Modern signalling is developed from three fundamental indications :

(1) Stop.
(2) Caution.
(3) Proceed.

The principles behind the design, construction and installation of signals and of train operation are as follows :—

Reliability :—This requirement is given priority over all other factors so that safety and facility of train may be obtained.

Uniformity :—To avoid confusion in the driver's mind and possible delay to trains, uniformity in aspects and indication is necessary.

Expansive Capabilities :—Light traffic and simplicity in track layout require a less elaborate signal system than does heavy traffic and more complicated track layouts ; however, the signalling for the light traffic or simple track layout should, for economic reasons, be capable of expansion to provide for increasing traffic to the ultimate capacity of the railway.

Simplicity :—Consistent with requirements, simplicity is an important factor in the design and construction of a signal system.

Distinctiveness :—Signal systems being of different kinds the signals used in each system should be distinctive either in design or making so that they can be readily classified.

Limitation :—By limitation is meant the restriction imposed by the indication given by the signal such as stop at next signal, pass next signal at restricted speed, proceed at slow speed, etc. Limitation as transmitted by the signal indications should be readily understandable for safe movement of trains.

Signals are an insurance against accidents and the

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SERVICE — RELIABILITY — SAFETY

TYER & Co. LTD., the oldest firm of railway signal engineers in the World, with the first name in signalling, is proud of its unexampled record of service and of its instruments record of safety and reliability. The Company's new Works at Merrow Siding, Guildford, Surrey produce a range of equipment based on the design policy of : "Unit construction–interchangeability–standardization of parts" Up-to-date production techniques include for die-cast light alloys, thermo-setting and thermo-plastic mouldings and rust-resisting alloy steels ; all ensuring long life, reliability and low maintenance.

KEY TOKEN APPARATUS
for single line block control, including the "Co-operative feature of a token being released after the acceptance of a train has been indicated at the receiving station.

AUTOMATIC TOKEN EXCHANGER
apparatus catering for all speeds and all types of engines.

DOUBLE LINE BLOCK APPARATUS
for use with One, Two or three Line Wires catering for all types of Lock and Block requirements.

ARM AND LIGHT SIGNAL REPEATERS
as separate or combined units Thermal expanders to suit all types of signal lamps.

TERMINAL AND FUSE UNITS
with plastic or ceramic bases with or w/out connecting links.

COLOUR LIGHT SIGNALS
two, three or four aspect types to suit all requirements light in weight and cost.

THEATRE TYPE ROUTE INDICATORS
with provision for 49 high, or low voltage lamp units in 7 Horizontal and vertical rows which include for the figure 19.

LAMP INDICATING UNITS
with flat, bulbous or stencilled roundels - all colours can be supplied as multiple units for shelf or wall mounting.

DIAGRAM PANEL UNITS
flush panel fitting coloured lozenge type cap held to the panel by it's lamp unit.

RELAYS
all types, track, line, polarized, thermal, interlocking, standard terminals and sealed cases.

CIRCUIT BREAKERS
"microjust" two, four or six way with plain or "Oilite" bearings long or short contact segments, with all types of drive arm and connecting links. Can be provided with the controlled drive feature ensuring "return to normal" should the unit become disconnected.

LEVER LOCKS
for all type lever centres, gravity or forced drop with or w/out circuit controllers.

ELECTRONIC DEVICES
to suit all requirements.

TELEVISION
closed circuit type for engineering purposes.

Telephone and Telegraph apparatus, Hand Generator units, 12 volts, Testing Panels, all types.

Plunger Switches—single change-over with fibre glass cover and nylon actuating bobbin.

AUTOMATIC TRAIN CONTROL EQUIPMENT, with permanent and energised track inductors including : Driver's Control Unit, Change-end switches and Reset plunger device.

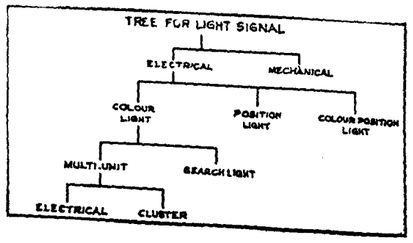
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Tree for Light Signals

money spent on providing them should be treated as the premium. It is the duty of railways to take their patrons safely to their destination and signals ensure this. Leaving apart this aspect, signalling gives speed of movement and greater operating capacity. They might have been originally put in to stop trains but the present accent is on their keeping trains moving. A great majority of accidents is due to the failure of the human element and the introduction of signalling reduces this to a minimum.

The main principle is that when a signal is given

(a) the section in advance is clear,
(b) the road is held in position, and
(c) no fouling movements take place.

The instrument should show a danger signal if anything goes wrong and a driver should have sufficient time to pull up a train if the next signal is at danger. No signalling system should be treated as infallible but all the essentials must be embodied in it. There should be track circuiting if possible or its equivalent and if not, control must be exercised through fixed signals. Track circuiting marks the most important stage in the development of signalling in block systems. The following are some of the trends of modern railway signalling based on continuous track circuiting.

(1) Closing of unnecessary signal cabins.
(2) Extending the sphere of control of signal boxes.
(3) Dispensing with lock bars.
(4) Introduction of power signalling at busy locations.
(5) Introduction of automatic signalling on single and double lines.
(6) Absolute-permissive block working.
(7) Centralized Traffic Control.
(8) Automatic Train Control.

TYPES AND ASPECTS OF SIGNALS

The two-position semaphore is still perhaps the most widely used signal in the world. In U.S.A., the early employment of electric motor operation enabled them to make wide use of the three-position semaphore (mechanical operation of this type involves accurate positioning of the arm). The general tendency throughout the world now is to adopt the light type signal whenever power operation is available, so obtaining the advantage of consistent day and night indication, fog penetrating power and simplicity of construction and maintenance. The light type signal is employed in two basic forms, i. e. colour light and position light. The former is almost universal for running signals and the latter is increasingly being used for shunt signals (thus avoiding incidentally the possibility of conflict between the two types.) Colour light signals use red, yellow and green lights in various combinations to convey the required information. Position light signals for shunting have two lunar white lamps disposed horizontally (stop), 45° from horizontal (clear, caution) and vertical (clear). In some countries, one lunar white and one red lamp are used for the stop aspect.

In a three-position signal, the aspects should be clear and the margin of error as low as possible. In a lower-quadrant two-position signal, even a drooping signal at an angle of 60° will give a 'clear' indication.

In a two-aspect territory, the driver almost feels his way through from signal to signal and is constantly kept guessing about the indication of the next signal. In a multi-aspect territory, he gets, at every signal, an indication of the position of the signal in advance. Red is preceded by yellow and there is sufficient braking distance before a danger signal. Two yellow lights give a less restrictive indication than one yellow light because if one of the lights goes out, a more restrictive aspect should be presented. There is divergence of opinion regarding yellow always preceding red but it is really a sound principle.

The attention aspect tells the driver to reduce speed and look out for the indication of the next signal. This gives a closer headway on sections where traffic is dense.

The inherent defect of a semaphore signal is its inconsistency of indication, i. e. a signal arm by day and a light by night. In colour light signalling, this

PYE V.H.F. all along the line

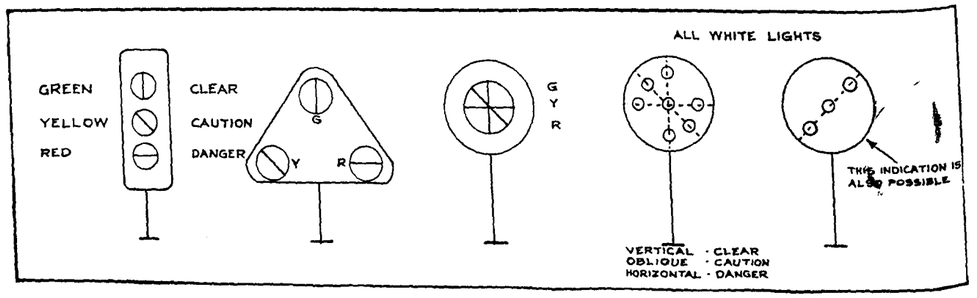


Pye V.H.F. Radio-Telephone equipment in use in a locomotive cab.

Railway systems the world over are now discovering the many advantages to be obtained from radio communication between locomotives and signal boxes, and end-to-end train communication similar to the American systems. Suitable for main-line and yard work, Pye V.H.F. AM and FM Radio-Telephones are currently being supplied to British and Overseas railways, and provide the means to pass accurate, immediate information to operators, thus achieving peak efficiency, greater safety and smoother running. For maximum safety, signals should always control actual movements. Operation in yards and engineering works is considerably simplified and more efficiently conducted by the use of V.H.F. Radio-Telephones. Pye Telecommunications Ltd., will be pleased to advise on any problem or scheme.

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Types of Light Signals.

is overcome to a considerable extent as we have only lights both day and night.

COLOUR LIGHT SIGNALLING

The semaphore signal has served its purpose well, but it has its limitations due to height, length of arms and moving parts. Its practical use was further complicated in that two entirely different aspects were used, one by day and the other by night. An effort was made to devise some arrangement whereby the same aspects could be displayed both day and night. Originally this effort was along the lines of illuminating the semaphore arm to make it visible at night rather than make the coloured lights visible during the day, due chiefly to the limitations of oil lamps.

With improved methods of producing electric lamps, renewed efforts were made to solve the matter of uniform day and night signalling. The light signal was developed in 1904 and was arranged to display indication equivalent to those given by the semaphore signal at night, but as there was no moving arm to change the colour of the roundel in front of the light, it was necessary to use individual lamps behind the proper coloured lens to give the various indications.

From the fact that light signals as originally developed required no moving parts other than the relays controlling the different lamps, it was soon recognized that there was a distinct advantage in their use over the semaphore signal, which on account of the large number of moving parts, required considerable labour and material to properly maintain them. It was also found that by using lamps of sufficient wattage, proper lenses, reflectors and backgrounds, light signals could also be used in daylight to display the same aspects by day and night.

The range and spread of light signals vary considerably with the type of lamp used. The more distributed the filament, the greater the spread and the shorter the range. The more concentrated the filament, the greater the range.

COLOUR LIGHT SIGNALS

As the name implies, colours only are used to give the different indications and these are similar to the corresponding night indication given by semaphore signals; that is red for Stop, yellow for Approach and green for Proceed, with sometimes an additional qualifying light to provide the desired indication.

To meet various requirements, there are a number of different types of colour light signals manufactured, which may be grouped into two classes, viz. long range and short range.

LONG RANGE SIGNALS

Long range signals are generally used where trains operate at high speeds and it is desirable to observe the indication as far from the signal as possible. The aspect of long range signals can be seen from a distance of 2,500 to 5,000 feet in daylight. This long range is obtained by the use of optically efficient lenses and reflectors and by accurate location of the lamp filament at the focal point of the optical system. Maximum efficiency is secured by the use of lamps having accurately located concentrated filaments, by the use of suitable backgrounds and hoods and by careful alignment of the projected beam.

Close-up indication for long range signals is provided through the use of deflecting prisms and where signals are located facing a curve, an outer roundel is

added in front of the existing outer to spread or deflect the beam as desired.

SHORT RANGE SIGNALS

The aspect of short range signals can be seen from a distance of 1,200 feet to 2,500 feet. They are generally used in tunnels, subways and for dwarf signals.

SEARCHLIGHT TYPE

This differs from the units previously described in that all aspects are projected through one optical system. This is accomplished by means of a movable member of the unit, placing a small coloured disc or roundel of the desired colour on the optical centre line of the signal directly in front of the lamp so that all rays from the light source are projected through it.

POSITION LIGHT SIGNALS

For the purpose of eliminating the coloured lights for display of the various signal indications and at the same time provide a similar aspect for day and night indications, the position light signal was developed.

The high signal consists of rows of three lamp units corresponding to the position occupied by the arms of semaphore signals.

COLOUR POSITION LIGHT SIGNALS

This type of signal is practically a combination of the two previous types in that colours as well as positions are utilised, except that two light units are used in a row.

ADVANTAGES AND DISADVANTAGES

The diagram reproduced below shows a "tree for light signals" and illustrations of the various types of light signals have also been furnished. In colour light signalling, the aspects are given by different colours such as green for "clear", yellow for "caution" and red, of course, for "danger". The principle is that the most restrictive aspect of a signal should be at a driver's eye level and hence red is always placed at that level. In a searchlight type, there is only one unit for a three-position signalling and all aspects are at the driver's eye level. If the "attention" aspect is also required, there will be another yellow at the top. In position light signalling, all lights are white lights and vertical means "clear", oblique means "caution" and horizontal means "danger". The advantages and disadvantages of colour light signalling are summarised below:

ADVANTAGES

1. There are no moving parts except in the searchlight type.
2. Painting of arms eliminated.
3. Greater visibility and range under adverse weather and background conditions.
4. Uniform indication day and night.
5. Quick operation of signal.
6. If light signal is of the position type, it eliminates the use of various colour lights and thereby difficulties of colour blindness of the running staff are relieved to a certain extent.
7. Fixation possible at driver's eye level.
8. No risk of false-clear failure due to elimination of semaphore mechanism.

DISADVANTAGES

1. Close up view difficult.
2. Glare at night (can be obviated by reducing voltage).
3. Phantom indication by sun's rays.
4. Limited visibility on curves (can be minimised by using wide-angle lens affording greater spread. This decreases the range but increases visibility on curves).
5. Lamp failures (obviated by (i) double lamps and (ii) standby lamps—caution in rear changes to red if lamp ahead fails).

The same colours are to be used if day and night. The day and night aspects of a position light signal should be such that the position on row of lights corresponds with the position of the arm of the semaphore signal giving the same indication.

The day and night aspects of a colour-position light signal should be such that the colours are the same as the night aspects and the position of the row of lights corresponds with the position of the arm of the semaphore signal giving the same indication.

The greatest bugbear with colour light signalling is the phantom indication. A phantom indication is produced when light from an extraneous source enters the lamp compartment and is reflected back from the interior through the lens combination, thus giving the impression to the observer of an illuminated aspect. When the sun's rays enter the lens, they give an indication that the particular unit is lit.

There are many methods of eliminating a phantom indication and a clear view can be given for 3,000 to 3,500 feet in clear sunlight.

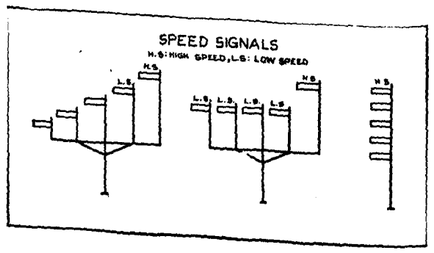
ROUTE AND SPEED SIGNALLING

With semaphore signals, unless speeds are low, it is necessary to provide a separate arm for each route. These arms are placed horizontally in relation to the route to which they apply and their relative height indicates the importance of the route. Where speeds are low (less than 30 m. p. h.) a single arm with an indicator displaying a number or letter to identify the route can be used. Earlier installations of colour light signals followed the semaphore plan for routing but this is now superseded by the use of the junction indicator which employs only the one colour light unit with arms consisting of 3, 4 or 5 lunar white lamps to give the route indication. The use of this type of signal has the advantage of requiring less space and provides the very desirable feature that the driver does not have to pass a red aspect (with separate routing signals, there could always be red lights showing in the signals applying to the other routes). For low speed movements, the character type route indicator can still be associated with a colour light signal.

SPEED SIGNALLING

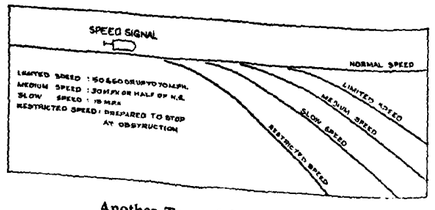
A route signal is interpreted by a driver as an indication applying to a particular line so that he can control his speed and enter the line at the speed fixed by the rules. On the Southern Railway, the entire lower quadrant signalling with bracket Homes is route signalling.

A speed signal is interpreted by a driver as direct information as to the SPEED at which he can safely operate his train in accordance with the route set. A few types of speed signals are shown below :

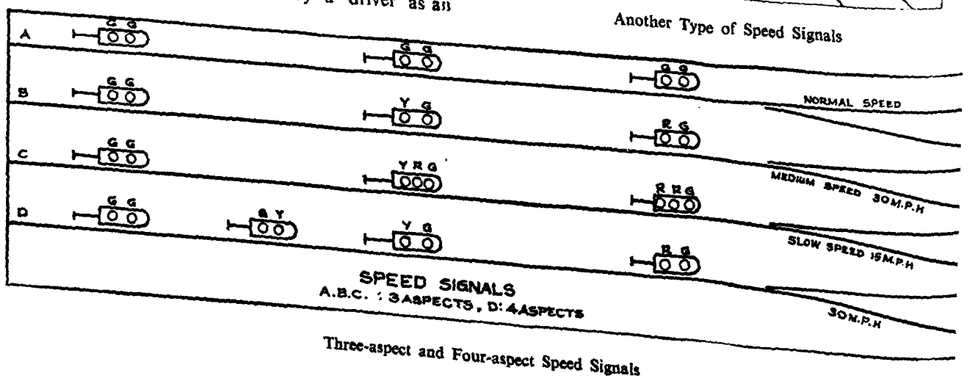


Speed Signals

In turn out of the type shown below, it is advisable to give the driver an indication of the speed at which he can proceed on the route set for him. From this standpoint, the speed signals are more useful than route signals.



Another Type of Speed Signals



Three-aspect and Four-aspect Speed Signals

As speeds are high in countries like Germany, France and U.S.A., the following are usually considered as limited speed, medium speed, slow speed, etc.

Limited speed	50 or 60 and upto 70 m. p. h.
Medium speed	30 m. p. h. or half the normal speed.
Slow speed	15 m. p. h.
Restricted speed	Be prepared to stop at obstruction.

The diagram on page S.I.8 shows how 3 aspects and 4 aspects speed signals (colour light) are provided for the various speeds :

Two more aspects can also be made available, viz., Medium approach and Medium-approach-slow.

The American Railroads use so many combinations of aspects that they may be found bewildering by railwaymen of other countries. The following are some of the combinations provided for in the "Standard Code of Operating Rules" published by the Association of American Railroads. (See diagram below).

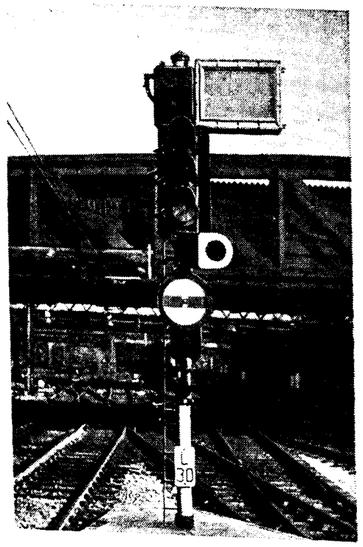
A. — Clear.
B. — Advance Approach Medium.
C. — Approach Limited.
D. — Limited—Clear.
E. — Approach Medium.
F. — Advance Approach.
G. — Medium Clear.
H. — Medium Advance Approach.
I. — Medium—Approach Slow.
J. — Approach Slow.
K. — Approach.
L. — Medium Approach.
M. — Slow Clear
N. — Slow Approach.

Signal Aspect in U. S. A.

MULTIPLE ASPECT SIGNALS

This means the employment of signals capable of giving a number of different messages to the driver. The first multiple aspect signal was a combination of the stop and distant arms on the same post. The three aspect signal sufficed for many years but with the development of fast running and close headway suburban services, the spacing of the signals for headway reasons became too close to give an adequate braking distance between yellow and red of successive signals and it became necessary to introduce a fourth aspect. No other suitable colour was available, so the fourth (preliminary warning) aspect was given by two yellow lamps. More recently cases have arisen when even the two signal section warning given by the four aspect system was insufficient for braking and in this case, rather than introduce a fifth aspect, the double yellow indication is repeated back a further signal section (or more if necessary).

Speed signalling involves the use of 2 and sometime 3 separate three-aspect units (semaphore or light type) on the same mast. In order to provide adequate spacing (minimum 5 ft.) between the units, the top unit of a three unit assembly has to be some 23 feet above rail level or 10 feet above the driver's head. At this height, a great deal of the effectiveness and efficiency of a light type signal is lost. On first introduction, the speed signal system appears very complex, there being 15 different aspects listed in the rule books of most U. S. A. Railways. Even after



Starter with colour light signals



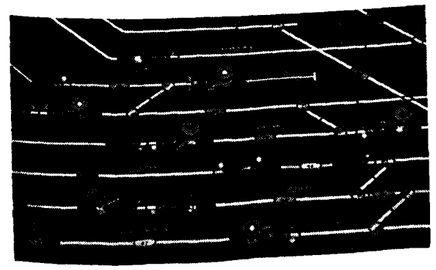
Route indicator with light signals

some study, the system appears to lack the simple logic of multiple aspect signalling with route indications. While speed signalling does not rely on the driver to adjust his speed for the route being followed according to his knowledge of the road, it does mean that the driver has no means of checking that the route on which he is being sent is the correct one. In the U. S. A. with speed signalling there are known to be 140 different colour light aspects in use and even the Standard Code shows 41 aspects. Compare this with four aspects for multiple aspect working plus a small number of variations on the routing signals!

LOCATION AND SPACING SIGNALS

Signals were originally employed for the purpose of stopping trains at the approach to junctions, intersections, etc., and these were followed by the introduction of signals giving permission to enter the block section. The latter coincided approximately with the introduction of space interval working. As centralization of the operation of points became the practice, it was possible to interlock the levers working points and Signals so that no signals could be cleared for movements which would conflict with each other. In addition, it is now the practice to provide devices to ensure that facing points over which a train has to pass are proved to be in their correct position before the appropriate signal can be cleared. The simplest signal layout, i. e., for an intermediate block post, consists of a Home signal (acting also as a section starting signal) and distant (or Warner) signal. When there are connections operated from the cabin, it becomes necessary to separate the Home and Starting signals and to add such intermediate signals as may be necessary for efficient traffic operation.

When a line carries mainly through short headway traffic, such as a suburban train service, it is necessary to space the signals to obtain even headway rather than for station and siding operation purposes. The simplest case of a purely headway signal is the intermediate block Home signal, which is provided to split an excessively long block section. Ideally, this signal is located so that the headway (in time) of trains is equal for the two sections thus formed. This does not mean that the signal will be placed midway between the existing block posts since its location will be affected by an incidence of gradients, stations, etc. If the section is level or of even gradient throughout and trains do not stop at a station, then headway time is proportional to distance and the location of the intermediate signal can be worked out on distance only. In a section where a change of gradient occurs, the intermediate signal has to be located in respect of headway time and not distance. If there is a station stop in the section, the decision whether or not to



Relay interlocking control panel

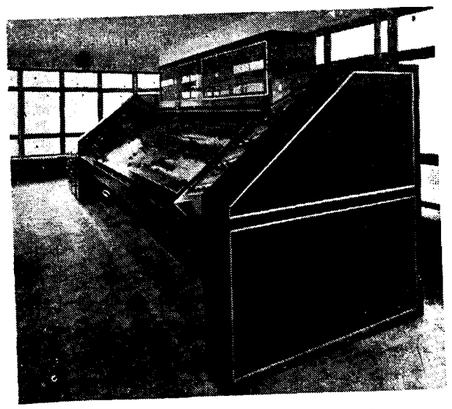
take the station stop into consideration will depend on whether the closest headway required concerns stopping or non-stopping trains.

When a whole section of line is to be signalled for close headway working, the signal locations are best determined from a graph representing the running performance of a typical train through the section.

In all the above examples, it has been assumed that overlap clearance (adequate distance) is required ahead of each Home Signal. The need for this provision is one which must be made individually by each administration and the decision will be governed by the experience regarding the incidence of over-running and also whether or not trains are fitted with continuous brakes. It is generally accepted that with four aspect signalling, it is permissible to reduce the length of the overlap since drivers always pass two warning signals i. e., YY and then Y. before coming to the stop signal. In countries where the Absolute Block System with the compulsory provision of an Adequate Distance is in force, the overlap is decided in the light of the rules framed.

AUTOMATIC SIGNALLING

In general, the equipment of an automatic section must be so arranged as to meet the requirements laid down for manual block. Since there are no signalmen to ensure that the first train has cleared the section and is complete before a second train can enter the section, continuous detection of the section must be provided either in the form of track circuits or axle counters. Where overlaps or "adequate distance ahead" are called for, the controlling track circuits must be arranged accordingly. Warners must be provided at braking distance from the stop signals (multiple aspect working). Steps must be taken to ensure that each stop signal goes to the danger



Full view of relay interlocking control machine

position after the passage of each train before a second train is permitted to enter the section. Since the signals are usually remote from signal cabins, special steps have to be taken against the failure of lamps. This can be done by proving the lamp to be all right before a train allowed to approach or by the use of auxiliary light units which are switched into operation should the normal lamp fail. In either case, it is advisable for a warning device to be operated in the nearest station or cabin in the event of lamp failure so that it may be immediately rectified and so minimise the possibility of delays to traffic.

On single lines again, the requirements for automatic working follow the manual block requirements. Instead of there being a token to establish the direction of working, electrical direction setting equipment is employed the reversal of which is only possible when the whole section is clear. For the established direction, the intermediate block signals work as for a double line, those for the opposing direction being held at danger. When non-attended passing loops are provided, it is possible to establish the direction of working automatically by the approach of a train to the signal giving entrance to the section. The first train to approach the signal at either end establishes the direction, provided the section is clear and this directional control remains set until the whole section is clear again. This form of control is often referred to as Absolute—Permissive Block System.

BENEFITS OF ADVANCED SIGNALLING

Railway signalling offers a means of improving operating performances by providing facilities for the

more intensive utilization of existing trackage, generally at a lower unit operating cost and a lower unit fixed cost than could be achieved by other types of improvements and therefore gives more increased capacity and facility of operation with a higher return on the investment. As traffic growth is normally at a slow steady rate, it is generally more economical to provide for greater utilization of existing facilities than to provide larger sums for additional capacity which could not be utilized because the traffic would not be great enough for a number of years to bring about a suitable saving on the additional capital expenditure.

Signal apparatus should be of such type that may be used to advantage even if changes are made in the original track layout. For example, if a single line section equipped with automatic block signals is later converted into a double line, the signal apparatus may be relocated to fit the new traok arrangement. Practically every signal installation contains an assemblage of certain basic apparatus which is largely interchangeable with that of other signal installations on the Railway and therefore signalling may be economically applied to a relatively temporary traffic situation as well as to a situation which promises to be more permanent.

A modern signal system will frequently provide the additional capacity needed to handle a seasonal peak traffic of relatively short duration in the most economical manner because the capacity required is furnished at the lowest possible capital investment. Such a system will not only reduce the investment required to handle this traffic expeditiously but will also bring about sufficiently improved operation during the periods of normal traffic throughout the balance of the year to make an attractive operating saving even at the periods of minimum traffic density. Modern signal systems do not require traffic at or near peak densities in order to justify the expenditure, although the rates of saving increase rapidly with increased traffic. The modern conception is to design the signalling to suit the traffic requirements.

TELECOM ON RAILWAYS

The fact that a good and reliable system of communications is a sine qua non for efficient railway operation has been long recognised by railway systems in the world and no expense has been spared for providing the latest gadgets which science has invented in the field of rapid transmission of information. Even as early as in 1850, when the electric telegraph was perfected, it was introduced on the early English Railways to enable signalmen to communicate with one another instantly. This, in fact, later led to the introduction of the " block " system.

As soon as the telephone was introduced, it was naturally introduced on the railways but what turned out to be a boon for railway operation was the discovery of the selector type which enabled the Train Control System (known in other countries as the Dispatching System) to be introduced. Except in some countries of the Far East like Indonesia and Thailand, where Train Control is unknown, the system is so common and so universally adopted that a detailed description of it here is superfluous. Apart from the many operating advantages of Train Control like wagon utilisation, punctuality and emergency action, it affords the following facilities purely from the communication point of view :—

(1) Enables the controller to contact all stations on his circuit.

(2) Enables him to contact omnibus control circuit (if any).

(3) Facilitates connection with other telephone exchanges including public exchanges.

(4) Provides direct connection with Trunks, Deputy Control lines and Phantom circuits.

In addition to individual control circuits, all control offices are provided with their own local exchanges which are also connected by trunk lines to other exchanges on the railway system so that independent means of communication through these administrative trunks are also available.

RADIO-COMMUNICATION

Land-telephony, however efficiently maintained, is liable to frequent failures owing to inclement weather, tampering of lines by outsiders and other causes. On many sections on Indian Railways, where the Railway control lines are maintained by the P & T Department, frequent control failures are seriously hampering railway operation. The working of a railway requires a high degree of co-ordination of the movements of men and vehicles at continually changing locations and the advantages derived from being able to keep in constant touch with locomotive or train crews and for mobile units to communicate with each other, have been the main reasons for the introduction of radio-communications on railways in recent years. In addition, the radio is, under special circumstances, a cheaper and safer alternative means of providing communication between fixed stations. Where circumstances are favourable for its introduction, radio-telephony is capable of increasing efficiency and enhancing the speed of working on railways.

As a rule, however, radio is used to provide communications of a character not practicable by physical means but has not superseded existing methods of communication. On the contrary, radio is supplementary to the main tele-communications system.

Generally following these lines, radio-communication has already been introduced on Indian Railways. The head offices are invariably connected by wireless with most of the Divisional or District Headquarters which are in turn connected by a number of satellite stations and loco sheds. Divisional Headquarters are no longer " cut off " from the head office due to a failure of the telephone. But the radio on Indian Railways is still in its infancy as the following description of its uses in other countries will show.

RADIO-COMMUNICATION ON TRAINS

Radio-telephony between the front and rear ends of long goods trains has been widely adopted in the U. S. A. where goods trains may consist of 125 wagons or more and the length of such trains will vary from about $\frac{1}{2}$ a mile to $1\frac{1}{4}$ miles and over. The locomotive crew at the front end of a train, usually consisting of a driver, a fireman and a hand-brakesman and the remainder of the train crew, usually consisting of a conductor and a rear-brakesman in the caboose at the rear end have need for inter-communication. Occasion for such inter-communication arises from a number of circumstances where safety of train operation is involved. The front and rear end crews may be separated by over a mile and furthermore trains may run at night; in all kinds of weather and terrain. There are many conditions under which visual communication between the two ends is actually impossible. The guard may observe a hot-box, dragging equipment or a dangerously shifted load or the driver may see an obstruction; and in either case, immediate communication between them is essential.

Radio-communication is also fixed between fixed points and moving trains. This enables train crews to contact the controller even from mid-section and even when the control phone had failed. In some countries, communication between moving trains and relief cars, between train engines and banking or assisting engines and between one moving train and another moving train is also provided. When end-to-end communication on trains on a railway is carried out on the same frequency, it enables communication to be established between one train and another, which can be used to pass information of condition likely to endanger a train running on the same or a parallel track. Sometimes, supervisory officials, with radio-equipped automobiles or track cars, establish direct communication with trains moving in their vicinity.

BETWEEN FIXED POINTS AND TRAINS

When control working fails, radio-telephony permits train crews to report to the controller as to the location of and exceptional conditions relating to their trains, thereby enabling him to co-ordinate movements in the most efficient manner and to make decisions quickly in the case of a mishap or unusual occurrence. On long branches and uncontrolled secondary lines, radio-communication can be used with advantage for the purpose of advising the controlling point of any untoward happening and of summoning assistance when required.

Quite often it is necessary for a member of a train crew to investigate defects on a long goods train in mid-section. The equipping of the train crew with portable radio sets enables instantaneous communication to be established with the controlling point and facilitates the execution of whatever measures that are found necessary to correct the trouble. Similarly, when a guard goes back to protect his train, he can speak to his own or an approaching train.

IN MARSHALLING YARDS

The efficiency and speed of working in a marshalling yard are largely dependent upon the character of the appliances provided to transmit and receive instructions. Normally, loud-speakers are employed for this purpose and most hump yards on Indian Railways have this facility. If, however, the speech can be transmitted and projected with equal volume without the provision of physical connections, it is obvious that the cost of providing and laying cable routes can be saved. Radio-telephony is, therefore, extensively employed in marshalling yards in the U. S. A. and to a lesser extent in European countries and in the case of new yards, it has enabled initial and maintenance costs to be reduced by curtailing shunting signals and loud-speakers. In hump yards, the use of radio greatly facilitates the transmission of instructions and makes possible the continuance of humping under conditions

of poor visibility. In flat yards, the person in charge of the operation can advantageously make use of the radio to issue instructions to engine crews about the change of lines and break-up of trains.

Radio is used on new railway construction projects to facilitate contact between the resident engineer, section engineers and the gangs and between different sections of one gang. In some countries, advantages are obtained by the use of radio when clearing lines in the case of an accident and for controlling the movements of snow ploughs, etc.

Microwave systems are now replacing radio systems in advanced countries. Microwave is very expensive initially but as it can provide as many as 10 voice channels like the carrier system channels, it is economical in the long run.

TELEPRINTERS

These machines are a form of printing telegraph. The transmitter consists of a keyboard similar to that of an ordinary typewriter but adapted to select the code of electrical impulses transmitted to the line.

Messages may be printed on rolls of paper or on narrow gummed tape. The receiving station need not attend the transmission of a message. The maximum speed at which a Teleprinter can be worked is fixed at about seventy words per minute.

As soon as the Teleprinter was perfected, the news agencies and newspapers naturally claimed it as an invention mainly intended for them. It undoubtedly created a sensation in the newspaper world and revolutionized transmission of news.

In due course, Teleprinter was introduced on railways for various purposes. In India its use at present is limited to transmission of telegrams between Railway telegraph offices where its provision can be justified by the volume of traffic handled. There are five Teleprinter circuits on the Southern Railway. Their main advantages are :—

(1) Speed, upto 70 words per minute (2½ times faster than Morse).

(2) Legibility of the received message, which is printed on the tape.

(3) Avoidance of the necessity of learning a code by the operating staff.

(4) Expert telegraphists not required.

(5) Messages can be filed neatly for future reference.

It is natural that such a useful appliance should serve better purposes on railways than the mere transmission of telegrams. One of the first uses the Teleprinter was put to was the transmission of Vehicle Guidances from one marshalling yard to another after the departure of goods trains. Before the introduction of Teleprinters, only one copy of the Vehicle Guidance used to be available with the Guard of the train while a summary of the formation of the train used to be prepared and phoned to the next marshalling yard through control as the phoning of the entire formation will result in the control wires being occupied for inordinate periods. Teleprinters enable an exact copy of the Vehicle Guidance being transmitted to the next marshalling yard within a few minutes of the departure of a goods train, thereby giving the staff there complete information and more than adequate time to plan their marshalling work. They also enable the Yard Masters of the two yards to be in constant communication with each other in a legible manner, with a permanent record of the messages exchanged. Indian Railways have plans for the opening of Teleprinter circuits between important marshalling yards as soon as circumstances are favourable.

Teleprinters can be used for multifarious operating purposes such as the transmission of yard report, engine position, sick lines position, etc., without impairing the efficiency of Control working. In Germany, all main clocks at stations are remotely controlled from Hamburg and are set once a day by means of start-stop teleprinting network. It goes without saying that every station clock shows the correct time. In the U. S. A., Teleprinters are used for sending the bulk of communication such as train make-up, departure, arrivals, wagon records, locomotive movements and even Pullman reservations. On the Pennsylvania Railroad, over 46,000 messages are handled daily.

PNEUMATIC TUBES

These are used for conveying quickly way-bills, cut-cards, Vehicle Guidances and messages among different offices or offices located on the different floors of the same building. By their use, time consumed by staff carrving way-bills, etc., from place to place is eliminated.

In marshalling yards, pneumatic tubes are used to distribute way-bills and cut-cards to the staff in the yard who handle the retarders, etc. The tubes are made of steel or aluminium and are of the oval type, 4 inches in diameter. The inside surface is very smooth and a hollow piston in which the documents are put travels along the tubes. Documents can be carried, sometimes over 2 miles away, across tracks and structures, within a few seconds.

When a goods train arrives into a yard, the Guard immediately places the Vehicle Guidance in a Carrier and it is carried to the general yard office. There it is checked and a marshalling list is prepared and transmitted to the hump foreman through the pneumatic tube. When the outgoing train is formed and ready, a fresh Vehicle Guidance is prepared and transmitted through the tube to the office at the departure end of the yard.

LOUDSPEAKERS

The use of loudspeakers at railway stations and marshalling yards is such a common feature that a detailed description of them is unnecessary. But the provision of loudspeakers should be made on a scientific basis if the best use is to be made of them. In the older type installations, only a few loudspeakers were installed, operating at high level resulting in a blaring noise for passengers near the loudspeakers, rendering the speech indistinct and producing echoes and howling. In modern installations, we have an adequate number of small loudspeakers, each spaced only a short distance away from the other and each delivering only enough acoustic power to cover the area immediately in front of it.

One cannot visualize a modern passenger terminal or junction without these public address systems. In some countries, loudspeakers are fitted in waiting-rooms and refreshment-rooms also and in Japan, they are provided in important express trains to announce to the passengers the time of arrival at and the name of the next stopping station, the situation of the platform, the connecting trains, etc. On the Southern Railway, loudspeakers fitted on trains were used successfully for dissuading passengers from giving arms to beggers in trains and encouraging unauthorised vendors.

It is highly important that the person doing the announcing should speak in a slow manner, pronouncing each word distinctly, standing at a pre-determined uniform distance from the microphone and allowing a short pause between each word. A woman's voice usually results in the best intelligibility: It is often considered best for an announcer to speak in the local dialect with the local accent. In multi-lingual areas, tape recorders are used with or without automatic control.

Loudspeakers are extremely useful in marshalling yards. They increase the efficiency of the yards by speeding up operations, reducing damages by shock and increasing the yardman's safety.

In Western countries, talk-back loudspeakers are located at strategical points along the tracks in a yard and provide a direct two-way communication between the yardmaster and the men in the yard. The loudspeaker in the yard is turned into a microphone and the yardman may speak direct to the yardmaster in the tower.

Paging loudspeakers are used to make a general call when the yardmaster does not know the whereabouts of his staff. Any staff noticing anything unusual in the yard, can also use the paging loudspeakers to inform the others of the condition.

Guna-Ujjain Line

The work on the proposed Guna-Ujjain railway line will start in the ensuing financial year 1959—60 and will be so phased that the expenditure during the Second Plan will be limited to final location survey, acquisition of land and construction of some portion of the formation and substructure of bridges. The estimate for the final location survey is under scrutiny of the Railway Board at present.

This information was given by Shri S. V. Ramaswami, Deputy Minister of Railways, in a written reply to a question by Shri Liladhar Joshi in the Lok Sabha. The Deputy Minister said that three routes were surveyed in connection with the proposed Guna-Ujjain railway line, namely, Guna-Biaora-Agar-Ujjain, Guna-Biaora-Shahjapur-Maksi and Guna-Biaora-Agar-Nagda. Of these three alignments Guna-Biaora-Agar-Ujjain route had been tentatively considered as the most appropriate.

Application of Modern Techniques on Signalling and Telecommunication on the Indian Railways

By A. K. Srinivasan, B. Sc. (Eng.), Grad. I. E. E., A. M. I. T. E.
Central Railway, Bombay

ALL progress is the result of increasing application of technological developments. The Railway signalling and communications have taken long strides during the last three or four decades. They have achieved remarkable results to improve the performance of rail transport. In our country, the monopoly and superiority of the railway for economical transportation by land has not so far been challenged, but in the future, the road transport will pose serious competition. The railway will have to adopt all technical means to achieve a higher standard of efficiency and economy if it has to retain its ascendancy. Even apart from the road competition, rail transport in a poor country like ours should continually strive to step up its efficiency and cut down costs so that its cheapness will encourage industrial development. In the effort towards efficiency and economy on the railways, the Signal & Telecommunication Department plays an important role.

In the early days when train speeds were low, signalling was only an instrument of safety and its functions gradually enlarged with the introduction of modern techniques to increase the traffic capacity of the track assets.

Mode of communication from the old slow morse telegraphy to the present day speedy wireless teleprinter machines has transformed the method of control and management on the railways. Modern communication has made it possible to pool the wagon resources of the far flung railways in our country and to facilitate their economic utilization by directing day to day control on their movement from information obtained telephonically and telegraphically right down from the various district units. Each railway headquarter is now able to obtain full information daily of the position of the engine power, coal and wagon position, wagon utilisation, punctuality, traffic demands and other important data from the divisions. Instructions are issued telephonically to the divisions for the proper utilization of the assets and for necessary co-ordination amongst them to cope with the traffic.

PRESENT SIGNALLING

On branch lines where the density of traffic is low, say 4 or 5 trains a day, the speed through the station is less than 30 m. p. h. and a rudimentary system of signalling consisting of two signals, an outer and a home, on either direction has been found to be adequate. At these stations there is no interlocking between the signals and the points. The system of block working is through morse telegraph instruments by which only exchange of information is possible. The requisite safety is secured by strict observance of train working rules. With the general increase in train service on the branch lines, an elementary system of interlocking should be provided to increase the safety margin. Token block instruments should replace the morse telegraph on sections where the number of trains exceeds six per diem.

When the speed through a station exceeds 30 m. p. h., interlocking between point and signal levers is essential to prevent conflicting signals being lowered when the points are set for a particular road. Three standards of interlocking exist, one for 30 m. p. h., the second for 45 m. p. h. and the other for unrestricted speed through the station. Line clear operations at these stations are mostly done on block instruments.

SECOND FIVE YEAR PLAN

With the impact of the Second Five Year Plan, the Indian Railways are required to increase the traffic capacity by nearly 50%. This is a very huge task and its immensity can be realised from the fact that one fourth of the country's total plan outlay, viz. 1125 crores, falls as the Railway's share. The line capacity has to be increased considerably on a number of sections. The existing tracks, signalling gear, rolling stock and engines have already been overworked during the war years and thereafter. Their utilisation so far to meet the additional traffic which has doubled during the last ten years, is itself an achievement though straining every fibre of the organisation. To

extract further capacity out of them would be taxing too much and unsafe.

During the Second Plan period, therefore, the main objective of the railways is to provide additional line capacity by all possible means, to rehabilitate only those tracks, stocks, etc. which are extremely and dangerously worn-out and are positively risky to be continued in service. Several Committees including the Accident Enquiry Committee have pinpointed the need to increase the safety of train working by undertaking works to improve the standard of interlocking. Accordingly a large number of signalling safety works has been included in the Second Plan. Improvement to telecommunication is also being attempted though not on a very large scale.

VALUE OF SIGNALLING TO INCREASE CAPACITY

Signalling becomes of immense value when the capacity of a line has reached its saturation limit. By adopting modern techniques signalling can provide a good marginal increase in capacity. For instance, on most of the existing broad-guage single line sections, with token instruments and standard III interlocking, capacity is reached with about 30 to 35 trains per day. In Japan, it is stated that as many as 60 trains are worked on single line. The use of tokens involve a certain amount of delay in taking the token from the block instrument at the station to the driver and taking back the token from the driver and putting it into the instrument. These have to be done manually and the delay in this process can be eliminated by the use of tokenless instruments which will also be interlocked with the starting signals for safety. Tokenless instruments are not used in our country at present while they are very common in the advanced countries in Europe and Japan. The increase in line capacity as a result of its adoption is nearly 10 to 15% with a small capital investment as against the alternative to double the line. Signal Engineers in India are now realising its usefulness and their adoption in the near future is certain.

Another modern method of increasing upto 50% the capacity of an already saturated single line is the employment of C. T. C. In CTC system the entire section is track circuited and remote controlled from one point. The track circuits are repeated on an illuminated diagram at the controlling cabin and the Controller gets a picture of the movement of the trains. The operation of points and signals at the various stations are controlled by him electrically. With the existing manual system, the mental strain on the Controller is considerable, because he is not only to draw the train chart from the information obtained on phone from the way stations, but also to order out instructions for crossing and precedence of trains. Delays due to misunderstanding of such orders are frequent. In heavily worked saturated sections, the strain on the Controller exceeds the limits of human endurance and the human element is likely to make costly mistakes if any more trains are pressed into service. With the application of C. T. C. further capacity on such saturated single line can be derived and at the same time, additionals safety and ease of operation are secured. Its installation is considerably cheaper than doubling the track.

On American Railways, double lines are being converted into single line working with C. T. C. as recurring charges on the latter are even lower than the maintenance cost on the second line. When this is the case, application of C. T. C. on the Indian Railways should be an attractive proposition. In fact, an American Railroad Team of consultants recently examined the need and feasibility of C. T. C. on two sections of the Indian Railways and had strongly recommended their introduction. Unfortunately, nearly all our tracks are laid on metal sleepers and their replacement by wooden ones for working track circuits becomes costly. Also the sleepers and the equipments are to be imported. Due to the present acute foreign exchange shortage, the provision of C. T. C. has been shelved.

It will be interesting to note that a modified C. T. C. system without the use of elaborate track circuits between the stations has been recently introduced on the Belgian Congo Railway for increasing line capacity on single line section. Track circuits are limited to small sections near the important signals. The block section is divided into two or three sections. Colour light signals are used and last vehicle detection on induction principle is an additional feature for ensuring safety.

Unless a few C. T. C. installations are provided on our railways, their design and maintenance problems cannot be learnt; the urge to manufacture similar equipments in our country cannot also be fulfilled. Now is the opportune time for undertaking a few installations when the need to increase line capacity is utmost. If this need is met by alternative method of doubling the track, though costlier, the chance for utilising modern economic methods is lost or atleast postponed by decades.

Judging from the availability of considerable thermal and hydro-electric resources which have yet to be tapped, the need for atomic energy plant is today by no means urgent, but still as modernisation is the key note of progress, huge amounts are spent for their installations. The same argument holds good for C. T. C. installations.

DOUBLE WIRE SIGNALLING

In mechanical signalling, upper quadrant double wire operation has many advantages including speed and safety. Signals on the Indian Railways before the First Five Year Plan were worked mostly by single wire and points by rodding. Modern installations employ double wire for operation of signals and points and this technique is very much in use in Germany and France and has several distinct advantages over single wire operation. A double wire single cabin can achieve what two cabins do by single wire at way-side stations which means much savings in buildings, staff and inter-cabin control measures and it also increase the speed in setting up or altering routes at the station. Due to the difficulty in providing automatic compensation, single wire suffers from the effect of temperature variation due to which the outer signal, being for away, droops. A drooping first stop signal is highly dangerous as the drivers mistake it as lowered and enter into the station which is not in a position to receive it. And consequently safety is jeopardized. Double wire signalling, is therefore, being increasingly adopted on the new installations and also where large alterations to existing yards are being carried out.

AUTOMATIC BLOCK SIGNALLING

By adopting automatic block signalling using track circuits and colour light signals, it is possible to enhance considerably the volume of transportation on double line. It also augments the speed of trains, raises the safety factor to a remarkable degree and reduces man power otherwise required for mechanical block and signal operation. Adoption of four aspect signalling will enable attainment of higher speeds above 60 m. p. h. This is absolutely necessary on all metropolitan suburban sections where a large number of high speed trains with a small headway is required to be run to bring the citizens daily from the suburbs to the business centre and back. Heavy works on extension of Automatic Block System in Bombay, Madras, Calcutta and Delhi areas are being undertaken under the Second Plan.

AUTOMATISATION

(a) *Junction Stations*

With the increasing demand of transport facility in the industrial areas which are expanding rapidly under the fillip of the 5-year plans, the existing junction yards have become bottlenecks and they are to be remodelled. Mechanical signalling with block controls are inadequate to meet the needs of several of these junction yards. Only automatisation can cope with the demand economically and efficiently. It consists in replacing several mechanical cabins by a central cabin converting the semaphore signals with colour light signals, operating the points by electric or electro-pneumatic machines. Setting a route and clearing the signal is done by a thumb switch or by pressing a pair of push buttons instead of setting the points on a route individually and then clearing the signal which delay the operations in a busy yard. As a train moves forward, the points left behind become free for being used for setting another route. Thus the operating flexibility and efficiency in utilising the track capacity are materially increased.

The centralised push button control eliminates major human errors. Due to automatic safety controls built in the systems, any error committed by the Operator will not endanger traffic but can only delay or stop a train.

The interlockings between the points and signals, route formation, etc. are all performed by intricate circuits using electrical relays. Electrical circuits facilitate perfect and quick proving of the various safety conditions. Necessary communication facility is also provided for speedy restoration of equipments in case of failure. A very high standard of safety and a large capacity as high as 600 to 800 trains a day on quadruple lines are attained. At Kurla on Central Railway and at Churchgate on the Western Railway, route relay interlocking systems have been recently installed and have promoted the capacity in these yards.

Plans are in hand for providing them at Bombay V. T. and Thana on the Central Railway, Basin Bridge in Madras on Southern Railway, Howrah on Eastern Railway, Delhi on Northern Railway and a few other stations. Where a relay interlocking system is not justified, a less costly arrangement is operation of signals and points by power with miniature levers on a frame in which the lockings are designed on the lines of a mechanical interlocking frame.

A. T. C. (Automatic Train Control) is still in trial stage on the Indian Railways. On heavily worked sections and where speeds are high A. T. C. is the last word in safety and will eliminate all chances of human error in the control of locomotives.

(b) *Marshalling yards*

At junction stations, goods trains will have to be split and the wagons re-arranged to form new trains for different routes. This operation is termed "marshalling". Uncoupled wagons are pushed over a hump by a humping engine and the wagons roll down and are diverted into the allotted marshalling lines, the routes of which are controlled from a cabin. When the number of wagons to be handled increases beyond 2000 automatisation of the yard is resorted to in advanced countries by which the—

(i) information of the wagon number and destination is obtained on teleprinters long before the train arrives at the yard;

(ii) the information is checked at the receiving end; Latest methods use television for this purpose

(iii) Card index machines punch out the marshalling order of the train and the information is sent to the different controlling points in the yard on tele-type tapes.

(iv) At the humping cabin, the tape feeds the information into magnetic memory units which controls the automatic switching system.

(v) Brake applying machines called retarders apply just sufficient brake pressure on the wheel flanges to enable the wagon to roll into the allotted track at pre-determined speeds and couple to the wagon on the tracks without damage. The factors determining the braking power depend mainly on the weight of the wagon, its speed, frictional effect of the track and the distance to go on the marshalling line. Special gadgets like automatic weighing machines, radar and wheel counters are employed to determine these factors and the calculation of the braking power to be applied by the retarders is done by electronic computers. The automatic switching system controls the operation of the retarders, sets the points for the wagons to roll down the pre-set routes and form trains.

Communication techniques for accelerating the yard operations are application of radio between the controlling cabin and the yard locomotives, two-way loudspeakers and telephone facility at various locations for passing instructions to the staff carrying out de-coupling of wagons, wagon inspections and repairs and various other functions in the yard.

In modern mechanised yards, as many as 4000 wagons are handled in a day, which means an average delay to a wagon of 6 to 8 hours in the yard, where as it could be 24 to 48 hours or even more in a non-mechanised yard. The increasing use of the technique of automatisation of the large goods yards on the Indian Railways will, of course, yield rich dividends but the huge capital cost and foreign exchange involved rule out their immediate application. Modernisation should, however, be taken up in the near future in gradual stages to achieve speed, efficiency and economy.

TELECOMMUNICATION

Communication on the Indian Railways has still a long way to go to be abreast of modern developments. The need for improved communications to assist train operation and to quicken the pace of work in the railway offices is being increasingly recognised only during the last two decades.

The control telephones are at present worked on D. C. code impulses transmitted for picking up the required station and the system has been working quite satisfactorily for a number of years. The length of the control line is however limited by transmission requirements. If suitable repeaters could be introduced for translating the ringing codes, it would be possible for long sections to be worked. Audio frequency coded ringing system should be tried out on very long sections.

There are at present a large number of magneto telephone exchanges in the head office, divisional offices and other important stations. Being outmoded, they are being gradually replaced by Auto exchanges which are supplied by Messrs. Indian Telephone Industries. If staff are properly trained, it will be possible to have even the small manual exchanges replaced by Auto exchanges and obtain economy and more efficient communication.

CARRIER WORKING

The Administrative Trunk Telephone system on the Indian Railways still employ an out-moded method of working on physical circuit with a series of voice frequency repeaters at regular intervals on the line. For long distance communication on land lines carrier telephony is universally adopted for good quality speech reproduction and the Indian P. &. T. Department has long back switched over to carrier for trunk telephone working. As it is possible to derive a number of speech and telegraph channels on a single pair of conductors in a carrier system good economy is attained. Heavy expenditure is incurred on the transmission lines and their maintenance—it is in the national interest that full benefit is derived out of these lines by extracting as many communication channels as possible. A number of existing telegraph wires can be either surrendered or utilised for other purposes. The overhead lines are now rented by the Railways from the P & T Department. Due to the inter-departmental conflict of interest the working of carrier on railway lines has not materialised so far. Indian Telephone Industries is now manufacturing carrier channel equipments and there should not be any difficulty in introducing them on the Railway circuits. In Britain and several other advanced countries, the Railways are running their own communication lines. This gives them a number of advantages, such as—

(a) deriving additional communication channels employing superimposed phantom and carrier.

(b) better maintenance standard. When the line wires in an alignment are shared by two departments, the maintaining department will always command better service on their own wires.

RADIO COMMUNICATION

The wireless networks on the Indian Railways supplement the land line communication and forms a main standby to be switched over at times of emergency. There is an inter-Railway wireless telegraph link which is used for handling important messages between the Railways and with the Railway Board. Inter-divisional wireless networks are provided on all Railways which share about 10% of the total telegraph traffic and are also used for telephonic communication when land lines fail. These wireless networks were formed after the Second World War by utilising the equipments from military disposals. As they are now due for replacements, advantage should be taken to provide SSB radio network with the facility of radio telephony. It is well known that SSB obtains a number of advantages over the orthodox double side band working, such as better signal strength for the same power and limited frequency spectrum and better utilisation of frequency allotment from the national point of view. Teleprinter working in conjunction with wireless will derive further benefits of economy, speed and accuracy. Teleprinter is at least three times faster than manual telegraphy and as it eliminates human errors, it will be valuable for clearing Railway messages which contain lot of numerical figures.

Application of V. H. F. wireless has immense possibilities in railway working. For close co-ordination between the humping engines and the yard master's office, V. H. F. is employed in several advanced countries. V. H. F. trials carried out on Central Railway in the marshalling yards have proved successful. V. H. F. mobile and "Walkie-Talkie" sets will be of considerable assistance for engineering construction, traction maintenance and other special purposes. V. H. F. multi-channel or Micro-wave communication has increasing scope for communication between important stations on ghat sections and other areas where overhead lines are unreliable or expensive. Messrs. Bharat Electronics have started manufacturing V. H. F. Walkie-Talkie and fixed station units and should be able to meet the demand of the Railways in the next few years without any need of foreign exchange.

Wired television in the marshalling yards for checking the wagon details and for remotely controlled level crossings may not have much application in our country for a long time to come. It is surely a luxury for the present.

With the expansion of transport facilities, the telegraph traffic is increasing rapidly and is congesting the existing manual telegraph channels. Both quality and speedier handling of the traffic call for the application of teleprinter in the telegraph offices. Teleprinters are also advantageously used for obtaining advance information of wagon details in big marshalling yards. With the proposed establishment of a teleprinter factory in the country in the near future, teleprinters should be increasingly used.

Electronics has great application on the Railways in the future for track circuits in signalling, for computers for statistical examination in offices and radar

in marshalling yards for determining speeds of wagons and for several other purposes.

SUMMARY

Summarising the above, modernisation on the railway signalling and communication should be directed as under:

SIGNALLING

(a) Minimum interlocking should be provided at the non-interlocked stations to raise the safety factor.

(b) Double wire operation of signals and points has several advantages over single wire and should be increasingly used in new and replacement works.

(c) Marginal increase in capacity on single line sections should be obtained by introduction of tokenless working. Even a good increase upon 50% should be derived by application of C. T. C. rather than undertake doubling of the track.

(d) On double line, automatic block signalling enhances the traffic capacity by leaps and bounds. Speed can be increased by adoption of four aspect signalling.

(e) Where the traffic is heavy, large junction stations signalling should be automatised with electro-mechanical power frame or route relay interlocking.

(f) Mechanisation of marshalling yards will augment the handling capacity and should be introduced in stages.

TELECOMMUNICATION

(a) Control telephone working on the Railways should be further improved by introduction of repeaters, and audio frequency ringing on long sections.

(b) The existing administrative trunk telephone with series of V. F. repeaters is an out-moded system and should be replaced by carrier working. Economy should be derived by the Railways themselves maintaining the transmission lines and working carrier on them for obtaining several high grade telephone and telegraph channels. Teleprinter should be increasingly used instead of the slow and inefficient manual telegraph working.

(c) Wireless is at present a stand by for land line. More economical use of the wireless should be aimed by increasing use of teleprinters on them. Application of V. H. F. wireless both mobile and walkie-talkie will considerably assist in marshalling yards and areas where land lines are susceptible to heavy interruptions as in mountainous and coastal areas.

(d) Electronics has great application on Railways in the future for track circuits, for computers in offices and for radars in marshalling yards.

RAIL CONCESSIONS TO HILL STATIONS

As in former years, the Railway Board has decided that concessional hill station return tickets at 1½ single journey fares should be issued this year also from April 1 to October 31, 1959 for first, second and third classes.

The concession return tickets will be issued to the following stations: Pathankot, Simla, Solan, Dharampore (Punjab), Dehradun, Kathgodam, Darjeeling, Kurseong, Shillong, Abu Road, Pipariya, Ootacamund, Coonoor, Kodaikanal Road, and Kotagiri Out-Agency.

The concession tickets will be available for three months and will be issued from all stations from which the chargeable distance is 150 miles or more. Tickets will be issued upto October 31, 1959.

The usual conditions regarding break of journey, reservation etc. attached to the issue of similar concession tickets last year would apply this year as well.

The Railway Board has also decided that concessional rail-cum-road and rail-cum-air tickets to Srinagar for first and second classes at 1.1/3 single journey fares and third class at 1½ single journey fares should also be introduced from April 1, 1959 to October 31, 1959 on the same terms and conditions as in the case of other hill stations.

Manufacture of Radio Receiving Valves in Bharat Electronics

By an Engineering Correspondent

IN the production of modern electronic equipment, the valve forms an essential and vital component part on which depends its efficient functioning and performance. It is the heart of all communication and radar equipment; and of broadcast and television receivers.

Valves are required in large numbers for domestic broadcast receivers and for professional communication equipments. At present nearly 200,000 broadcast receivers are being produced in the Country annually; and the valve complement required for these receivers will exceed 1.2 million. In Addition, there are the requirements of valves for normal replacements and for special equipments.

To meet these demands the manufacture of valves was therefore envisaged as an integral part of the BEL Project.

An Agreement has been signed with Messrs. Philips of Holland on 11—5—1959 for securing the necessary technical assistance and collaboration for the production of valves. Philips of Holland and their Associated Companies are one of the leading producers of radio valves in Europe and their organization is backed by extensive research and development facilities. The Agreement is a comprehensive one covering the manufacture of all types of receiving valves required not only for the broadcast receiver industry, but also for the special requirements of the communication



Sitting (Left) Mr. F.C.Beunke, Philips (Right) Mr. B.V.Baliga, Managing Director, Bharat Electronics.
Standing (From L to R) Dr. P.K.Kapre, Philips, Mr. C.R.Subramanian, Jt. Chief Inspector, Bharat Electronics, Mr. T.T.Joseph, Commercial Manager, Bharat Electronics, Mr. J.P.Kacker, Controller of Finance, Bharat Electronics.

WHEN YOU THINK
of Electronic Equipment think of Bharat Electronics

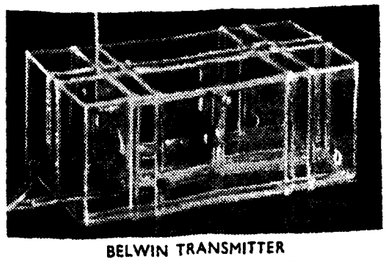
To meet the vital needs of the country in Electronic Equipment, Bharat Electronics (Private) Limited was established by the Government of India in 1954. Equipped with the latest machinery and with a team of experienced technicians, BEL now manufacture General Purpose Receivers, HF Transmitters, Airborne VHF Transreceivers, Manpack VHF Transreceivers, BELWIN Transmitter, Crystals for HF and VHF equipment etc.

BEL Electronic Equipment are now supplied to the Indian Railways, Civil Aviation, Defence and Police Departments.

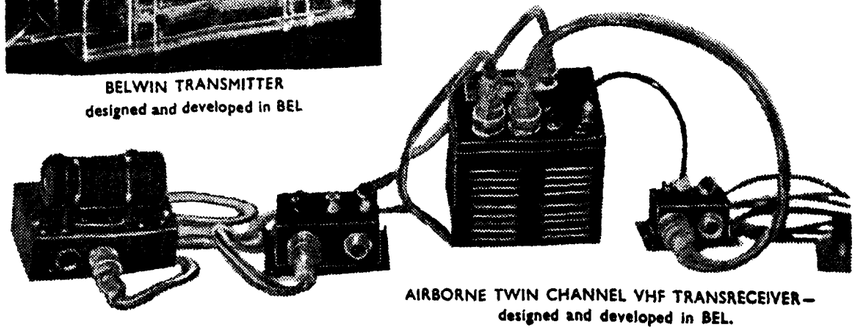


The famous Statue by RODIN

In the momentous years ahead, BEL will be able to fulfil its specialised role of producing the major portion of the country's need of Electronic Equipment.



BELWIN TRANSMITTER
designed and developed in BEL



AIRBORNE TWIN CHANNEL VHF TRANSRECEIVER—
designed and developed in BEL.

BHARAT ELECTRONICS (PRIVATE) LIMITED
(A Government of India Undertaking)
JALAHALLI — BANGALORE.

EP

services. The manufacture of special quality valves (ruggedised valves) used in the Defence electronic equipment also forms part of the Agreement. Philips will render necessary technical assistance for establishing production in BEL and for training Indian personnel in their Works in Holland.

THE DETAILS OF THE PROJECT

Philips will supply all the necessary equipment and machinery for establishing production according to the latest techniques adapted to suit Indian conditions. The capacity of the installed plant will be 1.8 million valves of the miniature type which can be substantially increased by double shift working if the demands warrant such a step. The Agreement also provides for the manufacture of subminiature valves required for man-pack and ultra portable communication sets.

The annual turnover will be of the order of Rs. 40-50 Lakhs when full production is reached. It is expected that the production cost of valves in BEL will not be appreciably higher than the imported cost when the Plant goes into full production.

PROGRAMME OF MANUFACTURE

A beginning will be made with the manufacture of a range of standardised valves for domestic broadcast receivers. The Radio & Cable Board and the Broadcast Receiver Industry have formulated a standard series of 18 valves for which there is a substantial demand.

They are:

EF	89	UF	89	DK	92
ECH	81	UCH	81	DF	96
EBC	81	UBC	81	DL	96
EL	84	UL	84	DAF	96
EZ	81	UY	85	DM	71
EM	80	UM	80	DCC	90

This series will be taken up for production in the initial stages; and new types will be gradually added as and when the demand justifies economical production.

According to the delivery schedule promised by Messrs. Philips, production is expected to commence within 20 months from the date of signing the Agreement. Production will be undertaken in gradual stages to enable training of Indian staff and gaining of experience in the techniques of valve production.

Self-sufficiency in respect of the valve requirements of the country will be the main aim and every effort will be made to achieve it in the shortest time possible. It is expected that with the production of valves in the country, the retail price of valves will also come down.

Foreign exchange savings will gradually increase from year to year after the production has commenced. When full production is reached, it is estimated that nearly Rs. 30 Lakhs of foreign exchange will be saved annually.

New Ry. Signal System to be introduced at Madras Central

The scheme for providing modern route relay interlocking system at the Madras Central Station has been approved by the Railway Board, it is understood.

The Southern Railway has already invited offers from manufacturers for the design, supply of equipment and technical supervision of the project.

The route relay interlocking system enables the railways to handle heavy traffic more expeditiously and with enhanced safety, perfect ease of operation, resulting in conservation of line capacity. Similar equipment was installed on the Western Railway at Bombay and this has enabled the railway to deal with more than 400 trains daily between Churchgate and Bombay Central, resulting in more expeditious movement of trains on this busy section. The installation was set up by Indian signal engineers on the Western Railway with the assistance of a private engineering firm. The equipment came from West Germany.

The Central Railway is also providing route relay interlocking at Kurla, near Bombay, with the help of a British firm. This project, estimated to cost about Rs. 25 lakhs is nearing completion. When the new interlocking system is commissioned, Kurla Junction will be able to deal with about 700 trains daily.

Similar interlocking is to be provided at Delhi main station where the control of an area of more than five miles from Mathurai, Bhatinda, Ambala and Gaziabad would be centralised in one or two cabins. The project is likely to cost Rs. 30 lakhs.

Also under consideration are similar schemes for proving the system at Howrah at an estimated cost of about Rs. 25 lakhs and at Bombay V.T. Station. With the completion of these projects signalling in India is expected to take a big step forward in handling heavy traffic. The Railway Board's Signalling and the Tele-Communication Department is also taking steps to encourage manufacturers in India to produce more signalling equipment within the country so as to conserve foreign exchange resources. A measure of success has already been attained by these efforts.

The total expenditure on signalling schemes on the Indian Railways during the Second Plan period is likely to be of the order of Rs. 30 crores, a six-fold increase over the First Plan provision.

FRENCH RAILWAYS

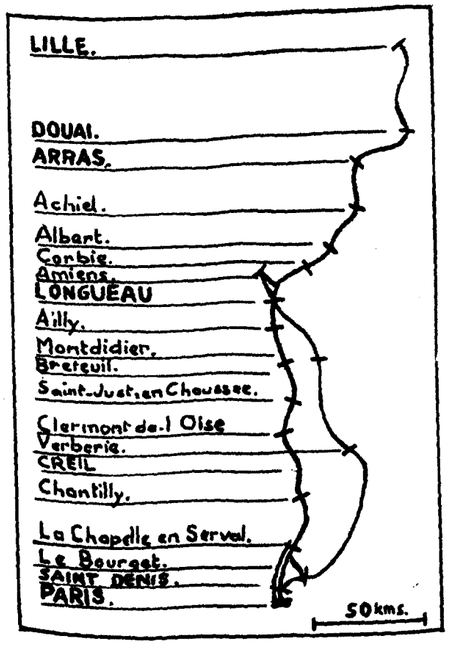
The last progresses in Signalling realized on the occasion of the electrification of the line PARIS–LILLE

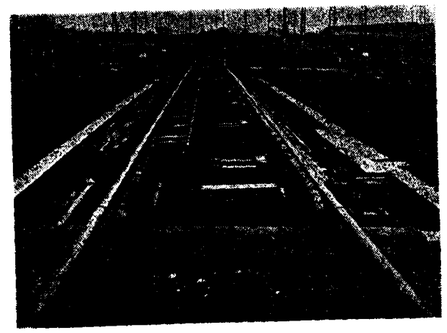
GENERALITIES

THE French Railways (S.N.C.F. – Societe Nationale des Chemins de Fer Francais) have just set to work the traction 25.000 volts Hz on the total line PARIS - LILLE, covering a length of 258 km.

This artery, one of the most important of the French Railways, which connects two centres between the most populated and most industrial parts of France, takes care of an extremely important traffic almost attaining 200 trains per day in the section PARIS CREIL.

The passenger service includes numerous trains, the quickest of which connect LILLE to PARIS at the commercial speed of 115 km/h. The merchandise traffic was "relieved" between LONGUEAU and





PARIS by the MONTDIDIER line, formerly occupied by trains coming from Mines and Collieries of the North of France, providing the Parisian region with coal. This last line not being provided for electrification, there is interest – in order to benefit completely from the advantages of the electrification of the direct line – to lead to that latter line the maximum of the merchandise trains.

THE EXPLOITATION

It depends from four Exploitation Departments, the head offices of which are at Paris, Amiens, Douai and Lille. In each of them exists the "control post", being in charge of regulating the traffic on that part of the line, being within the limits of the Department.

However, the immediate access to Lille and Paris is 'regulated' by the central signalling posts of these terminal stations.

The installations of the line are controlled from the pointing posts, several of which are of a very modern type, provided with important concentrations for control.

These posts are in telephone connexion with the 'regulator' on which they depend and which does not directly operate with points or signals, as it exists on the less occupied lines (CTC).

The line includes tracks from Paris to La Chapelle en Serval (32 km.) and two tracks from La Chapelle en Serval to Lille. The great capacity, demanded of same, can only be obtained thanks to the very perfected signalling it has been provided with.

The automatic block with track circuits has been completely renewed, considering the monophase traction current and the rolling of 140 km/h (150km/h) for certain trains with quick retarding. The electrification simplifying the track layout in the stations, numerous interlocking posts have been suppressed and replaced by posts, showing the most recent perfections (all relay posts with supple transit and electromechanical posts).

THE AUTOMATIC BLOCK

The signals

The section length of the automatic block is provided for the rolling at very high speed, two quick trains being able to follow each other at an interval of 2 minutes, and two trains for merchandise at a 6 minutes' interval.

The luminous boards of clear line usually show the 3 following indications: free track, warning and standstill, sometimes a forth: pre-warning.

The track circuits

The current of the track circuit must be different from the traction current 50 Hz. Three types of realization, each showing its advantage, have been adopted:

a — between LILLE and CREIL —

The track circuit with musical frequency with adoption of different frequencies for the contiguous track circuits (300,850, 1.500, 2000 Hz). This track circuit includes an oscillator at the feeding side and at the reception side a track relay with direct current, with interposition of an amplifier, in case of circuits at 300 and 850 Hz. that are employed for long zones. This type of track circuit has the advantage of a small consumption and reduced dimensions of the induction bridges, due to which the cost price is not very high.

b — between PARIS and CREIL —

The track circuit with a frequency of 83 3 Hz. has already been adopted some years ago. It has the advantage to allow without under-section the establishment of the longest track circuits and requires an inexpensive up-keep.

On the contrary, it needs a feeding by turning groups with a special frequency which is very expensive.

c — Finally, in certain stations the tracks of which are soiled and where the shuntage is difficult, the track circuit with tension pulses of several dozen of volts given by a thyatron has been used. The device indicates the best guaranties for the exact working of the track circuit at passage of traffic of all types.

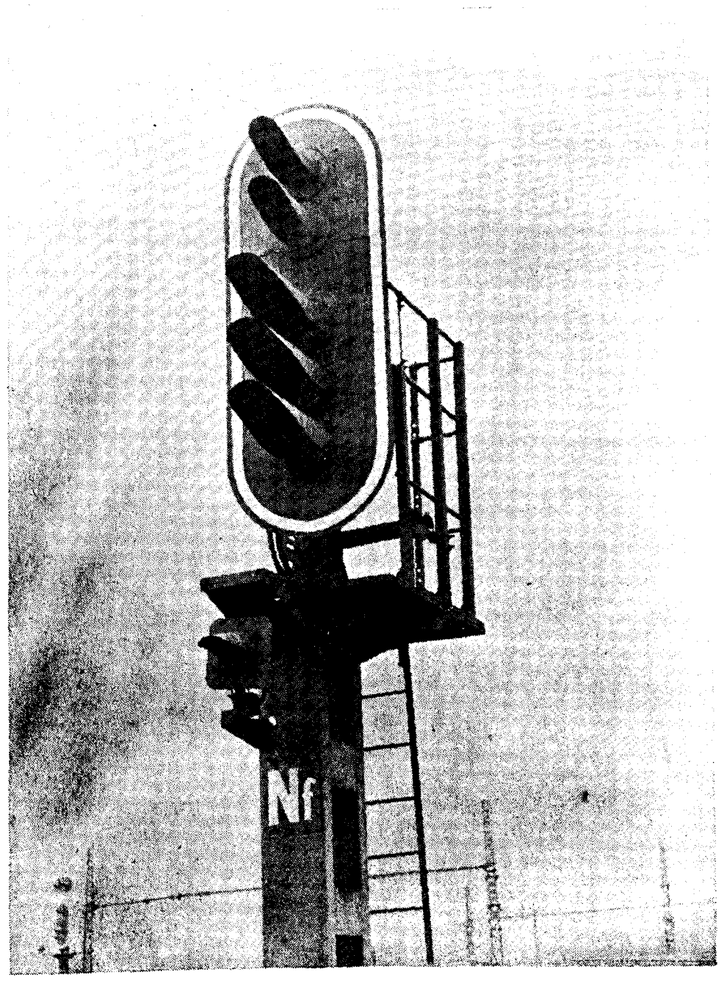
THE RELAYS

In the automatic block only relays of great safety are used, the "desexcitation" of which is certain in spite of very hard conditions, in which the material is installed. It is, in fact, disposed all along the track in cabins and boxes and is subject to the varying of the ambient temperature.

The quality of this material is such that any checking of 'desexcitation' is not necessary what simplifies the circuits.

THE PROVISIONAL SINGLE TRACK

In order to facilitate the up-keep of the track and the catenary, the possibility to free a track has been provided for in the most occupied section (LONGUEAU - ARRAS) in carrying out a provisional single track service at 60 km/h on the other line between the two neighbour stations. The safety is obtained by means of an 'interlocking of direction', realized electronically, in order to avoid induction effects on the signalling circuits of great length parallel to the catenary.



Standardised Light Signal.

INTERLOCKING POSTS

Amongst the important stations those of PARIS,



SAXBY

Joint Stock Company capital 183 750 000 Frs
HEAD OFFICE: 40, Rue de l'Orillon, PARIS (XIe)
Telephone: OBE 88-20 Post Box No. 171
Works at CREIL (Oise) Tel.: 153

R-52 TYPE RETARDER, retarding effort proportionate to weight of wagons braked

- SAFETY AND SIGNALLING DEVICES mechanical, electro-mechanical and electrical.
- RETARDERS
- electro-hydraulically controlled HALF-BARRIERS for protection of level crossings.
- handling lift trucks.



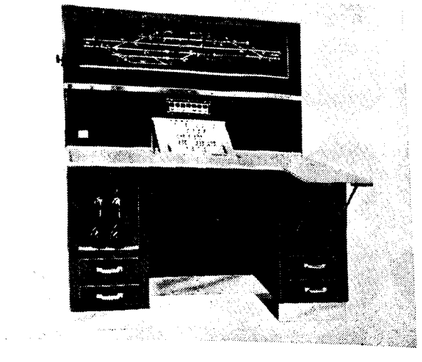
Paris North Station All Relay Control Desk.

ARRAS, DOUAI and LILLE have been entirely reorganized and have been equipped with an all relay single post with supple transit type SNCF (PRS).

The capacity of each of these installations consists of several hundred routes.

The extremely important knots of LONGUEAU and CREIL have kept certain posts of theirs that have been transformed. Others have been replaced by modern electromechanical posts, being very economical, in case of simple programmes. Finally, all the stations of the line of medium importance that are situated in that active district every 15 or 20 km have received all the improvements necessary to allow the siding of a slow train before a fast train within the shortest delay which is an imperative condition for the high capacity of the line.

For this purpose, the former route posts of CLERMONT and BRETEUIL have been modernized,



All Relay Cabin at St. Just Control Desk.

new all relay posts for routes (PRS) have been installed at CHANTILLY, ST. JUST, AILLY, CORBIE. The stations ALBERT and ACHIET have been equipped with mechanical and electro-mechanical posts of modern type with luminous signals.

Amongst these various installations, the new all relay posts of French National Railways (SNCF) merit a special mention.

Applicable to the important stations as well as to the stations of medium importance, they are, however, always designed according to the same principles.

They are all manufactured out of the same material of standardized type, produced by specialized French constructors. Their essential dispositions are described hereunder :

POINT OPERATOR'S ROOM

The operator has in front of him an inclined desk on which are disposed button rows for the route control. These buttons have 3 positions : neutral (or median), pushed, drawn, with automatic return into the neutral position what allows one button to build and destroy given routes and the reciprocal route.

The illuminated diagramme is provided immediately above the desk in the medium and small installations. It is distinct from the desk and placed with a certain retreat in the most important installations.

THE RELAYS

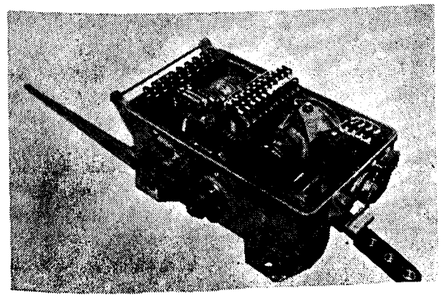
The relays that are located in a room inside the building are of great safety, not checked, which gives the maximum simplicity to the electric diagrammes. They are grouped in function blocks under boxes with automatic connector.

THE SIGNALS

Their general dispositions are similar to those of the automatic block signals, but usually they have more indications : slowing down, calling back of slowing down, manoeuvre.

THE POINT OPERATING MACHINES

The new motors allow to manoeuvre in 3 seconds the heaviest points and crossings, provided with automatic pointing locks.



Saxby Standardised Point Operating Machine.

The emergency manual manoeuvre is carried out easily by means of great lever in a very short time.

THE TRACK CIRCUITS

They are identical to those of the automatic block, the track circuits with tension pulses being more frequently used in the stations, in order to be protected against shunting difficulties.

Such are the essential dispositions of the signalling installations of PARIS LILLE. They have been completed satisfactorily by substantial improvements of telecommunication. That is why the aerial arteries have been replaced by underground cables with insertion of translators every 15 km.

The use of the technique of carrying currents allowed to considerably increase the number of circuits. The automatic communication has been extended all over the centres of the line.

On the occasion of electrification a novelty has been introduced as well in the field of telecommunications and gives new facilities to the user of the railways. In fast trains a traveller can call a post at his choice in France or in foreign countries and vice versa be called from any spot of the general telephone net ; this by intermediary of a Parisian central station.

This result is obtained by duplex radio connexion between the train and eleven fixed stations, situated along the line, connected with each other by a telephone+ ' quarte ' serving the line. These connections are made with low power (at least 50 watts) over metric waves.

The radio-electrical apparatuses of the trains are installed in the waggon-bar at the side of the insonorous cabin placed at disposal of the public.

The all directive aerial disk, specially designed, is fixed on the roof in the axle of the wagon.

The communications obtained are of high quality and efficiently protected against parasite fields, produced by the electric line.

SPECIFICATION FOR STORAGE TANKS

The Indian Standards Institution has drafted the following two Codes of Practice relating to storage tanks.

1. DESIGN OF VERTIFICAL MILD STEEL CYLINDRICAL WELDED OIL STORAGE TANKS [Doc : SMDC 7 (59)]. The Code covers materials, design, fabrication, erection and testing requirements for mild steel cylindrical welded tanks for oil storage, in various sizes and capacities, for erection above ground, of the following designs :

(a) Fixed roof tanks designed to operate only at nominal pressure and vacuum, designated briefly as non-pressure tanks.
(b) Fixed roof tanks designed to withstand small pressures/vacuums (Class A and Class B).
(c) Open-top tanks.

This standard is designed to provide the petroleum industry with tanks of adequate safety and reasonable economy ; and which can also be built in any size required to meet the needs of several branches of industry.

2. CODE OF PRACTICE FOR USE OF STEEL IN GRAVITY WATER TANKS [Doc : SMDC 7 (67)] The Code covers recommended practice for the design, fabrication and erection of steel gravity water tanks, elevated, or on concrete or earthy foundations.

Copies of the draft standards are being circulated widely to obtain the critical review of manufacturers, users, testing laboratories, and other interested parties. Last date for the receipt of comments is *8 September 1959.*

Route Relay Interlocking at Kurla

By T. V. Srinivasan
Divisional Operating Supdt., Central Railway, Bombay.

THE installation of Route Relay Interlocking of the 'One Control Switch' type has recently been completed at Kurla. The work was in progress for over three years and has cost more than 35 lakhs of rupees. The installation was undertaken by M/s. Westinghouse Co. Ltd.

An attempt has been made in this article to evaluate the need for the provision of Route Relay Interlocking at Kurla and its many advantages.

It is at the outset necessary to explain why Kurla was chosen for the provision of Route Relay Interlocking. Kurla is the most important junction on the heavily worked suburban section of Bombay-Kalyan It derives its importance from the fact that it serves as the nerve centre of the Bombay suburban section. The Bombay V. T.-Kurla main lines comprising of quadruple lines and the V. T.-Harbour Branch double line section converge at Kurla. Beyond Kurla extends the Kurla-Kalyan section of quadruple lines. Kurla is also important as a junction for the Kurla-Chembur-Mankhurd section and the Kurla-Trombay Section. The ribbon like expansion of the City of Bombay has extended its suburbs into Chembur where large residential localities have sprung up in recent years. Trombay is the base for the refineries worked by the Burmah-Shell and the Standard Vacuum Oil Companies, and the location of the refineries has given a fillip to the industrial development of the Trombay area, where the waste gases released by the refineries are available for providing the much needed fuel for the industries. The pivotal position occupied by Kurla will now be clear.

Apart from this, Kurla is the terminus for a large number of suburban trains. The suburban service of the Central Railway comprises 565 trains including 136 trains terminating at or originating from Kurla. The trains terminating at Kurla have to be turned back to Bombay V. T. and two platforms are exclusively used at Kurla for dealing with the suburban trains terminating at Kurla. It will be interesting to note that only 23 out of 565 suburban trains run daily in the Bombay area do not pass through Kurla. The intensity of the suburban trains handled at Kurla can now be clearly understood. The greatest density of the suburban service is obtained during the peak hours in the morning between 8-30 and 10-30 hours and in the evening between 17-00 and 19-30 hours. During these periods, trains virtually chase each other with a headway often as low as 4 minutes.

The car-shed for the suburban stock is also located at Kurla and this is one of the factors adding to the importance of Kurla in the suburban operation. All the suburban rakes are maintained at the car-shed at Kurla, and every day not less than 9 rakes have to be sent to the car-shed for their periodical inspection. The rakes are sent in immediately after the morning peak service is over, and they have to be taken out of the car-shed in the evening well before the commencement of the evening peak. Failure to despatch the rakes to the car-shed or to accept them from the car-shed in time would result in a shortage of rakes for meeting the evening service and give rise to cancellations during the peak period when the traffic density is the heaviest.

Kurla is also important for the sizable marshalling yard located there. The acceptance of goods trains into the marshalling yard, and the despatch of goods trains from the marshalling yard interfere with the suburban service, and very careful planning and co-ordination are necessary to ensure that the impact of of the movement of goods traffic on the suburban service is kept down to the minimum. The effect of the movement of goods trains on the suburban service can be easily imagined when it is realised that as many as 30 goods trains are run daily on the Bombay-Kalyan section in each direction.

Kurla station is provided with 9 platforms and one more is under provision. Suburban trains have to be received and dealt with on all the nine platforms, often on three or four platforms at the same time.

Kurla is also important as a diversion point for trains running on local and through lines. This perhaps needs a little clarification. The Bombay-Kalyan section is a quadruple line section and the Up and Down local lines are laid side by side and likewise, the Up and Down through lines are laid side by side. The local lines, as their classification would

indicate, are primarily intended to cater for the movement of suburban trains, while the through lines are essentially meant for the running of through trains and goods trains. The utilisation of local and through lines is not however, confined to the suburban or through trains as the case may be. During the peak hours in the morning and evening, both the local and through lines are used for the running of suburban trains, the slow ones running on the local lines and the fast ones taking the through lines. This is altogether unavoidable, as capacity has to be found for running the large number of suburban trains necessary to cater to the needs of the peak period traffic. Likewise, outside the peak hours, both the local and through lines are used for the running of through and goods trains. This again is unavoidable in the context of the growing needs of goods traffic.

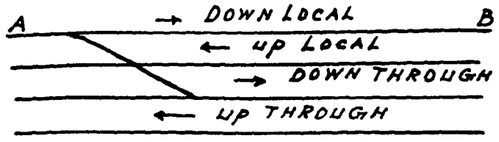
It is, however, not necessary to utilise the entire length from V. T. to Kalyan for running the suburban trains on the through line or alternatively the goods trains on the local line. This would take away the flexibility of operation and at times bring about a disorganisation of the suburban services, and it is for this purpose that diversion facilities are provided for diverting trains from the local line to through line and vice versa at suitable points. This enables the occupation of the wrong line being limited to the minimum necessary. The Controllers take full advantage of the availability of diversion facilities for ensuring the regularity of the suburban services and also for effecting the speedy movement of goods trains without affecting the running of the suburban trains to any appreciable extent. Kurla is an important point for the diversion of trains from the local to the through line and vice versa. Down trains can be diverted from the local to the through line near Kurla 'A' Cabin, while up trains can be diverted from the local line to through line at Kurla 'F' Cabin. Likewise, diversion from down through line to down local line can be effected near Kurla 'F' Cabin, while the diversion of up trains from the up through line to the up local line can be effected at Kurla 'A' Cabin.

Kurla is also an important point of diversion for the V. T.-Thana Harbour Branch locals. These locals, a legacy of the past, run on the Harbour Branch between V. T. and Kurla and are dealt with on platform Nos. 7 and 8 at Kurla. Between Kurla and Thana, they run on the local line. These locals have to be diverted suitably at Kurla. Their running creates difficulties and brings about detentions to the trains running on the main line.

The importance of Kurla in the suburban operation has been explained at length in order to enable an appreciation of the need for the provision of route relay interlocking at Kurla. In this context it is necessary to indicate the signalling and interlocking arrangements that were in force prior to the introduction of the Route Relay Interlocking.

Mechanical signalling was provided to control the admission and departure of trains in the entire Kurla area, including Car-shed and the yard. There were as many as 6 Block Cabins, commencing with 'A' Cabin at the Bombay end and ending with the 'F' Cabin at the Kalyan end of the station. The need for 6 Block Cabins can be appreciated if it is realised that the area controlled by these cabins is over two miles, and the limitations of the mechanical signalling arrangements are severe, particularly in regard to the lead. Moreover, the number of levers operated in each cabin has to be kept at a reasonable strength in order to make it possible for the cabin staff to pass trains under conditions of safety.

The provision of mechanical signalling arrangements with inter-cabin control, where necessary, and with as many as 6 Block Cabins to operate them, was certainly not conducive to the speed movement of suburban trains, and detentions at signals controlled by any of the six cabins, had the effect of slowing down the suburban trains, and sometimes making them run out of schedule. Detentions at signals were some times, not altogether avoidable, as the provision of intercabin controls and restrictive working orders were fruitful sources of detentions. The prescribed adequate distances had to be kept clear before permission to approach could be granted for a train by one cabin to the cabin in rear, or before signals could be taken 'OFF' for the admission of the train. When other trains were occupying the adequate distances required to be provided for the grant of permission to approach or for the take off of the signals, detentions resulted. Again the location of the Up and Down lines makes it necessary to block back on the up line, if, for instance, a down train is being diverted from the down local line to down through line. This is illustrated in the diagram below :



When 'A' Cabin diverts a train from down local to down through line, 'A' Cabin cannot grant permission to approach to 'B' Cabin for an up train coming on the up local line and has to block back to 'B' Cabin.

The impact of such limitations on the suburban service and the need to introduce greater safety in train working particularly in an area bristling with problems and dealing with an exceptionally high density of suburban service, governed the choice of Kurla for the provision of Route Relay Interlocking.

ROUTE RELAY INTERLOCKING— HOW IT FUNCTIONS

When Kurla was chosen for the installation of Route Relay Interlocking, the work of constructing the same was entrusted to M/s. Westinghouse Co. Ltd. The choice fell on the One Control Switch system, or O. C. S. system as it is popularly called, in view of the fact that it is ideally suited for operation under the conditions obtaining at Kurla. Under the One Control Switch system, the route upto the next signal is set and the signal taken off by the operation of a signal switch. This system contrasts with the NX system (Entrance—Exit System) of route relay interlocking installed at Churchgate, the suburban terminal of the Western Railway. Under this system of interlocking, separate buttons have to be pressed for the admission or departure of a train. It will be observed that this system is ideal for a terminal station where all trains terminate and turn back. The conditions obtaining at Kurla are entirely different, as a large number of trains pass through Kurla, and a considerate amount of route setting is involved.

It is outside the scope of this article to go into the technical details of the Route Relay Interlocking that has been provided at Kurla. It would suffice if the salient features of this system are indicated before an appraisal of the system from the Operating angle is taken on hand.

The points are electro-pneumatic, and the interlocking is provided by means of electrical relays. A compressor house is provided for adjusting the air pressure required for operating the electro-pneumatic points, while the relay room on the ground floor of the cabin houses all the relays. The operation of the points or the setting of the routes is by means of the operation of route or point switches, as the case may be, provided on a panel. Separate route switches, shunting route switches and point switches are provided on the control panel for all the routes and points. Normally it is not necessary to operate the point switches in connection with the admission and despatch of trains, as the operation of a route switch takes care of the correct setting of all the points in the route, and also takes off the relevant signal. Normally the route is from one signal to the next signal, and all the points in the route upto the next signal are automatically set when the route switch is operated, provided the route is clear not only upto the next signal but also for the overlap track beyond. The point switches are provided, only for the isolated operation of points in connection with shunting. The switches provided for the shunting routes, when operated, set the points for the shunting route and also clear the shunt signals. The shunt signals provided are of the position light type. They do not display any lights when they are at 'ON', but when they are taken 'OFF', display two white diagonal lights, authorising the shunting movement.

Separate route switches are provided for the various overlaps possible, in order to secure maximum flexibility. If on account of the occupation of the track ahead, the route cannot be set with the overlap in the direction of occupation, the same route can be set with the overlap provided on a diverging route which is free, thereby enabling the movement of the train without detention. The provision of separate route switches for each of the diverging routes over which the overlap can be provided is a great help in eliminating detentions.

The aspects of the signals operated from the Route Relay Cabin are reproduced in miniature on the control panel. The operator is thus always in a position to know the aspect displayed by each of the signals, and thereby to satisfy himself whether the signals have responded to the route operation.

An illuminated diagram of the entire area controlled by the operator is a necessary adjunct of the route relay interlocking system. The illuminated diagram is made to respond to the changes made by the operator in the route. When a route is set, it is indicated on the illuminated diagram by means of a row of white lights. When a track is under occupation by a train, it is indicated by the illumination of two red lights at the extreme ends of the track. For ensuring easy identification, the different track circuits are pointed in different colours, and they are also numbered serially commencing from 201. As a train progresses over a route, the occupation of each track circuit is indicated by means of the illumination of the red lights at the extreme ends of the track under occupation. When the track is freed, the lights are extinguished.

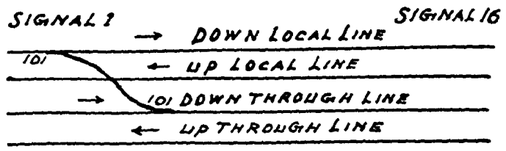
No interlocking is provided in the switches and any switch can be operated at any time, but conflicting routes cannot be set up even when the switches pertaining to them are operated simultaneously. This is one of the valuable safeguards provided in the Route Relay Interlocking system. When once a route has been set, no conflicting route can be set up even if the route switch pertaining to it is operated.

It is necessary to provide against the alteration of a route, when a train is on the approach track, in order to prevent accidents. (Incidentally each signal has an approach track). When a train has entered the approach track, it should not be possible to alter the setting of the route without ensuring that the train has first been brought to a stand. This is effected by means of Time Release. Time Release is provided for the routes that have to be cancelled at any time. When a route has to be cancelled or altered after it has been set, then a time lag varying from 90 seconds to two minutes is provided for the cancellation of the route to take effect provided an approaching train has entered the approach track. In other words, there is a definite time lag between the operation of the route switch and the effect of it on route setting. The signal pertaining to the route is immediately restored to danger when the route switch is operated to the normal position, but the route remains unaltered for a period of 1½ to 2 minutes to provide for the approaching train actually coming to a stop short of the signal, before the route is interfered with. This is intended to provide a valuable safeguard against the indiscriminate alteration of routes in the face of an approaching train.

There is also provision for sectional route release, and this is of considerable assistance in avoiding detentions to trains at signals.

When a route has been set up, the points in the route set are freed progressively as the train passes over them and thereafter, the freed points are available for operation in order to set a diverging route. It will be best to illustrate this.

When route switch No. 1 is operated for the admission of a train on the down local line, the route is set for the train from Signal No. 1 to Signal No. 16. The cross-over connecting the down local line with the down through line is No. 101. As the train passes



over cross-over No. 101 in the normal position, it releases the point for operation for the passage of a following train. In other words, even before the preceding train clears the route upto signal No. 16, it will be possible to divert a following train coming on the same line on to the down through line, by operating the freed cross-over No. 101. This is called sectional route release, as a section of the route is released for the passage of a following train even before the entire route is free. This is very useful in avoiding detentions particularly when trains follow at close margin.

The signals pertaining to the straight routes can also be operated as automatic in conjunction with the 'A' marker light. This is possible only for straight routes, and is arranged by placing the route switch in the 'Auto' position. When the route switch is in the Auto position, the 'A' marker light burns, and the signal automatically assumes yellow or green aspect depending on the occupation of the signal sections ahead.

Some of the signals are also worked as approach lighted signals. They are normally dormant, but when the track in rear of the signal is occupied, the signal is activated and displays an aspect depending on the occupation of the track ahead and the setting of the route.

It is pertinent to ask how the driver of an approaching train is to know that he is taking a diverging route. Route indicators or Junction indicators are provided to indicate to the driver of an approaching train that he has to take a diverging route. One or more route indicators are provided depending on the number of diverging routes permissible. The route indicator consists of a row of 5 white lights placed at an angle. These lights are normally dormant but are illuminated when the diverging route is set.

It is possible that the main filament of signal lights might fuse, of which the operator should have an immediate indication. This is given by means of an audible buzzer. It is also necessary to indicate at

least approximately the location of the signal whose filament has fused. Otherwise there will be considerable difficulty and delay in locating the signal with the fused filament, as signals are dispersed over a wide area of over two miles. For easy location of the defective signal, signals are grouped into six groups according to their location and are provided with group lights. When a filament is fused, the light of the affected group goes out, indicating that one of the signals in the group has failed. This facilitates the location of the signal affected. It may be mentioned here, that even when the main filament has fused, the signal does not cease to function, as the auxiliary filament comes into use immediately.

It is necessary to clarify as to how the failure of a signal affects safety. The principle of 'fail safe' is adopted in Route Relay Interlocking, and when a signal fails it always shows a restrictive aspect and the failure is therefore, one on the safe side.

The provision of route relay interlocking has created ample additional capacity at Kurla, and it will be possible to deal with considerably more trains than at present. At the same time, it has vested a tremendous amount of responsibility on the operator, who has to combine in him the functions of a controller as well as of a Station Master. The area controlled by the operator extends from the tracks at Sion to Ghatkopar—a distance of 4½ miles, and in addition to the reception and despatch of trains, the operator has to arrange for the regulation of suburban trains, within the area operated by him.

Before concluding the article it is necessary to examine the disadvantages of the system. For one thing, under this arrangement, the operator has no information as to what trains are on the track, as all that he comes to know is that a train is on the track. The controller advises him only of the unscheduled trains, goods trains and light engines, and as far as the scheduled trains are concerned the operator has to go merely by the time table. If the scheduled trains run late, then confusion is created and there is the danger of trains being dealt with on the wrong lines.

Another serious disadvantage arises when there is a failure of signals. The reception and despatch of trains is handicapped, as piloting of the trains past the defective signal is out of the question in view of the long distances that separate the signals from the cabin. It has been laid down that during periods of signal failures no diversion of trains should be permitted and that all trains should be dealt with on the straight roads. This is, however, possible only if even during failure of signals, the 'A' marker light burns. This arrangement, while adequate from the point of view of safety, would not make for speedy movement of traffic.

When there is a total failure of power feeding the signals and points, the movement of trains past the area covered by the Route Relay Interlocking system comes to a stand-still.

One more disadvantage arises out of the provision of electro-pneumatic points. When the point machine has failed, the maintainer has to be called in to set it right, whereas, with an electric point, it would be possible for the operator or Station Master on duty to hand crank the points and set it right.

Serious difficulties would also arise when there is a failure of the control panel or the illuminated diagram. On such occasions, trains will have to be dealt with only on the straight roads without any diversion being permitted.

Despite these limitations, the Route Relay Interlocking system has created a tremendous potential, eliminated the possibilities of accidents on account o the failure of the human element and made it possibl to provide for the speedy movement of trains past th difficult Kurla area.

Its provision marks a new milestone in the progress c the Central Railway towards better signalling in ord to provide for unfailing safety at very high speeds.

General Electric (U. S. A.) Engineer gets medal for Development of Gas-Turbine Locomotive

Arthur H. Morey, who 40 years ago began his railroad career shoveling coal on an old steam locomotive, has received a medal honoring him for his engineering contributions to the development of the gas turbine-electric locomotive—the world's most modern form of railroad motive power and a far cry from the old steamers of Morey's youth.

Morey, presently Manager of Railroad Locomotive Advance Engineering for General Electric's (U.S.A.) Locomotive & Car Equipment Department, Erie, Pennsylvania, was given the coveted George R. Henderson Medal in a formal ceremony in Philadelphia's world famed Franklin Institute.

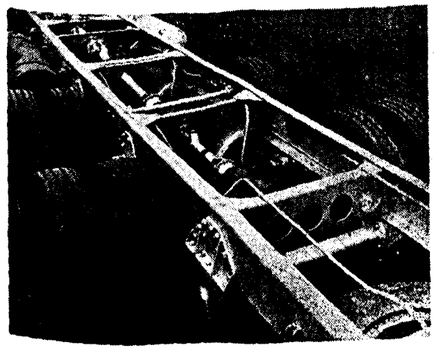
DIESEL-ENGINES, STEAM, ELECTRIC, DIESEL-ELECTRIC, DIESEL-HYDRAULIC & INDUSTRIAL LOCOMOTIVES SUPPLEMENT

British Bogies Defeat Traction Troubles

Outstanding mechanical details of double-drive unit design surveyed from the view-point of the overseas operator

IN almost every phase of heavy-vehicle operation overseas, involving the use of rigid six and eight wheelers, efficient and economical haulage depends, to a great extent, upon the correct distribution of weight on the driving wheels and the provision of design features that ensure maximum traction when rough terrain has to be traversed. These two factors constitute the major problems that confront the designers of double-drive bogie assemblies and British chassis manufacturers and specialist producers of final-drive units have collaborated to solve them by the means outlined in this article. Consideration of the subject from the viewpoint of the overseas operator will first be directed to the types of bogie assembly used in the largest vehicles in current production.

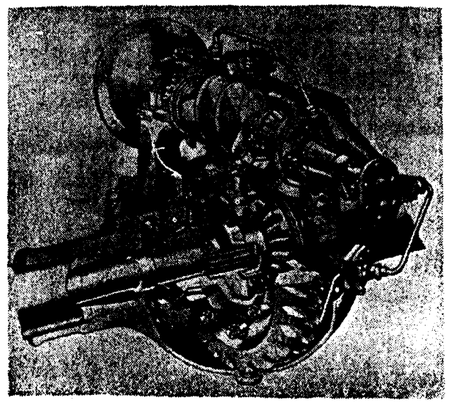
Prominent in this range are the 6 × 4 and 6 × 6 "Constructors" manufactured by Scammell Lorries Ltd., Watford, Herts., one for loads of 26 tons and the latest heavy-duty type, for special requirements, to carry approximately 40 tons.



Cross-members of generous proportions add to the robust characteristics of the Atkinson twin-drive bogie.

For both models, the bogie consists of two heavy-duty spiral-bevel and epicyclic double-reduction axles suspended on two centrally mounted semi-elliptic springs, in order to eliminate weight transference between the axles during driving and braking. Each axle is driven by a separate propeller shaft and, to ensure maximum tractive effort, a third differential is omitted.

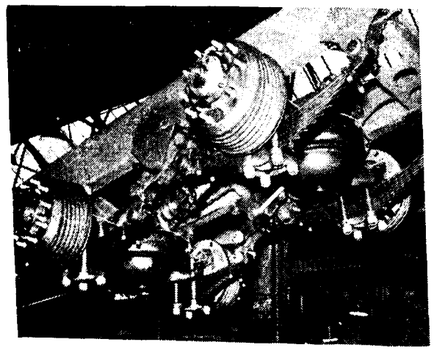
The axles are attached to the ends of the springs by ball and slipper mountings, and are located fore and aft in the chassis frame by torque arms and laterally by radius links, thus relieving the road springs of all driving and braking reactions. The method of suspension allows for a 12-in. upwards and downwards movement of the bogie and for a 17-in. transverse articulation for cross-country travel.



Cut-away view of the Leyland worm-driven axle unit, which has a gear-type pump to provide positive lubrication.

For many years worm drive has been a prominent feature of British passenger and goods vehicles and is

likely to remain so, but, technically, there is a point in favour of bevel gearing in circumstances where heavy loading and long gradients are encountered in overseas haulage work. Under such conditions, road speeds are generally low, as is the efficiency of worm gearing by comparison with bevel drive.



View of the Foden double-worm-driven bogie from below, showing the action of the suspension-system balance beams.

Accordingly, the design of the heavy-duty bogie manufactured by Kirkstall Forge Engineering Ltd., Leeds, to carry weights up to 24 tons, incorporates hypoid-bevel gears for primary reduction and hub gearing to provide a subsequent reduction, by which means a lower torque loading falls upon the axle shafts than is possible with single-reduction units. The mechanism for multiplying the hypoid ratio consists of concentric spur gearing that meshes with an internally toothed ring in the wheel hub. At the outer end of each half-shaft is a sun pinion with which are meshed a gear ring, secured to the hub, and three planet spur gears. These spur gears revolve on roller bearings mounted in a carrier attached to the outer end of the axle tube. The hub reduction is 3.5 to 1 and overall ratios ranging from 6.59 to 1 to 10.18 to 1 can be provided by varying the ratio of the hypoid-bevel pinion and crown wheel.

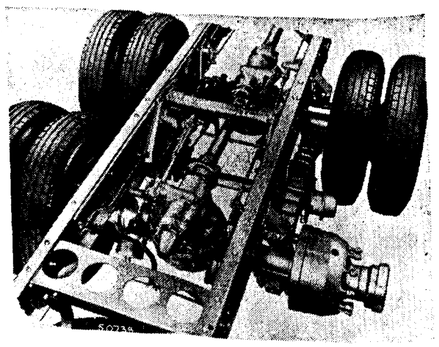
Conforming to standard Kirkstall practice, the axle casings are one-piece forgings with detachable front and rear covers. A third differential, contained in a separate housing mounted on the front cover of the leading axle, divides the torque between the two units of the bogie.

Single trunnion-mounted, inverted, reverse-camber semi-elliptic springs, 5 ins. wide, are used for the bogie suspension. Located above the axle are torque and radius arms, consisting of a pair of rubber-bushed rods, each connected at one end to the axle casing and at the other end to upward extensions of the frame trunnion brackets.

For three and four axle vehicles manufactured by A. E. C. Ltd., and intended for specially arduous duties, two identical double-reduction units, providing an over-all ratio of 7.9 to 1, are employed. Primary reduction is by spiral-bevel pinion and crown wheel. Mounted on the countershaft carrying the crown wheel is a double helical pinion, which engages with a corresponding double-helical wheel.

A four-pinion differential gear is contained in the helical-wheel assembly and the drive is completed through involute teeth cut on the ends of fully floating axle shafts, which engage with the road-wheel hub caps. The differential pinions are fitted with renewable thrust washers, the whole assembly being mounted in large diameter roller bearings. The wheel hubs have opposed taper-roller bearings, with selective shims for adjustment.

The bogie suspension system depends upon the action of two reverse-camber semi-elliptic springs. These are attached by U-bolts to malleable-iron carriers fitted with bronze bushes and pivoted on a transverse tube secured rigidly to the chassis frame. The spring ends are joined to the axles by forks, which are free to rotate about a longitudinal axis in carriers pressed in the axle casings. This arrangement allows the bogie to articulate without twisting the road springs.



View of the Leyland double-drive bogie from the rear, showing the two overhead-worm units, the torque reaction links and suspension layout.

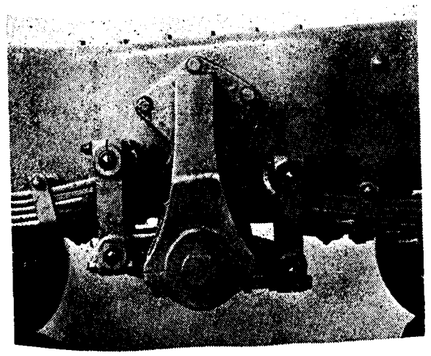
Torque reaction is resisted by ball-jointed torque rods between the tops of the reduction-gear casings and a tubular cross-member which connects the top ends of the spring pivot tube brackets.

The axles have 3½-in articulation, measured at the bump pads, so that they can have 7 ins. of relative displacement whilst remaining parallel to each other, without any wheel losing contact with the ground. If diagonally opposite wheels are raised, the displacement between them can be up to 14 ins.

The A. E. C. double-reduction drive bogie is not fitted with an inter-axle differential, so that traction is maintained even if the wheels on one axle are slipping. This feature makes the bogie particularly suitable for "off-the-road" operation.

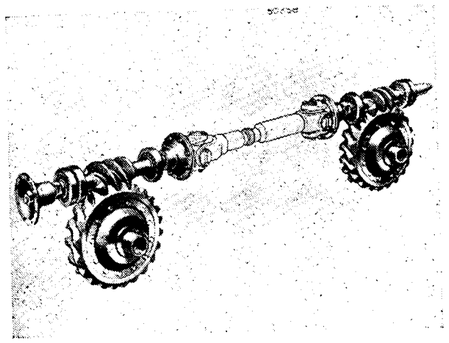
Double—reduction bogie units are also adopted for some of the heavy-duty vehicles produced by other British manufacturers, notably the "Nubian," "Big Ben" and "Mighty Antar" models produced by Transport Equipment (Thornycroft) Ltd., Basingstoke, as well as for the six and eight wheelers made by both Atkinson Vehicles Ltd., Walton-le-dale, near Preston, and E. R. F. Ltd., Sun Works, Sandbach, double worm drive being used by other makers.

The A. E. C. worm-driven bogie unit incorporates an inter-axle differential, which prevents tyre-scrub and possible overloads on the gearing under certain mainroad haulage conditions. The degree of articulation is calculated to ensure that all four bogie wheels maintain contact with the ground.



THORNYCROFT Balance Beam Suspension on the rear bogie of the latest "Trusty" maximum load 8-wheeler.

For goods-vehicle applications, the drive is transmitted to the road wheels through identical overhead worm and worm-wheel units interconnected by short universally jointed shafts and inter-axle differential units. Alloy-steel worm shafts are supported by opposed taper-roller thrust bearings at the front ends and by roller bearings at the rear. The front worm shaft is hollow, so that the drive can pass through to the spider of the inter-axle differential. This is



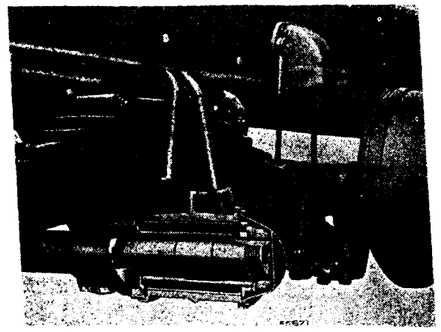
The two identical worm-driven units for the Leyland bogie, with interconnecting Hardy Spicer universally jointed coupling shaft.

contained in a housing bolted to the rear end of the forward worm unit, the output shaft to the second axle being carried by two taper-roller bearings.

Machined from high-quality phosphor-bronze, the worm wheels, together with their differential-gear assemblies, are supported by roller bearings of large diameter, for which shim adjustment is provided. The worm units have 8-in. centres and reduction ratios of 6¼, 7¾ and 10⅓ to 1 are available. The articulated movement is less than that obtained from bevel-drive bogies, as the inter-axle differential restricts the length of the propeller shaft between the two worm units.

Subject to the fitment of suitable wheel and tyre equipment, this bogie can carry maximum loads of 19 tons. Conventional cam-operated brakes of standard A. E. C. design are used, two air-brake cylinders being employed, one on each side member in a position that keeps them clear of mud and dirt, or the possibility of accidental damage. The brake linkage incorporates spherical bushes, which are designed so that axle articulation does not affect brake action.

The double-drive bogie produced by Leyland Motors Ltd., Leyland, Lancs., employs a standard worm unit of the type used for all models in the company's range of heavy-duty trucks. The latest design has 9-in. centres, which enables the axles to transmit a far greater torque than that actually imposed by the Leyland 125 b. h. p. and 150 b. h. p. diesel engines, thereby giving a margin of strength that should result in long and trouble-free service.



The patented trunnion bearing for the Leyland double-drive bogie incorporates a rubber bush that does not require lubrication.

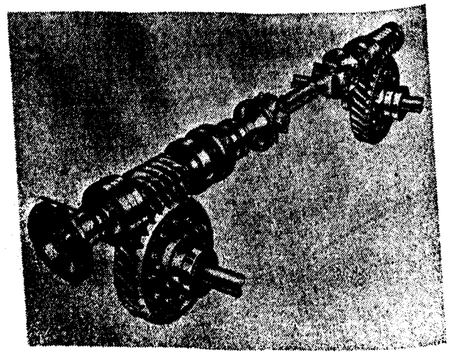
The axle casing is of three-piece construction, comprising a cast-steel centre casing with alloy-steel tubular arms. The involute-splined half-shafts are said to have a fatigue life three or four times longer than the half-shafts used previously. The wheel hubs, made from alloy-steel stampings, are mounted on taper-roller bearings and, in addition to the oil-seals fitted to the hubs and shafts, efficient oil throwers are provided to prevent the risk of leakages on to the brake mechanism.

The new driving unit, mounted above the axle centre in a malleable cast-iron casing, incorporates a centrifugally cast worm wheel of improved design, a new worm shaft with multi-start thread, and a differential unit with larger bevel sun wheels and planet pinions. Other details of interest include the introduction of positively located renewable thrusts behind the differential pinions, in addition to those behind the bevel wheels.

Laminated semi-elliptic springs, 3½-ins. wide and shot-blasted on the tension side to increase resistance to fatigue, are used on all Leyland bogie units. In the case of the "Hippo" and "Octopus" models, the springs are inverted and secured at their centres to the trunnion-bearing housings by inclined U-bolts, which pass over semi-circular clamping pads situated on top of the spring assemblies. The patented trunnion bearing incorporates a rubber bush that requires no lubrication and the outer ends of the springs are attached to the rear axles by swivelling trunnions.

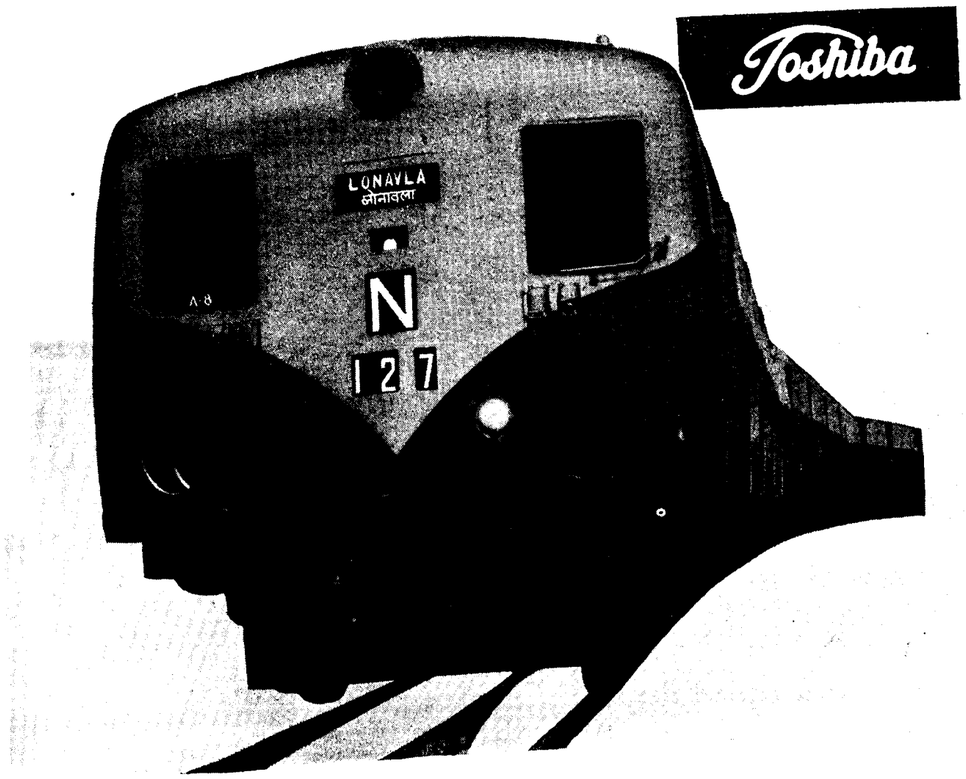
The alternative to the pivoted reverse-camber spring method of bogie suspension is by what is known as the compensated four-spring system. In this arrangement, two semi-elliptic springs on each side of the chassis are connected, at their adjacent ends, to shackles which swing at each end of a compensated balance beam. This beam is free to swing about its centre, thus equalizing the distribution of the load imposed on the two axles. Torque and brake reaction is resisted directly by the springs which are mounted above the axles and attached to them by U-bolts.

Most heavy-duty chassis built for operation overseas are equipped with air-pressure brakes, working at an average pressure of 75 lb. per sq. in. Air is supplied to the system by a two-cylindered compressor driven either from the engine or from the gearbox. The brake pedal is coupled direct to the air-pressure control valve and this provides a sensitive control of the air released from the reservoir to the brake-operating cylinders.



Overslung worm and worm-wheel units used in the A.E.C. bogie are interconnected by a short universally jointed shaft and an inter-axle differential gear.

(Continued on page D.E.6)

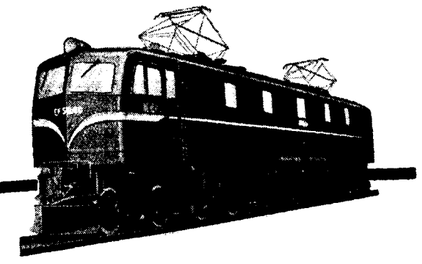


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Testing New Locomotive Design in Rolling Laboratory

AN experimental diesel-electric locomotive built by General Electric's (U. S. A.) Locomotive & Car Equipment Department will soon undergo exhaustive tests in a unique "rolling railway laboratory", the firm announced recently.

The rolling laboratory is a four-unit diesel-electric locomotive built by G-E and operated in regular heavy freight service by the Erie Railroad between upstate New York and Chicago, Illinois. It has been in operation since 1954 and has been used to develop and prove locomotive components under actual operating conditions on a main line railroad, Globe Press Service notes.

Many of the engineering refinements made possible by the unique laboratory on wheels have been incorporated into General Electric's line of universal-type diesel electric locomotives. These locomotives, which can be used in any type of railway service, are currently in use on many major railways throughout the world.

The new locomotive design will be tested by using it in place of two units of the four-unit laboratory locomotive. This combination will then be operated as a three unit diesel-electric locomotive. The new unit will be periodically inspected by General Electric engineers.



Photo shows General Electric's (U.S.A.) famed "rolling railway laboratory" just before two 1200 horsepower units were retired in favor of a new experimental locomotive which will be thoroughly tested under actual operating conditions.

The new unit will replace two 1200 horsepower units of the present laboratory locomotive. The remaining units are each rated at 1800 horsepower. The new three-unit set up will be controlled by one engineer in the same manner as the original four-unit rolling laboratory.

The new three-unit locomotive will be operated by the Erie Railroad. Like its predecessor, it will be used to evaluate advanced concepts of locomotive design and construction.

(Continued from page D.E.4)

A non-return unloader valve is fitted to the reservoir to prevent overstressing the compressor valve when the correct storage pressure is reached. Drain cocks are also provided to cater for condensation.

Each brake assembly has its own operating cylinder, which actuates the brake camshaft through a simple push rod and lever. This linkage also incorporates a screw regulator, so that fine adjustments to each individual brake quickly and easily.

The air-release valve, controlled by the brake pedal, regulates the amount of air pressure for brake operation. The action of this valve, while providing the "feel" for ordinary braking, will, in an emergency, produce a rapid build-up for full braking power. For normal braking purposes, the pressure of air released to the operating cylinders is in direct proportion to the pedal travel. Then at a certain point in the pedal throw a much greater pressure can be applied to produce full emergency braking.

This form of control prevents heavy brake applications inadvertently and, at the same time, gives highly sensitive control over the lower ranges of braking.

Double-worm bogie units, possessing similar features to those described above, are employed by Albion Motors Ltd., Scotstoun, Glasgow, for its "Reiver" 6 × 4 and the "Caledonian" 8 × 4 models; by Guy Motors Ltd., Wolverhampton, for its "Invincible" 6 × 4 and 8 × 4 chassis, and by Fodens Ltd., Sandbach, Cheshire, for its heavy-duty range.

When summarizing the technical features that characterise current British designs of bogie assemblies for three and four axle heavy-duty vehicles, it will be seen that in respect of axle load distribution, maximum traction, suspension efficiency, and braking power, overseas operators can rely upon the mechanical qualities, high performance and durability that are traditional attributes of British products.

Bristol Siddeley Maybach Engines ordered for British Railways Western Region

As we go to Press, we learn that the "BRISTOLIAN", which runs from London to Bristol made a record-breaking first run under diesel power. The Locomotive is powered by two Maybach MD 650 type engines. The London-Bristol run is the fastest scheduled route in the British Isles. —Editor.

THE popularity of the modern high speed diesel engine for railway traction duties is increasing yearly. Railway engineers the world over find daily proof that diesel power is increasing railway efficiency and reliability, whilst dispensing with the unsightly power pylons or deadly live rails of the all electric system, and the smoke, noise and dirt of steam locomotives. Examination of the salient points of the modern diesel reveals the reason for this popularity.

The diesel's high power to weight ratio enables a lighter locomotive than hitherto used, to haul a given trailing load. This, in addition to cutting the transport cost of the load, enables routes with limited axle load ratings to carry traffic whose locomotives were previously far too heavy for the route rating. In addition, the diesel locomotive can be extremely compact in relation to its power so that limitations imposed by manoeuverability or tunnel and bridge dimensions are fewer. This low weight and compactness also makes the diesel engine ideal for powering railcars.



The British Railways Western Region 2,200 H.P. diesel hydraulic locomotive 'Sir Brian Robertson.' It is powered by two Bristol Siddeley Maybach Type MD 650 12 cylinder engines and is seen hauling the Cornish Riviera Express.

Made under licence from Maybach Motorenbau G.m.b.H.

The characteristics of the diesel locomotive make it especially useful for shunting duties. Its compactness, smoothness and ease of control enable the collection and dispersal of freight trains in crowded goods yards where steam engines would be too long and cumbersome and where electric power is excluded on safety grounds. The smoothness of control also ensures that shunting can be carried out without the noise and damage to goods so often associated with this operation.

A further advantage of diesel power is that full engine power can be utilised—through either hydraulic or electric transmission—to provide starting torque. The steam locomotive with its direct drive transmission is at a great disadvantage when hauling a dead load from rest. With either of the aforementioned transmissions systems providing almost infinitely variable gearing, the diesel engine is capable of hauling a greater trailing load from rest than is a steam locomotive of equivalent power rating. This advantage, although also held by electric power, is attained by diesels without resort to costly electrification systems.

Knowledge gained over a long period shows that the diesel engine runs exceptionally long distances between overhauls, distances of 600,000 miles being accepted practice. Furthermore, the performance does not drop noticeably as an overhaul becomes due. Again, owing to the small general dimensions, a diesel engine is more easily handled and worked upon during overhaul than is its rivals. The majority of the components are quite small and light so that very heavy lifting tackle and similar equipment is almost entirely dispensed with.

Fully alive to the need for the utmost reliability and economy, the railroad engineers of the world place great importance upon the full exploitation of

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British Railways Standard Class 8, 3-cylinder, 4-6-2 Type Locomotive designed for heavy express passenger services. Steam distribution is by A.L.E. Rotary Cam Poppet Valve Gear with duplex outside drive to the camboxes of the outside cylinders. This system, which incorporates British-Caprotti principles, ensures optimum cylinder performance over extended service-free periods, an effective aid to improved traffic-handling capacity with fuel economy and higher locomotive availability.

Photograph by courtesy of British Railways.

Further order in hand for 30 sets of complete equipment for British Railways' Standard Locomotives.

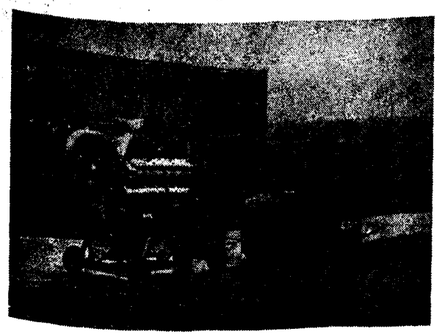
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AL398

modern diesel power. The engineers of Europe are especially fortunate in that their own countries manufacture many good examples of this type of power. This very closeness of the engineer to the origin of the power unit tends to make him more discriminating when making a choice.



A completed MD 650 engine for British Railways in transit from the assembly shops to test house at the Bristol Siddeley Engineering Centre, Ansty, nr Coventry.

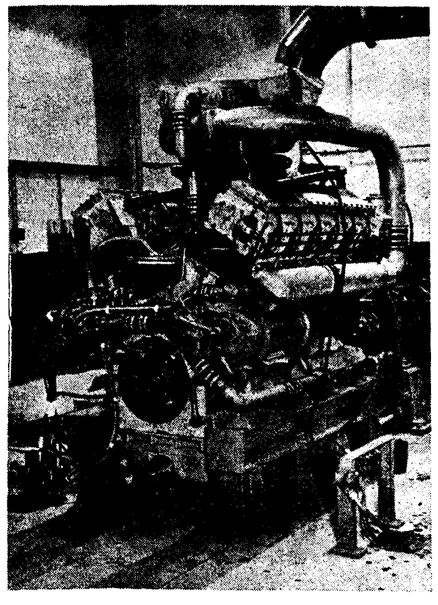
This 12 cylinder engine is turbo-charged and its power rating for rail traction application is 1,152 h.p. at 1,500 r.p.m.

Made under licence from Maybach Motorenbau G.m.b.H.

One of the most widely used engines is the Maybach designed in Germany and used by many European countries from Sweden to the Irish Free State for their railway systems. Following the complete modernisation plans for British Railways, Bristol Siddeley Engines of Coventry, England, negotiated an agreement with the Maybach Company for the building of the latest MD range of engines. The initial order for 92 engines for use on the Western Region of the British Railways system was soon received. Since then other substantial orders have been placed and today really large numbers of the engines are on order and passing through the new specially equipped workshops.

The Bristol Siddeley Maybach engines are available in eight sizes for rail traction purposes – with International Rail Traction Specification horse-power ratings from 400 to 2000. Although this range encompasses almost all power requirements, simplicity is retained by the use of standard bore and stroke dimensions throughout the range. This enables many common parts—such as pistons and cylinder heads—to be used on all engines. The whole Maybach engine range has been designed with the following requirements in mind :— Efficiency, Light Weight, Reliability, Long Life and High Power. A brief description of some design features will indicate the way in which these requirements are attained.

The Bristol Siddeley Maybach Rail Traction Engine is a pressure aspirated, watercooled, four stroke and is available with four or six in-line cylinders and with eight, twelve or sixteen cylinders in Vee Formation. In either Vee or In-line form an extremely light and compact power unit results. The crankcase is a one-piece casting with a separate transverse wall between each bore (or pair of bores in Vee engines). Each of these walls is pierced by a large diameter, annular orifice—hence the designation 'Tunnel Type'. The one piece, forged crankshaft is unorthodox in that each crankweb is disced. Each roller main bearing



A completed MD 650 engine for British Railways shown in an engine test house at the Bristol Siddeley Engineering Centre, Ansty, nr Coventry, undergoing its acceptance test prior to delivery. This turbo-charged engine which has 12 cylinders in Vee formation is rated at 1,152 h.p. at 1,500 r.p.m. for rail traction applications.

Made under licence from Maybach Motorenbau G.m.b.H.

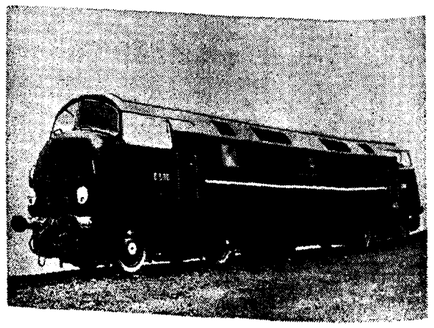
then utilises the periphery of a crank disc as an inner race and an orifice in a crankcase wall as an outer race—thus providing a main bearing of immense strength between each cylinder or pair of cylinders. The interchangeable cylinder liners are sunk into the crankcase casting and are of the wet type. Each liner is completely surrounded by circulating cooling water during operation.

Each piston is in two parts. The steel crown, which carries three compression rings, is attached to the lower aluminium part of the piston by six screws. This lower section of the piston carries two oil control rings, one of which is situated just above the lower edge of the piston skirt to combat piston tilt. The pistons each have a positive cooling oil supply to the underside of the crown—thus closely controlling piston and ring temperatures. This feature, besides enabling pistons and rings to run at minimal tolerances, allows the use of thin wall, lightweight pistons.

All the cylinder heads are separate, interchangeable units and each houses three inlet and three exhaust valves, situated concentrically. They are actuated by separate gear driven, overhead inlet and exhaust camshafts through trailing cam followers. The use of a number of small valves enables far quicker heat dissipation than is possible with two larger valves of the same total area. Disposed centrally between the valves of each cylinder head is a complete special pump and injector unit. This unit has been specifically designed for Maybach diesel engines and injects a relatively large charge in a very short closely controlled period. It is operated by the camshaft through a rocker arm and is a major factor in the engine performance.

As mentioned previously, Maybach engines are pressure aspirated. Exhaust gases are utilised to drive a high mounted turbocharger which compresses in-going air and thereby increases the weight of air induced per induction stroke. This in turn allows better exhaust scavenging and enables a larger quantity of fuel to be injected than would normally be possible and so results in a significant power increase —without the need to tap off engine power to drive the turbo charger. Additionally, in the Vee type engines an air cooler is provided in the induction system so that an even larger charge is induced for a given ambient temperature.

The Maybach lubrication system is particularly comprehensive. In addition to the piston cooling arrangements previously mentioned, there are two other semi-independent lubricating oil circuits. These ensure copious lubrication by cool oil to all



The British Railways Western Region 2,200 H.P. diesel hydraulic locomotive 'Sir Brian Robertson' is powered by two Bristol Siddeley Maybach Type MD 650 12 cylinder engines.

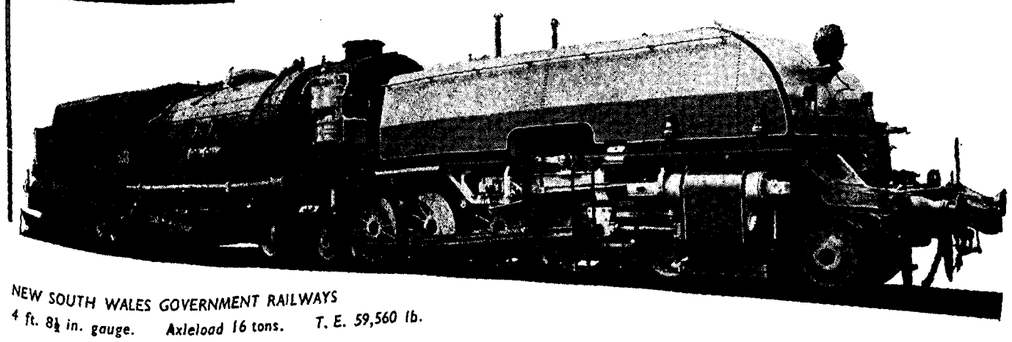
Made under licence from Maybach Motorenbau G.m.b.H.

moving parts. Such is the efficiency of the lubrication system that it is general for the plain shell big-end bearings to run without any metal-to-metal contact. To ensure a fluid film for the bearings immediately on starting, a safety device has been introduced in the lubricating system of the main running parts and valve mechanism. Thus an oil priming pump is started immediately the engine starting switch is actuated and only when the oil pressure in the engine has built up sufficiently is the starter brought into action. Consumption of lubricating oil is remarkably low at .0035—.0045 lb. per horse power hour at full load for all engines.

The foregoing serves to show why the Bristol Siddeley Maybach diesel is held in such esteem in Europe. Used in conjunction with either hydraulic or electric transmission, this engine is in use in almost every country in Europe and in every type of railway classification from the humblest shunting locomotive to the fastest main line express.

In addition to producing the Maybach engine range the Bristol Siddeley Organisation has produced high class motor cars for over 50 years, aero engines for over 40 years and liquid fuel rocket motors for over 10 years. The organisation has also produced over 50,000 of its own, smaller, diesel engines since the end of the war and these are in operation in over seventy different countries. The organisation's other products range over a large variety of precision engineering works. It will be recalled that the highly successful 'Black Knight' re-entry research rocket, fired recently at Woomera, Australia, was propelled by a Bristol Siddeley Gamma Rocket Motor.

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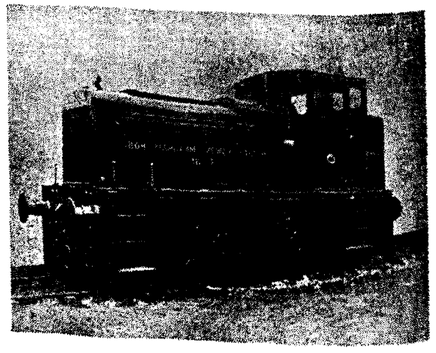
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OVER ONE HUNDRED YEARS OF LOCOMOTIVE DISTINCTION ESTD. BP 1854

302 H.P. Diesel Hydraulic Locomotive for Central Electricity Generating Board

A little over a year ago, Messrs. Andrew Barclay, Sons & Co. Ltd. produced a diesel hydraulic locomotive of 200 H. P., fitted with a Twin Disc torque converter. This locomotive has now been in service for fifteen months in the hands of the National Coal Board and during this time its performance has been perfectly satisfactory, so much so that several repeat orders have been received from the N. C. B. for locomotives of the same size and type.



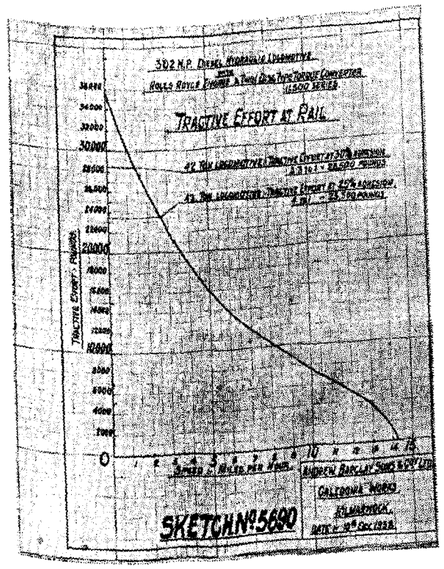
Messrs. Barclay have now produced a larger type of diesel hydraulic locomotive, capable of an exceptionally high tractive effort for a four-wheeled locomotive. This locomotive is the first of four ordered by the Central Electricity Generating Board for handling coal at their new power station at High Marnham. It has recently been delivered and is now in daily use.

The weight of the locomotive in working order is 42 tons and the maximum tractive effort is 28,500 lbs. at 30% adhesion and at 1½ m. p. h. It will run up to a maximum speed of about 14 m. p. h. with light loads. These figures are shown on the T. E./speed curve. The locomotive will start a load of 1600 tons on the level assuming a starting resistance of 18 lbs./ton and will haul this load at a maximum speed of 2½ m. p. h. It will haul 1000 tons at 5 m. p. h. on the level.

In this connection it should be noted that the speed range of this type of locomotive can be varied by altering the ratio of the final drive reduction gears so that a higher maximum speed can be provided if desired. This will of course necessitate a reduction in the maximum tractive effort at low speeds but a locomotive which will run up to 20 m. p. h. would still have a maximum starting tractive effort of 25,000 lbs.

The efficiency of the three-stage torque converter, which Rolls-Royce make under licence from Twin Disc, is very high and the torque multiplication of 5 or 6 : 1 from a single converter is almost as good as that obtained by combining torque converters and gear boxes in other systems of transmission. As the necessary torque multiplication can be obtained in one unit, there is no necessity for change-over valves or complicated mechanisms to ensure engagement of gears at the appropriate speeds. In fact, the system of transmission on these locomotives is as simple as it can possibly be made, both in construction and in operation. The driver controls the train and the speed by use of the throttle and brake levers only. There is a plate-type friction clutch between the engine and the torque converter which is provided in order to avoid running the torque converter while the locomotive is standing and also to facilitate reversing by removing the drag of torque converter from the reversing gear teeth. This clutch is engaged with the engine idling and is not used to take up the load, consequently there is practically no wear upon it. It is of the over-centre type and will stay in or out of engagement as required.

The engine in this locomotive is the Rolls-Royce Type C8SFL, an eight-cylinder supercharged engine which develops 302 B. H. P., 12-hour rating at 1750 r. p. m. The cylinders are 5.1/8" diameter × 6" stroke and are of the wet liner type. It is a dry sump engine and the lubricating oil is cooled in a heat exchanger which is integral with the crankcase. Another heat exchanger is mounted above the torque converter to cool the torque converter fluid. Cooling is provided by a belt-driven centrifugal pump which circulates the water through the lubricating oil heat exchanger, then through the torque converter heat exchanger and then through the engine water jackets and radiator. A thermostatically operated valve is provided to by-pass the radiator until the engine has reached a predetermined temperature. The supercharger is of the Roots type, mounted on the crankcase and driven by a gear train and spring drive from the timing gears at approximately twice the crankshaft speed. This gives about 8 lbs. per sq. inch pressure at full engine speed. Electric starting is fitted, using a 24-volt starter motor of the axial type and large capacity batteries which are capable of starting the engine at temperatures down to -8°C. A large air cleaner of the Airmaze type is connected to the supercharger air intake. It draws air from outside the engine casing.

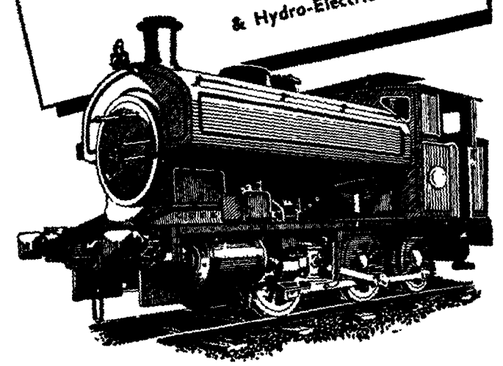


The torque converter is connected to the engine crankcase by an S. A. E. type housing, making the engine and converter a single unit. The torque converter uses fuel oil as its working fluid and this oil is constantly changing as it circulates back to the tank through a bleed orifice. This orifice also serves to eliminate air from the torque converter. The necessary pressure is maintained in the torque converter by means of a gear pump mounted on the engine and a filter is fitted in the circuit. The heat exchanger for the torque converter is of ample proportions to prevent any possibility of overheating when hauling heavy loads. As a precaution against overheating of the converter fluid at high speed when running light, an output shaft governor is provided which limits the maximum speed at which the locomotive can be driven.

(Continued on page D.E.14)

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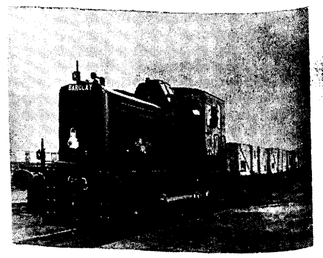
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PAS

More Barclay Diesel Shunters for British Railways

DELIVERY of the third batch of Diesel Locomotives built by Andrew Barclay, Sons & Co. Ltd. for British Railways has now commenced and eight are already in service in the Scottish Region. They are Diesel Mechanical Locomotives of the 0-4-0 type, of 204 p. h., and the transmission consists of a Vulcan Sinclair fluid coupling, Wilson epicyclic five-speed gearbox and a Wiseman reverse and final drive unit. Although the locomotives are of the 0-4-0 type, they are heavier than the 0-6-0 type previously supplied, the weight being 36½ tons in working order against 32 tons and the maximum tractive effort 19,800 lbs. against 15,340 lbs. With the engine running at maximum speed, the following speeds are obtainable on the five gears:

Gear	*Speed*	*Tractive Effort*
1st	3.0 m. p. h.	19,800
2nd	5.25 ,,	11,320
3rd	7.9 ,,	7,530
4th	12.25 ,,	4,850
5th	22.8 ,,	2,600



The following are the principal dimensions:

Rail wheels 3′—7″ dia., wheel base 7′—0″, length over buffers 25′—11″, overall width 8′—3½″, overall height 11′—10¼″.

(Continued from page D.E.13)

The engine is carried on flexible mountings of Metalastik Ltd.'s make, connected to the engine and to the locomotive frames by cast steel brackets. These mountings are arranged so that they will absorb buffing shocks and frame deflections as well as engine vibration.

A propeller shaft with Layrub flexible couplings is fitted between the torque converter and the reverse and final drive unit. The latter is of Wiseman manufacture and consists of a spiral bevel reverse gear with sliding gear clutches operated by compressed air, which is followed by a double reduction gear to the jackshaft. The bevel gears and all shafts in this gearbox including the jackshaft, are carried on ball or roller bearings. The casing is of cast iron of massive design and is bolted direct to the frames so that it forms part of the frame structure and makes for maximum rigidity. The frame plates are 1½″ thick and the buffer beams 6″ thick of mild steel. In order to provide sufficient adhesive weight large cast iron ballast weights are fitted between the frames. The platform plates are 3/4″ thick for the same reason and altogether the framework of the locomotive is exceptionally massive and rigid.

The fuel tank is situated at the top of the engine casing and will carry 200 gallons which should be sufficient for six days' work under normal day-shift working.

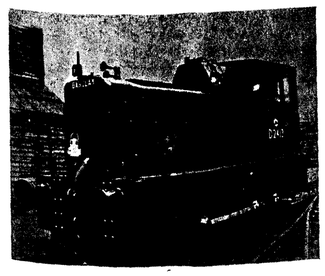
Compressed air brake equipment by Westinghouse is fitted, operated by a self-lapping driver's brake valve, compressed air being supplied by a 25 cu. ft. air compressor driven by belt from an extension shaft at the front of the engine. The radiator fan is also driven from this shaft. The vee belts for these drives are endless and renewal is comparatively easy by the removal of a distance piece under the self-aligning ball bearing at the front end of this shaft. Provision is made for fitting an exhauster for a vacuum brake for the train if required at a later date.

All controls are mounted on a desk in the front of the cab and throttle and brake controls are duplicated so that the locomotive can be driven from either side. A patented device is fitted so that the reverse gear cannot be moved unless the locomotive is stationary. A seat is provided at each side for the driver and a Clayton heater supplied with hot water from the engine cooling system is fitted under the driver's desk. An instrument board to carry the speedometer and mileage recorder, tachometer, pressure gauges, etc., is mounted above the driver's desk and is independently illuminated. The cab has large windows giving an excellent view in all directions and electric wipers are fitted on the front and rear windows.

Compressed air sanding equipment is fitted.

The engine is of the well-known Gardner 8L3 type which develops 204 B. H. P. at 1200 r. p. m. It is basically a standard production and is fitted for electric starting by two 24 volt C. A. V. axial pattern starter motors. Oil bath type air filters are fitted. The starting batteries are of the lead acid type. A C. A. V. dynamo of unusually large proportions is fitted as it is required also to supply a hotplate for heating the engine driver's meals. The hotplate is of 500 watt capacity and the circuit is so arranged that the current for it is supplied direct from the dynamo and does not affect the starter batteries. In addition to starting, these batteries also supply the lighting. The lighting consists of the usual railway headlights and marker lights, together with cab, casing, instrument lights and a portable inspection light.

The locomotives are provided with exceptionally large fuel tanks of 325 gallons capacity which should be sufficient for two or three weeks' continuous service. A filler is provided on top of the tank in addition to which Lockhead self-sealing couplings are provided under the platform at each side of the locomotive for pressure fuelling.



The radiator is a sectional type manufactured by Reliance Manufacturing Co., with cast iron headers. All sections are easily detachable and renewable. A thermostatic valve on the engine water outlet controls the temperature of the water in the cylinder jacket.

The hot water from the engine cooling system is used to supply a Clayton heater for the driver's cab.

The brake equipment is of the Westinghouse vacuum controlled straight air brake type. The straight air brake is of the normal automatic type controlled by a self-lapping driver's brake valve. Air for the braking and control systems is furnished by a twin cylinder compressor driven by vee belt from the engine. The vacuum brake equipment is provided for use with vacuum-braked wagons. Application of the driver's air brake valve will not operate the vacuum brake but the vacuum-air proportional brake valve with duplicated control applies the air brake on the locomotive when the vacuum brake is applied on the locomotive or the train. A deadman system is incorporated and provides for control from either side of the cab. The release of either of the deadman pedals applies the brake after a delay of approximately seven seconds and then shuts down the engine. A Westinghouse reciprocating type exhauster, which is belt driven from the engine, provides the vacuum.

The locomotive portion does not call for any special comment except to note the exceptionally heavy steel buffer beams, also the shunter's footsteps at the front of the locomotive and the wide bottom footstep under the cab floor.

The cab doors are in halves, the top half being fitted with a window. The side windows slide to open. A good all-round view is obtained from the cab and electrically operated wipers are fitted on the front and rear windows. All controls are duplicated so that the locomotive can be driven from either side.

A patent safety reverse device is fitted which prevents a driver from engaging reverse gear before the locomotive has come to rest, in addition to which another interlock is provided to prevent the reverse gear being moved unless the gearbox is in neutral.

SELF-SUFFICIENCY IN RAILWAY COACHES AND WAGONS

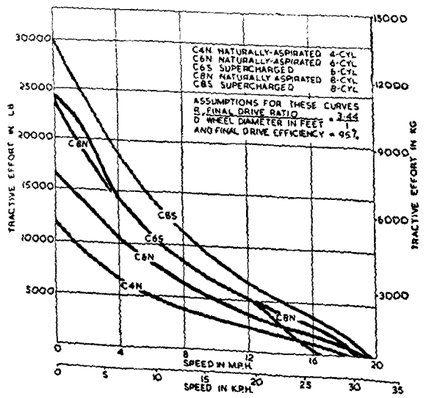
The question of developing manufacture of rail cars will be taken up soon, said Shri Shah Nawaz Khan, Deputy Minister of Railways, in reply to a question by Shri Ram Krishna Gupta and two other members in the Lok Sabha.

The Deputy Minister added that India was already self-sufficient in respect of coaches and wagons excepting special types of vehicles e.g. rail cars and E.M.U. stock etc. for which capacity did not exist at present. Capacity for production of E.M.U. stock was, however, being developed.

Diesel Traction Equipment by Rolls-Royce

ROLLS-Royce do not themselves build locomotives or railcars, but they provide sets of propulsion equipment to undertakings having existing facilities for building. Rolls-Royce can supply everything, from the driver's handles and control system down to and including the final drive, which facilitates production of well-designed lay outs.

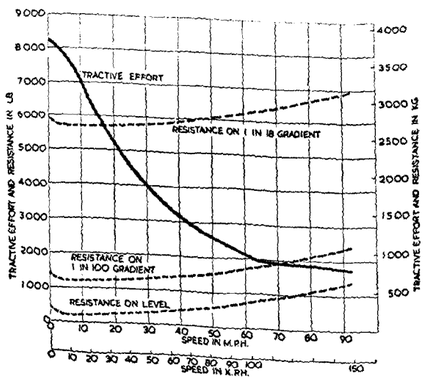
Besides the engines, transmissions and final drives Rolls-Royce are able to supply radiators and all the usual auxiliaries such as generators, compressors and exhauster. For railcars the radiators can be supplied for under-floor mounting with direct mechanical drives to the fans or with remote hydraulic drives to enable them to be mounted in the roof, or elsewhere convenient to the builder.



TYPICAL TRACTIVE EFFORT CURVES FOR LOCOMOTIVES WITH ROLLS-ROYCE ENGINES AND TORQUE CONVERTERS TDG 135

Rolls-Royce four-stroke, direct injection, liquid-cooled engines are already well established in railway applications and other uses. They are of four, six or eight cylinders, either naturally aspirated or supercharged by Roots or by exhaust turbine blowers to develop 100 to 350 hp.

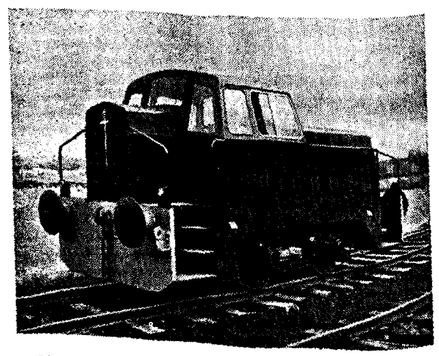
Rolls-Royce diesel engines have been specially developed for railway traction applications, and experience in service has demonstrated that this development has been successful in conferring long reliable life. We recommend that our railway traction engines be overhauled when 9000 hours have registered on the engine service counter.



TRACTIVE EFFORT CURVE FOR A 44·4 TON RAILCAR USING TWO 227 HP ENGINES AND TORQUE CONVERTERS TDG 136

On shunting duties these 9000 engine service counter hours (or mobile hours) are equivalent to about 16,500 shift hours, during which a locomotive would have a driver allocated to it; or to about 13,750 hours if deductions are made for meal breaks and light running to and from the sheds. On single shift working this represents seven years' service, or proportionately less for two—or three—shift working.

In railcars on ordinary services with maximum speeds of 70 m. p. h. and gradients of up to 1 in 50, these 9000 engine service counter hours are equivalent to 250,000 miles.



Shunting locomotive equipped with Rolls-Royce engine and torque converter.

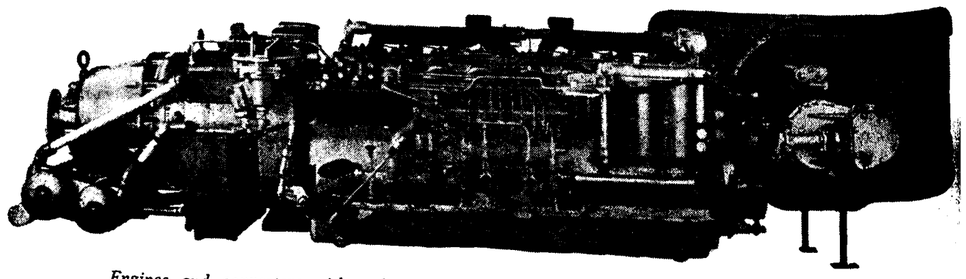
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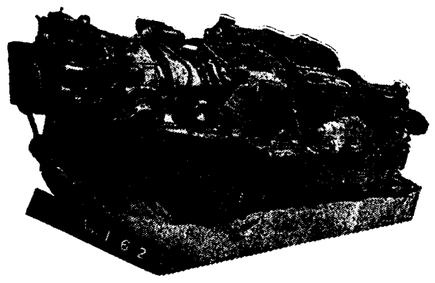


Engines and converters with radiators and auxiliary drives as supplied to British Railways.

TRANSMISSIONS

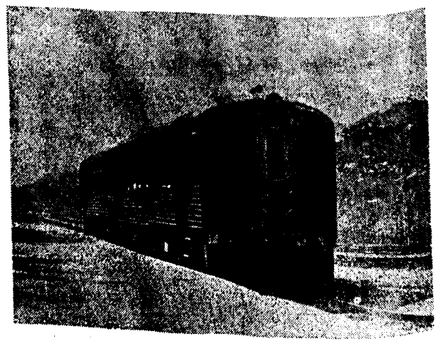
Rolls-Royce have chosen hydraulic transmissions for these horse-powers. They make Lysholm-Smith torque converters to a refined design under licence from Twin Disc of America. Reversing occurs in the final drive or in a reverser attached to the torque converter. The whole transmission is compact and light; and maintenance can be carried out cheaply by mechanical fitters when the engine receives attention.

The torque ratio varies continuously with speed, without interruption of effort, and no gear-changing or change-speed control lever is required. It allows the engine to develop high power continually at high r. p. m. and an internal direct-drive shaft can automatically by-pass the converter for maximum efficiency at high speeds. The drive is smooth, which is pleasant and also helpful to the driver in avoiding wheel-slip. The cooling arrangements can confer continuous rating, even at stall.



Engine, torque converter and reversing gearbox as supplied for South Australian Railways.

Investigations in collaboration with British Railway have shown that torsional oscillations commensurate with engine torque, which are present in many if not in all types of railcar, are excited by vertical motion of the final drive at rail joints. Rolls-Royce have produced a torsionally resilient cardan shaft to smooth the oscillations out.



Railcar supplied to the Malayan Railway with Rolls-Royce engines and torque converter.

CONTROLS

Rolls-Royce also supply controls. It is sometimes possible to engineer up-to-date systems to couple to ones in use: for example, an order has already been received for power equipment for diesel-hydraulic railcars with Rolls-Royce controls that couple with existing railcars having four-speed gearboxes and which are of a different horse-power.

(Continued on page D.E.19)

Hydraulic Transmission for Large Diesel Locomotives

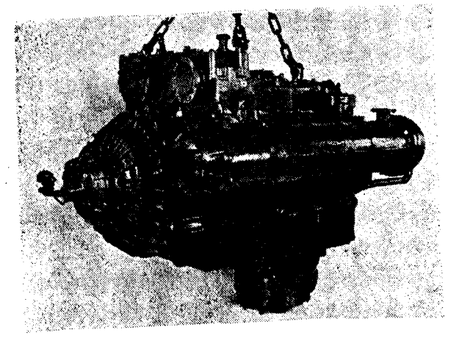
By a Correspondent

Almost interesting aspect of diesel traction today is that in Western Europe alone there are at work about 100 diesel-hydraulic locomotives of 1,600 to 3,000 b. h. p., plus another 160 under construction.

These locomotives operate or will operate in both freight and passenger traffic; indeed, the most powerful of them all, of 3,000 b. h. p. on 100 tons weight and 17 tons axle load, is engaged in daily haulage of mineral trains up to 2,200/2,500 tons in weight over a distance of 135 miles and with a ruling gradient of 1 in 125 (0.8 per cent); and has also shown its capability of hauling 622 ton trains up 1 in 40 gradients with 660 ft. radius curves at a sustained 17 m. p. h.

The growing preference for diesel-hydraulic locomotives for the heaviest traction duties is readily understandable. Many of the earlier locomotives of this type and of 2,000 b. h. p. or thereabouts have been engaged mainly on fast passenger work with trailing loads of 250 to 600 tons, because the high standard of locomotive design permitted by the combination of lightweight quick-running engines and hydraulic transmission gave high h. p. per ton of weight; and, a locomotive being primarily a traffic machine, it was only natural to use that characteristic where it showed to best and most immediate advantage, that is in light and very fast trains. The specific efficiency of locomotive design, as indicated by power: weight ratio, for line-service locomotives may be seen in the accompanying table.

But growing experience has demonstrated practically and most forcibly what was always revealed theoretically by any basic investigation, and that is the superior traction characteristics of hydraulic transmission in the heaviest drag freight working, and in handling heavy passenger and freight trains up long and steep gradients without any damage or strain to engine or transmission components.



Maybach Mekydro four-speed hydraulic transmission for power input up to 1,800 H.P., with heat exchanger attached. Weight: 4.1 tons.

There are several fundamental reasons for this, all of which have now not only been proved in practice, but the results have been *measured* in practice, so that the present status is not a matter of opinion; it is a matter of fact. The inefficiency of

(Continued from page D.E.18)

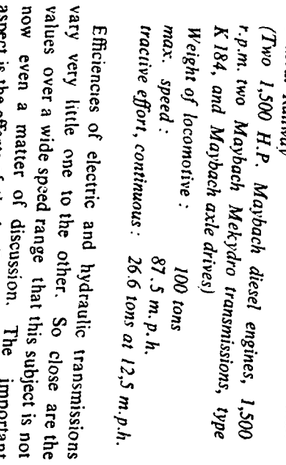
TESTING

In addition to the normal production and development testing facilities, Rolls-Royce have an endurance test-bed on which a railway installation is operating continually: its cycle of operations is controlled by a cam so that the loads and speed correspond to any chosen railway line. However, the test engine gives much more power than those on sale and the transmission is correspondingly overloaded. Many readers will know from experience that cyclic operations are a much more searching test than continuous loading.

TECHNICAL HELP

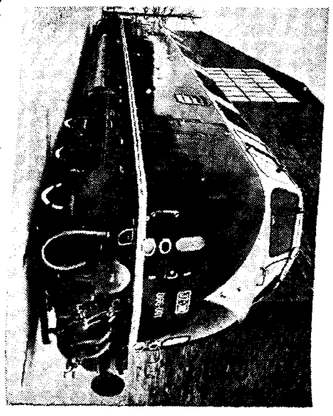
Rolls-Royce Railway Traction Department are always prepared to make technical investigations into customers' requirements and to co-operate in engineering the installation of equipment supplied from the separate Rolls-Royce factories.

a transmission system, whether it be electric or hydraulic, always appears as heat, and as heat which must be dissipated. With hydraulic transmission this dissipation of heat can be, and is, dealt with much more easily than it possibly can be with electric transmission, where expensive forms of ultra-modern insulation, much copper and high-capacity traction-motor blower sets are needed to cope with the heat generated. Indeed, with the latest type of powerful diesel electric locomotive for freight service it has even been found necessary to provide a separate blower set to force-ventilate the main generator, in addition to two traction-motor blower groups. Compare this with the simple heat exchanger mounted direct on the transmission casing of hydraulic transmission, and which has proved capable in practice of dealing with the most onerous possible conditions—that is repeated standing starts with the brakes still partly on, and with a zero-speed tractive effort up to 30 to 33 per cent adhesion having to be maintained for one to two minutes at a time.



Diesel-hydraulic 3,000 H.P. C'C' type locomotive hauling a 2,400-ton mineral train of the German Federal Railway
(Two 1,500 H.P. Maybach diesel engines, 1,500 r.p.m. two Maybach Mekydro transmissions, type K 184, and Maybach axle drives)
Weight of locomotive : *100 tons*
max. speed : *87.5 m.p.h.*
tractive effort, continuous : *26.6 tons at 12.5 m.p.h.*

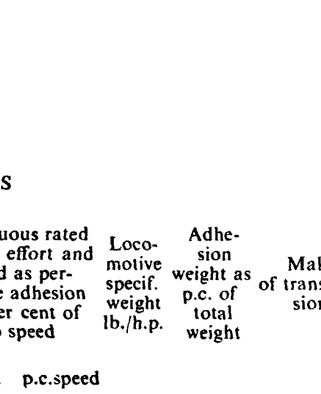
Efficiencies of electric and hydraulic transmissions vary very little one to the other. So close are the values over a wide speed range that this subject is not now even a matter of discussion. The important aspect is the effects of the inefficiency. The inefficiency side of electric transmission builds up a cumulative effect rapidly, so that a principal characteristic of diesel-electric locomotives is that they cannot sustain high tractive efforts for long periods at low track speeds, except by very expensive construction and



2,200 H.P. diesel-hydraulic C'C' type locomotive of the Yugoslav State Railways (Krauss-Maffei) equipped with 2×1,100 H.P. Maybach engines and Mekydro transmission.

substantial addition to the weight. This defect was found out as long ago as 1925 when the first main-line diesel-electric locomotive was put on to freight service It has never since been remedied On the other hand because of the inherently smaller and nearly non-cumulative effects of the same heat generation (that is, with the same transmission efficiency) in hydraulic transmission there is practically no limitations or necessity for a short-time rating.

This appears strikingly in what is perhaps the most important single value in practically every diesel locomotive of any type, and which indicates how suitable or unsuitable is the locomotive for general railway working. That factor is the continuous rated tractive effort. It should be as high as conveniently practical at—and upwards from—as low a track speed as possible. The continuous tractive effort as a com-



2,200 H.P. diesel-hydraulic B'B' type locomotive of British Railways, equipped with Maybach engines and Mekydro transmissions.

CHARACTERISTICS OF MAIN LINE DIESEL LOCOMOTIVES

Railway	Locomotive Class	Axle Arrangement	B. H. P.	Loco-motive weight tons	Adhesion weight tons	Max. axle load tons	Top Speed m. p. h.	Continuous rated tractive effort and speed as per-centage adhesion and per cent of top speed		Loco-motive specif. weight lb./h.p.	Adhe-sion weight as p.c. of total weight	Make of transmis-sion
								p.c.adh.	p.c.speed			
Diesel-electric :												
Brit. Railways	Deltic	Co-Co	3300	106	106	18	90	12.2	38.9	72	100	English Electric
S. N. C. F.	060 DA	Co-Co	2000	118	118	19.7	46	18.4	25.7	132	100	C.C.M.
Brit. Railways	D 200	1-Co-Co-1	2000	133	108	18	90	12.8	21.1	149	81	English Electric
Spanish State	Alco DL500	Co-Co	1980	107	107	17.8	65	19.2	18.1	121	100	General Electric
S. N. C. F.	060 DB	Co-Co	1860	110	110	18.4	81	13	18.5	133	100	Alsthom
Brit. Railways	D 5500	A1A – A1A	1250	104	72	18	75	13.9	22	186	69	Brush
Diesel-hydraulic :												
(Krauss-Maffei)	ML 3000	C-C	3000	100	100	16.7	87	26.5	14.3	75	100	Mekydro
Brit. Railways	D 800	B-B	2200	78.5	78.5	19.6	90	21.4	13.9	80	100	Mekydro
German Federal	V 200	B-B	2200	78.5	78.5	19.6	87	27.5 (M) 20.0 (V)	12.9 16.1	80	100	Mekydro or Voith
Jugoslav. State	D 66	C-C	2200	96	96	16	75	26.8	12.5	97.5	100	Mekydro
Italian State	(Ansaldo)	B-B	1600	63	63	15.8	87	27.5	12.9	88	100	Mekydro

parative value usually can be taken as equal to a percentage of the adhesion, and the lowest speed at which it can be exerted as a percentage of the top designed speed. A diesel-electric line-service locomotive commonly does not show a continuous rated tractive effort of more than something like 20 per cent adhesion, and many have a lower value; also the speed at which it is exerted is in many types 20 to 30 per cent of top speed. On the other hand, diesel-hydraulic line-service locomotives commonly have continuous rated tractive efforts of 22 to 27 per cent adhesion, and at no more than 13 to 16 per cent of top speed. The following table shows some examples.

In shunting and transfer locomotives, where obviously high sustained tractive effort at very low speed is one of the first essentials, the difference in favour of hydraulic drive is just as startling. Some well-known diesel-electric locomotives of this type show continuous rated tractive efforts of only 11 per cent adhesion at 30 per cent of top speed! Clearly such a locomotive design cannot be used either up to h. p. or to adhesion capacity except for short periods. On the other hand, diesel-hydraulic locomotives built as standard in hundreds show, for similar duties, a continuous rated tractive effort up to 30 per cent adhesion at 13 per cent of top speed.

This is one of the reasons that diesel-hydraulic shunting locomotives have been so widely accepted all over the world.

However, as was already pointed out afore, similar trends are becoming conspicuous now in regard to powerful line-service locomotives.

The fact that the weight of hydraulic power transmissions is but a fraction of that of the heavy electric transmissions permits the construction of locomotives which, with an identical number of axles, offer appreciably higher outputs per locomotive unit than could be hitherto realised in the case of diesel-electric locomotives.

A good example of this is the 4,000 b. h. p. locomotive designed by the order of the German Federal Railway, the weight of which as a six-axle C' C' type is 112,5 tons only including the heating boiler required for conditions prevailing in Germany.

1960 ANNUAL GROUP MEETINGS OF INTERNATIONAL ELECTRO-TECHNICAL COMMISSION

It is learnt that Dr. S. Radhakrishnan, Vice-President of India, will inaugurate the Annual Group Meetings of International Electro-technical Commission, scheduled to meet in New Delhi from 31 October 1960 to 12 November 1960.

It would be the first time in its history of 54 years, that the Commission would be meeting in an Asian Country.

It is expected that more than 400 foreign experts in the electrical field will attend the various meetings of its technical committees: and the Indian Standards Institution, which is acting as host to IEC for the 1960 Meetings, has already taken in hand the preliminary preparations in this connection.

The IEC is the electrical division of the International Organization for Standardization (ISO); and the object of the Commission is to establish international standard practices in the field of electrical technology, by facilitating the unification of national standards and by co-ordinating the activities of other international organization in this field. Its scope includes both the heavy electrical engineering and the communication fields.

The Commission was set up in 1904, and celebrated its jubilee in 1954 in the USA. During these years, it has made valuable contributions to the progress of the profession through standardization activity in different fields of electrical engineering and has earned for itself a position of leadership in the international sphere. India together with eight other countries, elected for a term of nine years, form the Committee of Action of the IEC which functions as its executive body.

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IRAQI RAILWAY DELEGATION IN NEW DELHI

A four-member Iraqi Railways Delegation headed by the Director General of Iraqi Railways and Civil Aviation, General Salih Zaki Towfiq, arrived in New Delhi on 27th April, 1959 on a study tour of the Indian Railways and for discussion of technical problems with Indian railway authorities.

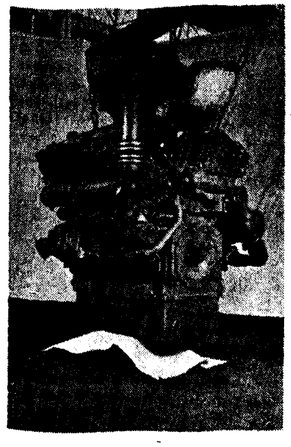
They remained in India for a little over a week, as guests of the Indian Railways. Members of the Delegation had a meeting with the Railway Board. They left for Perambur to see the Integral Coach Factory and from there went to Calcutta and later to Chittaranjan.

The Status of the Quick-Running Railway Oil Engine

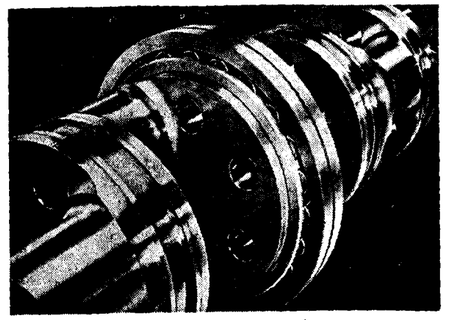
By a Correspondent

FOR many years there was a widely-held opinion that slow running diesel engines in locomotives and railcars were superior to quick-running types in regard to maintenance and repair costs, and also in regard to miles per failure. Actually no evidence ever accumulated to support this opinion, and comparative figures were never available until the last three or four years. Now, however, recorded experience is showing that not only is the modern quick-running engine equal to the slow speed one in reliability and low running cost but is actually superior to it as far as thoroughly proven records are concerned; while, additionally, its small bulk and its effect on transmission weight and bulk is enhancing the standard of locomotive design.

First, the opinion of a user may be quoted. After experience extending over 10 years with slow-running engines of three different makes and five different models ranging from 500 to 1,200 b. h. p. alongside four different quick-running engines of 112 to 400 b. h. p. on Coras Iompair Eireann (C.I.E.) in Ireland, the works manager and assistant works manager of that system, in a paper "Experience with Diesel Engines on the Irish Railway" read to the Irish section of the Institution of Mechanical Engineers in January 1959, recorded that they considered "the high-speed engine to be just as reliable as its slow-speed predecessor for railway applications, and that its low weight per b. h. p. will give it the advantage in future designs of locomotives and railcars".



800 H.P. 8-cylinder Maybach diesel engine, 1,500 r.p.m., type MD 435.



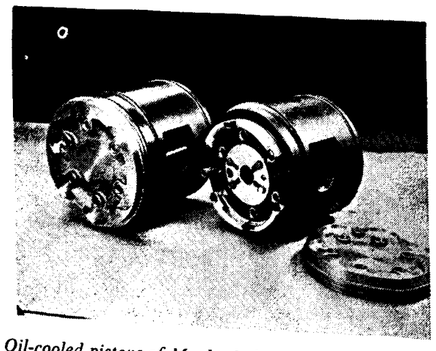
Disc-webbed crankshaft and roller main bearing of Maybach tunnel engines.

Over a total service period of about 2 years with 19 Maybach engines in heavy shunting and freight-transfer work, these two authors recorded that the maximum work to be done on these engines had been the replacement of two cylinder head gaskets.

Now this lines up entirely with the even more extensive experience on the German Federal Railway. In railbuses and shunting tractors upto 150 b. h. p. road transport engines are used. Above that output, and up to 2,000 b. h. p. per engine, over 90 per cent of all locomotive and railcar oil engines run at 1,400 to 1,550 r. p. m. and are of lightweight types, and their carefully recorded performance is astonishing. The original 39 Maybach tunnel engines of 650 b. h. p. at 1,400 r. p. m. have proved capable throughout a period of nine years of running 1,000,000 km (620,000 miles) between heavy repairs, and with no more than two piston lifts and no other dismantling work between. Even so, at heavy overhauls no major parts have needed renewal; indeed, in these original 39 engines the cylinders and heads of pre-war engines were embodied, so that many of these parts have run even a far greater mileage without renewal; yet cylinder wear does not exceed 0,02 mm per 1,000 service hours.

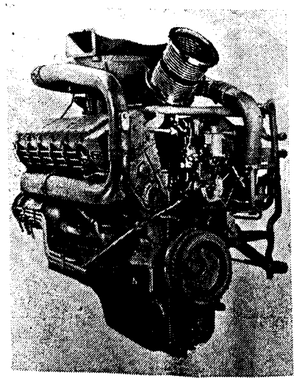
Some years ago, when the first engines had exceeded 500,000 km (310,000 miles), the gradually extending performance of these engines promoted two major developments.

First, is substantiated the growing performance of equal calibre, of the then new Maybach MD engines of 1,200 b. h. p. upwards, in which the tunnel crankcase with roller main bearings encircling the crankwebs was allied to a new head and combustion system with a separate pressure-oil circuit for the pistons. These large engines, now used for main-line high-power locomotives in Germany, England, Italy and Jugoslavia, (and with repeat orders under way for three of those countries and a new order for Bulgaria in addition) are now duplicating the performance of the smaller tunnel engines of MD and GTO types in Germany, Ireland, South Africa, Finland, Italy and elsewhere; and they are being built upto 2,000 b. h. p. U. I. C. rating per engine, making possible diesel-hydraulic locomotives of 4,000 b. h. p. on an axle notation of C-C and without maximum axle load exceeding 19 tons. Moreover, it was an oil engine of this MD-type which ran as a test continuously at full load for 3,500 hr. on normal fuel oil; and then, after some small modification to suit the coarser characteristics, ran a further 2,500 hr. continuously on marine diesel fuel.



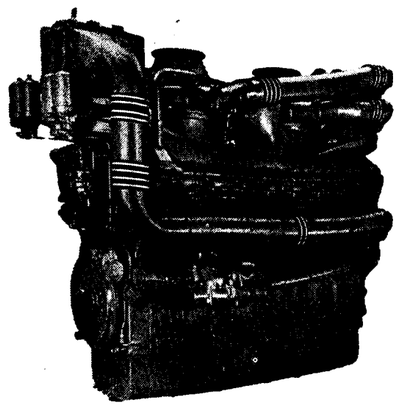
Oil-cooled pistons of Maybach diesel engines, MD type.

Secondly, when in 1954 the German Federal Railway required 279 standard shunting locomotives of 48 to 50 tons weight and 600/650 b. h. p., the financial sanction was given only if thoroughly proven constituents were to be adopted. Of six or seven engine types available in Germany, only the Maybach tunnel engine could show the requisite performance, and set to 650 b.h.p. at 1,400 r. p. m., was ordered for 270 locomotives. Further, when another 66 locomotives were ordered in 1957, and again when no fewer than 390 more locomotives of this V. 60 standard shunting class were



1,200 H.P. 12-cylinder Maybach diesel engine, 1,500 r.p.m., type MD 650.

ordered towards the end of 1958, the same engine was specified for all without further question. And it is instructive to note that for the 726 locomotives a total of no more than 761 engines has been ordered. That is, the reserve is less than 5 per cent, though the locomotives themselves are distributed all over Western Germany.



2,000 H.P. pressure-charged and intercooled 16-cylinder Maybach diesel engine, 1,500 r.p.m., type MD 870.

A good many of the V. 60 locomotives delivered in 1955-56 have now exceeded 20,000 hr. in service; and though that period was set as a check to dismantle the first engines, the experience and wear measurements have been such that only a piston check-up will generally be made after this mileage without there being any indication that a major overhaul is required. Despite the more frequent engine starts and stops in shunting service compared with long distance mainline runs, the cylinder wear is far less than 0,01 mm per 1,000 hr.

Thus, one and the same well-designed quick-running light-weight engine has been proved thoroughly reliable and cheap to maintain in fast long-distance railcars and in shunting locomotives dealing with both freight and passenger shunting in hump and flat yards. Moreover, this German experience of quick-running engines in shunting locomotives has been borne out in Ireland, Australia and other countries with 400 and 600 H. P. MD-type engines running at 1,500 to 1,600 r. p. m. in shunting and freight-transfer work.

This range and standard of performance opens up—on definite proved figures over many millions of miles and millions of service hours—quite a new vista on oil-engine standardisation and interchangeability of parts, covering every type of locomotive from 400 to 4,000 b. h. p., and railcars and fast multi-car diesel trains from 400 b.h.p. upwards; for something like 80 per cent of all wearing and the great majority of non-wearing parts are standard and interchangeable over every MD engine from 400 to 2,000 b. h. p. railway rating. Practically, only the crankcase, crankshaft, and camshaft length vary with the number of cylinders. Moreover, if an ample supply of cooling water can be made available, the top outputs can be increased substantially without added thermal stresses. The 16-cylinder engine, for example, though of 2,000 b. h. p. U. I. C. rating when intercooled in normal locomotive applications, is run up to 3,000 b. h. p. top output where an ample supply of cold seawater is available, as in marine installations.

For large locomotives this type of engine is finding a rapidly increasing use. For example, of 160 diesel-hydraulic locomotives of 1,600 b. h. p. upwards under construction and in course of delivery in Europe at the present moment as many as 120 have Maybach MD engines up to 2,000 b. h. p. per unit.

MANUFACTURE OF DIESEL COACHES

Mr. Shah Nawaz Khan, Deputy Minister for Railways, told Pressmen in Madurai that as the steel position improved with the production of steel in Bhilai and Rourkela, the implementation of railway development schemes would progress much more rapidly than now.

The Minister said that the Government of India were encouraging Indian manufacturers to take up the manufacture of diesel coaches and there had been a good response from certain firms. He hoped that in the not distant future such coaches would be manufactured in India itself.

Expressing the view that there would be no need for further electrification of lines in the South, the Minister said, that electrification of more lines had to be considered only if the present arrangement could not meet the needs of the public. At present the Southern Railway was able to cope with the traffic. Of course, there was overcrowding in trains, but it was not as much as it was in other parts of the country, he said.

As regards the possibility of laying new lines in the South under the Third Plan, Mr. Shah Nawaz Khan said that schemes would be taken up only in order of priority suggested by the Planning Commission.

LIFT FOR HOSPITAL

The Deputy Minister for Railways switched on a new electric lift installed in the premises of the Madurai Railway Hospital, which he visited, accompanied by the Divisional Superintendent, Mr. G. N. Nair.

The Minister was received at the hospital by Mr. P. R. Balakrishnan, District Medical Officer, Southern Railway, Madurai, and was taken round.

CHOICE OF ELECTRIC TRACTION Versus DIESEL AND STEAM TRACTION

By S. P. Tonse
Dy. Chief Electrical Engineer, Western Railway

HISTORY OF DEVELOPMENT OF RAILWAY TRACTION

THE first public Railway was opened in 1825 between Stockton and Darlington, followed in 1830 by the inaugural run of the first passenger train between Liverpool and Manchester. The steam locomotive held undisputed supremacy and until recently, has maintained its position as the principal form of railway motive power.

Although Faraday announced his discovery of the electro-magnetic induction in 1831 and thereby founded electrical engineering, it was only in 1879 that the application of electricity to traction was demonstrated by the opening of the first electric railway in Berlin. From about 1900, railway electrification proceeded at a steadily increasing rate but did not seriously compete with steam. It was the diesel locomotive employing an electric transmission system which first threatened the supremacy of steam and from 1940 onwards this form of traction developed at a phenominal rate. However, recent developments indicate that in the next few years there will be a very rapid expansion in straight electrification. Given below are the main features of different modes of traction.

STEAM TRACTION

The steam locomotive is a complete motive power plant on wheels. Due to the limitation of space and moving dimensions placed upon its design, the scope for developing a really highly efficient unit is limited. The reciprocating engine is invariably employed on account of its inherent simplicity, the simplicity of the connection between the cylinders and the driving wheels and the ease with which the speed can be controlled. Owing to the difficulty of installing a condenser on the locomotive, such engines operate non-condensing and therefore have a very low thermal efficiency of 6 to 8% due to considerable wastage of heat through the exhaust steam. Moreover, it is not possible to obtain very efficient combustion, with the result that considerable quantities of combustible materials are lost through smoke and cinders. Low thermal efficiency necessitates the transport of large quantities of coal or other fuel to running sheds and also in the locomotive tenders. This automatically reduces the pay load of the train and also entails provision of coaling and watering facilities en route.

Disadvantages of the steam locomotive are its strictly limited overload capacity and the fact that it is only available for hauling for about 60% of its working day, the remainder of the time being spent in preparing for service and in maintenance and overhaul. It becomes necessary to reverse the engines at the terminal stations entailing provision of turntables and loss of valuable time.

In the conventional steam engine, there are reciprocating parts which lead to unbalancing and the tractive effort is also fluctuating. Although considerable progress has been made in the technique of counterbalancing, use of box section wheels and lighter designs of reciprocating parts, it has not been possible to completely eliminate these disturbing forces. There is considerable wear on the track caused by unbalanced reciprocating parts and corrosion of steel structures by the smoke emitted.

The permissible axle loads in the case of steam locomotives are much less and the maintenance of the track is more costly. The effective adhesion is also less because of the fluctuating tractive effort, as compared to a locomotive which is capable of delivering uniform torque at the driving wheel. The power/weight ratio of steam locomotive is naturally higher than an electric or diesel electric locomotive.

A few locomotives employing steam turbines have been built which use a condenser and which have reduction gearing between the turbine and driving wheels. Although such locomotives have an efficiency of 10 to 15%, their high initial and maintenance cost have not so far justified their general use. Recently, gas turbine locomotives have also been built.

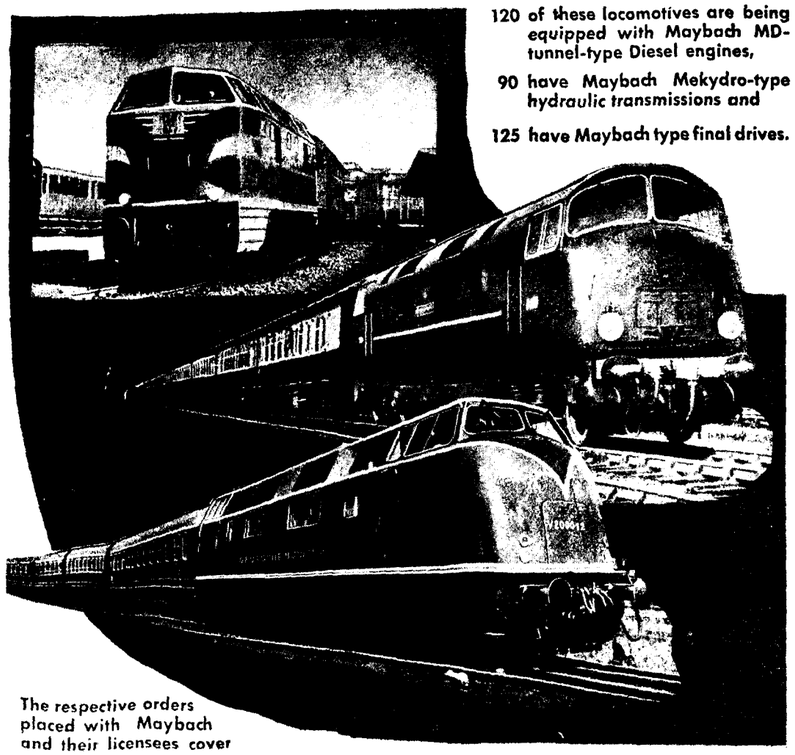
The steam locomotives require high grade coal,

The Advance of powerful Diesel Hydraulics in Main-Line Traction!

Apart from numerous small and medium size locomotives ordered, there are actually orders in execution as part of the modernisation programme of large European railways for about

160

powerful diesel-hydraulic main-line locomotives of 1600 to 2400 b.h.p.



120 of these locomotives are being equipped with Maybach MD-tunnel-type Diesel engines,

90 have Maybach Mekydro-type hydraulic transmissions and

125 have Maybach type final drives.

The respective orders placed with Maybach and their licensees cover

200 high-speed MD tunnel-type Diesel engines of 800, 1200 and 2000 b.h.p.
140 hydraulic Mekydro transmissions of 1100 and 1800 h.p. power input capacity and
500 Maybach final drives suitable for 400 to 500 h. p. and axle loads of 17 to 20 tons.

Maybach

MAYBACH-MOTORENBAU GMBH. FRIEDRICHSHAFEN
GERMANY

which supplies are very limited in our country. Such high grade coals are vital, specially for metallurgical purposes and hence the need for conservation. There is however, a significant trend of thought that by introducing mechanical strokers, slack or small coal should be burnt in steam locomotives, giving better thermal efficiency and usage of coal to the country's advantage, until such time abundant and cheap electricity becomes available to adopt electric traction.

Reciprocating steam locomotive has been at the peak of development for a long time and there remains little prospect of further major improvement. It has been said that it is in a fuel efficiency sense, one of the least efficient machines to survive in a modern age, and must now give way to inventions with machines more in keeping with the modern way of life. Certainly it is sturdy, reliable and cheap, but in this respect the alternative use of diesel and electric traction are more reliable and economic in suitable conditions.

DIESEL TRACTION

In the case of diesel traction, each locomotive is also a self-contained power station on wheels as in the case of steam locomotive. Modern diesel electric locomotives consist of a diesel driven D. C. generator feeding power to the traction motors of medium voltage. In contrast to straight electric system drawing power from a constant voltage source, the diesel electric unit obtains power from a constant power source. Usually, a number of notch positions are provided and for each of these the engine is run at constant speed and at constant power output regardless of the speed of the locomotive. For any notch position, the speed of the engine is kept constant by governor control and the power output is similarly maintained at the designed figure by regulating the fuel rack position to give constant power.

There are two types of transmission for diesel locomotives viz. electric transmission and hydraulic transmission. Electric transmission is universally adopted in U. S. A. whereas in Europe it is electric and also hydraulic. Two stroke and four stroke Diesel Engines, with supercharging for large units are in use.

The great advantage of diesel traction lies in the overall operating economies that are possible. In the first place there is economy in fuel. The nett thermal efficiency of the diesel locomotive is about 26% at the rail, as compared with the figure of about 7% for the steam locomotive. It is claimed that in U. S. A. one ton of diesel oil would do the work of about 10 tons of coal. In the annual report of the South Australian Railways for 1954—55, it is stated that one ton of diesel fuel oil is doing approximately the same amount of work in a diesel locomotive as 15 tons of coal in a steam locomotive. If these figures are translated into money however, the results would vary a great deal in different territories, depending upon the differences in prices of fuel oil and coal.

A major revolution occurred in American Railroads after the dramatic change over from steam to diesel traction which began in 1940 and is now almost completed. In that country at the end of 1954, diesel electric traction accounted for 85% of the gross ton miles in freight service, 88% of the passenger car miles and 99% of the shunting hours in the yard service. The total number of locomotive units of all types decreased from 48,000 in 1934 to 33,000 in 1954, even though the total revenue ton-miles handled were twice as great.

The diesel electric locomotive has many of the virtues of the straight electric locomotive. Fundamentally the difference between the electric locomotive and the diesel locomotive is that in the latter the prime mover is carried in the locomotive itself. Considerably less time is required for servicing, repairing and inspection than with steam and as a result availability and utilisation are better than in the case of steam

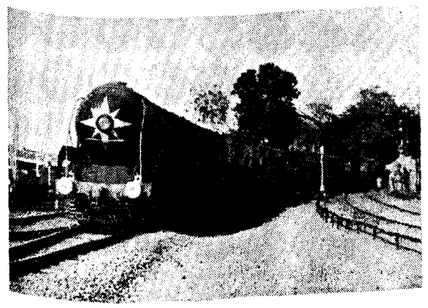


Latest type Electric Locomotive hauling " Deccan Queen " on the Central Railway.

locomotives. Smoke abatement has led to cleanliness of trains and other Railway property. Absence of sparks reduces the fire hazard. The elimination of halts for watering, coaling and firing when on general service are advantages in operation. The diesel electric locomotive is an easy machine to be operated. The crew could be accommodated in comfort and there is excellent visibility of the track.

ELECTRIC TRACTION

It is often claimed that the electric locomotive is not a locomotive in the true sense. It is held to be a converter in that electric energy is supplied from a stationary prime mover and converted into mechanical energy in the locomotive. However, the electric locomotive is an efficient form of motive power with a high standard of reliability and availability and ever superior to all other types of locomotives. It is capable of rapid acceleration up to the limits of adhesion and has got great advantages in ascending gradients because it can draw almost unlimited power from the line. Regeneration or rheostatic braking can be used for descending gradients. This gives perfect control of the train by the driver and reduces the wear and tear of the mechanical brake gear. It eliminates smoke and is capable of quick turn-round when fitted for driving at each end. Compared with other types of locomotives, it is cheap and easy to manage.



W.P. Steam Engine hauling Air-Conditioned Express train on the Western Railway.

The electric locomotives depends on fixed installations for supply of power which is a disadvantage. But where the traffic density is sufficiently high, this cost could be justified on economy grounds. The detailed analysis of the conditions in and around Calcutta, on the basis of the cost of coal and electric power has revealed that for any traffic density in excess of 4.23 million trailing ton miles per running track mile per annum on a double track section, electric traction is more economical than steam.

The efficiency of electric locomotive is 85 to 90% although the overall efficiency of the entire system from source to the wheel rim is between 15 to 20%. By the concentration of large capacity prime movers in a few Central Power Stations, the maintenance cost is considerably reduced and a much lower grade fuel can be burnt. The maintenance of the electrical equipment on the locomotive is very simple and such locomotives can, if desired, be kept in service for 95% or more of a working day. The only serious technical disadvantage of track electrification as against the use of self-contained power units perhaps is the fact that a breakdown of the electric supply causes a complete stoppage of the system. Such an occurrence is however, sufficiently rare nowadays to be a negligible factor in making a comparison.

There are various systems and voltages for electrification. The three principal ones holding the field at present are 1500 V. and 3000 V. D. C. and 25 KV single phase A. C. at industrial frequency. While there is no dispute about the superiority of D. C. traction motor as the ideal unit to meet the requirements of traction, the difference is in the methods of supply. In the case of 1500 and 3000 V. D. C. a number of fixed installations are required for stopping down the transmission voltage and converting it from A. C. to D. C. for feeding the overhead catenary and contact wire. In the case of A. C. electrification, the converting equipment is omitted in substations, but instead each locomotive carries its own rectifier unit. The chief advantage of A. C. electrification is lower initial cost, longer spacing of substations, lighter overhead equipment, better performance of rectifier locomotive of the Bo-Bo type, which is reputed to have a very high factor of adhesion (about 40%). However, there are some peculiar problems like unbalance on the supply network and interference with telecommunication circuits as well as other aerial wires running in the vicinity.

INCREASING SECTION CAPACITY

There are different ways of increasing a section capacity. Provision of additional running lines, crossing stations, loop lines, remodelling of yards, improvement to signalling, electrification or dieselisation. It has been shown by facts and figures that the saturation point for steam traction is reached much earlier than with diesel or electric traction.

Electric or diesel traction schemes in addition to augmenting section capacity would affect considerable savings in operation. However, before a final choice can be made between these two alternatives, it is necessary to consider a number of factors. Although the main factor is that of economy, the choice of the system can ultimately be influenced by political, strategic and other considerations as well. In a countr

like India where there are no large natural resources of oil so far located, the dependence upon other countries especially in times of war can be a major factor against the use of diesel traction on a large scale.

There is little to choose between diesel or electric traction from the point of view of increasing section capacity. It would be possible to maintain average schedule speeds with both types of traction than is possible with steam traction. Long halts for watering, coaling, etc., necessary with steam traction are virtually eliminated in the case of diesel traction and are not at all required for electric traction. The improved tractive effort characteristics of the diesel and electric units also enable trains to work up to speed in a short interval, thereby affecting considerable improvement in the operating time of trains with steam traction.

CHOICE BETWEEN DIESELISATION AND ELECTRIC TRACTION

Among factors which will influence the choice between electric and diesel traction, the initial charges and annual running expenses would have an important bearing. In this connection, a survey of recent traction developments inU. S. A. and Europe indicate that the Railways in U. S. A. are wedded to a policy of dieselisation whereas electrification is proceeding rapidly in different European countries. It is apparent that the developments in these two areas are following lines best suited to individual needs and peculiar local conditions obtaining.

The circumstances which led to the phenominal development of diesel traction in U. S. A. are—firstly cheap and abundent supply of oil. As all the Railways in U. S. A. are operated by private companies, financing of a diesel project is facilitated, as almost the entire capital outlay on such a project is expended on locomotives which are movable assets capable of being shifted from one end to another. Mass production of diesel units has also resulted in lower manufacturing costs.

On the contrary, in Europe oil is expensive as it is required to be imported, whereas hydro-electric and thermal power is available at reasonable rates. The lighter and more frequent train services offer greater economies in the initial cost of electrification.

Conditions in India are similar to those in Europe. So far no large sources of oil have been proved. Oil will therefore, have to be imported and hence will be costly. We also cannot depend upon imported oil supply in the event of any serious international tension. On the other hand, it is estimated that the total known potential of hydro-generation in India that can be harnessed is over 30 million Kilowatts. Plans are also in hand for the installation of atomic power stations to provide ample and uniform supplies of electric power in areas located far from hydro-electric or coal resources. Low grade coal and lignite are available plentiful which can be burnt in Central Thermal Power stations for producing cheap electric power. With the completion of the above projects and with large scale power resources still in reserve, the availability of electric power in our country will gradually develop to meet the growing demands of electric traction also.

The expert Committee on Coal Consumption on Railways has suggested that the Railways should aim to reach a target of 30% electric traction, 20% Dieselisation and 50% steam traction by 1977.

RELATIVE MERITS AND DEMERITS OF ELECTRIFICATION VERSUS DIESELISATION

(i) The initial cost of a diesel electric loco is much higher than the cost of an all-electric loco. This is due to the fact that on a diesel electric loco a self-contained oil engine power plant with its compressors, lubricators, tanks for fuel oil, cooling water plus the electric generator itself have to be provided in addition to the traction motors and control gear. Moreover the maximum horse power of a diesel electric loco is also less than the electric loco due to various factors. The ALCO locos which have been recently purchased by the Indian Railways are rated at 1950 HP. The elec. locos on the other hand in use on the Central Railway vary from 2100 to 3600 H.P. The cost of an ALCO Loco of 1950 H.P. is approximately Rs. 12 lakhs whereas the cost of the 3600 H.P. all-electric loco is of the order of Rs. 8 lakhs only.

(ii) The higher efficiency of elec. loco coupled with the lower cost of generation in large Central Power stations helps to off-set the recurring charges on the fixed installation viz. transmission and distribution lines, substations, etc.

(iii) The maximum overload capacity of a diesel engine is of the order of 25%, which limits the power available for acceleration. In the case of an all-electric loco, the traction motors are capable of meeting a momentary overloads up to 100% which is very useful for starting heavy trains, especially on a gradient.

(iv) Large scale oil sources have not yet been located in India, requiring oil to be imported from Foreign Countries, but electricity can be generated either from low grade coal of which the resources are fairly

abundant or from hydel sources which are also developing very rapidly due to the various multipurpose River valley schemes sponsored by the Government, primarily in connection with the flood control and irrigation. Even in the case of thermal power stations, it is possible to burn efficiently low grade coals with high ash content which at present have limited use in spheres other than electric generation.

(v) With the use of diesel oil there is always the fire hazard in the oil depots. As only limited quantities of fuel can be carried on the loco itself, it becomes necessary to have fueling depots enroute with the result that fire hazard gets multiplied. Besides staff etc. are necessary for looking after these oil depots and fueling the engines at the Railway stations. No such arrangements are necessary in the case of all-electric locos.

(vi) The operation of a diesel engine is more complicated than that of an all-electric loco. This affects not only the operation but also maintenance, and the degree of skill required for maintaining the diesel locos is much more than required for maintaining the elec. locos. With the rising cost of labour, this is a very important point.

(vii) As the maintenance is not complicated, longer availability of the electric loco results in better utilization of the capital invested. It also means less number of locos required.

(viii) The installations in the repair shed also becomes more simple in the case of elec. locos.

(ix) In India electrification has inherent advantage over dieselisation. Electrification would give a base load and improve the load factor of electric supply net-works all over the country. It would also help the State Governments to push their schemes of rural electrification.

ECONOMICS OF DIFFERENT MODES OF TRACTION

From the economic point of view, the following factors merit consideration:

(a) Comparative costs of oil and elec. energy.
(b) Traffic density
(c) Initial capital cost of rolling stock, transmission and distribution systems and sub-station equipment.
(d) Operating costs, wages of staff, sundry stores and spares.
(e) Cost of maintenance

At the outset it may appear that the all-electric system is likely to be uneconomical due to the fact that a large amount of annual charges will have to be borne to cover interest and depreciation on the vast capital outlay of fixed installations (viz. transmission lines, substations and distribution equipment) in addition to the locos. On closer analysis however, it is seen that the advantages in favour of diesel traction diminish as the traffic density increases until a point is reached when the annual all-in charges for both the systems balance each other and thereafter the complete electrification becomes a more economic proposition than dieselisation. The main problem, therefore, is to investigate in each case this optimum figure of the density of traffic where the two systems reach the economic balance. Obviously this optimum figures of traffic density will vary according to the cost of energy, Diesel oil, capital cost of equipment.

CONCLUSION

The electric locomotive is the most powerful and efficient of all types and the easiest to maintain. The highest speed ever attained on Railways was by a train hauled by a 1500 V. D. C. locomotive between Facture and Morcenx in France towards the end of March, 1955 when a speed of 331 Km/h (206 mph) was reached. The most powerful locomotive of all types in existence is an electric locomotive of 12000 HP operating in Switzerland.

The saving of high grade coal is an extremely vital matter for our home industries and, if surplus, to be exported as foreign exchange earner. The diesel locomotive is rapidly supplanting steam where electrification cannot be fully justified. Dieselisation can never be a solution for a country like India where oil is scarce, if not non-existent, to meet our requirements. With our five year plans, the development of hydro and thermal production of cheap electricity should give ample scope for large scale electrification of Railways which, apart from almost doubling the track capacity, provides a faster and economical transport system.

In the foreseeable future, the application of atomic power for traction will of necessity be dependant on a normal supply of electric energy from atomic power plants. An atomic locomotive may follow which may need no refuelling for about a year. The amount of protective shielding required and the risk from radio activity would perhaps present problems mainly connected with excessive weight and size of such locomotives.

In all the above forms of motive power, there is increasing scope for further development and improvement. Depending on individual merits, each mode of transport will find increasing application on the World's Railways in the service of mankind.

Performance of the ALCO Model 251 Diesel Engine

By D. N. Chamberlain
Director - Foreign Sales ALCO Products, Inc., New York

THE world's technical press has published, in the last few years, a number of articles describing the main features of the ALCO 251 diesel engine. In addition, many of the engines have been delivered to railways, pipe line pumping stations, and for marine applications throughout the world.

As a result, a substantial number of those engaged in the use and application of power by internal combustion engines are well acquainted with this engine.

In the railway field alone, over 600 locomotives with the ALCO 251 engine have been delivered outside the United States and Canada. The Indian Railways operate 100 Model DL-500-C "World" locomotive—all powered by the 12-cylinder 251 engine.

For easy reference, we will list the major characteristics of the engine :

GENERAL CHARACTERISTICS

Cycle	4 stroke—highly turbo-supercharged
Bore	9 in. (228 mm)
Stroke	10-1/2 in. (267 mm)
Stroke/bore ratio	1 : 1 166
Cylinder Swept Volume :	668 cu. in. (10, 95 l.)

RATINGS FOR RAILWAY SERVICE

At sea level, and 60° F. (15,8°C) intake temperature

Rated Speed	1000 RPM
Brake Mean Effective Pressure	193.5 psi (13,6 Kg/cm²)
Rated Load	162.5 BHP/Cyl. (164, 775 CV/cyl.)
Mean Piston Speed	1750 f. p. m. (8,81 m/s)

ENGINE CHARACTERISTICS

	6 Cylinder	*12 Cylinder*	*16 Cylinder*
Total Displacement - cu. in.	4008	8016	10688
Gross HP for railway service	975 (988,65 CV)	1950 (1977,30 CV)	2600 (2634,4 CV)
Weight, Engine alone, dry	22,100 lbs. (9945 Kg.)	32,650 lbs. (14,800 Kg.)	42,000 lbs. (19,026 Kg.)
With standard GE generator Auxiliary generator, exciter, oil and water	34,450 lbs. 15,600 Kg.	45,980 lbs. 20,800 Kg.	57,000 lbs. 25,821 Kg.

Note : These are also the International Ratings for Railway Traction (UIC Code 623-OR 3rd. Edition 1—1—58, Section III, Paragraph 3.)

Figure 1 shows a three-quarter view of a 16-cylinder engine. The ALCO water-cooled turbosupercharger, the air-to-water aftercooler, water pump and lubricating oil pumps are clearly visible.

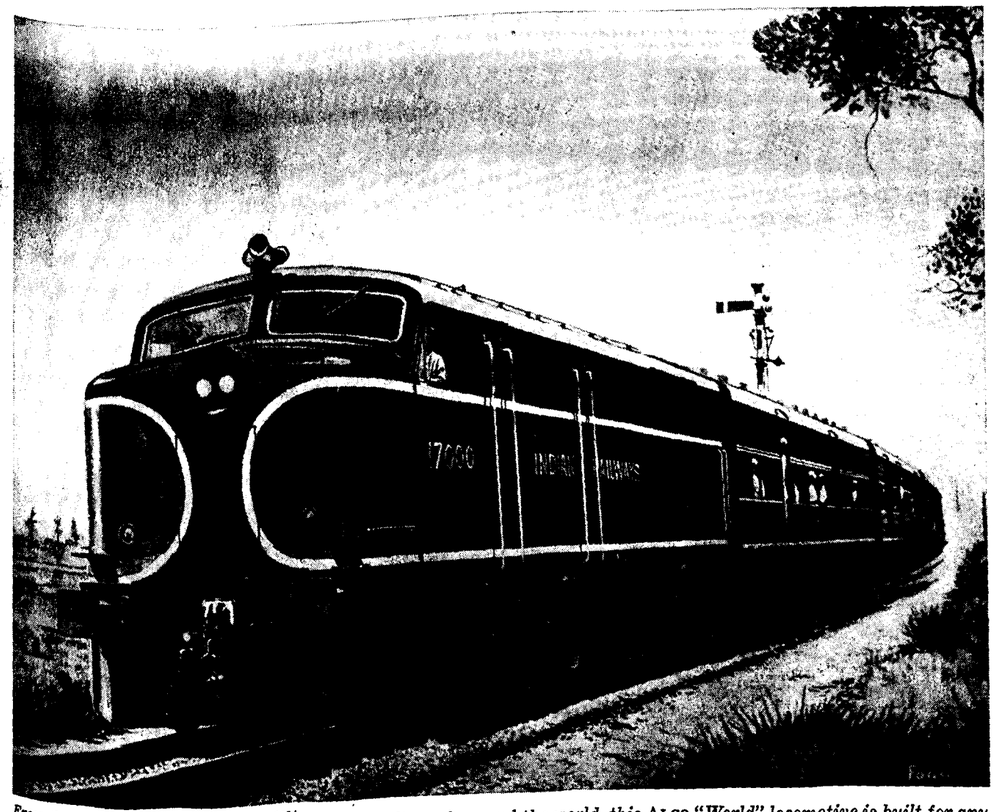
At this time, as the first 251 engines delivered to United States railroads reach the mileages or time in operation tentatively recommended for first light overhaul, ALCO is beginning to collect much valuable data on wear rates, expected life of components, etc. Throughout this period, fuel consumption under actual operating conditions has been carefully recorded in many places.

A clear and gratifying picture has been obtained, and is being reinforced by other data which we are accumulating almost daily.

Fundamentally, this is what the data reveals :

1. Rates of wear of engine components are lower than predicted, and the estimated intervals between overhauls can readily be revised upwards.

2. Fuel consumption, when measured under actual operating conditions against other



From the ALCO collection—write for 20 x 12½ inch color reproduction, suitable for framing.

Proved around the world, this ALCO "World" locomotive is built for any gauge track, and operates in high-speed passenger or freight service.

INDIA GOES DIESEL WITH 100 ALCO "WORLDS"

A major step in the dieselization of the Indian Railways has been completed. Deliveries of ALCO diesel-electric "World" locomotives have been made on one of the largest locomotive orders ever placed from India.

The 100 new streamlined "World" locomotives are the first broad-gauge, main-line diesels to be used in India. Designed exclusively for overseas service, these 1950-hp ALCO locomotives are contributing to the economic progress of forward-looking countries throughout the world. Now also operating in Argentina, Spain, Peru, Pakistan and Australia, they have been proved in service on nearly every continent of the globe.

The "World" locomotives are powered by the turbo-supercharged ALCO 251 diesel engine and utilize ALCO's famed running gear. They operate in high-speed passenger or freight service and feature high availability, simplified maintenance and low operating cost.

Built by the world's most experienced locomotive manufacturer, established in 1848, ALCO diesel-electrics mean progress the world over.

ALCO PRODUCTS, INC., 30 Church St., New York, U.S.A. · Cable Address: Locomotive, N. Y.
FOREIGN ASSOCIATES AND LICENSEES: ALCO Products Export Company, Inc., 25 Victoria St., London S.W.1, England; Montreal Locomotive Works, Ltd., P.O. Box 1000, Place d'Armes, Montreal, Que., Canada; A. E. Goodwin, Ltd., 315 Parramatta Rd., Auburn, N.S.W., Australia. Agents throughout the world.

ALCO



These ALCO DL-500-C "World" locomotives, shown during shipment from the Port of New York in 1958, are now in daily service on the Indian Railways.

(Photo : Port of New York Authority)

types of locomotives of comparable power, is lower by a margin that ranges from 5 per cent upwards.

In view of our large experience with the predecessor model, the 244 engine, and the extensive laboratory and field trials preceding the introduction of the 251 engine to actual service, we did not expect to have to redesign any component, and, indeed, no redesign work has been found necessary. Even the unavoidable small changes have been far fewer than could reasonably be expected.

We are confident that the goals set when starting the development of this engine, that is, to produce a highly dependable power plant, economical to operate, and with a large growth margin in its basic design, have been amply achieved.

A number of interesting examples supporting these contentions can be produced. Because of space limitations, and to avoid redundance, we will list a few.

Figure 2 shows the measurements taken of compression ring gap clearance in a DL-701, 1800-hp road-switcher locomotive operating in heavy, low-speed service. The measurements taken at the end of 31 months were intended exclusively to furnish some data to determine inspection and overhaul periods for a fleet of such locomotives, there being, at the time the inspection took place, no indication of any need to remove or change parts from this engine.

The cylinder numbers are listed across the bottom of the chart and numbers 1, 2 and 3 for each represent the three compression rings—No. 1 being the top ring. The clearance measurement is represented by the scale up the left side of the graph and the horizontal black band at the bottom is the 0.045″ to 0.055″ range permitted for a new ring. The wear limit of 0.200″ is represented by the horizontal black line at the top of the graph.

On the left bank only, the No. 1 ring on cylinder L-2 registered as high as the 0.100″ mark and that is only 33 per cent of permissible wear. Three of the top rings checkled less than 0.090″ gap, or less than 27 per cent of permissible wear, while two of them checked at 0.080″ or below, or less than 20 per cent worn. The No 2 and No. 3 rings in all cases show less than 20 per cent wear. The right bank shows much the same story. Except for No. 1 on R-1, which

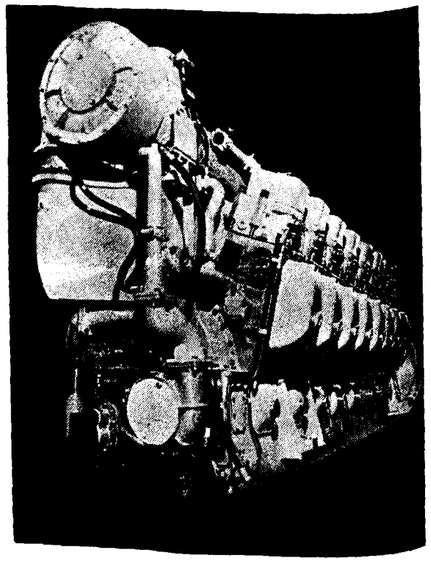


Fig. 1.

shows 35 per cent wear, all other top rings show less than 30 per cent and all No. 2 and No. 3 rings less than 20 per cent wear.

Figure 3 shows the compression ring to groove clearance measured in the "as removed" condition before the rings were taken from the pistons. The pistons and rings had been washed to remove all the

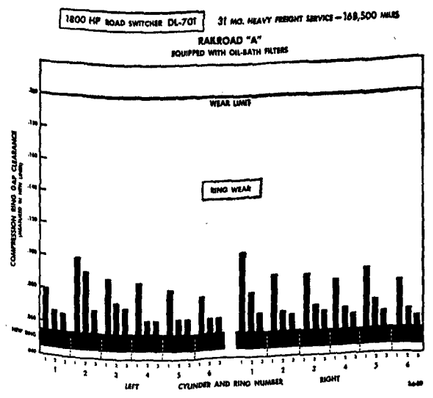


Fig. 2.

carbon and oil, and the vertical readings represent the maximum thickness of feeler gauge that could be entered between the ring and land for the full groove depth. Across the bottom are the cylinder and ring numbers and a new tolerance band is indicated by the area between. .005″ and .007″. The No. 1 rings on L-2 and R-5 had the most side clearance, representing 60 to 65 per cent wear, respectively. The rest of the top rings show less than 50 per cent wear while the No. 2 rings on all pistons are either within new tolerances or within 0.001″ of new. Readings were not recorded on the No. 3 rings as all were within the new tolerance range.

The pistons were again checked using a new ring, and the groove sizes were all within the new tolerance range. The wear indicated here took place on the rings and not on the pistons.

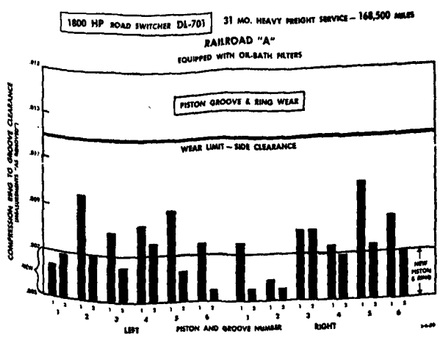


Fig. 3.

Figure 4 indicates the wear that was measured on the chrome-plated cylinder liners. Across the bottom are the cylinder numbers for both banks and the marks under the two columns for each are the readings taken perpendicular to and parallel to the crankshaft. The difference in the height of the columns for each cylinder gives the out-of-roundness. Along the vertical scale at the left of the chart are dimensions representing the liner diameter measured 2 inches from the top at the step created by the top ring reaching the height of its travel. This point gives the maximum wear reading on the whole liner bore. Across the top the black line represents the wear limit at a diameter of 9.009″, which is the recommended limit before returning the liners for replating The band across the bottom from liner diameters of 8.9985″ to 9.0015″ gives the range of diameters found in new liners.

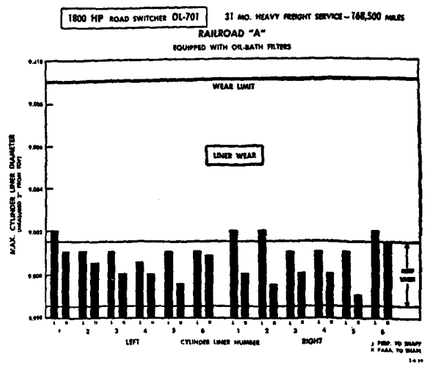


Fig. 4.

From the height of the bars, only four of the twelve liners measured outside the new liner range and these exceeded the range by only 0.005″. While the unworn portion of these liners was not recorded, if a 9-inch base diameter is assumed, the maximum wear on these four liners represents an increase of only 0.002″ on the diameter or 22 per cent of the allowable wear before replating. The 9.002″ dimension exceeds the drawing maximum by only 0.0005″ or 11 per cent of the permissible wear from this point. All of the other eight liners measured 9.001″ or less in the direction perpendicular to the crankshaft, which is normally the direction of highest wear due to the thrust on the piston. Out-of-roundness was a maximum of 0.0025″ on one cylinder—R-2. R-1 and R-5 had 0.002″ and all others were less than 0.002″.

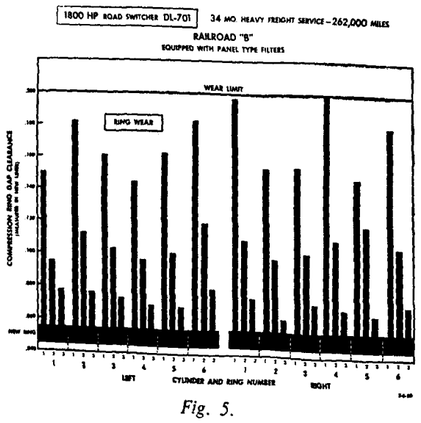


Fig. 5.

The railroad also checked other items, with these results:

1. Crankpins and journals—no wear or out-of-roundness could be measured.

2. Main and connecting rod bearings—not a single bearing in the engine given "top deck" inspection was worn through the overlay and none had the transparent appearance of an overlay just about worn through. There were a few very slight dirt scratches observed, but none that penetrated the thickness of the overlay. While all bearings looked almost perfect, good practice indicated complete replacement.

3. Writs pins and bushings—no wear or out-of-roundness could be measured. All were re-used without benching.

4. Valves and valve seats—The 251 engine uses hardened valves and valve and valve seat inserts, and there was only slight wear and light, normal pitting observed. The valves and heads were benched for cleanup and re-used.

5. Gears—visual inspection showed good tooth contact and no measurable wear.

6. Camshafts—visual inspection indicated no wear on any of the cams. The bearings were not inspected.

7. Water pump—the pump was dismantled and the seals replaced. There had been no leakage prior to the overhaul and only normal wear was found.

8. Water side of block and liners—This is a wet block engine and chromate-type water treatment had been used throughout the 31 months of service. There wasn't a mark on any of the liner water sides or in the cylinder block passages. The liner seals, while somewhat hardened, showed no indication of leakage and the lower liner fits in the block were perfect.

9. Fuel pumps and nozzles—The fuel pumps had probably been in service for only about 24 months, as there was a guide sleeve modification and these were not original pumps. It had been the railroad's practice to change nozzles annually, and, again, from the load test and stack appearance, all appeared good.

In summary, the only engine parts that were discarded were piston rings, bearings, water pump seals, liner seals and miscellaneous gaskets. Everything else was made ready for re-use either by just cleaning or by light benching, and many of the items were still within new tolerances.

Similar data from "Railroad B" also involves a DL-701, but this time with 34 months of heavy, high-speed freight service during which 262,000 miles were accumulated. The engine is a standard 12-cylinder Model 251 with panel type air-intake filters.

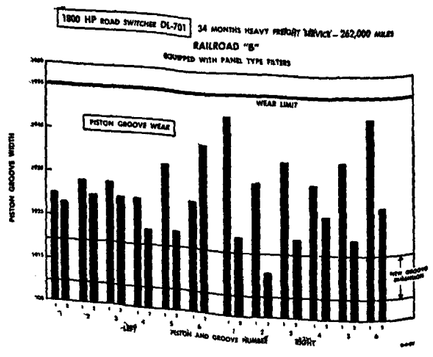


Fig. 6.

Figure 5 illustrates ring wear measured on a DL-701 from Railroad B. The No. 1 ring on R-4 has reached the wear limit and the No. 1 ring on R-1 is very close. Three more top rings are approximately 80 per cent worn and the remainder are 70 per cent or less. All of the No. 2 rings show less than 50 per cent wear and average around 30 to 35 per cent. The No. 3 rings are all less than 20 per cent worn. Please note that this engine had panel-type air filters while the previous one had an oil bath air filter.

Figure 6 differs from Figure 3 slightly in that the vertical scale represents the actual groove dimension instead of the ring side clearance. Two of the pistons, R-1 and R-6 show groove width increases of about 85 per cent of the permissible allowance on the top groove and the average for all the pistons is about 50 per cent. With the exception of L-6, all No. 2 grooves show increases of 0.001" or less above the new range.

Figure 7 illustrates the liner diameter measured at the top of the ring travel both parallel and perpendicular to the crankshaft. R-6, at 67 per cent of the permissible wear, leads the group, but the majority of the liners measured 9.003" or less. Five of them were still within the new tolerance range.

The other items checked were reported as follows:

1. Crankshaft—no ridging, scratches, wear, or out-of-roundness.

2. Main and connecting rod bearings—neither main or rod bearings showed wear through the overlay. All lower rod shells and a few upper rod shells showed evidence of erosion in the split line area. It was felt that the bearings could have remained in service for another three years.

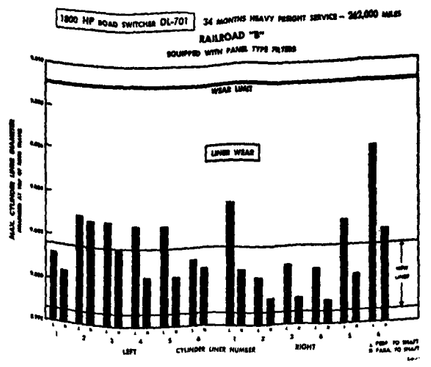


Fig. 7.

3. Wrist pins and bushings—no wear.

4. Valves and valve seats—the air valve seats showed approximately 0.015" wear but the exhaust valve seats were in good condition. The valve stems were practically at new dimension limits although two were found worn about 0.005" at the lower end.

5. Gears—visual inspection showed them to be nicely polished with still some evidence of the original shaving marks at the ends of the teeth.

6. Camshafts—all found to be in good condition except for some light pitting on one fuel cam.

7. Water side of block and liners—chromate treatment had been used and the outside of the liners and inside of the block were in excellent condition. The lower liner fits were all in good condition and the "O" rings were pliable.

The general conclusions drawn from this examination were that, with the exception of the top compression ring gap increase, the engine could have operated another year before top deck overhaul. It should be possible to rebuild the engine with all but one of the original liners, and all but four of the original pistons and expect at least three additional years of operation before another top deck overhaul. Checks have been made of other units on railroads "A" and "B" and these two specific cases are typical of each railroad. There are many other roads that have this type of power, but not for as long a period as railroads "A" and "B." Here is some brief information on their experiences to date:

Fuel consumption is a major item in the operating expenses of a locomotive. At the same time, experience shows that bench measurements of specific fuel consumption have only a relative value in predicting actual results in service. Conditions vary from place to place; auxiliary loads are different, acceleration requirements are seldom the same, and full and part load operation with their slightly

(Continued on page D.E. 38)

Diesel Engines for Locomotives

By M.A.N.'s Engineering Correspondent

THE Diesel engine is an ideal source of power for locomotives. Its thermal efficiency surpasses that of all other prime movers. It requires very limited space, is easy to handle and can be conveniently refuelled under conditions of absolute cleanliness. A Diesel locomotive can go wherever there are rails without being subject to the many limitations imposed on other forms of railway traction and permits an important cut in number of engines and personnel.

There is no need for a detailed justification of Diesel traction since the economic and technical advantages which it affords are known to railway experts. A comparison of the average efficiency figures over a year, which work out at roughly 5% for the steam locomotive versus 24% in the case of the Diesel engine, carries so much weight that no further comment is required.

The United States was the first country where the shift from steam to the Diesel engine was carried out on a large scale. 95% of all locomotives purchased by U. S. railroads during recent years were Diesels and nearly 65% of all locomotives at present in operation are powered by Diesel engines.

Important locomotive builders have completely abandoned the construction of steam locomotives. The Netherlands have followed suit and there is ample indication of other countries taking the same course.

As is generally known, the Augsburg division of M. A. N. is the birthplace of the Diesel engine. More than 60 years of untiring effort have been devoted to the further improvement of this reliable and sturdy prime mover which is ready for service at a moment's notice. M. A. N. were one of the first designers to develop a light-weight high-speed Diesel engine and,

(Continued from page D.E. 37)

different specific consumptions come into the picture to make predictions quite difficult.

On the other hand, if a fleet of locomotives of two or more types is under observation with all units performing the same work, or if trials are conducted under controlled conditions (equal schedules, tonnages, etc.) a much more useful picture obtains.

Again, we have been able to secure valuable information pointing to the economical working of the 251 engine.

On a major railroad in the eastern United States, it was determined that locomotives with the ALCO 251 engine could be assigned to certain runs and that the fuel costs would average $ 0.1781 per locomotive unit mile. Other locomotives assigned to the same operations averaged $ 0.2014, or a difference of 11.3 per cent.

An overseas railway conducted some very elaborate tests, consisting of running trains of which the weight was carefully determined, over a hilly territory, with a ruling grade of 2.5 per cent. The passenger consist chosen weighed 368 long tons, and the distance was 404 miles. The schedule was that normally assigned to the train in question.

Runs with each engine were made, until results were consistent within 1 per cent. The following was observed:

	Total Fuel Consumed	
	Imp. Gals.	*U. S. Gals.*
Competitive Engine	550	659
ALCO 251 Engine	455	545

	Specific Fuel Cons.	
	Imp. Gals. (1)	*U. S. Gals. (2)*
Competitive Engine	3.7	3.95
ALCO 251 Engine	3.06	3.27

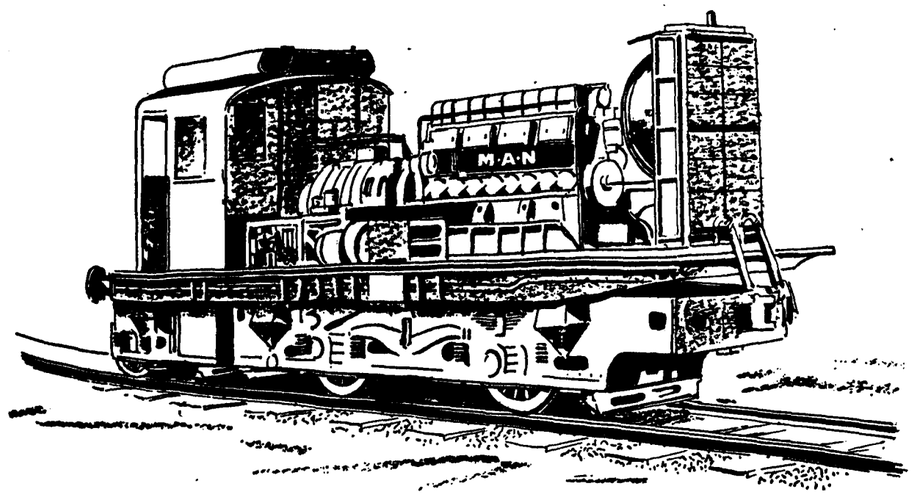
(1) Imperial gallons/gross thousand long ton miles.

(2) U. S. gallons/gross thousand ton mile.

This shows an advantage of 21 per cent in favour of the ALCO 251 engine.

Development work now underway should enable us to report further progress in this and other associated fields, within a short time.

M·A·N DIESEL ENGINES



at the service of INDIAN RAILWAYS

Dieselization is in progress on Indian Railways. M.A.N diesel engines are already in service on them and elsewhere, giving highly satisfactory results.

Central Railway	22 engines
Northern Railway	10 engines
Burmah Shell Refineries	1 engine
Tisco Jamshedpur	3 engines
Bombay Port Trust	11 engines
Bhilai Steel Plant	2 engines

M·A·N Diesel Engine Manufacture starts in India this year

ESCORTS (AGENTS) PRIVATE LTD
PRATAP BUILDING, CONNAUGHT CIRCUS, NEW DELHI.
BRANCHES: CALCUTTA — BOMBAY — MADRAS

SPM-MO/8-17

by the introduction of supercharging, to make a very important contribution toward increasing power and cutting weight.

With such a wealth of experience to rely on, M.A.N. is in a singular position of leadership as a designer of Diesel engines which meet all demands arising in locomotive service. Practice has shown that these are often of a highly variegated nature, as determined by widely divergent operating conditions in the districts concerned. Vital factors are maintenance, keeping of spare parts, time in service and frequency of inspections.

Numerous railway companies prefer the sturdy Diesel engine operating at speeds between 700 and 1,000 r.p.m. for installation in high-powered locomotives. Others are in favour of the space and weight-saving high-speed variant, especially where loads are lighter or the nature of the road bed imposes limitations on the weight per axle, and where maintenance facilities are on a high level.

Since the M. A. N. programme includes appropriate types of Diesel engines in all power and weight brackets, we are in a position to give our clients impartial advice and to suggest solutions of their traction problems which are adapted to individual requirements.

SOME DIESEL LOCOMOTIVE SPECIMENS

Following some earlier experiments with small Diesel-electric units, the first high-powered locomotive equipped with a 1,200 h. p. M. A. N. engine and electrical transmission was built in Germany as early as 1923. Two years later came a locomotive with the same engine, but mechanical transmission. Others ranging from 175 to 1,100 b. h. p. followed and the total of locomotives and railcars that have since been equipped with M. A. N. Diesel engines reaches the impressive figure of 1,500. All of them have a highly satisfactory service record.

WHAT M. A. N. DIESEL ENGINES HAVE IN COMMON

M. A. N. Diesel engines are known for reliability and long life. They are produced by highly skilled workers in up-to-date shops with equipment and machinery coming up to the latest standards. All of the Diesel engines are of the 4-stroke type of construction embodying a precombustion chamber. This design is known for low fuel consumption and ability to operate on inferior grades of fuel. The engines have trunk pistons and water cooling is employed. Smooth running and minimum rate of wear are outstanding features. Needless to say that all equipment has been selected with special consideration of the requirements of locomotive service.

In addition such accessories as have no direct bearing on the working of the engine have been provided in view of the rough usage which is unavoidable in locomotive operation. Equipment in this category, which has been developed in close co-operation with firms specializing in such lines, includes oil-bath air cleaners, remote-control and monitoring devices, clutches and vibration dampers, flexible supporting elements, effective silencers designed for minimum aerodynamic resistance and hoses with high-tensile couplings for water, oil and fuel.

BOOSTING ENGINE POWER BY SUPERCHARGING

The power output of the engines described in this publication can be considerably increased by supercharging. This is accomplished by equipping the Diesel engine with an exhaust gas turbo-blower with the turbine rotor and compressor impeller mounted on a common shaft. The exhaust gases from the Diesel engine drive the turbine and the blower impeller wheel compresses air which is supplied to the engine. With the greater volume of air more oxygen becomes available for combustion, meaning that more fuel can be burnt with the result that engine power is increased up to 90% with almost no change in engine bulk.

In M. A. N. exhaust gas turbo-superchargers the shaft carrying the turbine rotor and impeller wheel has its bearings between the two wheels. This affords the advantage that the bearings are not affected by heat expansion and that the whole assembly is not subject to distortion. More-over, the designer has full latitude with respect to the arrangement of exhaust gas and air ducts.

Supercharged engines are known for flexibility, i.e. ready adaptation to prevailing load conditions. Their overloading capacity is far better than that of uncharged engines. The exhaust gas turbo-supercharger need not be treated as a separate unit and automatically adapts itself to engine operating conditions over a wide range.

COOLING AND LUBRICATION SYSTEMS

The cylinder blocks and heads of M. A. N. Diesel engines are water-cooled. The cooling water is kept in circulation by an engine-driven pump (automatic water temperature control).

In small engines the cooling water radiator is combined with an oil cooler. In high-powered engines the lubricating oil is cooled in heat exchangers.

The engines are closed at the bottom by an oil pan or sump in which the oil dripping down from the moving parts is collected. The oil pump aspirates this oil and forces it back into the circuit through the oil cooler and a filter.

The lubricating system is basically the same for all engines except for such variations as are accounted for by difference in size. The oil emerging from the delivery line first lubricates the crankshaft bearings and then passes through bores in the shaft and webs to the connecting rod big end bearings. These communicate with the piston pin bearings through longitudinal holes in the connecting rods. The timing gears, governors and other accessories are lubricated through branch pipes. The piston skirts are splash-lubricated. The oil pressure can be set on a control valve.

FLEXIBLE COUPLINGS AND VIBRATION DAMPERS

Drive shafts as a means of transmitting the engine torque to the wheels have become almost standard in locomotives of substantial power output using hydraulic transmission gears. This system permits the construction of locomotives with bogies incorporating 4 or 6 mechanically driven axles with the result that running properties and curve flexibility are considerably improved over the standard design with rigid side rods.

Satisfactory curve flexibility as required in view of the sharp bends occurring on many foreign railways can only be obtained if the locomotive frame is supported on bogies. It has been proved that locomotives of this type of construction strain the road bed to a much lesser degree.

On the other hand great care is necessary to exclude torsional vibration where drive shafts are used. Since critical speeds must be avoided over the whole range, M. A. N. has developed special types of flexible couplings permitting great angles of deflection which are arranged between the engine and transmission gear. The elasticity of the coupling is such that the resonance point of the fundamental vibration is lower than the normal range of vibration frequencies occurring in operation. The resonant range, therefore, must be passed only while the engine is started or stopped. Power is transmitted through two rubber discs bonded to steel plates.

The coupling is highly flexible and very compact. Combination couplings of this type are required where the power transmitting elements (drive shaft and primary shaft of transmission gear) must be protected against overload while passing through the resonant range. When the torque for which the friction clutch has been set is exceeded just after starting the engine, this overload causes temporary slipping of the clutch.

DRIVE MECHANISMS AND TRANSMISSION SYSTEMS

Since an internal combustion engine is not suited to direct drive of the wheels because it cannot normally start under load, some form of transmission system becomes necessary. The design of appropriate transmission organs to permit exploiting the potentialities of the Diesel engine as a source of locomotive propulsion was one of the main problems.

Three forms of transmitting engine power to the wheels are available :

(a) mechanical transmission incorporating sliding gears and clutches ;

(b) electric transmission ;

(c) hydraulic transmission.

Each of these forms of transmission has its advantages and adoption of one or the other will be determined by considerations of engine power, weight, load per axle and cost of procurement.

(a) In the case of limited engine power, mechanical transmission systems similar to the automobile type are employed. Within the range up to approximately 150 b.h.p. or, in special circumstances, 300 b.h.p., transmission systems embodying a clutch mechanism are used.

(Continued on page D.E.42)

Paxman Powered Freight-Transfer Locomotives

By an Engineering Correspondent

68-ton double-bogie diesel-electric design for fitted and non-fitted freight trains, and suited to summer non-heated secondary passenger trains

AMONG the diesel-electric locomotives delivered to British Railways towards the end of 1957 under the pilot orders placed in November, 1955, was the first of a batch of ten Bo-Bo locomotives of 1,000 b. h. p. supplied by the British Thomson-Houston Co. Ltd. as main contractor, and powered by Paxman engines, with B. T. H. electrical equipment, and with the mechanical portion built by the Clayton Equipment Co. Ltd., and the Yorkshire Engine Co. Ltd. Clayton built the bogies and superstructure, and Y. E. C. built the underframe and undertook the final erection of the locomotives.

All ten of these locomotives have been allocated in the beginning to Devons Road motive power depot of the London Midland Region. This is one of the sheds of the old North London Railway, and the locomotives are to work the transfer freight traffic between Poplar, Temple Mills, Acton and Willesden. No train-heating equipment is installed. The locomotives have been given Nos. D. 8200-8209.

General particulars of this conventional double-bogie single-cab design with swing-bolster bogies are given in Table I. Further dimensions and the general layout of equipment, which shows that a long power and cooling casing extends in front of the driving cab and a short casing is located to the rear of the cab to house the control gear and certain auxiliaries.

MECHANICAL PORTION

A plain conventional dished centre pivot is mounted



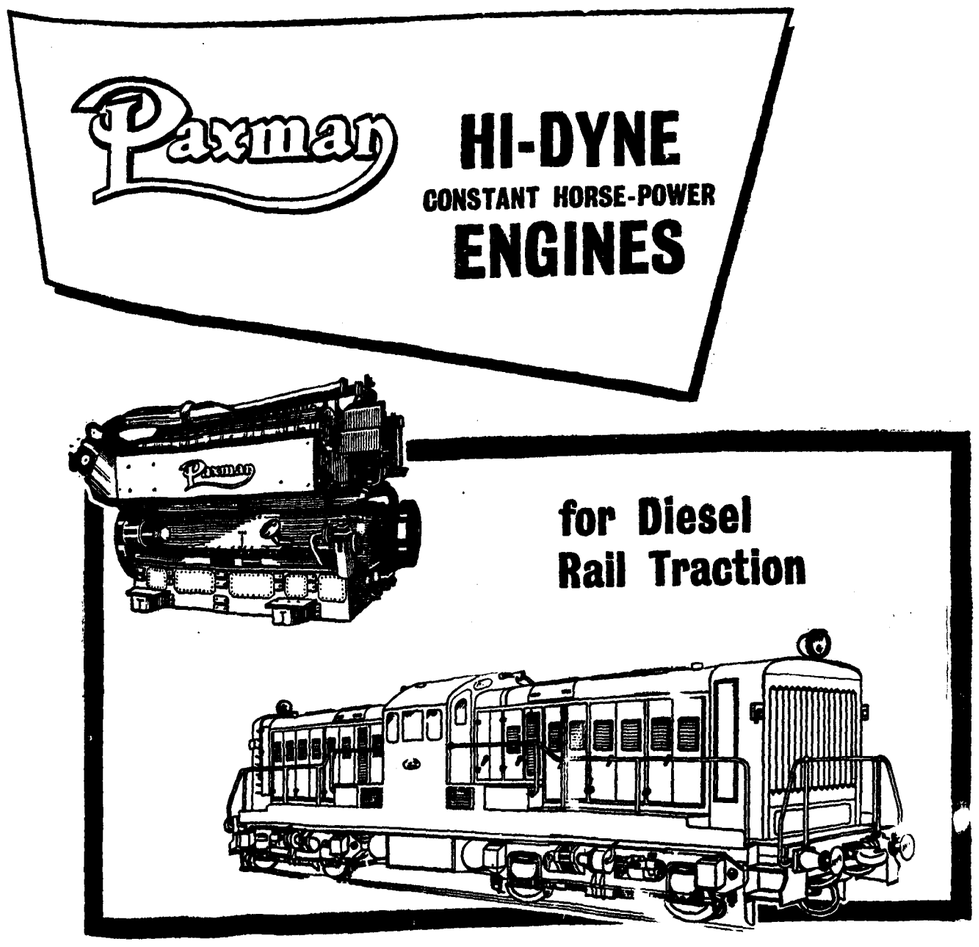
(Continued from page D.E.41)

Transmission systems of this type are comparatively cheap and characterized by high efficiency.

(b) Electric transmission is used to a very large extent, especially in the USA. The Diesel engine drives the generator which is for the most part directly flanged to it. The current produced by the generator is conveyed to the traction motors which drive the axles through simple spur gears. This type of transmission permits distribution of the propulsive force over several driving axles. The system is safe in operation and prolongs the life of the Diesel engine. Electric transmission is applied to small, medium and high-powered units and has given very satisfactory results for several decades. Its outstanding advantage is flexibility under conditions of varying load and high tractive force in starting.

(c) Hydraulic transmission systems with a fluid drive and torque converter are making much headway. In this system the energy of flow of the fluid is used as the power-transmitting agent. Hydraulic drives also can be used up to the highest engine outputs, as required in the propulsion of express and goods trains. They are of simple construction, proven reliability, comparatively light weight and low cost.

Several variants of hydraulic transmission systems have been developed. The features they have in common are smooth starting and automatic stepping up of gears. They are very easy to handle and the rate of wear is low as compared to other transmission systems.



on the bogie bolster, and through it are transmitted the superstructure weight, the tractive effort, the braking forces and the pivoting. The male and female cast steel pivot portions have a bronze liner between. Normal side bearers are provided. The bolster itself is fitted with a double full-elliptic spring at each side. The SKF single-row self-aligning roller-bearing axleboxes on each side are connected by an

TABLE I—PARTICULARS OF B. T. H. LOCOMOTIVE

Bogie wheelbase	8 ft. 6 in.
Bogie pivot pitch	22 ft. 6 in.
Length over headstocks	38 ft. 6 in.
Length over buffers	42 ft. 0 in.
Weight in working order	68 tons.
Maximum axle load	17 tons.
Starting tractive effort	37,500 lb.
Continuous rated tractive effort	20,000 lb. at 10½ m.p.h.
Wheel diameter	39 in.
Top speed	60 m. p. h.
Fuel tank capacity	400 gal.
Engine type	Paxman 16 YHXL
Engine output	800 b.h.p. at 1,250 r.p.m.

equalising beam attached to their bottom faces, and between these beams and brackets on the bogie frames are two helical springs and two vertical Woodhead-Monroe hydraulic shock absorbers. The boxes run in normal cast-steel guides, with manganese-steel wearing plates on guides and boxes to take end thrusts and lateral thrusts. Bogie frames are of almost entirely riveted construction.

Underframe construction is of straight and tapered channel sections with cross-bearers of channels and plates; but here, again, the construction is almost entirely riveted. Battery boxes and main fuel tank are slung beneath the underframe between the bogies, the fuel tank being in the centre and flanked by the Chloride batteries. There is no considerable drag-box structure behind the buffer beams, but just substantial riveted gusset connections from behind the buffers. There is a central drawhook with rubber springs; and on the buffer beam are also a bifurcated engine control pipe, bifurcated main reservoir equalising pipe, carriage-heating through-pipe connections, multiple-unit socket, multiple-unit cable outlet, and dummy socket. The carriage-heating through-pipe is provided in case the locomotive is working a passenger train in tandem with a diesel locomotive fitted with train-heating boiler and equipment.

Superstructure is of riveted plate and angle. Full-depth hinged doors cover most of the side of the engine casing and generator compartment, and removable hatchways are in the roof. Ventilating louvres extend the full length of the casing, on the cantrail curve. The main compartments thus are ventilated by unfiltered air; but Air-Maze panel filters are attached to the casing plates through which air is led the main generator, air compressor, and, in the front and rear auxiliary compartments to the traction motor blowers. An angle is welded on the upper surface of the footplate round the engine to provide a leakage sump, from which oil can be drained away to the side.

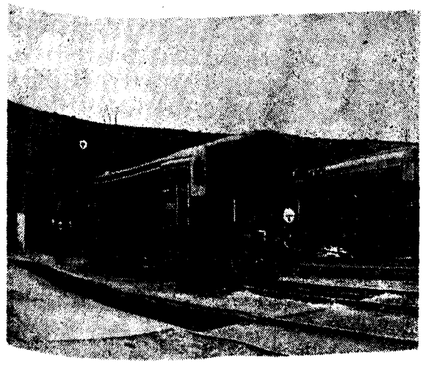


In front of the engine casing is the cooling compartment, with Serck radiators on the side panels and a roof fan shaft—and gearbox-driven from the front of the main engine shaft. The radiator header tank, however, is in the engine room. Horizontal adjustable louvres are fitted outside the radiator elements, and these are air-operated by manual selection in the cab.

Two driving positions are provided in the cab, one for each direction of travel. At each position there is a swivel seat, master controller, air-brake valve, vacuum brake valve, sanding valve, deadman pedal, two-tone horn, and an illuminated instrument panel. Other cab fittings include a Laycock window wiper on each of the four end windows, food cup-board, hot-plate, hand fire extinguisher, two Clayton heaters, and four de-misters. There is also a Pyrene fire-extinguishing system for the engine room, fitted with one pull handle in the cab and others on each side of the cab accessible from the track. Cab and headlights are of Stone's type.

BRAKES

Because of the vacuum-braking of British freight trains it was expedient to fit two braking equipments to the locomotive, one a straight air brake for the locomotive itself, and the other composed of vacuum apparatus to apply the train brakes and with proportional equipment for the application of both systems simultaneously. Westinghouse equipment is used throughout, and includes a CM. 38 compressor, which provides air supply not only for the brakes, but also for the sanding, the whistle, and the electro-pneumatic control of engine and transmission. This is a motor-driven compressor housed in the rear auxiliary compartment; but in the generator compartment there are two motor-driven exhausters, which are normally run at slow speed to maintain the vacuum in the manner of a small ejector, but are speeded up to obtain quick release by operating a trigger on the driver's vacuum brake valve. Additional to these exhausters and compressor, brake equipment includes two self-lapping driver's straight air-brake valves, two driver's vacuum brake valves, one vacuum-air proportional valve, with the usual isolating valves,



reservoirs and so on. Each bogie carries two horizontal air brake cylinders with combined slack adjusters, and these operate two blocks on each wheel. The handbrake operates on one bogie only. Air sanding is applied to each wheel, the sand coming from boxes carried on each corner of the bogie headstocks.

ENGINE EQUIPMENT

Power comes from a Paxman 16 YHXL pressure-charged engine with 16 cylinders in V formation, of 7 in. bore by 7¾ in. stroke, and in these locomotives is set to a continuous traction output of 800 b. h. p. at 1,250 r. p. m., corresponding to a b. m. p. of 106 lb. per sq. in. and a piston speed of 1,615 ft. per min. This is a conservative output framed to suit the duties for which the locomotive was intended, and the maker's continuous traction rating is 1,000 b.h.p. at 1,250 r. p. m., equivalent to a b. m. p. of 132 lb. per sq. in. Engine dry weight including ancillaries is about 12,600 lb., or 15¾ lb. per b. h. p. on the 800 b. h. p. output. Oil in sump and water in the jackets account for another 1,000 lb. Specific fuel consumption at 800 b. h. p. and 1,250 r. p. m. is about 0.375 lb. (170 gr.) per b. h. p. hr. Two Napier pressure-chargers are fitted, one for each bank of cylinders. Overall width of engine with pressure-chargers mounted is 64 in. (1,626 mm.), overall length 132 in. (3,353 mm.), depth below shaft centre line 21¼ in. (540 mm.), and height above shaft centre line 46 in. (1,168 mm.).

Engine and main generator are combined in one group mounted on a common welded steel underbed, which is the sump-underbase of the engine and in the form of two I-section longitudinals, stress-relieved and shot-blasted before machining. This carrying frame is resiliently supported at four points on the locomotive frame structure.

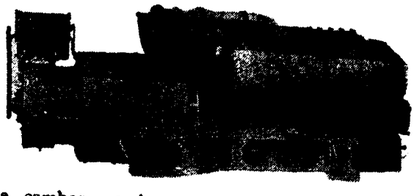
Crankcase structure is a one-piece fabrication carrying the separate water jackets, and is fully stress-relieved and shot-blasted. It is attached to the sump underbase by bolts and located by fitting bolts. Removable covers are provided at each end for ready access to the camshaft chain drive, and to the gear drives for the water and lubricating oil pumps. The 10 main bearing housings are steel forgings, welded into the crankcase cross-members, and include stud bosses for attachment of the steel main bearing caps. Lightweight steel plate covers are provided on each side of the cylinder housing to give access to the big-end and main bearings, and to permit of the withdrawal of the pistons and connecting rods. Individual cast iron water jackets are fitted, and assuring that no water is in contact with any part of the crankcase which is under stress. These jackets encase centrifugally-cast iron liners.

Single-unit cylinder heads of high-strength aluminium-alloy seat on the cylinder blocks with a spigot ring form of gasket, interposed to ensure gas-tight joints. Each head carries two inlet and two exhaust valves, renewable aluminium-bronze valve seats which are particularly well cooled to reduce to a minimum the need for attention and re-grinding, and

a centrally-located fuel injector. Valve diameters are large, and the ports are designed to give efficient intake and exhaust flow without throttling. The valve rocker gear is of forged aluminium and is carried on the upper face of the cylinder head; it is force-lubricated from the main engine system. The whole of the rocker gear is totally enclosed by easily removable covers. Cylinder heads are identical and interchangeable in all respects.

Immediately above the valve camshaft, and gear driven from it, is a jackshaft coupled to a further camshaft which operates individual-type C. A. V. flange-mounted fuel pumps by direct tappets. These pumps are mounted in line down the centre of the engine on top of the fuel-pump camshaft housing. The engine is fitted with a gear-type boost pump to ensure an adequate supply of fuel under positive pressure to the fuel pumps. The injectors are of the multi-hole needle type, spring loaded, and readily accessible; they may be removed without disturbing the cooling system. Contamination of the lubricating oil by fuel oil leakage is impossible, since lubrication of the fuel pumps and fuel-pump camshaft is achieved by a separate lubricating oil system provided with its own sump, pump and strainer, and completely isolated from the main lubricating system.

The forged steel engine camshaft, with hardened cams and journals, is carried centrally in the V in an independent cast-iron cambox, and is chain-driven by a heavy duplex chain from the drive end of the crankshaft. The cams run in an oil bath, and operate hardened roller-type cam followers which transmit reciprocating motion to the tubular push rods resting in the spherical seatings in the cam-follower rocker arms. The camshaft runs direct in the cast iron of



the cambox, and, together with the rocker arm bearings, is fully force-lubricated. Tappet clearance is controlled by means of screw-type adjusters in the valve bridges, the cylinder head covers being easily removable for this purpose.

Pistons are heat-treated one-piece castings of Y-alloy. Three cast iron compression rings and one oil control ring are located immediately above the gudgeon pin, and one oil control ring below the gudgeon pin. Hollow-bored gudgeon pins of 5 per cent nickel case-hardened steel are fitted. These are fully floating and are retained longitudinally by means of circlips. Small-end bushes are of silicon bronze. Fork-and-blade connecting rods are heat-treated carbon steel stampings accurately matched for balance and weight. Attached to the lower end of the forked rod is a block, housing the copper-lead shell type crankpin bearing. This block has a chromium-plated external surface on which the shell-type bearing of the blade rod rides. Before final assembly, the bearings are lead-plated to assist their initial running-in; this considerably prolongs their working life. Should bearing replacement become necessary, the shells may be changed without the necessity for any fitting or scraping.

The crankshaft is a drop forging of EN.26U steel and is provided with balance weights. A torsional damper of the viscous type is fitted to eliminate the incidence of high torsional vibration stresses over the whole speed range of the engine. Amply proportioned and rigidly supported main bearings carry the crankshaft, which is flanged at the drive end to accommodate the usual coupling bolts. All main bearings comprise steel shells which are lined with copper-lead. These are lead-plated before final assembly.

Forced lubrication is employed throughout by means of engine-driven pumps, located in an aluminium housing on the outside at the free end. The main pressure pump is of the gear-type, driven from the crankshaft, and has a short suction pipe of large bore. This pump supplies lubricant to the engine via a full-flow felt element filter, and is protected by a safety valve normally adjusted to 80 lb. per sq. in. By this means all oil is filtered before entering the main gallery and valve gear, while the capacity of the filter is such as to ensure a minimum pressure drop, moderate velocity, and optimum efficiency.

The high-pressure filtered oil enters the main gallery via a pressure relief valve which controls engine oil pressure at approximately 50 lb. per sq. in. The pressure relief valve incorporates a reducing valve, to supply the camshaft and valve gear with oil at 10 lb. per sq. in., and a connection to the governor and pressure gauge. The lubricating oil system has been designed so as to reduce the length of exterior pipework to a minimum, at the same time retaining full accessibility to those components requiring regular attention, such as filters, or those subject to adjustment, such as relief valves. The engine sump is of sufficient capacity

to ensure long periods of operation without the addition of extra lubricant. It is fitted with a large sized drain for rapid emptying, and a dipstick for oil level indication.

A second pump of the same design is located in a separate housing as the pressure pump. This pump is employed to pass oil at low pressure through the oil section of the radiator for cooling purposes. On return from the radiator this oil is passed through an Auto-Klean strainer before re-entering the sump. The use of the dual pump system protects the radiators from the high pressures associated with single pump circulation, and, furthermore, allows flow through the radiator to be regulated by an independent relief valve which can be adjusted to suit local conditions.

Two centrifugal circulating water pumps, one for each bank, are gear-driven from the free end of the engine. Each pump has a cost iron casing which houses the bronze impeller on a stainless steel shaft with plain bush journal bearings and suitable glands. Inlet manifolds are secured to the lower portion of the cylinder blocks by flanged joints, flexible connections to the pump delivery pipe being used. Outlet manifolds are connected to the heads by short lengths of pipe and flexible connections and are located above the V between the two cylinder banks.

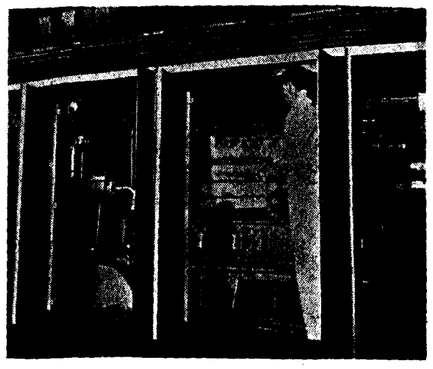
Incorporated in the starting circuit is a motor-driven lubricating oil priming pump which is set in motion by depression of the engine starting button. When pressure has built up in the engine system, the governor draws the fuel bar over to the starting position, where a unit switch is tripped to close the starter contactor circuit, which is completed by the closing of a pressure switch in the lubricating oil line to the bearings. It is thus impossible for the engine to be started until the oil pressure is sufficient to flood the bearings.

Engine shut-down is effected by de-energising a solenoid in the governor. When de-energised, this valve shuts off the supply of lubricating oil to the governor which in turn will cause the supply of fuel oil to the engine to be stopped. A centrifugally-operated overspeed shut-down device is installed in the engine; this functions in the event of an engine overspeed and cuts off the supply of fuel oil to the engine.

An electro-mechanical engine tachometer is fitted, and is wired direct from the generator in the normal way. An Ardleigh 303 traction-type servo-assisted governor with infinitely-variable pneumatic speed control is fitted, and this permits single remote control of one or more power units. A form of automatic torque control is incorporated in the governor; it consists of a load control valve which regulates the flow of oil to and from a hydraulic servo motor mounted adjacent to the engine governor.

Engine starting is by using the main generator as a motor operating from the 48-cell Chloride KFD11 lead-acid battery of 137 amp. hr. capacity at the five-hour rate. The engine-starting push-button is located on the driver's controller, and when this is depressed the starting sequence is initiated. The electrically-driven priming pump feeds lubricating oil to the engine bearings and also supplies oil to the starting controls in the governor; after this, the starting contactors close. As the engine fires and gathers speed, the starting circuit is automatically disconnected even if the engine-starter push-button is held depressed.

Engine speed is controlled by compression of the governor control spring which is effected by variation of air pressure in a pneumatic cylinder built into the governor. The engine control air pressure pipe is carried through the locomotive and, when working in multiple unit, is connected from one locomotive



to the next. Variation of air pressure is effected by a pressure control valve located in the driver's controller.

ELECTRIC EQUIPMENT

The generator unit comprises three machines, viz., a main generator of B.T.H. type RTB. 10858, a differential exciter type DY. 2816, and an auxiliary generator type RTB. 7420. The main generator is a single-bearing six-pole separately-excited self-ventilated

machine solidly coupled to the diesel engine and mounted upon an extention of the engine underbed. It is a 500-kW machine rated at 690/337 volts 720/1,320 amp. 1,250 r.p.m. The armature is built up on a fabricated cylinder, a stub shaft being provided at the bearing end. The drive from the engine is taken on the full diameter of the cylinder, ensuring great torsional rigidity and freedom from the effects of cyclic variation of torque. A special commutator construction is used which prevents the possibility of loosening of segments in service.

The auxiliary generator is an eight-pole separately-excited constant-voltage machine of 40 kW 110 volts 625/1,250 r.p.m. the armature of which is mounted on an extention of the shaft of the main generator, the frame being an extention of the main generator frame. The excitor is a four-pole machine with separate, self, and differential series excitation windings. It is mounted upon an adjustable platform on top of the auxiliary generator frame, and is belt-driven from the main generator shaft extention.

The four quite conventional nose-suspended series-wound traction motors drive through single-reduction gearing. They are force-ventilated, two separate motor-driven blowers, each with a 5.3 h.p. motor of 110 volts 45 amp. 2,620 r.p.m. being mounted in the body of the locomotive, and each providing ventilating air to a pair of motors. Each traction motor has a one-hour rating of 136 h.p. 340 volts 360 amp. 315 r.p.m. and a continuous rating of 144 h.p. 380 volts 330 amp. 375 r.p.m.

Nose suspension is in the form of a link employing Silentbloc bushes at each end; and a further link with Silentbloc bushes is connected horizontally between the motor frame and the side of the bogie; this second link controls lateral movement of the motor irrespective of side movement of the axle, thus reducing flange wear and improving the riding of the locomotives. The gear wheels are of resilient construction, and consist of a hub and toothed rim connected through rubber bushes which cushion mechanical shocks due to accelerating forces and track irregularities.

The control gear is divided into two sections: the control frame and the cab control equipment. The control frame unit is mounted in a dust-tight compartment behind the driver's cab and is remote from engine fumes and heat, and free from chance of contamination by oil or engine water. On this control frame are located all contactors, relays and switch devices. Separate contactors are provided in each motor circuit. The reverser is of the butt contact type, having silver-faced main contacts; it is electro-pneumatically operated. Access to the control gear is conveniently obtained by means of doors at either side of the locomotive. The cab control equipment comprises two master controllers and instrument panels, one at each driving position, together with alarm identification panel, engine instrument panel, lighting switch boxes and fire alarm unit. The storage battery is maintained in a charged condition by the 110-volt auxiliary generator controlled by a Brown Boveri sector-type regulator.

The characteristic of the combined generator-exciter unit is that of the well-known three-winding generator. The exciter has a differential series winding which carries the main traction current, and also a separately-excited winding which is externally controlled both the driver's controller and the automatic load control; due to the low value of excitation current in this small machine, small control devices can be employed. The shape of the characteristic is the familiar drooping curve, the excitation being proportioned so that there is a definite maximum limit to the current which can be delivered to the traction circuit at standstill, and so that, at this point, the demand on the engine is less than its rated output. The section of the characteristic which intersects the constant h.p. curve of the engine is artificially controlled to prevent overloading by varying the separate excitation of the exciter by means of a hydraulically-operated rheostat. The movement of this rheostat is controlled by a hydraulic valve located within the engine governor. This arrangement automatically varies the generator loading so that it agrees with the predetermined engine output at any particular engine speed. The four traction motors are connected in parallel across the main generator with one step of motor field weakening.

PROTECTIVE DEVICES

The protective devices provided on this locomotive are of two types; (1) apparatus for the safety of the locomotive in traffic; (2) apparatus to protect the engine and transmission equipment. Under category 1 there is the deadman pedal with its corresponding push-button on the opposite side of the cab, which permits the driver to cross the cab to observe signals. Also air-operated switches are provided to prevent the locomotive from being driven until there is sufficient compressed air and vacuum to operate the locomotive and train brakes. In addition, the new B.R. type of automatic train control is fitted.

Apparatus in the second category can be further divided into two classes: (*2a*) devices which act to prevent danger to the equipment; (*2b*) devices which are warning only, leaving the driver to take appropriate action. Under (*2a*) provision is made in the event of low water level or low oil pressure occurring for the engine to be automatically stopped; the appropriate latched relay then operates on the identification panel of the locomotive affected. An engine-stopped light at the driving position indicates if any one engine is stopped when running in multiple unit. This alarm also serves as a guide when starting engines on locomotives coupled in multiple, since the start push-button is merely held depressed until the engine-stopped alarm becomes normal.

Earth leakage causes the earth-leakage relay to operate and the traction circuit to be opened. Provided the earth fault has cleared, the relay can be reset by moving the driver's controller to off, but a flag on the relay remains displaced until reset by hand, thus indicating to the shed staff that an earth fault has occurred at some time during service. In the event of traction motor blower failure or high water temperature, the alarm indication is made at the driving position by an indicator light, whilst a latched relay operates on the alarm identification panel of the locomotive affected. A wheel slip indicator light is fitted at each driver's position.

Under (*2b*) there is a fire-alarm system which gives warning of excessive temperature rise in the engine room, and there is a fire-extinguishing system consisting of a large CO_2 bottle and pipes to various parts of the engine room. The CO_2 is released by a lever in the cab or by similar levers mounted on each side of the locomotive and accessible from the track.

SPECIFICATION FOR BUTCHER KNIVES

The Indian Standards Institution had undertaken the formulation of Indian Standards specifications for various type of knives at the instance of the Chief Inspectorate of General Stores (Ministry of Defence) and the Development Commissioner, Small-Scale Industries to assist in regulating the quality of indigenous production.

The Institution has already prepared the following three specifications for knives:

IS: 922—1958 Specification for Cook's Knives.

IS: 923—1958 Specification for Carving Knives.

IS: 925—1958 Specification for Pocket Knives.

Latest in the series is the Indian Standards Specification for Butcher's Knives (IS: 921—1959). The standard covers the requirements for butcher's knives of the following four types:

a) Flaying Knife, Large.

b) Flaying Knife, Small.

c) Cutting Knife.

d) Sticking Knife.

*** *** ***

ITALY OPERATES HYDRAULIC LOCOMOTIVES

Two, out of 20 diesel hydraulic locomotives ordered have gone into operation in Italy. The most important innovation in this type lies in the gear change control, which operates automatically by fluid through a special toothed clutch.

*** *** ***

Year's first quarter plan has been successfully carried out in the Kolomensk V. V. Kuibyshev Diesel Engine Locomotive Plant in the Moscow. Brigades assembling the diesel engine locomotives and mobile diesel power stations are outstripping the graphic.



In the Diesel Engine Locomotive Assembling Shop, the above diesel engine locomotive just before leaving the shop.

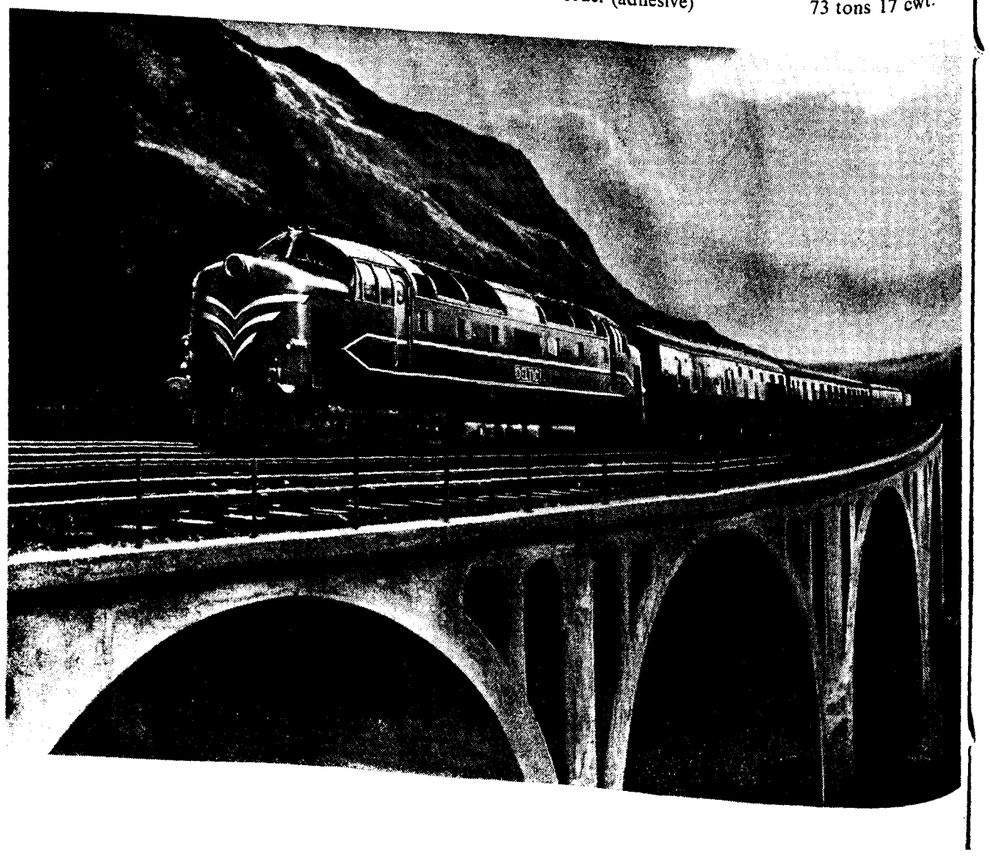
Type "2" Mixed Traffic Diesel-Electric Locomotives for British Railways

Bo-Bo Design Powered by single turbo-charged Deltic 9 cylinder engine.

TEN of these Type "2" 1,100 H.P. main line diesel electric locomotives were ordered by the British Transport Commission as part of the railway modernisation programme and are now in traffic on the Eastern Region. They have been designed and built by The English Electric Company Limited in conjunction with their associates, The Vulcan Foundry Limited and D. Napier & Son Limited.

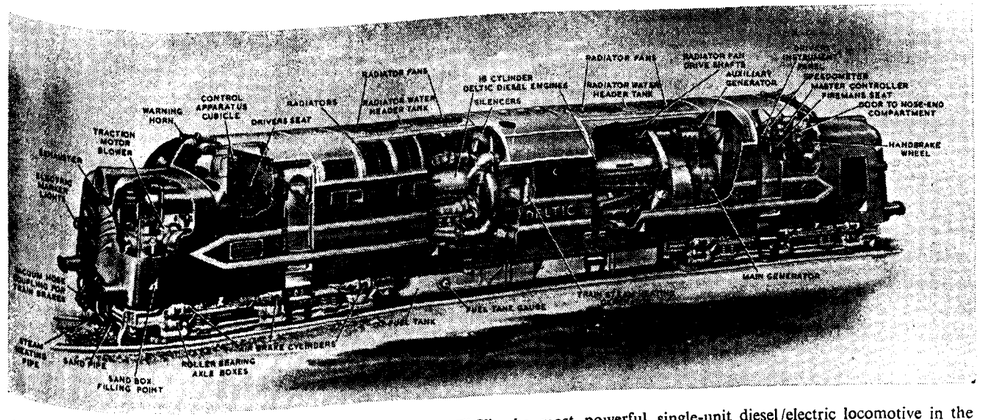
They have been designed primarily for short distance passenger train working and are equipped with a train heating boiler. Although they are geared for a maximum speed of 75 m.p.h. the locomotives will be used on local freight services.

They may be operated in multiple unit either with similar locomotives or with the Types 1, 3 and 4 locomotives already in service and coming into service on British Railways.



PRINCIPAL DATA

Wheel arrangement	Bo—Bo
Weight in full working order (adhesive)	73 tons 17 cwt.
Maximum axle load	18½ tons
Gauge	4′ 8½″
Length over buffer beams	52′ 6″
Overall width	8′ 10¾″
Overall height	12′ 8″
Bogie wheelbase	8′ 6″
Bogie centres	32′ 0″
Wheel diameter	3′ 7″
Minimum curve negotiable	4½ chains
Brakes	Air on locomotive; vacuum for train
Rating	1100 H.P. at 1600 r.p.m.
Diesel engine	Napier Deltic T9–29
Maximum tractive effort	47,000 lb.
Continuous rated tractive effort	30,600 lb.
Maximum service speed	75 m.p.h.
Fuel (engine and boiler)	550 gallons
Compressor	Westinghouse 2EC72A (mech. driven)
Exhausters	2 Reavell FRU 5¼×10 (motor driven)



An annotated cut-away drawing of the English Electric "DELTIC", the most powerful single-unit diesel/electric locomotive in the world. Its generators are driven by two 1,650 h.p. 18-cylinder Napier Deltic high-speed diesel engines. Its service speed is in excess of 100 m.p.h.

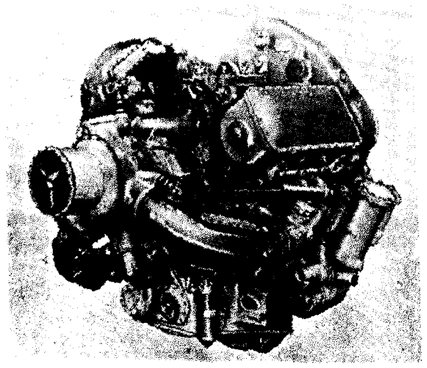
Radiator fan	Mechanically driven
Train heating boiler	Stone/Vapor
Boiler rating	1750 lb/hr. at 100 p.s.i.
Boiler Water	500 gallons

DIESEL ENGINE

The diesel engine is a Napier Deltic Type T9–29 rated at 1100 H.P. at 1600 r.p.m. It is a nine cylinder two stroke, pressure charged unit, with the cylinders arranged in groups of three. Cylinder blocks form the sides of an equilateral triangle with a crankcase at each cornor. As the engine is of the opposed piston type, this arrangement enables each crankshaft to serve two adjacent cylinders, two connecting rods being attached to each crank throw.

Phasing gears at the driving end link the three crankshafts and combine their outputs in a common drive gear through which the engine output is transmitted. The turbo-blower is mounted on the free end of the engine; port timing being so arranged that the blower completely scavenges and pressure charges the cylinders.

The main generator is bolted solidly to the diesel engine, and together with an auxiliary generator mounted on top form a compact integral power unit. Resilient supports allow normal flexing of the loco-



Napier Deltic 9-cylinder supercharged high-speed diesel engine of the type used to drive the generator installed in a light diesel/electric railway locomotive in service with British Railways.

motive underframe without the transmission of stresses to the power unit. Removal of the complete power unit is a comparatively simple operation.

Oil and water are cooled by a double bank radiator, one radiator panel being mounted at each side of the locomotive. A mechanically driven fan draws air across the radiators and expels it through the roof. Radiator shutters, controlled from the engine room, provide protection against frost. The temperature of the cooling water is automatically controlled by a thermostatic radiator by-pass valve.

THE MAIN GENERATOR

The main generator is d. c. self-ventilated, single bearing machine. It has a separately excited winding for normal running, and a series winding when the generator is connected across the battery for engine starting.

The electrical output is varied by control of the engine speed and main generator field exitation.

THE AUXILIARY GENERATOR

The auxiliary generator is driven by an auxiliary shaft from the engine phasing gearbox. It is a d. c. self-ventilated machine, and its output is maintained at 110 V by a carbon pile regulator.

The low tension supply for charging the battery, operating the control gear and driving the exhaust motors is from the auxiliary generator. Also this source supplies the train heating boiler control gear, the boiler auxiliaries, cab heating and locomotive lighting.

AUXILIARY MACHINES

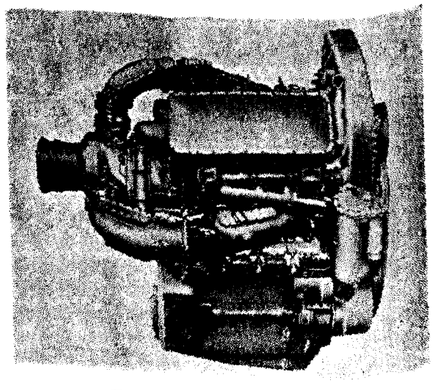
These comprise two exhausters, a compressor and two traction motor blowers.

The two motor driven Reavell FRU 5½×10 exhausters, provide the vacuum for operating the train brakes. This rotating vane type of machine normally runs at 715 r.p.m. but may be speeded upto 1430 r.p.m. under the control of the driver should a more rapid brake release be required.

The Westinghouse 2EC72A compressor is driven through a plate clutch from an auxiliary gearbox which in turn is driven by a shaft from the engine. The compressed air supply operates the locomotive brakes, control gear, warning horns and the sanding equipment.

The traction motor blowers, are centrifugal fans, one of which is driven from the auxiliary gearbox and the other from an extension shaft on the auxiliary generator armature.

The radiator fan is roof mounted and is also driven from the auxiliary gearbox. The vertical drive is through a shaft with flexible couplings interposed. A centrifugal clutch in the final drive limits the torque imposed on the fan when starting up or shutting down the diesel engine.



Turbo-charged Napier Deltic 9

TRACTION MOTORS

The four axle-hung nose-suspended traction motors drive the road wheels through single reduction spur gearing. They are series wound, direct current machines. The use of field-strength weakening by field divert resistances extends the range of locomotive speeds over which full engine power is available.

Each pair of motors is force-ventilated from the adjacent blower in the locomotive superstructure, the air being led from the blower by ducts and flexible bellows connections to the air inlet at the commutator end of the motors.

CONTROL GEAR

All control gear is housed in a single cubicle which faces into one of the cabs and is placed transversely across the locomotive.

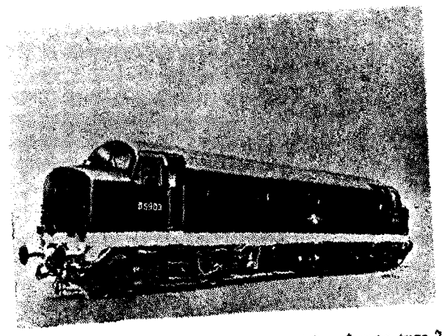
The traction motors are connected in two parallel groups across the main generator, each group consisting of two in series. Wheel slip protection circuits are included but in the event of wheel slip occurring the driver is warned by an indicator light. The tractive effort is reduced automatically until wheel slip ceases.

Additional warning lights are placed at the driving position to indicate that the diesel engine has shut down and the presence of a fault, such as high water temperature. In the event of low lubricating oil pressure or low cooling water level, the diesel engine is shut down automatically.

There are two master controllers, one at each driving position. The control circuits are energised by electro-pneumatic and electro-magnetic contactors and relays. Stepless variation of the diesel engine speed gives a range from 600 r.p.m. to 1600 r p.m. and the loading is adjusted automatically to cause the engine to deliver the maximum available power output corresponding to the selected r p.m. The advantage of this system is that the diesel engine runs at the lowest possible speed at which the load demand can be met. Fuel consumption is thereby reduced, and wear minimised. An Ardleigh governor controls the engine r.p.m.

SUPERSTRUCTURE

The driving cab at each end has access doors at both sides. A door in each cab rear bulkhead allows



The English Electric Type 2 (The article refers to type 2 only) diesel/electric locomotive which is powered by a single 1,100 h.p. turbo-charged Napier Deltic T9-29 9-cylinder high speed diesel engine. Ten are now in service with the Eastern Region of British Railways.

Length over buffer beams	52 ft. 6 in.
Overall width	8 ft. 11 in.
Overall height	12 ft. 8 in.
Bogie wheelbase	8 ft. 6 in.
Bogie centres	32 ft. 0 in.
Max. tractive effort	47,000 lb.
Cont. rated tractive effort	30,600 lb.
Max. service speed	75 m.p.h.

entry into the engine compartment. This compartment may be reached also through one door in each body side. The superstructure has nose ends in which are accommodated the vestibule gangways.

The locomotive underframe is made up of four longitudinals, the two main members being joists and the two outer members being channels. These are cross connected by transoms of welded construction to form the bogie pivot centres and there are additional cross stretchers. Drag boxes are welded at both ends of the underframe to carry British Railways standard screw couplings and side buffers. Provision has been made also for fitting buck-eye couplers.

The fuel and water tanks are both underslung from the centre of the underframe and are recessed at one side to provide platforms to carry the batteries. The battery boxes are well ventilated, and ready access for topping up or removal of the batteries is through drop-down hinged doors.

The superstructure side framing is pre-fabricated and attached to the underframe by welding. Removable roof sections over the control cubicle, the power unit and the boiler to facilitate the maintenance of the equipment.

BOGIES

The bogie frames are of fabricated construction, the solebars being welded to form a box section. The fabricated transom and headstocks are riveted to the solebars.

The load from the superstructure is transmitted by a single bolster riding in each bogie. The bolster is carried on semi-elliptic laminated springs, which in turn are carried on a swing plank. The swing plank is supported from the bogie frame by inclined swing links. Springing between the bogie frame and the road wheels is provided by nests of coil springs which are located between the underside of the bogie frame and the top side of the equaliser beams. In turn, the forged steel equaliser beams are underslung from the roller bearing axleboxes. These are forged steel horn-clips on each side of the axlebox guides, and manganese-steel liners on the axlebox guides and on the axleboxes. Similar liners reduce wear on the traction faces of the bolster and bogie transom. The lateral swing of the bolster is limited by rubber blocks. All wheels have clasp brakes. The air brake cylinders are mounted on the bogie solebars and operate the brake gear through a system of levers and rods.

BRAKE EQUIPMENT

The brake equipment is manufactured by the Westinghouse Brake & Signal Co. Ltd.

In each cab there are two brake handles : one controlling the straight air locomotive brake ; the other, the vacuum brake. There is a vacuum/air proportional valve.

There is a deadman's pedal at each driving position and the locomotive has standard British Railways ATC equipment.

LAYOUT OF EQUIPMENT

Immediately behind the rear bulkhead of No. 1 cab is situated the train heating boiler and beyond that are radiators and fan.

The two motor driven exhausters are situated between the main generator and the control cubicle.

VENTILATION

Oil wetted filters are provided in the body sides and all air taken into the locomotive passes through these. The diesel engine and generators, together with the traction motor blowers, draw their air from the filtered supply in the engine compartment.

DRIVER'S CONTROLS

The driver's controls in each cab are built into a desk.

The master controller is locked and made inoperative by a master key. Once the controller has been unlocked, one of its two handles, which has four positions, normally would be moved from the "off" position to "Engine only". When the engine has been started and the first handle has been moved again to select the direction of travel, the power output is controlled by the second master controller handle. The driver may change from one cab to another without stopping the diesel engine, as the "engine stop" button control is independent of the interlocks. In addition to the master controller, there are the two brake handles enabling the driver to select the vacuum train brake, or the air brake for the locomotive only.

In each cab instruments are provided together with indicator lights to show the conditions of the equipment and to provide a warning of fault conditions. Additional instruments in each cab include two air gauges, a vacuum gauge, a speedometer and an ammeter to indicate the main generator current. At the second man's side there is an indicator light to prove satisfactory functioning of the boiler and a steam pressure gauge. Switches are provided for operating the sanding gear, windscreen wipers.

Every consideration has been given to the comfort of the locomotive crew. The seating is upholstered and adjustable. Four kW of cab heating is available, and there is an electric cooker in the engine room.

Biggest British Undertaking Since War

A FOUR-YEAR plan to modernise the London Underground Railways at a cost of more than £ 30,000,000 has been announced by Sir John Elliot, Chairman of the London Transport Executive. The amount will be shared by the Piccadilly, Metropolitan and Central Lines for re-equipment works and modernisation of the underground current distribution system. There will be 200 new "silver" trains replacing more than a third of the present fleet.

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WELDING SUPPLEMENT

WELDING OF CAST IRON

BY GRIESHEIM'S ENGINEERING CORRESPONDENT

I. GENERAL

IN order to meet all requirements in welding of cast iron, it is necessary to give careful consideration not only to questions of economics and welding technique, but a knowledge of the materials involved, as well as of the metallurgical principles, is also important. Since in most cases we are concerned with repairs to castings, it is also necessary to investigate the reason for the damage, and to take into account the requirements of the finished article.

Here a short review of the special properties of cast iron as a material will be given, and then attention will be drawn to the possibilities of meeting the requirements by using the "GRIESHEIM" electrodes developed for these purposes.

II. THE MATERIAL

Grey cast iron:

Grey cast iron is a ferrous material containing more than 1.7% carbon, the greater part of which is present (in the structure) in the form of graphite. This graphite gives to the fracture a colour varying from light to dark grey.

Compared with steel, grey cast iron has a low malleability caused by the separation of a major proportion of the elementary carbon in form of graphite laminae, which form as a foreign element network throughout the metallic matrix.

Comparison of the mechanical properties of steel and high quality grey cast iron:

		St 37	Grey cast iron
Tensile strength	tons/sq. in.	23.5-28.5	24
Elastic limit	tons/sq. in.	15	—
Elongation	%	25	1
Hardness	HB	150	220

The matrix can be ferritic or pearlitic.

The type of structure depends both on the chemical composition and on the conditions of cooling.



Fig. 1. Grey cast iron with ferritic structure 200 : 1



Fig. 2. Grey cast iron with pearlitic structure 200 : 1

The chemical composition of normal machine castings is as follows:

Carbon	3 to 3. 5%
Silicon	1. 5 to 2. 5%
Manganese	0. 6 to 1. 2%
Phosphorus	0 4 to 0. 6%
Sulphur	0.05 to 0.18%

If we take the effect of the alloying components into account we obtain approximately the following order:

(a) CARBON

The average content lies between 2.5 and 3.75%; it has the effect of lowering the melting point, this

increases fluidity considerably, which must be taken into account in welding. The size and distribution of graphite formed depends on the percentage of carbon; graphite has a decisive effect on the properties of the cast iron.

(b) SILICON

The effect of this element is of equal importance to that of the carbon. If we assume that the maximum content of carbon in the cast iron is 4.3% (ledeburite-line) then we can classify cast iron on the basis of its silicon content.

Silicon assists considerably the separation of graphite, improves density, prevents the burning off of carbon and other alloying components, and extends the solidification range.

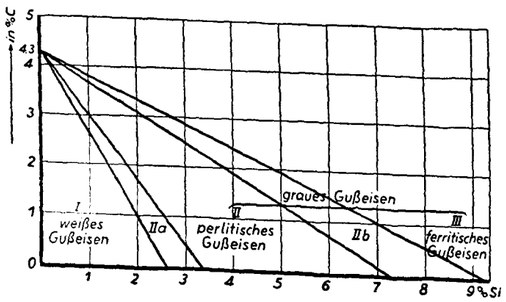


Fig. 3. Maurer's cast-iron Diagram.
I. White cast iron
II. Pearlitic cast iron
III. Ferritic cast iron } Grey cast iron

(c) MANGANESE

In amounts over 0.5% this stabilises carbide, increases the tensile strength and causes the formation of manganese sulphide, which is mechanically considerably less harmful than an iron sulphide network.

(d) PHOSPHORUS

Phosphorus is to be found in all types of castings as a main impurity and is added, particularly to fine castings and art castings, in amounts up to 1.5% in order to increase the fluidity.

(e) SULPHUR

From the welding point of view amounts up to 0.12% may be regarded as harmless. In the casting there is generally sufficient manganese present to convert it into the harmless form of manganese sulphide.

Apart from the elements listed under the heading a) to e), in order to achieve certain mechanical properties and a certain resistance to corrosion, as well as to avoid oxidation at high temperatures, further elements such as nickel, copper, aluminium, chromium etc., may be added.

WHITE MALLEABLE CAST IRON

In white malleable cast iron the carbon occurs in a combined form as iron carbide; it contains hardly any graphite precipitation and is very hard, brittle and cannot be worked with cutting tools. When dealing with workpieces we speak of chilled cast iron and distinguish between completely hard, and case-hardened chilled cast iron. Malleable cast iron is mainly used in the manufacture of rollers.

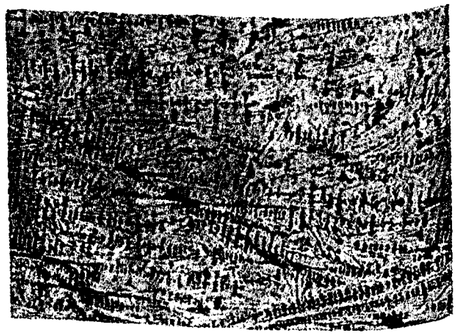


Fig. 4. White cast iron Ledeburite 200 : 1

The cooling conditions play just as important a part in the structural formation of cast iron as the chemical composition; the slower the cooling proceeds, the greater is the tendency towards formation of a ferritic structure, i. e., the carbon separates in the form of graphite in a ferritic matrix. Under normal conditions, some types of cast iron which harden white or mottled may become pearlitic due to slower cooling. Here we term "sensitivity to wall thickness" the fact that in thick cross-sections, which cool more slowly, strengths are lower than in thin cross-sections, and this is attributed to the different structure formations.

Strength properties and structure formation depend on the shape of the workpiece.

SPHEROIDISED CAST IRON

Spheroidised cast iron is a comparatively new constructional material, which combines to a great extent the possibility of casting and working grey cast iron, with the mechanical properties of cast steel. Contrary to grey cast iron, in which the free carbon is embedded in the matrix in the form of laminar graphite, the laminae being present throughout the matrix, in spheroidised cast iron the graphite occurs in spherical shape. We differentiate between ferritic, pearlitic and austenitic spheroidised cast iron.

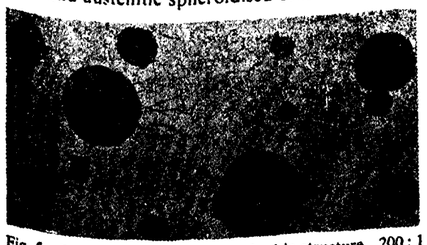


Fig. 5. Speroidised cast iron with ferritic structure 200 : 1

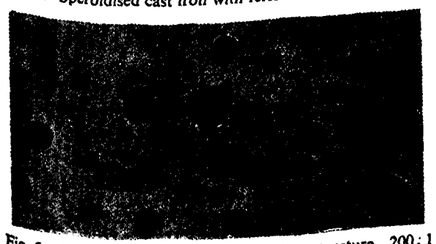


Fig. 6. Speroidised cast iron with pearlitic structure 200 : 1



Fig. 7. Spheroidised cast iron with austenitic structure 200 : 1

In these types of castings the spherical graphite is embedded in a ferritic, pearlitic or austenitic matrix.

The outstanding properties of this new material based on formation of the free carbon are :

good castability, good machineability,
ductility toughness and high tensile strength.

Spheroidised cast iron can be worked more easily than cast iron of equivalent hardness. Further it can be rolled hot and can be forged in the die. The carbon is separated out in the form of spherical graphite in the cast iron by different methods through the addition of magnesium or more seldom, cerium. Magnesium is generally added in the form of a key alloy with nickel.

The following table gives the range of the chemical composition of spheroidised cast iron :

C	3.3	to	4.2%
Si	1.0	to	4.0%
Mn	0.1	to	0.8%
P (max)	0.05	to	0.1%
Ni	0	to	3.5%
Mg	0.005	to	0.1%

The following are the approximate mechanical properties of ferritic spheroidised cast iron :

strength	tons/sq. in	28.5
elastic limit	tons/sq. in	20.3
elongation	%	15 to 25
hardness	HB	140 to 160

In case of spheroidised cast iron these figures depend both on the chemical composition and on the previous treatment.

MALLEABLE CAST IRON

Malleable cast iron comprises of white cast iron poured into moulds and subsequently subjected to a tempering process. Two types of malleable cast iron are encountered in the industry, viz. white and black.

In the case of *white* malleable cast iron a de-carbonising tempering is carried out. The carbon is removed in this manner at varying depths from the surface according to sheet thickness and duration of the tempering process. The fracture surfaces are light grey, similar to steel, but in thicker sheets the core may be dark grey to black due to the separation of temper carbon. Except in thin-walled castings, which can easily be tempered throughout, white malleable cast iron is not a homogeneous material. Castings which are tempered all through can be easily welded.

In the case of *black* malleable cast iron annealing is carried out in a neutral atmosphere, so that the only

effect is the conversion of the cementite into ferrite and temper carbon. The fracture surface is black all over. We therefore have a homegeneous material, but it can be welded only under certain conditions.

III. THE WELDING OF CAST IRON

In most cases cast iron can be satisfactorily welded, but for each particular case the suitable type of welding must be selected. Even castings which are difficult to weld, such as fired castings, or components which have been in contact for a long time with superheated steam, can in many cases be welded nowadays by special methods using special electrodes such as "GRIESHEIM" GUSS MC.

A prerequisite for the success even of the most difficult welding processes is the control of casting and heat-stresses. Since the workability of cast iron is much less than that of steel. the former is very sensitive to the heat stresses which are an unavoidable result of welding. Even the casting process causes stresses in the workpiece (cooling, contraction), and the stresses occur particularly at transition zones from small to larger cross-sections. This is generally the case with thick-walled hollow bodies, double-walled cylinders, in large frames reinforced by ribs, in wheels and discs as well as in other complicated welded structures. If the stresses present in the workpiece have in addition the heat stresses produced by uneven partial heating during welding, then cracks, which are larger and have more effect than those which are to be repaired, are liable to occur.

In this connection we should like to discuss briefly the fundamentals of shrinkage and stresses.

When heated, a rod of cast iron expands just like any other metal, and when it cools it contracts to its original size (shrinkage). Now if this rod were to be tightly clamped on both sides and subsequently could not expand when heated, a compressive stress of definite magnitude at the clamped surface would be produced. If the clamping surfaces are not sufficiently rigid the rod will buckle. When the rod cools, a tensile stress which may result in breakage of the rod is created. If this line of reasoning is applied to a casting, it shows that two types of cracks may occur due to local heating.

a) When a zone is heated locally, and the neighbouring zones are not of adequate strength, cracks may occur in the workpiece due to compressive stresses.
b) When the heated zone, including the weld, shrinks, cracks may occur in the neighbouring, weakest point of the workpiece.

Fig. 8a

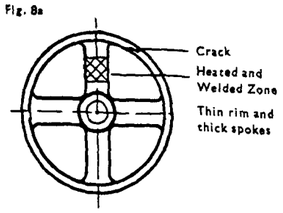
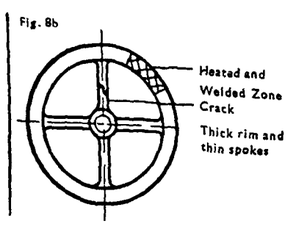


Fig. 8b



BASIC RULES

Apply local heat only where parts can expand without restriction (free thermal expansion);
in arc welding keep the weld junction small and apply as little heat as possible; drill the start and the end of the cracks; weld as far as possible from the inside to the outside; to equalise the stresses, hammer the weld.

IV. SELECTING THE WELDING PROCESS

The alternating mechanism (expansion—contraction) determines, in accordance with the position of the defect in the workpiece and itspossibi lities for expansion and contraction, the type of process. In principle we can distinguish between two different processes for welding cast iron namely, with pre-heating, and without pre-heating. A special type of the former involves some pre-hea ting only.

For a particular repair job, the most appropriate process to be selected can be decided by studying the following factors :

1. Technical points of view.

   Stresses on and workability of the finished weld, workshop installation, size and shape of workpiece.

2. Economic points of view.

   Cost of repair and time required with due consideration to a breakdown in production.

In addition to these considerations of an economic and technical kind, the experience and the ability of the welder as also the quality of the filler material are of outstanding importance. The decision as to which method is to be preferred by reason of low cost and best result, can be made only in every individual case, and it will never be possible to lay down an exact rule. The various points of view must be weighed one against the other, and a compromise reached.

V. WELDING WITH PRE-HEATING

When Welding cast iron with pre-heating, whether carried out autogenously or electrically with low melting-point cast iron rods, the weld will be identical to the base material both in structure and in mechanical behaviour. The welding material combines intimately with the cast iron, has the same hardness and the same workability as the neighbouring material. But in order to heat the casting uniformly to dull red heat (800 to 900°C) it must be dismantled and brought up to temperature slowly and uniformly in a furnace or in a welding pit surrounded by a charcoal fire. The necessary arrangements for this type of work are available only in few works. When welding cast iron with pre-heating, particular attention must be given to the preparation of the crack for welding. Broken parts must be held by bolts. The defects are first chipped out and formed in with carbon moulding plates, so that the liquid well cannot flow off. When forming in, long welds are subdivided into individual sections.

When the workpiece has been raised to dark red heat slowly and uniformly, it is covered up until only the welding position is visible. The welders must be protected from the heat radiation.

For large jobs a number of welders can be employed, one relieving the other. In order to thoroughly to fuse the edges of the grooves, the arc is continually run along the side and the whole of the molten pool is maintained liquid until the welding operation has been completed. After welding, the working position must be covered again and the workpiece allowed to cool very slowly and uniformly.

The slow cooling causes the carbon to separate out in the form of graphite, freeing the weld of shrinkage stresses. The result is a homogeneous and high-quality welded joint. The welded zones can be satisfactorily worked machanically.

VI. WELDING WITH LITTLE PRE-HEATING

In special cases, when the shape of the workpiece is favourable and the crack in a suitable position, welding with slight pre-heating can be carried out; the only difference from welding with pre-heating is in the type of pre-heating. The workpiece is pre-heated to approximately 250°C. When doing this the position of the repair is shaped beforehand in the same way as when welding with pre-heating. Welding with slight pre-heating promises success when it is desired to repair parts within a workpiece which protrude in some direction, and which would otherwise break away as a result of considerable heating. Smaller workpieces are almost all welded autogenously. Welding with slight pre-heating, involving arc welding, is carried out in principle with cast iron electrodes. In the case of heavy and complicated constructions both processes, with pre-heating and with slight pre-heating, can be carried out one after the other.

VII. WELDING WITHOUT PRE-HEATING

In many cases it is possible to leave the homogeneity of the joint out of consideration, and to weld cast iron without pre-heating. The present state of development of suitable filler materials makes it possible to carry out repairs to cast iron by this method with a high degree of reliability, technical perfection and economy. The electrodes are selected after considering the reasons for the crack or damage the state of the material, the necessity for subsequent machining and mechanical stressing of the workpiece.

When this method of welding cast iron is employed the workpiece is not pre-heated; on the contrary, care should be taken that as little heat as possible is applied to the base material, in order to keep the local heat stresses to a minimum, and to restrict subsequent effects on the structure of the cast iron.

VIII. WELDING WITH STEEL ELECTRODES

If welding is carried out with a steel electrode, then cast iron is admixed with steel in the liquid state. If the cast iron has a carbon content of 3 and the unalloyed steel electrode a content of 0.1%, we obtain a weld material that has all carbon contents between these two limits, i.e. from soft ingot steel, to highly carburised steel and on to cast iron. In addition, in the neighbouring material, which may be in a plastic or molten state, there is a structural change into malleable cast iron, i.e. the carbon which

separates out as graphite goes into solution, and iron carbides are formed during cooling. We therefore have considerable differences in hardness in the welded joint, so that in some parts it is difficult to work with cutting tools.

When welding cast iron without pre-heating the transition zone is particularly critical. At this position, as tensile forces cannot be transmitted cracks can easily occur, owing to change in structure and hardness. By selecting a greater joint angle than in the case of steel welding an increase in the holding surface is achieved, and simultaneously the tensile forces are converted into sheer forces.

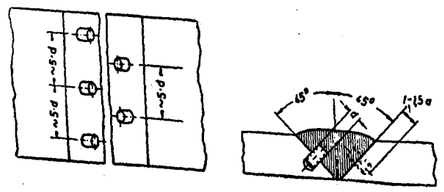


Fig. 9. Arrangement of "pinning" with steel pins or screws.

A particularly popular method of reinforcing the weld is by "pinning" with steel pins or bolts, which are screwed into the surface of the casting which is to be welded, and are welded in with it. They form a supporting framework, which absorbs a large proportion of the stresses at the weld. In some cases clamping by means of dovetail-type straps or brackets made of steel is resorted to, these being fitted and then welded in. Recently new developments have led to progress in the field of welding without pre-heating. The "GRIESHEIM" GUSS MC electrode, comprising of steel as basic material, has the following novel advantages from the welding point of view :

1. Perfect weld joints in greasy and heavily rusted castings.

2. A large proportion of alkali-based coating materials makes it possible to settle the greater part of the impurities in the cast iron, they are combined in the slag, and a joint can be made even with burnt castings.

IX. WELDING WITH NON-FERROUS ELECTRODES

When welding cast iron using steel electrodes, and without pre-heating, apart from the intrinsic hardness of the welding material, hard zones are produ the junction, and these may make it diffi even impossible, to work the transition zon the weld with cutting tools.

If good *workability* is required, and if t must be very dense then electrodes with a nickel-copper- or nickel-iron-base must be use as in the case of silicon, nickel promotes the tion of carbon in the form of graphite, so diffusion of these two elements into the neigh zone of the base material in the fused cast in that affected by heat, causes the carbon to out as graphite. A soft transition from the the base material is obtained; the weld c satisfactorily worked.

Just as in welding with steel electrodes, in also welding is carried out with as low a curren as possible, small electrode diameter and lengths are preferred so that, in view of the of cast iron to stresses, as little heat as p applied. In order to equalise the stresses in welded lengths these are hammered immediat welding.

It is often of advantage at first to hard fac surfaces with the selected electrode, and only cooling to begin welding with full penetration avoids excessive disturbance of the base materi too great an application of heat.

X. WELDING WITH DIFFERENT ELECTR

It may sometime be advisable to use a combi of different electrode types when welding cast

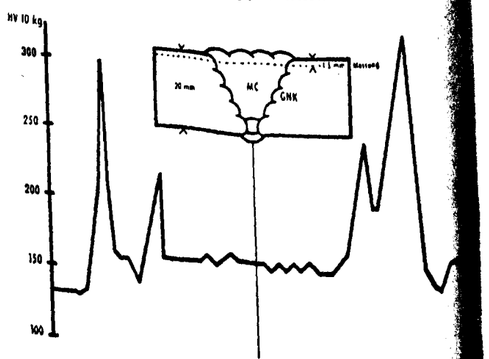


Fig. 10. Weld the root and sides with GNK (Pure ni electrode and fill the remaining with GUSS MC.

without pre-heating. But if workable welds are required, and if by reason of the high price it is not economical to fill up completely large cross-sections with nickel-copper or nickel-electrodes, then the middle layers are welded with steel electrodes, and only the upper layers and the root with the special electrode which can be machined later.

A second method is to use the filling-in technique which is shown diagrammatically in Fig. 10 which gives a considerable saving in cost together with satisfactory workability.

XI. "GRIESHEIM" ELECTRODES FOR WELDING CAST IRON

Of decisive importance for the success of cast iron welding without pre-heating is, in addition to observance of the basic conditions, the selection of the suitable filler material. In the "GRIESHEIM" electrodes for welding cast iron without pre-heating there are available nowadays welding filler materials which meet the highest requirements for this welding process; they have been developed and tested in modern laboratories to ensure that they are suitable for welding cast iron both with and without pre-heating.

"GRIESHEIM" 34/37

The "GRIESHEIM" 34/37 is a very thinly coated, readily weldable, cheap electrode for general use. (Conforming to type Es 111d DIN 1913) its application for welding cast iron without pre-heating is advised everywhere where rough repairs are to be made to castings. The adhesion to the base material is satisfactory. But due to the admixture of the soft steel of the core wire with the cast iron, there is in the region of the joint a hard and brittle structure of ledeburite and cementite. This zone is liable to cracks. The maximum hardness in the region of a joint can amount to 500 HV, depending on the casting and on the amount of cast iron which is fused, as well as on the speed of cooling.

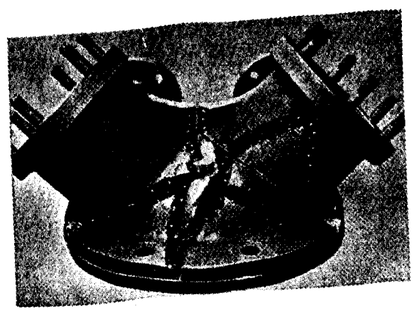
When welding with this electrodes special care should be taken that not too much heat is applied to the workpiece; firstly in order to keep the hardened zone as narrow as possible, and secondly in order to keep the thermal stresses to a minimum. The very thin coating on the "GRIESHEIM" 34/37 makes it particularly suitable for welding cast iron without pre-heating; it can be used both for D. C. and A. C. welding.

"GRIESHEIM" GUSS MC

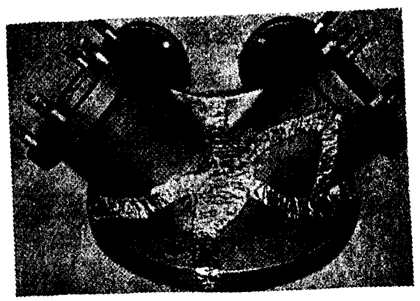
The "GRIESHEIM" GUSS MC special electrode for welding cast iron without pre-heating is particularly suitable for welding very heavily rusted, old castings, dirty material and "built-up" castings, when time-wasting cleaning is to be avoided. In addition it is possible to weld castings to steel; it is an ideal electrode for welding cast iron without pre-heating, when subsequent machining is not required.

The completely novel coating with an alkali base makes it possible, with very low current densities, i. e. with application of little heat, to produce an excellent joint with the base material using a stable arc. On account of the comparatively high alkali-base content, a proportion of the sulphur is combined into the slag, so that, in addition to the formation of little slag, high resistance to cracking is achieved. The admixture of the added welding material with the base material, and the hardening of the cast iron, are extraordinarily small.

Fig. 11. Welding with GRIESHEIM 34/37 without preheating.



Prepared job.



Finished job.

It is advisable to apply the electrode in thin layers, and to weave slightly. The welding characteristics are matched in such a way that even very complicated castings which are liable to stresses can be welded easily and reliably. The slag can be very readily removed. Traces of slag remaining in positions which are accessible with difficulty can easily be fused again. The electrode can also be used satisfactorily for welding different types of castings, e.g. malleable cast iron, steel and grey cast iron to one another, and then the welding material gives a good equalisation of the different co-efficients of expansion.

The electrode can be used for welding in all positions, including the overhead position. In order to avoid hair cracks it is advisable to weld only lengths of approx. 20 mm (0.8 in).

The deposited metal from the GUSS MC is just workable if the electrode is correctly handled, the current density is kept as low as possible, and thin electrodes are used. The electrode has also been found satisfactory for filling in shrinkage holes and defects.

The electrode can be used for welding with A.C. and D.C. With positive polarity flatter melt runs are generally obtained with a very soft arc, and the penetration is deeper than with negative polarity. For larger deposits it is advisable to weld with the electrode



Fig. 12. Repair work on an anvil.

at negative polarity, where it has a very high build capacity.

"GRIESHEIM" GK

The "GRIESHEIM" GK is an electrode w extruded coating having a nickel-copper wire core.

The special combination of core wire and c makes it possible to weld with low current de and thus to apply the minimum of heating t workpiece. Stress cracks and hardening of the near to the weld are avoided. This effect is reinf by the nickel content of the core wire, because diffuses into the neighbouring base material, a formation of the hard cementite in the structu avoided to a great extent.

The soft homogenous flow of the electrode make possible to weld without forming grooves at the jo of the weld.

The weld material deposited is free of pores dense; it gives a strong adhesion to the base mat In the case of long welds it is always advisab hammer lightly the deposited material, in particul the crater after taking off the electrode. The slag be removed both when hot and when cold. The are clean, clearly defined, and can be satisfact worked; they are almost the same colour as the iron. The joint with the base material is soft en to be filed, and can be worked very well with cu tools. The main field of application of "GRIESHEIM" GK is nowadays the filling o defects in castings, as well as pores shrinkage h and unimportant cracks in castings.

The electrode can be used with D.C. and A when using D.C., negative polarity is to be preferred

"GRIESHEIM" NiF 25

The "GRIESHEIM" NiF 25 was developed special electrode for welding spheroidised cast iron.

In addition to spheroidised cast iron the electrod also suitable for welding grey cast iron, malleable iron and cast steel, as well as all types of carbon for making joints with the castings named above. electrode can also be used for building-up welds intermediate layers for wear-resistant or chemic resistant armouring. Further, with its aid w



Fig. 13a. File soft weld material.



Fig. 13b. Grooved out crack.



Fig. 13c. Welded and Hammered.



Fig. 13d. Machined finish.

joints can be made between grey cast iron and rust-free steel, and all nickel alloys.

The "GRIESHEIM" NiF 25 has a wire core made from a nickel-iron alloy, and has a basic coating. The low fusing speed with a very soft arc on one hand, and high nickel content of the deposited metal on the other hand, give a low penetration, transition zones free of notches, and a deposit which is soft enough to be filed.

The degree to which the deposited metal mixes with the base material, and in particular due to the C- and Si-content, has a decisive effect on the mechanical properties of the welded joint.

It is therefore of advantage to arrange that the welding groove, and in particular the root, is not too small, and to deposit first on the edges, so that a purer deposit is obtained in the centre of the weld.

It is advisable to hammer the deposit. In the case of very rigid castings only short portions of the joint should be welded, and in the case of multiple layers it is advisable first to fill in before continuing the weld.

When welding grey cast iron a proportion of the P-, S- and C- content is converted into slag by the strongly basic coating, and this greatly increases the resistance of the weld to cracking. The graphite which is absorbed into the weld separates out in the form of finely divided small spheres.

The electrode can be used for welding both with D.C. and with A.C. With positive polarity the smallest penetration is obtained and with negative polarity the deepest penetration. A.C. gives values which are intermediate.

The "GRIESHEIM" NiF 25 is one of the most resistant electrodes to cracking among those used for welding cast iron, even for the heavier cross-sections.

"GRIESHEIM" GNK

The "GRIESHEIM" GNK is an electrode with an extruded sheath and a nickel core, which gives a good joint with the cast iron, with extremely small penetration. The whole welding process is very similar to soldering.

Due to the low welding current and the low-temperature characteristics of the electrode, very little

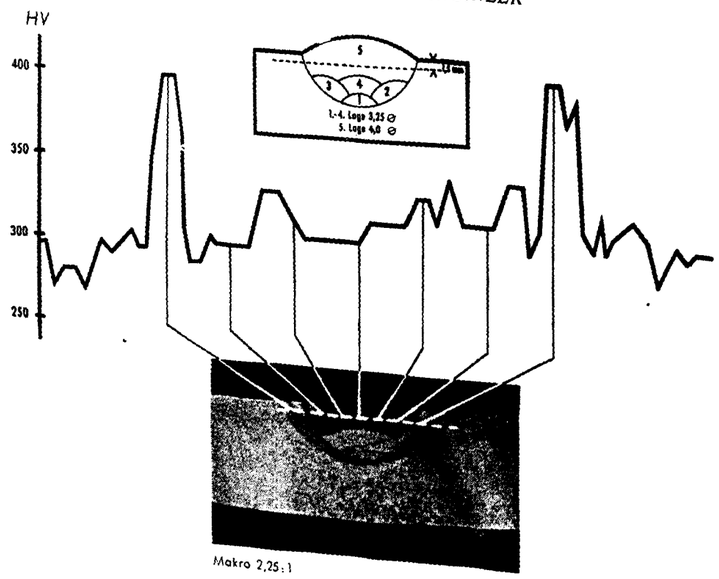


Fig. 14. GRIESHEIM 'NiF 25' welded groove on spheroidised cast iron.
Depth of the groove 15 mm.
Width of the groove 6 mm.

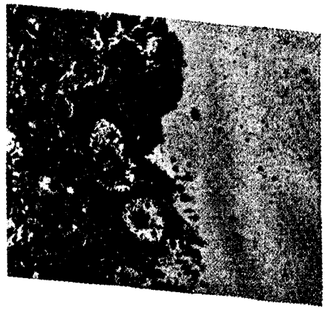


Fig. 14a. Transition zone.

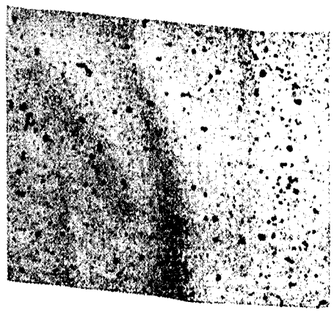


Fig. 14b. Weld material.

heat is applied to the workpiece, so that the neighbouring zones are not hardened and stress cracks are avoided to a great extent.

The electrode is suitable both for the repair of shrinkage holes and cracks as well as for very long welds; pre-heating is not necessary.

If required the deposited metal can easily be metallised. The arc is very stable and soft, so that, using a very low current density both flat and built-up deposits can be obtained. In all circumstances "GRIESHEIM" GNK gives a powerful adhesion the weld to the base material. The comparati small amount of slag can be easily removed.

In order to prevent the spread of a crack d welding, the ends of the crack must be drilled. advisable to weld only in small sections, and t hammer the bead lightly to reduce the stresses. B continuing to weld the deposited metal is allow cool.

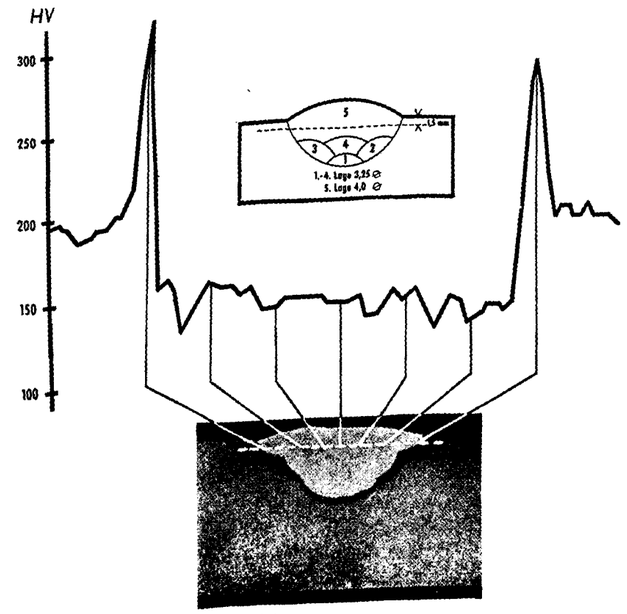


Fig. 15. GRIESHEIM 'GNK' welded groove on grey cast iron.

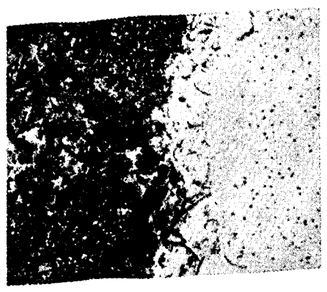


Fig. 15a. Transition zone 200 : 1



Fig. 15b. Weld material 200 : 1

In the case of the GNK also it is advisable to use a larger groove angle in order to increase the adhesion surfaces. During preparation care should be taken that the casting is clean and free from grease and that at positions where the final run extends beyond the width of the groove, the skin of the casting should be removed to a small depth.

The excellent welding characteristics make it possible to obtain deposited beads and welds in corners without any notches at the transitions.

The "GRIESHEIM" GNK gives welds of excellent density, free from cracks; of the metal electrodes which are used for welding cast iron this is the one

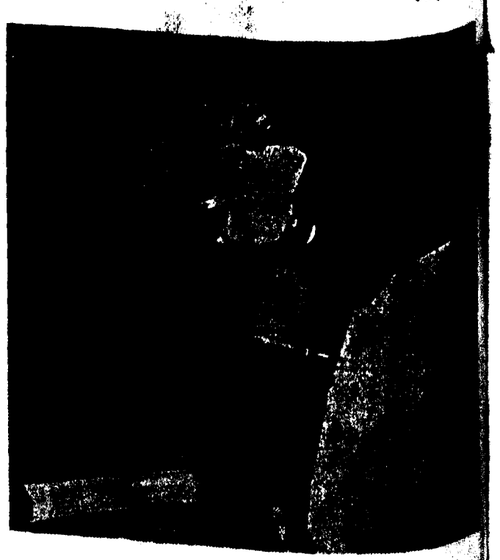


Fig. 16. Repair work on a heavy cast iron plate.

Welding of a gear box.



which, while giving high resistance to cracking, gives the surest guarantee of workability.

The "GRIESHEIM" GNK can be used both with A. C. and with D. C.

With positive polarity the heating effect on the workpiece is extremely small. In this case the electrode gives a comparatively high build-up, and it is possible to obtain a deposit with very high alongation. It is advisable to use this polarity when large grooves have to be filled in.

With negative polarity of the electrode more heat is applied to the workpiece; more spread is obtained in welding, and the hardening of the joint is smaller. It is advisable to use the negative polarity for difficult positions and for repairs.

With A. C. the effect is intermediate between that for the positive and negative polartity.

Photographs and material:
Courtesy, KNAPSACK-GRIESHEIM AG, werk Griesheim Autogen, Frankfurt (Main), West Germany.

New Rail Line in West Bengal

The Railway Board has ordered the final location survey for a 3.6 mile long broad gauge line between Tildanga and Farakka in West Bengal on the Northeast Frontier Railway. The Tildanga-Farakka connection would be a part of the Khajuriaghat-Malda rail project and it would reduce the distance from South Bengal to Malda and centres beyond in North Bengal and Assam by about 100 miles. It would also help in reducing congestion on the Eastern Railway main line to Howrah.

PIONEERS IN BRONZE WELDING

The Wide Application of "Sifbronze" Rods and Equipment

PIONEERS in the production of welding rods and fluxes, the Suffolk Iron Foundry (1920) Ltd., of Stowmarket, England, have been welding specialists for over forty years. The company has been exclusively concerned with gas welding, that is, the oxy-acetylene process, and has contributed to the general advances in quality and performance of almost every ferrous and non-ferrous welding rod for most commercial metals.

Its most outstanding contribution has been the development of the bronze rod, and, in this connection, it has introduced many new types which, apart from having vastly superior physical qualities, greatly simplify the actual welding operation. Universally known as "Sifbronze" welding, the process has the advantage of low temperature application (it is in the region of 750°C to 950°C) and can be used on all types of metals except aluminium at high welding, or brazing speeds, and with a minimum of distortion.

The primary techniques used with the oxy-acetylene processes are (a) fusion welding of all metals; (b) "Sifbronze" welding of all metals except aluminium; (c) brazing of steel and copper with "Sifbronze" and "Sifbronze" flux, and the brazing of aluminium with "Sifaluminium" rods and fluxes.

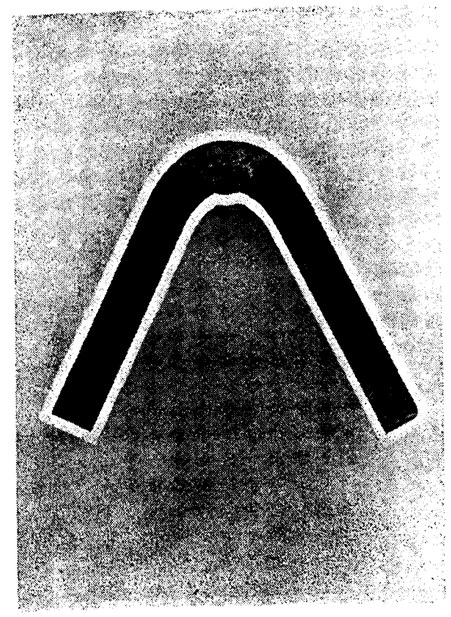
The Sifbronze range includes 33 different welding rods, and the latest additions are revolutionary in their class—namely Sifbronze 101 and Sifbronze 104.

The 101 process comprises a new Sifbronze filler rod and a new "tinning" flux which the Company has developed specifically for cast iron, and it produces joints infinitely superior to anything previously obtained. The old sluggishness of flow across the joint face has been completely eliminated and a far greater degree of "penetration" of bronze into the parent metal makes "peeling" of joints a thing of the past.

The application of the new rod and flux differs slightly from the orthodox method of operation.

It is first necessary to give the joint faces an initial tinning, and when this has been done, the standard Sifbronzing technique can be used to fill in the vee.

Process "101" can be used on all grades of cast iron, although it will be found that the greatest benefits from the technique are obtained with the ordinary grey variety of metal.



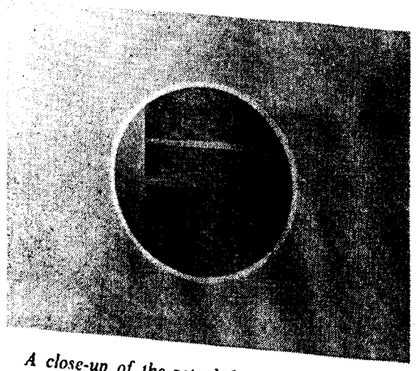
This M.S. test piece shows the ductility and toughness of Sifbronze "101". The piece was bent to an internal angle of 56° without sign of fracture.

There is no doubt that this new Sifbronze process gives a stronger joint than original cast iron.

The other new introduction, Sifbronze Process 104, has been effected to meet welding problems in shops where the accent is on continuous production.

These rods are of the same alloy as Sifbronze Rods 101, but are coated with a new kind of flux coating for continuous welding. The flux itself has a strong scavenging action on cast iron and malleable iron.

Sifbronze 104 Rods are ideal for continuous production in such industries as motors and aircraft, and all types of tubular structure such as bicycles and furniture.



A close-up of the actual fracture which is well clear of the weld.

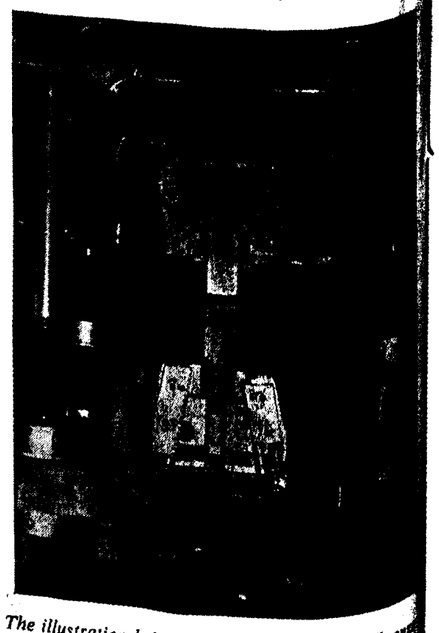
Research into rods and fluxes has also been accompanied by development of equipment. For instance, recent trends in the design of blowpipes of both the "injector" and "non-injector" type have been towards lightness in weight and ease of handling. To meet this demand, Suffolk Iron Foundry have produced the "Demon" blowpipe range which is now the leader in its field. An ultra-light pressure blowpipe of one-piece nozzle construction, it employs patented gas mixing devices which ensure correctly proportioned gas feeds and automatic inter-mixing of gases calculated to prevent flashback and backfire.

The "Demon" Cutting Blowpipe is designed on the injector principle, and its one-piece copper nozzle permits ready access to awkward places. The injector can be examined and cleaned in one minute, the weight of the tool is 3 lbs. 8 ozs., with an overall length of 21 inches and it has a cutting range of up to 10 inches.

In the fields of gas regulation, the Sifbronze regulator is furthering the case for single-stage gas pressure control. The special feature of this regulator is the easy replacement of both main valve and diaphragm—the only components likely to give trouble in operation. Maintenance costs are thus considerably reduced by the elimination of service exchanges.

Continuous research is confirming the view that, in the near future, there will be introduced new types bronze rods and fluxes which will give even g scope of application, strength and ductility. innovations will in turn widen the welding field, automatic and semi-automatic control being emp wherever possible. For instance, mechanisation been singularly successful in the case of modern frequency induction or electro-gas methods, ther oxy-acetylene processes are capable of still f expansion.

The immediate possibility of some other proc replacing gas welding in its fullest application se remote, as witness its growing use in the aircraft motor industries. The modern car, in fact, is per



The illustration below shows a high tensile Sifbronz C.I. test bar measuring approx. ½" × 1" × 8" bel pulled for tensile.

the best example of the advantages of welded cons tion. Practically every welding process employe one stage or another of its production, and the res graceful lines, roomier interior, increased ca loads, and higher speeds—is achieved without appreciable increase in size or rating of the power

Welding and Coach Construction

By Sri K. Swarup

Chief Mechanical Engineer, Integral Coach Factory, Perambur.

MAKING rail travel more and more comfortable and safe has been continuously receiving the attention of coach designers and builders. The conventional coach, with the wooden-body bolted on to the steel underframe, is by itself heavy and therefore leaves little room for increase in weight by way of additional amenities. Further the coach is susceptible to telescoping and the wooden body offers little protection in the case of accidents. An all-steel coach with the body welded on to the underframe, by virtue of its rigid structure offers resistance to telescoping and, being all welded, weighs less giving greater margin for the increase in weight by the provision of amenities. The all-steel, all-welded coach can, therefore, be said to be a great step forward in making rail travel safe and comfortable. Two conditions had to be fulfilled before the all-steel, all-welded coach became a reality and they were the development of satisfactory welding techniques for welding of highly stressed members, of different thicknesses, which go to make up a coach, and availability of steel of assured weldable quality. Hence if all-steel, all-welded light weight coaches are on the line today, it is primarily due to the rapid advancement made in welding techniques in the recent past.

As the quality of steel used is an important factor in the construction of all-welded coaches, a few details of the steel used will not be out of place. A low carbon and physical properties of the low alloy steel used in the I.C.F. for coach construction are as under :—

Chemical properties

Carbon	0.027%
Manganese	0. 25%
Phosphorus	0.013%
Sulphur	0.016%
Copper	0.2 — 0.25%

Physical properties

Minimum Tensile stress	23 tons/sq. in.
Yield point	19 -do-
Elongation	26%

The presence of copper provides inherent resistance to corrosion.

The different parts of a coach are fabricated in the form of sub-assemblies and minor assemblies before they are brought together to form the complete coach. Different kinds of welding are called for in the manufacture of coaches depending on the thickness of material used, and complexity of the item. The types of welding followed in the I. C. F. are as under :—

(a) Arc Welding

(b) Submerged Arc Welding—Automatic & Semi-automatic

(c) Resistance welding

(i) Seam welding

(ii) Spot welding

(iii) Flash butt welding.

(a) *Arc Welding*

D. C. welding sets are used in preference to transformer sets as the considerably reduced spattering gives a cleaner weld and makes for higher speed. The higher working speed assumes importance in view of the extensive welding that is involved in the manufacture. The loss of electrode by spattering is considerably less and the saving thus effected more than offsets the higher price of D. C. sets compared to transformer sets.

The other advantages of D. C. welding are :—

(1) *Safety*: Safer to work with, as the no load voltage is only between 25 and 40 as against 80–90 in transformer sets. As welding will be carried on in an all metal coach this aspect is all the more significant.

(2) Permits the use of a wide variety of electrodes.

(3) Striking an arc, particularly when using special type of electrodes and while doing vertical and

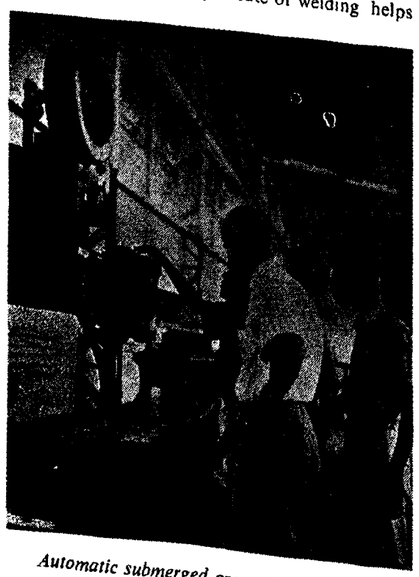
overhead welding is easier. Specially suited for welding thin sheets and executing short welds which necessitates striking an arc often.

(4) A steady supply of power with little fluctuation is obtained. The objection raised to D. C. welding because of its arc blowing effect is not of much significance, as the higher amperage at which the blowing effect takes place is seldom reached in work connected with coach construction

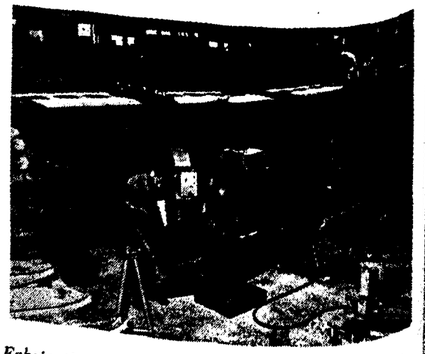
Electrode—As it is difficult to arrange for relieving of stresses after completing the coach, considerable care has to be bestowed in selecting the electrodes so as to ensure a minimum of residual stresses in the fabricated structure. Low hydrogen electrodes are used extensively to avoid hydrogen embrittlement.

(b) *Submerged Arc Welding—Automatic:* In Automatic Submerged Arc Welding, molten metal, from a continuous wire electrode, is deposited on the parent metal under a blanket of granular flux. The granular flux melts while welding, to form a slag and it has a triple function to perform. Firstly it acts as a heat insulator and concentrates the heat to the relatively small welding zone. Confining the heat to a narrow zone combined with the rapid rate of welding helps to minimise distortion and contractional stresses. Secondly it affords protection against the atmosphere and other gases. Thirdly it acts as a cleansing agent resulting in the weld metal being very clean and dense with good physical properties.

Fillet or butt welding of heavy members, i. e. plates upto a thickness of 5/8" is done in the Submerged Arc Welding machine. The equipment consists of a welding head on a self-propelled carriage, moving in a straight line on a cross beam with a fixture below for holding the work-piece The welding head performs the triple function of progressively depositing the flux along the joint to be welded, feeding the electrode to the welding zone and transmitting the current to the electrode. The electrode is kept at the correct distance from the work-piece by means of voltage relay. Welding speed of upto 30" per minute is obtainable in this machine. *Submerged Arc Welding—Semi-Automatic*—The principle of welding is the same as that of the automatic machine, but as the name implies the welding is controlled manually; the welding head being guided by hand. This method of welding can be used on curve joints and in places inaccessible to the automatic machine. The other advantage of this machine is that it is portable and can be taken to the work. Heavy sections such as bogie, side frame, headstock of underframe, bogie and body bolsters and end stanchions are fabricated by this process.



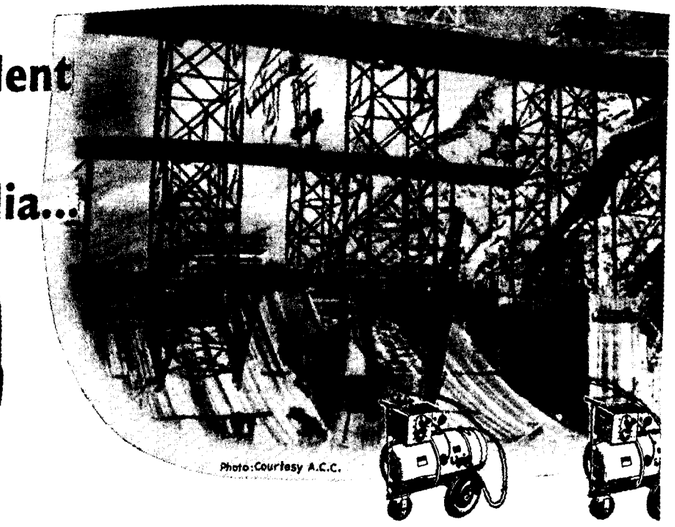
Automatic submerged arc welding machine in action.



Fabrication of bogie bolster by semi automatic submerged arc welding

(c) *Resistance Welding*—In this process, the two or more parts to be welded are joined together by the combined use of heat and pressure; the heat required for the weld being generated by the passage of a relatively short-time flow of low voltage high density

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electric current across the intended joint and the pressure being supplied by the contacting electrodes. The different types of resistance welding adopted in coach construction are:

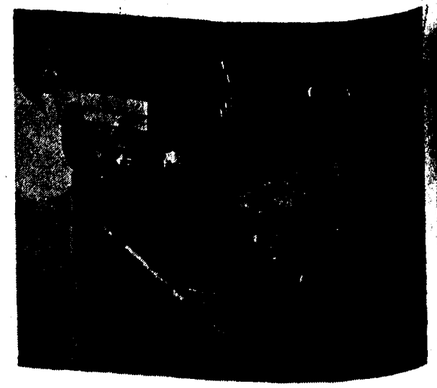
1. *Spot Welding*—In spot welding, the pressure built up by the electrode, the value of current and the time of current flow are important. Electronic controls are used to exactly control the time of current flow. The fixing of waist



Side wall being spot welded.

rails and pillars to side wall sheets, stiffeners to end panels and trough sections to floor, is done by single spot welding. As the sheets to be joined are thin and as with any other form of welding the sheets are likely ro be burnt, spot welding is resorted to for this work. The speed at which spot welding can be done can be appreciated from the fact that two pairs of spot welding machines working in unison, spot-weld 464′ of waist rails and 168 pillars to side wall sheets, totalling a length of 232′ in eight hours.

2. *Seam Welding*—The steel sheets that form the side wall panels, roof and end panels are butt welded by the same welding process. The principle involved in welding is the same as of spot welding, but the electrodes are replaced by rolls. As roller electrodes run from one end to



Seam welding of panel plates.

the other of the machine, a series of overlapping spot-welds being made along the joint. A steel foil is fed in above and below the joint ahead of the electrode rolls, the purpose being to increase the electrical contact resistance, produce a homogenous temperature zone at the place of contact and protect the hot surfaces from oxidation. A smooth and water-tight joint is obtained by this process and the rate of welding is also quite fast; as much as 15′ being covered in 2½ minutes.

3. *Flash butt welding*—In flash welding, the two parts to be welded are placed in an electric circuit opposite to each other and an electric potential is applied. A current of sufficient magnitude to cause a flashing action flows as the abutting surfaces are brought together. When sufficient flashing has occurred to heat the metal to welding temperature, the weld is



Brake pull rods being flash butt welded.

consummated by the application of upset pressure and the welding current cut off. Certain parts such as brake beam, pull rods etc. are welded by this process.

(d) *Expansion, Contraction and Distortion*—Welded structures are liable to have a number of defects but they can be controlled and kept to the minimum by using different types of jigs and fixtures according to the type of fabrication. *Control of Shrinkage*—Shrinkage due to welding may be controlled or reduced to a minimum by:—

1. employing closed root for joints,
2. reducing the number of welds,
3. keeping the size of welds to the smallest that meets the requirements of design, fabrication and service, and
4. using intermittent welds to the maximum extent.

Control of warpage—To prevent warping, a fixture may be used to hold down the parts or the product may be partly or completely assembled by tack welds. In case of thicker sections the parts to be welded can be deformed in the direction opposite to that in which warping would normally occur. This deformation can be brought about mechanically. With all these precautions, warping may occur but it can be set right by the application of heat. In the case of side walls, end walls spot heating is done with the aid of heating plates.

In coach construction more than 400 welding jigs are used for fabricating sub-assemblies and main assemblies. These jigs not only assure the correctness of the product to the drawing but also aid the increase in the rate of production.

(e) *Inspection*—For many types of welds reliance is placed principally on visual inspection. Even when radiographic methods are specified, visual inspection plays a large role in actual working. It is most extensively used because it is easy to apply, is quick, inexpensive and gives a good indication.

Testing—A percentage of the welded structures are subjected to non-destructive tests by radiographic methods and magnetic methods of weld inspection. Besides, destructive tests are also conducted. For each batch order, one test piece is manufactured and it is subjected to tensile, shear, crush, bend, impact, nick-break and hardness tests.

By taking all precautionary methods to obviate defects and carefully inspecting and testing the components, the quality of work is maintained at a high level so that, as mentioned at the commencement of the article, the comfort and safety of the travelling public can be ensured.

Self-Sufficiency in Signalling Equipment

The Railway Board has invited global offers from manufacturers of railway electrical signalling equipment for supply of certain specialised items as well as for development of manufacturing capacity for this equipment within this country.

The offer covers nearly 170 items including block instruments, signalling relay cables, relay interlocking panels, colour light signals and other ancillary equipment. The total value of the electrical equipment needed by the railways is in the neighbourhood of Rs. 2,00,00,000.

The manufacturers have been asked to submit offers in three parts: (1) items which are already being manufactured within the country and can be supplied indigenously; (2) items which can be assembled in India from imported parts; and (3) urgently required items which will be wholly imported.

A provision will also be made for the training of Indian railway personnel in the manufacture of this equipment by firms which are allotted contracts.

The second plan provides for an expenditure of Rs. 33 crores on vast expansion of signalling and telecommunication facilities on the Indian railways.

While the railways spent only Rs. 3.58 crores during 1957—58, expenditure in the following year nearly doubled, to Rs. 6.4 crores, and is expected to be over Rs. 10 crores in the current year.

While mechanical signalling requirements were of the order of Rs. 60 lakhs annually during the first Plan period, they are between Rs. 4 to 5 crores per annum in the current Plan.

There has been a marked increase in the indigenous production of this equipment, and the value of the indigenous production now comes up to about Rs. 4 crores annually.

The present global offer is intended to step up the manufacture of electrical signalling material within the country, if necessary with foreign collaboration.

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CONTRIBUTIONS are invited from the Engineering Profession in India and abroad in the form of original articles, research write-up, Summary of papers read before Technical institutions etc. relating to Civil, Electrical, Mechanical, Signal & Interlocking and Telecommunication Engineering sections and of particular interest to the Railway Engineers. Besides, suggestions for the technical improvement of various aspects of Railway Engineering Practice are also invited with suitable write-ups and photographs wherever possible.

Contributions are accepted on the distinct understanding that they are sent solely to the "Indian Railway Engineer". The Editor accepts no responsibility for the views and statements of the Contributors.

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EDITOR

AIR COMPRESSORS SUPPLEMENT

ROTARY COMPRESSORS FOR RAILWAYS

By C. H. Reymond

PRESSURE air and vacuum have become important factors of production in the modern industrial processes. An ever growing variety of machines, tools, apparatus etc. is being designed for pneumatical drive or control. This applies not only to manufacturing industries but also to associated technical undertakings such as e.g. the Railways. An increasing number of factories and workshops depend nowadays on a continuous supply of pressure air and/or vacuum. The compressors and vacuum pumps used for the purpose have, therefore, to be designed in such a way that high efficiency as well as absolute reliability are ensured during a continuous and long lasting service. Furthermore, low maintenance costs are required for an economical running of the installation. The user's requirements regarding pressure, vacuum, suction capacity and pureness of the air or gas to be handled being different from case to case, it is essential to plan pressure air and vacuum installations carefully according to the individual needs.

Appreciating the various advantages offered by Rotary Compressors and Vacuum Pumps, an increasing number of users in many countries, including India are now favouring this type of machine. Railways and their various technical services are continuously using pressure air and vacuum for many purposes. The Railways being among the most important public utility services, have to follow a progressive way in selecting the most efficient and modern equipment for their rolling stock and workshops. In pursuance of this general policy Railway Authorities and associated undertakings in India are now more and more taking advantage of the excellent performance and reliability of Rotary Compressors and Vacuum Pumps.

One of the most uptodate Compressor installation is supplying pressure air to the *Integral Coach Factory at Perambur*. The supply and erection of the compressor equipment was entrusted to Messrs. Swiss Locomotive & Machine Works, Winterthur, Switzerland, through their Branch Office in Bombay. Having acquired wide experience and excellent reputation as manufacturers of locomotives ever since their establishment in 1871, Messrs. SLM are of course well conversant with problems of production, service and maintenance of railway rolling stock. Since, furthermore, the manufacture of Rotary Compressors and Vacuum Pumps was taken up by SLM as early as 1915, this firm has widely contributed to the development and improvement of Rotary machines. While planning the Compressor station of the ICF, Perambur, the general requirements, necessary pressures, the fluctuating demand of pressure air as well as the location of the compressor room and the peculiarities of the factory had to be considered.

The installation having to operate fully automatically, the space available being limited and in order to reduce the receiver capacity to a strict minimum, selection of a rotary type of compressor was called for. This type offers considerable advantages, particularly in respect to automatic operation, continuous air flow, limited space required, light and small foundations.

The total requirement of the factory was estimated to 7100 cfm, out of which 47% for the smithy, 18% for the body & bogie shop, 10% for the sheet metal shop whereas the remaining 25% were to be distributed more or less equally between other sections such as assembly shop, fitter shop, machine shop, millwright/tool and die shop and window & prototype shop. The working pressures were estimated to range from 85 to 120 psig.

For economy's sake and flexibility in service, six SLM 2-stage Rotary Compressors, each with an actual suction capacity of free air of 1375 cfm. at 100 psig, running at a speed of 750 r.p.m., were selected. The twin first stages and a single second stage of the same size with mostly identical parts allow maximum interchangeability of spares. The Compressors are directly coupled to auto synchronous ASEA Motors placed between the Compressor stages. Auto synchronous motors were selected in order to improve the overall power factor of the factory. Each set is fitted with a double automatic governor, cutting automatically the supply of pressure air and switching off subsequently



the Electric motors when the required pressure is reached. Since the Compressors will automatically be put again into service only if the pressure decreases to a pre-set minimum, all the running sets are working at full capacity and maximum efficiency. The automatic equipment includes also the automatic cut-in and cut-out of the cooling water. Other main accessories of each compressor unit are the suction air filter, non-return valve, intercooler & aftercooler each with automatic condensate trap. A centrifugal condensate & oil separator is also fitted to each set, the extraction of condensated water being of particular importance in view of the rather humid climate in Madras.

The compact and robust design of *SLM-Rotary Compressors* offers some outstanding advantages which are highly appreciated by users :

1. *Continuous air flow* : On account of its rotary motion and multiple cells an uniformed flow of air (no impulses) is being supplied. Whereas in the case of reciprocating compressors an air receiver is required for equalizing the pressure fluctuation, it is sufficient to provide a rotary compressor installation with a pressure air vessel, if any, to meet the fluctuations of the consumption only, thus allowing to reduce the capacity of the receiver to a strict minimum. Due to the absence of pressure impulses the noise level of the machine is lower and no fatigue of the apparatus, fittings & pipe system will occur.

2. *No reciprocating motion* : It is evident from the engineering point of view that a purely rotary machine has a smoother running than a piston type compressor. The rotary motion being fully balanced, no vibrations are transmitted to the foundation which can, therefore, be made lighter, with a socket penetrating only a few feet into the ground. Furthermore, the lubrication problem are considerably simplified.

3. *Compact design* : The rotor runs smoothly in roller bearings and the elimination of delicate parts like stuffing boxes, valve springs, piston rings allow an absolutely safe running at a higher speed and, therefore, direct coupling to the prime mover. Furthermore, maintenance, and as well as possibilities of breakdowns are considerably reduced.

4. *Minimum of Wear* : Special wear preventing floating rings rotate in the casing with the blades thus absorbing their centrifugal forces and the automatic sight feed forced lubrication ensure continuous safe running without overhaul and a long life of the machine.

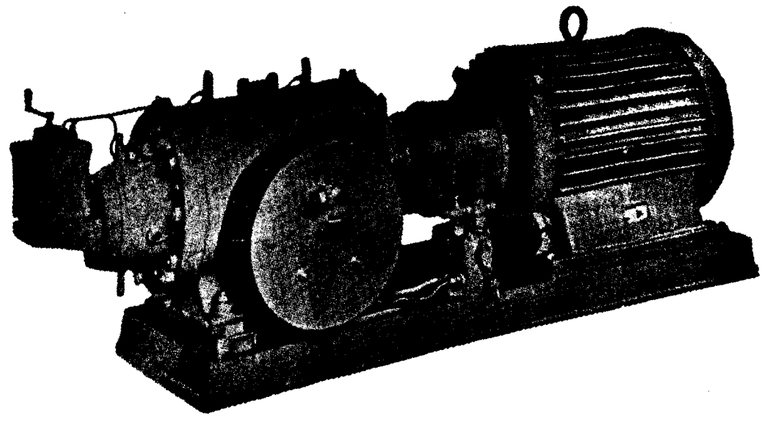
5. *Low running costs* : Whereas with the piston Compressor, the efficiency decreases with the wear lines

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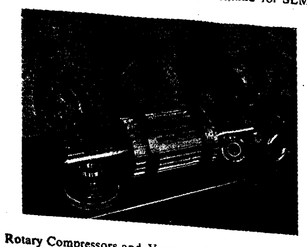
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pistons and piston rings, the efficiency of a rotary machine is not affected, as, even if a wear of the rotor blades occurs, the centrifugal force compensates it and the sealing with the casing remains perfect. Leakages are avoided by the special metallic glands which do not need any attention whatsoever.

Over 20,000 Rotary Compressors and Vacuum Pumps have so far been supplied by SLM. Due to the excellent results obtained all over the world and particularly also in this country, the demand for SLM



Rotary Compressors and Vacuum Pumps is steadily increasing. Fast industrial developments in India as well as restrictions on imports have induced SLM to consider the manufacture of their rotary compressors and vacuum pumps in this country. After due consideration of the problems involved, SLM entered into an agreement with Messrs. T. Maneklal Manufacturing Co. Ltd., Bombay, for the local manufacture of these products, which are now produced in India under the trade name SLM-MANEKLAL in close technical collaboration with SLM and under the supervision of SLM Works' specialists. Quality and high efficiency of the well-known SLM Rotary Compressors and Vacuum Pumps is thus being maintained for all locally manufactured items.

SLM BRAKE COMPRESSORS AND VACUUM PUMPS

An important contribution of SLM towards safety and reliable service of Railway rolling-stock are the Rotary SLM Brake Compressors and Vacuum Pumps, built for capacities of 24 to 106 cfm. at pressures of upto 115 psig. Although these items are not as yet being manufactured in India, it might be of interest to Railway engineers to learn that SLM Rotary Compressors and Vacuum Pumps are of the two stage type with forced air cooling, directly coupled to standard electric motors. Since over 25 years Swiss as well as foreign Railway companies have been using the highly reliable and efficient SLM Rotary Brake Compressors and Vacuum Pumps to their entire satisfaction.

PRESSURE BARS FOR SEWING MACHINES

It may be recalled that the Indian Standards Institution had undertaken the formulation of a series of Indian Standards for sewing machines and their components on the recommendations of the Tariff Commission and at the instance of the Development Commissioner, for Small Scale Industries, Ministry of Commerce and Industry. The series at present comprises the following Indian Standards:

IS : 1294—1958 Bobbins for Sewing Machines.
IS : 1295—1959 Needle Bars for Sewing Machines.
IS : 1296—1958 Pressure Feet for Sewing Machines.

Another standard in the series for Pressure Bars for Sewing Machines (IS: 1297—1959), has now been issued by the Institution.

This standard covers the requirements for pressure bars for sewing machines of the so-called household pattern.

***

VERTICAL TURBINE PUMPS FOR FRESH WATER

The Indian Standards Institution has drafted a standard for VERTICAL TURBINE PUMPS FOR CLEAR, COLD FRESH WATER [Doc: EDC 35 (446)], which covers the requirements for vertical turbine pumps (commonly known as 'bore hole pumps') for clear, cold fresh water. The standard is principally applicable to shaft type bore hole pumps, though a few sections, included in it, are also applicable to electric submersible pumps.

The standard is expected to provide guidance to manufacturers and users of such vertical turbine pumps. Its implementation requires manufacturers to make a number of changes in their existing manufacturing practices, which include length, wall thicknesses and pitch of threads of pipes. Before these changes could be brought out, procurement problems with particular reference to column pipes and shaft enclosing tubes have to be solved. Realising this, the standard has recommended a transitional period, upto 1 January 1961, for completing this change over in all details.

MACHINE TOOLS & PNEUMATIC TOOLS SUPPLEMENT

High-Speed Production of Non-Ferrous Components

Improvements in design of the Herbert No. 2 Flashcap Lathe to widen its field of application

THE Herbert No. 2 Flashcap Lathe has all the features essential to high production of brass and other non-ferrous components having internal or external threads, or both, necessitating frequent spindle reversals at high speeds. Its performance in the brass industry on work requiring up to six operations, in batches from 100 to continuous production with the same tooling set-up, has been outstanding as is evidenced by the hundreds of machines now in use. Greater accuracy and faster machining cycles are being obtained on work which had, prior to the installation of the Herbert Flashcap Lathe, been done in seconds.

A specially-designed motor control gear provided for instantaneous starting, stopping and reversing by a fluted handwheel and knob on the headstock and, in addition, automatic reverse and change to forward effected by movement of the capstan slide, when required. This automatic change of the direction of spindle rotation is effected by push-rods: a rod can be mounted above each face of the turret to actuate the spring-loaded plunger in the headstock to operate the motor switch. Thirty reversals per minute with the spindle running at 1,240 r. p. m. are permissible.

To widen even further the field of application of the Herbert No. 2 Flashcap, the lathe can now be fitted with :—

(a) Bar feeding arrangement with mechanism for automatic opening and closing of a dead-length bar chuck.

(b) Air-operated indexing two-jaw chuck that can be indexed without stopping the spindle.

(c) Automatic stopping of the spindle after completion of the cycle of operations.

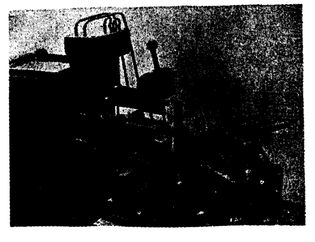
Most components produced on the Herbert No. 2 Flashcap Lathe are machined from hot brass pressings. Rough work material of this nature can be produced to very accurate limits, thereby eliminating a large amount of machining and, being much cleaner, is less destructive to the cutting tools, where homogeneity is essential for reasons of strength and pressure retention, hot pressings are preferable to castings.

There are, however, numerous simple concentric components which can, if machining capacity is available, be machined from the bar and thus reduce raw material costs. It is to meet this requirement that a bar feeding arrangement with fully-automatic chucking, has been designed for use on the Flashcap.

A standard Herbert weight-operated bar feed unit which accommodates bars up to 8'0" long, is used. The bar is inserted at the front of the swing-forward feed tube. The 1¼" capacity chuck is of the air-operated dead-length type which has been mounted with the air cylinder at the rear instead of above the chuck, so that it does not interfere with the standard automatic motor reversing controls and enables the automatic chuck closing and opening control to be fitted.

The dead-length bar chuck imparts no end movement to the work being gripped when the chuck is closed. It enables the full capacity of the machine spindle to be used as the closing mechanism is self-contained and no chuck tube is required. The chuck will accommodate variations in the diameter of the bar of about 0.003" at a given adjustment.

The automatic chuck opening and closing mechanism incorporates a combined operating lever and dead stop mounted on one face of the capstan photo-

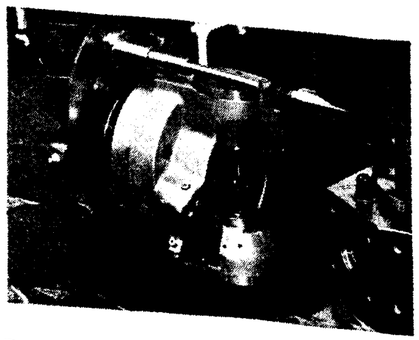


graph F. 20. Forward movement of the capstan slide brings the forward face of the swivelling lever A into contact with the push rod B which, through the air cylinder and yoke, actuates the closing sleeve which opens the chuck. The bar then moves forward under weight control until it contacts the dead stop C. In operation, contact is made during the forward movement of the capstan slide up to the slide stop, at which point the slide is stationary and the forward feed of the bar pushes the dead stop into its supporting bracket, a movement which swivels the lever A to contact the push rod B to operate the chuck closing mechanism. These combined movements can be set to ensure accurate feeding to length. It should also be appreciated that the chuck will remain open unless the feeding of the bar, as pre-set, is to the correct length.

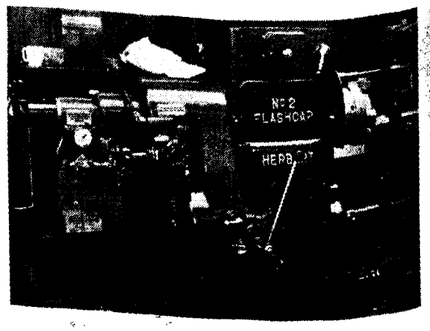
Separate chuck operating controls are also fitted: lever D is for hand-operation when setting-up whilst knob E provides for retaining the chuck in the open position for loading the bar.

Accurate repetition machining to length, essential when tapping blind holes or screwing up to a shoulder, is not affected by the virtually instantaneous reversal of the rotation of the spindle carrying bar stock which varies in weight due to the reduction in the bar length as components are machined.

Flashcap Lathes equipped with bar feeding are supplied with a fixed saddle having either a screw-or lever-operated cross slide, for parting-off or forming.



To reduce chucking times when machining multiple-end components such as elbows, tees and crosses, a new-type air-operated, two-jaw indexing chuck can now be fitted to the Flashcap, see photographs E720/1. Thus, only one chucking is necessary to machine all ends whether of similar or different size or form, and



machining can be continuous without stopping the spindle.

Since the chuck, to be known as the Quadra-chuck, can be indexed through 90° or 180° faster than the hexagon turret, it is advantageous, when all ends of the component require the same operations, to index the chuck and perform all operations with one face of the turret before indexing to the next turret face.

The fact that the capstan slide is withdrawn just sufficiently to clear the work to permit indexing, has a marked effect on the floor-to-floor times.

Closing of the chuck jaws is effected by a lever on the headstock. This lever controls a revolving air cylinder at the rear of the spindle and, through a draw tube and levers, actuates the self-contained hydraulic system in the body of the chuck.

The chuck jaws are mounted on the end of hydraulic cylinder pistons which permit their rotation, in addition to end movement for gripping.

A foot pedal controls the chuck indexing. Pressure on the pedal half indexes the jaws and removal of the foot from the pedal completes the 90° indexing and locking of the jaws. A 180° index is obtained by a double actuation of the foot pedal.

The tenon-located jaw blanks can be machined to suit the workpiece.

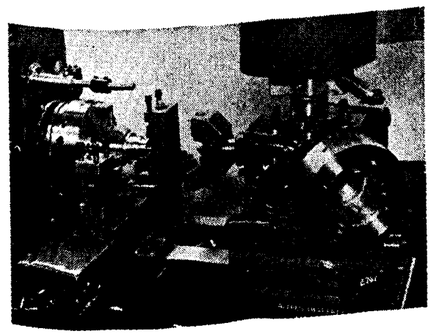
The chuck will accommodate work which can be indexed in a radius of 2½": the maximum jaw stroke is 3/8".

High-speed machining can best be maintained on the Herbert No. 2 Flashcap Lathe by the use of end tooling and, although the machine can be supplied

when required, with a cross slide, cross traverses should be avoided if possible: the same applies to work involving long traverses of the capstan slide, particularly for internal diameters which require machining from the solid.

A great deal of work which is being machined on the Flashcap Lathe today was originally considered unsuitable for the machine, but subsequent machining times amply justified its installation.



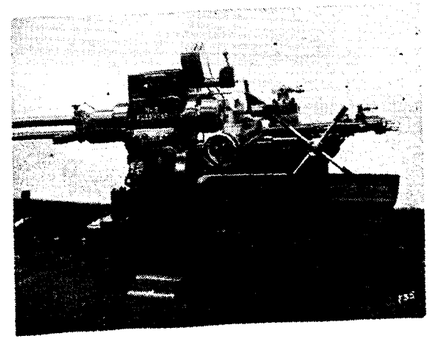


A good example is provided by the machining of the fire hose coupling shown in photographs E 740/1. Machined in two operations, the actual floor-to-floor times of 12 seconds (1st operation) and 25 seconds (2nd operation) are half the estimated times which were considerably less than the times taken with other methods.

This coupling is machined from brass pressings, in the following sequences:—

1st Operation, see E. 740.

(a) Grip the pressing in a Herbert 6" 3-jaw air-operated chuck, locating the flange against the face of the jaws.



(b) Support in the bore of the component with a roller mounted on a bar which also carries two cutting tools. All are held in a standard boring bar holder bolted to the 1st face of the turret.

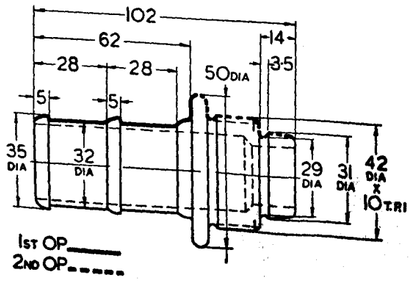
(c) Form two grooves behind the two 35 mm. diameters with tools held in the toolpost on the front of the cross slide.

(d) Whilst still supporting the component, a reverse transverse movement of the cross slide locates three cutting tools for profile turning the 32 mm. diameter stem and forming the radii on the stem and flange. Longitudinal movement to the profiling slide is actuated by the cam plate bolted between the boring bar holder and face of the turret. Traverse of the capstan slide pushes the profiling slide to turn the stem and the supporting roller further into the bore of the component until the two tools on the bar radius the end of the stem and chamfer the mouth of the bore.

Machine stops control the transverse movements of the lever-operated cross slide and the longitudinal movement of the capstan slide to ensure accurate repetition machining of diameters and lengths.

2nd Operation, see E. 741.

(e) Grip the stem of the coupling in a Herbert 6" 3-jaw air-operated chuck. The machined face of the flange is located against the face of the jaws.



DIMENSIONS IN MILLIMETRES

(f) Simultaneously turn the 42 mm. thread diameter, form the taper, radius the end and chamfer with the cluster tool holder on one face of the turret.

(g) Form the radius on the flange and undercut the thread diameter and undercut the thread diameter with the tool held in the rear toolpost on the cross slide.

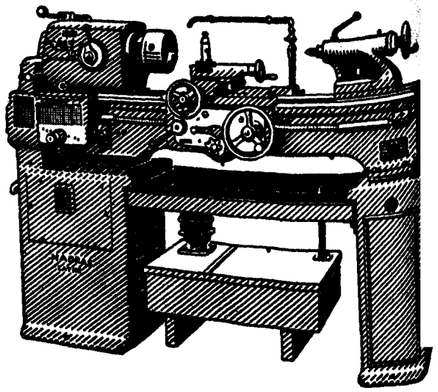
(h) Undercut the taper and chamfer the thread diameter from the front toolpost.

(m) Cut the 42 mm. × 10 t. p. i. thread with a Herbert 2½" Solid-adjustable Diehead fitted to the turret. The rotation of the spindle is automatically reversed by the push-rod motor control for withdrawal of the die-head.

FOUNDRY FACING MATERIALS

Foundry facing materials are used to prevent fusion of liquid metal with the sand at the mould or core face. They are applied as a thin coating, by spraying or painting in the form of a suspension, or by dusting or rubbing as dry powders. Graphite is one of the materials used for this purpose and with a view to covering the requirements for graphite, used as a facing material in foundry, the Indian Standards Institution has issued a Specification for Graphite for use as Foundry Facing Material (IS : 1305-1958).

STREAMLINED LOOK
BETTER PERFORMANC



Strikingly modern in design, MADRAS LATHES (Height of Centre 165 mm, admits between Centres 750 mm) have many up-to-date features which include eight spindle speeds ranging from 48 to 1000.

Precision-built with best quality material these GEARED HEAD lathes have unusual strength to render perfect service for many years of regular operation.

Ask for illustrated details - a study of its features will convince you that MADRAS LATHES are unbeatable in their group for target production.

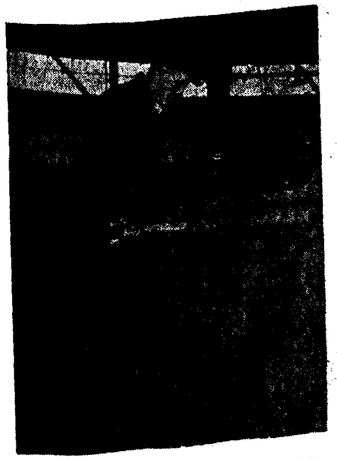
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Role of Armstrong Whitworth Pneumatic Tools in Railway Workshops

TO compile a list of tools for use in Locomotive, Carriage and Wagon Works would mean quoting almost every tool in the Armstrong Whitworth No. 53 Industrial Catalogue, as there is not a tool in the Industrial range for which a suitable 'Railway" application could not be found.

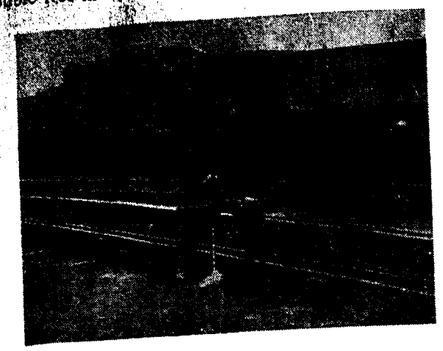
Armstrong Whitworth's experience in the design and manufacture of portable power tools ensures that each tool is built to the highest standards of engineering precision. The arduous conditions found in the Railway industries to which these tools have been supplied, have proved them to be robust in construction and trouble free in operation.



Thor/Armstrong Whitworth size 9300 Rivet Buster.



An Thor/Armstrong Whitworth size 5V Surface Grinder is used on the Horn Cheeks of a locomotive.



Drilling holes for Chair Screws with an Armstrong Whitworth Woodborer Size 362 RHW.

Armstrong Whitworth manufacture a complete range of reversible and non-reversible rotary air drills, from the 362 series with a capacity of 29/32" and 1", up to the 363 series with a capacity of 1¼", 1⅝" and 2". These drills can be used for drilling, reaming and tapping, or adapted for tube expanding and flue rolling. Also in this range is the 362 series woodborers, which have capacities up to 4"—tools of practical necessity in the construction and maintenance of the permanent way.

The Armstrong Whitworth Size 3RDC/35 panel saw is specifically designed and manufactured for repair work on Railway coaches, such as cutting out for patch-repairing panels in sheet metal, when they have become badly rusted. This tool is an ideal tool for fast accurate sawing of light timber, it has a 2½" diameter blade, is extremely powerful, and has a fixed Dead Handle for accurate manoeuvrability, whilst being perfectly safe by the provision of a fixed guard.

Armstrong Whitworth also manufacture a complete range of Rotary Air Impact Wrenches which have capabilities for nutsetting up to 1¼" capacity bolt diameter, and can be effectively used with available attachments for screwdriving, tapping, drilling, grinding, wire brushing, and sanding. The Sizes 48HG and 80 Impact Wrenches are particularly

Machineries for Railway Workshops

CHARLES Taylor (Birmingham) Ltd., Birmingham 5, England, who will be celebrating their Centenary next year, have always specialized in the manufacture of machinery for railway workshops. A large proportion of their manufacturer goes overseas and particularly to India for use in the Indian railway workshops.

Items of particular interest to the railways are capstan lathes, cutting off machines, duplex head milling machines and the famous Taylor chucks and machine vices.

CAPSTAN LATHES

Illustration No. 1494 shows the 1½" capacity capstan lathe which is one of a complete range. The lathe has a friction geared headstock and automatic feeds to the saddle and capstan slide. It has been designed for the rapid and accurate production of component parts in brass and steel from round and section bars. The machine incorporates high standards of quality and the ease and convenience of

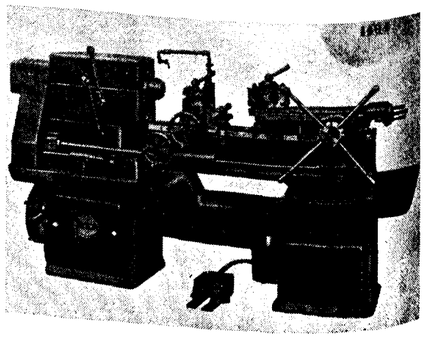


Illustration No. 1494

the operator have been studied throughout. This means that a high out-put can be obtained throughout the working day without undue fatigue. Moreover, due to the accurate stops provided for the different movements, this output is achieved without loss of quality.

The headstock is fitted with a double friction

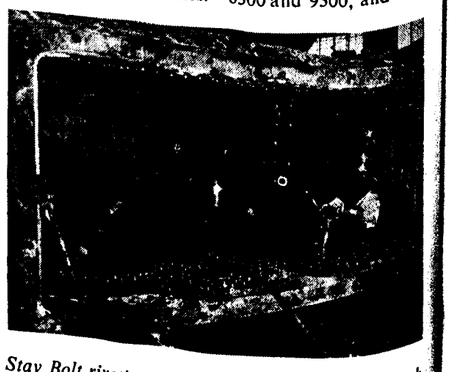
(Continued from page M.T.5)

suitable for heavy duty work, such as the removal or running down of nuts with bolt diameter up to 1¼".

The 5V Series Grinders are ideal tools for use in locomotive works for the grinding of horn cheeks. Their rugged construction and tremendous power make these tools first choice for cup wheel grinding. Their design includes a built in muffler which reduces the sound level to 1/6 of that of similar machines.

Armstrong Whitworth manufacture a complete range of Riveting Hammers which are ideal tools for locomotive works, for applications such as stay bolt riveting. The light riveting hammers sizes 76, 79, 712, 46 and 417, have capacities up to ⅝" Hot Rivets, and the Size 83S Close Quarter Riveting Hammer had a capacity of ¾" Hot Rivets. The range of long stroke Riveting Hammers covers Sizes 43, 53, 83 and 93 which have capacities up to 1¼".

Another tool suitable for Locomotive work is the Armstrong Whitworth Rivet Buster. This tool is manufactured in two Sizes. 6300 and 9300, and can be



Stay Bolt riveting in a Locomotive Fire Box with Armstrong Whitworth Size 406 Riveting Hammers.

used with a wide variety of Cutting Chisels and Knockout Punches.

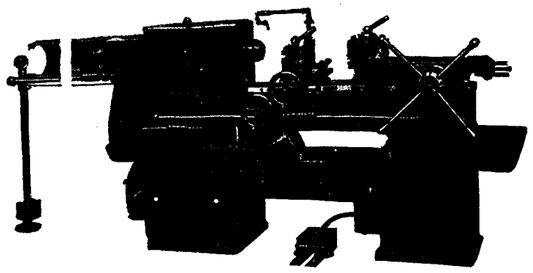
TAYLOR

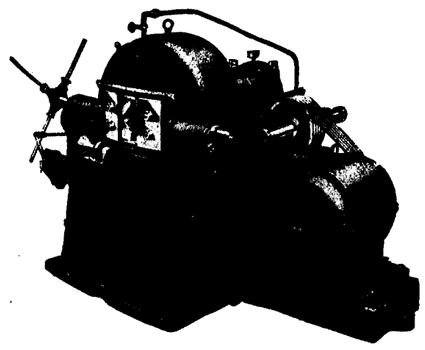
MACHINE TOOLS FOR THE RAILWAYS OF THE WORLD

CAPSTAN LATHES

A complete New Range with Bar Capacities from 12.7 M/M(½") to 38.1 M/M (1½")

Designed for simplicity of operation, ideal for unskilled or semi-skilled labour.





CUTTING-OFF MACHINES

The fastest Machines made for the heavier bars and tubes giving maximum production with cheap tool life.

SIMPLE TO OPERATE
EASY TO MAINTAIN
SPARES ALWAYS AVAILABLE

MADE IN TWO SIZES

For bars up to 114.29 M/M (4½") Dia.
or Tubes up to 168.27 M/M (6⅝") outside dia.

TAYLOR SELF CENTRING CHUCKS

The world famous chuck with all the working parts Hardened & Ground.

Every Chuck carries two years unconditional guarantee against breakage from any cause.



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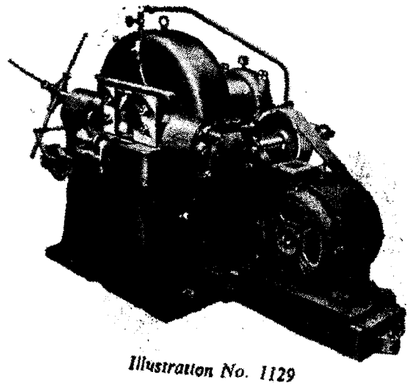


Illustration No. 1129

clutch which is operated by a lever mounted in a convenient position at the front of the headstock. On one side of the clutch the drive is transmitted direct to the spindle giving the fast speeds of 834, 500, and 300 RPM. On the other side it is transmitted through gears on an intermediate shaft giving 196, 118 and 70 RPM. The friction clutch is of the expanding type actuated by hardened steel toggles, and is adjustable for wear at all points. The collet mechanism is operated by a lever mounted on the front of the headstock. Where an air line is available, the collet mechanism can be arranged air operated.

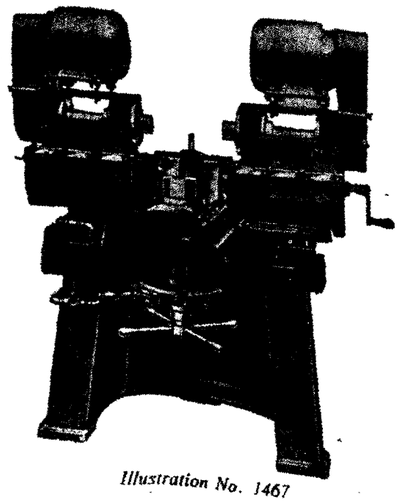


Illustration No. 1467

An electrical control panel gives complete protection to the motor and is enclosed in the right hand

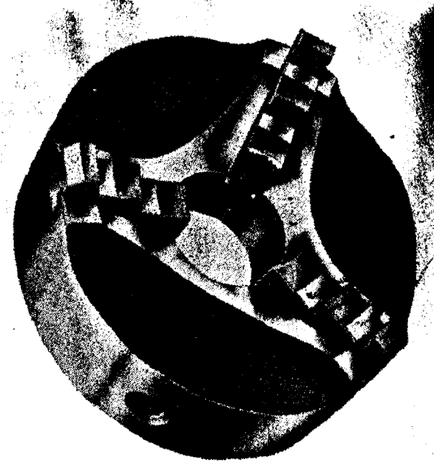


Fig. 1

pedestal, easily accessible for servicing. Two foot operated switches, one for forward and one for reverse are fitted and are used to speed up output by making use of the operators feet when his hands are productively engaged.

The lathe is now supplied fitted with an electrically operated bar feed for automatically feeding the bar

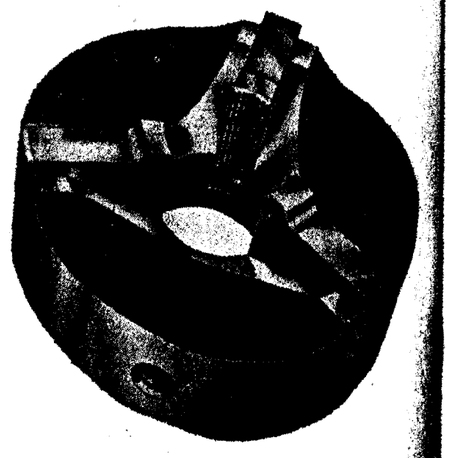


Fig. 2

through the collet. It is designed to accommodate nominal six foot length of bar but it can be supp

to take longer bars when required. The bar feed is fully automatic after loading and is simple and foolproof in operation.

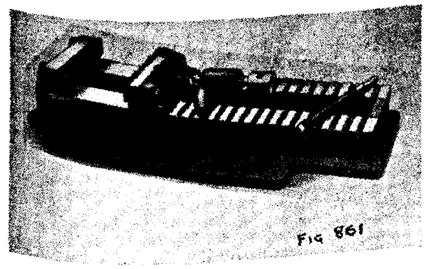


Fig. 861

This Company make a complete range of capstan lathe equipment and accessories and complete tooling can be supplied to suit Customers' components.

CUTTING OFF MACHINES

Railway workshops in particular require a fast machine for cutting off the large quantities of bars and tubes required in railway engineering. For this purpose the Taylor rotary cutting off machine range are ideally suited and many are sold yearly to the railways of the world. Illustration No. 1129 shows the largest of the range for the rapid cutting off of

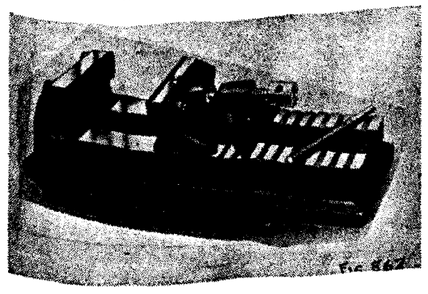


Fig. 862

bars from 2" to 4½" dia. or tubes from 3" to 6⅝" dia. On these machines the cutters revolve round the stock, which is held stationary in a vice, thus obviating all the unpleasant features of revolving long and heavy stock and facilitating moving up and re-gripping. As the cutters need not be stopped, the time lost between cutting off several pieces in succession is reduced to a minimum. The machine has power feed to the cutters and quick return of the cutters also by power. Speed, combined with clean cutting, is main feature of these machines and the following sample times will illustrate this point. Times quoted were actual cutting times taken in the workshops of our customers.

4½" mild steel bar	50 seconds.
4½" brass bar	35 seconds.
6" steel tube (5" bore)	45 seconds.
3½" copper tube (3" bore)	18 seconds.

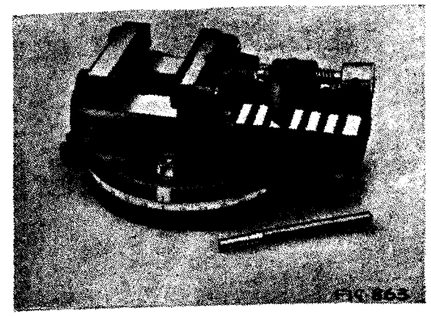


Fig. 863

The cutters give long life between re-grinds, are cheap to replace and easily re-ground on an ordinary grinding wheel to gauge supplied.

The vice takes all sizes of bar within the capacity of the machine without alteration. It is manually operated by the pilot wheel. Where an air line is available however, the vice can be supplied air operated when required.

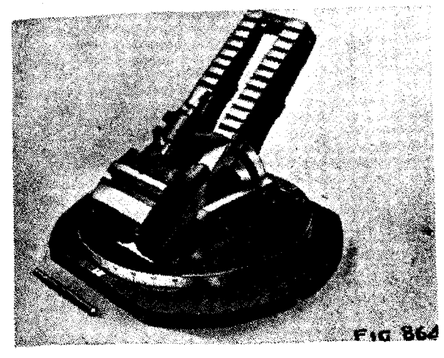


Fig. 864

DUPLEX HEAD MILLING MACHINE

It happens quite frequently in engineering practice that a certain component—usually a large one—has two faces of such characteristics that these can be milled simultaneously. When such circumstances arise, it is of inestimable benefit to production to have a machine with two milling heads. Illustration No. 1467 shows such a machine manufactured by this company. These machines are extensively used in railway workshops throughout the world for machining brass and Gun metal components. The headstock spindles run in adjustable taper and parallel roller bearings and the headstocks are independently controlled. This arrangement provides stability and true running and also enables any play which may develop after prolonged service to be taken up quite readily. Round fluted cutters with taper shanks are used secured by long bolts passing through the headstock to the back.

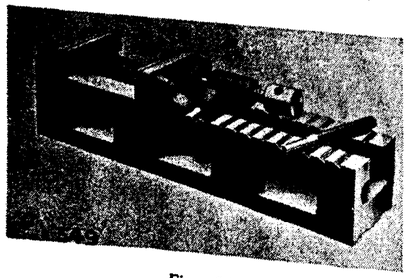


Fig. 549

A control lever enables the dividing fixture to be rotated rapidly for work presenting four, six or eight sides; rigid locking of the fixture in the required position being ensured by a return movement incorporated in the lever mechanism. Faults due to carelessness or lack of skill on the part of the operator are eliminated by adopting this system. The work is held and released by the pilot wheel underneath the fixture but this action can be supplied air operated if an air line is available.

TAYLOR SELF-CENTRING CHUCKS

With all the moving parts hardened and accurately ground, the Taylor chuck is made of high tensile cast iron and has its front face in the form of a hollow cone. This face is machined with ways in which the jaws can slide. The back of the chuck retains the internal working parts in position and also contains the recess for locating the adaptor. Hardened steel is used for the spiral which is ground true. It has teeth in the back and is revolved by means of any of the three pinions. The front face which has the shape of a hollow cone is cut with a spiral thread, which engages the teeth cut in the back of the jaws. Thus the jaws can be advanced or withdrawn simultaneously and will grip the work truly without resetting. Support is given to the jaws immediately behind and at right angles to the line of pressure caused by gripping the work, thus all stresses are taken by the hardened steel spiral and not by the chuck body. It is this construction, unique in chuck manufacture, that makes the Taylor chuck a real HEAVY DUTY chuck comparable in strength with any steel chuck of conventional design.

Two types of jaws are usually supplied with each chuck as shown in Figs. 1 and 2 but jaws for internal gripping can be supplied when required. For holding work of odd or irregular shape sets of soft jaw blanks are available which are interchangeable with the standard jaws. Their front portion is left soft so that they can be machined out to hold the work but the teeth at the back are hardened which ensures long service. The bevel pinions for revolving the spirals are of chrome molybdenum steel having teeth of particularly strong design. They are heat treated, ground and tested before assembly. Certain sizes of Taylor chucks can be supplied to suit direct mounting American type spindle noses of long taper and camlock design. We are also specialist for the mounting of chucks onto Herbert and Ward lathes.

TAYLOR MACHINE VICES

Charles Taylor (Birmingham) Ltd., were the original designers and patentees of the rack type machine vice and now make a range of over 20 types and sizes.

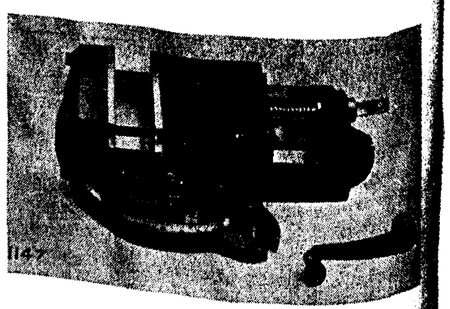


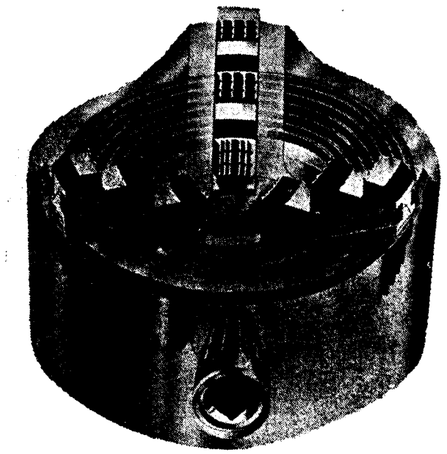
Fig. 1147

Here again, a unique feature is incorporated in the ... that the jaws are spring loaded. The ... of ... ch jaw is taper and rests against two springs and ... e jaw also stands on a spring. The result of this arrangement is that when the vice is tightened onto the work, the jaws move downwards taking the work with them. This pulls the work dead flat onto the base of the vice and eliminates all hammering and setting of the work. The loose jaw is free to swivel, enabling taper work to be held without slipping out laterally. The vice can be opened to its maximum position instantly and only hand pressure on the tolly lever is necessary to grip the work very tightly.

Illustrations show the following vices:—

Fig. 861, Standard machine vice.
Fig. 862, Special deep jaw machine vice.
Fig. 863, Swivel base machine vice.
Fig. 864, Universal swivel machine vice.
Fig. 549, Milling machine vice. Can be mounted on its side when required eliminating vertical head milling machine.
Fig. 1147, Toolmakers screw all the way machine vice mounted on swivel base. Can be supplied without swivel base if not required.

In conclusion we would advise that Messrs. Machine Tools (India) Ltd., of Calcutta, Bombay and Bangalore and Messrs. Alfred Herbert (India) Ltd., of Calcutta and Bombay are joint sole Agents for this Company in India. They will be pleased to give any further information required concerning the above products on request.



'Ghost' Photograph of Taylor Chuck.

COPPER-BASE ALLOY SAND CASTINGS

The Indian Standards Institution has published a number of standards on copper-base alloy ingots and castings. A few more standards are under preparation.

With a view to facilitating industrial inspection of these castings, the Institution has drafted an Indian Standard Recommended Procedure for Inspection of Copper-Base Alloy Sand Castings, [Doc: SMDC 11 (106)]. It is expected that when these procedures are adopted in industrial inspection of castings, maximum possible information on the properties of sand castings with minimum expenditure of materials and efforts could be obtained. Further, the recommended procedures are expected to assist both the designer and founder in improving the quality of castings.

The recommendations, which are not intended to be rigidly adhered to in all cases, indicate the significance and value of the various steps in the inspection procedures, and also give guidance to inspecting authorities on the most useful lines of inspection for various classes of castings.

The Institution has also issued the following two drafts relating to copper and copper alloys:

(i) Specification for Tin Bronze Ingots & Castings [Doc: SMDC 11 (116)]. This standard was first issued in 1951 as a tentative standard. The main modification made in this revision is to include sampling clauses for physical tests and provisions for some general requirements. One of the grades namely Grade 3, which is mainly used in Railways, has been omitted in this standard for inclusion in the specification for Railway Bronze Ingots and Castings which is also under wide circulation now.

The chemical composition of the other two grades of the material covered in this revision are modified so as not to allow any intentional adding of Nickel.

(ii) Specification for Solid Drawn Copper and Copper Alloy Tubes [Doc: SMDC 11 (117)]. This standard specifies the requirements for solid drawn copper and copper alloy tubes for use in the manufacture of condensers, evaporators, heaters and coolers.

Brief resume of "WRIGHT" Vertical Spindle—Horizontal Table-Surface Grinders

ONE of the main activities of Wright Electric Motors (Halifax) Limited over the past 15 years has been the manufacture of Vertical Spindle—Horizontal Table—Surface Grinders (British Patent No. 531, 584). Originally made in two sizes only, fitted with 8" diameter or 12" diameter cup-type grinding wheels, these machines have been generally adopted by a wide range of industries for roughing and finishing operations requiring a reasonable degree of accuracy and speed. We have actually supplied with our Table Surface Grinders, the following industries which have been selected at random from our records :—

Internal Combustion Engine Manufacturers and Repairers.

Agricultural Machinery Manufacturers and Repairers.

Engineering Works of all kinds.

Light Foundries, Ferrous and Non-Ferrous.

Aircraft Manufacturers and Repairers.

Dockyards and Shipbuilders.

Armament Manufacturers.

Navy, Army and Air Force Workshops.

Sheet Metal Works, Cabinet Makers, Welders.

Die Stamping and Metal Moulding Works.

Tool Makers.

Plastic Moulding Works.

Tile Works.

Electric Motor Manufacturers.

Switchgear Manufacturers.

Car and Cycle Manufacturers.

Makers of Electric and Gas Stoves.

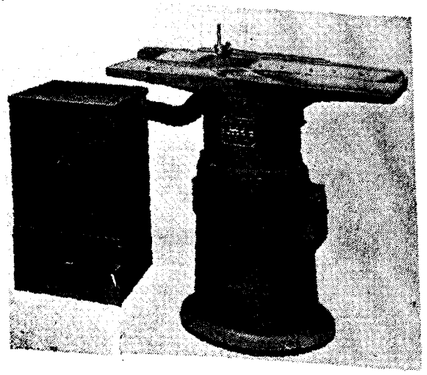
Railway Repair Works.

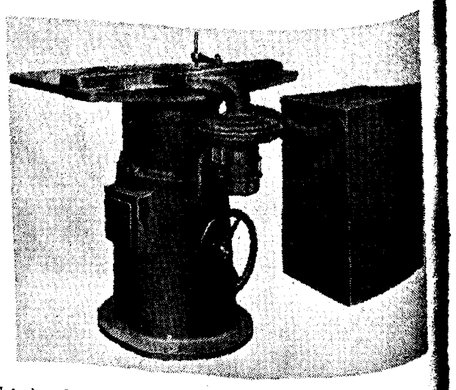
Car, Tractor and Lorry Repair Shops.

To meet a steadily increasing demand for machines which can easily be operated, also by female labour, and where adjustment of depth of cut and/or compensation for wheel wear can be obtained with the least effort, we have recently designed and developed new types of machines for which Provisional Patents have been registered under numbers 11957/54 and 31507/54.

Grinders are now made in six different sizes having grinding wheels of 8", 10", 12", 14", 16" and 20" diameter, all of which are available in pillar construction, whilst the 8" and 10" machines are also available as bench types.

"WRIGHT" Vertical Spindle—Horizontal Table—Surface Grinders, Models 54/8" and 54/10" have a





"WRIGHT" Model 54/Ex.12 Patent Table Surface Grinder fitted with dust extractor motor fan unit. Process dust discharge pipe leading into our No. 1 Dust Collector Unit.

WRIGHT

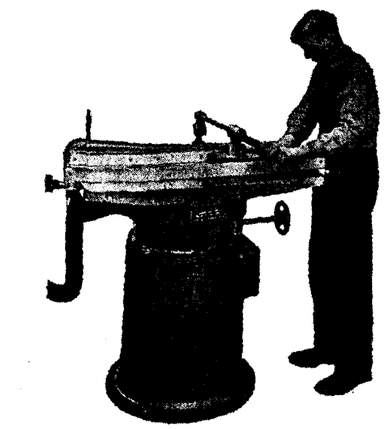
TABLE SURFACE GRINDERS

Covered by World Patents

Wheel Diameters from eight to twenty inches

The Ideal Machines for Roughing and Finishing Work in all Engineering Works and Foundries. Suitable for Metals, Alloys, Plastics, etc.

These Table Surface Grinders incorporate a unique and patented means of compensating for wear of grinding wheel and adjusting the depth of cut. The position of the grinding wheel in relation to the surface plate is adjusted by moving a handwheel conveniently placed on the base of the machine. A second handwheel locks the grinding wheel in the selected position.





- Simple to Operate
- Easily Adjusted
- Precision Built

Numerous machines have been installed in railway repair shops the world over

Sole Agents for India:

ALFRED HERBERT (India) PRIVATE LTD.

13/3, STRAND ROAD, CALCUTTA-1



"WRIGHT" Model 54/Ex. 12 Patent Table Surface Grinder fitted with Dust Extractor Motor Fan Unit. Process dust discharge pipe leading into our No. 1 dust collector unit. Illustration shows surface grinding of turbine components undertaken by girl labour.

cast iron rectangular working table, each provided with an insert plate and a wheel centre disc made of high tensile, wear resisting, hardened steel. The whole surface of the table is accurately machined and ground over. A guide fence is fitted, faced with a hardened steel strip, the body of the fence being of cast iron and arranged so that it acts as an exhaust hood, having cast—in ducts. A fan mounted on the motor shaft creates a vacuum below the grinding wheel and draws the process dust for discharge via a cooling baffle into the dust bag.

For grinding operations involving large quantities of process dust, we recommend the use of our No. 2 Self-contained motorised Dust Collector Unit having an 0.5 B. H. P. fan motor running at 2800 r. p. m.

The grinder body is of heavy cast iron construction, giving extreme rigidity. A swivelling truing block, to take a diamond-tipped wheel dresser is fitted. A cup-type grinding wheel is carried on a cast iron wheel hub, clamped with a steel plate screwed to hub. The wheel hub is keyed on to the tapered shaft extension of the driving motor and secured through a lock nut. Compensation for wheel wear and/or adjustment of depth of cut is obtained by vertical adjustment of the motor rotor by means of a handwheel through a pair of bevel gears, the rotor always remaining within the magnetic field of the stator. The whole rotating mechanism is dynamically balanced ensuring smooth and vibrationless operation.

The driving motor, forming an integral part of the grinder, is of the Totally Enclosed, dust proof type, of special design having high torque and low starting current features. The rotor shaft, made of high tensile steel, is fitted with deep groove single row ball-bearing at the top, and double purpose ball-bearing at the bottom end, both being stauffer lubricated. Continuously rated to B S. S. 168/1936 developing 1 B. H. P. at 3000 r. p. m. synchronous in connection with the 8" machines, whilst the 10" models are fitted with 1.5 B. H. P. motors.

The 12" models are of similar construction but the exhaust hood, having cast-in ducts, is provided with an outlet to which an independent motor-driven suction fan is connected. The latter draws the process dust and discharges it into a suitable receptacle. The fan motor (developing 0.25 B. H. P.—3000 r. p. m. synchronous) is wired to start up simultaneously with the main driving motor.

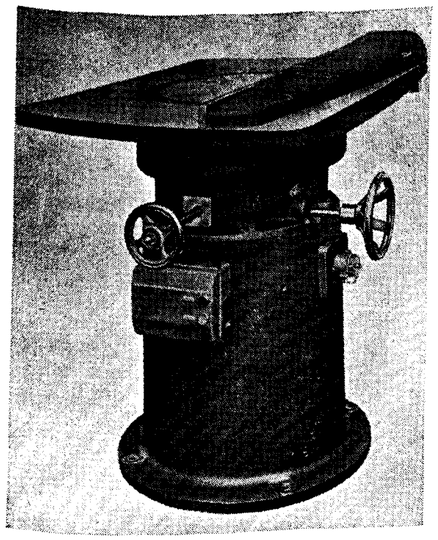
The driving motor, mounted vertically in the grinder casting, is of the Totally Enclosed, dust proof type, of special design having high torque and low starting current features. The rotor shaft, made of high tensile steel, is fitted with deep groove single row ball-bearing at the top, and double purpose ball-bearing at the bottom end, both being stauffer lubricated. Continuously rated to B. S. S. 168/1936 developing 3 B. H. P. at 1500 r. p. m. synchronous.

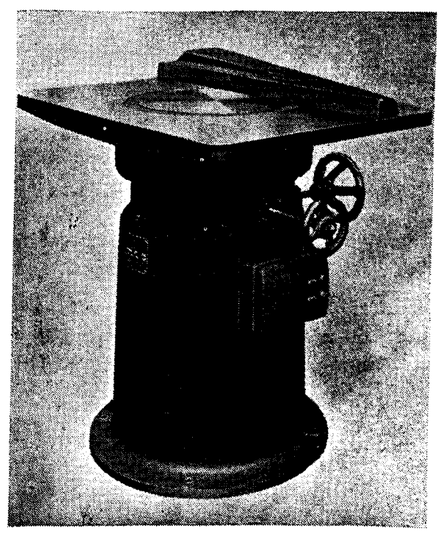
For A. C., 2 or 3 phase supply, an Inset pattern push button direct-on line starter is fitted in the base of the machine, and is provided with no-volt and overload releases.

For A. C., single phase supply, a hand operated graduated type starter is provided with no-volt and overload releases.

The 14" size, powered by a B. H. P. motor, can also be fitted with the independent motor-fan unit, but we recommend with this machine the use of our No. 2 Self-contained motorised Dust Collector Unit. For grinding operations involving large quantities of process dust, the No. 3 size extractor unit should be employed, this being similar in construction to the No. 2 size, but the fan in this case is driven by a 0.75 B. H. P. motor.

Designed for particularly heavy duty applications





The illustration shows a "WRIGHT" Model 55/20 Vertical Spindle Horizontal Table Surface Grinder, widely used for various surface grinding operations in Machine Shops, Tool Rooms, Assembly Lines, Factories etc. Available in Six different sizes from 8" up to 20" diameter wheels. Patents granted in all Principal countries.

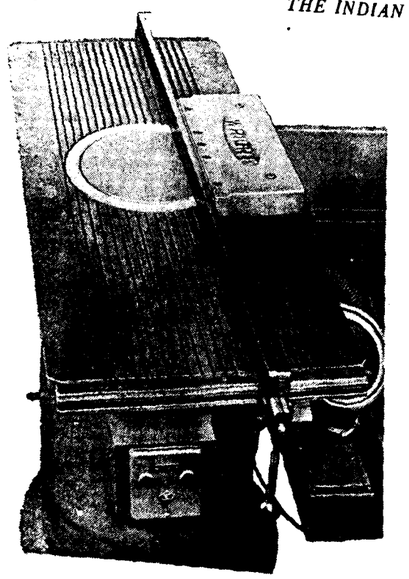
Models 55/16 and 55/20 have 16" diameter and 20" diameter cup-type grinding wheels respectively. These are carried on a cast iron wheel hub, spigotted on to the upper end of the rotating member of the vertically adjustable piston, the latter being of high tensile steel and carried in a double row angular contact bearing. Compensation for wheel wear and/or adjustment of depth of cut is controlled by operating a handwheel, which engages through gearing the vertically adjustable piston. Setting of depth of cut is maintained by means of a handwheel-operated locking device.

The 16" machine has a cast iron, rectangular box section table 38" in length by 23" wide, the 20" model table is 40" × 30". They are provided with an insert and wheel centre disc made of high tensile, wear resisting, hardened steel. The whole surface of the table is accurately machined and ground over. A guide fence is fitted, faced with a hardened-steel strip, the body of the fence being of cast iron and arranged so that it acts as an exhaust hood, having cast-in ducts for carrying dust to an outlet, to which a dust extracting system can be connected. The grinder body is of heavy cast iron construction to give extreme rigidity. The whole rotating mechanism is finely balanced to ensure smooth and vibrationless operation.

The 16" machine is driven by a Totally Enclosed motor, mounted vertically in a heavy base casting. The motor, which is of the squirrel cage type for A. C. supply, is of special design and incorporates high torque, low starting current features. Continuously rated to B. S. S. 168/1936 developing 5 B. H. P. at 1450 r. p. m.

Control is by an Inset pattern triple pole Air Break Contactor, push button operated, direct-on line starter with inherent no-volt release and three compensated thermal overload releases.

The motor powering the 20" model develops 7.5 B. H. P. at 960 r. p. m. and is controlled by a triple pole Air Break Contactor operated, automatic Star Delta starter with overload and no-volt releases, having "Start" and "Stop" buttons fitted. However, for installation in areas where electrical supply regulations permit direct-on line starting of 7.5 B. H. P. motors, this model could be fitted with an inset pattern triple pole Air Break Contactor, push button operated, direct-on line starter with inherent



" WRIGHT " Horizontal Table Surface Grinder—Model 57/MIC.12



The illustration shows a " WRIGHT " Model 57/MIC-EX.12 Horizontal Table Surface Grinder, on which a grey iron casting is being surface-ground and from which the Guide Fence and Wheel-Centreplate have been removed.

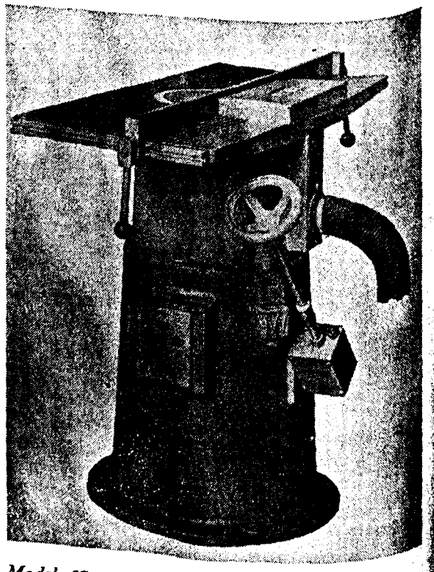
no-volt and three compensated thermal overload releases.

With all our grinders a parallel hand feed attachment, complete with workpiece adaptor can be supplied as an optional accessory if required, as well as diamond-tipped wheel dresser.

We stock spare grinding wheels in grits and grad to suit application. These are available as Categ A—Aluminium Oxide Abrasive, and Category C Silicon Carbide Abrasive.

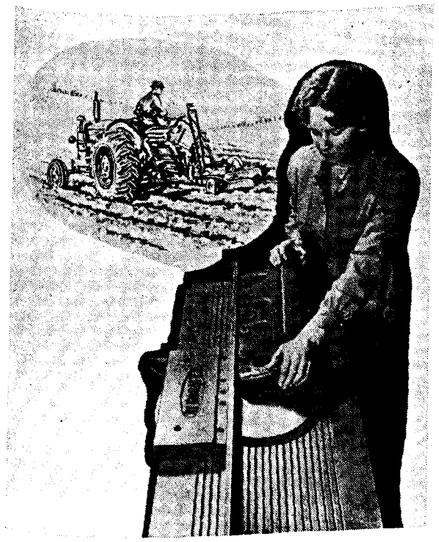
With the object of speedy production grinding "WRIGHTS" have recently developed a self-contained motorised Vertical Spindle Surface Grinding Head which can easily be adapted as a versatile attachment to Planing, Milling, Boring and Turning Machines.

The vertical spindle motor, developing 1 B. H. P. at 3000 r. p. m. synchronous for A. C. 2, or 3 phase 50 cycles supply, is of special design (Provisional Patent Register No. 11957/54), dust proof, Totally Enclosed, with triple pole "ON-OFF" rotary type starting switch fixed direct to shell. The rotor spindle, made of high tensile steel, is fitted with double row angular



Model 57 MIC - EX. 12 Table Surface Grinder fitted with fluted working table, adjustable guide rail and micrometer control for wheel adjustment.

(Depth of cut and compensation for wheel wear). Guide rail and wheel centre plate are removable to facilitate oscillating of warped or distorted workpieces, (For instance: Cylinder Heads), across the 12" diameter wheel. Provision is also made for connecting up to dust extracting equipment..



The illustration shows a " WRIGHT " Model 57/MIC14 Table Surface Grinder, indicating how very indispensable these machines are for quick and accurate re-conditioning of distorted or corroded engine blocks, cylinder heads, manifolds etc.

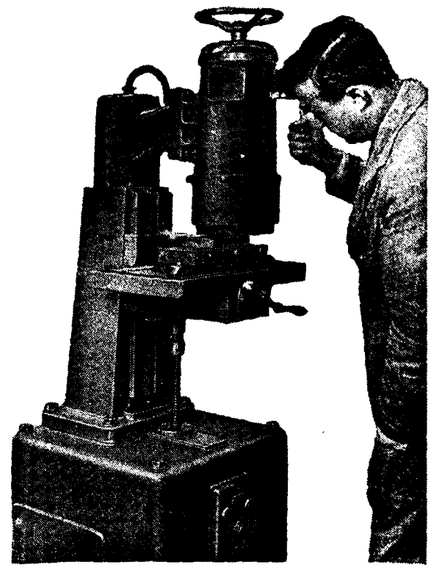
contact ball bearing at the top, and deep groove ball bearing at the bottom end.

A cup type grinding wheel of 8" outside diameter × 6½" inside diameter × 2" deep, (peripheral speed 5960 ft./min.) is clamped with a steel plate and screwed to cast iron wheel hub. The latter is keyed on to the tapered shaft extension of the driving motor and secured through a lock nut. Compensation for wheel wear and/or fine adjustment of depth of cut is obtained by vertical adjustment of the motor rotor by means of a spring-loaded handwheel positioned at the top of the motor, the handwheel engaging the Acme threaded top ball bearing housing. Below the handwheel is fixed an accurately calibrated scale ring and locking screw, for securing the vertical adjustment position.

Higher powered units up to and including 5 B. H. P., having correspondingly larger diameter grinding wheels, are being developed.

WRIGHT ELECTRIC MOTORS
SURFACE GRINDING MACHINES

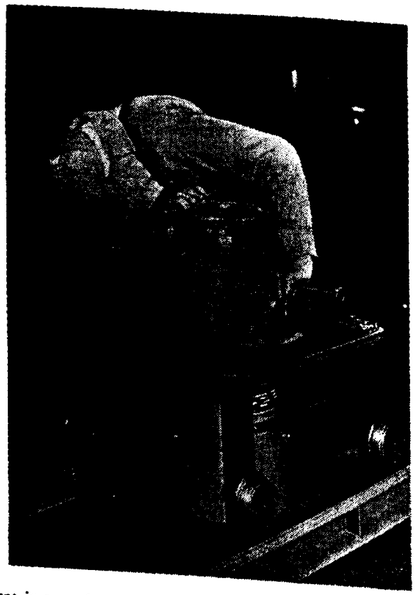
Wright Electric Motors (Halifax), Ltd., Pellon Lane, Halifax, have recently developed the type 58/V6 cross-swing, column mounted, surface grinding machine, shown in Fig. 1, for use in toolrooms and machine and assembly shops, for accurately grinding small components, such as dies, precision rings, and keys.



The Illustration shows the prototype of our recently designed and developed Model 58/V6 Column Mounted Cross-Swing Surface Grinder.
The motorised Grinding Head, developing 1.5 B.H.P. at 2900 R.P.M. is dust-proof, totally enclosed and fitted with heavy duty ball and angular contact bearings. Setting of depth-of-cut and compensation for wheel wear is obtained through lateral movement of the motor-rotor.

A box-section column, with vertical slideways, supports the work table, and is bolted to a cabinet base which forms a tool cupboard. The motorised grinding head is secured to a sleeve on the top of the column, which is fitted with high-precision taper roller bearings. Dry grinding is performed by swinging the head by hand in an arc over the table. Alternatively, the head can be locked in the central position and used in conjunction with an auxiliary compound table which provides for longitudinal feed of the work under the grinding wheel.

To enable wet grinding operations to be performed,

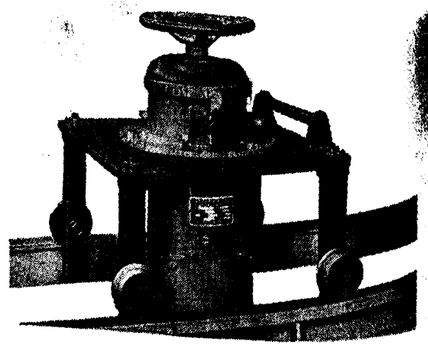


there is a coolant trough surrounding the work table, which has a T-slotted surface measuring 14¾ by 10 in. Vertical adjustment of the table is obtained by hand lever, gearing and screw, and the maximum distance from the grinding wheel to the surface is 10 in. The table can be locked to the vertical slideways in any desired position and, if desired, bellows can be fitted to protect the ways.

Motorised grinding heads are available for A. C. 2— or 3-phase, 50- or 60-cycle supply, and can be wound for any one standard voltage. The units are of the totally-enclosed, dustproof type and are fitted with heavy-duty, dual-purpose, angular contact ball bearings.

A handwheel at the top of the head provides compensation for wheel wear and a fine vertical feed, the maximum adjustment being 1¼ in. A scale-ring calibrated in increments of 0.001 in. is provided below the handwheel. Normally, the ring grinding wheel is of 6 in. diameter, 5 in. bore, and 1¼ in. thick, but, if increased work area coverage is required, an 8-in. diameter wheel of 7-in. bore can be employed. The floor space occupied by the machine is 22¼ by 19¼ in., and the approximate weight is 8 cwt.

Fig. 2 shows an interesting application of the self-contained motorised grinding head, which has hitherto been supplied as an attachment for use on heavy-duty



The Illustration shows a "WRIGHT" Model 2|2P Self-Contained Motorised Grinding Head, Flange Mounted into a four wheeled Bogie, running on Rails.



The Illustration shows a "WRIGHT" Model 1.5| 2P Self-Contained Motorised Grinding Head, Flange Mounted into a four-wheeled Bogie, running on Rails and in this instance being used for surface-truing of turbine foundations.

Photograph by courtesy of
Messrs. C. A. Parson & Co. Ltd., Newcastle-upon-Tyne.

lathes, also on planing, milling and boring and turn machines. The unit is shown in operation on building site, and is flange-mounted in a 4-whe bogie, arranged to run on rails, for surface grin large components which cannot be accommodate a conventional machine.

This grinding head is available in five sizes 4 h. p., at 3,000 r. p. m. synchronous. To enabl operator to control the wheel-working load, an amm can be fitted to the head. The rails are 3 by 2 in. channel sections, fitted with machined facing strips, are available in standard lengths of 3, 5, 7½ and 10

(Reprint from 'Machinery', 4th March, 1959

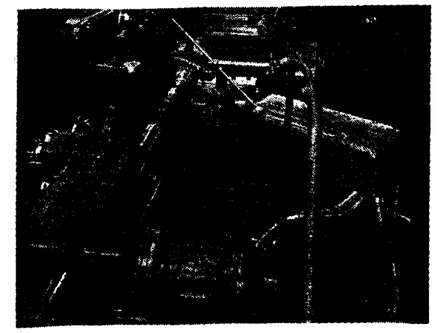
SCHAERER — Lathes

THE manufacturing programme of SCHAERER-Lathes includes Universal and Production Lathes for medium and high cutting capacities with centre heights varying between 220 and 560 mm.

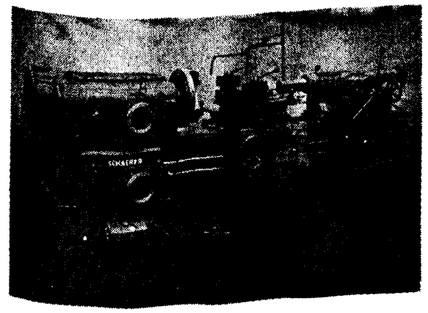
An outstanding feature of the SCHAERER-Lathe are the covered guideways of the carriage protected against grime and damage by their position and the unusually high driving power compared with height of centres.

Spindle speeds, feeds and threads can be pre-selected.

The exterior of the lathe is distinguished by the smooth and elegant design with only a few levers, what means easy operation.



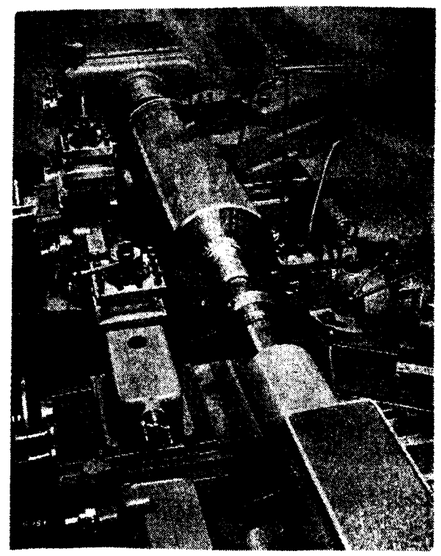
Schaerer – Lathe Type UD 500 with twin slide, with standard top slide at the front and copying slide at the back and with boring tailstock for simultaneous machining of parts by means of three cutting tools.



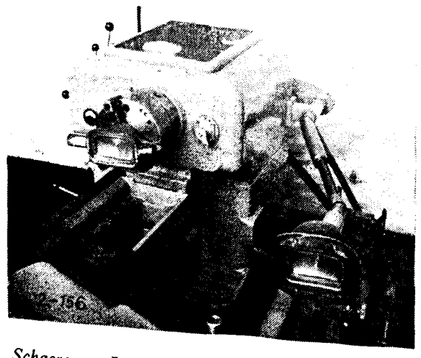
Schaerer – Lathe Type UD 630, equipped with twin slide, boring tailstock and air-chuck attachment.



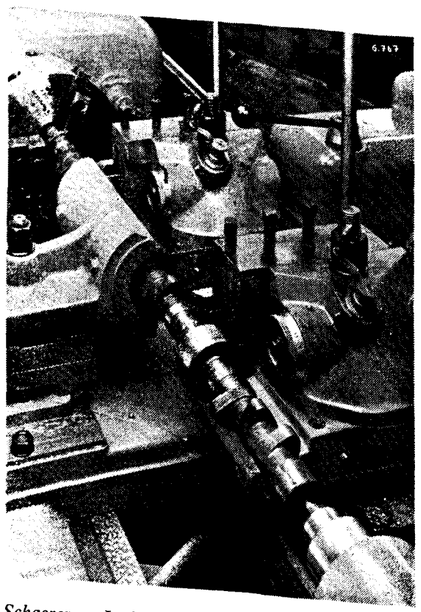
Schaerer – Lathe Type UD 800 with carriage type grinding attachment for machining of paper rolls.



Schaerer – Lathe Type UD 1000 with 2 bed carriages. Each carriage equipped with twin slide— standard top slide at the front and hydraulic copying equipment at the back — for simultaneous machining of the 2 pivots of the rolls.

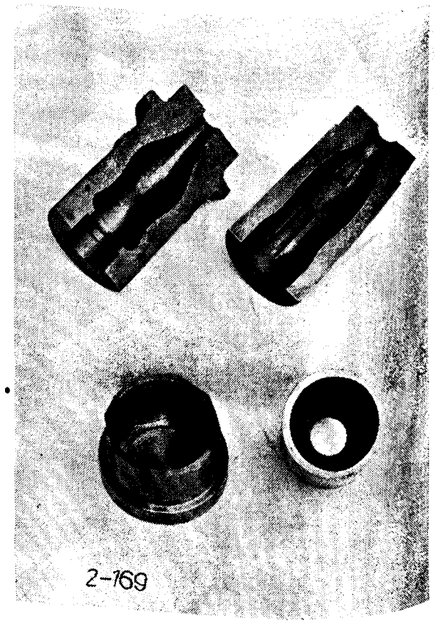


Schaerer — Lathe Type UD 500 with non-circular copying equipment for copying of polygonal glass moulds.



Schaerer — Lathe Type PD 630 equipped with two non-circular copying equipments for simultaneous copying of two cams.

All types of our programme can be equipped with a wide range of special attachments and are thus serving



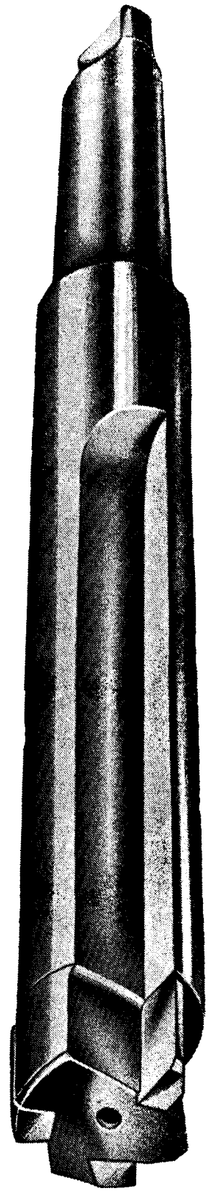
Glass moulds which have been machined by means of our non-circular copying equipment.

as universal lathes for usual works and for special turning problems of mass production.

Our hydraulic copying equipment " SCHAERER-PROFILE " demands special attention. This equipment is economical even for small series of copying work as production times are considerably lower than with the usual turning procedure. Copying times often can be considerably reduced by using the twin slide with the copying equipment as the use of the twin slide permits simultaneous machining of parts by means of two cutting tools.

A further speciality of the SCHAERER-Lathe is the non-circular copying procedure, i. e. the turning of working pieces with non-circular cross-sections, such as glass moulds, cams, control cams, and similar parts. For this purpose we are constructing universal and special lathes.

HIGH SPEED MACHINING OF HIGH ALLOY AND STAINLESS STEELS



BIRMINGHAM Tool & Gauge Co. Ltd., Birmingham, England, have advised us of a continued demand for the Gun Reamers which they have developed over the past two years, and introduced in 1958 for the reaming of high strength alloys.

These Gun Reamers now furnish a solution to the problem of producing holes to extremely exacting standards of size, ovality and finish.

The Reamer is manufactured from 4% Nickel-Chrome-Molybdenum Steel, Heat Treated to 100 ton tensile and is provided with a robust Tungsten Carbide cutting blade and Tungsten Carbide rubbing pads. These latter execute a buinishing action giving extremely high finish and permitting deep holes to be reamed without loss of alignment or size. The use of large carbide tips facilitates maintenance and reduces the tendency of the edge to chip when used on high tensile steels, a common source of trouble when using standard type reamers with their very fragile tips.

When used on High Tensile or Stainless Steels, Gun Reamers give production rates approximately 50/60 times greater than by normal methods of reaming whilst on non-ferrous materials rates 10/20 times faster can be achieved. They are truly end cutting and have no tendency to follow the drilled hole.

A range of B. T. G. Gun Reamers is available but they can also be supplied with Straight Shanks or to customers requirements, whilst intermediate sizes can be manufactured to any diameter or length.

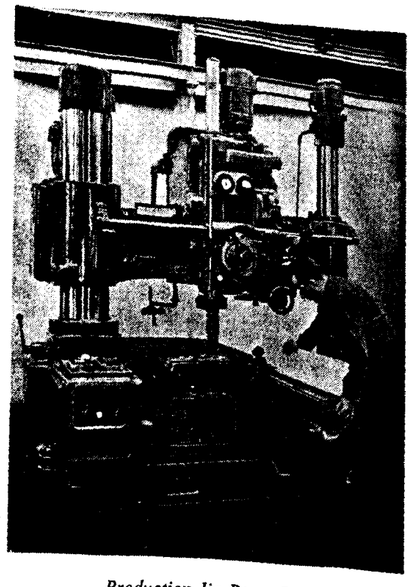
New Railway Lines

The Railway Board has approved of the construction of new railway lines at a cost of Rs. 4.2 crores in Bihar. The new lines will link Bakhtiarpur and Rajgir, covering 33 miles, and Ranchi and Hatia section in Chotanagpur where the heavy machinery plant of the Government of India is being built. Necessary steps have already been taken by the Eastern Railway to start construction of these new lines. The Bakhtiarpur and Rajgir link will, obviously, render greater facilities to tourists who visit Nalanda, Rajgir, etc. It will also serve the subdivisional town of Bihar sharif in Patna district.

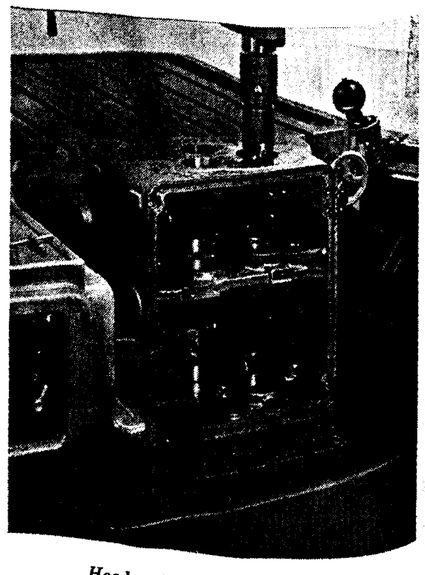
Boring more Accurate and Faster

THE frame type production jig borers introduced by OERLIKON MACHINE TOOL WORKS BUEHRLE & CO. SWITZERLAND are being employed with advantage in various branches of the engineering industry for carrying out multiple boring operations with a high degree of precision on workpieces required either singly or in batches. They do an excellent job in manufacturing a great variety of precision parts as for example in a railway repair shop. There, such a machine dispenses with jigs and costly fixtures, and does all the work with standard tools and simple clamping. Three sizes of machines are available, and the smallest, designated type R2, is shown in the figure. It has a 900 mm by 1000 mm table and the co-ordinate setting capacity is 1080 mm by 650 mm. The type R3 borer has a 1130 mm by 1200 mm table, and a co-ordinate range of 1200 by 720 mm and on the largest machine, type RE3S the table measures 1255 mm by 1425 mm, and the co-ordinate range with the auxiliary table comprehends 1200 by 1350 mm. The latter machine is intended particularly for handling bulky workpieces.

The drilling capacity is 55 mm dia. with a feed of 0.8 mm for the type R2, and 70 mm dia. with a feed of 0.73 mm per revolution for R3 and RE3S. Eighteen spindle speeds, in a wide range, are provided, and there are 12 boring and drilling feeds, and three reaming feeds. Co-ordinate setting of the table and the spindle head along the arm are made, to an accuracy of 0.01 mm with reference to gauge rods and dial gauges. Alternatively, optically precision scales can be fitted. To speed up repetition work there is together with the optical setting, a positioning equipment available. The types R2 and R3 are also equipped with a table feed gear box to permit light precision milling operations. Three examples, selected from the wide range of work now being carried out, afford an indication of the production capabilities of these Oerlikon jig borers. The machining times given, it may be noted, are based on cutting speeds of 15 to 21 m/min for high speed steel tools, and 65 to 95 m/min for carbide tiped tools. Feed rates range from 0.1 to 0.3 mm per spindle revolution. The example below shows a housing for the headstock in cast iron for the Oerlikon lathe DEO. In the section view, bores and faces machined are shown by heavy lines. This job has been done mainly with standard boring tools and therefore low cost of tooling. For a batch of 50



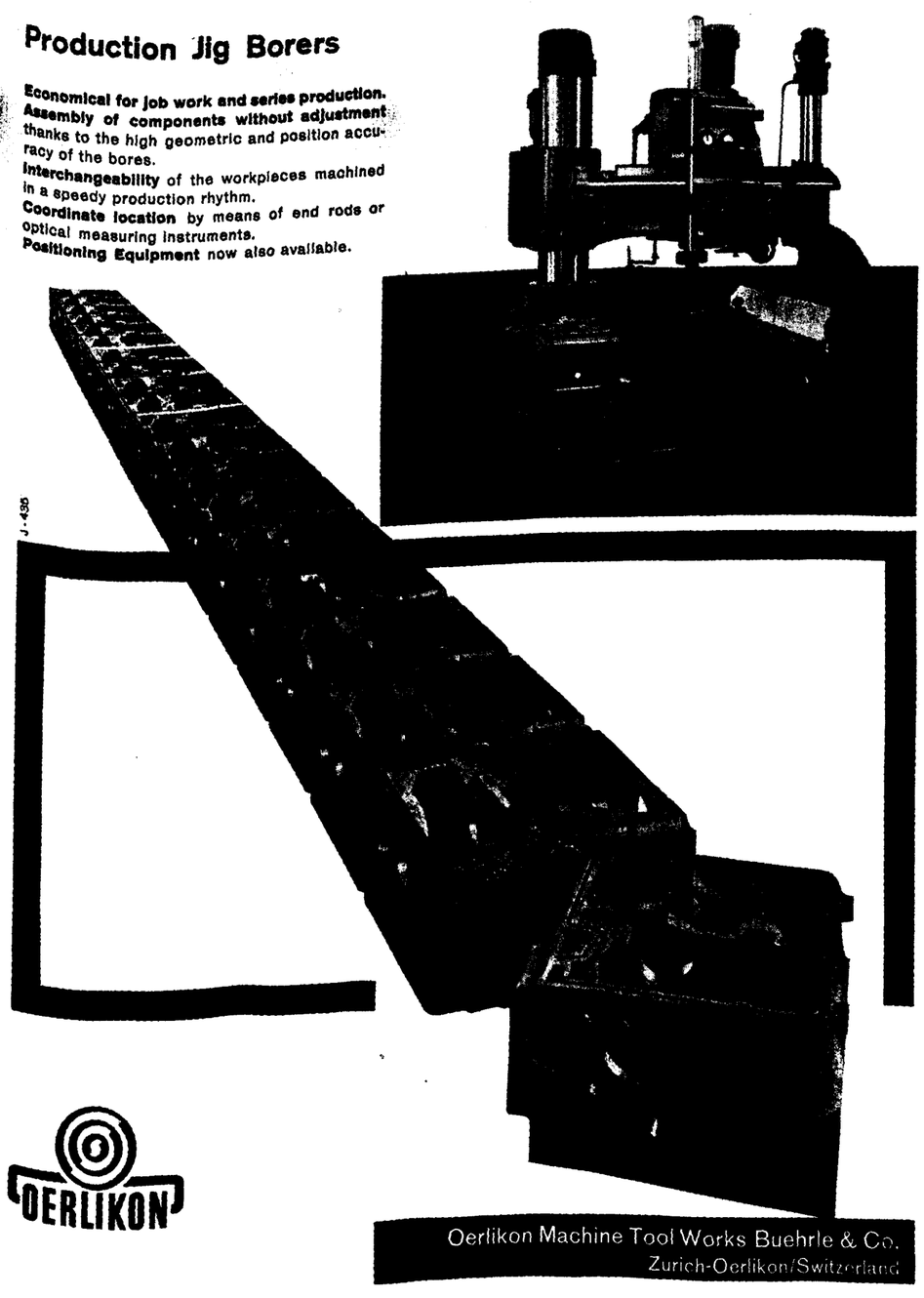
Production Jig Borer R2.



Headstock Lathe Type DEO.

Production Jig Borers

Economical for job work and series production.
Assembly of components without adjustment thanks to the high geometric and position accuracy of the bores.
Interchangeability of the workpieces machined in a speedy production rhythm.
Coordinate location by means of end rods or optical measuring instruments.
Positioning Equipment now also available.

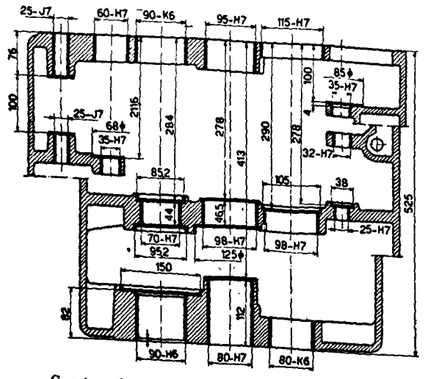


J-436

OERLIKON

Oerlikon Machine Tool Works Buehrle & Co.
Zurich-Oerlikon/Switzerland

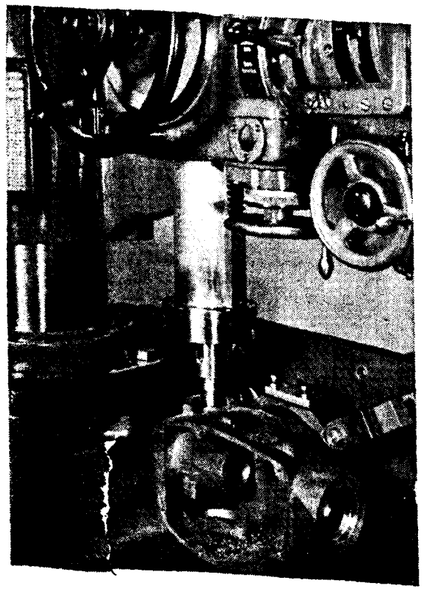
castings, the required time per casting was 73 min. for roughing 222 min. for finishing, representing a total floor-to-floor time of 295 min.



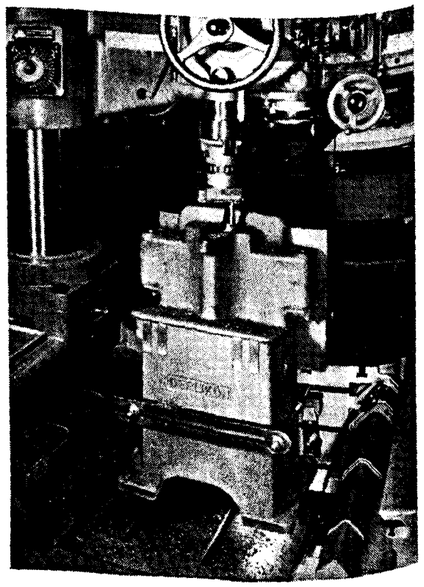
Section through headstock of Lathe DEO

The following two photos show further pieces machined on those machines with equally advantageous results.

To take full advantage of such a machine, however, a complete range of boring, fine boring, face turning, recessing, tapping and thread cutting tools are necessary. Circular table angle-plates and indexing attachment allow even tricky work to be machined with favourable times.



Spindle Housing for Universal Drilling Machine UB2.



Machine Base for Profil Cutter Grinder FS21.

THE POSITIONING EQUIPMENT FOR OERLIKON JIG BORERS

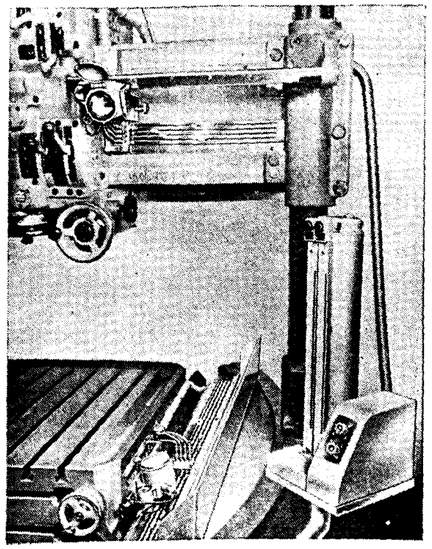
The table and quillhead are each provided, parallel to their traverse direction, with a bar carrying four slots for the dogs representing the co-ordinate dimensions. Each dog slot refers to a feeler and is alternatively brought into relation with a Solex gauge by means of selector knob, one for the table and one for the quillhead, so that every co-ordinate can alternatively be set on any dog slot.

While traversing the table of the quillhead for setting to the desired co-ordinate, a dog is slipped along. The co-ordinate is set by the optical device and thereafter recorded by accurately adjusting the dogs under the feeler with the help of a simple device. The Solex gauge indicates the position of the dog. For the further components of the batch, the table and the quillhead are each positioned to the recorded

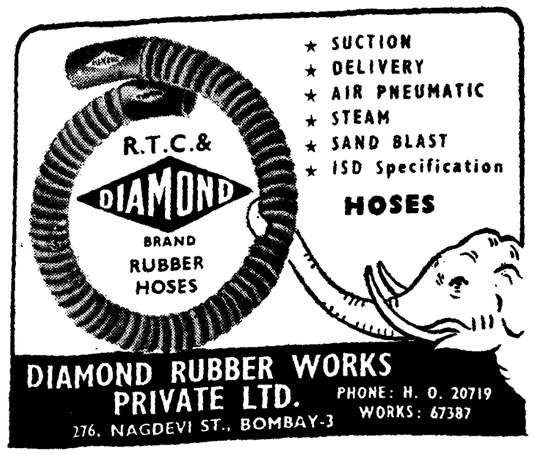
co-ordinates without the help of the optical reading device. By actuating the motor switch (short-stop motor) the table is traversed until the reference edge of the particular feeler is brought on the locating edge of the desired dog. Thereafter, by fine adjusting the table, the water column of the Solex gauge is brought to the gauging level, thus setting the co-ordinate. Positioning the quillhead is carried out analogously. Rough setting is thereby performed through the quick-traverse handwheel. This positioning method is characterised by its speed and simplicity. Since four stop rows are available, an extensively large number of co-ordinates can be set.

The feeler bracket and the optical instrument of the table and quillhead are mounted on a slide that can be adjusted by means of a screw to ± 7.5 mm for zero-point displacement.

If you need any further information about this jig-borers or other OERLIKON machines please contact our representative in this country—Francis Klein, Royal Exchange Place, *Calcutta*.



Positioning Device with Solex Air Gauge.



The 'PEARSON' Electro-Hydraulic Machine Tools

FOR Railway Workshops, Shipyards and Plate Fabricating shops, the versatility, precision and ease of working of the 'PEARSON' Guillotine Shears and Flanging Presses has to be seen to be fully appreciated.

All 'PEARSON" machines are of welded steel construction of ample strength and ruggedly conceived with a long life of hard work in view.

GUILLOTINE SHEARS

Among the several distinguishing features of the shears, the top blade carrier is perhaps one of the most outstanding.

PEARSON

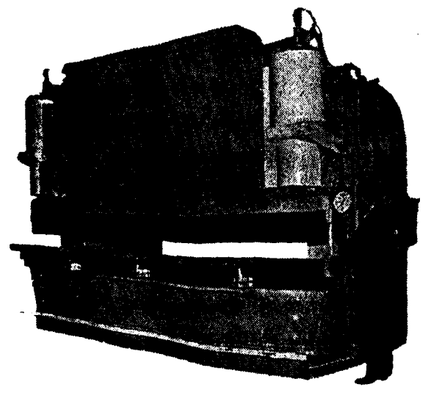
ELECTRO-HYDRAULIC MACHINE TOOLS

GUILLOTINE RANGE – 6'-0" x ¼" TO 12'-0" x 1"

The Guillotine shears are powerful sturdily built machines with the accuracy and delicacy of control of precision instruments.

Their unique design reduces maintenance and wear to a minimum and their sensitive variable pressure pumps ensure long life to the blades.

The Pearson flanging presses or press brakes are ideal companions for the shears. Their ease and completeness of control gives an operator absolute mastery over his machine. In both the presses and shears the top moving beam returns to its 'up' position immediately the control pedal is released. An automatically controlled valve maintains the pressure beam parallel with the bottom tool or at a pre-determined inclination for fade out work.
Full pressure is available throughout the stroke.



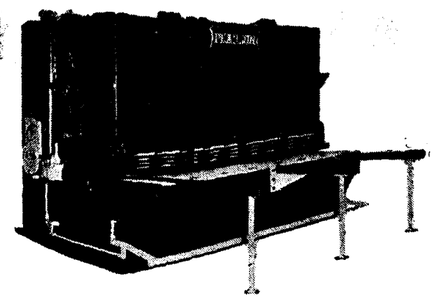
FLANGING PRESS RANGE – 75 TONS TO 1000 TONS

Write for catalogues

PEARSON MACHINE TOOL Co. LTD.

WALKER · NEWCASTLE UPON TYNE · ENGLAND

Cablegrams: PRESHEAR NEWCASTLE UPON TYNE



The top blade is mounted on a swinging arm which is pivoted on two large self-aligning roller bearings which control the movement of the blade with an accuracy and rigidity not possible with any other form of guide.

This precision of blade control permits of the blade gap being set at the minimum, and when desired, the one setting can be used for the full range of plate thicknesses within the capacity of the machine.

Blade gap adjustment however is provided on all machines. On the heavier machines—$\frac{5}{8}$" to 1" capacity—the simple operation of moving an indicator to the thickness of plate to be cut automatically adjusts the blade gap to the standard 5% of the plate thickness.

The reduction of wear and maintenance to an absolute minimum is another great advantage of this method of guiding the top blade over orthodox sliding type guides.

The overall simplicity of the machines is another impressive feature.

The Hydraulic system of the shears is comprised of a multi-cylinder, variable pressure, radial type pump, driven by a directly coupled electric motor, a control valve, a safety valve, holding down Jacks and two Main Cylinders.

The Return or lifting movement is operated by one or two hydraulic rams powered by a Hydro-Pneumatic Accumulator which is entirely independent of the main system.

This independence of the Return stroke has several advantages, one of which is the immediate automatic return to the 'Up' and safe position of the Top blade at any moment the operator lifts his foot from the operating pedal, or the power fails due to a fault either in the electric or Hydraulic systems.

It follows from the foregoing remarks that unless required, it is never necessary for the stroke to traverse the full length of the blades.

Pieces can be cut from a 1" wide strip using no more stroke than is necessary to complete the parting off. This constitutes a great saving in time and power.

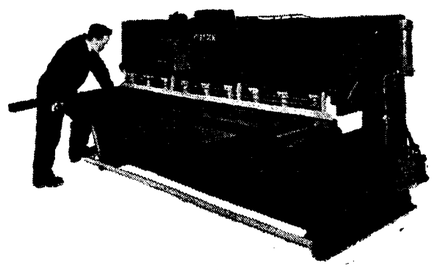
The facility to stop the cut at any pre-selected point enables strips to be cut from the edge of plates longer than the machine by using it scissors fashion, stopping the cut before the end of the stroke and then moving the plate along ready for another cut.

The Pump has been described as a multi-cylinder, radial, variable pressure type. It has been designed to supply a large volume of oil at low pressure to operate the Jacks and for the quick approach of the blade and immediately upon the blade making contact with the work, the pressure rises instantly to that required to shear the plate.

Another advantage derived from the use of the 'PEARSON' variable pressure, variable volume pump is found particularly in the heavy machines, when cutting thin or narrow plate. As the volume produced is in inverse ratio to the pressure developed, the speed of cut is boosted when cutting thin plate, because of the greater volume being supplied due to the lower pressure required.

It follows also that when cutting narrow plate the operational speed is increased due to the shorter cut which these versatile machines are able to make.

The Control and Distribution Valve has three hydraulically balanced valve spindles. The centre



one, controlled by the operator, directs the flow of oil to the second spindle which is automatic in action, directing the oil first to the Holding Down Jacks at low pressure, and when they have a firm grip of the plate, locks them in position and automatically diverts the flow of oil to the Main Cylinders for the shearing stroke. Should the operator fail to release the foot or control pedal at the end of the stroke, the Top blade carrier automatically brings the third valve spindle into operation, which cuts off the flow of oil to the Main Cylinders and causes it to circulate freely from the pump through the third spindle or 'cut-out' valve, directly back into the reservoir.

The blade will remain in the Down position so long as the control pedal is kept depressed.

The safety valve is a simple spring loaded balanced type valve which is set at the Works to afford protection to the whole machine, Hydraulic system, Structure and Blades.

The Main Cylinders and Rams are housed in the fabric of the end frames and are set tangentially to the arc of motion of the Top blade carrier, and by direct thrust give full effect to the power available.

The Holding Down Jacks are individual in operation, i. e. each Jack can accommodate a plate thickness different from that of its neighbour with equal and uniform pressure which makes it possible to hold securely an uneven or wavy plate.

Cutting to a line is facilitated by the provision of Shadow Line Lighting as standard equipment.

Backstops, either manually or power operated are supplied as extras.

The manually operated backstop has a scale incorporated in the fitting at the rear of the machine.

The power operated backstop is push button controlled from the front of the machine and is equipped with an indicator registering in inches to two places of decimals.

The standard electrical equipment is for 400/440-volts, 3-phase, 50-cycle A. C. supply, controlled by a star-delta starter, with cartridge type fuses and isolation switch.

Non-standard equipment can be supplied to meet special requirements.

The 'PEARSON' Guillotine shears are made in a comprehensive range of sizes from 6′ 0″ × ⅜″ to 12′ 0″ × 1″.

FLANGING PRESSES

The 'PEARSON' Presses have the same basic characteristics as the 'PEARSON' shears, being simple in design, robust in construction, accurate and efficient in performance.

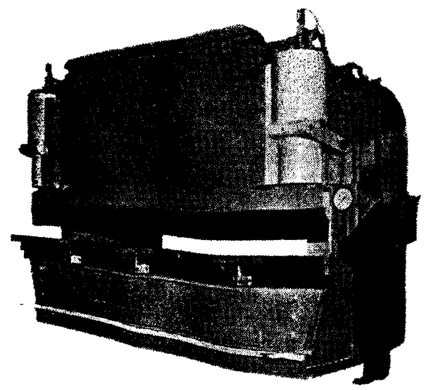
The Main Frames of the machines are fabricated from high grade rolled steel.

The Hydraulic system is very similar to that of the shears.

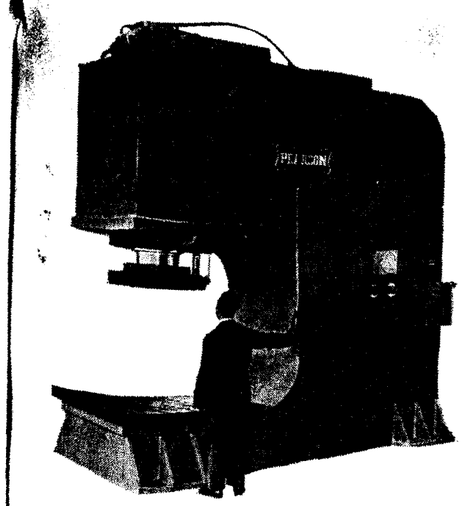
The Pump develops two pressures; low for the fast approach of the pressure beam, and high for the actual pressing operation. The high pressure is available whenever required, throughout the entire stroke, if the work in hand demands it.

The Control Valve of the presses has two balanced valve spindles. One spindle under the control of the operator governs the functioning of the machine. The other spindle is the Equalising valve which automatically controls the flow of oil to the two main cylinders maintaining an equal movement of the two main rams to produce a resultant parallelism in the pressure beam.

A Pressure Regulating Valve is provided to enable the operator to pre-select the pressure most suitable to



450 Ton Press. 14′-6″ OB



the work in hand and so prevent damage or distortion of plates by excessive power.

Set at the highest pressure, this valve still constitutes a safety valve affording protection to the whole machine, Hydraulic system and Structure, making overloading virtually impossible.

The Main Cylinders are each mounted on the front edge of a side housing, being so designed that the Pressing load is taken on the centre line of the housing, thereby avoiding eccentric loading of the structure.

The independent closed Hydro-Pneumatic system for the Return or Lifting stroke gives the same facility and ease of working as obtained with the Shears.

The downward stroke can be ended at any point of its travel and immediately the control pedal is released, the pressure beam returns to the 'Up' position.

The standard range of sizes is from 75-tons × 8′ 0″ to 1,000-tons × 17′ 6″.

OPEN FRONT GAP PRESSES

The 'PEARSON' Gap Presses constitute a very useful range of General Purpose machines.

They also are fabricated in the robust 'PEARSON' fashion and can be relied upon to give a lifetime's yeoman service.

Basically, the Hydraulic system is the same as in the other two types of 'PEARSON' machines.

The sizes in this range are from 75-tons to 500-tons.

In the three ranges of machines, there are new sizes constantly being added to the standard lists.

DIESELIZATION OF RAILWAYS

At present 135 Broad Gauge, 25 Metre Gauge and 8 Narrow Gauge diesel locomotives were in operation on different services on the Indian railways, said Shri S. V. Ramaswamy, Deputy Minister of Railways, in a written reply to a question by Shri Ram Krishna Gupta in the Lok Sabha.

The Deputy Minister added that 11 Broad Gauge main line diesels were now in the process of being received and would work on the Eastern Railway and on the steel belt area of the South Eastern Railway. Seven more B. G. diesel shunters of 650 h. p. had been ordered on M/s. MAK, Germany, on March 11 this year.

*** *** ***

RAILWAY FREIGHT FOR MANGANESE ORE

Shri S. V. Ramaswamy, Deputy Minister of Railways, told Shri Vidya Charan Shukla, during question hour in the Lok Sabha that no decision had been taken on the question of reduction in the railway freight for manganese ore. The Deputy Minister added that the time that was being taken was due to the delay on the part of certain mining and trading interests to furnish factual information as to the cost of production and to afford facilities for a general verification of the correctness of such figures of cost as were furnished by them.

SHIBAURA-BERTHIEZ Vertical Boring and Turning Mill (Tyre Boring Machine)

GENERAL

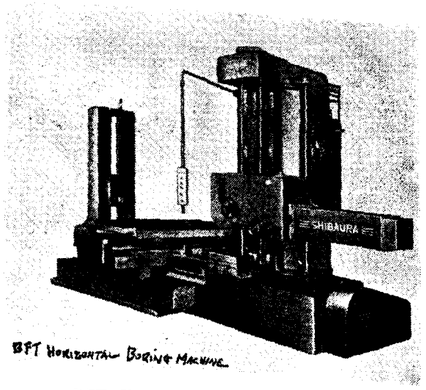
WE can see various kinds of machines and equipments being employed in a railway factory in general. Most factories in Japan are using home made machines.

In order to manufacture Loco-Tyre and Axle Box we emphatically recommend Berthiez's TBJ type Vertical Boring and Turning Mill specified for this purpose.

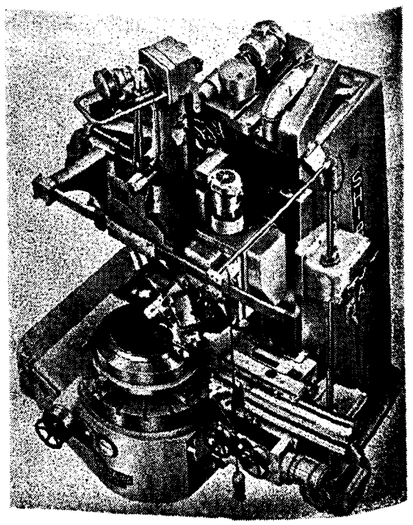
Under license Shibaura Machine Works, Tokyo, Japan is manufacturing the "Shibaura-Berthiez" machines of 3 different sizes of table diameter viz, 1000 mm, 1250 mm and 1500 mm for markets in Japan, Tailand, Philippines, Indonesia, Burma, Korea and Formosa, while the market in India belongs to Ste Ame des Ancience Ets CHARLES BERTHIEZ, 5 Rue Montalivet Paris 8e, France.

THE (3) SPECIFIED MODELS FOR SIZED WORKPIECE

The cross-slide is molded into the block of the column. There also are three different kinds of model by the heights up to the surface of the cross-rail table. The reason of these specified models is that the cross-rail will not be required to be movable when the workpiece is limited in size. Especially for Loco-Tyre of small in height, the low type machine is most preferable.



BFT Horizontal Boring Machine.



Shibaura-Berthiez Vertical Boring and Turning Mill.

There is no side-head but the tool-head mounted on the cross-rail — the saddle traverses horizontally while the Ram moves up and down. As the tool head, either turret head or square ram head can be employed either of which can swivel 450 mm on both sides.

VERSATILE SPEED RANGE

From the same principle as the cross-rail, the table plate has a speed range over four kinds—low, medium, high and super—which is selective according to quality of the workpiece. For Loco-Tyre which diameter is comparatively larger, a medium speed type can be adopted, while for axle box type of less diameter, the super speed type is available.

In order to perform high speed and heavy cut under high-speed tools, the machine equips precision tapered roller-bearings in the table. The chucking dog of Loco-Tyre is so equipped as to be facilitated in mounting and removing. Gear Box including main motor is entirely of vertical axis and not of bevel gears.

ELECTRO-COPYING DEVICE

All of the operation of the table, hydraulic pre-selective device of table speed, tool head feed, rapid feed, and selection of tool head feed are controlled by a remote switch board. The machine can be equipped with the copying device made by Shibaura under the technical co-operation of S. E. A. (Societe D'Electronique et d'Automatisme) in France. As a mass production method, it is generally understood that the use of a copying device has a great advantage.

Being not required to have the workpiece pre-measured, these copying devices can automatically perform measuring and machining simultaneously regardless of the shape of the paragon to use.

In case where Loco-Tyre is forged without having the outline formed, the most accurate and rapid work can automatically be performed by using Shibaura's Vertical Boring and Turning Mill when combined with the said copying device.

Even without the copying device, however, the machine itself can perform automatically sizing job by using the sizing device especially equipped to meet with vertical and horizontal feed of the tool head.

Other special equipments are
Screw cutting device
Tapered Turning device
Coolant system
Tool Holders.

Herewith is a list of specifications of our Model TBJ made by Shibaura Machine Works, Ltd., Tokyo, Japan.

		TBJ—100		TBJ—125		TBJ—150	
		in.	mm	in.	mm	in.	mm
Diameter of table	..	40	1000	49	1250	59	1500
Maximum outside diameter to be turned	..	48	1220	57	1450	67	1700
Maximum height available—under cross-slide	..	20	500	20	500	25½	650
		25½	650	25½	650	31½	800
		31½	800	31½	800	37½	950
		27½	700	27½	700	27½	700
Displacement of slide fitted with pentagonal turret	..	40	1000	40	1000	40	1000
TABLE SPEED	rpm	3.15	100	2.5	80	2	63
Low speed range	rpm	6.3	200	5	160	4	125
Medium speed range	rpm	10	315	8	250	6.3	200
High speed range	rpm	16	500	12.5	400	10	315
Extra high speed range							
Power of main drive motor	KW (HP)		17 (22)		17 (22)		17 (22)
—for low speed range	KW (HP)		24 (35)		34 (45)		34 (45)
—for medium, high extra high speed range	kg		6500		8000		10300
Approximate nett. weight							

SHIBAURA's BFT Horizontal Boring Machine

GENERAL

The important role of horizontal boring machines among the range of present machine works has been widely closed up. In compliance with the recent advancement in manufacturing gears, spindles, and bearings, increased are requirements for super precision in boring jobs and heavier cutting works in general as well as for utilizing more various attachments so that working performance can be promoted.

Our Shibaura's model BFT Horizontal Boring Machine (Table Type) meets with all these requirements with its versatile features which have ever been provided.

STURDY CONSTRUCTION

The construction of the machine is sturdy enough to perform heavier cutting work with harder tools; the main molded components are made of meehanite-molded-iron while the gears and spindles are of special high steel under heat treatment, ensuring maintenance of high precision in performance.

The bed which is constructed in rigid box type, has double slide-way with supplement slide-way provided with super finish which ensures the saddle with most accurate and smooth movement.

The rigid saddle carrying heavy workpiece travels along the bed-way.

Of the main spindle head which is made into a sealed box type, the main spindle and sleeve of nitriding steel, are executed super finish.

SUPERIOR PERFORMANCE

The sleeve firmly supported by super roller bearings ensures to hold at its end a cutter-attachment of larger diameter which can perform milling cutting.

Special belts are adopted to the high rotating units of the head spindle to obtain a smooth operation. By applying a turning plate to the spindle, facing job is also available.

Other facing jobs on both parallel and aslant way can further be performed by attaching universal head or vertical head. The outer-support-block moves together with the head spindle.

The direction of the head spindle fe· ·d can manually be settled with the feed-handle and /or micro-feed handle.

The positioning of the spindle hea d in vertical movement, the table in back and forth, and of the saddle in traversing are settled by the han dles on the bed front and on the saddle side.

The positioning of the spindle head and the table plate is performed under the positioning app· aratus by applying inside micrometer and bar-gauge thr ough the pendant switch board, or sometimes manually by the vernier scale.

AUTOMATIC OPERATION

Major operation can be performed automati ·ally through the pendant button push—selection of feed for the main spindle, spindle head, or saddle table—selecti on of speed for the boring feed, rapid feed or positionin g etc. These are all controlled on the said switch boar d.

All clamping is effected through snap switch, and the range of the spindle rotation can be shifted by the lever attached to the spindle head. The rpm is manually changed by the shifting lever of the head.

BFT HORIZONTAL BORING MACHINE SPECIFICATIONS AND ACCESSORIES

Model			BFT-7.5	BFT-9	BFT-11	BFT-13
Dia of milling spindle		mm	75	90	110	127
Tapered hole dia. of Spindle-end		Morse No.	5	5	6	7
Longitudinal travel of boring spindle		mm	600	700	900	900
Distance between spindle-centre and table face		mm	0–900	0–900	0–1,200	0–1,200
Maximum travel between sleeve and outer-support		mm	1,700	2,000	2,300	2,600
Table working area		mm x mm	900x1,500	900x1,500	1,000x1,850	1,200x1,850
Maximum cross travel of table		mm	1,200	1,200	1,500	1,500
Maximum longitudinal travel of saddle		mm	850	1,100	1,200	1,400
Height from bed lower surface to the table face		mm	1,000	1,000	1,000	1,000
Spindle speed		rpm	27	27	27	27
Feed speed		per/min	13–1,500	13–1,500	9–1,200	9–1,200
		rpm	36	36	81	81
Rapid-feed speed		mm/min	0.0025–18	0.0025–18	0.002–24	0.002–24
Main motor		mm/min	1,600	1,600	1,600	1,600
		kw	7.5	11	15	19
		(HP)	(10)	(15)	(20)	(25)
Height of machine (H)		mm	2,600	2,600	3,070	3,070
Floor area	A × B	mm	2,900x4,150	1,900x4,450	3,650x5,590	3,650x5,890
Weight of machine		kg	12,500	14,000	20,000	21,000

Special Accessories :
- Automatic Positioning device.
- Screw cutting device.
- Tool setting gauge.
- Circular table facing plate.
- Vertical Head.
- Boring Bar.
- Optical measuring device for headstock and table traverse.

NEW MODELS OF LATHES

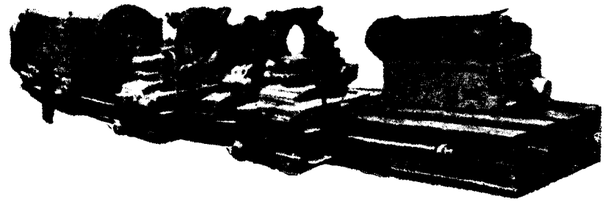
PROMISE for increasing the export of Soviet engineering products results from the vast scale of industrial production in the Soviet Union and its rapid development.

A new powerful increase in industry is planned for the next seven years. The production of the machine-building and metal-working industries are to be almost doubled in this seven-year period.

From 190,000 to 200,000 machine tools will be produced in 1965. This is one and a half times the 1958 production rate. The 1965 figure includes 38,000 special-purpose, specially equipped and unit-buit machine tools. This doubles the 1958 production for these types of machines.

This article deals with certain machine tools of the lathe type that are exported by V/0 Stankoimport to many countries.

A number of heavy duty and unique lathes, including models 1660, 1670, 1680, 1682 and 1683 as well as the increased bed-length models 1660G, 1680A, 1682A, etc., have been designed in the last few years and are being manufactured at the present time. These lathes accommodate workpieces 1250, 1600, 2200, 3200, 4000 mm in diameter, respectively, and have distances between centres from 6300 to 30,000 mm.



The 1670 Heavy-Duty Lathe

Two types of lathes are available in each model of this range : a heavy-duty and a normal-duty design.

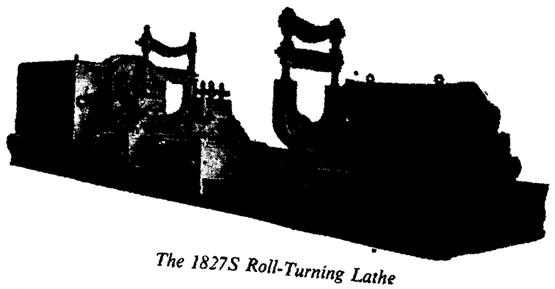
The normal-duty type is employed in machining large-size works of comparatively light weight (paper machinery rolls, mine hoist drums, tanks, etc.) Smaller works of heavier weight such as motor rotors, propeller shafts, turbine shafts, etc. may be machined on the heavy-duty types.

Lathes accommodating work 1600, 2000 and 2500 mm in diameter over the bed are available with a 4-speed gearbox and a D. C. motor drive. On special order, these lathes are also available with a drive from an A. C. electric motor. Lathes for work 3200 mm in diameter and larger are available only with a D. C. motor drive. The application of a D. C. electric motor with a speed variation of 1 : 3 and a speed gearbox with four speed steps enables a general spindle speed variation of 1 : 100 to be obtained. In accordance with the distance between centres, these lathes have different numbers of carriages. They are available with two or more front carriages mounted on two or three bed ways. Lathes equipped with rear carriages have four bed ways.

These lathes have high upper speeds, ample power and infinitely variable speed regulation. They also possess such features as rapid traverse movements of the cross slides and saddles, hydraulic gear shifting in the speed and feed gearboxes, power traverse of the tailstock, remote controls and others.

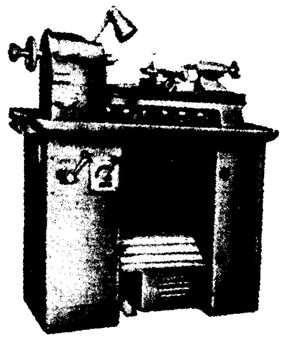
A number of lathe models are manufactured for use in the metallurgical industries to turn ingots and rolls. The Roll-Turning Lathes models 1825 and 1827S are designed for using cemented carbide tools to their full capacity and for operation with heavy feeds. These lathes are equipped with rapid traverse movements of the carriages. The 1825 Lathe has remote controls, while the 1827S Lathe is furnished with infinitely variable spindle speeds, obtained by changing the speed of the drive motor, as well as hydraulic gear shifting in the speed gearbox.

Besides the standard engine and heavy-duty lathes mentioned above, precision lathes, such as models 1602, S193, 1610, 1622B and 1633 are also produced in the USSR super-precision lathes models 103, IR610, KT-24 and 1622 are also manufactured for use in cutting lead screws and for machining gauges and other similar work. The performance accuracy of the super-precision models is twice as high



The 1827S Roll-Turning Lathe

as for the precision lathes. The design of the super-precision lathes embodies a device for compensating periodic and accumulated errors appearing in the manufacture and operation of these lathes.



The S-193H Super-Precision Lathe

The 1602 Precision Lathe accommodates a workpiece 130 mm in diameter and has a distance between centres equal to 250 mm. It is designed for performing various precision lathe work in the manufacture of instruments. The spindle has a range of speeds from 125 to 2500 r. p. m. and is driven from a 0.6 kW electric motor through a friction-type variable speed unit and a belt drive. Longitudinal feeds are obtained from the spindle through a belt drive and feed gearbox to the lead screw. Feed rates from 0.003 to 0.2 mm per spindle revolution are available. Provision has been made for operation to positive stops both with power longitudinal feed and hand cross feeds.

The positive stops for limiting cross travel of the cross slide is adjusted by means of a dial indicator device.

The S193N Universal Precision Lathe accommodates work 200 mm in diameter and has a distance between centres equal to 500 mm. This lathe is designed for precision operations in experimental shops and tool rooms. The lathe has a bar capacity of 14 mm and will accommodate a diameter of 200 mm over the bed. Spindle speeds range from 250 to 3000 r.p.m. The three-speed main drive electric motor has ratings of 0.5, 1.2 and 1.5 kW. This lathe is furnished with many accessories and attachments for cutting threads, milling and for external and internal grinding. Work may be mounted in a collet or jaw chuck on the faceplate or between centres.

Multiple-tool semi-automatic lathes have two or more carriages with independent feed and a more highly powered drive than in ordinary lathes. In these lathes, the work is turned with a number of tools at the same time. This considerably reduces the machining time on any operation.

Multiple-tool lathes require more time for setting up to machine various work than ordinary lathes and, consequently, they are used in lot production. These lathes may operate on an automatic cycle.

Multiple-tool semi-automatic lathes are available with the following combinations of slides and slide motion:

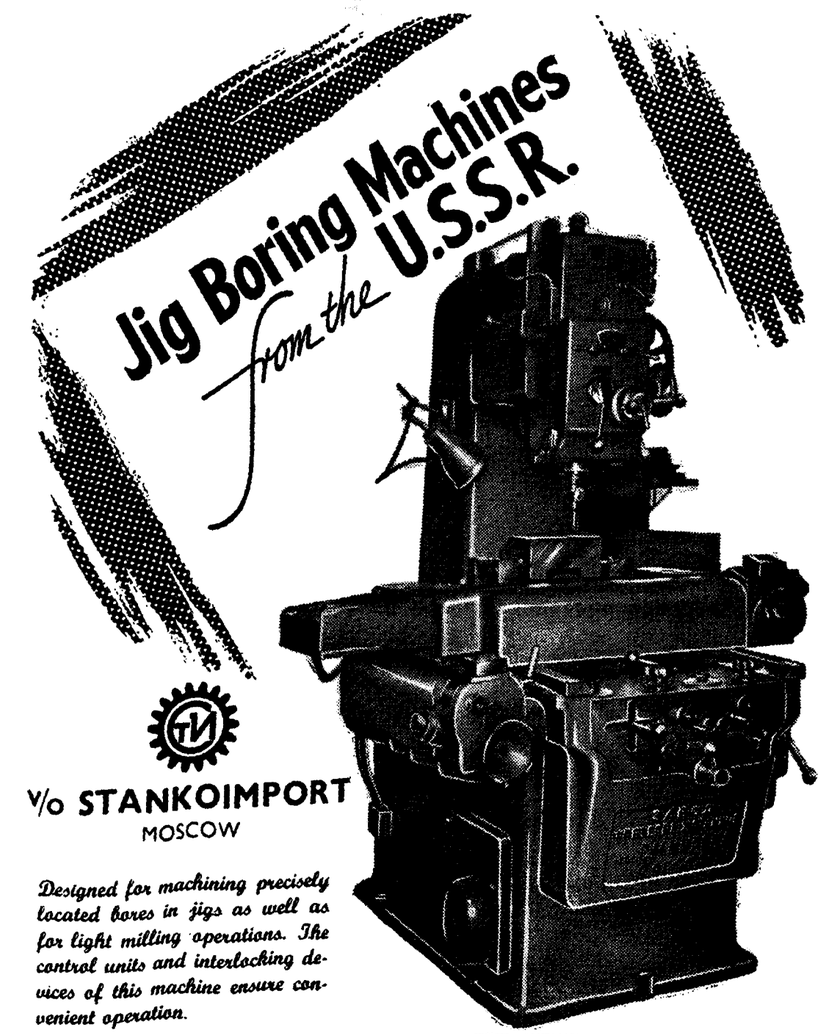
with a longitudinal carriage and a cross slide for machining a large variety of work held either in a chuck or between centres. These lathes are available in both horizontal and vertical designs;

with several longitudinal carriages and cross slides for machining long work with a large number of stepped surfaces;

with only longitudinal carriages for turning long shafts;

with a longitudinal, cross and boring carriage for machining complex work held in a chuck, when internal machining operations are required. These lathes are available in both horizontal and vertical designs;

special-purpose machines designed for machining crankshafts, camshafts, wheel sets, etc.



V/O STANKOIMPORT
MOSCOW

Designed for machining precisely located bores in jigs as well as for light milling operations. The control units and interlocking devices of this machine ensure convenient operation.

Sole Agents in India
POWER TOOLS & APPLIANCES CO.
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BOMBAY MADRAS NEW DELHI

ABIAN

Among the many models of multiple-tool semi-automatic lathes manufactured in the Soviet Union are the following :

Models 1721 and MR-25 which accommodate work up to 200 mm in diameter and up to 800 and 1250 mm long, respectively, between centres ;

Model 1731 which accommodates work up to 320 mm in diameter and up to 750 mm long between centres.

The design of these lathes incorporates the most up-to-date means of automation including hydraulically actuated carriage and slide motions, hydraulic tracing system for copying operations, pneumatic or hydraulic facilities for work clamping and others.

Special design features of all Soviet multiple-tool lathes and particularly of the models 1721 and 1731 are :

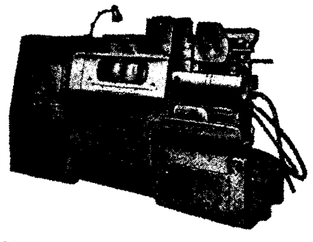
high powered main drive, high spindle speeds and ample rigidity which enable cemented carbide tools to be used to their full capacity ;

arrangements of the slides in an almost vertical plane which facilitates proper protection of the operator against flying chips and also facilitates automatic work handling through the lathe if the latter is built into an in-line transfer machine ;

provision of electro-hydraulic remote control of the operating cycle which allows the lathe to operate an automatic cycle ;

provision of an electrical control unit which allows the required operating cycle to be set up in a few minutes.

Each slide has five standard operating cycles. Additional slide operation cycles may be obtained by slight alterations in the hydraulic systems and electrical circuits of the lathes.



The 1721 Multiple-Tool Semi-Automatic Lathe

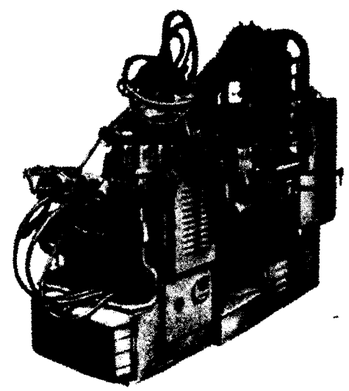
In addition to the multiple-tool semi-automatic lathes described above, several models of semi-automatic copying lathes are also manufactured in the USSR. The latter lathes are also of the multiple-tool type and are capable of using cemented carbide tools to their full cutting capacity. In addition to the significant reduction in machine time, these lathes also provide for considerable saving in handling time on many operations. Semi-automatic copying lathes may be built into in-line transfer machines.

The following models of semi-antomatic copying lathes are manufactured : model 1712 with a maximum diameter of 125 mm for work between centres, maximum work-piece length of 500 mm, 14 kW main drive motor and maximum spindle speed of 2000 r. p. m. ; models 1722 and 1722A with a maximum diameter of 200 mm for work between centres, maximum workpiece lengths of 800 and 1250 mm, respectively ; these models are powered with a 28 kW electric motor and have a maximum spindle speed of 1300 r. p. m. and finally, models 1732A, 1732 and 1732B with a maximum diameter of 320 mm for work between centres and maximum workpiece lengths of 800, 1250 and 1600 mm. respectively. These three models are powered with a 40 kW electric motor and have a maximum spindle speed of 1000 r. p. m.

In the copying process, tool movement is controlled by the transverse hydraulic value mounted on the carriage. The stylus of this valve follows a master workpiece or template whose contour is reproduced on the workpiece. The dual co-ordinate copying arrangement, here applied, considerably increases the production capacity as it enables machining to be carried out at the most expedient speeds and feeds to suit the form of the part of the contour being machined. In addition, the quality of surface finish is the same over the full contour of the workpiece.

The 1712 Semi-Automatic Copying Lathe, is also available with an automatic loading device (model MR-101). It is designed for turning shafts up to 90 mm in diameter and up to 400 mm long.

This machine is furnished with a chain conveyer driven by an electric motor. The blanks pass from the chain conveyer to a hydraulically actuated intermittent conveyer. This device holds up to 20 blanks and the conveyer operates on an intermittent cycle to



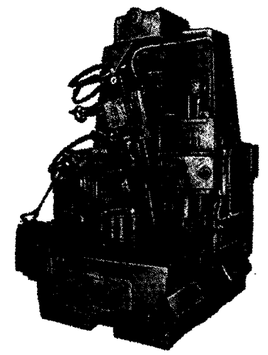
The 1712 (MR-101) Automatic Copying Lathe

feed the blanks between the centres. The conveyer idles in continuous operation when the last blank has been machined. The 1712 Semi-Automatic Copying Lathe, is equipped with a device which allows the cutting tool to "skip" sections of the workpiece that do not require machining and a device for turning work in several cuts with the tracing slide. The latter device enables work to be turned from bar stock in an automatic operating cycle. It is impossible to turn such work to a template in one cut due to the excessive machining allowance at certain parts of the contour.

The 1962 Program-Controlled Copying Lathe is designed for turning shafts from 25 to 60 mm in diameter and up to 370 mm long. The spindle is powered by a 10 kW electric motor through a belt drive and a speed gearbox. The spindle speeds range from 200 to 2000 r. p. m. The feed mechanism is driven from the MG-154 Hydraulic Motor, through a reducing gear with a 1 : 3.3 ratio to a lead screw 40 mm in diameter and with a 12 mm pitch.

This lathe operates on a fully automatic working cycle and is equipped with an automatic loading and unloading device. The application of a program control system, embodying "remembering" by means of a punched card, enables the working sequence, speeds and feeds to be planned before hand. This feature reduces set-up time to a minimum value. The lathe may be built into an inline transfer machine.

The MR-4 Vertical Multiple-Tool Semi-Automatic Lathe is designed for turning bearing races from 250 to 500 mm in diameter and from 65 to 200 mm wide. The bearing races are clamped in either a jaw or collet chuck and are machined from the longitudinal, cross and boring slides. This lathe possesses high power and rigidity which enable high speed and high feed machining to be applied in multiple-tool operations.



The MP-4 Vertical Multiple-Tool Semi-Automatic Lathe

Workpiece speeds range from 29 to 225 r. p. m. The workpiece is driven from a separate 55 kW electric motor through a flexible coupling and a speed gearbox. Work is machined in an automatic operating cycle which includes simultaneous rapid approach of all the slides, working feed and separate rapid retraction of the slides at the end of the cut. One or any pair of slides may be excluded from the operating cycle.

The Four-Spindle Vertical Semi-Automatic Lathe, model 1288, is designed for operation in large scale and mass production shops. It can be used for machining work up to 800 mm in diameter that requires a number of consecutives operations, such as cylindrical and taper turning, facing and boring.

Features of this machine include : the application of a screw-type feed mechanism, electro-hydraulic control of the operating cycle, possibility of being built into an inline transfer machine, possibility of powering the main drive with a 100 kW electric motor and the provision of a device interlocking the main drive motor with the lubrication system which prevents the motor from being switched on upon failures in the lubrication system.

(Continued on page M.T.38)

Herbert Face Milling Cutter Lapping Attachment

For lapping the dish angle of inserted blades on Face Milling Cutters

TO ensure flatness and fine finish in face milling, it is essential that the cutter teeth operate in a true plane parallel to the work surface and that their cutting edges are very finely lapped. When these factors are coupled with modern milling machines, resultant surface finish is such that subsequent grinding operations are often unnecessary.

Fig. 5 illustrates the success which has been achieved using these methods in our own machine shop. When the two mating faces of the headstock fitted to a Herbert No. 7 preoptive Combination Turret lathe are bolted together the half bores line up to carry the layshaft bearings; any unevenness in these mating faces would distort the bearing housings and tend to tighten the bearings.

These faces were originally ground, but it was found that by lapping the cutter teeth on the machine and using fine milling, the finish was such that a subsequent grinding operation was eliminated.

This condition is common to several of our machines, the milled surfaces producing perfectly oil-tight joints.

To obtain the necessary relationship between the cutter and the workpiece it is necessary to lap the cutter in position on the spindle from the machine table. This ensures that any inaccuracy in the spindle and cutter is corrected relative to the movement of the machine table surface and the face of the cutter.

To achieve this, an attachment which bolts directly to the machine table has been designed to enable the operator to obtain this true relationship, and also to restore, quickly and easily, the fine lapped finish to the blades. On mass or batch production work this has a tendency to increase the life of the tool as the operator is more likely to lap the cutter, if the equipment to do so is available, when wear first begins to appear, rather than wait until severe wear has taken place, necessitating the replacement of the cutter. This lapping operation takes place on the machine without the setting being altered, allowing almost continuous machining with a minimum of idle time. The attachment is also portable, enabling it to be moved from one machine to another with a minimum of delay whenever the need for it arises.

This attachment, which is entirely new in design, with many features which make it very versatile in use and very simple in operation, is available as a single wheel unit. Provision is made on the attachment for fitting the lapping wheel at either end of the spindle, enabling lapping to be carried out in any position within the limits of the attachment when used on vertical or horizontal single-spindle milling machines.

(Continued from page M.T.37)

Vertical lathes have a number of distinct advantages over horizontal types, including: reduced floor space requirements, convenient chip disposal, convenience in loading and unloading work, etc.

Multiple-tool semi-automatic copying lathes possess the following advantageous features:

(a) A significant reduction is obtained in the time required for setting up work and for taking measurements. In operation by the tracing method it is sufficient to measure only one diameter and one length on the work. The correctness of the remaining dimensions are ensured by the operation of the tracing system and the template being used.

(b) Higher speeds and feeds may be applied as a lesser number of tools is required. In most cases only one tool is used.

These features explain the tendency to use more and more semi-automatic copying lathes for large scale and mass production at the present time.

Please address all inquiries concerning the purchase of Soviet machine tools to V/O Stankoimport, Moscow G-200.

The services of Soviet engineers are always available on request for technical aid and consultation in selecting machine tools, as well as in their installation and operation.

separate wheel and indexing box can be provided, converting this attachment into a more universal one for use on Duplex or multi-spindle machines, where it is not always convenient to change the position of the wheel.

As would be expected where accuracy is required, the face milling cutter lapping attachment is of robust construction to ensure rigidity and to eliminate vibration. The vertical column which is a webbed casting with a large base for bolting to the machine table to give extra stability, permits the wheelhead to be adjusted vertically to any height within its range.

The adjustment is obtained by unlocking the clamping handle and rotating the jack screw elevating the swivel base which runs in a tenon slot in the column. Attached to this base is the swivel head which can be set in a vertical or horizontal position and can be adjusted to a maximum of ten degrees either side of the horizontal or vertical position to produce the required clearance angle on the cutter blade. To set this angle, the locking lever is released and the wheelhead is rotated to the angle required. Although the attachment is designed primarily for vertical and horizontal machines and graduations are at 90° intervals, extra graduations can be added for intermediate angles if required. A further bracket is bolted to this swivel head for setting the dish angle which is adjusted by means of a micrometer thimble. This bracket in turn carries the wheelhead mounted on ball-bearing pivots, enabling it to oscillate smoothly without sticking and allowing it to return, by means of spring loading, to its original position when released. An electric motor on the wheelhead casting drives, by means of a rubber belt, the lapping wheel spindle which is mounted in precision angular-contact preloaded ball-bearings, to eliminate all axial and radial play. The feed of the lapping wheel which applies the required cut is achieved through a micrometer dial adjustment on the spindle quill, which allows very small increments of feed to be applied. The attachment is designed to cover a large range of machines, the capacity can be increased by using simple packing blocks and it is suitable for lapping most makes of inserted-blade face milling cutters.

To set the attachment it is necessary first to ensure that a cutting face of one of the blades is parallel to the machine table tenon slot. Two datum lines are

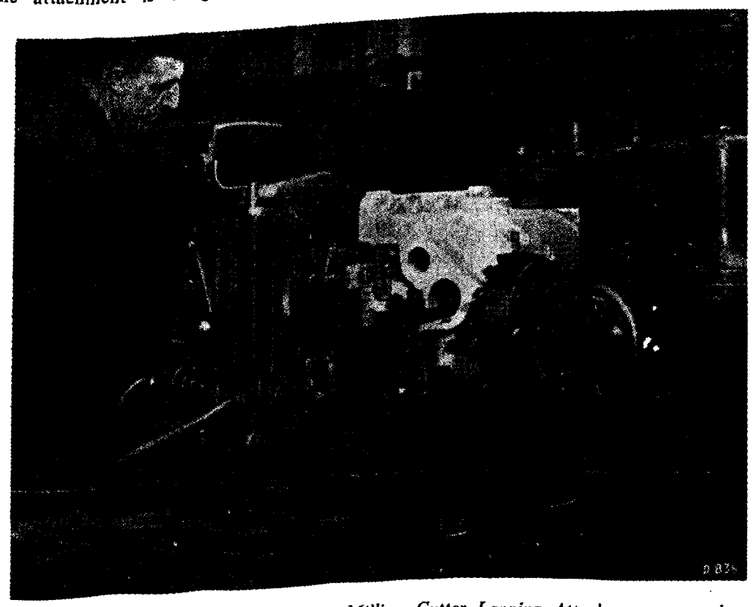
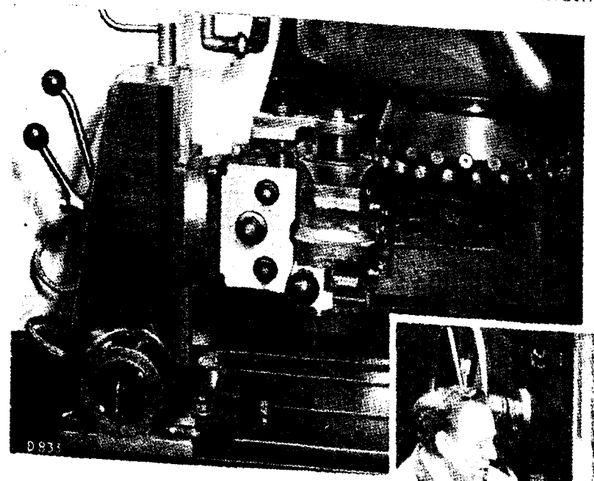
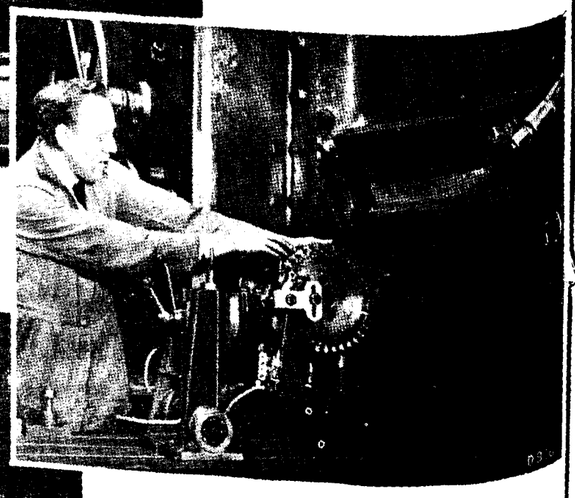


Fig. 1. The Herbert Universal Face Milling Cutter Lapping Attachment mounted on the table of a Duplex Milling Machine for lapping both cutters without removing them, or the work, from the machine. The advantage of not disturbing the set-up is obvious.





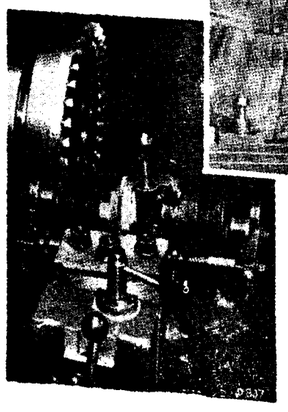


Fig. 2. Other applications of the Herbert Milling Cutter Lapping Attachment. D.833 shows its use on a Vertical Milling Machine, D.836 lapping the side cutter on a Plano Milling Machine, and D.837, the relationship of the cutter and the indexing finger from the operator's position, on the latter machine.

then marked on the front face of the cutter A-A and B-B, as shown in the sketch, Fig. 3. These lines will be transversely on a vertical machine and vertically on a horizontal machine and should be $\frac{5}{8}$" either side of the centre line of the cutter. The lapping attachment is bolted square on to the machine table and a dial indicator gauge is clamped on the attachment. The machine table is then traversed and readings taken with the indicator gauge on the datum lines, at points 'C' or 'D', see Fig. 3. The machine table

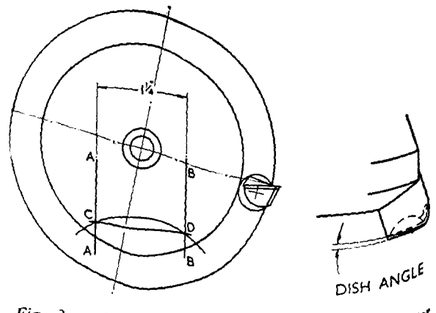


Fig. 3. Markings on the face of the milling cutter body for setting the attachment to lap the dish angle.

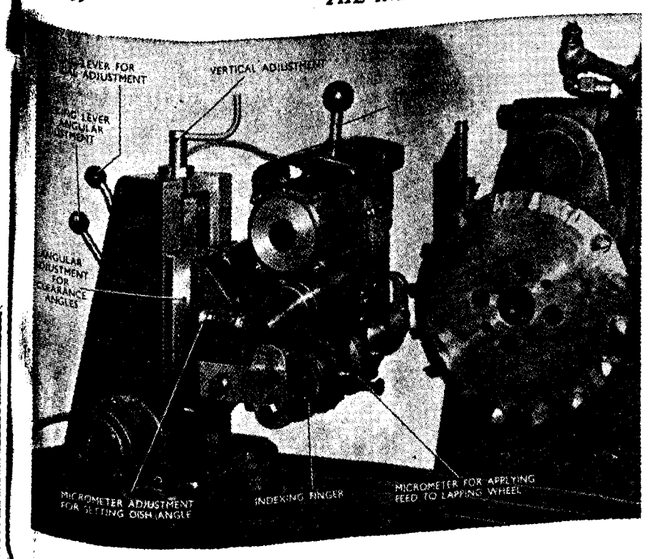


Fig. 4. The lapping attachment in use on a Horizontal Milling Machine. The principal setting controls are indicated.

is then set so that when the wheelhead is in its free position the indicator gauge is on point 'C' or 'D'. The wheelhead is then oscillated and the dish angle adjusted so that the indicator gauge readings at 'C' and 'D' are identical to the previous readings. This setting would now produce a perfectly flat face on the cutter blade. These setting should be noted down so that if the attachment is replaced in exactly the same position on the machine table, the readings can be used again without resetting. The wheelhead is then set to the clearance angle of the cutter and the dish angle is then determined by means of the dish angle micrometer, each graduation representing .0005" in 1¼" or one forty-eighth of a degree.

An indexing finger on the attachment is set in front of the Norton diamond wheel and it is so positioned that when one blade has been lapped and the cutter is rotated, the next blade is located in the correct relationship to the lapping wheel. On machines not fitted with a neutral spindle position or machines on which the cutter is difficult to turn, a dial indicator gauge should be used, with the gauge finger resting against the indexing finger support so that repeat readings are obtainable as successive teeth are positioned.

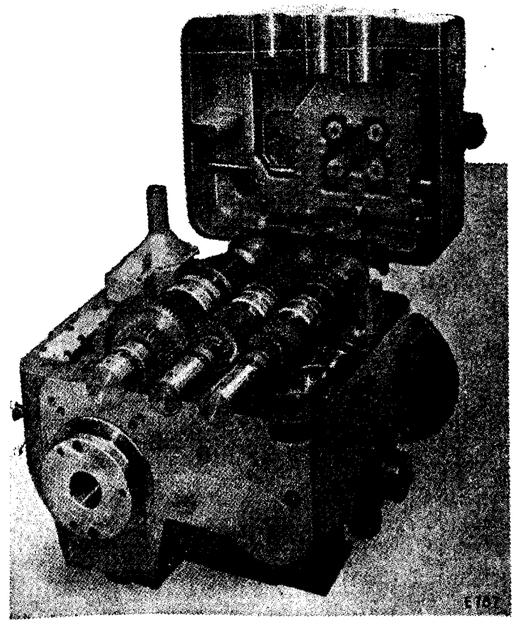
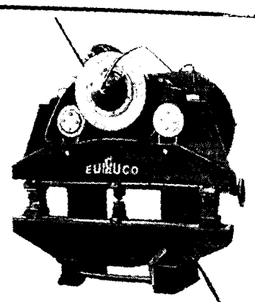
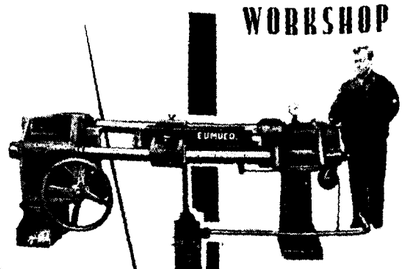


Fig. 5. Face milling the joint faces a lathe headstock with a cutter lapped whilst on the milling machine spindle, has eliminated a subsequent grinding operation in our own works.

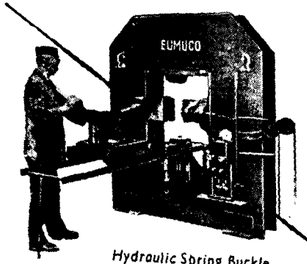
MACHINES FOR RAILWAY WORKSHOP



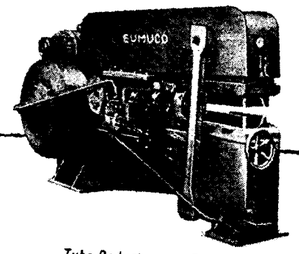
Eccentric Press for Springs



Hydraulic Spring Buckle Pulling-off Press

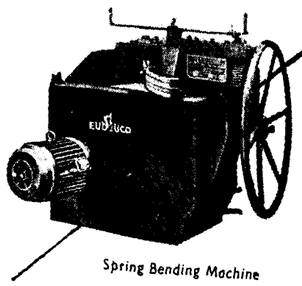


Hydraulic Spring Buckle Mounting Press

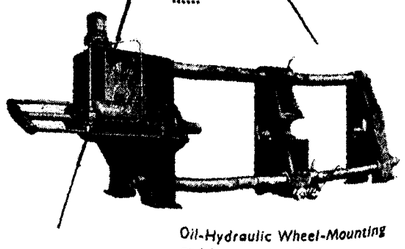


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EUMUCO



Spring Bending Machine


Oil-Hydraulic Wheel-Mounting and Demounting Press

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New Cincinnati Filmatic Number One Centerless Grinding Machine

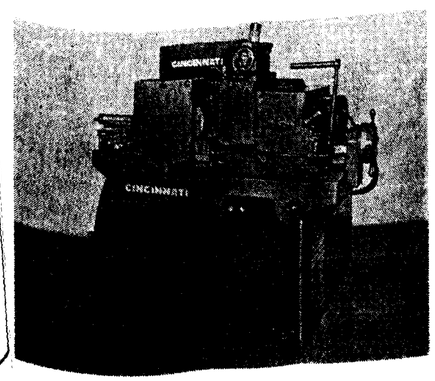
By An Engineering Correspondent

We have great pleasure in reproducing below certain technical features of the new Centreless Grinding Machine recently added to the range of manufactures of Messrs. Cincinnati Grinders Incorporated — the only manufacturer of centreless grinding machines. According to the manufacturer the new Cincinnati handles infeed and thrufeed precision work up to 1½" diameter, small lots and large lots, form grinding with crush trued wheels, and, with proper tooling, continuous automatic production. It may be recalled here that this firm manufactures this type of machines from its manufacturing units both in United Kingdom (Birmingham) and Netherlands. We are sure the following paragraphs would interest our Mechanical Engineers on Indian Railways.

Editor—IRE

A new size, No. 1 Centerless Grinding Machine has recently been added to the line of centerless grinding machines built by Cincinnati Grinders Incorporated. The new machine, rated at 7½ hp. for the grinding wheel drive, has a capacity of 0 to 1½" diameter work.

Principal features include Cincinnati's exclusive Filmatic bearings for the grinding wheel spindle. These bearings, consisting of three segments, automatically adjust for load and eliminate spindle flutter. The grinding wheel spindle is supported in a fixed mounting in the bed casting. A double slide and swivel plate construction between the regulating wheel housing and bed simplifies setups. The regulating wheel and work rest can be positioned individually or together in relation to the grinding wheel, and, through the swivel plate, can be adjusted to compensate for slight errors of alignment in setup or truing.



New Cincinnati Filmatic No. 1 Centerless Grinding Machine.

Ways for the regulating wheel pile are lubricated from a central reservoir with manual pump. However when the machine is equipped with an automatic infeed attachment, automatic pressure lubrication is supplied for the ways. Like other Cincinnati Grinding



Crush Truing Attachment for Cincinnati Filmatic No. 1 Centerless Grinding Machine. The motor on top of the bracket drives the crushing roll, and an auxiliary motor drives the grinding wheel at the slow speed required for accurate crush truing.

Machines, the grinding wheel spindle bearings are automatically lubricated and protected by an electrical cut-out switch.

Regulating wheel speeds are infinitely variable. A wide V-belt running between two pairs of variable pitch sheaves provides the method for changing speeds. An individual ½ hp. motor supplies the power, and a built-in tachometer indicates the spindle speed.

A hydraulically actuated unit, mounted on the bed behind the wheel guard, trues the grinding wheel. The unit incorporates a micrometer diamond adjusting dial, truing rate selector knob, and direction control lever. Straight screw type diamond truing is supplied for the regulating wheel. For convenience of operation, this unit is located directly above the wheel, and mounted on a swivel to facilitate truing on a line equivalent to work contact with the wheel. Profile truing equipment may be obtained in place of standard straight truing, if desired for both the grinding and regulating wheels.

Electrical controls are contained in a cabinet engineered for the No. 1 Centerless. With the exception of the regulating wheel drive motor, wiring conforms to J. I. C. Electrical Standards.

The machine handles infeed and thrufeed operations equally well, and can be equipped with attachments and fixtures for unusual setups or continuously automatic operation. Attachments and accessories include infeed and thrufeed work rests and blades; two types of automatic infeed attachments; crush truing; profile truing; grinding wheel positioning and others.

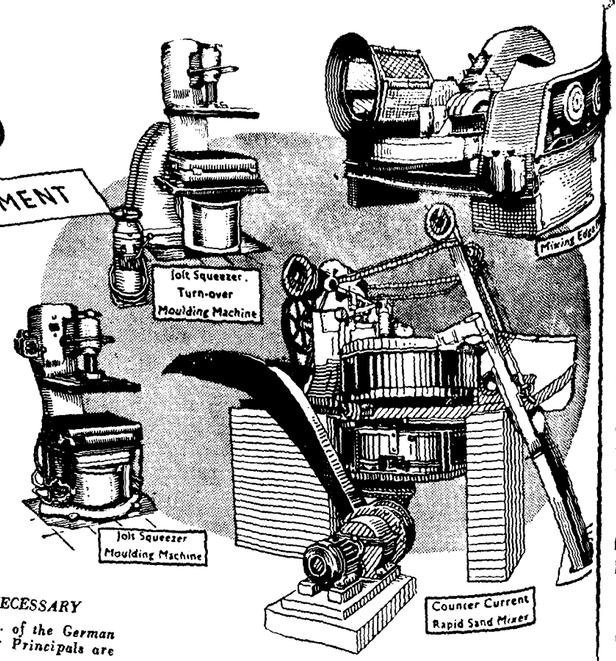
Complete information may be obtained from Cincinnati Grinders Incorporated, Cincinnati 9, Ohio, or through their selling agents in India Messrs. Heatly & Gresham Ltd., Calcutta, Bombay and Madras.

FOR

DIA (EAST GERMAN)

Such as :- FOUNDRY EQUIPMENT

Turnover type jar-ram moulding machines • Air jar squeezer flask lifting moulding machines • Air jar squeezer moulding machines • Heavy duty jar-ram moulding machines • Core moulding machines Smoke black mixers • Shaking Screens Cleansing drums • Mixing edge mills Sand centrifugal mills • Sand dressing plants for foundry shops • Die casting machines • Core sand mixers • Moulding machines for large-space moulding plates and Flask moulding plates of all types



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Range of Industrie-Werke Karlsruhe's Machines

By An Engineering Correspondent

MACHINES sold under the name of "IWK" and "PELS" in the world market are manufactured by Messrs. INDUSTRIE-WERKE KARLSRUHE, Aktiengesellschaft, Karlsruhe/Baden.

These machines are known for their robust construction, their absolute dependability and high efficiency and for their precise working.

IWK transfer presses are fully automatic machines designed for the continuous production of blanked, pressed and drawn components to very close tolerances. At each stroke of the ram a fresh blank is cut and at the other end of the machine a finished component is ejected, while at the intervening stations a number of intermediate forming operations are performed on a corresponding number of partly finished components on their way through the machine. The machine effects a great reduction in the total working time required to turn out a given component, as compared with the time required to turn out the same component on a series of single-acting presses. Not only is the time required for stacking and conveying the components between presses eliminated, but owing to the short interval between successive forming operations on the IWK press there is generally no need for annealing between stages.

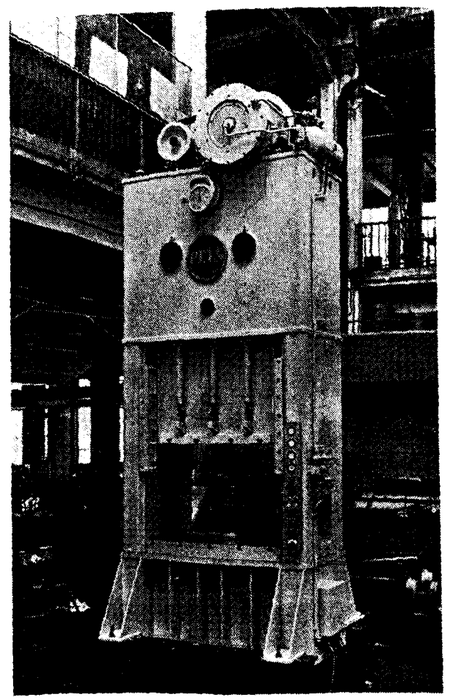
The time required for tooling and setting up IWK transfer presses is so short, as a result of certain special features of the design, that these machines are economical not only on long runs but also on repeating short runs, and in this case the saving in working time is still more marked.

IWK transfer presses are particularly marked by two features, viz. "quick tool changing" and "unusually high working speed".

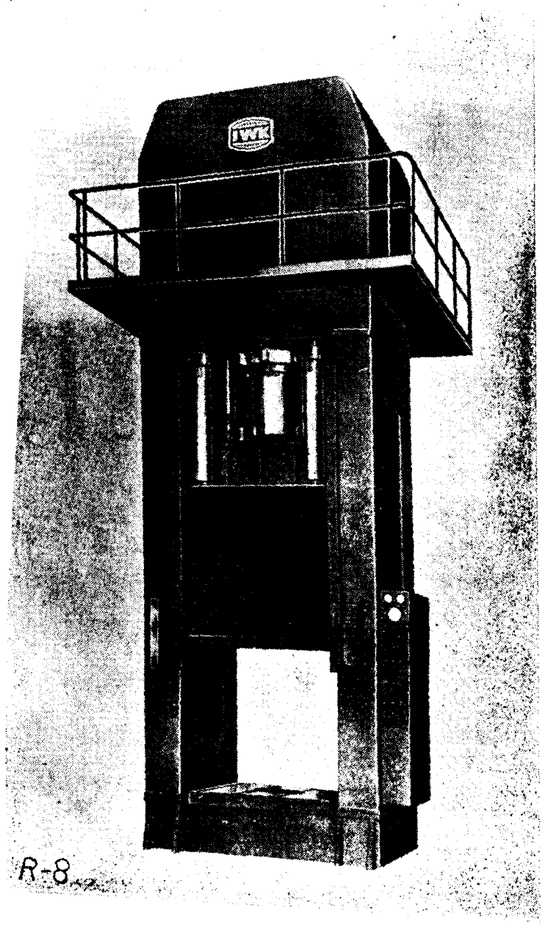
To achieve quick tool changing locating of the top tools, ejectors, and gripper system, and the adjustment of the air pressures are carried out according to a detailed set of instructions supplied with each set of tools. The bottom tools are mounted on a common bolster placed on the table of the machine and pressed into position against stops by means of a crank lever.

IWK transfer presses are built with press powers from 16 tons upwards and with even numbers of tool stations from 6 to 14. In accordance with the shape and size of the part to be formed speeds of 40 to 85 strokes per minute can be achieved with presses of small capacity and of 10 to 30 with big presses.

IWK transfer presses are equipped with a number of electrically operated automatic safety devices of special design, their operation being visually indicated



PELS Straight Side, Double Stand Crank Press Type P2K 160/1350



Oil hydraulic downstroking straight-side drawing press 800/400 tons

at the control panel. It is by virtue of them that the IWK transfer press can properly be claimed to be a fully automatic machine which only requires supervisory attention during normal running.

PELS straight side crank presses with 100 to 500 tons press power are made by IWK of proved design with all-steel bodies of welded construction as one point or two point suspension forming presses of high working capacity and as one point suspension blanking and punching presses with reduced working capacity.

PELS straight side crank presses are throughout built with transversal shaft drive doing away with crank shafts liable to breakage or deflection. In their place fixed axles, their bearings being close to one another and running on them toothed wheels with cast-on eccentric, form the crank drive. The short axles with bearings in a small distance from one another guarantee a uniform pressure on the flanks of the teeth, while cross arrangement of the shaft avoids any torsional stress on the driving gear and any edge pressure on the journals. Power transmission from motor to ram goes the shortest possible way. The drive is well accessibly installed in the press head.

The ram is guided on long adjustable prismatic gibs. The weight of the ram is generally counterbalanced by pneumatic cylinders.

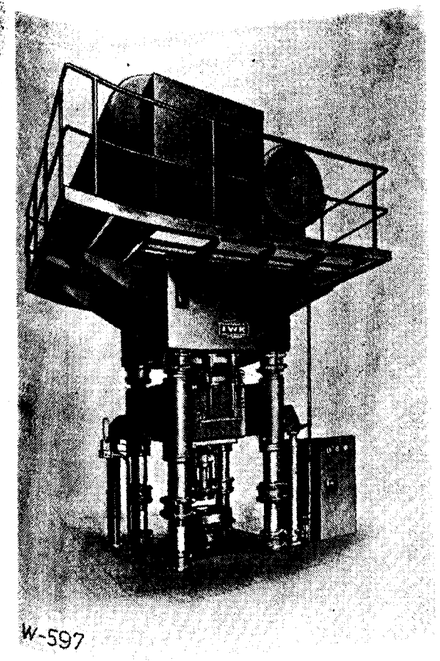
The clutch is engaged by compressed air, the spring loaded brake is released by air pressure, both are electro-magnetically controlled. They react very quickly and make the press stop immediately in any position whatsoever. The controls are actuated by two hand safety push button switches and can be adjusted for setting, single stroke and continuous run. For the manufacture of drawn pieces the presses can be equipped with pneumatic draw cushions.

IWK oil hydraulic straight side presses are built since 65 years, besides the specially developed long stroke presses standard types are available with from 160 up to 1000 tons press power and more. The press body is welded of heavy steel plate, up to 315 tons of monobloc design, above that capacity consisting of foot with table, two side standards and the head piece joined by 4 tie rods. The press table is a heavy forged steel platen.

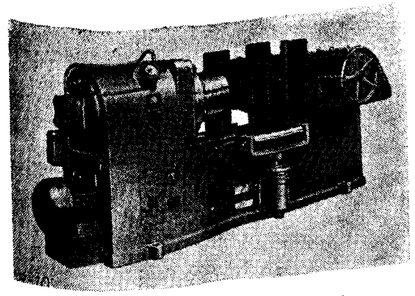
The ram box shaped and equally welded of thick steel plate is guided on 4 adjustable prismatic gibs. Cylinder and piston are of high quality material and polished by grinding.

Draw presses are either equipped with a blank holder hanging on two piston rods and four coupling bolts and guided along the same gibs as the ram, or with a hydraulic draw-cushion built into the press table.

Ram and blank holder are dropped with high speed at the beginning of the stroke and braked



Oil hydraulic downstroking four column press 1200 tons



Oil hydraulic straightening and bending press 200 tons

shortly before setting on the blank. Also the return movement is accelerated.

A hydraulic multi plunger axial disposition pump of the most modern design with a reliable capacity regulator serves as driving unit. The working pressures are infinitely variable within a wide range of adjustment and can be read off on pressure gauges. When making big pieces of thin sheet the down-holder pressure regulating valve can be made to vary the pressure by means of a cam during the drawing operation eliminating the formation of cracks near the bottom.

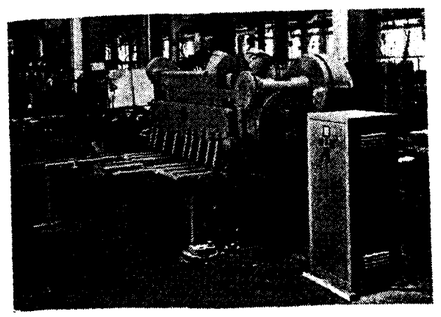
Setting of tools or working in single stroke action or continuous run can be adjusted on a selective switch in the most economical way and with the smallest possible stopping and embossing intervals.

PELS plate shears are high precision cutting machines robustly built of heavy steel plate and fulfill all demands in regard to high quality of cuts and economics. The main features of PELS plate shears are :

low cutting rake,
high downholder pressure,
blade slide adjustment,
robust design of all main components,
single disk friction clutch and brake,
quick adjustment of cutting clearance,
oblique blade slide guidance,
large daylight between uprights,
worm drive of eccentric shaft,
elevated number of cutting strokes.

From this result :

straight cuts by secure clamping of the plate applying hydraulic downholders adjustable as to the downholding pressure and by rigid construction of the shearing table and of the blade slide,



PELS Plate Shears Type STA 10/2050
cutting length 2050 mm
plate thickness upto 10 mm

clean cuts owing to the PELS cutting clearance quick adjustment allowing to regulate the cutting clearance for each plate thickness up to the maximum shearing capacity,

rectangular cut by oblique blade slide guidance creating an almost accurate vertical fissure between blade edges,

twistfree cut-offs with a minimum width of 10 times plate thickness, the cut off strips do not require any straightening,

straight line cuts by exact adjustment of cutting clearance compensating the bow caused by the thrust of the upper blade,

parallel cuts can be guaranteed with a tolerance of 0.1 mm (0.004″) over a length of 1m (3′—3.3/8″) for plates up to 8 mm (0.315″) and of 0.2 mm (0.008″) for thicker plates.

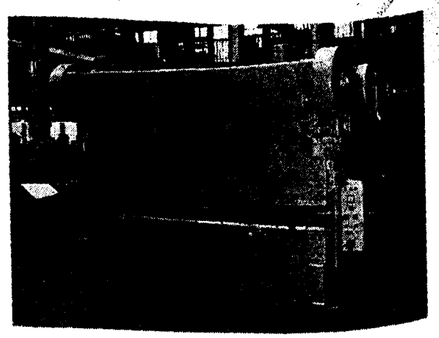
Trimming cuts can be carried out down to half the plate thickness achieving clean, rectangular plate edges.

Besides, PELS plate shears are most economical owing to their very high useful number of strokes, the extreme utilisation of material by straight cutting, the reduced quantity of waste when trimming and the possibility of cutting plates of up to 100 kg/mm² (65 tons/sq.in.) tensile of suitable elongation.

The worm drive of the shaft bearing, the two eccentrics and over-dimensioned bearings in conjunction with single disk friction clutch and brake ensure the quiet working of the shears. The flywheel runs vibrationless on a robust hollow shaft bearing.

PELS press brakes are the ideal machines for the manufacture of folded sections made of sheet metal and of constructional components as doors, windows, stairs, railings, covers and conveyor parts like chutes etc., steel furniture, safes, heating and air conditioning plants, lifting tackle, cranes, containers, boilers, fuelling installations, tubes, bridges, bodyworks, lorries, boats, locos, airplanes and others. Not only steel sections and steel sheet can be worked, but also light metal alloys etc.

PELS press brakes supply accurate, clean and uniform products and allow manufacturing by simpler and cheaper processing of sheet metal. They are generally made for two working speeds of the ram,



PELS Press Brake Type AP 04400
maximum press power 125 t
working length 4000 mm

the change being effected by compressed air over a speed changing gear.

It is possible to supply them with a selection gear to choose 3 different ways of operation by means of 2 clutches, namely :

(1) quick motion travel,

(2) slow motion travel,

(3) combined process of quick—slow—quick motion travel.

To avoid overloading of the press each press standard is equipped with an extensiometer which stops the ram movement immediately in case of extreme stress being put on the frame.

An electrically driven ram height adjustment allows a guide adaption of the press brake to various plate thicknesses, thickness tolerances and tensiles and to new conditions when changing the parts to be worked. The extend of effected height adjustment can be read off on the counter fixed to the front side of the machine with an exactitude of 0.1 mm (0.004″). Both the end positions of the ram are secured by limit switches.

PELS billet and slab shears cut square, round and flat steel bars and give uncommonly clean cutting faces of good rectangularity without burrs, fissures or scales, almost as good as sawn pieces.

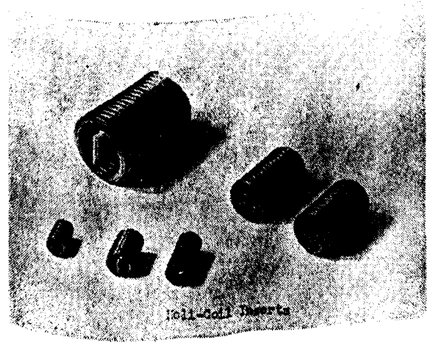
Due to an easily adjustable and securely clamping downholder and to an upclamping device joined to the

Heli-Coil Screw Thread Inserts

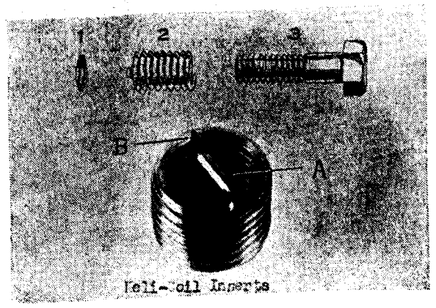
By an Engineering Correspondent

SCREWS are utilized as integral parts for fastening in components of all kinds of machines. Simple as thread mating members may seem, they are susceptible to material, mechanical or functional troubles of varied descriptions. Internal thread wear, abrasion, galling stripping, corrosion, seizing and break are frequently experienced. To solve such problems has the Heli-Coil Screw Thread Insert been developed since its invention in the United States in 1939.

First Heli-Coil Inserts were used as screw bushings in air frames and engines. Today they have a broad range of application in vehicles, locomotives, automobiles, vessels, industrial machines, electrical appliances, etc., as well as airplanes. Their nature is as under.



Heli-Coil Inserts.



Heli-Coil Inserts.

1. A Heli-Coil Insert is a kind of thread bushings with diamond-shaped cross section of extreme accuracy.

2. The material of Heli-Coil Inserts is 18—8 stainless steel or phosphor bronze.

3. The accuracy of Heli-Coil Inserts meets the requirement of the highest class threads, and available sizes are as follows :

Metric threads : dia.: 3 mm to 30 mm
pitch : 0.6 mm to 2.0 mm

(Continued from page M.T.48)

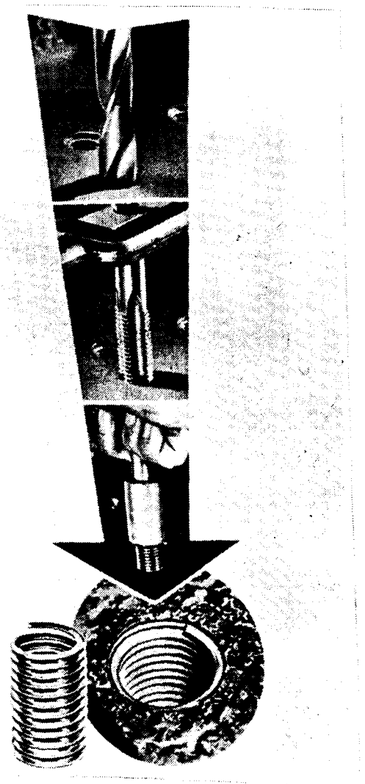
upper blade support and exercising a tonglike grip straight, hardly bent off cut sections are achieved.

The bars enter the shears with a determined angle to obtain a cutting face rectangular in regard to the longitudinal axle of the bar. A back stop engaged and disengaged by compressed air, provided with an oil brake working on both sides guarantees cut off pieces of equal length. Also bent billets can be cut without readjustment of the shears.

All feeding, stopping, downholding, upclamping and cutting movements are automatically controlled and overlap each other making short operation cycles and a quick sequence of cuts possible.

A roller table with several driven rollers with adjustable guide rings feeds the billets into the shears, it is automatically lowered before cutting takes place.

The movements of the shears and the roller table are controlled from a control board on which the keys and lamps of all push button switches are joined. Clutch and brake are electro-magnetically controlled and actuated by compressed air. The oil pressure for the hydraulic shock absorber between upclamping device and swinging blade support is supplied by an air pressure loaded multiplier.



Heli-Coil Inserts.

Inch threads: dia.: 1/8" to 1.1/2"
tpi: 40 to 6 tpi

The advantages of Heli-Coil Inserts are:

Reinforce female threads: Inserts provide stainless female receiving threads in cast iron, light metals, plastics, wood, etc. Provide durable thread fastenings: Inserts prevent thread failures caused by wear, corrosion, heat, vibration and provide durable thread members which will not wear, regardless of repeated cycles of reassembly and disassembly.

Increase ultimate tensile strength: Inserts withstand repeated operating stresses and high loading torques as they provide uniform stress distribution over all engaged threads.

Reduce space and weight: Inserts require less space than conventional bushings, thus saving weight and reducing bulk. This represents savings of materials.

Simplify designs: Inserts eliminate studs or bolt-and-nut assemblies. Simpler designs and stronger thread connections improve the qualities of products.

Salvage defective parts: Inserts save thousands of dollars in otherwise expensive thread repair operations or even the complete rejection of an expensive part during production.

Heavy Cables for Electricity Supply

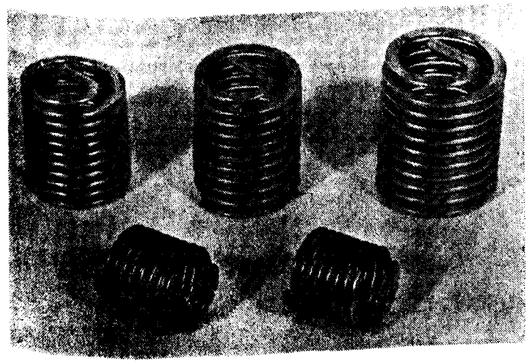
Indian Standards Institution has already formulated a series of Indian Standards for insulated wires and cables, a few important ones among the series being IS: 434.1953—Rubber-Insulated Cables and Flexible Cords for Electric Power and Lighting (for Working Voltages upto and including II Kv), IS: 693—1955 Varnished Cambric Insulated Cables for Electricity Supply, and IS: 694—1955 PVC Cables and Cords for Electric Power and Lighting for Working Voltages upto and including 650 Volts to Earth.

The Institution has now prepared and issued on general circulation, a draft Specification for PVC Insulated (Heavy Duty) Cables for Electricity Supply and Control Purposes for Working Voltages Up to and Including 11 kV [Doc: ETDC 2(64)]. This draft covers the requirements for single core, two core, three core and multi-core cables, PVC sheathed with flat or round steel wire armour.

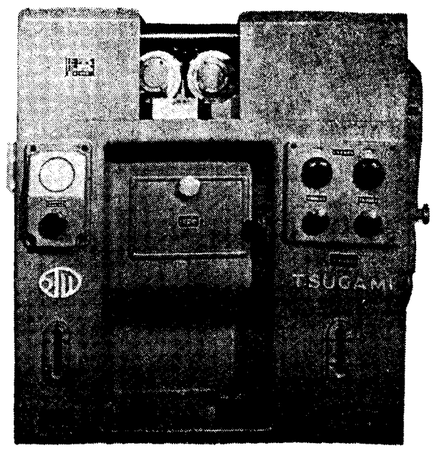
Experience in several countries has shown that it is possible to use PVC insulated cables under the same conditions and for the same purpose as armoured paper insulated lead covered cables. PVC cables are also found useful at any place where differences of levels between the cable ends require the use of non-draining type cables. As manufacture of such cables is expected to start in this country in the very near future, this specification has been formulated with a view to guide such manufacturers as well as users.

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MAIN PRODUCTS
Machine Tools
Measuring Machines
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Gauges
Small Tools
" Heli-Coil " (thread bushes)



(Heli-Coil)



Thread Rolling Machine Type A5D can be attached Automatic Feeding device

Cold forming on Thread Rolling Machines offers advantages

material saving
material strenghening
improvement of surface finish
reduction of working hours and costs

TSUGAMI MFG. CO., LTD.
1, 4-chome, Tamura-cho, Shiba, Minato-ku, Tokyo
FACTORY Nagaoka Shinshu

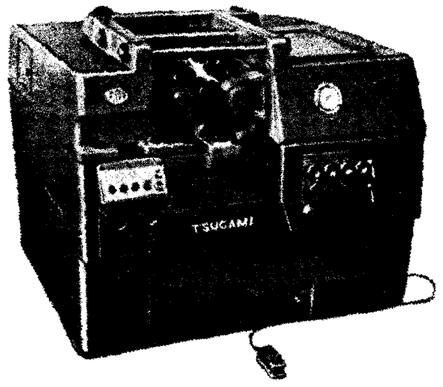
Advantages of Thread Rolling

By an Engineering Correspondent

FOR making screws there are several methods such as turning, milling, grinding, cutting by die head, rolling, etc., and each method has its merits and demerits, but at present the rolling method is prevailing in advanced countries for the mass-production of screws on account of the following advantages :

1. *Strength :*

Whereas in the conventional thread cutting method the metal fiber flow is cut off at each pitch, in the rolling method the fiber flow is not broken but is corrugated along the surface of threads and its density concentrates at the roots of threads where the residual

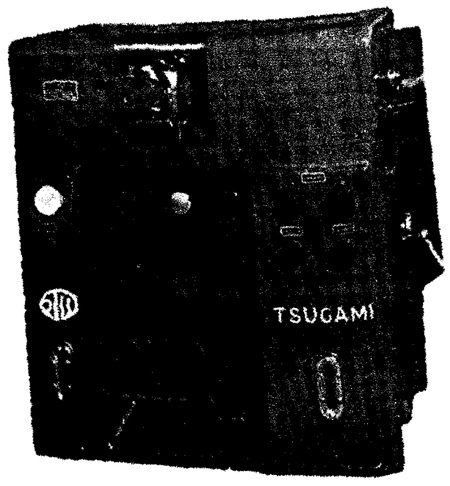


Tsugami's Thread Rolling Machine Type 25D (T-ROL 25D)

compressive stress is produced to prevent the tensile stress from rising so high as to cause the fatigue destruction. On the other hand, the surface of thread is equally burnished by rolling contact of roll dies and the finish leaves no such evil spots, e.g. a flow, a cutter mark, a chatter, etc., as may be a cause to the fatigue destruction. It is proved through experiments that the fatigue strength of rolled screws is by 50 to 75 percent stronger than that of cut screws.

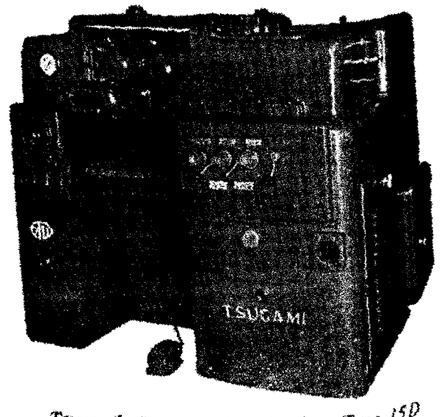
2. *Accuracy :*

In the rolling method, threads of roll dies are reproduced as they are on the workpiece, so naturally it is very easy to obtain very accurate screws since accurate roll dies and accurate blanks are employed under correct condition.



Tsugami's Thread Rolling Machine Type A 5D (T-ROL A 5D)

Furthermore, the uniformity in accuracy is maintained for many screws because the life of a roll die is



Tsugami's Thread Rolling Machine Type 15D (T-ROL 15D)

very long (1 roll die endurable without regrinding for 300 to 500 thousands of screws), whereas, in case of cutting method, the tool is worn so easily as to necessitate the regrinding even in the course of working.

3. *Mirror-finish of Surface :*

When rolling, all parts of the workpiece are burnished and a brilliant smooth surface is obtained irrespective of any difference in surface roughness, equality or heat-treatment of the material.

4. *Material Economy :*

Whereas the cutting method inevitably produces chips, the rolling method never makes a waste of material. In case of Metric or Witwarth thread series, nearly 20 per cent of material is saved in average in the rolling method as compared with the cutting method.

In conclusion, the rolling method is the most advanced method of threading and by its adoption the manufacture of screws will be much simplified and improved in all respects.

Specifications for Compasses

Compasses in regular use today range from small pocket compasses, used in Engineering practices or by Armed Forces for determining directions of features or marches, orientation of maps for laying guns, to surveyor's compasses used for largescale topographical survey. Though primarily these work on the same fundamental principle, that a magnet once suspended or pivoted centrally and freely about a vertical axis will tend to assume always a constant direction, the direction being that of the magnetic meridian, they differ from one to the other in so far as their constructional details are concerned, so as to suit various purposes for which these are designed. Normally, the size varies from 25 to 50 mm.

Magnetic compasses though of limited accuracy have the advantage of giving reading directly in terms of directions or bearings referred to magnetic north. Thus, for orienting a map or plane table and making a survey or traverse, where speed rather than accuracy is essential, the compass is a very useful instrument.

With a view to laying down specifications for compasses, the Indian Standards Institution has drafted the following two specifications.

1. *Prismatic Compasses* [Doc : EDC 36(422)] This specification covers various aspects of prismatic compasses, both dry and liquid type, which can be independently used or used in conjunction with other angle measuring instruments.

2. *Trough Compasses* [Doc : EDC 36(436)]. The standard covers the requirements for trough compasses used in conjunction with plane table.

Unlike prismatic compasses, trough compasses which are intended to give the direction of the magnetic north, do not by themselves form a complete surveying instrument; rather they work as adjunct to some other surveying instruments.

***

SPECIFICATIONS FOR BOILER AND SUPERHEATER TUBES

The Indian Standards Institution has circulated, for eliciting comments from interested manufacturers, consumers, technologists, laboratories, and others concerned, a draft Indian Standard Specification for Boiler and Superheater Tubes [Doc : SMDC 5(100)] covering the requirements for the following series of boiler and superheater tubes, made from carbon steel :

Cold drawn seamless tubes
(31.5 kg./sq.mm. minimum ultimate tensile stress)

Cold drawn seamless tubes
(42.5 kg./sq.mm. minimum ultimate tensile stress)

Hot finished seamless tubes
(31.5 kg./sq.mm. minimum ultimate tensile stress)

Hot finished seamless tubes
(42.5 kg./sq.mm. minimum ultimate tensile

Electrically welded tubes
(31.5 kg./sq.mm. minimum

Cold drawn elec
(31.5 kg./

Remodelled Sabarmati Yard Relieves Congestion

The Sabarmati transhipment yard, which has been remodelled at a cost of Rs. 1.5 crores, has started functioning satisfactorily and has relieved the congestion experienced here for years.

The scheme of remodelling the yard was sanctioned in 1954 and work was taken in hand immediately.

During the post-war period the work load on this important yard had increased and the transhipment quota from Broad Gauge to Metre Gauge had to be increased gradually from 72 B. G. wagons in 1946 to 120 in 1952. With the remodelling of the yard, the daily traffic handling capacity has gone up from 500 to 750 B. G. wagons and from 825 to 1,100 M. G. wagons. The transhipment capacity has also increased on the Broad Gauge, from 90 to 250 wagons, and on the Metre Gauge, from 80 to 250 wagons daily.

This yard serves transhipment traffic, traffic in wagon loads booked to sidings at Sabarmati and traffic in smalls. On the Broad Gauge side it serves Bombay, Ahmedabad, Viramgam main line and on the Metre Gauge side it receives and despatches trains in two directions viz. the Saurashtra side and the Delhi side. In addition it serves Asarva yard (Ahmedabad) and also the Ahmedabad-Khed Brahma section.

Prior to remodelling there were on the Broad Gauge one main line, one 1,600 ft. long passenger loop, 6 lines in the goods yard of lengths varying from 1,150 ft. to 2,447 ft. and on the Metre Gauge one main line, one 1,490 ft. long passenger loop, two reception lines and two despatch lines for goods varying in lengths from 436 ft. to 815 ft. In 1952, to cope with heavy famine traffic, four additional lines were constructed at one end of the yard for stabling metre gauge loads.

Despite these facilities, the transhipment from B. G. to M. G. had to be restricted to 120 wagons per day, and even less than this number sometimes due to inadequate facilities at the yard.

The remodelling involved the laying of 21 miles of additional metre gauge track and 15 miles of broad gauge track, additional transhipment platforms with a total length of 11,950 ft., and the provision of inward, sorting and despatch yards. The total track mileage in the yard at present is 31 miles for M. G. and 23 miles for B. G. Additional facilities include on the Broad Gauge, main line and two passenger loops 7,350 ft. long, and four reception lines, 2,500 ft. long, ten inward sorting lines of lengths varying from 450 to 1,250 ft. and six outward sorting and despatching lines length varying from 1,700 ft. to 2,260 ft. On the Metre Gauge two main lines and three passenger loops, 2,000 ft. long, four reception lines, 1,750 ft. to 2,250 ft. long, seven inward sorting lines 1,000 ft. to 1,800 ft. long, six outward marshalling and despatch lines 1,600 to 2,100 ft., ten finger lines for outward sorting 1,000 ft. to 1,900 ft. long and six additional transhipment platforms.

*** *** ***

SLEEPER COACH SERVICE INTRODUCED ON BOMBAY-DELHI AIR-CONDITIONED EXPRESS

The Western Railway has introduced the 3-tier type sleeper coaches on the Air-conditioned Express train between Bombay and Delhi with effect from 17th May, 1959.

This sleeper coach will be attached to this train in place of one of the ordinary III class coaches till now attached to this train.

Sleeping accommodation in the 3-tier coaches in this train service will be on the same terms and conditions, as in the sleeper coaches at present used on the Dehra Dun Express.

Sleeping accommodation will be provided between Dohad and Gangapur City in the Delhi bound train and Gangapur City and Dohad in the Bombay bound Express. A special surcharge of Rs. 3/- per night or part of a night per passenger plus a reservation charge of 25 nP. would be levied in addition to the existing III class fares.

A conductor would be posted on each coach to regulate the entry and exit of passengers to see that the coach does not carry more than the marked carrying capacity and also to generally look after the comfort and convenience of passengers travelling in the coach.

CRANES, TRAVERSERS, HOISTS, CONVEYORS, LIFTING AND MECHANICAL HANDLING EQUIPMENT SUPPLEMENT

New lift truck palletless handling system speeds movement of sugar at Southern Railway Pier

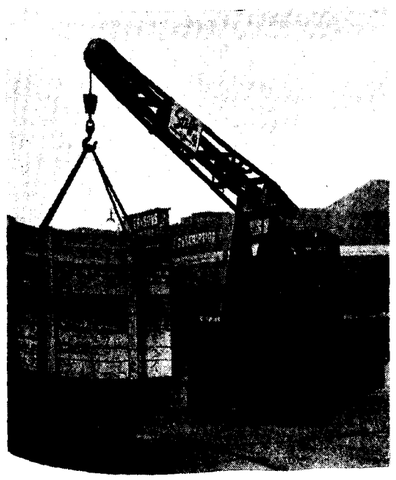
A system of palletless handling with a fleet of eight Yale lift trucks has greatly increased the efficiency and all but eliminated manual handling in the movement of about 110,000 tons of bagged raw sugar each year through the New Orleans Terminal Company pier of Southern Railway System at Chalmette Slip, Arabi, Louisiana.

By providing the flexibility and low maintenance impossible with a former overhead handling system, the new method permits one man operating a lift truck and his crew of two helpers to load out from pier into railroad cars approximately 425,000 pounds of sugar each day, the equivalent of five full box cars.

The trucks which provide the key to the system are Yale G-52 gasoline powered models of 3000 pounds capacity equipped with pusher devices which eliminate the need for pallets.

Bags of raw sugar are handled through a 78,000 square foot single story warehouse in the vast dock facilities which make up Chalmette Slip.

What makes the Staffa 3 Britain's top mobile crane?

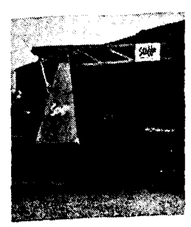


Hydraulic luffing, 10,000 lb. tested tipping load, manœuvrability, ease of maintenance and overhaul, 10 m.p.h. road speed. These and many others are the characteristics of the Staffa 3, which makes it one of the most efficient and reliable mobile cranes in the world.

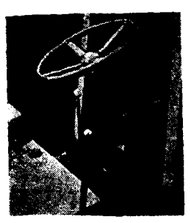
Rigorous testing and careful checking of the smallest details ensure that *every* Staffa 3 leaves our works in top working condition.

'Staffa 3' (2 to 3 tons) Semi-Slewing Mobile Crane is basically the same as the standard 'Staffa 3' but is partially reconstructed to enable jib to slew through an arc of 100 degrees.

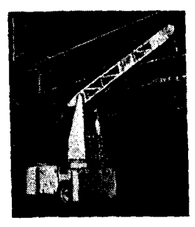
'Staffa 3' mobile cranes, petrol or diesel models, are available for quick delivery.



Will operate under a roof 10 ft. 6 in. high.



Standard car type controls enabling the crane to be operated by drivers with minimum training.



Extreme manoeuvrability and capable of turning within a very small radius.

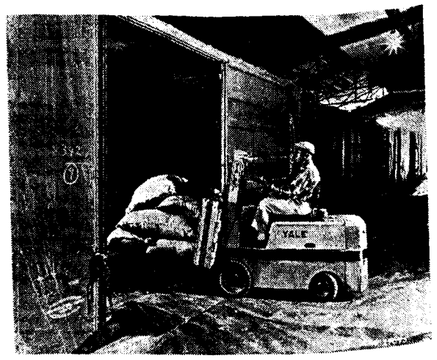
CHAMBERLAIN PLANT LIMITED

MEMBER OF THE CHAMBERLAIN GROUP OF COMPANIES

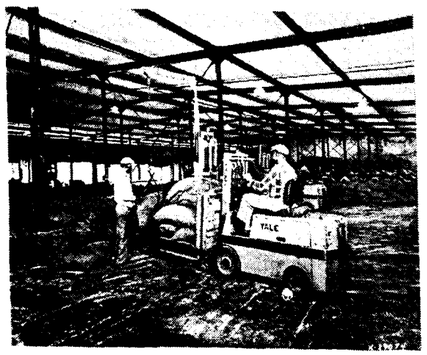
Crown Works, Southbury Road, Enfield, Middx. England.



The open rack design of dolley on which loads are stacked permits the entry of the forks of the Yale G-52 truck so that the load can be picked up directly on the forks without the need for a pallet.



From the stacking operation in the warehouse, loads are taken directly to box cars.



As soon as a load is built up by the old Yale engine-generator electric truck equipped with a boom attachment and a crew member working with the tongs at the end of the boom chain, the operator of a G-52 moves in to pick it up.



The compact overall design of the Yale G-52 permits easy manoeuvering inside the box car.

The Southern Railways System's handling procedure takes over after the bags of sugar have been placed in piles on the floor of the warehouse by a stevedoring concern.

Fifteen-year-old mechanical lift engine-generator electric powered Yale trucks which have become obsolete for normal handling operations at the Southern pier have been fitted with boom attachments in the Southern Railway shops to stack the loose bags.

A crew consisting of an operator of the engine-generator electric truck and a man standing on the floor to guide the boom pick up the individual bags in an attachment which resembles a pair of ice tongs and

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ANY PLACE—
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ASIAR

place them in interlocked stacks on an open frame metal dolley designed just for this purpose.

The spaces between the pipe frames of this dolley permit entrance of the forks of the G-52 truck under the load so that it can be picked up without a pallet.

While the operator of the gas truck moves his load to a waiting box car, the stacking crew readies another load on a dolley. Mobility of the engine-generator electric trucks permits easy movement among the bags on the floor as warehouse clearing progresses.

In the box car the load is put into position by the truck pusher attachment which slides it forward off the truck forks onto the car floor or on top of a stack of bags already placed. Compact overall design of the G-52 trucks permits easy manœuverability inside the car.

The pusher is of a low headroom design to permit stacking right up to the roof of a freight car when this is necessary to make up a full weight capacity load.

Individual bags of sugar weigh about 257 pounds and an average load transported by the G-52 truck weighs around 1500 pounds.

Movement of raw sugar from Cuba and Puerto Rico in this manner constitutes about 75 per cent of the materials handling conducted in this warehouse at Chalmette Slip. Occasionally the system is also used to handle bagged shipments of fish meal and bone meal.

Deputy Minister for Railways opens Third Extension of Kalyan Power House

The Third Extension to the Kalyan Power House of the Central Railway at Thakurli, near Kalyan was declared open in the evening of the 14th April 1959 by Shri S. V. Ramaswamy, Deputy Minister for Railways. The Deputy Minister, the General Manager, the Heads of Departments and other guests proceeded to Thakurli by a special train from Victoria Terminus.

Welcoming the Deputy Minister and the guests, Shri B. Arora traced the history of the Kalyan Power House from 1929 and explained the various changes by which the First, the Second and the Third extensions came to be provided. The present project known as the Third extension consists of one set of 18 MW with necessary electrical equipment, one boiler of 205,000 lbs./hour steaming capacity and two circulating water pumps of 20,000 gallons per minute capacity. Shri Arora went on to explain that with the completion of the Third extension, it would be possible to meet the present and the anticipated future requirements of the existing electrified sections and when electric traction on the Central Railway is extended beyond Igatpuri to Bhusaval, the additional requirements of power would be met from the Koyna project and other projects.

Speaking on the occasion, Shri S. V. Ramaswamy, Deputy Minister for Railways, said that he was very happy to participate in this function as this was the largest Power House being run by the Indian Railways and as Deputy Minister in charge of Railways, he was legitimately proud of this. Shri Ramaswamy also emphasised the importance of electric traction in the Bombay area which was fast developing a ribbon of Industries. Dwelling on the possibilities of electric locomotion in this country Shri Ramaswamy went on to say that this was still in its infancy and it was only recently that the electrification of nearly 1,400 miles on the Eastern and South Eastern Railways had been commenced and he hoped that within the Second Plan period, the electrification of at least 800 miles would be completed. Although he felt the steam locomotive cannot be altogether displaced, Shri Ramaswamy struck an optimistic note on the future electric traction in this country and speaking on the tremendous scientific achievements that the next 25 years might witness. Shri Ramaswamy indicated that scientific research might bring about many more changes in our conception of Railway locomotion.

Shri J. D. Malhotra, Chief Electrical Engineer, proposed a vote of thanks to the Deputy Minister, the General Manager and the distinguished guests for their presence at the function. After light refreshments, the Deputy Minister for Railways and the guests were taken round the installations by Shri B. Arora, the General Manager, Shri J. D. Malhotra, Chief Electrical Engineer and Shri Gupta, the Power House Superintendent.

The Thakurli Power House was colourfully and tastefully illuminated on the occasion and the entire colony wore a festive look.

Material handling Engineer's place in Modern Industry

By K. B. Khanna, A.M.I.M.H. (London)

MATERIALS and Mechanical Handling has become an indispensable factor in any factory, warehouse, contract or business.

The very origin of any industry, warehouse or business gives birth and deems the essentiality of Materials handling, as the science of Materials handlings starts at the source of raw material and continues till the finished product is in the hands of an ultimate consumer.

Ever since the stone age man has been confronted with the problem of moving materials. Through the years he has learned to apply certain principles of mechanics viz. — the lever, the wheel, the pulley and the inclined plane. This trial and error attempt has today developed one of the major science of engineering and a wide range of Materials handling Machines are in the Market which give precision movements and such machines have proved a boon to some industries and trades.

No matter what industry it is, it calls for a Materials Handling Engineer who should brilliantly plan the various handling problems involved in that particular industry. He has to keep in mind the area of the shop floor and then draw an economic picture of the movements of the raw materials, semi-finished materials, finished products, and so on.

The Materials Handling will have to prepare intelligent cost report of the various handlings and then see which Mechanical Handling equipment and machines could be used most effectively and economically.

To get most out of the available or existing floor space the Materials Handling engineer will have to use not only the most economical, but most efficient, speedy methods and equipment which does not affect the flow production and output under any circumstances. Since the floor space is becoming very expensive, methods will be explored and evolved by the Materials handling engineer how to store the maximum raw material and finished products effectively and efficiently. This storage will be done very methodically so that no damage is done and all sorts of accidents are avoided.

A very versatile equipment or machine will be employed by the Materials Handling Engineer. He will see that such a machine is switched in action which can do the maximum with minimum movement, e.g. in a warehouse or a store if stacking is to be done and if the stacking space is quite an extensive one and the heights or stacks are considerably high, then the ideal machine will be a full-circle slewing crane, as this crane will be able to swing 360° in either way, unload or pick at any angle and stack it at any place within the radius of the boom. If it was not a full-circle crane, for every position the crane would have to travel and the positioning would have to be done, a lot of room would be required for turning circle, which means the floor space now used for stacking would have to be left out for the turning of the crane. For higher stacking and considering the load with its physical dimensions, a fork lift truck with a monomast attachment could be considered but all is dependent on the material and a number of other factors.

The experience of Materials handling engineers shows that where mechanical handling equipment is not employed there, in many operations, as much as 60% of the time at the work is spent in handling materials. You will appreciate that 60% time wasted on Materials handling will considerably affect the production and in mass production increase the cost of the product and it is likely that you may go behind the schedule which can have a very adverse effect on your business.

A quality product must be handled to a mininum and by minimum handling we cut down the chances of damaging the product. So it is evident that "The part least handled is the part best handled." Moreover, every movement of the material is made at the expense of Time and Effort, which adds to the cost. Adding to the cost means making your product expensive and hence uncompetitive.

The continued upward trend in the costs and ever unceasing requirement for improved productivity per unit of time, both aspects of reduced production costs and increased output for both home and overseas markets call for improved and refined Materials handling.

Materials handling is an integral part of every industry and as a science, it is governed by the laws of engineering and economics, just like any other Engineering Science. It is for these reasons that Materials Handling Engineer occupies a vital position and has a big say in today's refined industrial age.

Terminal Handling of Goods Traffic

By A Correspondent

TWO major problems always face rail goods traffic terminal managements; how to reduce handling costs and how to increase throughput. The modernisation of rail transportation equipment should result in a greater volume of traffic handled per rail truck per journey, and per running mile. It should result in lower direct transportation charges. Unless it is possible to reduce the cost of handling wherever railway wagons are loaded or discharged, all other gains are nullified.

With increasing average load carried per mile and with increasing volume of goods passing along important railway routes, terminal handling problems become intensified. There is less time available to load or unload railway trucks and the dangers of terminal congestion of and detention to goods become very real. Fortunately, there is a whole range of mechanical aids to goods traffic terminal handling and



COLES Crane, model S88, loading rail trucks at a rail goods depot in England.



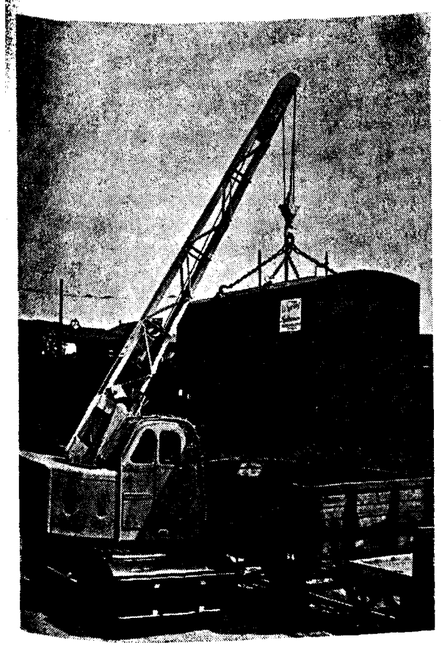
COLES Crane, model S410, loading a rail car. The crane is in service with the Canadian National Railways.

the railway transport systems have been quick to take advantage of them. Indeed, they have been in the van of proper utilisation of the latest plant for Materials Handling. They have found that the correct selection and use of mechanical aids speeds up terminal handling, frees valuable space and reduces goods handling costs.

Every single consignment handled by a railway network bears a charge for terminal handling regardless of the length of haul.

LOADING GOODS ON TO COLLECTING VEHICLES

Rail goods traffic may consist of bulk loose commodities, such as coal, gravel, sugar beet, and other agricultural products, or of bulk commodities



COLES Crane, model S88, unloading a railway container at a Railway Goods Depot.

which are shipped in large sealed units such as beer, milk, petroleum, sulphuric acid, cement, etc.. Or goods traffic may consist of prepacked unit loads, ranging from small parcels weighing a few ounces to containers weighing many tons.

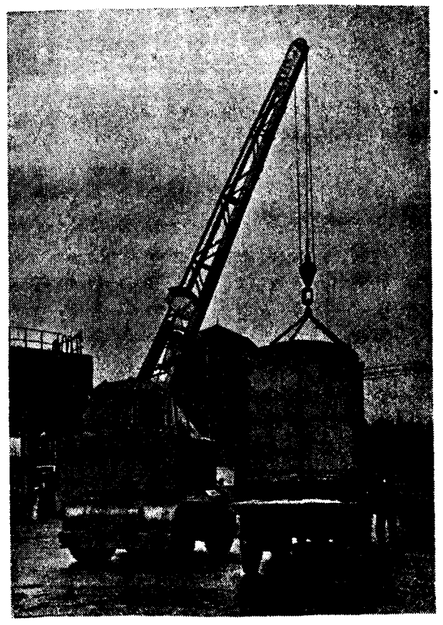
Unit loads may consist of cardboard boxes, wood crates, steel castings unpacked and unprotected, bundles of shovels or wire etc. Small packages may be assembled into larger boxes or crates, or unto pallets.

Whatever materials handling equipment may be employed in the customers despatch bays, the railway transportation authorities will always find it to their advantage to see that all collecting vehicles are properly served by suitable loading facilities and that the vehicles themselves are designed to take full advantage of handling facilities at the customers premises.

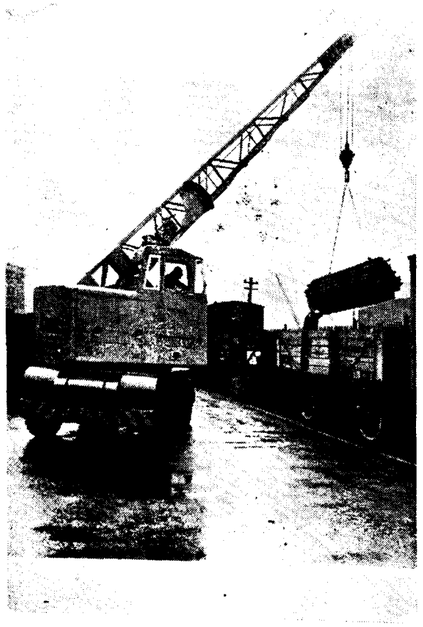
If the railway authorities have available at convenient centres a fleet of self-propelled and truck mounted cranes, any kind of load can be handled with speed and economy, and the waiting time of the vehicle is reduced to a minimum.

Terminal waiting time must be cut to a minimum if expensive transport vehicles are to prove profitable. A modern light powered diesel-electric mobile crane can load or unload the heaviest, largest or most awkward load with consummate ease, in a few minutes, thus perhaps saving hours.

Self-Propelled and truck mounted cranes can be equipped with a wide range of special load handling devices. There are available grabs of many kinds for handling loose materials such as coke and sand, electro-magnets for pig iron, steel ingots and scrap metal. For the handling of sheet steel, various types of automatic tongs, suction tongs and plate clamps are available as alternatives to the electro-magnet. Automatic tongs which require no slingers are also ideal for baled material, barrels and drums, packing cases, paper rolls, concrete slabs and many other such loads. For long loads there are equalising slings and spreader beams.



COLES Crane, model S1210c, owned by the British Transport Commission loading a railway container onto road transport at a Bradford goods yard.



COLES Crane, model S710, loading steel tubes to rail wagons. The crane is owned by British Railways, Glasgow, Scotland.

LOADING AND OFFLOADING RAIL TRUCKS AND WAGONS

Rail truck loading plant is, of course, also profitably employed for unloading. There are two basic types of unloading operation; those which are followed immediately by sorting and re-loading of storage: and those which are bulk transfers of load from one vehicle, truck or train to another.

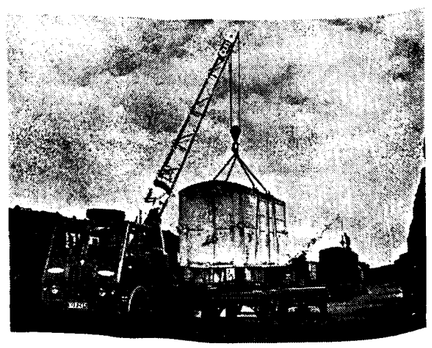
Mobile cranes equipped with searcher jibs are ideal when heavy loads have to be picked up from within covered rail vans or lorries. These can pick up—or set down— a heavy and bulky load in a remote corner of the van; they are particularly useful where large crated items are being handled.

Where one mobile crane must serve several railway stations a great degree of mobility is required and for this purpose a truck mounted crane able to travel at relatively high speeds is a wise choice. Such a machine combines the characteristics of a road vehicle with those of a self-propelled, full circle slewing crane. It is able to handle large railway type containers and can lift a container from a second line of railway trucks, working right over an adjacent line of trucks if necessary.

Container traffic is an important part of any rail operation and there are available specially designed mobile cranes for this type of work. Such machines are able to lift the largest of containers out of high sided trucks, even between two closed vans, which necessitates a clear vertical lift. The load can be slewed through any arc of the circle and the crane can travel with the container suspended on the hook until the road delivery vehicle is reached. In this way it is possible for mobile cranes to penetrate into railway sidings and to remove the heaviest containers.

A mobile crane has been specially designed in collaboration with railroad engineers to provide the solution to many of the railroad handling problems. Truck mounted, the crane employs diesel-electric transmission to give an accurate and delicate control of loads. Full circle slewing, specially reinforced cladding and a cantilever jib are important features.

Unlike the conventional type truck mounted crane, all motions—derricking, hoisting, slewing and travelling—are operated from the chassis cab. A swivel seat is provided so that the operator can swivel through 180° from the travel position to the crane operating position. This eliminates the necessity for the operator to transfer from a crane cockpit on the superstructure to the chassis cab every time chassis movement is required. Travel speeds up to 12 m.p.h. are available



COLES Crane, model 99622, specially designed for handling railway containers, at Great Yarmouth, Norfolk, England. The crane is one owned by British Railways.

(This is the special crane referred to in the article)

and the crane is also fitted with a two speed gearbox with the availability of an alternative gear ratio.

A diesel-electric rail crane, with its powerful shunting ability, can expedite independent wagon and train movement during unloading of freight and avoid the necessity of a shunting loco standing by when trucks are being discharged. Such a machine can, of course, load and discharge trucks and road vehicles as well as perform shunting duties.

TRAFFIC MOVEMENT AND SORTING SHED MECHANISATION

Major economies can be gained by sorting shed mechanisation. The aims are not only to increase the number of consignments handled and to make full use of available manpower and equipment, but to ensure that excessive labour is not employed and that no consignment of individual packet or parcel is put down, except onto a vehicle, conveyor, pallet or stillage.

What can be gained by a policy of sorting shed mechanisation? Consider these figures; there are more than one thousand railways systems in the world. One of the largest carries on average of one million tons of goods traffic every working day of the year which could comprise 200,000 separate consignments. Terminal handling cost of miscellaneous merchandise varies in an efficient railways system from 2/6d to 5/- per ton. The expenditure on terminal handling in such a system would be of the order of £187,500 per day.

It will be obvious therefore that even a modest saving of say 10% in the handling costs would result in a substantial contribution to the operating profit of such a railway system or alternatively, in an appreciable reduction in freight rates. The terminal handling costs of road-hauled merchandise are heavy and the sorting sheds are not always ideal for achieving minimum terminal handling costs. Nevertheless, the use of carefully selected modern machines will do much to minimise the cost of loading and unloading goods.

Sorting shed mechanisation will reduce rail and road terminal handling costs and will enable greater advantages to be gained from vehicle or truck loading and unloading facilities.

Where a power-driven moving slat conveyor is installed, road or rail consignments of light packaged goods are handled economically but if is a far better practice for heavy items to use the flexibility of mobile cranes for the purposes of handling these, as they are capable of carrying and stacking their own heavy loads or transferring these loads to their means of conveyance without the aid of any other mechanical apparatus.

A battery-electric tractor, equipped with steel-faced buffers, is ideal for moving rail wagons right into the sorting shed, thus relieving the shunting locos. Such a tractor is fumeless, free from fire risk, and highly manoeuvrable, making it ideal for work inside the shed or in the congested goods yard.

Mobile handling equipment should be kept fully employed. This may be achieved by sharing amongst several small stations or depots.

Where muscle power is still employed, one man normally moves 2 cwt. of goods at say 2 m.p.h. with the aid of manually-propelled barrows, but this is often followed, as a rule, by double handling and re-handling over and over again, so that the overall costs and times are heavier than is apparent from a study of direct manual haulage of traffic on station platforms and in sorting sheds. If mechanised methods are employed, the costs and time of handling will be cut to a fraction of what it was.

Global Tenders for Tyres and Wheels

The Railway Board has invited global offers for the supply of nearly 11,500 locomotive tyres of various types and about 1,400 wheels. The present offer represents our requirements in excess of what is produced in the country.

The estimated cost of the materials ordered is slightly over Rs. 38 lakhs.

* * *

TWO RAILWAY YARDS REMODELLING SANCTIONED

The Railway Board has sanctioned a scheme at a cost of about Rs. 9,00,000, for the provision of a subsidiary marshalling yard at Narayanpur Anant on the North Eastern Railway, three miles from Muzaffarpur.

The Board has also approved the provision of additional facilities in the railway yard at Kanpur-Anwarganj, on the North Eastern Railway, at a cost of nearly Rs. 5,00,000.

MECHANICAL HANDLING OF GOODS

By An Engineering Correspondent

THE aim of industry all over the world is to produce more at lower costs and there can be little doubt that one of the heaviest charges on production is the cost of handling and moving goods. These costs are often large and unfortunately they add absolutely nothing to the value of the goods produced. In many industries elaborate measures are taken to check and reduce manufacturing costs, but the study of movement of goods is largely ignored and old fashioned and time wasting methods are retained, adding needlessly to the cost of the goods produced.

The handling of goods can never be eliminated but the battery powered truck, in its many forms, can and does reduce the costs involved in moving, stacking and warehousing materials and finished products. A power operated truck system keeps pace with increased production and greater loads are moved at faster speeds using less labour. To give a very rough indication of the saving possible, in labour costs alone, compare a hand truck moving 6 cwts at 2 m. p. h. with a power truck moving 30 cwts at 5 m. p. h. Obviously, even allowing for the truck driver to be better paid than the labourer with the hand truck, the hand truck costs will be about 12 times the cost of the powered truck. This does not take into account the delays incurred in loading and

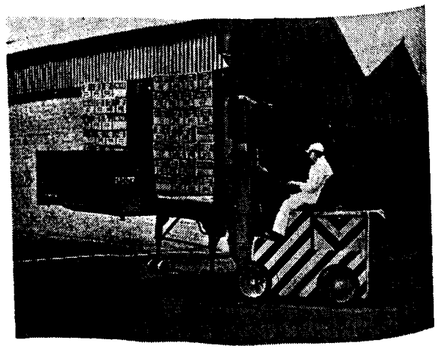


An Electric Tractor and a Forklift Truck being used in conjunction with one another. The Tractor is bringing palletised loads on trailers from factory to warehouse and a forklift truck is stacking goods or loading for despatch.

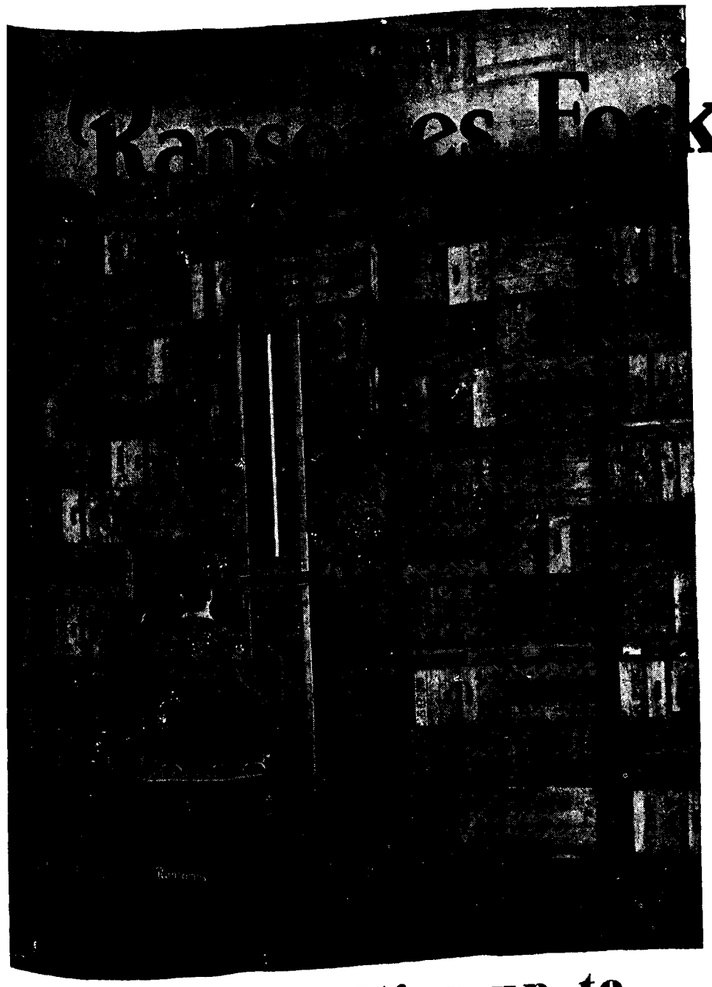


Forklift Truck, with special clamps, handling cartons of foodstuff in cold store.

The Electric truck is ideal for working in such conditions. The low temperature has no effects on the running of the truck, and there are no contaminating exhaust fumes.



Forklift Truck stacking palletised loads of cartons on to lorry for despatch.



Ransomes Forklifts

THE FIRST NAME Ransomes IN TRUCKS

with capacities up to 5000 lbs.

Sturdy, Reliable, Silent —

capable of lifts up to 14 feet, with a wide range of special platforms and gripping clamps, Ransomes Forklifts Trucks ensure quicker, more efficient handling for all types of off-loaded goods.

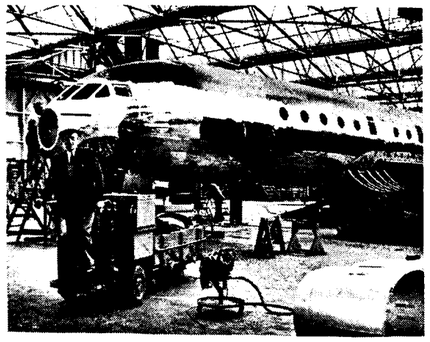
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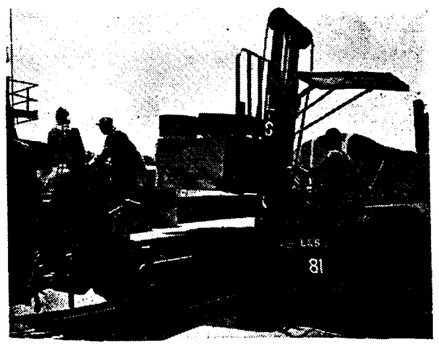
RANSOMES SIMS & JEFFERIES, LTD., IPSWICH, ENGLAND.



An Elevating Platform Truck with stillage servicing the assembly line in an aircraft factory.

unloading, which could be eliminated altogether by using an electric truck and a quantity of stillages.

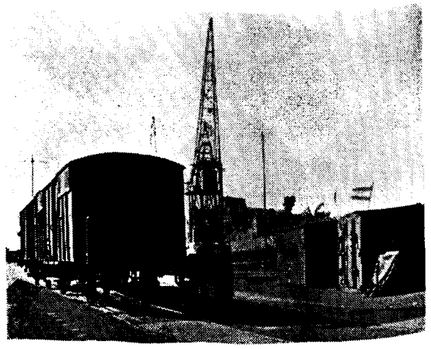
The Platform Truck is made in two forms, one with a fixed platform and the other with an elevating platform. The former replaces directly the hand barrow but has a far greater capacity and speed. The load is placed on the platform by hand or other external means, or perhaps run up a ramp at the side or end of the truck. These trucks are useful on large railway stations transferring mixed loads from baggage depots to vans and vice versa. When fitted with suitable tanks they are also employed in servicing the trains. The absence of exhaust fumes, the silent running and manoeuvrability, and ease of operation combine to make the platform truck the ideal machine



Forklift Truck fitted with special hydraulically operated clamps, loading barrels on to Railway wagons.

for all station work. These platform trucks are also used by many Dock and Harbour Authorities, for moving goods unloaded by crane from ships holds. The same chassis can also be fitted with a tipping hopper to deal with such materials as sand, ore, clay, ash, fertilisers, etc., where the commodity is handled in bulk.

The Elevating Platform Truck has a platform that can be raised hydraulically about 5 inches and is used in conjunction with a stillage system. The truck is driven under the stillage, the platform and stillage are raised and the latter is driven to the spot required and deposited by lowering the platform. In this way time is saved at loading and unloading points, the truck is constantly on the move, and since one truck can serve a number of stillages, it could under certain circumstances do the work of two or three



An Electric Tractor shunting rail wagons on dockside. (Hook of Holland).

fixed platform trucks. In production plants raw materials can be taken to a machine and finished articles brought back to a loading bay or store, obviating any stacking at the production line. On a dock side the stillage system is used extensively for transporting unloaded cargo to transit sheds for storage.

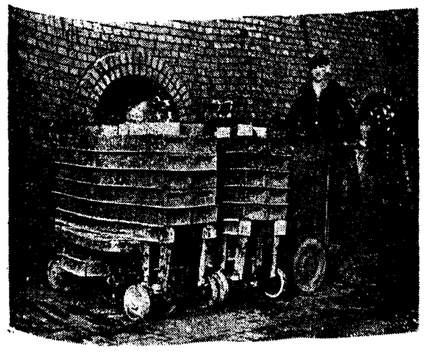
The stillages themselves are made to suit the particular type of work, the most usual being of platform or box type standing on rigid legs. Where, however, loads are taken into lifts, stillages are fitted with wheels, the truck takes the load to the lift gates and the stillage is wheeled into the lift and on arrival at an upper floor another truck can take over the load or it can be manhandled to the required position.



A Hopper Truck (capacity up to 36 cu feet) at work.

The platform truck capacity varies from two to four tons and it should be remembered that these trucks will pull or push trailer loads of double their capacity. They are easy to drive in either direction and at all times the operator has a clear view both of the load and the road ahead.

Another type of power truck with a wide sphere of usefulness is the crane truck fitted with a jib crane of about ½ ton capacity which can lift the load onto its platform from either side. In railway stations or goods yards the crane truck does a useful job of work and eliminates much manhandling in delivering loads direct into wagons or vans.



A Two Ton Elevating Platform Truck at work in a brickworks. An example of the use of special wheeled stillages so that the bricks can be placed directly into the kilns.

The electric tractor is also popular and in some cases can be used to a greater advantage than an ordinary platform truck. These tractors can haul loads of up to 25 tons on a hard road or 50 tons in rail wagons. One tractor can keep three trains of trailers going, one loading, one unloading and one in transit. In freight yards or on quays they can also do shunting operations.

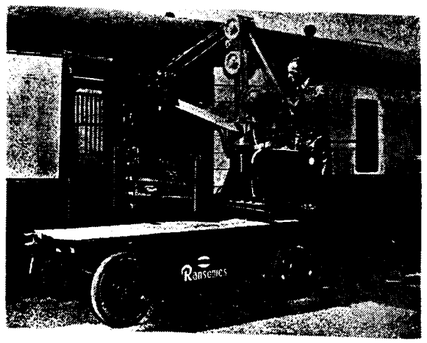
Almost every industry to-day can find a use for a Forklift Truck, which, with standard equipment or special attachments can pick up, move or stack a bewildering range of goods ranging from bales of wool or cotton, paper rolls, cartons, coils of wire, motor tyres, drums of oil, liquid in barrels, timber, iron, bars, sheet steel, sacked goods like sugar or fertilisers, crates of bottles, etc. In fact the Forklift



A Fixed Platform Truck, with trailers, receiving cargo by crane from ship's hold, and transporting loads to transit sheds.

Truck has become the most versatile appliance in mechanical handling. In recent years the use of pallets has greatly increased and movements of loads of goods can now be carried out speedily and safely. The pallet is a flat platform, usually made of wood, on which cartons, boxes, metal sheets or other commodities are stacked up to about 6 feet high. The forklift picks up this load, raises it while travelling, and deposits the whole load into a van or railway wagon or stacks it in a warehouse. In the latter instance no shelves or bins are needed and pallet loads can be stacked three or four high. Storage space, time and labour are saved and the job is done more neatly than manual labour could achieve. Palletisation can mean a lot to

Railways as it affords an easy means of door to door transport hitherto the perogative of road haulage. Special pallet vans are being used, and with a forklift truck at each end of the journey loading and unloading are reduced to a minimum and no damage is done in handling.



A Platform Crane Truck loading direct into a railway goods van.

In general the electric battery vehicle, in any of its many forms, is rapidly becoming the popular machine for material handling, and the following factors help to make it so much sought after to reduce movement costs in transport and industry.

Materials handling involves very frequent starting and stopping and few forms of power can be efficiently applied to such conditions and any form of power with a constantly idling engine can never be really efficient. High torque at low speed is required and this is just what an electric motor can give, but it can only be achieved by an internal combustion engine by frequent and rapid acceleration causing strain and wear on engine and clutch. Not only does the electric motor give high torque at low speed but the battery delivers full power instantly to the motor and just as quickly power can be cut off, with no loss whatsoever during stops.

Low operational and maintenance costs. Almost everywhere electricity is the cheapest form of power and its cost remains steady. The truck only uses power while actually at work. Instant starting, whatever the weather means the truck is always ready for work. With no complicated reciprocating mechanism the electric motor is very easy to keep in order and 'one-shot' lubrication systems now fitted mean that moving parts are adequately lubricated while the truck is at work. "Out of Service" time is reduced to a minimum and a very small maintenance staff is necessary.

The electric truck is clean and silent in operation. There are no fire risks and no dangerous exhaust fumes.

Finally long life; a battery, well looked after will give about five years satisfactory service and 20 to 25 years is reckoned to be the average life of a truck.

New Railcars in Spain Save Time

As from the 10th February this year, new railcars have been in service on the lines of the *Compania, General Ferrocarriels Catalanes*. These new units cover the distance between Borcelona and Igualada in 1½ hours; the trains in service on this same line before the introduction of the railcars took 2½ hours for the same journey.

The new vehicles are of German construction; they are fitted with two diesel engines of 150 h. p. each, placed under the floor of the coach; they can carry 52 passengers and haul a trailer of identical design to that of the power coach.

The units are also equipped with well-appointed toilets with hot water. For the driving coaches, the hot water is provided from the engine cooling system; in the case of the trailers it is supplied from an oil-burning boiler situated in the trailer itself.

The authorities of Barcelona and Igualada took part in the inaugural journey of this new service, and the General Director of the Railways went to Barcelona for this occasion (C. I. C. E.)

* * *

MORE ROLLING STOCK FROM SWITZERLAND

The C.F.F. have decided to buy 30 first class coaches of a modern uniform type for the shuttle service trains, as well as 30 couchette coaches, 2nd class, destined for international service. These coaches made up of closed compartments with accommodation for six persons constitute a kind of sleeping car within reach of everybody. These coaches can also be used during the day as ordinary coaches for through trains (C.I.C.E.)

Importance of Material Handling

By *K. B. Khanna*, *A. M. I. M. H. (London)*

WE are passing through an important phase of Atomic-Industrial age, where the rate of evolution is so accelerated that all parts of the globe are set in a race.

In this Atomic Industrial age the naked eye of human being is focusing on mechanisation and automation to handle all scientific and engineering developments. In all the modern engineering refinements Mechanical Handling is playing a vital role, and as a matter of fact Mechanical & Material Handling has become a part and parcel of any industry small or big.

Any industry which wishes to survive in this fast and competitive age must organise itself to the most economic and modern way.

To operate this modern economy the science of Materials Handling must be switched on in a way so that the movement of materials is rationalised and minimised.

Today the human muscle is too perplex, and expensive for any industrial organisation which is engaged in flow line production to use for mere lifting, moving and stacking.

True, in some parts of the globe still the expensive muscle is engaged as the motive power, but you may be rest assured that this cannot remain much longer. Not only is the enormous saving which matters, but imagine the time saved. Time saved means advancement which keeps you ahead of your competitor. This does not bring an end, but the standard of living and the dignity of the human race is closely linked with this.

All production experts and efficiency engineers shift the load from man to machine to handle at a faster rate for cheap and faster production.

Materials Handling is inherent in and essential to all industries in one form or the other.

Handling, transporting and storing the goods all add greatly to their ultimate cost to the client, but in no way do they increase the value of the goods.

In a world where everyone today is ambitious, floging after money and higher standard of living, the only way these costs can be cut down and time saved is by mechanisation. Behind one worker in U.S.A. there is 8 HP of mechanical aid, behind one European worker 2½ HP and behind one Asiatic 1/10th of a HP.

So it is quite evident that for prosperity higher standard of living and a profitable business for a businessman, the only way left is to mechanise his materials handling. There is a wide range of machines used in Materials Handling, e.g. Portal Crane, Mobile Crane, Overhead Crane, Rail Crane, Truck mounted Crane, Barge mounted Conveyors, Fork Lifts, Magnet and grab attachments and many more.

All these Materials Handling aids as you can call them are today incorporated with modern refined features of the engineering and further researches are being carried out by the specialists to mechanise these machines.

Not only the mechanisation is of importance but certain fool-proof devices are a necessity in Materials Handling.

Since the range and the scope of these mechanical handling machines is so wide that in nearly every part of the globe, the planners, engineers and contractors are wrestling with the problem of how best to utilise the modern high-speed Mechanical & Materials Handling aids in the execution of their jobs.

Materials Handling comprises of three main advantages (viz.) :—

(a) Economic Advantages

(b) Production Advantages

(c) Human Advantages.

Economic Advantages include lower production costs, indirect labour cost cut, lower operating costs in loading and discharging cargo, elimination of demurrage, less material to be scrapped, less damage to finished goods and finally reduced overheads resulting from increased output.

Production Advantages lead to increase output from the same plant, greater productivity of skilled workers. Better use of production floor space and improved quality of production.

Human Advantages account for fewer accidents, more men are employed in the skilled nature of work, leading to improve working conditions and hence improved labour relations.

These facts lead us to believe that :—

1) Mechanical Materials Handling Reduces Time, Cost and Effort.
2) Mechanical Materials Handling accelerates Production, Leisure & Safety.

While concluding on the subject, the only thing I can say is that Materials and Mechanical Handling is a MUST for every industry.

New S.N.C.F. Bar-Coaches (France)

A bar-coach of a new type has just been placed into service on trains 1 and 2 between Paris and Bordeaux; it is the first of a series of eleven coaches being fitted out.

This coach includes a spacious bar compartment, with a bar counter 4.45 metres in length, equipped with a coffee machine. In an adjacent compartment fitted with a "snack-making" apparatus, grills and simple dishes are prepared. Four 2nd class compartments are situated on the other side.

This arrangement enables passengers to be served at the counter with drinks, sandwiches, cold dishes, (ham, chicken, cheese, fruit cakes), and hot dishes of simple preparation (ham and eggs, omelette, grills, sausages, sauerkraut, weish-rarebit). Service is carried out by two attendants of the International Sleeping Car Company.

The programme envisaged in agreement with the above-named Company, for the placing into service of these vehicles, includes several methods of utilisation :

1. Replacement of the 'Itinerant sales' in trains where this is no longer sufficient to satisfy the clientele;
2. Replacement of buffet-cars or restaurant cars where these do not pay;
3. Equipment of supplementary trains doubling regular trains which include a restaurant car;
4. Creation of additional service in trains where the restaurant car is insufficient to satisfy the whole clientele.

The utilisation of this first bar-coach on trains 1 and 2 as an integrating service has given convincing results. During the first days of operation, daily revenue reached about 60,000 frs. without a reduction of that of the restaurant car.

Passengers have been very satisfied with this service and have appreciated the possibility of taking a simple, light and economical meal. The warm dishes most in demand are ham and eggs (250 frs.) and omelettes (200 frs.). (C.I.C.E.)

* * *

METRIC STEEL TAPE MEASURES

The move for introduction of metric system in the country originated as early as 1867 and an Act of Government of India was passed in 1871. The Act, however, remained inoperative. The question again assumed national importance immediately after independence. In 1948, the ISI set up a Special Committee for the purpose of recommending to the Government a uniform system of weights and measures to be adopted throughout the country. Following the recommendations of that Special Committee, the Government of India decided to replace the existing weights and measures in use in different parts of the country by metric weights and measures, within a period of 10 years. Necessary legislation for this purpose (Standards of Weights and Measures Act, 1956 - Act No. 89 of 1956) has already been passed and steps are being taken to effect the changeover.

At the instance of the Standing Metric Committee of the Government of India, the Indian Standards Institution undertook the preparation of a series of Indian standards for commercial weights and measures; the following specifications having already been issued.

IS :	1056–1957	Commercial Metric Weights
IS :	1057–1958	Metric Carat Weights
IS :	1058–1958	Commercial Metric Capacity Measures (flexible)
IS :	1059–1957	Commercial Metric Length Measures (Non-flexible)
IS :	1269–1958	Metric, Woven Metallic Tape Measures.



PERMANENT WAY ENGINEERING SUPPLEMENT

Vossloh High Tension Spring Washers for Railway Permanent Way

HEAVY DUTY SPRING WASHERS

THE design and construction of railway permanent way requires in most cases the use of a screw or bolt as the main fastening element. The purpose of the screw is to hold together the individual components of the track. In particular the screw has the function of maintaining contact between the railfoot and the sleeper with maximum possible pressure. This pressure is necessary to reduce rail creep and to give the track some lateral stability. This is particularly important where long length welded rails are in use.

The screw is subjected to considerable tension and it is essential to maintain this tension Z. The best possible means of maintaining tension is by the insertion of a spring washer, a component which is most usefully used either below the head of the screw or behind the nut. The spring action should therefore be equal to the tension Z on the screw. The function of the spring washer is to take up all deformation and changes in position of the complete assembly, and to compensate for the load on the screw so that only a very small loss of tension $\triangle$ Z occurs in the screw itself. (Fig. 4.)

Deformation of the permanent way is caused by the varying loads imposed on the track. These loads are firstly elastic and are of short duration caused by the passage of each axle over the sleepers. The second is a permanent deformation which increases slowly as e. g. by the plastic compression of the base plates and sleeper surface or by gradual wear on the individual components of the track. The spring washer must be able to compensate for both types of deformation and can only give satisfactory results if the spring characteristics, that is to say the relationship between spring load and spring movement, are sufficient to compensate for the expected degree of deformation. The spring characteristics are dependent on both material and on the cross sectional area of the steel but particularly to the exact shape of washer.

The variations in tension + or − $\triangle$ Z (Fig. 5) must be controlled by the elastic deflection of the spring

Fig. 1



Fe 7

Fig. 2



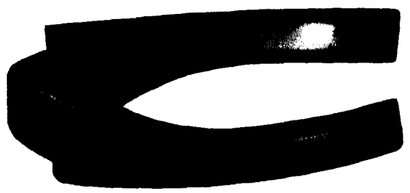
Fe 6

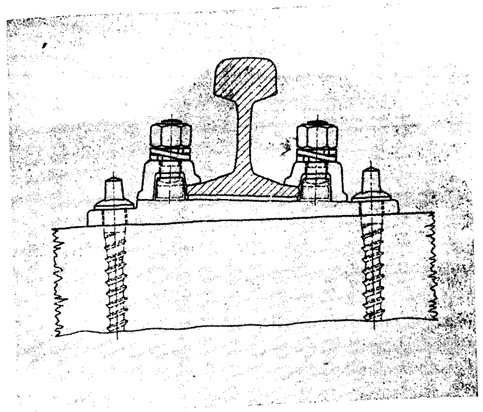
Fig. 3

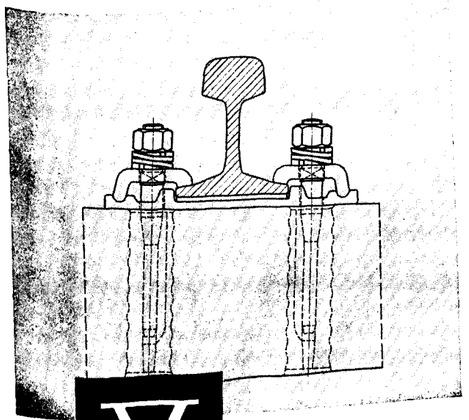


Fe 19

Fe 6







Fe 19



High Tension Spring Washers for Permanent Way

Fe 7



VOSSLOH-WERKE GMBH

WERDOHL-WESTFALEN · GERMANY

washer, and must be carefully considered from the angle of fatigue (Fig. 6), resulting from millions of stress changes over the life of the track.

Screws carrying a high load, as is generally the case with railway permanent way, require heavy duty spring washers. These are so designed that they are not in the form of a regular spiral but that they include corrugations in their coil, these corrugations being of particular size and shape. If these spring

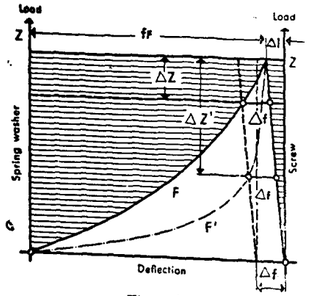


Fig. 4

Determination of reduction in tension load △ Z from the deflection load diagram of spring washer and screw shaft

f_F = *compression of spring washer at Z (t)*

$\triangle_l$ = *elongation of screw shaft at Z (t)*

$\triangle_f$ = *vertical deformation of design structure*

with a good spring washer

F = spring characteristic △ *Z = reduction of tension load*

with unsatisfactory spring washer

F = spring characteristic △ *Z' = reduction of tension load*

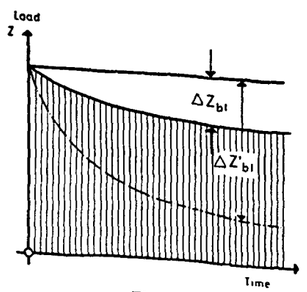


Fig. 5

Reduction in tension load △ Z_{bl}

as a result of permanent deformation △ f_{bl} *in design structure*

(△ Z'_{bl} *gives the conditions with the use of an unsatisfactory spring washer)*

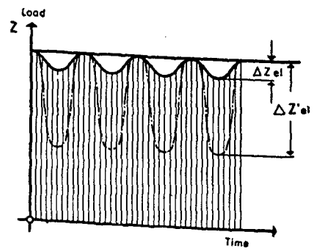


Fig. 6

Reduction in tension load △ Z_{el}

as a result of elastic deformation △ f_{el} *in design structure*

(△ Z'_{el} *gives the conditions with the use of an unsatisfactory spring washer)*

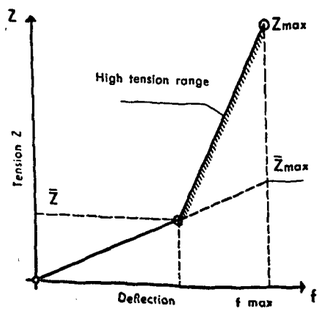


Fig. 7

Deflection diagram of heavy duty spring washer

washers are gradually loaded, a very soft springing results as shown in fig. 7 but resulting from the existing torsion loading, as soon as the coils reach a predetermined pressure $\bar{Z}$, the springing becomes harder, simultaneously a considerable increase in resistance arises which has the result of compressing the corrugations in the coil.

The compression potential of the spring washers is very considerably increased by the special corrugations in the coiling. The maximum compression strength Z max is reached at the maximum actual compression f max. Without the additional bending moment, but purely operating as a simple coil spring, the spring washer could only carry out its function for a far smaller value of $\bar{Z}$ max.

The only yardstick for measuring the capacity of a spring washer is its ability to accept stresses under heavy loading conditions.

The Deutsche Bundesbahn as well as many other railways have been successfully using for many years the main types of heavy duty spring washers e. g. the single spring washer type Fe 7, the double spring washer Fe 6 and the triple spring washer Fe 19 (see figs. 1 to 3).

The main consideration when comparing the three types is that the increased number of coils enables the number of corrugations to be increased that is to say to increase the range, which means that the spring washer under heavy duty conditions becomes more resilient and therefore more efficient.

In practice the maximum value Z max is not used. The spring washer is only compressed with a load of approx 3 tons and has the result that the loading of the spring washers remains entirely elastic.

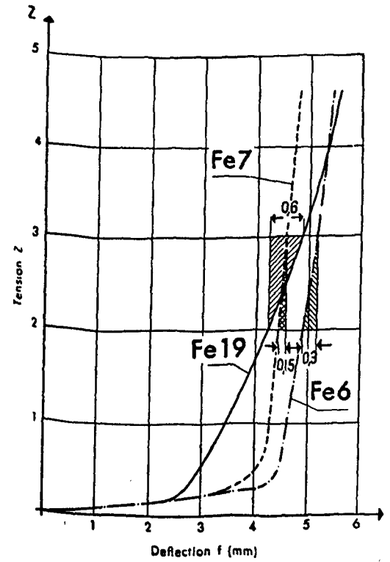


Fig. 8. Characteristic curves of three types of heavy duty spring washer.

Fig. 8 shows in graph form the characteristics of the three types of spring washer. From these curves the capacities are clearly seen, e. g. with a load of △ Z = 1 ton using spring washer Fe 7, Fe 6 and Fe 19, the spring movement △ f = 0.15, 0.30 and 0.60 mm. respectively i. e. ratio 1 : 2 : 4. On this basis one would therefore use the single coil type washer Fe 7 in such cases where track conditions lead to low working deflection value in the fastening, the triple coil spring washer Fe 19 on the other hand would be used when relatively high values △ f are expected and the double coil spring washer Fe 6 is the washer which is used most frequently for average conditions.

It is always advisable when choosing the type of washer to use the heavier type in all borderline cases because the difference in price between the various types is of secondary importance.

The screw has certain advantages, particularly that it can be easily tightened, so that it is possible to compensate completely for plastic deformation or wear of the components. Frequent tightening means, however, increased maintenance costs, and it is certainly more economic and generally better practice to make use of an efficient heavy duty spring washer under the head of the screw, because the tightening operation becomes necessary less frequently or can under certain conditions be dispensed with completely.

The life of a spring washer is mainly a question of its strength under continuous varying load. This is dependent on various factors, e. g. material, surface loading, wear resistant properties of the bearing surface, corrosion conditions and particularly the fact that even under good conditions only a small vibrating load △ Zel can be absorbed for long periods. From this point of view it is therefore a major advantage to use an efficient spring washer. The greater the length of the corrugations in the spring washer coil, the lower will be the change of loading with a given spring movement △ F.

The life of a screw in a wooden sleeper or in the wooden insert of a concrete sleeper is also dependent on the factors Z and △ Zel. An efficient spring washer with a high resilience characteristic therefore guarantees satisfactory seating of the screw for long periods.

Railway managements must decide for themselves which type of spring washer is most satisfactory for securing the various types of screw used in their track. They will require each type of washer to be supplied in bulk with maximum possible similarity, that is to say that variations in spring characteristics between individual washers must be a minimum.

Our products prove beyond doubt that this objective can be attained.

The particular characteristics of our spring washers are determined by very careful selection of materials, accurate manufacturing with consistent precision of form and heat treatment.

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Dimensions of the Deutsche Bundesbahn

Bolt-Diameter		Inside ○	Cross Section Width × Thickness	Type	Designation	Weight in kg each
"	mm	mm	mm			
3/4"	20	21	9×5	double coil	Fe 8	0,058
7/8"	24	25	10×6	double coil	**Fe 6**	0,090
			10×6	single coil	**Fe 7**	0,050
7/8"	24	26	10×6	triple coil	**Fe 19**	0,145
1"	26	28	12×6	double coil	Fe 15	0,126
			12×6	single coil	Fe 16	0,070

High tension spring washers of other dimensions than stated above can be supplied on request.

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New Chairman, Railway Board

By Our Correspondent

As we go to press we learn that Shri Kailash Behari Mathur, Member, Transportation, Railway Board has been appointed as Chairman, Railway Board in the place of Mr. P. C. Mukherjee who has proceeded on leave preparatory to retirement from railway service.

Shri Mathur is an authority on operating and commercial aspects of railway affairs in India. He has personally studied railway systems in America, Europe and the Far East. He is of firm conviction while our railways have much to learn from the railways abroad, we have also something to teach them too. Proof of his conviction lies in comparative operational efficiency statistics showing India as one of the world's leaders in this field.



Shri Kailash Behari Mathur—our new Chairman

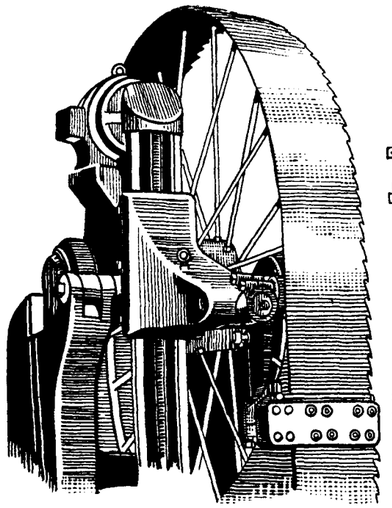
As Member, Transportation, Railway Board he has done quite a lot to tone up operational efficiency. In particular he put down inefficiency in every branch of operation and drove men hard to get more work out of wagons that were available and extracted the maximum advantage out of available line capacity.

It will not be out of place if we mention in this context a few words about his service during the last war. Shri Mathur was specially selected for the Post of Miltraff in which capacity he served as Chief Liaison Officer in charge of large-scale rail movements of men and materials to the Burma front. After the war, he undertook an extensive reorganisation of rail movements in coal fields to step up transport capacity which took him nearly two years.

Shri Mathur has been intimately connected with the formulation and implementation of Second Five-year plan of the Indian Railways. He is responsible for securing the three World Bank loans totalling $ 225 million for the development and modernisation programme of the Indian Railways during the second plan period. As Chairman, he has now added responsibility in formulation of the third-plan and we are sure under his able guidance and expert advice INDIAN RAILWAYS are bound to progress and earn a name as the best railway system in Asia.

We may mention here that Mathur is the first Operating man to be appointed as Chairman of the Railway Board as hitherto this coveted post has been the monopoly of Engineers only.

Shri Mathur is one of the regular contributors to the "INDIAN RAILWAY ENGINEER" and we are proud that the honour has been bestowed upon one of our distinguished contributors. We wish him long life, prosperity and all success so that he may serve the country for many more years to come. JAI HIND!



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New Machine for Automated Production of Railway Sleepers

A fully automated machine for trimming, marking, adzing and boring railway sleepers at the rate of ten per minute has been designed and produced at the Rochdale Factories of Thomas Robinson and Son Ltd. Orders for the machine have already been placed by British Railways for their Greenhill and Hayes Depots and by the Southern Railway, Madras State, India. Models of an earlier machine, the MJ/T, are already installed at Dhilwan and Clutterbuckganj.

The machine is controlled by one man from a central panel. Special attention has been paid in the design to obviating stoppages caused by occasional faulty sleepers. The possibility of auger breakages has also been greatly minimised by arranging for the boring heads to rise and fall with the augers, and guides have been provided which give support to the augers right up to their point of entry into the sleepers. The machine can, therefore, be relied on to produce at a constant rate over long periods.

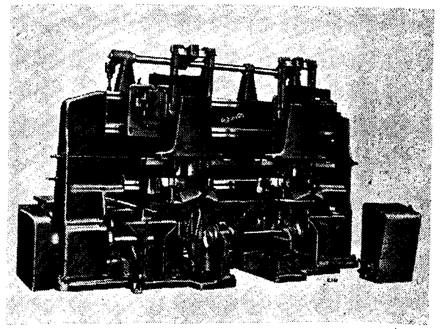
Briefly stated, the procedure is that conveyor chains feed sleepers into the machine where they are trimmed to length, trenched to seat the rail chairs and bored for the hold-down spikes or bolts, in one continuous sequence. Sleepers for tracks of any gauge from one metre to 5 ft. 6 in. can be handled, as can sleeper lengths from 6 ft. to 9 ft., nominal widths of 8 in., 10 in., or 12 in., and nominal depths of 5 in. to 6 in.

The design of the machine, which is known as the EJ/T, is such that it can be incorporated in a planned flow production line, with sleeper handling equipment and a Robinson timber incisor which prepares all four sides of the sleepers for deep penetration of preservative. The infeed and outfeed conveyor speeds of this latter machine are arranged to provide an evenly spaced flow of sleepers to suit the production rate of the adzing and boring machine.

The EJ/T adzer and borer is motor driven throughout and comprises an infeed conveyor, a cross-cut saw, the main adzing and boring section, the necessary feed mechanism and an outfeed conveyor.

The infeed conveyor consists of two steel chains with suitable dogs, driving shafts, supporting channels and chain tensioning arrangements. The drive for the conveyor is taken from the machine's feed gearbox by a heavy type chain.

The 24 in. cross-cut saw which trims the sleepers is an optional feature and is placed beside the infeed conveyor before the adzing heads. It has horizontal adjustment to accommodate sleepers from 6 ft. to 9 ft. long and can be built on either side of the machine.



Out-feed end of the Robinson Adzing and Boring Machine showing the boring heads. The control panel is on the right.

The saw spindle is mounted on ball bearings and is vee-belt driven from a 10 h. p. totally enclosed, fan-cooled, high torque, s.c.r. motor. A hinged front portion of the table allows quick and easy access to the saw for removal and replacement.

There are two independent, horizontally adjustable, adzing spindles, each mounted on ball bearings and vee belt driven from a 10 h. p. totally enclosed, fan-cooled, high torque, s. c. r. motor.

Each spindle carries a solid two-knife cutterblock with 11" diameter normal cutting circle suitable for working chair seatings up to a maximum of 22 in. long. Cutters can be set for either horizontal or angular (1 in 20) seatings. Shoulder cutters are fitted to leave a clean shoulder to the adzed seatings.

Hinged combined exhaust hoods and cutter guards are provided, allowing quick access for changing cutters without breaking connection to exhaust

system. Each exhaust hood has a flexible nose piece to assist in catching chips over the uneven top surface of the sleeper. Chip baffle boards are also fitted to assist exhausting.

There are two independent, horizontally adjustable, boring head units, which may be set to bore any number of holes up to four at each end of the sleeper and at either vertical or angular (1 in 20) settings.

The ball bearing boring spindles in each unit have universal joints and are adjustable between centre settings of:—

	in width of sleeper	in length of sleeper
Minimum	2½ in.	4 in.
Maximum	6½ in.	17½ in.

The angularity of these joints has been kept low and each joint is totally enclosed in a dust-proof and grease-loaded cover.

Each boring head unit is driven by vee-belts from a 10 b. h. p. totally enclosed, fan cooled, high torque motor through a ball bearing gearbox with lubricated hardened gears.

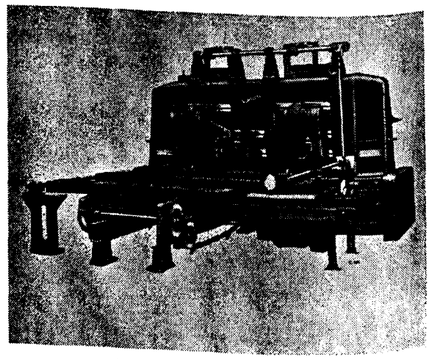
The boring and withdrawal of each unit is entirely automatic, synchronised with the feed gear and controlled by a cam, roller, levers and links, operating through an overhead rocking shaft.

The ½ in. parallel shank augers are fed into the sleepers by the weight of the boring unit slide, with some spring assistance when commencing boring. Their withdrawal is positive.

This design ensures that if, whilst boring, undue resistance were encountered, due, say, to a broken auger, the downward movement of the boring heads would be immediately arrested. All holes would be left uncompleted, but the operating cycle would continue without interruption and the damage would be confined to the affected auger. All augers are right-hand, thus saving in their first cost and reducing stocks of spares.

Two fixed top guides are provided for locating the sleepers whilst being bored. Each guide comprises three adjustable cast iron brackets, to the underside of which is attached a wood slipper. When a sleeper passes under the boring units its adzed seatings are pressed up to these slippers by the flexible bed. The bracket of each guide is formed with a bevelled nose which takes the initial impact of the sleeper and so minimises wear on the wood slipper.

When being fitted the slippers should have holes drilled through them the same size as the augers being used and at the settings required for the sleepers being worked. They can then be used as setting-jigs for the augers.



In-feed end of the fully automated Adzing and Boring Machine manufactured by Thomas Robinson and Son Ltd., showing the adzing heads with the marker saw between these and the trimming saw in the foreground.

The slippers also give support to the augers right up to their point of entry into the sleepers. This, coupled with the fact that the boring spindle ball bearing housings are placed as close to the augers as possible and rise and fall with them, ensures constant maximum auger support in all positions.

The top guides also form parts of exhaust hoods for dealing with the chips from the boring heads.

An automatic self-centring device is fitted to locate taper or varying width sleepers centrally under the boring spindles. The device will centre sleepers from 7½ in. to 12½ in. wide and operates through a cam, levers, rocking shaft, spring-loaded links and scissor-arm quadrants. The cam is carried on the same shaft as the crank disc for reciprocating feed dogs and boring operation cam, thus ensuring synchronisation.

The sleepers, whilst being adzed and bored from their top faces, are supported under each adzing and boring unit on separate flexible bed sections with independent rise and fall at each side of the machine.

Accommodation is thus provided for the irregularities and variations of warped or pit sawn sleepers.

The sleepers are located endwise against the long side fence.

For the adzing operation the top faces of the sleepers are located against the shoe type guides fixed to the adzing heads; these are adjustable to permit variations in the depth of the adzed seatings.

For the boring operation the adzed seatings of the sleepers are located against the fixed height guides under the boring heads as previously described.

The self-adjusting flexible beds, working through plungers and counterbalance weights in conjunction with the top guide shoes, accommodate sleepers either of uneven thickness or taper sawn, whilst retaining pressure on them as they pass under the adzing heads and during the boring operation.

The Outfeed Conveyor is generally similar to the infeed conveyor. Sleepers are delivered to the outfeed platform for transfer to creosoting bogies. The drive is taken from the machine's feed gearbox.

The infeed and outfeed conveyors are chain driven. The feed under the adzing and boring heads is by reciprocating hinged dogs actuated by crank disc, connecting rod and levers.

The drive is by vee ropes from 10 h. p. totally enclosed, fan cooled, high torque motor through a gearbox, the input shaft of which is mounted on ball bearings and carries a slipping clutch in the drive to prevent damage being done in the event of sleepers becoming jammed. An emergency brake for the feed drive, which when applied automatically switches off the motor, is included.

Normally one rate of feed is provided, i.e. either up to 10 sleepers per minute for soft woods, or up to 6 sleepers per minute for hard woods, where suitable handling facilities are available. For customers handling both hard and soft wood sleepers, however, suitable change pulleys for both rates of feed can be supplied.

All motors are identical and interchangeable.

GENERAL

The fence can be made to fit on either side of the machine according to requirements. This is particularly useful when sleepers are fed into the machine from a conveyor system. A long guide is provided after the cross-cut saw on the opposite side of the machine to the fence.

Provision can be made for a small motor to be fitted between the adzing cutterheads to carry one or more saws to mark the top surface of sleepers as worked with various combinations of grooves and spacings. This is useful as a means of identification of different kinds of sleepers, hole positions, age of sleepers etc.

ELECTRIFICATION OF RAILWAY STATIONS

During the second Plan electrification of 980 stations has been programmed. These include also stations where power would be available under rural electrification schemes of the State Governments.

This information was given by Shri S. V. Ramaswamy, Deputy Minister of Railways, in reply to a question by Shri Subodh Hansda, Shri S. C. Samanta and Shri R. C. Majhi in the Lok Sabha.

*** *** ***

THIRD CLASS TOURIST RAIL CARS

Replying to a question by Pt. D. N. Tiwary in the Lok Sabha, the Deputy Minister of Railways, Shri Shah Nawaz Khan, said that steps had been recently taken to provide additional third class tourist cars and tourist special trains. During the period January 1, 1959 to March 15, 1959, 20 tourist special trains had been run, nine for foreign tourists, eight for kisans, two for pilgrims and one for students. Thirty-six broad gauge and sixteen metre gauge third class tourist cars had been ordered for construction during the second Five-Year Plan.

Replying to another part of the question, the Deputy Minister said that 36 broad gauge tourist cars were being built by the South Eastern Railway departmentally. As regards metre gauge, 10 had been built by Messrs. Kays Construction Co. (P.) Ltd., Calcutta, and the balance six by Messrs. Noorulla Ghaznaffarulla, Allahabad.

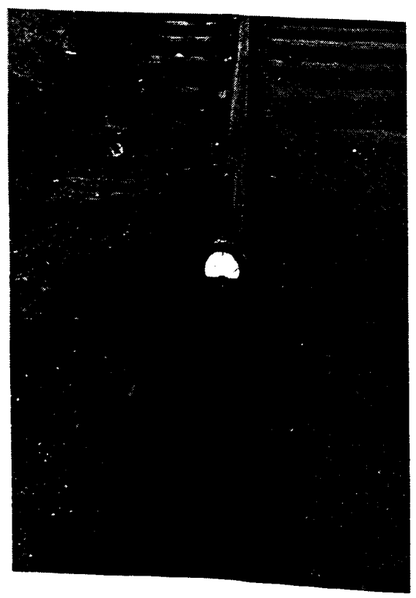
New Ferranti High Voltage Indicator for measuring voltages on Railway 25 kV Overhead Lines

AT the request of British Railways, Ferranti Limited have developed a high-voltage indicator, in order that measurement of voltages on railway 25 kV a. c. overhead lines can be carried out quickly, efficiently and safely. The indicator can distinguish between d. c. static, ordinary a. c. and induced voltages.

Of the electrostatic type, the indicator has two ranges, 0-15 kV and 0-30 kV, the accuracy being approximately ± 5% of full scale.

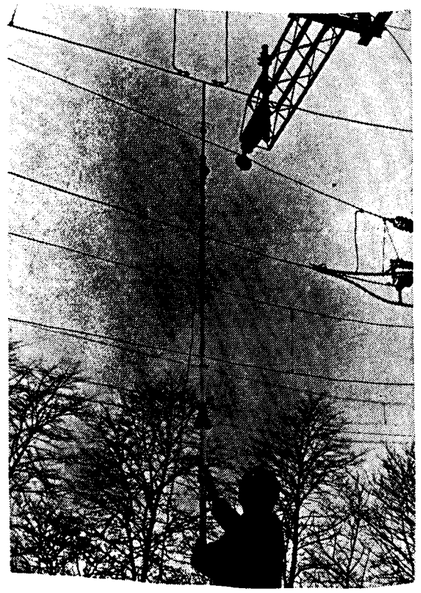
To facilitate reading from below, the scale is marked with black figures in bold characters on a white background, and the angle of the voltmeter can be varied to suit requirements.

The new high-voltage indicator is basically similar to the conventional Ferranti indicators, except that



the testing head can be hooked over the conductor under test. An insulated disc on the rod prevents over-shooting of the conductor.

The testing rod comprises three separate sections, each about four feet long. The top section carrying the steel hook is made of thick high-grade bakelised paper and the remaining sections are of fibre glass.



The complete equipment, i. e. testing rod, 2½ in. dial electrostatic voltmeter and flexible earthing lead, can be easily dismantled and packed in a lightweight carrying case.

* * * * * *

NEW FERRANTI CLIP-ON AMMETER FOR MEASURING CURRENT IN ELECTRIFIED RAILWAY LINES

The introduction of a new clip-on ammeter by Ferranti Limited for measuring current in electrified railway lines has extended the range of the Company's clip-on instruments, which is claimed to be the widest range offered by any manufacturer in the United Kingdom.

This instrument, which is the first of its type to have been developed specifically for railway applications, is basically similar to the conventional Ferranti clip-on ammeter operating on the split-core current transformer principle, except for the triangular-shaped core which is necessary so that all standard types of railway lines can be easily embraced and measurements taken quickly and efficiently by linesmen.

Six separate ranges are obtainable on the instrument, which are controlled by a thumb-operated selector switch. These are 0-10, 25, 50, 100, 250 and 500 amps a. c. Accuracy is within 5% of full scale on all ranges.

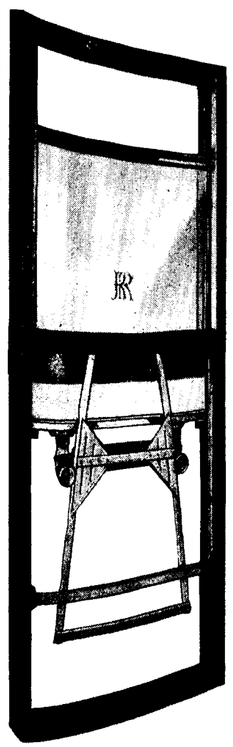
Kurla-Chembur Double Line Inaugurated

At a simple ceremony at Kurla in the evening of 13th April, 1959, the Kurla-Chember double line in the Bombay suburban territory—work on which was recently completed—was declared open by Shri Bhishma Arora, General Manager. The gathering included members of the Railway's Advisory committees, leading citizens and Railway officials.

In a welcome speech Shri V. S. Sathe, Engineer-in-Chief, Central Railway, explained the tremendous increase in Suburban traffic from and to Chembur and the justification that led up to the doubling of this 1.27 mile long section between Kurla and Chembur.

Declaring the double line open, Shri Bhishma Arora hoped that doubling would afford some relief to Chembur residents particularly during the peak period and would make travel to and from Victoria Terminus easier. Speaking on punctuality in the Bombay suburban territory Shri B. Arora appealed for public co-operation in securing the best results.

Shri P.B. Aibara, Divisional Superintendent, Bombay, proposed a vote of thanks to the General Manager and the guests at the function. Shortly afterwards, the General Manager cleared the ribbon and a special train carrying the General Manager, the Government Inspector of Railways and other guests left for Chembur.



R. R. Type STURDY balanced full drop window.

RAWLINGS WINDOWS

FOR forty years Rawlings have supplied various types of their railway windows to British Railways, South African Railways, Egyptian State Railways, Finnish State Railways, Poland, East Africa, the Rhodesias and Ghana. Engineering with careful attention to detail these windows embody many design refinements contributing to maximum service under the most arduous operating conditions.

One feature of their *STURDY* balanced type is its ability to be completely removed without removing or disturbing panelling below the waist rail. Other types of Rawlings windows are in successful service in New Zealand and Australia.

* * * * * *

PURCHASE OF RAILWAY SLEEPERS FROM JAMMU AND KASHMIR

It is a fact that Railway Ministry had decided to purchase wooden sleepers from the Government of Jammu and Kashmir State, said Shri S. V. Ramaswamy, Deputy Minister of Railways, in a written reply to a question by Shri A. M. Tariq and Shri Ram Krishna Gupta in the Lok Sabha.

The Deputy Minister added that in all nine lakh wooden sleepers would be purchased from the State Government from January 1, 1958 to December 31, 1959 and their total value would be approximately Rs. 1.8 crores.

Replying to another part of the question, the Deputy Minister said that about four lakhs of sleepers had been procured from January 1, 1958 to March 31 this year at an approximate value of Rs. 80 lakhs.

Concession Rail Tickets for Three Months Railway Board's Decision

The Railway Board has decided that concessional return tickets at 1½ single journey fares should be issued from July 15 to September 15, 1959 for first, second and third classes, as in previous years.

Return tickets will be issued only between stations situated more than 300 miles apart. Break of journey will be allowed on the outward journey according to normal rules, but it will not be permitted on the ruturn journey.

The dating of the return halves of the concessional tickets before the commencement of the return journey is compulsory and passengers holding return halves without being so dated will be treated as travelling without tickets.

The concessional return tickets will be available for 20 days in the case of journeys from 301 to 500 miles, for 25 days from 501 to 750, and for 30 days from 751 miles and above.

The period of availability will be reckoned from the midnight of the date of the commencement of the journey. However, the return tickets will not be available for completion of the return journey after the midnight of September 30, 1959 For instance, a ticket issued for over 750 miles on September 15 will be available for completion of the return journey only upto September 30, 1959 (and not upto October 15).

***

AWARDS FOR RAILWAYMEN LEARNING HINDI

To encourage the spread of Hindi amongst railway employees, the Railway Board has sanctioned a scheme under which cash awards ranging from Rs. 50 to Rs. 300 will be given to employees securing the highest percentage of marks Railway-wise at the Prabhod, Praveen and Pragya examinations, conducted twice a year by the Railway Ministry. At least half the prize money will be given in the form of books in Hindi and the other half may be granted in cash.

Altogether, the eight zonal railways will award 100 prizes, twice a year, in each of these three grades of Hindi examinations.

The Railway Board has also asked Railway Administrations to enlist the services of the Dakshin Bharat Hindi Prachar Sabha, Madras, and the Rashtra Bhasha Prachar Samiti, Wardha, for teaching Hindi to railway employees, in addition to arrangements made by the Home Ministry and by the Railway Ministry.

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Double-corrugated light-weight Wheels

By an Engineering Correspondent

THE trend to build lighter rolling stock is unmistakable and in the course of this development it has been found necessary to build light-weight wheels and axles for railway vehicles, too. The Klockner-Werke AG have undertaken to develop over several years a light-weight wheel set, which meets the requirements of the German Federal Railways. Normally discs of rail vehicles are single-corrugated or straight; a thinner web of this shape, however, will not stand the alternating loads but any kind of corrugation will increase the stability of the wheel disc. For this reason the light-weight wheel developed by Klockner-Werke AG. shows a sinusoidal 5-fold (odd-numbered) corrugation in axial as well as in radial direction (fig. 1).

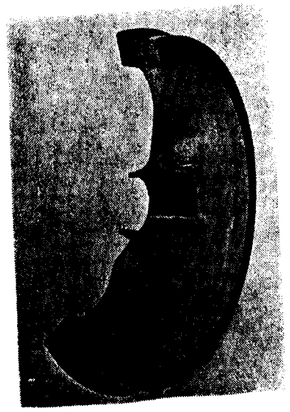


Fig.1

On our own test stand (fig. 2) and on those of the German Federal Railways the wheel was submitted to tests for repeated dynamic stresses and the stress-strain diagrams were determined. The number of load alternations rose up to 25 million with a speed of 150 km/h and a moment of flexure of 2000 mkg to 2500 mkg corresponding to an axle load of 16 to 18 metric tons. The stress values determined are shown in fig. 3 SK 138 and it can be seen, that they are mostly compressional.

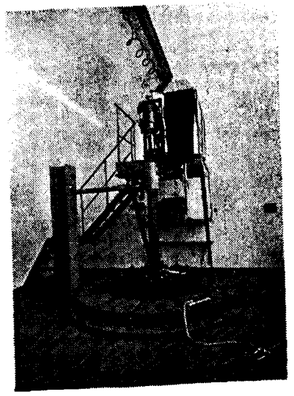
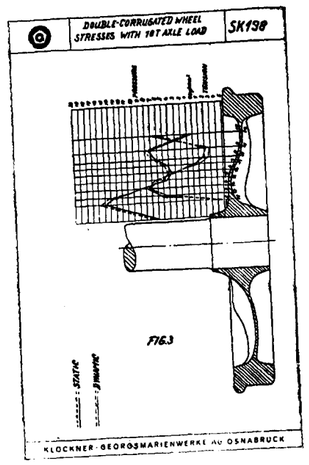
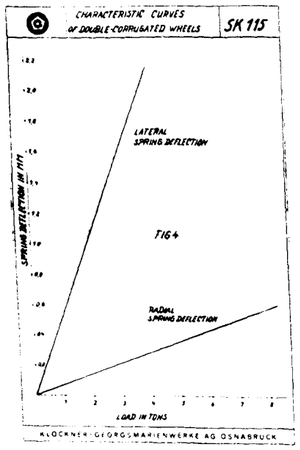
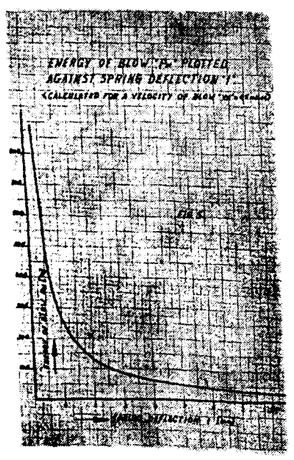


Fig.2



A certain elasticity is desirable to protect the vehicles and conserve the permanent way. The wheel in question shows an elasticity in axial direction which comes near to that of a resilient wheel with rubber insertions. This may have a favourable effect on the wear of the flange. Furthermore there is a certain elasticity in radial direction, decreasing the energy of the blows (fig. 4 SK 115 and 5 SK 081).





Braking tests with block brakes on appropriate test stands have shown positive results. The new wheel can be supplied as solid wheel or as tyred wheel and it has been approved by the German Federal Railways.

Fig. 6 shows the front view of such a wheel and fig. 7 a complete wheel set. In order to decrease further the total weight we can supply the wheel set with a hollow axle, too.

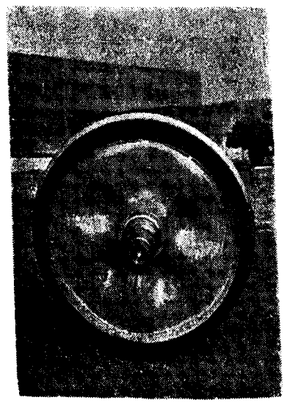


Fig. 6

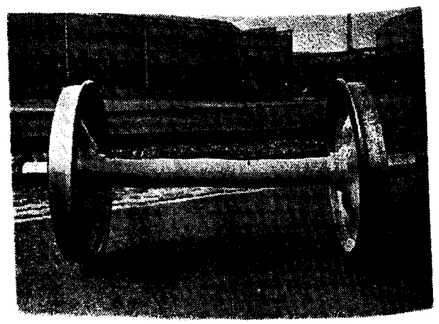


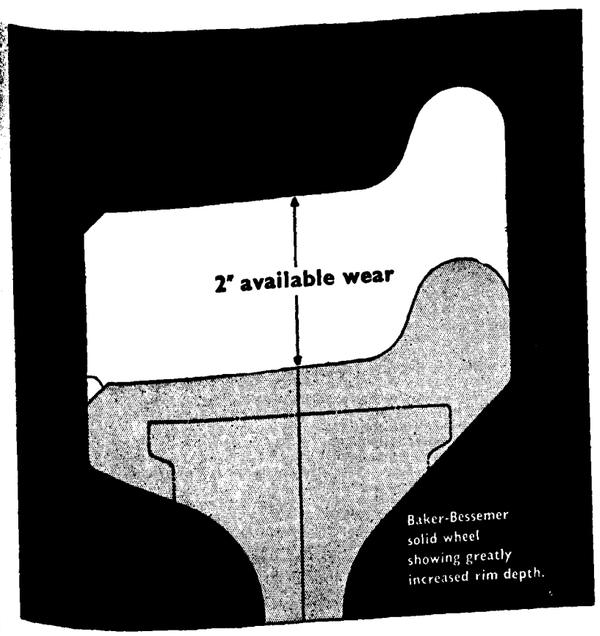
Fig. 7

Klockner have thus succeeded in fitting a wheel set with double corrugated light-weight solid wheels.

Let us now go into details of the advantages of a light-weight solid wheel over a light-weight tyred wheel, both having 950 mm dia. on tread :

I. Compared to a tyred wheel the solid wheel can wear down as far as almost equalling two changes of tyres.

a) Drawing ER 2380 (fig. 8) shows a solid wheel having 950 mm. dia. on tread. The dotted lines signify :



The solid wheel has an initial life 20% greater than the corresponding type of tyred wheel. This is fully illustrated by a comparison of the solid wheel, I.R.S. Drawing No. WA. 22, and the built-up wheel to I.R.S. Drawing No. WA. 23.

More than 20% increase in life



Agents for the whole of India,
Samuel Osborn (India)
Private Limited,
Third Floor, 24, Chittaranjan Avenue,
Calcutta-12.

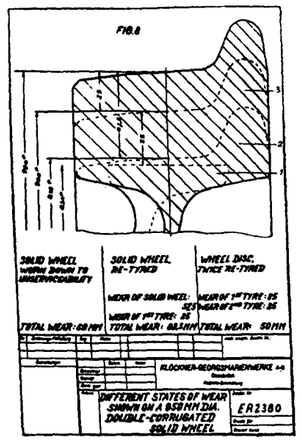
B B

JOHN BAKER AND BESSEMER LIMITED

OVER 80 YEARS OF RAILWAY SERVICE

KILNHURST STEEL WORKS ROTHERHAM

PHONE MEXBRO 2154-5-6 GRAMS 'TYRES' MEXBROUGH



1) the contour of a 830 mm. dia. wheel disc,

2) the contour of a tyre with just the minimum thickness of 35 mm. permitted for passenger coaches in Germany, shrunk on a 830 mm. dia. wheel disc,

3) the contour of a solid wheel after having been worn down as far as to still enclose the section of the 830 mm. dia. wheel disc.

If it is not intended to convert the worn down solid wheel into a 830 mm. wheel disc the solid wheel may be worn down even some more millimeters than shown under 3). This results in the following total thicknesses which are worn down, shown on dwg. ER 2380:

for the solid wheel worn down to unserviceability	..	60 mm.
for the solid wheel converted to a disc with one tyre	..	82,5 mm.
for the wheel disc fitted twice with a tyre	..	50 mm.

II. Tyre and disc forming one solid piece there is no danger of the tyre becoming loose due to

a) increase in temperature on long braking distances

b) cold work-hardening caused by the tyre hammering constantly on the rails and the resulting increase in dia. of tyre

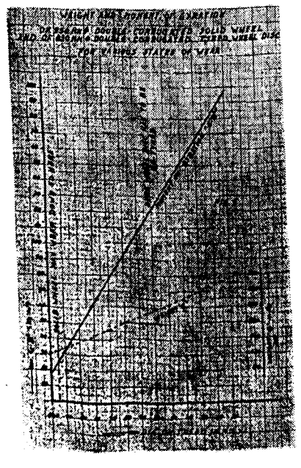
III. In the long run the solid wheel is more economical in service

a) because it requires no maintenance and

b) because of its low weight combined with a lower moment of gyration, shorter stopping distance, and smaller accelerative forces.

IV. With a double-corrugated tyred wheel disc made out of a double-corrugated solid wheel no loosening of the tyre because of II. a) or II. b) above is to be feared as by the initial radial tension, inherent in the disc, the rim is always firmly pressed against the enlarging tyre.

V. It may also be of interest to the reader to learn about some data on the economic savings caused by the wearing down of the tyres:



The diagram ER 2381 (fig. 9) shows the weight G and the moment of gyration G. D^2 plotted against the diameter on tread. From this diagram it can be derived that the weight of a double-corrugated solid wheel with its diameter on tread worn down to 900 mm is approx. 185 kgs. This is the point where a 830 mm wheel disc wants re-tyring. The solid wheel, which may wear down to 835 mm. dia., then arrives at a weight of approx. 100 kgs. only. The moment of gyration is being reduced even more rapidly from

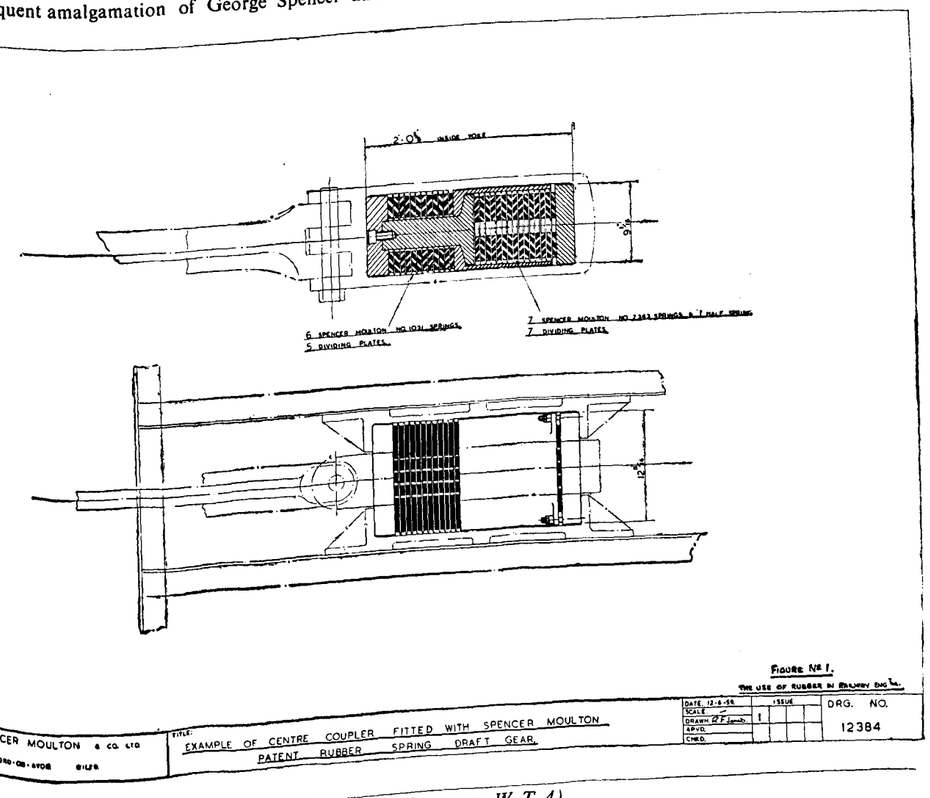
G. D^2 = 123 kgs. m^2 with 900 mm. dia. on tread to

(Continued on page W.T.5)

The use of Rubber in Railway Engineering

THE use of rubber in Railway Engineering dates from 1852 when George Spencer, a London Consulting Engineer, was granted a Patent for a Rubber Railway Spring. These springs were manufactured by one of the earliest Rubber Companies, Stephen Moulten & Co., at Bradford-on-Avon, and the subsequent amalgamation of George Spencer and Stephen Moulton resulted in the present day firm of George Spencer, Moulton & Co. Ltd.

The success of the circular rubber springs produced since 1852 laid the foundations for the very widespread use of rubber as an engineering material. This first application of rubber was in buffers and it was soon



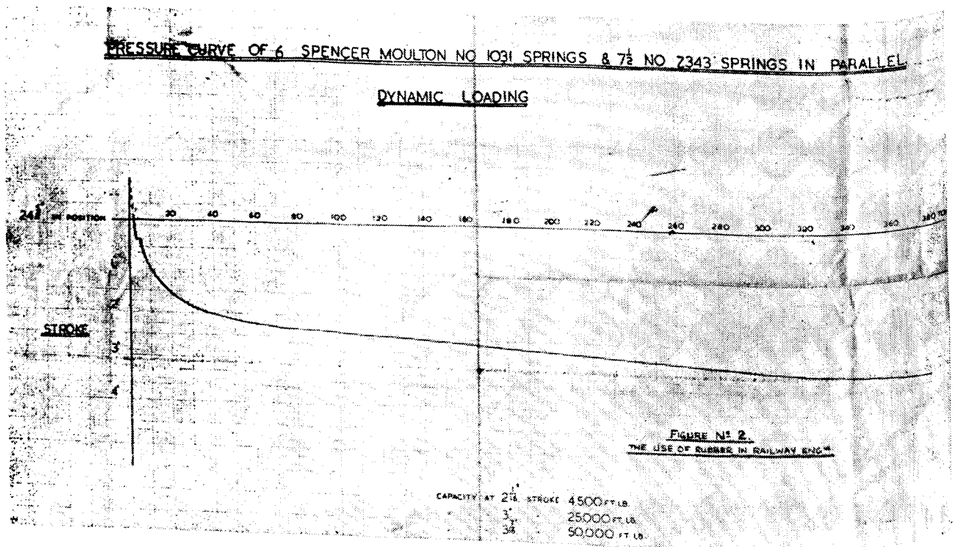
(Continued from page W.T.4)

G. D^2 = 25 kgs. m^2 with 835 mm. dia. on tread.

It is obvious that the lighter wheel with the smaller moment of gyration necessitates also smaller driving and braking forces than a heavier wheel with a greater moment of gyration.

The weight of a double-corrugated solid light-weight wheel measuring 950 mm. on tread amounts to approx. 295 kgs.; that of a double-corrugated wheel disc with tyre shrunk on—with the same dimensions—is approx. 310 kgs.

In railway traffic there is an obvious trend towards faster trains that can carry more payload—and our light-weight double-corrugated wheels and axles are one valuable contribution to this goal.



found that a rubber spring has many advantages :—

1. Since rubber cannot rust or seize up it requires little maintenance and may be left in operation for many years.

2. Shocks, vibration and noice are absorbed by rubber, and passenger comfort and vehicle life are therefore much improved.

3. The inherent damping properties of rubber contain the energy of impact and reduce the recoil forces.

4. Rubber springs prevent metal to metal contact and have a considerable reserve capacity for dealing with excessive shock loads. The rising rate of the load/deflection curve is particularly suitable for cushioning buffing and draw shocks.

5. A rubber spring gives instantaneously under the application of a load, thus giving immediate protection to the wagon and merchandise.

6. Finally, rubber is reliable and safe.

The early use of rubber springs in side buffers was followed by the development of central buffing and draw gears. These are now widely used on the Railways of the World, and have given many years of good service and trouble free running. A typical Spencer Moulton central buffing and draw gear is shown in Fig. 1, and Fig. 2 shows the relation between the applied load and the stroke of such a gear. The gear consists of two columns of rectangular bar springs housed in a tough metal framework designed to resist the heaviest loads. In operation the columns of springs work in parallel and by this means the capacity of the gear is very much increased. It will be noted that the gear will sustain an end load of 250 tons at a stroke of 3 ins. giving a total energy absorption of 25000 ft. lbs. This gear is typical of a wide range which are available, and such gears are used for locomotives, wagons and passenger stock.

Typical rubber springs from side buffers and central buffing and draw gears are illustrated in Fig. 3.

Amongst the other uses for rubber in railway engineering, one should mention hoses of all descriptions and these are used for locomotive feed water pipes, air and vacuum brake pipes, and steam heating pipes. The combination of rubber and fabric produces hoses which are tough and resistant to weathering and heat, whilst possessing the valuable property of flexibility.

In the brake cylinder itself there are no fewer than eight rubber components, several of which have to be manufactured to very fine tolerances. For example the rolling ring used in the vacuum brake

cylinder has to be controlled in section within limits of ± three-thousandths of an inch.

A relatively new use for rubber is in the suspension of carriages and wagons, and a number of applications are at present being tested by British Railways. The primary (axle box) suspension may be achieved by the use of rubber to metal bonded shear pads or by the use of rubber cone springs. In the secondary (bolster) suspension the steel Helical springs may be replaced with rubber cone springs. The great advantage of this replacement is the improved ride and the fact that there is no danger of breakage of the cone spring. A rubber suspension is also used successfully on Mine Cars, giving a considerable reduction in maintenance costs.

Finally, there is a new Civil Engineering use for rubber. Many Railways are now changing to the use of concrete sleepers and are using rubber pads between the sleeper and the rail to cushion the shock loads and high frequency vibrations of the track. The French Railways in particular have used such pads with complete success for many years, and with the wide-spread introduction of long welded rail and concrete sleepers there is a vast potential for this new use of rubber.

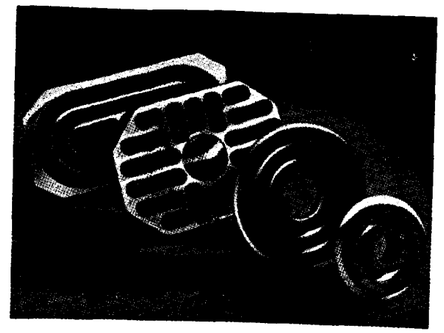


Fig. 3. A group of Spencer Moulton Rubber Springs.

Space does not permit mention of many other rubber items which are used in the manufacture of Rolling Stock. There are for example sensitive edges for sliding doors and carriage window glazing rubbers. Enough has been said, however, to show that rubber is now firmly established as an engineering material with unique properties.

FRANCE HONOURS DR. SADGOPAL

Dr. Sadgopal, pioneer and leading worker in the field of essential oils, has recently been honoured, for his life's work on Indian perfumery materials, by the French Organizers of the Second International Congress on Essential Oils, to be held in Grasse, this year. Dr. Sadgopal, who is Deputy Director (Chemicals) in the Indian Standards Institution and a member of the Essential Oils Research Committee of the Council of Scientific and Industrial Research, has been actively associated with research and development of the various resources of Indian aromatic plants.

He has been officially invited by Monsieur P. Lerouge-Benard, President of the Syndicat National des Fabricants et Importateurs d' Huiles Essentielles etc. as a guest of the Syndicat, to fly over from India and read a scientific paper in the Congress on his outstanding work on " The Development of Essential Oils and their Constituents in Aromatic Plants ". More than 200 delegates, from all over the world, are expected to attend the Congress in Grasse—the world renowned city of Flowers and centre of the perfumery industry—and about two dozen leading scientists from France, Switzerland, Italy, Bulgaria, Yugoslavia, etc. led by the Nobel Prize Winner, Prof. L. Ruzicka, will participate in the technical sessions.

Dr. Sadgopal will also be presenting two special messages to the Congress, from Prof. M. S. Thacker, Director General, Scientific & Industrial Research and the Secretary, Ministry of Scientific Research, Government of India, and from the Chairman, Essential Oils Research Committee.

After attending the Congress in France, Dr. Sadgopal will be proceeding to Figueira da Foz in Portugal to attend the fifth Plenary Meeting of ISO/TC 54 Essential Oils of the International Organization for Standardization, ISO. Dr. (Miss) B. S. Khambata, Chemist Incharge, TOMCO, will also be joining him as a member of the Indian Delegation.

High-production Spring Coiling Machine

By an Engineering Correspondent

THIS machine makes right-hand and left-hand helical springs form round, rectangular or square section stock It meets mass production requirements in every way. The machine is exceptionally rugged in construction and at the same time guarantees the necessary standard of accuracy in the springs produced.

The drive to the input shaft of the machine is taken via V-belts from an electric motor mounted on the rear.

The machine is equipped with a readily accessible change gear transmission. By changing only one gear it is possible to coil three different pitches with each train.

The desired pitch is selected by means of a lever on the headstock. Left-hand coiling is effected by mounting an idler gear. A leadscrew imparts the necessary feed movement to the coiling mandrel which gives the spring its lead. The feed travel (equal to the length of the spring) is terminated by readily adjustable stops the two control rods.

The feed carriage is movable horizontally and the stock feed head vertically. The design also permits an additional swivelling action to the carriage. When setting up the machine the carriage can be swivelled dead parallel to the lead of the spring. This feature ensures that the stock runs on to the coiling mandrel perfectly straight and also with constant lead.

A graduated collar allows the feed carriage to be lined up with the utmost accuracy and permits rapid setting of the pitch besides providing a check on the constancy of the pitch.

In the stock feed head of the machine the stock bears sideways over the full depth. The large-area support thus afforded is manifested in the accuracy of the spring pitch.

The machine is started and stopped under push button control.

The built-in multi-disc brake ensures that the rotary movement of the coiling mandrel always terminates in the vertical position.

The brake is operated electrically via a solenoid.

Provision is made for stopping the machine instantly by means of a foot-operated emergency switch. All the necessary switchgear is grouped in a control cabinet self-contained in the machine.

WORKING PRINCIPLE OF MACHINE

The coiling mandrel to suit the type of spring being made is mounted in the machine and locked by a key fastening. The stock feed head and the stops on the control rod are now set to suit the type of spring being made. The spring stock is entered under the driving lug on the end of the coiling mandrel. An electrical device controls the machine in such a manner that the driving lug always comes to rest in front of the stock feed.

The machine is started by push button within convenient reach of the operator and this action starts the coiling mandrel rotating. The spring can now be coiled for a certain pre-determined distance without any lead being applied. After this initial stage feed is applied automatically and the spring is then coiled with the desired pitch. The machine can also be set to work so that the feed is applied instantly to the coiling mandrel. During coiling, the stock feed—which to begin with had to remain backed out owing to the presence of the driving lug—is advanced towards the coiling mandrel. As soon as the spring has been coiled to the desired length the feed is disconnected automatically. As with the start of the spring, the finishing end also can be coiled without lead. By reversing the motor, likewise under push button control, the coiling mandrel is caused to return to its starting position and the finished spring is stripped off. A fresh working cycle can now start. Left-hand springs are coiled in the same manner after the machine has been suitably set up.

SPRING EYE ROLLING MACHINE

This machine is designed for the long-run production of leaf springs with spring eyes dead square with the spring axis and absolutely true to size and cylindrical.

The machine is equally suitable for rolling eyes on automobile springs or on railway rolling stock springs.

WORKING PRINCIPLE

The eye is formed in the spring end in a single heating and in three successive stages as follows :

1. First, the spring leaf is held by an automatic clamping device, rough-rolled and cut off at an angle.
2. During this stage the obliquely trimmed and rough-rolled leaf is finish-rolled.
3. A sizing die now imparts the true form to the outside diameter of the closed eye, whilst at the same time the inside diameter of the eye is accurately sized by the passage of a mandrel.

DESCRIPTION OF MACHINE

The machine is built on exceptionally sturdy and rugged lines as befits its purpose. All shafts are of open hearth steel and run in large-area bearings provided with red brass bushes. The countershaft is carried in self-aligning roller bearings. The various tool motions are derived from a mainshaft via cranks or cams. Rough-rolling and clamping of the spring leaf are effected by an oil-hydraulic system.

The machine is controlled electro-hydraulically by means of a foot-operated switch. The machine features readily renewable safety devices as a protection against overloading (shear plates and shear pins) which effectively safeguard the main frame against damage.

SPECIAL-PURPOSE ROLLING MACHINE

These machines are designed for rolling a taper on the ends of leaf springs as used primarily for automobiles and railway wagons. The two housings of the machine are of one-piece high-grade cast iron construction. Each housing is reinforced by two full-length steel tie bolts. The two housings and the two ring-lubricated bearing units for the high-speed shaft are mounted on a common base.

The top roll has a parallel barrel and is of chilled cast iron. The bottom roll spindle of top grade machinery steel is designed to take several chilled iron roll segments which mount side by side and are easily changed. Each roll segment handles one particular type of taper.

Top roll adjustment is provided by two massive screws. If desired, however, the roll adjustment can also be made centrally via a worm and worm wheel. To prevent any overloading of the machine a breaker block is fitted on each side between the top bearing and the adjuster screw. The design of the roll spindle bearings is such that in the event of the rolls needing to be changed they can be withdrawn sideways from the machine after detaching a pair of guide bars.

To enable the stock to be entered square a rest with adjustable stop is provided in front of the rolls. An upsetting attachment driven by bevel gears and a crank is located on the entering side to compress the end of the spring edgewise before rolling. The drive is by electric motor coupled by V-belts direct to the flywheel of the machine.

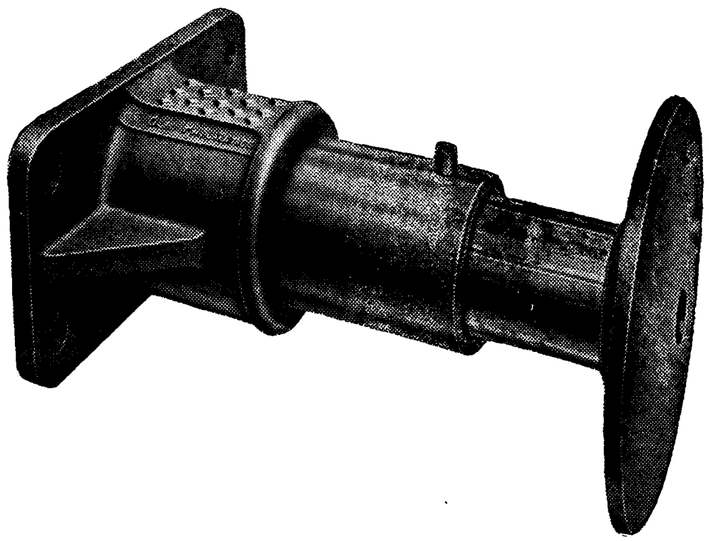
Leclanche Type Dry Batteries for Flashlights

An Indian Standard Specification for Leclanche Type Dry Batteries for Flashlights (IS : 203–1958), laying down the dimensions, tests, and performance requirements of Leclanche type dry batteries, used for flashlights and for service under the Indian climatic conditions, has been issued by the Indian Standards Institution. The standard relates essentially to batteries used in flashlights ; but can be used for certain general purpose requirements as well.

This standard is a revision of the one originally published in 1950. Since the first publication of the standard, the International Electrotechnical Commission (IEC) have progressed considerably in their work on primary batteries. This revision has accordingly been aligned, more or less, with the IEC Publication No. 86 Recommendations for Primary Cells and Batteries. The manner of designation of cells and batteries has been changed to follow the IEC practice. However, for convenience in understanding, the corresponding former designations, as specified in IS : 203–1950, have also been indicated in the tables. The dimensions in the revised standard nearly align with the IEC recommendations, keeping in view the requirements of the battery industry in India. Another important change introduced in this revision, is the deletion of all references to internal constructional details of the unit cell. The revised standard deals essentially with the complete battery, comprising a single cell or multiple cells.

Hydraulic Railway Buffers

A MAJOR TECHNICAL CONTRIBUTION TO THE RAILWAY MODERNISATION PROGRAMME



Oleo wagon buffers, embodying powerful hydraulic shock resistance in combination with controlled pneumatic recoil, are capable of absorbing shunting shocks up to thirty times more severe than mechanical buffers. Supplied as standard equipment for many new and converted wagons, they offer a considerable reduction in the incidence of damage to wagons and goods in shunting operations. The ability of Oleo buffers to absorb energy has made an important contribution to solving the problems of braking freight trains from high speed. Sturdy and compact, the Oleo buffer has also been selected for use on a large number of new diesel and electric locomotives.

Let us help you in any problem you may have in connection with the absorption of shock and the arresting of heavy mobile masses.

Oleo Pneumatics
LIMITED

KENILWORTH · ENGLAND

BRAKES, BUSHES, BUFFERS, COUPLERS AND SHOCK-ABSORBERS SUPPLEMENT

BUFFER AND COUPLING RESEARCH

TO obtain the full benefits of faster freight trains and mechanised handling systems at terminals, or the door-to-door facilities of containers, involves the need of greater economies in the time and labour taken up in wagon marshalling and shunting. With loose couplings and hand brakes wagon handling and sorting take time, but the coupling of wagons fitted with continuous brakes involves a somewhat tedious time-consuming process. Hence arises a need for reinvestigation of automatic coupling under British conditions. The fact that damage to freight and wagons may be occasioned by impacts during marshalling is a further aspect demanding attention.

The development of new buffing and coupling equipment can alleviate these problems. Although final pre-acceptance proving is the responsibility of the British Transport Commission, a good deal of original research and development has been undertaken by equipment manufacturers. The Dowty organisation, although a comparative newcomer into the railway equipment field, is strongly entrenched in the hydraulic engineering world. It can now claim the first self-contained, fully instrumented test site in England for carrying out under practical conditions all types of research and development concerned with the buffing and coupling of wagons. To date, these facilities have been engaged in the development of the Dowty hydraulic buffer and more recently an entirely new automatic central wagon coupler to meet B. T. C. specification. We now append a description of the test ground and of its evolution.

HYDRAULIC BUFFER

It is first desirable to indicate the equipment evolved by the Dowty group. The buffer consists basically of a combined reservoir and cylinder, housing a piston loaded by a helical spring. On impact, the inward movement of the piston displaces fluid into the surrounding reservoir through orifices in the cylinder wall. The restriction imposed on the oil flow causes a back pressure which reacts on the piston, giving the buffer its resistance to closure. Only one dynamic seal is fitted and this is never subjected to high pressure, for adjacent to its pressure side a groove in the cylinder wall intersects holes leading to the reservoir. Thus pressure at the seal never exceeds the low reservoir pressure.

Unlike a mechanical spring which provides a fixed resistance for any given closure of the buffer, the reaction of this hydraulic buffer is related to the speed at which it closes. Due to the square law governing flow through orifices, the pressure generated in the buffer is directly proportional to the energy to be absorbed. Consequently the Dowty buffer is self-adjusting to change in impact energy resulting from variations in wagon velocity. Violent recoil is obviated by energy dissipation, instead of energy storage. Impact energy is converted into heat energy as the buffer closes, and the small quantity of air trapped in the buffer is compressed slightly as displaced fluid raises the level in the reservoir. On completion of the stroke the bulk of the impact energy has been dissipated and controlled recoil results from the combined effects of the load in the recoil spring and the air pressure.

AUTOMATIC COUPLING

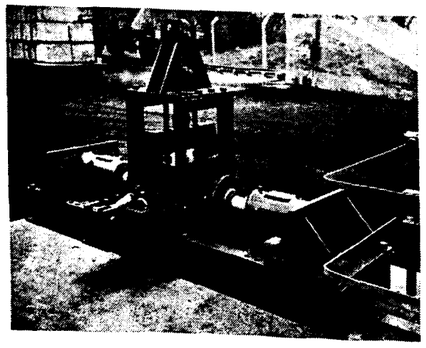
The Dowty automatic coupler incorporates simultaneous connections of the vacuum brake pipe and is compatible with all existing freight stock. It will engage and lock under a wide range of track curvature and gradient conditions, while uncoupling is achieved simply by operating a lever mounted on either side of each wagon. When coupling wagons not fitted with automatic couplers the unit can be swung through 90 deg. to present a standard drawhook. It is interchangeable with conventional draft gear without modifications to the wagon.

The manufacturer anticipates that this coupler will have a far-reaching effect, as the automatic coupler has posed considerable problems hitherto in Western Europe; there are virtually no automatic couplers for freight stock on main-line railways in this area.

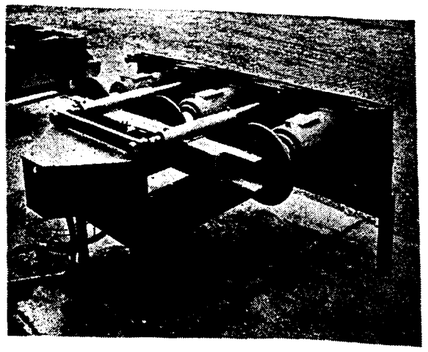
Intensive tests have been made, and British Railways is now testing 50 wagons fitted with Dowty units in the London Midland Region.

EVOLUTION OF TESTS

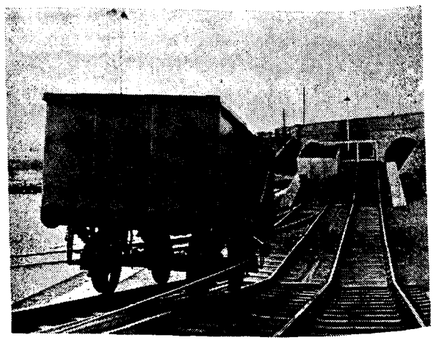
Before describing the Dowty test site at Ashchurch, Gloucestershire, as it is now, it is worth-while mentioning some of the more interesting aspects of its evolution. Developing suitable test equipment was in itself a considerable problem. Experience eventually proved that the only way to obtain the required data with complete accuracy is to use modern electronic equipment. Originally, the company was interested in buffing equipment so initial efforts were concentrated



Rig for measuring rate of wear of heads of Dowty Hydraulic Buffers.
This is part of the equipment at the Railway Equipment Test Site of Dowty Hydraulic Units Ltd, at Ashchurch, near Tewkesbury, Gloucestershire.



Cycling Rig for endurance testing of Dowty Hydraulic Buffers at Railway Equipment Test Site of Dowty Hydraulic Units Ltd., Ashchurch, near Tewkesbury, Glos.



Gradients for testing impacts of buffers at the Railway Equipment Test Site of Dowty Hydraulic Units Ltd., at Ashchurch, near Tewkesbury, Gloucestershire.

on providing suitable proving facilities. The first test arrangement consisted of a solid buffer block against which wagons were shunted by a small improvised locomotive, built out of a converted four-wheel drive 5-ton Bedford diesel-engined lorry. It is heavily ballasted and has had an axle and wheel conversion to suit standard-gauge rail track.

EVENTUAL SATISFACTION

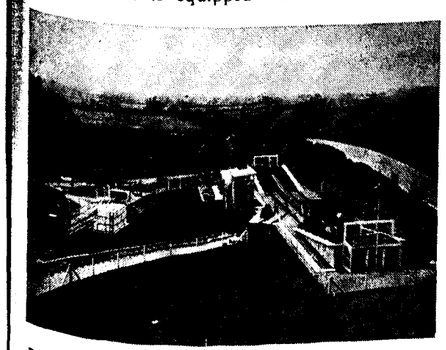
To augment this arrangement a cable and weight method of propulsion was investigated which, though simple to operate, has a number of disadvantages. The object of this particular test is to analyse the buffer shock absorption characteristic which cannot be done accurately when part of the impact energy is dissipated by cable stretch and other external means. Furthermore, service recoil conditions would not be exactly reproduced with a wagon striking a solid stop. Hydraulic wagon movement was turned down for identical reasons. The next ideas to be investigated were the use of single and double pendulum systems; these were eventually shelved as too remote from operational conditions. The scheme finally adopted and now in operation involved two opposed ramps which enable all operating conditions to be factually reproduced. This set-up is described later along with a summary of the other Dowty proving facilities.

The site is extremely compact. The standard-gauge track is laid out to incorporate curves down to one chain radius with runs of straight track for speed testing. There is a direct connection to the B. R. line at Ashchurch. Mineral wagons of 16-ton

capacity are used for normal operating tests; all standard types of wagon can be accommodated.

TEST SITE LAYOUT

The centre piece of the site is the ramp layout for impact testing. There are two identical ramps built in line and each is equipped with dual track. The



Part of the Railway Equipment Test Site of Dowty Hydraulic Units Ltd., at Ashchurch, near Tewkesbury, Glos., where the Dowty Hydraulic Buffer and Automatic Coupler were developed.
The gradients on the right are for buffer impact tests. Electronic recording of tests is controlled from the observation room in the centre.

second track is isolated from the first and is used for endurance and destruction testing. Buffers and couplers are mounted on "dollies" for these tests to avoid unnecessary damage to complete wagons. The ramps are placed about 160 ft. apart and slope at angles of 15 deg. Impact speeds in excess of 25 m. p. h. are possible, or over three times current average shunting speed. Adjustable scotches are used to hold wagons on the ramps. These scotches, which slide on a light section rail, are located to determine impact speed and are pinned in position to their rails. The pin holes are spaced to allow impact speed adjustments in increments of 1 m. p. h. Winches, one for each ramp, are used for shunting the wagons. The winches are of standard manufacture and have been converted to hydraulic operation by employment of Dowty hydraulic motors.

The wagons are hauled by cable over the scotches, where they are held by their axles. An over-centre cable mechanism actuated by a hydraulic ram is incorporated in each scotch. The wagons, which can have gross laden weights up to 40 tons, are released by withdrawing the scotch rams. Two Dowty hydraulic pumps, joined in parallel, power the whole system and make available approximately 70 h. p. at the winch motors. A header tank and boost pump are included in the circuit to maintain a nominal pressure when the system is in operation. Maximum circuit working pressure is approximately 1,500 lb. sq. in. All operations are controlled from a console on the upper floor of the observation room, situated alongside the track between the ramps. Hydraulic pipes between the observation room, where the power and control units are housed, and the winch motors and scotch rams run in conduit below ground. The hydraulic equipment was provided by Dowty Hydraulic Units, Limited, from standard units.

BUFFER TESTING

Buffer testing covers the electronic recording of three basic essentials from which it is possible to compile a complete performance analysis. A strain-gauge pressure pick-up is screwed into the end wall of the buffer pressure chamber to measure reaction variation on impact. This pick-up is a small cylinder on to which a strain gauge is wound; as the cylinder dilates under pressure the resistance of the gauge increases. The gauge is calibrated before the tests to determine the relationship between pressure and resistance. The strain gauge forms part of a Wheatstone bridge circuit. Voltage changes produced during an impact are fed into a d.c. amplifier and then into a driver amplifier of the first channel of a three-channel c. r. o. set. The beam movement caused by changes in pressure is calibrated by switching a fixed resistance into the bridge. The second channel of the c. r. o. set records wagon motion.

A potentiometer, in which the sliding contact is fastened to a probe, is mounted so that the probe contacts the wagon 6 in. before the buffers meet. Just as the buffers touch the sliding contact is arranged to coincide on the potentiometer winding with a fixed contact which changes the polarity of the voltage after the slider has moved past this point. The time scale of these two traces is obtained by feeding signals at intervals of 1/200 sec., from a fork-controlled oscillator into the third c. r. channel and recording the pulses simultaneously with the signals from the other two channels. All three traces are recorded photographically.

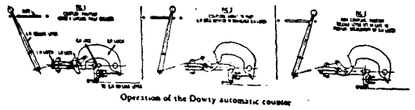
From this information the following data can be calculated :

(*a*) Wagon impact velocity.
(*b*) Deceleration rate of wagon.
(*c*) Force reaction at buffer on impact and during deceleration.
(*d*) Buffer shock absorption capacity.
(*e*) Energy destruction efficiency of buffer.
(*f*) Buffer stresses.
(*g*) Kinetic energy of wagon.

By using additional strain gauges stresses in various parts of the wagon frame and the effect of load movement during impact are also analysed.

COUPLING TESTS

In so far as coupler testing on the ramps is concerned, the object is to prove the geometry of the design and the strength of the materials under accelerated endurance shunting conditions. Instrumentation is used to record the efficiency of the automatic vacuum braking connection incorporated in the coupler. Gathering and uncoupling tests are undertaken on a special section of track, which has been laid down to reproduce simultaneously the most severe curvature conditions occurring on British Railways and a comprehensive range of vertical and horizontal misalignment.



Operation of the Dowty automatic coupler

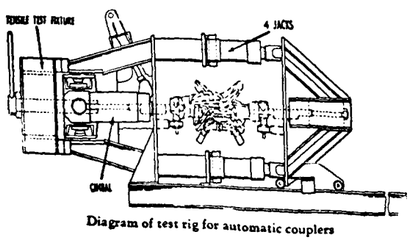


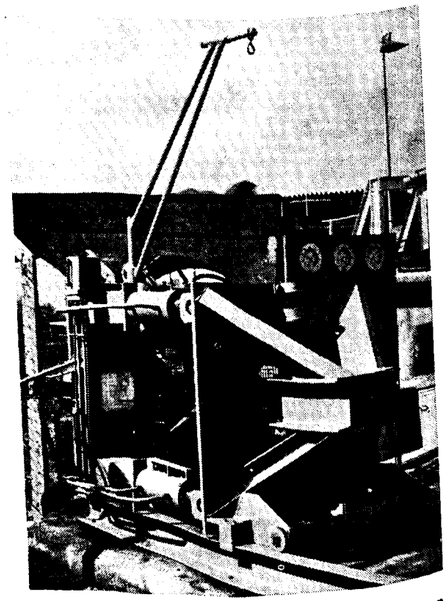
Diagram of test rig for automatic couplers

The site includes a number of static rigs for endurance and fatigue testing under specific conditions. On one rig buffers are subjected to a rapid cycling test to establish the rate of buffer head wear and also the efficiency of the sealing arrangement. The rig automatically cycles at 40 full closures per minute. Buffers undergo this test in batches of six, so that test figures are compiled from a factual average. So far it has been established that after 200,000 complete cycles about one pint of oil is lost. In terms of railway usage this means that a buffer will require oil replenishment once in every five years.

DRAFT SIMULATION

Couplers are placed in a draft simulation rig which rapidly varies the misalignment whilst maintaining a heavy drawbar pull. This rig subjects the coupler to conditions far worse than would be encountered in service. An enclosure built around the rig enables environmental and climatic tests to be undertaken. Dust, sand and water can be injected into the enclosure in turn at varying intervals. Freezing conditions can also be created. Instruments indicate the degrees of misalignment, drawbar pull and vacuum connection efficiency of the couplings under test.

All the rigs are hydraulically operated and are extremely interesting applications of hydraulics from



Draft simulation rig for testing automatic rail wagon couplers at the Railway Equipment Test Site of Dowty Hydraulic Units Ltd., Ashchurch, near Tewkesbury, Gloucestershire.

(Continued on page B. 13)

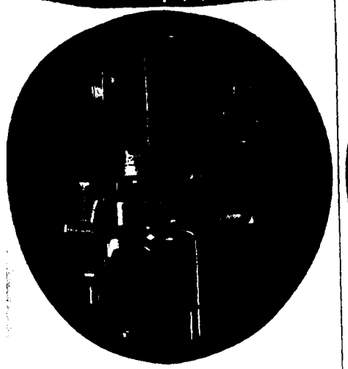
Safe
Modern
Universal

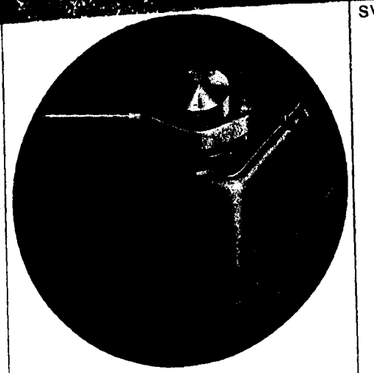
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Introduction of an Automatic Centre Buffer Coupler on Rail Vehicles

By Walther Scharfenberg

THE President of the United States of America said in 1889, on the occasion of the introduction of an automatic type of coupler.

> "It is a reproach to our civilisation that any class of American workman should, in the pursuit of a necessary and useful vocation, be subjected to a peril of life and limb as great as that of a soldier in time of war."

And accordingly, a Law came into force by which, during the time of 1893 to 1900, the Janney Cluth Coupler was introduced throughout the United States.

With the increase in weights of trains are increasing, as well as the tendency of faster traffic performance and the number of additional air tubes and cable lines to be coupled-up simultaneously, we are rapidly advancing towards the necessity of introducing the Automatic Centre Buffer Coupler.

Japan also decided, as early as 1918, to introduce Automatic Couplers. While the preparation work covered a period of seven years, the actual change-over took place within twentyfive hours, on 17 July 1925, with a view to avoid traffic disturbances as little as possible. In this way, the Japanese State Railways chose a method which eliminated any equipment of transition device when changing over from the Screw type to the Automatic type of Coupler.

That was, of course, the most simple and most convincing way to change over from the screw to automatic coupler, but the question is left open whether it is practicable for other railway administrations too, as conditions prevailing are different everywhere. It seems to be for this reason that it is said in the Preliminary U. I. C. (International Union of Railways) Specifications :—

> "The design of the Automatic Coupler must provide for two types, viz. an intermediate type and a final type of coupler. Both types must match for automatic coupling-up one with the other.
>
> Tractive forces only are to be transmitted by the transition coupler. It is destined for being attached to the draw gear of existing vehicles. It must be possible to fit the transition coupler to all the vehicles of the European railway administrations, for being brought into service conditions within a very short time limit, preferably within one day. Meanwhile, it must not disturb the existing use of the screw coupler.
>
> Particularly, it must not reduce the space hitherto available for servicing the screw coupler (Berne rectangle), nor must it, in case of buffer impacts during shunting work, be a source of danger to the man standing between the buffers and engaged in servicing the screw coupler. The final type of coupler must be capable of transmitting both tractive and compression forces. It is to be connected to the underframe of appropriate design in such a way that, later on, the side buffers may be suppressed, but nevertheless it must operate conveniently as long as all the vehicles are still equipped with side buffers."

The procedure stated above certainly makes it possible to profit from the advantages of Automatic Couplers within the shortest space of time, permitting the modification of the vehicles (for purpose of mounting the Centre Buffer Couplers), at convenient times one after the other, e. g. on occasion of main inspection of the vehicles. Procurement of new vehicles may include the mounting of central buffer couplers and of side buffers. The Automatic Transition Coupler—also called 'Draw Coupler'—must permit coupling up one with the other as well as with a Centre Buffer Coupler, and must also not disturb the coupling of the existing Screw Coupler.

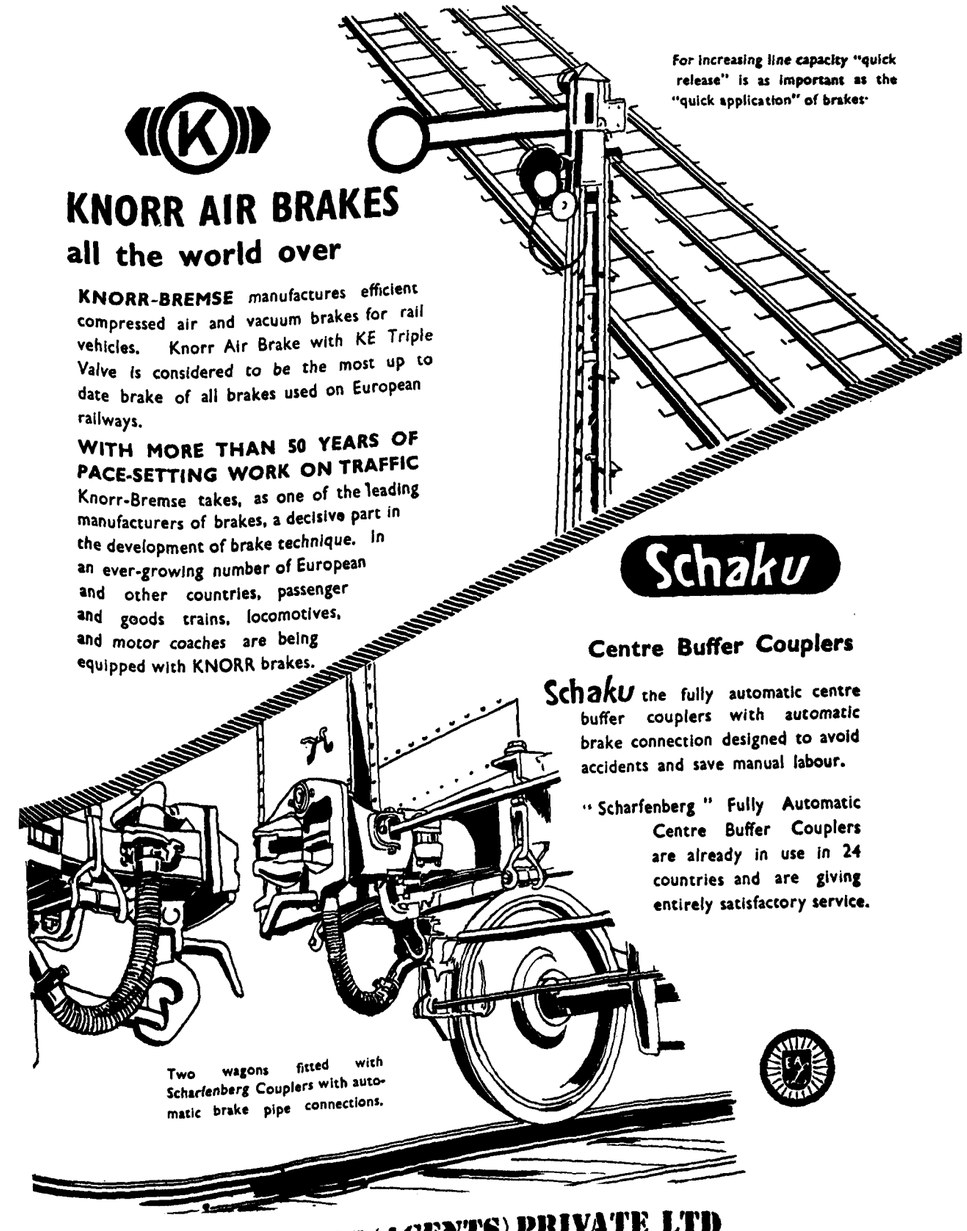


Fig. (1) shows the stages of change-over to the Centre Buffer Coupler.

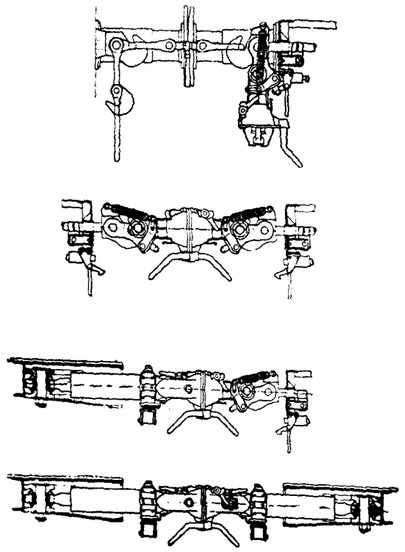


Fig. 1

Such a design of Centre Buffer Coupler and Draw Coupler, fully satisfying the U. I. C. and other conditions is offered by the Scharfenbergkupplung GmbH of West Germany, based on their fifty years of experience in design and manufacture of Automatic Couplers for Rail Vehicles. This coupler can be supplied as a normal type, for goods wagons, equipped with one or several 'automatic' pipe couplings for compressed air or vacuum type of brake system and also with an Auxiliary coupling permitting alternative coupling with a draw hook by hand (Transition Coupler)—Fig. 2. In case of using the Draw Coupler, however, this Auxiliary coupling is not required for the period of transition—Fig. 4. This Coupler can also be supplied equipped with cable boxes arranged laterally, and with compressed air uncoupling device. All coupling operations and opening or closing of the air pipes are effected automatically (Fig. 3). If required, the cable boxes, in coupled-up condition, can be switched off also mechanically. A building-up system of attachments and the installation of other components required, makes it possible to modify the coupler for goods wagons into a fully automatic Coupler for Railcars. Care has been taken in the design and development work, to ensure that both coupler types can be coupled-up with each other.

Also, for this coupler the well-known Parallel Tight Lock, which is in for more than 50 years, has been provided. However, it has been transplaced in the coupler-head casing, as far as possible, in direction to the buffing face. This makes it possible to include the protruding centralizing device for the purpose of serving as a guiding face, as the coupler eye now—contrary to what happened with the couplers of the single position type which were hitherto in use—does not come out of the centralizing device any longer. Thus, a gathering range, even far greater than provided in U. I. C. Specifications, has been made possible.

In consideration of the U. I. C. requirements, the maximum strength up to breakage has been established to 150 t for tension, and to 250 t for compresion. The elongation limit for tension is of approx. 115 t. But if required, manufacture of the couplers is possible for 200 t tension, 350 t compression and 145 t elongation limit.

The draw and buffer gear of any capacity can be supplied with the standard coupler head, such as—

Capacity	draw and buffer stroke	efficiency
50.3 t	50 mm	1325 mkg
50.3 t	100 „	2650 „
87 t	125 „	4020 „
104 t	125 „	4320 „

This provides for adaption of the Coupler to a rather wide range of prevailing conditions (see mkg diagrams in Fig. 2).

The Draw Coupler (Fig. 4) is supplied inclusive of draw hook and bar reaching till the shell sleeve, in order to obtain the fixing of the Draw Coupler on the draw hook in a correct manner. During the coupling operation of a car equipped with Centre Buffer Coupler and a car equipped with Draw Coupler, the Draw Coupler has to absorb the full stroke of the side buffers opposing each other since the Central Buffer under the low pressure of the Draw Coupler does not give way. Therefore, the buffer stroke of the

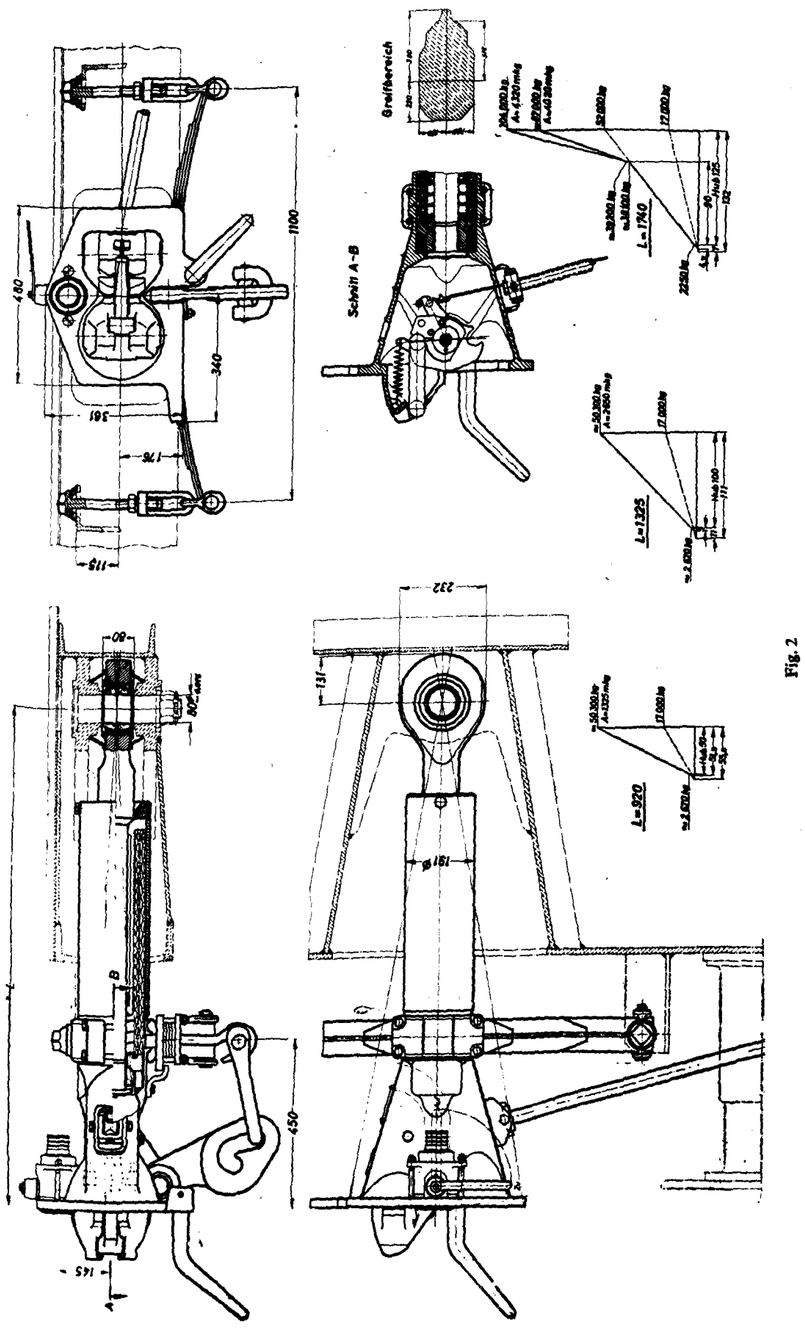


Fig. 2

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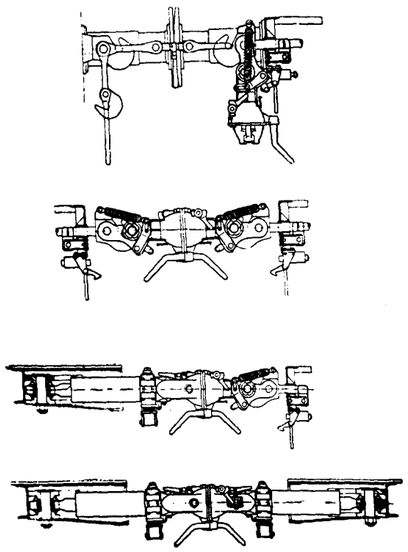


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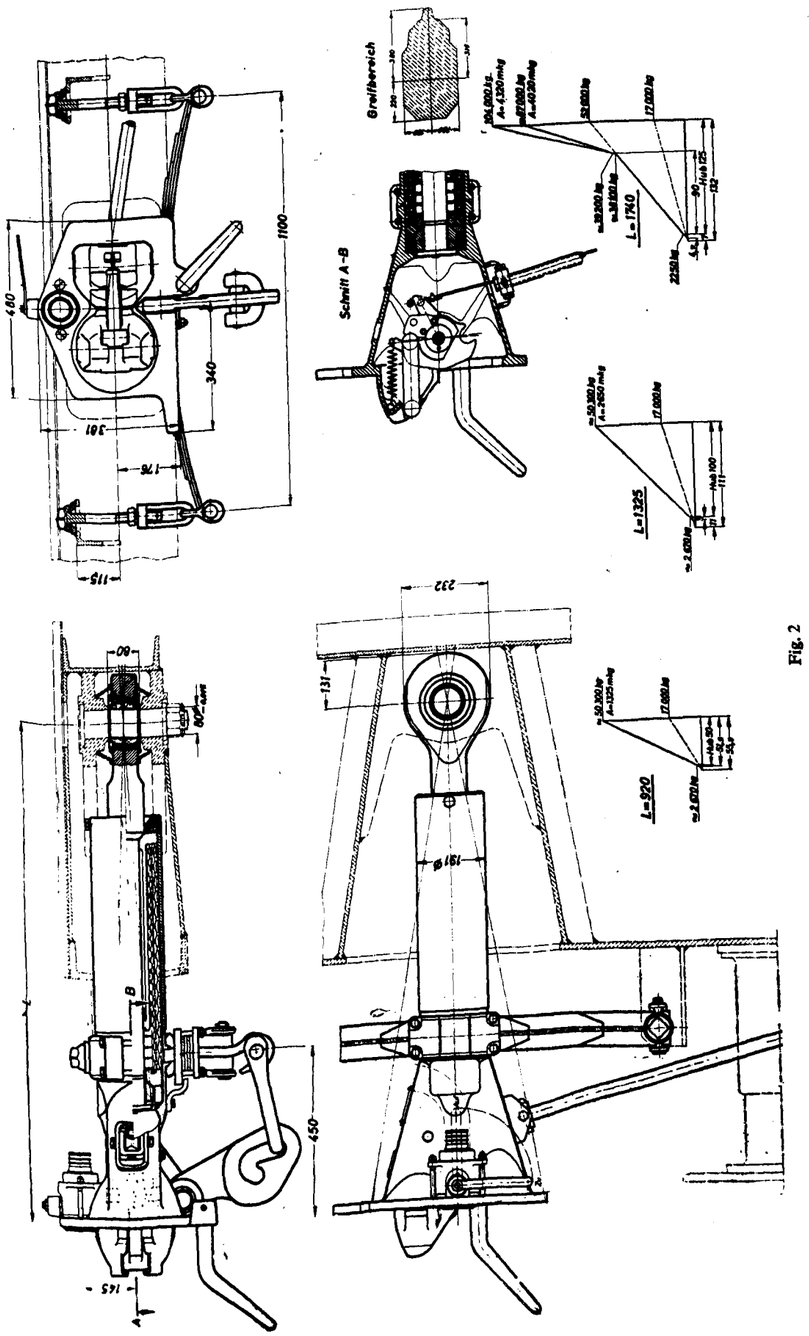


Fig. 2

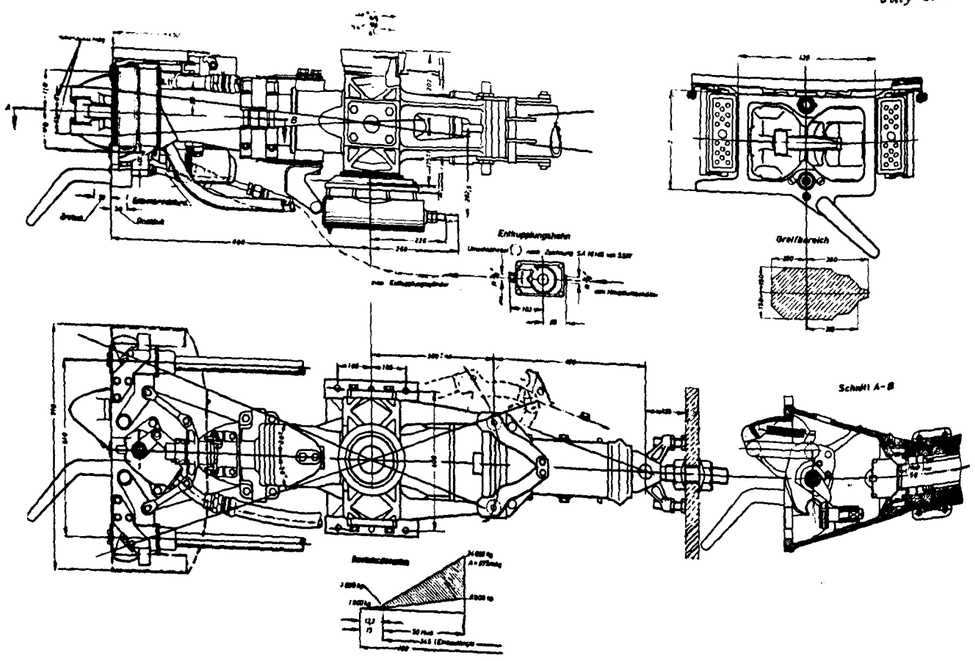


Fig. 3

Draw Coupler must be as long as possible. This has been achieved by allowing the couplers to swing under the draw hook when the buffers are completely driven home. Both the springs provided keep the coupler in horizontal position ready for coupling, providing at the same time for the spring travel of the buffer stroke. If the Draw Coupler is not needed, it is easy to swing it downward. An automatically operating catch keeps the coupler in neutral position. In case the coupler is wanted again, the catch can be released from side of the car, and the coupler—now under tension effect of the draw springs—takes again its horizontal position ready for coupling.

There is no doubt that the method of changing over from Screw Coupler to Centre Buffer Coupler, as provided in the U. I. C. Specifications, incorporates the disadvantage of being rather expensive, for reason of necessity to equip first all vehicles with the so-called Draw Coupler which is later on eliminated. The illustrations in Fig. 5 show another method of change-over, which eliminates the use of a Draw Coupler. This plan provides for installation of all new vehicles with the Draw and Buffer Gear of the selected capacity for the Centre buffer coupler. However, instead of the Centre Buffer coupler head, first a Draw Hook with Screw Coupler will be attached, by means of the shell sleeve. During the transition time—for instance on the occasions of main inspection—the old vehicles may be modified for adaption to the new conditions, and get also equipped with the draw and buffer gear. For the time being the side buffers must be kept in position. After some years all the vehicles will have been modified accordingly, making possible, within a short space of time to dismantle the draw hook by unscrewing the shell sleeve, to mount the Automatic type of coupler head instead and on this occasion, to take off the side buffers. This procedure could be performed within one or two days, preceded by the respective preparation and organisation. The advantage of this method consists in beginning the change-over with the new built cars, without causing any trouble for traffic service. This is to say: In this way, the Automatic Coupler compulsorily grows into the new rolling stock. The Railway Administrations are free to cut down the time of change-over.

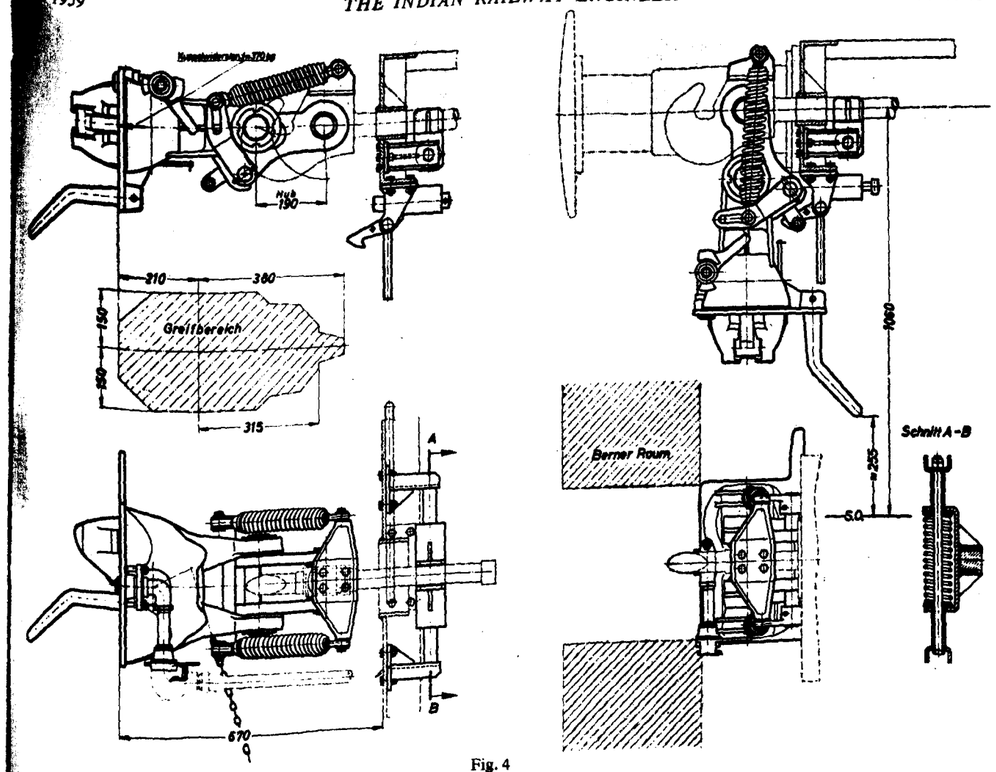


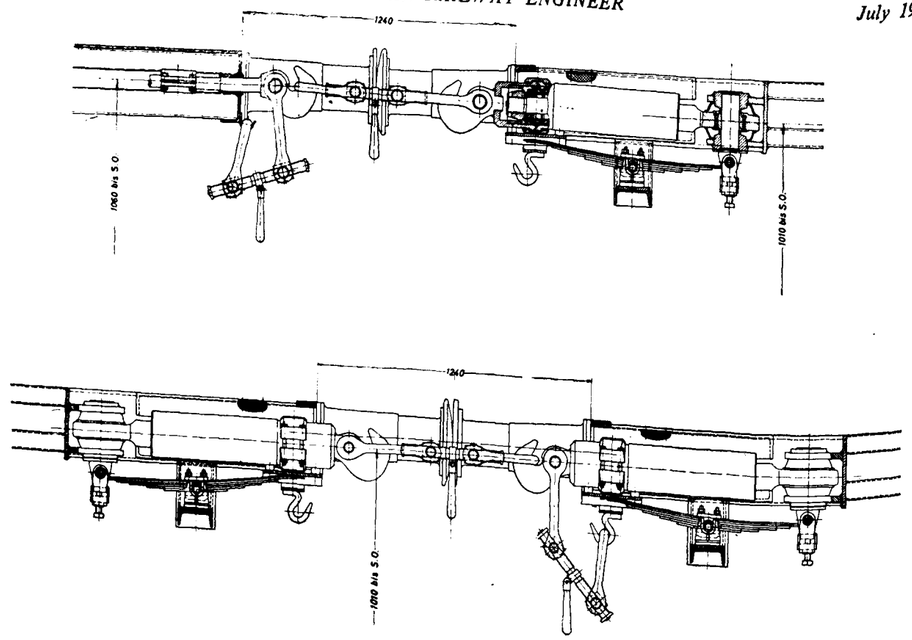
Fig. 4

Another advantage is that the mounting of the coupler heads and the dismantling of the side buffers result in shortening the distances between the cars, and consequently, in a considerable reduction of the total lengths of trains.

The coupler head casings are made of plate shell pressings welded to each other. This procedure is more simple, exact, light and cheap, and reduces wastage to a minimum, the percentage of which is always considerable in case of manufacture of steel castings required for other types of couplers. The weight of the complete coupler of a capacity of 50.3 t and 100 mm. of draw and buffer stroke, has been kept within the limit of 330 kgs, inclusive of the draw and buffer gear, the auxiliary coupling, the brake coupling, and the leaf spring suspension, and this in spite of the high degree of resistance to traction and compression.

Beyond what is stipulated in the U.I.C. Specifications in respect of strength requirements, the Scharfenbergkupplung GmbH have also designed a special type of coupler for extremely heavy duty conditions. The design of this coupler provides for the following values of strength :—maximum strength up to breakage of 350 t for tension and of 500 t for compression; capacity of draw and buffer gear of 140 t with a draw and buffer stroke of 80 mm, resulting in an efficiency of 5400 mkgs.

Experience with Fast Running Trains and Railcar Sets has shown that it would be expedient to provide for a stabilizing effect between the individual vehicles with a view to prevent disagreeable rolling motions. For this purpose, a Stabilizing Device has been developed, having the effect of retaining the coupler, with a certain amount of inherent force, in its central position. This force for normal railcars measured at the buffing face level—is of 800 to 1000 kgs, and it decreases with the increase of the side displacement of the coupler, i.e. the smaller the curvature of the track, the smaller is the transverse force. This design of the Stabilizing Device serves the purpose of reducing the wear of the wheel flange of vehicles at the time of negotiating curves. Fig. 6



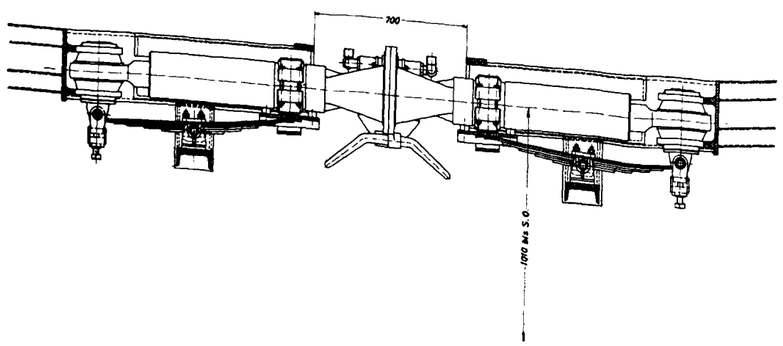


Fig. 5

shows a Full-Automatic Scharfenberg Coupler, with a draw and buffer gear of 32 t capacity, and a stabilizing device. As the coupler heads are attached to the draw and buffer gears by means of a shell sleeve connection which can be easily unscrewed, the full-automatic coupler head can, of course, be supplied with any of the aforementioned draw and buffer gears.

Compared with other coupler types, the Scharfenberg Couplers possess several appreciable advantages which should not be overlooked.

The coupling process is effected entirely automatically not only on straight and level tracks but also on the

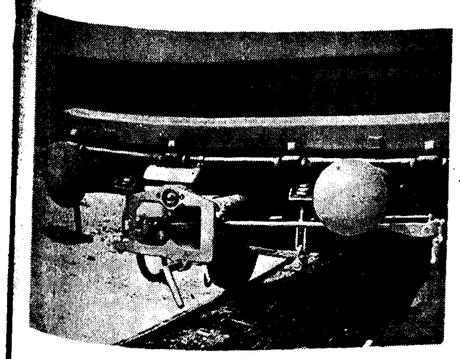


Fig. 6

smallest of track curves and on points of change of gradient. The movable parts lie protected in the interior of the coupler head casing. They possess or need no locking device which might lead to fracture in actual operation.

Wear is reduced to a minimum because both halves of the coupler, when coupled up, form a rigid rod so that they can be hardly moved against each other. The pivoted connection to the cars is effected by globe joints which are working free from play so that there is also minimum motion and wear at these spots. Unintentional disengagement of the couplers of not uniformly loaded cars with great differences in buffer height as a consequence of shocks when travelling is made impossible as—unlike the claw type couplers—it is not possible that one of the coupler halves could jump out. Cars are protected against telescoping or climbing up on top of each other as it is often the case when vehicles equipped with flexible couplings are involved in railway accidents (collisions or derailments).

Considerable problems are no doubt involved in changing over from the Screw Coupler to the Automatic Centre Buffer Coupler, but the more the moment of changeover is postponed, the greater will be the problems later if the railway system is expanding in magnitude and traffic performance. Therefore, a bold policy should be adopted by the railway administrations, taking a cue from Japan which has avoided greater problems by changing over to the new system earlier rather than after the fuller development of its railway system.

Mr. Loven of the World Bank Team in Bombay

Mr. Loven accompanied by Shri O. S. Murthy, Director (Railway Planning), and Shri P. R. Pusalkar, Joint Director (Transportation), arrived in Bombay from Madras by air in the evening of Tuesday the 26th May. Mr. Loven was received at the airport by Shri D. P. Mathur, Senior Deputy General Manager.

Mr. Loven conferred with Shri B. Arora, General Manager of the Central Railway and the Heads of Departments of the Central Railway in the morning of Thursday the 28th May at Victoria Terminus. Welcoming Mr. Loven to the Central Railway, Shri Arora described briefly the important features of the Central Railway system and presented an overall picture of the Central Railway's operating position in terms of the approved statistics of performance. He outlined briefly the task before the Central Railway, the problems that have arisen, the measures that are being taken to solve them and to develop the Railway's transport capacity on the various sections to meet the increase in goods traffic under the tempo of the Plan. Shri Arora also referred to the importance of the Khandwa-Hingoli metre gauge rail link now under construction which when completed would provide a vital connection between the Southern and Northern metre gauge systems.

At the conclusion of the conference Mr. Loven thanked Shri Arora for the valuable information furnished by him.

Earlier in the day Mr. Loven had made a quick trip to Lonavla to see the Central Railway tracks over the Western Ghats. In the evening of 28th May he visited the Route Relay Interlocking work at Kurla which has been designed to cater to the intensive movement of nearly 650 trains daily at Kurla. Mr. Loven was accompanied on this trip to Kurla by senior officers of the Railway who explained the features of the new installation. A brochure bringing out the salient aspects of the Route Relay Interlocking system at Kurla was handed over to Mr. Loven on the occasion. The Route Relay Interlocking system at Kurla would be commissioned into service by about the end of June 1959. Mr. Loven flew back to Delhi the same evening.

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ZONAL RAILWAY USERS' CONSULTATIVE COMMITTEE MEETS

The Sixteenth Meeting of the Zonal Railway Users' Consultative Committee of the Central Railway, was held on the 18th May 1959 at Victoria Terminus, under the Chairmanship of Shri Bhishma Arora, General Manager. Members of Parliament, Members of Legislative Assemblies from the States, representatives of the State Governments and non-official Members drawn from trade and industry and public life were present.

In accordance with the recent decision of the Railway Board to associate one Member of the Zonal Railway Users' Consultative Committee with the Claims Prevention Campaign in the Railway, Shri M. A. Karim was unanimously elected as the Committee's representative and Shri Devji Rattansey was elected to serve on the Suburban Railway Users' Consultative Committee of the Central Railway.

The General Manager announced at the meeting that with a view to providing reserved Third Class accommodation and also additional Third Class accommodation in the through coaches between Bombay and Lucknow by 5 Down/6 Up Punjab Mails, the First, Second and Third class composite bogies of the old type now running between Bombay and Lucknow by these trains would be replaced by the newly built First and Second complete coaches.

A Member suggested tightening up of ticket checking arrangements in First Class of Deccan Queen trains and there was a general discussion on this subject.

On the question of providing the public address system and mechanical contrivances at Agra Cantonment station for issue of tickets, the General Manager said that in view of the limited funds available for passenger amenities and the difficult foreign exchange position, it will not be possible to implement these suggestions immediately. A general discussion followed on improvement of the standards of the departmental catering service. In reply to a query as to when the Metre Gauge line now under construction between Akola and Kanhergaon would be thrown open for traffic, the General Manager explained that according to present indications this line may be available for traffic by the end of the year and that a clear indication could be given only after the work has been completed. On a suggestion that an additional Express train should be run between Bombay and Calcutta, the General Manager indicated that owing to heavy engineering works between Howrah and Nagpur on the South-Eastern Railway, and capacity limitations on the Central Railway by the Jabalpur route, it would not be possible to implement this suggestion for sometime to come.

The General Manager also announced that Hindi/English composite forms will be brought into use as early as possible on this Railway for the issue of Way Bills, Luggage Tickets, Parcel Way Bills, Goods Invoices indemnity notes and forwarding notes for general merchandise.

Other Among subjects discussed were: the opening of an Out-Agency at Chhatrapur (in Madhya Pradesh) to be served by Harpalpur station, amenities to passengers at Bhopal station, a separate quota for reservation of First class berths from Bhopal to Delhi, the punctuality performance and traffic operation on the Central Railway and the claims and financial position.

*** *** ***

BOMBAY REGIONAL RAILWAY EQUIPMENT ADVISORY COMMITTEE MEETS

The Seventh periodical Meeting of the Bombay Regional Railway Equipment Advisory Committee was held on the 13th May 1959, at Victoria Terminus, under the Chairmanship of Shri Bhishma Arora, General Manager, Central Railway. It will be recalled that the functions of this Committee are to make recommendations for development of new capacity and utilisation of available capacity for manufacture of Railway stores with the aim of attaining self-sufficiency in Railway equipment.

It was announced at this meeting that the purchase of Railway stores will, in future, be made by classifying items of Railway equipment under three groups. Items to be procured (1) from large industries (2) exclusively from small industries and (3) from both large and small industries. 27 items have been listed which, in future, will be procured from small industries only. Regarding items which are to be procured from both large and small industries, a price preference upto a maximum of 15% will be given to small industries over the price quoted by the large industries.

After discussion on the capacity of Railway workshops for certain items of manufacture and the relative capacity of the trade in the same sphere, it was decided that details would be furnished in future of the nature and quantum of manufacture carried out in Railway workshops, together with an indication of proposed expansion scheme of the Railway, so that the private sector will have a clear picture before it of the demand and the capacity.

on a brake equipment for electric or diesel locomotives in use on railways having vacuum brakes on the trains

THE JOURDAIN MONNERET Department of the French Westinghouse Brake Co., which has specialized for years in automatic vacuum kes, has developed, for modern electric or diesel ctric locomotives, a *combined vacuum air brake*, ich has several interesting features, and chiefly plicity.

The loco has a conventional air brake, while the in has got automatic vacuum brakes.

The driver controls the brakes through a vacuum driver's brake valve and both systems are synchronized through a "Model GD synchronizing valve" which has obtained French patents

On operation of vacuum brakes, any admission of air in the train pipe operates the valve and sends compressed air to the brake cylinders on the loco.

The air pressure in these cylinders is proportional to the drop of vacuum in the train pipe and is maximum when the train pipe is fully open to atmosphere.

Moreover, the device allows an adjustable delaying of the brake on the loco in connection with the braking of the train. In other words, the synchronizing valve can be operated only after a slight application of the brakes on the train. This avoids reaction between train and loco.

The loco is also fitted with direct air brake to be used when it is running alone.

The locomotive brake can also be shut off entirely.

Such equipments have been designed for the single-phase electric locomotives for India, now in course of erection (built by ALSTHOM KRAUSS MAFFEI,

BRAKES OF ALL SYSTEMS

For Steam, Electric and Diesel Locomotives, and Rolling Stock

COMBINATION VACUUM BRAKES FOR TRAINS WITH VACUUM-CONTROLLED DIRECT AIR BRAKES ON LOCOS

As supplied to: ARGENTINE, INDIA, VIETNAM, TOGO, ALGERIA, TUNISIA, MOROCCO, FRENCH WEST AFRICA, etc.
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NIVELLES, KRUPP) also for diesel-electric locos for Argentine (built by ALSTHOM) etc.

Cylinder can be fed with *high pressures* as the cylinder pressure can be higher than the pressure in the train pipe.

It is *adjustable*.

Maximum cylinder pressure can be adjusted between 1, 5 and 6, 6 Kg/cm2 (21 and 94 p. s. i.).

It provides a *two rate braking* (" loaded empty " or " dry track—wet track ") under control of the driver. A pneumatic device, operated while running actuates the adjusting handle and changes the value of the pressure admitted in the cylinder.

It provides a braking rate *proportional* to the load through an automatic device operated while running, and using the variation of suspension springs deflection to operate the adjusting lever and change the value of the pressure admitted in the cylinder.

It provides a *two-rate braking proportional to the load* through a combination of the two former features.

It is particularly *quick-acting*.

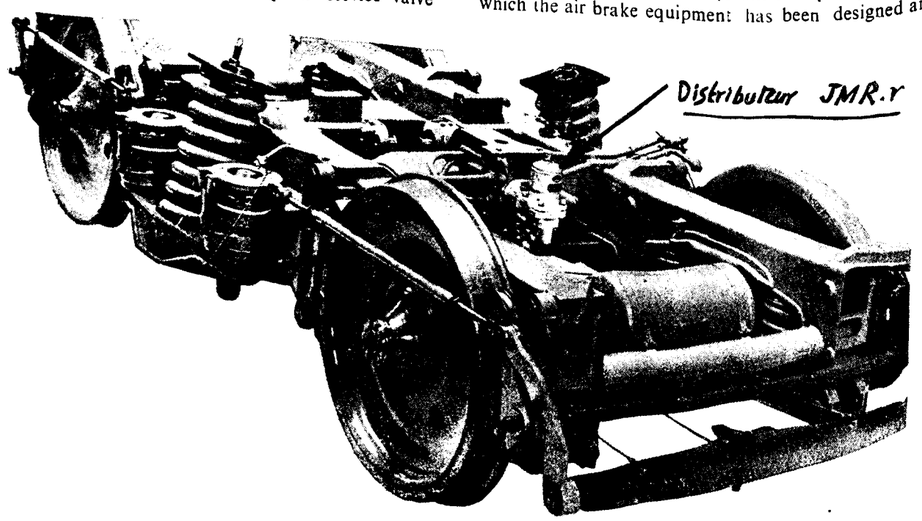
On the first application, the quick service valve takes in part of the air in the train pipe and brings a quick drop of pressure. The distributing valve acts then as a relay.

It can be *coupled* with *any* system of automatic air brake.

Its construction and maintenance are very *simple*.

The JMRr is mounted on a double bracket fitted with air-strainers with unions for the piping.

In the case of long trains (more than 220 yards) the JMRr distributing valve can be supplemented by a quick service valve which brings a very quick drop of pressure in the train pipe, resulting in a pre-application of brakes, at the same time avoiding immediate reactions between cars.



Fitting of Distributing valve on bogie.

BRAKE EQUIPMENT FOR RAIL-CARS AND SHORT AUTOMOTIVE TRAINS IN USE ON THE FRENCH RAILWAYS

With the aim of greater speed, safety and comfort, the National Company of French Railways has now in use a quite up-to-date rolling stock including 300, 600 and 825 hp railcars and fast automotive units of the R. G. P. model (long distance diesel engined short trains) on the T. E. E. (Trans-Europ-Express) for which the air brake equipment has been designed and

by Freins Jourdain Monneret (a department of French Westinghouse Brake Co).

The chief feature of this brake equipment is the odel JMRr distributing valve, which is described eafter.

The advantages of this distributing valve are the llowing:

It is *full-automatic* which means that it operates en a drop of pressure occurs in the train pipe. is drop of pressure may be originated normally rough the driver's brake valve, or by the operation an emergency valve, or accidentally by the breaking a coupler or any other cause bringing a drop of pressure in the train pipe below the pressure value of 4,700 K. per square cm (67 p. s. i.)

It is *moderable*, both on application and release. This means that any increase or decrease of pressure in the train pipe results in a proportional increase or decrease of pressure in the cylinder. Full release (cylinder pressure : null) is obtained for a pressure of 5 Kg/cm2 (71 p. s. i.) in the train pipe. Full application (cylinder pressure 1, 5 to 6, 5 Kg/cm2 i. e. 21 to 92 p. s. i.) is obtained with a pressure of 3,400 Kg/cm2 (50 p. s. i.) in the train pipe.

It is *inexhaustible* as the auxiliary reservoir is fed constantly during an application.

It ensures *perfect safety* as it operates even in case of a slow drop of pressure.

Cylinder pressures is independent from piston stroke and from slight leaks in gaskets.

(Continued from page B.4)

n engineering viewpoint. Particularly so is the draft imulation rig which produces a number of misalignment conditions at irregular intervals and at varying peeds. This is achieved with standard Dowty control nits.

UFFER HEAD STRENGTH

At the end of the straight track is the original 70-ton oncrete buffer block now used, among other things, or the standard British Railways inspection test for uffer head strength. Buffers are mounted on the lock at an angle of 30 deg. and are impacted by a buffer plate attached to the wagon. Impact speeds up to 17 m. p. h. are attainable. High-speed cameras show that during impact tests with a 40-ton laden wagon the block moves 1½ in. and then gradually returns.

The Dowty group was originated in 1931 by Mr. (now Sir) George H. Dowty, who wished to improve aircraft undercarriages. Since the war components for gas turbine fuel systems, rubber seals, electrical equipment and pit props have been added to the products ; there are 18 companies in the group.—

(By Courtesy : Modern Transport)

RAILWAYMEN'S DAY MARKED IN USSR

In accordance with the established tradition the orking people of the Soviet Union widely marked ailwaymen's Day on 2-8-59 – the first Sunday of Aug.

ver 50,000 Moscow railwaymen with their families hered in the Gorky Central Recreation Park in scow to take part in festivities. A gala concert he open air theatre in the park drew over 15,000 ngsters and their parents. Concerts of railway-n's amateur art groups and professional artists re also given on other stages in the park.

Many railwaymen visited the USSR Exhibition of nomic Achievements where meetings of visitors h renowned railwaymen were arranged at the oviet Transport " pavilion.

Hundreds of thousand of Leningraders came to the Kirov Central Recreation Park to see an exhibition illustrating the technical progress of railway transport in the Soviet Union. Festivities in this park on the Kirov island lasted late into the evening and ended with a youth bail.

The citizens of Riga celebrated Railwaymen's Day in the Recreation Park and the " Locomotive " Stadium. Mass sports competitions followed the march past of sportsmen. Special performances were given in a number of theatres.

Festive concerts, sports displays, lectures and talks about the development of railway transport were also arranged in Vilnius, Minsk, Baku, Stalino and other Soviet cities.

THE DOWTY HYDRAULIC BUFFER

By F. Pawling, A.M.I. Mech. E., A.F.R.Ae.S.

RAILWAY engineers are determined to meet the challenge of road transport. More and more special wagons are being built to carry particular freights. Mechanical handling is replacing man-handling of goods. And rail traffic is integrating with road transport to offer the best economies of both.

But all these efforts will be of little value unless an equal effort is made to reduce the damage which can occur when goods are sent by rail. Special wagons, mechanical handling and a co-ordinated transport policy will not eliminate the big difference between road and rail transport—wagons are shunted, road vehicles are not.

Figure 1 gives an idea of the enormous amount of energy which must be absorbed when one wagon collides with another. Typical 2—axle wagons can be laden to an all-up weight of 40 tonnes; and marshalling speeds of 15 km per hour are not unusual. At this weight and this speed, the buffers, wagons and freight must absorb 18,000 mkg of energy. A set of spring buffers absorbs less than a quarter of this amount; the rest goes into the wagon and its contents. No wonder there is so much damage to both wagon and freight.

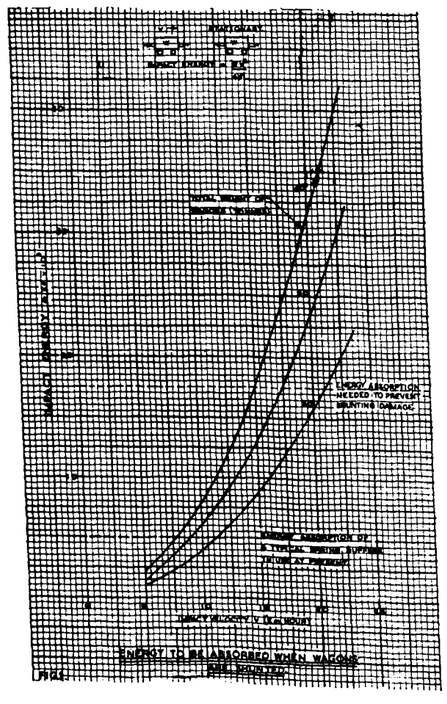
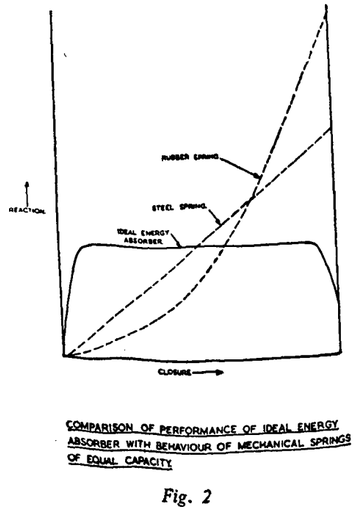


Fig. 1

What is needed is a buffer which supplies the smallest possible force to absorb the energy of an impact.

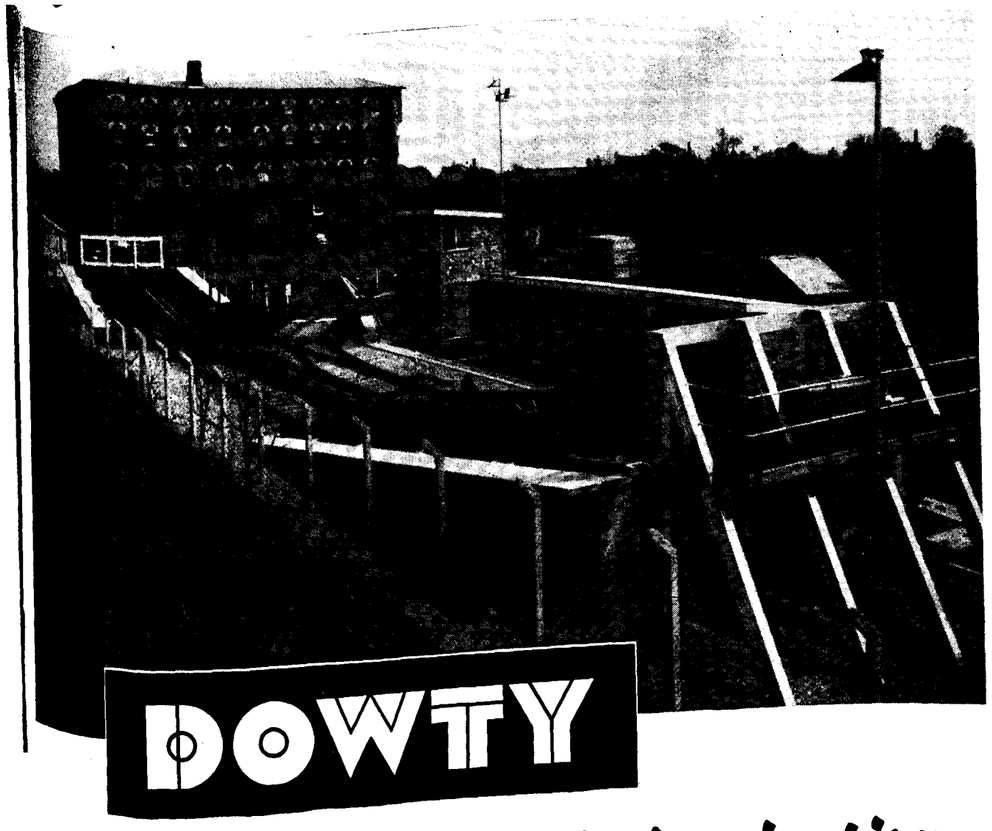
This means that the buffer must always use the full available closure; less than full stroke will result in an unnecessarily high force. It also means that, to make the best use of the closure, the buffer force must build up very quickly to the required load and stay at this value throughout the rest of the movement. And, because the buffer always closes completely, its resistance—the only factor which consequently can change—must vary directly with the energy to be absorbed.

Figure 2 shows that the shape of the ideal



COMPARISON OF PERFORMANCE OF IDEAL ENERGY ABSORBER WITH BEHAVIOUR OF MECHANICAL SPRINGS OF EQUAL CAPACITY

Fig. 2



aiding Railway Modernisation

The comprehensive Dowty test site at Ashchurch for the development of new railway equipment under actual service conditions.

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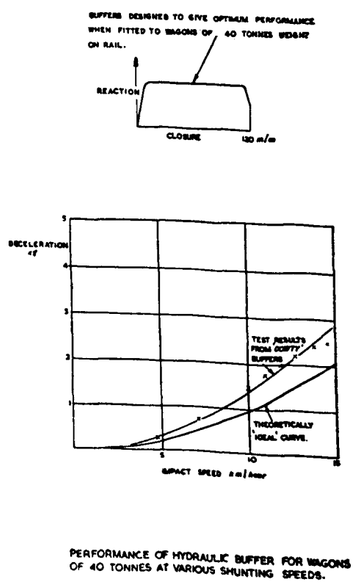
load/closure curve is nearly rectangular. The full working reaction does not act immediately the buffer begins to close, nor does it cease just when the buffer has closed. Instantaneous changes in buffer resistance would produce an effect like that of a suddenly-applied load.

THE HYDRAULIC PRINCIPLE

Because impact energy varies with the square of the shunting speed, buffer resistance should vary in the same way.

This relationship between resistance and speed is similar to the law governing pressure-drop when fluid is forced through an orifice. The pressure-drop depends upon the square of the fluid speed.

This principle can readily form the basis of a buffer in which resistance varies directly with changes in energy arising from changes in impact speed. Suppose a piston attached to the buffer head forces fluid from a cylinder through an orifice. The pressure drop will [illegible] the force on the piston. The magnitude of the force will be proportional to the square of the piston speed.



PERFORMANCE OF HYDRAULIC BUFFER FOR WAGONS OF 40 TONNES AT VARIOUS SHUNTING SPEEDS.

Fig. 3

By simply varying the design of the orifice system the level of resistance at different parts of the closure, and hence the shock-absorbing performance, can be matched to the conditions under which the buffer must work.

For example, wagons which spend most of their life fully laden, such as mineral traffic wagons—or wagons which carry very little load, such as brake vans—are best protected by buffers designed to give their optimum performance at the maximum load of the vehicle. The behaviour of this type of buffer for wagons of 40 tonnes all-up weight is shown on Figure 3. Whatever the shunting speed these buffers will produce, within practical limits, the ideal performance of uniform resistance throughout the closure.

However, for vehicles which may carry very heavy freight of one journey and may be laden with fragile goods on another, different characteristics are needed. A hydraulic buffer reacts only to speed; it cannot sense changes in wagon weight. Consequently the initial buffer force at a particular impact speed will be the same regardless of the wagon weight. This means that if a buffer is designed to give ideal performance on a heavy wagon, the resistance will be unnecessarily high when this buffer is working on a lighter vehicle.

It is quite easy, however, to make the buffer insensitive to change of weight. Instead of designing the orifices with one weight in mind they are designed to cover a range of wagon weights. If, for example, a wagon weighs 10 tonnes empty and 40 tonnes full, the weight range is 4. The performance of a hydraulic buffer designed to bridge this weight range is shown on Figure 4. It will be seen that the maximum deceleration is just under one and a half times greater than the ideal in each case, i. e. for both variations in wagon weight and shunting speed.

A further advantage of hydraulic shock absorption is that it separates impact from recoil. Forcing fluid through a hole dissipates energy; it is not stored as in a compressed spring. Consequently the type of recoil system and its performance can be chosen independently of the buffing behaviour. Furthermore, if the required recoil forces are large, the hydraulic fluid can be used for damping purposes during recovery of the buffer.

HYDRAULIC VERSUS SPRING BUFFERS

It has already been pointed out that the capacity of

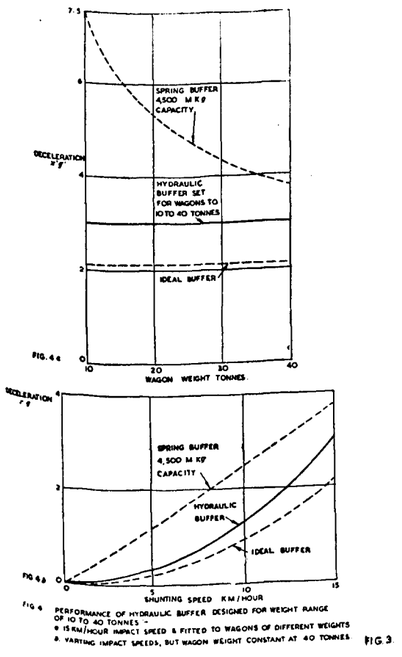


Fig. 4

existing spring buffers falls for short of the energy to be absorbed during wagon marshalling. But, even if springs could be fitted which had the capacity to contend with large impact energies, their performance would be far from satisfactory. Figure 2, for example, shows that the peak reaction of a helical spring will be twice that of an ideal buffer of the same energy capacity; the reaction of a rubber spring will be at least three times as great. Similarly Figure 4 gives the comparative performance of a spring buffer capable of controlling impacts between wagons of 40 tonnes moving at 15 km/hour. The performance of the hydraulic buffer is markedly superior to that of the spring, particularly when the weight of freight in the wagon is reduced.

THE DOWTY HYDRAULIC BUFFER

It is often easy to invent a way of doing something: it is usually harder to put the scheme into practice. However, after four years of intensive development, the Dowty Hydraulic buffer embodies in a practical form the principles described above.

The guiding philosophy throughout this work has been to build a unit which has all the refinements of a high performance buffer and yet is reliable and robust enough to stand up to severe working conditions. Figure 5 shows how this philosophy has taken practical shape in a buffer which has been supplied in many thousands to British Railways.

There are only two main items—a piston (1) working in a cylinder (2). As the buffer closes, the piston forces oil out of the cylinder through a series of holes (3) whose size and position determine the performance required in buffing. The oil flows into an annular reservoir (4) and the filler (5) is arranged so that, even when full, air is trapped above the oil level. This air is compressed when the oil is displaced from the cylinder. It therefore provides a pressure which helps to recharge the cylinder. It also acts in conjunction with the recoil spring (6) to re-extend the buffer.

The seal is the heart of any hydraulic mechanism. Yet, although pressures up to 1,500 atmospheres can be generated in the cylinder, the seal is only an 'O' ring (7) backed-up by a nylon scraper (8). This simplicity has been achieved by ensuring that only the pressure in the reservoir (atmospheric pressure at full extension, 6 atmospheres when fully closed) reaches the seal. A groove and some radial holes in the cylinder wall just inboard of the seal provide an

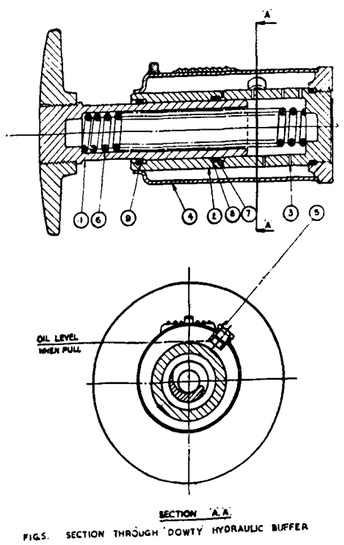


FIG.5. SECTION THROUGH DOWTY HYDRAULIC BUFFER

Fig. 5

escape route for any high-pressure oil which flows past the piston during closure. High-pressure oil therefore never reaches the seal. Leakage past the seal under the low pressure acting on it is negligible. However, the reservoir has an extra 0.5 litres of oil to make sure that the buffer can work for many years without being topped up.

The outstop (9) is in the form of a split ring which abuts against a step at the junction of the piston neck with the main piston diameter. Because the exposed part of the piston is smaller in diameter than the cylinder bore, damage to the piston neck will not score the bearing surfaces inside the buffer. And, dirt on the piston neck is scraped off by the outstop ring as the buffer compresses.

Except for the seals, all the parts of the buffer are made from steel. Buffers designed for British Railways must withstand working reactions up to 100 tonnes and meet a dynamic test load of 150 tonnes without failing. The forces acting on the bearing surfaces of the piston under these conditions are extremely severe. But by careful development of the piston design, and surface treatment of the piston and cylinder, it has not been necessary to use special lubricants in the buffer. The fluid is a straight mineral oil of the light hydraulic type.

Initial compression of the oil inside the piston and cylinder prevents the pressure mounting instantaneously as the buffer starts to close, and so automatically gives the slope required at the front of the ideal load/closure curve. Similarly the piston cuts off the last hole in the cylinder wall just before full closure. The trapped oil acts as a "liquid spring" and stops the piston bottoming during an actual impact.

The Dowty buffer therefore contains all the advantages of hydraulic shock absorption—high capacity, tailored performance, independent buffing and recoil, and an oil cushion at full closure. Yet its simplicity and ruggedness ensure trouble-free operation under the toughest duty demanded of railway wagons.

The manufacturers will gladly furnish on request any other information on the research and trials carried on British Railways.

INDIAN STANDARDS CONVENTION — 1959

Representatives of Standards Bodies in Burma, Indonesia, Japan, Pakistan, Turky, UAR, and Lebanon have been invited to participate in the fifth Indian Standards Convention, being held at Hyderabad from 27 December 1959 to 2 January 1960.

Hitherto the practice had been to invite delegates only from India to attend such Conventions. Since the Conventions had grown to be established for the propagation of ideas of standardization in the country, it was felt that the participation of representatives from neighbouring countries would help the Indian delegates in discussing many matters of technical details regarding standardization movement in the context of the pace of Industrialization in the neighbouring Asian countries. Since India has trade relations with these countries, it is expected that participation of delegates from neighbouring countries would also help propagating the use of Indian Standards in these countries.

Shri Lal Bahadur Shastri, Union Minister for Commerce and Industry would be inaugurating the Convention, which will be discussing the subjects relating to "Implementation of Indian Standards; Certification for Small Industries Products; Standardization as a Pre-requisite to Productivity; Preparation of Standards in Terms of Metric Units; Design for Industrial Experimentation; Tropicalization of Electrical and Electronic Equipment; Latest Techniques in Chemical Analysis; Non-Ferrous Metals Industry and Standardization; and Documentation".

A Reception Committee under the Chairmanship of Shri C. S. Tyabjee, Chairman, Federation of Chambers of Commerce and Industry, Hyderabad, has already been formed to make arrangements for the stay, technical visits, tours etc of the delegates. Nearly 500 delegates including women delegates are expected to participate in the Convention.

It may be recalled that so far four Conventions have been held at Calcutta, Bombay, Madras and New Delhi, the last one having been inaugurated by the Prime Minister Shri Jawaharlal Nehru.

LATEST IN RAILWAY BUFFERS

By A. C. Bhattacharya, A.M.I.P.E.

THE life of a railway rolling stock specially the wagon stock, seldom runs upon peaceful lines. It is pushed around quite a bit, force impact acts upon it and more arduous nature of odern operating conditions places considerable rain on it. Subject as it is to so many reverses, its uffers must be designed and built to withstand uch.

The railway buffers are primarily intended to ithstand impact and then to maintain mutual end ressure between the adjacent vehicles to prevent teral oscillation, while at the same time they must be apable of yielding to the requisite amount, to allow exure of the train on curves. They must, therefore, e sufficiently strong and also resilient enough to save he wagon from undue shocks.

Buffers perform a useful function during the process of stock marshalling in yards and sidings. For arriages, the buffing gear play an important part in teadying the vehicle when running at high speeds, and or wagons, they provide for protection to both the ehicle and its contents.

Buffers mitigate the effects of collisions and play an portant factor in preventing telescoping in many es, and in minimising effects upon passengers and mage to the vehicles.

RLIER TYPES

The earliest spring buffers designed were with mbined draw and buffing springs incorporating f-elliptical laminated springs. Early in 1900 a ng-buffer was evolved, which contained in one a buffer-ram, a volute spring, a guide, and a plate which the buffer-guide was fixed. It was a self-tained unit and secured to the head-stock by two p-bolts and two bolts. A sectional view of this of buffer is shown in Fig. 1.

bsequent development in buffer design was ted to the use of steel spiral springs or rubber s or both. Then in the constructional design res, there have been two types, known as the dle type and the plunger type.

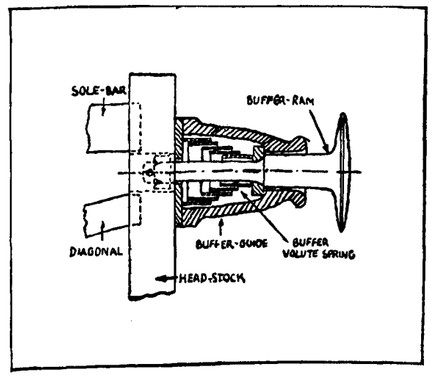


Fig. 1. Self-contained spring buffer.

INDIAN RAILWAY STANDARD BUFFERS

The standard buffers used in Indian Railways are of the plunger type and are built in the following separate units: (a) Buffer Plunger, (b) Buffer Case, (c) Spindle and Plug, (d) Spring centering washers, distance pieces, flat washers & Nuts and (e) Buffing and recoil springs.

The buffing and recoil springs are either of steel or rubber springs. While the buffing steel springs may be either helical or volute, although helical is now the type mostly used, the rubber springs used for buffing are of the concentric type springs, where the elements are moulded on both sides of the reinforcement plate. The division plates for concentric type springs are either of malleable cast iron or mild steel.

In the light weight coaches of Indian Railways now being built in the Integral Coach Factory, Perambur, the buffer design incorporates separate concentric "Batra" rubber rings which are held in position by suitable corrugated parting plates. The recoil spring is fitted on the buffer spindle just behind a steel base plate and not behind the headstock. This, however, requires large holes on the headstock to allow for the recoil springs to slide in. These buffers

are provided with special tubing inside which will collapse under heavy impacts before damaging the buffer casing and thus absorb great shock energy.

RUBBER VERSUS STEEL SPRINGS

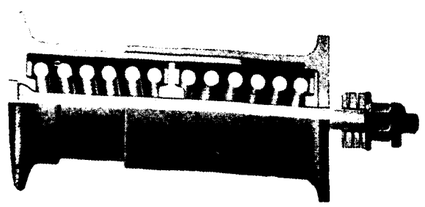
Among the rubber and steel springs, which one is the most economical, still remains a controversial question. The relative mechanical properties and other qualities of rubber and steel springs are however mentioned below.

From a comparison of their respective life, it may be stated that steel springs, if correctly manufactured have a longer life as compared to rubber springs. This is specially so in India, which has a tropical climate. Climatic conditions in the tropics can and do change much and greatly influence the life of rubber springs.

Rubber springs can become partially ineffective in service and remain in this condition undetected, leading to damage of headstocks. In the case of steel spring, a defective spring is very evident and can quickly be detected. There is however one point which is that a steel spring does not function when it is broken and the impact damages the headstocks, whereas, with rubber springs, usually the buffer does not fail completely but the efficiency decreases gradually. Further all the rubber springs in a buffer assembly do not get damaged simultaneously and only a few need replacement, but in the case of steel springs, the complete spring invariably requires replacement.

It is more difficult to attend to the repairs of buffer with broken steel springs as compared to the one fitted with rubber springs.

Steel springs have a high co-efficient of restitution and are very rapid in recoil. They produce vibration when compressed.



Steel Spring Buffer—A standard pattern of the Indian Railways.

The rubber spring has a low co-efficient of restitution and is very sluggish in recoil. The slow recoil and restitution make rubber preferables for duties of absorbing shock.

Due to rubber being non-rigid, non-metallic and semi-fluid in nature, the chief advantage lies in its use is the moderation of the intensity of the stress producing acceleration and in the effect of the blow.

When rubber springs are compressed they expand radially so that there is a dispersal of lateral effort, or cross component, which in a rigid train of metal work would produce vibration.

Rubber Springs are at least initially cheaper and rubber spring fitted buffers are much quieter in action.

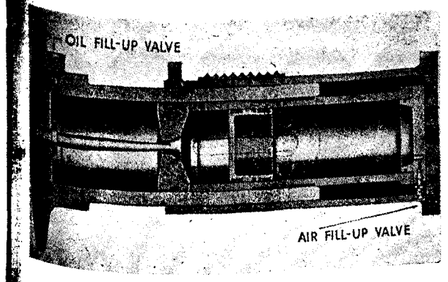
In the steel spring group, the volute spring possesses a very definite advantage over the helical spring in buffing application as the load necessary to cause unit deflexion increases very greatly towards the end of the stroke, as in the rubber buffing springs.

In providing against collisions, the important point to be aimed at in designing buffers, is to provide an elastic medium, in compressing which the momentum of the train should as far as possible be absorbed and the longer the time which can be occupied in the process, provided that the speed of the train be, in the meantime, rateably reduced, the better. There should be, however, no recoil of the compressed medium whatever the medium may be, and this is where ordinary buffer fails in its work. The recoil of the buffer springs in a collision often does a great deal of damage.

Another difficulty with the ordinary spring buffer even if it were made incapable of free recoil is, that in severe collisions the longitudinal stress thrown on the buffers, is extremely great as compared with the strength of the buffer springs, so that they yield readily, causing the behaviour of the vehicle of the train to be a great extent the same as would be the case if the vehicles were without buffers.

LATEST—HYDRAULIC BUFFERS

Such troubles as encountered in standard spring buffers were responsible for initiating research into the improvements of railway buffers and have ultimately resulted in the development of hydraulic buffers. All the different types of such buffers so far designed, are



Hydro-Pneumatic Buffer—the latest in Railway Buffers. The hydraulic and air cylinders are enclosed, and thus fully protected from damage by dirt and corrosion.

of the hydraulic-pneumatic type in that air is used for the recoil.

The design of such buffers is derived largely from those of various hydraulic shock absorbers for aircraft landing gear, and evolved on experience therewith.

Based on the principle of energy dissipation rather than energy absorption, the arrangement in the hydraulic buffer provides for the conversion of impact energy into heat energy as the buffer closes and automatically produces a steady retarding force of such a value that whatever the speed of impact, the vehicle is brought to rest as the buffer-stroke is completed. In the standard steel spring buffer, the spring recoiling speed is nearly as great as the speed of the impact, but with the hydraulic buffer the force is reduced to almost nothing very soon after the instant at which the vehicle comes to rest.

Hydraulic buffers reduce the shock in trains fitted with continuous brakes. With the present arrangement the time taken for the application of brakes at the back of the train is comparatively long, as a result after which the rear of the train catches up the front part and compresses the buffers. By the time, the rear is brought to a halt, the buffers expand and cause an outwards pressure so as to push it away again. A series of jerks takes place and the surge may travel up and down the train once more. Since violent recoil is obviated by the design of the buffer which, as has already been stated, is based on the principle of energy dissipation, the surges are almost eliminated.

The difference in the action of the hydraulic buffers

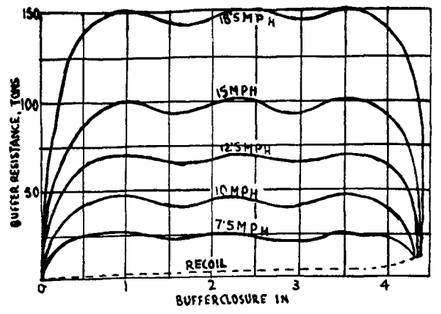


Fig. 2. Automatic variation of buffer resistance according to speed of impact.

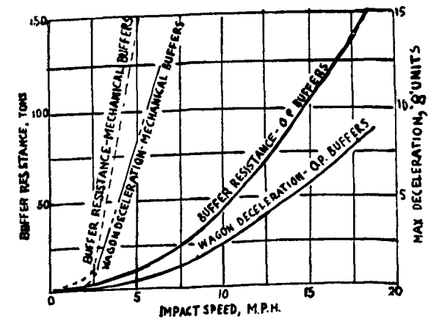


Fig. 3. Comparative tests of mechanical spring buffers and hydraulic buffers.

from that of the conventional spring buffer lies in the fact that whereas the former, for the same maximum retarding force, starts with a high initial resistance and maintains the same throughout the stroke, the latter starts with a low resistance on impact, rising to a maximum at the end of the stroke. As a result, the hydraulic buffer absorbs the maximum energy without a damaging peak resistance at the end of the stroke. Automatic variation of buffer resistance as it takes place according to speed of impact is shown in Fig. 2. How the impact shock is reduced for a given shunting speed by as much as 90 per cent in case of the hydraulic buffer, is illustrated in Fig. 3, which shows the comparative tests of conventional spring buffers and Oleo-pneumatic hydraulic buffers.

The only limitation which the hydraulic buffer has, is its inability to automatically adjust itself to variations in the mass of the vehicle, as would be needed in the ideal buffer.

ACTION ON IMPACT OF HYDRAULIC BUFFERS

Different types of hydraulic buffers have now been placed in the market. A particular type is also being tried out in Indian Railways to determine its suitability in this country. It is proposed to discuss about them in detail in one of the next issues of this journal.

In all cases the damping fluid used is oil and either air at atmospheric pressure or compressed air or gas is used in recoil to return the oil.

On impact the oil is forced through small orifices and the restriction thus imposed on its flow provides the resistance of the buffer to closure and the pressure energy is dissipated as heat and not just stored up as in a spring buffer, to be released in the form of a violent recoil. A screwed cap provides for initial filling of oil.

Construction and production problems having now been overcome, the hydraulic buffer for railway vehicles in a sense has no further problem. With the continuous increase in traffic density and shunting speeds, both wagon builders and users will welcome its advent due to its high shock absorbing capacity with better wagon and freight protection.

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Manufacture of Steel

Sardar Swaran Singh, Union Minister for Steel, Mines and Fuel, announced that he would shortly set up an all-India advisory council of steel manufacturers, re-rollers, consumers and other interests concerned to go into their requirements and difficulties.

The Union Minister, who was addressing the U. P. Foundries and Engineering Works Association, suggested to U.P. industrialists to start electric furnaces for the manufacture of steel by utilising the surplus scrap available in the region. He said his Ministry had set up a small-scale blast furnace on an experimental basis. If the experiment succeeded, a number of small-scale blast furnaces would be set up in the country.

He referred to U. P's claim for allotment of a steel plant in the Third Plan and said that one had to take into account a number of factors in judging suitability of location of industries. U. P's interest alone could not be the sole governing factor. The question had to be decided on the basis of national interest rather than regional interest, he said.

Mr. H. N. Bahuguna, Deputy Minister for Industries and Labour, who spoke earlier had urged the Union Minister to allot a steel plant to U. P. under the Third Five-Year Plan.

Sardar Kripal Singh, President of the Association, in his speech also urged that U. P. should be given a steel plant in the Third Plan.

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INTEGRAL COACH FACTORY

The Deputy Minister for Railways, Mr. Shah Nawaz Khan, disclosed in the Rajya Sabha that 440 integral coaches were expected to be manufactured in 1959-60 at the Integral Coach Factory, Perambur. He was replying to a question by Mr. N. R. Malkani.

Replying to another part of the question, the Deputy Minister said that it was expected that more indigenous sheets and plates would become available early in the Third Plan period.

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REFRIGERATED VANS ON RAILWAYS

Replying to a question whether Government proposed to introduce refrigerated vans for the transport of perishables on the railways, the Deputy Minister for Railways, Mr. S. V. Ramaswami, said in the Lok Sabha "There are no refrigerated vans on the Indian Railways. The Ministry of Food and Agriculture have, however, a proposal for procurement of six broad-gauge refrigerated vans for transport of fish as an experimental measure under T. C. M. aid programme. The Ministry of Railways will run these vans."

He added that the proposed experiment would be watched by the railways before embarking on a large-scale provision of such specialised stock for the movement of fish and other perishable traffic on Indian Railways.

RAILWAY ELECTRIFICATION SUPPLEMENT

Utilisation of Electricity in Workshops

By Shri S. P. Tonse
Deputy Chief Electrical Engineer, Western Railway

ISTORY OF DEVELOPMENT

OWER, like other commodities, is most economically produced in large quantities and generally applied in comparatively small quantities. Power from a central source must be split up and transmitted to various points of application. This may be accomplished directly through mechanical means or indirectly through electrical conversions. Mechanical transmission is being rapidly superseded by electric drive.

Until early twentieth century, steam/oil engine prime movers were the major source of motive power for workshop drives. Direct coupling or use of gears, belting, ropes or chains for transmission was adopted. Electric drive has progressively replaced these prime movers.

In the initial stages direct current motors were used because of the development of the electric system. However, with the progressive development of grid net-works, electric power is more commonly available A. C. system. Hence the extensive application A. C. motors in the recent years. But the D. C. motor continues to hold a well deserved preference for any specific applications. Each type has its legitimate use, the proper decision depending upon the specific requirement of a particular case.

DVANTAGES OF ELECTRIC MOTOR DRIVE

The following are the principal advantages of electric motor drives :—

(i) Increased production and improved quality of product—Uniformity in speed, perfection and ease of control, cleanliness and better lighting all contribute to this end.

(ii) Ease and accuracy of control—The motors offer a tremendous advantage for machine tool drives through their flexible control, ease and accuracy with which they may be started, stopped, accelerated and braked and the wide range of speed afforded with adjustment in small increaments. Accuracy, ease and rapidity of speed adjustment are valuable features in many instances.

(iii) Free from mechanical restrictions—A machine driven by a coupled or geared electric motor constitutes a self-contained unit which may be placed most advantageously with reference to the routing of product, the handling of material, crane service, lighting considerations and similar factors.

(iv) Free Head Room—Motor driven devices may be readily served by overhead cranes. They can be set out into the open and high headroom afforded.

(v) Independent Units—A plant which depends upon a mechanical transmission system places all its eggs in one basket. Failure of the main engine, slippage of a belt, heating of a bearing, or any mishap at a single point in the line of drive may cripple the entire plant or a portion thereof. Motor drive offers reliability because of the independence of units and consequent localisation of failures.

(vi) Efficiency—Electric power transmission involve conversions of energy from one form to another thus involving losses. In spite of this, it is a more efficient means of distribution than mechanical transmission through belts and shafts. The losses are proportionate to the power delivered and are discontinued altogether as soon as a motor is shut down. The continuous and fixed nature of the mechanical drive losses is in contrast with the proportionate losses with motor drives, leaving a wide margin in favour of electric power.

(vii) Purchased power—The power can be purchased in the form of electrical energy for motor drive from the local electric Supply Company. Even when power is generated, the possibility of its purchase from the local source for overtime, emergency, or supplementary service deserves consideration.

(viii) Portable Machines—The portability of motor driven tools has encouraged and developed methods of bringing the tool to the work rather than moving heavy pieces between tools.

(ix) Influence on Buildings—Motor drive in eliminating the need for heavy shafts and belts, sometimes makes possible the use of lighter building construction. Good shafting alignment often requires the use of heavier construction than is necessary in other respects. The absence of shafting in motor driven shops lessens the fire risk from overheated bearings.

(x) Protection—Fuses and circuit breakers in motor circuits protect not only the motors but also the driven machines and the load can be quite definitely restricted, if desired.

(xi) Metering—It is possible, through the use of indicating or recording electric motors, to determine the service of an electrical driven machine to study its cycle of operations, periods of idleness, variations under different conditions and like features. Such studies often lead to marked improvements in processes and methods.

(xii) Ease of braking—Dynamic braking may be used to obtain a quick stop. This adds to the safety.

(xiii) There are also other advantages of motor drive such as controllability, cleanliness, independent operation, safety, simplifications of machinery etc.

LOAD SUMMARY

In the first instance it is necessary to carry out a load survey, shop-wise and total. Connected load of various machinery, plant and equipments should be ascertained and diversity factor applied for determining the maximum demand.

H. T. BULK SUPPLY

Electric energy to the Shops may either be purchased from the Local Supply Company or generated with private plant in the Workshop itself. In the past there has been a considerable amount of controversy regarding the relevant merits of the two schemes. Except in special cases, however, the modern tendency is to draw power from the Local Supply Source, whenever this is available for the following reasons :—

(i) The management is relieved of the responsibility of generation and can concentrate entirely on its manufacturing processes.

(ii) Ample overload capacity is available and extensions to the plant can be carried out at short notice.

(iii) There is less probability of complete and prolonged shut-down due to faults or accidents in the power supply equipment.

(iv) The low rate at which electrical energy can be purchased in most areas makes the use of a public supply definitely more economical than the use of a private plant in the majority of cases.

H. T. TARIFF

The standard H. T. Bulk supply tariff comprises of the following chief items :—

(a) Fixed charge per KW of maximum demand.

(b) Running charge per unit.

(c) Fuel price variation clause for increasing or decreasing the energy cost, based on the variation of the fuel cost per ton over the basic cost figure.

(d) Power factor clause—If the power factor falls below .85 at the time of the maximum demand, the KW charge is increased for every 0.1 by which it falls below .85.

Apart from the standard H. T. bulk supply, various special charges or arrangements can also be made to

ecial or unusual requirements of the Workshop A minimum guarantee for the energy mption either per month or annum is also times insisted upon by the local Supply pany.

ouble circuit H. T. lines from the local Supply Co. generally laid to the Receiving station in the rkshop, to ensure continuity of supply. Failure of wer supply results in rendering idle a large number machines and staff, in addition to lower out-turn d hence should be avoided by all means.

ECEIVING STATION AND SUB-STATION

H. T. Bulk supply from the local Supply Co. is tributed to the various shop substations from the ain Receiving station. The H. T. bulk supply from e local Electricity system is laid to a panel, drop-wn, draw-out truck type switchboard installed at e Receiving station to be sited in the heart of the ctory area. The Receiving station H. T. witchboard should be in two sections, linked up by a section O. C. B. and each section with panels, one r receiving the local Supply Co.'s feeder, one for the ut-going workshop feeder, one for the out-going ownship feeder and a spare unit. The two out-going H. T. workshop feeders form a closed ring main and nnect tee-off ring main substations located at load ntres in the different shops. The township feeder diates to the staff colony to connects various outdoor bstations.

All the substations are of the enclosed busbar type ith 400 V. 3 phase 4 wire standard voltage on the T. side and with transformers delta connected on H. T. side and star connected on the low tension e. The incoming and outgoing H. T. supply at h Shop substation is controlled by oil immersed d breaking type isolators. Drop-down, draw-out k type O. C. Bs on H. T. side and metal clad C. Bs. on L. T. side provide control for transfor- in Shop substations, while in the outdoor tations, air-break pole-mounted isolating switches bined with drop-out fuses may be used for H. T. trol. The substation L. T. switchboards comprise former O. C. Bs. with adequate number and size ch-fuse feeder units, lined up on either side eof.

T. POWER DISTRIBUTION IN SHOPS

he capacity and location of various substations e to be determined by the loads of individual shops. Each shop has its own peculiarity of load and load conditions. The power distribution in the Shops for the various electrical machines and plug points is designed on what may be termed as the "cascade" system. The outgoing cable feeders from the various substation L. T. switchboards vary in size from single 3 or $3\frac{1}{2} \times 0.04$ sq. in. PILC DSTA cable to twin 3×0.3 sq. in. PILC DSTA cables for different loads and are run in conventional main and subsidiary cable trenches laid along and across the length of the Shops alongside columns.

The feeders terminate on primary feeder pillars sited at load centres close to the Shop columns with the minimum encroachment on working space in the Shop floor area. Each outgoing feeder from the pillar connects a main distribution board (M. D. B.) similarly sited, which in turn feeds sub-distribution boards (S. D. B.) and thence the individual machines. Different types of feeder pillars and distribution boards with incoming and outgoing switch-fuse units with H. R. C. type fuses ranging from 15 amps, capacity to 300 amps capacity may be used in this planned distributions. Large individual loads are fed by separate feeders directly from the substations. Most of the machines are provided with their own individual lights of modern design for precision working.

For the operation of portable welding sets in the various shops, adequate number of 3 phase interlocked power plugs may be provided on the shop columns or on the jigs themselves to suit the individual convenience. Similarly, a number of single phase interlocked plugs are installed on the shop columns and on the jigs themselves for the operation of electrical hand tools and small tools to suit the convenience of work. For safety reasons, provisions should be made for single phase 24 V. plugs for inspection lamps.

In planning L. T. distribution in shops, the size of 3 or 4 core L. T. underground cables should not exceed 0.3 sq. in. with a view to minimise difficulty in handling and laying the cables. If, however, the load of a particular shop or a machine demands a higher size of cable, laying of duplicate cables of smaller size instead of one large cable exceeding 0.3 sq. in. section, deserves consideration. Separate feeders should be laid for motive power and lighting circuits with a view to avoid flickering of lamps or lowering efficiency of lighting due to drop in voltage incidental to the large and fluctuating load of machines under operation.

METHOD OF POWER DISTRIBUTION IN SHOPS

For main and sub-distribution feeders, PILC DSTA or SWA underground 3 or 4 core cables are the accepted practice. The overhead distribution system using bare copper wires on the roof trusses would present difficulties in maintenance and may also involve frequent interruptions of supply, affecting the out-turn. Moreover, if there are overhead cranes, the trusses are necessarily at a great height and will involve additional expenditure of tapping the feeder down to the machines. To ensure continuity of power supply to shops, interconnections between sub-stations and duplicate or ring feeders on L. T. side are provided, depending on the importance of shop load.

Overhead Busbar system—The modern tendency in factories is to change from group drives to individual drive of machines by electric motors. It is therefore a natural development in the distribution of electric power to provide a system in which power points are available at frequent intervals so that connections can be made to live busbars, quickly and safely.

Such a flexible system of power distribution, with overhead busbars and fused plug-in boxes, was first introduced by M/s. English Electric Company in 1935. It was developed in conjunction with the motor car manufacturing industry, which is involved each year in a rearrangement of machine shop layouts to suit the annual change in car design. The new system was designed to permit this plant rearrangement to be effected.

(a) Quickly, with minimum loss of production time.

(b) Without necessitating the shut-down of machines not involved in the change.

(c) Economically with negligible loss of existing conduits, cables, etc.

The overhead busbar system of electrical distribution at or near roof truss level, in addition to meeting the above requirements is much superior to other methods of distribution, whether the machine shop layout is subject to frequent change or not. In the majority of plants it has also proved to be cheaper on the basis of installed cost, the saving being directly proportional to the number of machines over the area. Several factors contribute to this economy, some of which are detailed below :—

(a) It eliminates costly chasing of the floors to sink conduits between fuseboards and machines.

(b) It is more economical on conduit and cables.

(c) Labour costs are reduced since it is installed more easily and quickly than other systems.

Thus while the cost of the busbar itself may be more than for fuseboards, a complete busbar installation usually shows a saving compared with a complete distribution board installation.

POWER FACTOR AND ITS IMPROVEMENT

Due to the use of oversize A. C. induction motors on various machines, the power factor of a workshop load is generally low ranging between 0.5 and 0.6. Low power factor will involve larger currents for the same load, necessitating the use of larger size cables, generating and transforming equipment, etc.

It is, therefore, necessary to improve the overall power factor in large workshops to about 0.85. Static condensers are installed at suitable locations across low power factor machines or in shop sub-stations. Large size machines such as compressors should be specified with synchronous motor drive, as this will not only improve the power factor but will ensure constant speed drive for the plant.

INDIVIDUAL VERSUS GROUP DRIVE

The power for machines in factories may be obtained either by individual drive, in which each machine has its own separate motor/motors or by group drive, in which a single larger motor drives a number of machines through shafting. Individual drive is taken to its limit in certain machine tools where each movement of the tool has a separate motor, while the limiting case of group drive occurs in certain old factories changed over from steam/oil engine to electric drive simply by replacing the engine by an electric motor of corresponding output, all the old shafting and belting being retained. The usually accepted meaning of the term "group drive" refers however, to anything between a group of two or three machines of similar size situated close together, and all the machines on one floor of a factory.

CHOICE OF DRIVING MOTOR

Essential to successful application of electric motors and control for workshop drive are :—

First— familiarity with the various types of motors and their performance characteristics ;

Second— a knowledge of the principles of electric controllers, their functions and their adaptation, and

Third— information both general and specific, as to the requirements of machinery to be driven and consideration of every aspect of its action affecting the drive.

The success of an electric drive for any purpose depends on the correct choice of the driving motor for the particular conditions under which it is has to operate, and in making this choice attention should be devoted to any or all of the following factors :—

(i) *Electrical characteristics*

Running characteristics.
Starting characteristics.
Speed control.
Braking.

(ii) *Mechanical features*

Type of enclosure (viz. open, screen-protected, drip-proof, flame-proof, pipe ventilated)
Bearings.
Transmission of drive to driven machine.
Noise.

(iii) *Size of motor*

Whether for continuous, intermittent, or variable load.
Whether its overload capacity and pull-out torque are adequate.

(iv) *Cost*

Capital cost.
Running cost—losses, power factor, maintenance and depreciation.

It can thus be seen that the choice of an electric motor for a given drive includes a large number of factors, and although in any particular case some of these may be definitely fixed by existing circumstances, other will probably be conflicting, and a thorough understanding of the various possibilities is therefore essential to the making of the most satisfactory compromise. Although the question of cost has been placed last in the above list, it must be remembered that in any commercial concern it is this factor which ultimately governs all others, since the correct motor to choose is that which will give the required service at the minimum overall cost.

PREVENTIVE MAINTENANCE

It is essential to introduce a good and efficient maintenance practice of regular periodical attention and overhaul, renewal of parts in order to keep the workshop machinery plant and equipment in satisfactory working order, thus minimising sudden break downs or failures resulting in interruption of work and consequent reduction of the out-turn.

Distance from a source of supply and transportation facilities and conditions of service such as damp or corrosive atmosphere, overloads, frequent starts etc., should also be taken into consideration in arriving at the maintenance schedule.

In carrying out maintenance advantage should be taken of the shop recess hour and Sundays and Holidays when machines are not working. For major overhaul, however, there should be a planned outage in consultation with the Mechanical Department. Here also, advantage should be taken to carry out electrical overhaul alongside the Mechanical overhaul, as far as possible.

A programme for periodical maintenance of various machines in the shops should be drawn out and strictly adhered to. A proper record of the work carried out as well as breakdowns on individual plant and machinery should be maintained.

SHOP LIGHTING

Adequate lighting of factories is of importance, since, in addition to providing improved amenities for the employees, it has a definite economic value in reducing accidents, with their consequent lost time and compensation payments, and also in increasing production. Investigations have been carried out in several industries to determine the influence of lighting on production ; results obtained in type setting indicate that with an illumination of about 20 lumens per

square foot a production equal to that obtainable in good daylight can be maintained, while with lower values of illumination the output falls off. In addition to the lower output resulting from poor illumination there was also an increase in the errors.

GENERAL REQUIREMENTS AND TYPES OF LIGHTING INSTALLATION

In addition to providing an adequate illumination on the working plane, a factory lighting installation, in common with other indoor equipments, should give a good distribution of light, employ simple and easily cleaned fittings, and avoid glare. It is necessary not only to avoid glare from the lamp itself but also reflected glare from any polished surfaces which may be within the line of vision.

(i) General lighting—The usual scheme in workshops is to mount a number of lamps at a height sufficient to ensure a uniform distribution of light over the working-plane. In large machine shops the height is governed by the necessity for keeping the lamps above the travelling crane, and in such cases it is often desirable to supplement the main lighting by side lighting, giving additional illumination on a vertical plane. Light coloured walls and ceiling add to the effectiveness of an installation, and the value of the increased illumination obtainable from a given scheme is usually more than sufficient to pay for the necessary whitewashing or painting.

(ii) Local lighting—Where fairly intense illumination is required, at one or more particular points, local lighting can be provided by means of adjustable fittings attached to the machine or bench in question, or mounted on portable floor standards—such lamps should be mounted in deep reflectors to avoid glare. For maintenance work and emergency lighting portable hand lamps are used, attached to wall plugs by means of a trailing lead. With any form of local lighting which is within reach of the operator of a machine there is a danger of shock, and the use of a low voltage A. C. of not more than 50 volts is recommended. This has the further advantage that low-voltage lamps have thicker filaments, and are therefore more robust than those for normal voltage. The supply for such lamps can be obtained from a special low-voltage distribution system running throughout the factory or by means of a small transformer for each individual lamp. 24 volts has been standardised for portable hand lamps in Railway workshops, running sheds, etc.

It must be stressed that local lighting should never be employed alone; good general lighting is essential in order to avoid dark spaces between the local lighting units, which would lead to fatigue of the eye due to its continually having to adjust itself to new conditions.

(iii) Police lighting—With a view to economise on electric consumption it is advisable to provide restricted lighting in the shops for night watchmen. Some workshops work on a restricted scale only during the night. They are also closed during Holidays and Sundays when no general or local lighting is needed.

(iv) Exterior lighting—Uncovered areas between shops and yards may be lighted either with projectors mounted on masts or with "Duo-Flux" fittings. Perimenter lighting along the boundary compound wall is also necessary for security purposes.

CONCLUSION

Since the creation of machines by man, the advance from the steam engine to atomic power, from the pulley-belt to automation, has represented his emancipation from muscle-slavery. Electric motive power has been universally accepted as the best and the most efficient source for workshop drive. Availability of adequate, reliable, continuous and cheap electric power supply is the primary consideration in deciding the location of large workshops. Uniformity of speed, flexibility of control, cleanliness, improved layout and better lighting, possible only with the use of electric energy, have contributed in no small measure in industrial prosperity and rise in the living standards of the humanity all over the world. Electricity—a terror to primitive man is in fact the best and the strongest handmaid of modern man.

The New Electric Locomotive Pantographs for Indian Railways

By An Engineering Correspondent

THE Indian Railways have ordered Bo Bo mixed traffic electric locomotives in Europe and Japan to operate on their new lines, electrified according to the modern technic of High Tension single-phase current 50 c. p. s.

These engines will all be equipped with two pantographs of an entirely new type, which testify of a great progress in the current collection. Falling out of the shape traditionally pentagonal of the pantographs which equip most of the electric locomotives, these apparatus, of revolutionary design, present a bold shape which, at first sight, surprises the non-informed looker-on.

Before we present the numerous advantages brought by this new type of pantograph, designed and built by the Ets. Faiveley specialized in this manufacture since 30 years, we shall describe briefly this apparatus and its control mechanism.

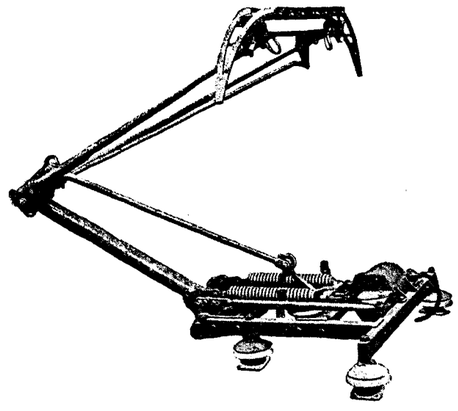
When this equipment made its first appearance, some years ago, it was nicknamed "The One-Legged" or "Half-Pantograph". Anyhow, let us say now that, this apparatus, the Builder calls "Type AM", replaces advantageously a pantograph of conventional shape.

This pantograph "AM" comprises the following essential elements—the fig. 1 represents one of the type presently working :—

1°—A base, which is very light and is made of

Etablissements L. FAIVELEY
93, rue du Dr Bauer, SAINT-OUEN (Seine)

PANTOGRAPHS FOR ELECTRICAL LOCOMOTIVES AND MULTIPLE UNIT SETS



DOORS AND POWER-OPERATED DOOR EQUIPMENTS

DESIGNERS AND SUPPLIERS OF ROLLING STOCK EQUIPMENTS

welded sections, carrying, on two self-aligning bearings, the articulated system.

Rubber abutments limit the articulated system folding. 2 —An articulated system formed by :

—An operating-rod turning in the two bearings which are part of the base.

—A lower arm welded to the operating-rod.

—An upper framework articulated on the lower arm in a bearing and made up from two tapered tubes braced by an horizontal tube.

—A thrust rod pivoted at a fixed point on the base and at its opposite end on the upper frame bearing.

This rod ensures the positioning of the upper frame as a function of the rotation angle of the arm.

—A transversal and horizontal tube, turning in sleeves integral with the upper frame, carrying at its ends spring boxes which bear the bow resiliently.

—A positioning link maintains the contact plane horizontal during vertical movement of the bow.

—Two working springs or " up-springs " whose tension balances the mass of the articulated system and provides the static contact force of the bow. The tension of both springs is adjustable.

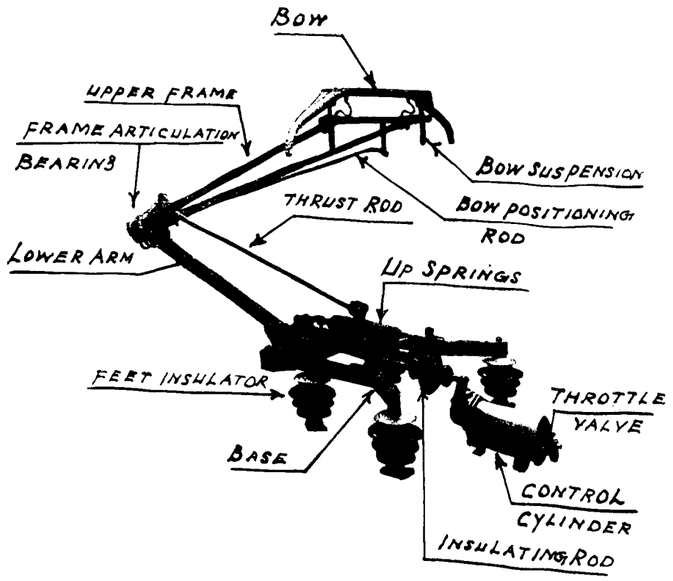
3 —A Control Mechanism.

This pneumatic device, which is identical with that of the normal pantograph lowered by springs, controls the pantograph raising and lowering.

The control-cylinder contains powerful springs called " down springs " whose force overcomes that of the " up-springs " and held strongly the pantograph in its down position.

When air is admitted to the control cylinder, the piston displaces itself and compresses the " down springs ", thus permitting the pantograph raising under the action of the " working springs ".

This method of control, which is the most currently used, presents also the highest security for, if air



pressure fails, the pantograph comes or stays down and there is no more H. T. on the locomotive.

The control cylinder is feeded through a throttle-valve which regulates the admission and escape of air, to obtain correct raising and lowering times.

As one can easily understand, the design of this pantograph has permitted an important reduction of weight and cost-price. Though these reasons seem sufficient to justify the creation of such an apparatus, it is, in fact, the rapid development of Railway Systems which led to study current collectors well adapted to the new requirements and of a higher efficiency.

The present problem of current collection became much more complicated when new lines appeared, feeded with High Tension single phase current of industrial frequency, using a sole contact wire, light, very sensible, without auxiliary carrier, and when the Traffic Departments were obliged to increase train speed and tonnage.

Numerous track tests proved that a pantograph must answer to the following characteristics :

—A bow with a contact plane always horizontal at all extension heights.

—The displacement of that bow in a plane perpendicular to the track during the pantograph extension and folding.

—A dynamic contact force of the bow decomposed as follows :

—a static force given by the " working-springs and independent of the extension.

—a precise aerodynamic overpressure, increasing proportionally to the speed.

—An articulated system of a mass as small as possible.

—A very high sensibility, to follow the contact wire inequalities.

The bow horizontality is ensured by the articulated system arrangement and the presence of the positioning rod which is adjustable in length.

Four adjustable cams fixed on the operating rod, allow, by variating the torque exerted by the working-springs, to obtain a perfect balance of the articulated system at all heights. The working-springs give to the bow a contact static force on the catenary which is adjusted to 7 Kg for the Indian locomotive pantographs ; this value can vary between 5 and 9 Kg when one modifies the working-spring tension.

The aerodynamic overpressure is produced by the wind action on the pantograph and bow whose shapes are specially studied in wind-tunnel. Under 25 KV catenaries, it is generally looked for an over-pressure reaching 6 kg at a speed of 160 km/h, this value giving good results.

Besides, the pantograph AM offers, a very important lightening of the articulated system, a reduction very noticeable of frictions by reduction of the quantity of articulations and the extensive utilisation of ball-bearings, and the elimination of strains in the tubes—strains existing in the pentagonal articulated system.

The whole of these qualities gives to the apparatus a very low fictitious weight of the moving parts and a very high sensibility, never realized by normal pantographs.

The fictitious weight of the pantograph " AM " distortable system is only of 27 kg, when a conventional distortable system reaches 40 kg. Its sensibility is easily shown when one looks at the static adjustment curves ; both raising and lowering curves are practically mingled, they are comprised, in the useful part of collection, between two verticals divided by about 0.500 kg, when a separation of 3 kg was normal with apparatus of conventional design.

Subjected by different Railways Administrations to lengthy official trials, very often in hard working conditions, the pantograph " AM ", corroborating the hopes its characteristics let us foresee, revealed excellent collection qualities until speeds of about 170/180 km/h and an important superiority in comparison with conventional pantographs.

It is quite interesting to note that the pantograph " AM " is able to collect in both running ways ; indeed, though essentially of dissymetric shape, its designers succeeded, after experiments in wind tunnel, in giving to this apparatus symmetrical aerodynamic effects.

Furthermore, at equal speed and static effort, the pantograph " AM " produces smaller rising of the contact wire than a conventional pantograph, thus

reducing catenary hooking risks and causing less important wear of the friction strips and contact wire, these advantages lead to an important economy.

The Indian Railways Bo Bo type locomotives, the first of which are to be achieved soon, will be equipped of pantographs "AM", nearly identical, in their external aspect, to the apparatus shown fig. 1, but will be different by certain characteristics to take into account the special working and climatic conditions in India.

This type of equipment will include :

—a protection of the metallic parts with special impregnation and paint coating (the inside of the tubes are also protected).

—a light bow, very long (1.800 m) fitted with aluminium alloy horns and steel wearing strips.

—insulating feet specially designed to take into account the important hydrometric degree.

—a throttle-valve which ensures a lowering speed easily adjustable ; this speed is slowed down at stroke end to avoid shocks on the abutments.

—a powerful pneumatic control-cylinder ensuring a fast lowering of the pantograph at all speeds. This motor cancels completely the hovering tendency observed with certain type of pantographs lowering by gravity.

One must note that the control cylinder is independent of the pantograph ; fitted on the locomotive roof, it is earthed and operates the pantograph, in live, by means of an insulating rod.

For single-phase H. T. lines, this method is, by far, preferable to those using a motor in live, feeded through an air insulator, to avoid flashover risks, caused by deposit of conductors (water, oil, dust,....) on the inside wall of the air insulator.

The lightness and small size of the pantograph "AM" give facilities in stocking, handling and fitting on electric engines and allow the utilisation of light roof framework strengthened at fixation points.

Maintenance and repair expenses are equally reduced ; the ball-bearings, greased when mounted for the length of their working time, do not need maintenance ; only some articulations transmitting small efforts are to be greased periodically.

In case of hooking, it is very easy to dismount the upperframe which is the most exposed and to replace, if necessary, the damaged tubes.

Originally designed to operate on single phase current lines, the pantograph "AM" has proved, during years of experiments, that it could be used equally, with great advantages over conventional type apparatus, on direct current and heavy traffic lines, for its excellent collection and its economical utilisation.

Of course, the equipment must be adapted to its working conditions and, consequently, there are different types of pantograph "AM", some including for example ahead with double bow and a control cylinder in live. We point out that locomotives equipped with the pantographs "AM" are at present working in France, Algeria, Morroco, and soon in England.

The pantograph "AM" brings a smart and above all efficient solution to the collection problem, as it is at present laid ; in spite of this satisfactory result the Ets. Faiveley do not stop the continuous research to supply, at lower prices. Users with the most improved pantographs, which will contribute, for a small part, to the progress realized in the equipment of the future electric locomotives and motor-coaches.

French Locomotives for the Soviet Union

France has undertaken to deliver 50 locomotives to the Soviet Union, designed to meet specific requirements. Suitable to operate within variations of temperature from minus 50° C to plus 40° C, they will be of three types : 30 weighing 138 tons to pull heavy trains of 5,000 tons at 100 km p.h. ; 10 with a system of recuperation braking ; and 10 others for express trains running up to 160 kilometres per hour. Belonging to the "C-C" type of the French Locomotives, they are powered by six motors, each of which can turn an axle and develop a power of 6,000 h.p.

PREFORMED products for Railway Signalling and Communications

By An Engineering Correspondent

SIGNAL and communications products, developed by the Preformed Line Products Company, Cleveland, Ohio, provide an entirely new construction concept for railway communications. All Preformed products are based on the patented Preformed principle, a combination of maximum holding power and low distributed pressure, which reduces stress concentrations, fatigue damage, vibration and abrasions.

The unique feature of all these patented products is that they are *applied by hand*, require no tools. This simplicity of application results in complete uniformity, and greatly reduces the chance for human error.

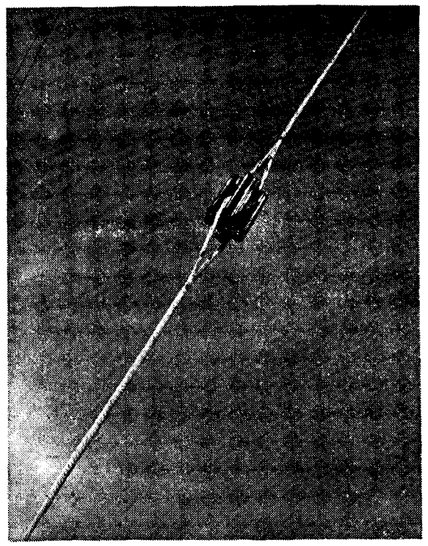
Designed in Preformed's Research & Engineering Center, all products are subjected to severe and precise laboratory testing to prove their sound mechanical and electrical characteristics. Thorough testing in the laboratory and in the field substantiates the practicality of the designs and applications.

Of paramount interest to Railway Engineers are those products developed specifically for the communications industries. Included are :

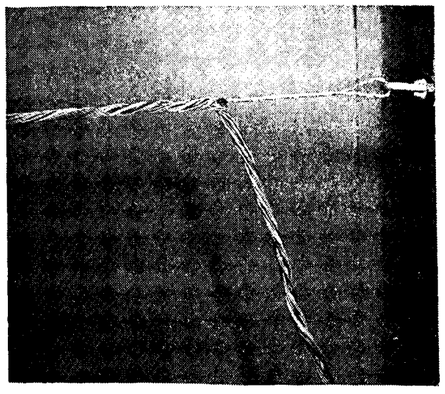
Preformed GUY-GRIP dead-ends for pole down-guying and span guying made of materials that are homogenous with the strand to which they are applied (for example, they are made of Galvanized Steel wire for Galvanized Steel guy strand). The problem of corrosion, therefore, is lessened. In addition to Galvanized Steel they are made of Aluminized Steel, Stainless Steel, Alumoweld, Copperweld and Bronze.

GUY-GRIP dead-ends for pole down guying are designed to hold the full-rated strength of the strand, provide a dependable link at three places : the top of the pole, the guy breaker and the anchor.

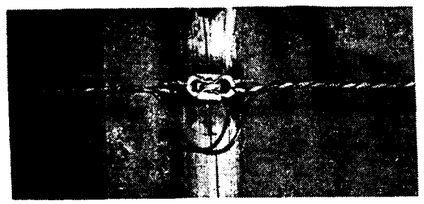
The need for clamps and clips is eliminated, resulting in a finished, craftsmanlike appearance at a greatly reduced cost for labor. Installed in minutes, Preformed GUY-GRIP dead-ends have their own loop eye (no looping back of the strand is necessary). The result.... considerable savings of guy strand. They also are reusable, another economy feature.



Preformed Guy-Grip dead-ends installed at the guy breaker.



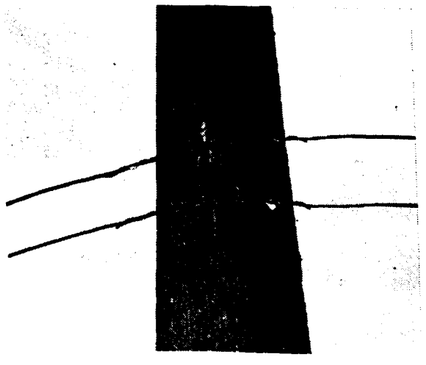
Preformed dead-end for telephone line wire and Messenger of Rural distribution cable.



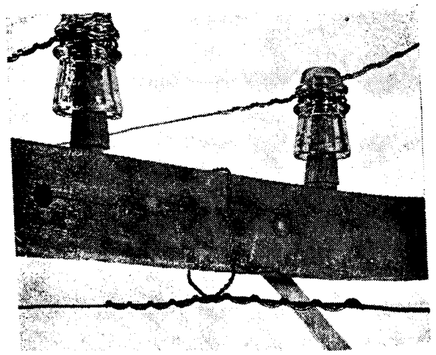
Preformed Dead-Ends with their large-area, uniform, low pressure contact surfaces can be used safely with plastic-covered multiple pair cable.

Preformed Dead-Ends, made for both open line wire and covered conductors, provide a low radial pressure over the large holding area. Preformed Dead-Ends for "B" Rural Messenger or open line wire are made of Galvanized Steel or Copperweld; for covered conductor, of Aluminum. Especially designed for "C" Rural or one-pair distribution wire, they are made of Stainless Steel, neoprene coated to cushion their grip.

Preformed Tangent Supports designed for three different applications of "C" rural or one pair distribution wire to poles or cross-arms. One consists of a short loop and helical legs to append to a drive hook. The other has an elongated loop to append to the same drive hook when an additional wire is strung. The third tangent support is shaped in specific sizes to fit standard cross-arms. It is designed to be stapled on each side of the cross-arm and wrapped around it with the helical legs extending horizontally below.

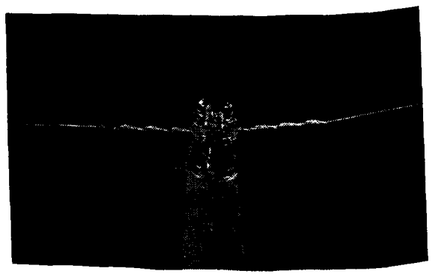


Preformed Tangent Supports
(Short Loop and Elongated Loop)
Made of stainless steel for corrosion resistance, they are coated with neoprene to cushion their grip and uniformly distribute holding pressure.



Preformed Crossarm Tangent Support

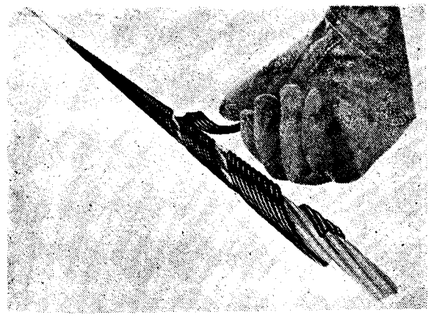
Preformed's One-Piece Communication Tie creates a protective cradle for the conductor at the insulator. Direct contact between the conductor and the insulator is eliminated, thereby preventing the usual cause of fatigue damage and abrasion.



Preformed One-piece Communications Tie installed on insulator to prevent tie wire vibration fatigue damage.

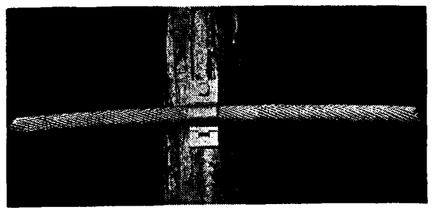
Laboratory tests disclose that the rigors of two hundred million cycles of vibration fail to leave a trace of wear or abrasion on the assembly resulting in greatly enxtended service life for outside plant. A sustained unbalanced load of 500 pounds fails to disrupt the inherent holding strength of the Preformed Communication Tie giving positive assurance that "pull through" will not result in the event of line failure. Thus the need to re-sag the line from pole-to-pole is eliminated and adjacent spans are not placed under stress conditions because of "pull through". One-Piece Communications Ties are made of Copperweld and Galvanized Steel, and are designed for specific insulator and line wire sizes.

Preformed Splices, a safe and simple means of plicing messenger strands, guy strands, ground wires nd open line wire. They will hold the full-rated reaking strength of the particular strand or wire to hich they are applied—Galvanized Steel strand, opperweld and M Type Copperweld strand. Preormed Splices are prefabricated in "subsets" for quick and easy application without tools. On open line wire they can be applied at mid-span; or at the insulator, for repair of abraded or completely severed line, to restore full conductivity.



Application of the Preformed Splice is fast and easy. No tools are required.

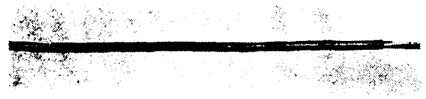
Preformed Line Guards, made of two different materials, aluminum alloy and plastic. Aluminum Line Guards are used at tangent support points for plastic covered self-supporting telephone cable. Preformed Plastic Tree Guards are used to protect covered messenger from abrasion by trees or other objects.



Preformed Line Guard of aluminum alloy for plastic covered self-supporting telephone cable.



DIAMOND RUBBER WORKS PVT. LTD.
276, Nagdevi St. Bombay 3



Preformed plastic tree guard used to prevent abrasion by trees and other objects.

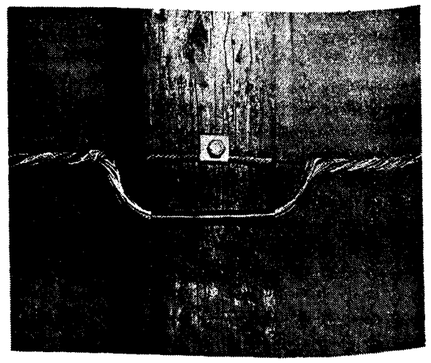
Preformed Lashing Rods completely eliminate the use of clips, clamps, or spinners to secure wires to supporting strand. Preformed Lashing Rods are made



Preformed Lashing Rod
consisting of single preformed rods to lash cables to messengers without use of clamps.

of spring temper material (Galvanized Steel or Copperweld) in sizes to embrace various combinations of cable and messenger.

Preformed Armor Rods, made of aluminum alloy, protect covered wire and messenger under a tangent



Preformed Armor Rods
protect insulated messengers against clamping pressure or abrasion damage.

support clamp. The messenger is securely held to the pole with a clamp. The damaging effects of chafing are eliminated because the messenger is encased in Preformed Armor Rods.

Preformed Line Products Company has pioneered the development of these products and many others that provide simple and economical ways to install and protect communication lines.

Preformed Line Guards, Lashing Rods and Armor Rods are manufactured in India by the Electrical Manufacturing Company, Limited, P. O. Box 300, Calcutta, India.

Specification for Aluminium Utensils

It may be recalled that at the instance of the Tariff Commission, the Government of India, have banned the export of aluminium utensils, aluminium of which was not certified by the Indian Standards Institution, under the provisions of ISI Certification Mark Act. 1952. This was done because complaints were received that the quality of exported utensils was not always uniform.

Since then 13 manufacturers have already obtained licences from the institution for carrying the ISI Mark on their products, to convey to consumers in foreign markets, a sort of third party guarantee to the effect that the aluminium used for the utensils is in conformity with the rigid specifications laid down by the Institution in IS : 21—1953.

The Institution has now drafted a specification for Aluminium Utensils [Doc : EDC 47(514)] covering general requirements for some of the most popular types of wrought aluminium utensils. It is hoped that with the formulation of this standard, the long-felt need for a standard prescribing the quality material and the relationship between the size of circles from which the utensils are made and the thickness of the metal would be fulfilled.

RAILCAR, EMU COACH, CARRIAGE & WAGON SUPPLEMENT

Refrigerator trains from the German Democratic Republic

THE fact that big multitudes of the population show an upward trend in their standards of life necessitates the construction of modern means of transport for the refrigeration traffic, in order to place the goods to be exported by countries producing agricultural products and meat at the disposal of the consumers in a qualitatively irreproachable state in summer as in winter. Therefore, the problem of transport of easily perishable and temperature-dependent goods was set about in many countries aiming at creating possibilities of transport on rail and road which offer the guarantee that the goods forwarded by these vehicles in fresh or frozen state go from the producer to the consumer without any deterioration of their qualities.

The development of such special rail vehicles was also tackled anew about 10 years ago in the VEB Waggonbau Dessau, and that for the time being by the manufacture of four-axle refrigerator wagons of welded steel construction with water-ice-refrigeration.

However, in order to meet all requirements which must be made towards means of transport, regarding climate and technique of transport, during the forwarding on long distances, the development and construction of trains cooled mechanically was necessary in bigger units. Thus in Dessau the production of refrigerator trains consisting of 23 wagons each for long-distance traffic in the Soviet Union began. These trains dispose of a central Diesel and refrigerating machine plant. By means of the Diesel plant all consumers of energy of the train are supplied with current. The cold produced in the refrigerating machine plant (refrigerating means: ammonia) is transferred to the ribbed pipe systems arranged at the ceiling of each refrigerator wagon by the refrigerating means (refrigerating brine) through a main pipe extending all over the whole train and comprising operation there and back; thus the loading rooms are refrigerated.

The regulation of temperatures in the loading rooms is made by a magnetic valve with distant control in each refrigerator wagon. For regulating the temperatures desired in the refrigerator wagon serve thermostats in each loading room which switch the magnetic valves automatically on or off on demand and regulate the temperatures by the brine supply. The adjustment of the electric heaters is also made analogously at low outside temperatures.

The temperatures are measured by double contact thermometers. The result is transferred to the wagon with the Diesel plant electrically and read there at the test desk for temperatures. Electric fans care for the air circulation in the loading rooms. One wagon each for placing the Diesel-electro-station, the refrigerating machine plant, and the staff rooms is arranged in the middle of the train. These three special wagons are connected one with another by communicating gangway-bellows, 10 four-axle refrigerator wagons each of 49,2′ length serving for the transport of the goods to be loaded are added on both sides of the 3 special wagons. They have a weight of load of about 590 British t altogether.

Trains of the same construction are also in service in the PR of China. The refrigerating machine plants of these trains, however, are equipped with cold compressors operating in two stages, in order to obtain yet a liquefaction of the refrigerating means according to the prevailing higher temperatures in China. By these plants adjustable temperatures of the loading rooms can be attained from + 10°F to + 53,6°F at outside temperatures from + 104°F to —49°F. In case of low outside temperatures the loading rooms can be heated electrically, as mentioned already above. The installed Diesel power amounts to 395 HP altogether

From these types of trains originated the refrigerator train of 12 wagons for the Soviet Union as a variant. These trains also operate according to the principle of the refrigerator trains of 23 wagons. The regulation of the temperatures in the loading rooms is also made

entirely automatically by adjustable thermostats. The train consists of one wagon with Diesel-electro-station and staff rooms, one wagon with the refrigerating machine plant and 10 four-axle refrigerator wagons of 55,8′ length each. Here also the two special wagons are placed in the middle of the train; 5 four-axle refrigerator wagons each follow on both sides.

In the interior the refrigerator wagons are equipped with self-supporting walls of galvanized steel plate. Upward-tilting hot-galvanized floor gratings serve for storing the goods to be loaded. This type of refrigerator train has a loading capacity of about 395 Bt.

A further development led to the construction of refrigerator trains of 5 wagons. On principle, these are different from the construction of the trains described hitherto. The supplying of the individual refrigerator wagons with "cold" is not made here by a centrally arranged refrigerating machine plant used for long trains described in the beginning, but by individual refrigerating machine plants in each of the refrigerator wagons of the refrigerator train consisting of 5 wagons being supplied with electric current by a central Diesel-electro-station of 177,5 HP altogether.

The refrigerating machine plant in each wagon consists of two single stage 2-cylinder cold compressors each functioning independently from each other. The refrigeration is made by means of direct evaporation (refrigerating means: Freon 12). All wagons have foreign current connection to supply the refrigeration plants with current from local networks and to be able to refrigerate also without the central power station on demand.

By these plants temperatures in the loading rooms are attained within the limits of + 10° F resp. + 53,6° F at outside temperatures of 86° F resp. —49° F. Also fruits not precooled can be cooled down from + 77° F to + 39,2° F at an outside temperature of + 86° F in the course of 72 hours.

The regulation of the temperatures in the loading rooms is made by thermostats effecting automatically the switching of the refrigerating machines or heaters dependent on the temperatures in the loading rooms.

An installation for the supply of fresh air can be regulated from outside for summer and winter service on demand; this air flowing in is precooled in summer before the entrance in the loading rooms and preheated in winter. This train of 5 wagons consists of the following parts:

1 wagon with refrigerating machine compartment, Diesel compartment and loading room

1 wagon with refrigerating machine compartment, stay-room for the train staff and loading room as well as

3 wagons with refrigerating machine compartment and loading room.

The length of each wagon amounts to 55,8′, the carrying capacity of the train to ab. 175 Bt.

As a further task the development of individual refrigerator wagons mechanically cooled and working fully automatically was well to the fore of which also series were manufactured and delivered to the Soviet Union. With the same type of wagons, suitable for the transit-traffic on the European network of railways with standard gauge at a length of wagon of 55,8′, a many-sided test was finished successfully ere long. This wagon is equipped with two Diesel aggregates of a continuous output of 22,6 HP each and with two 4-cylinder refrigerating means compressors operating in two stages.

Power and refrigerating machine plant as well as temperature regulation work also fully automatically at refrigerating and heating. The regulation of the refrigerating plants is made by thermostats being arranged in the loading room.

Loading room temperatures of + 3,2° F resp. + 53,6° F at a max. outside temperature of + 95° F resp. —22° F can be attained. Also fruits can be cooled down from + 86° F to 39,2° F in about 24 hours during the transport at a max. outside temperature of +95° F.

The interior equipment of the wagon contains self-supporting crimped walls of oxidized light metal sheets, adjustable air supply for freezing and refrigerating transports and upward-tilting light metal floor gratings. For protection against heat penetration high-quality insulating materials were used of corresponding strengths for the walls of the wagon bodies to obtain a K-value (co-efficient) below 0,3 kcal/m²h°C.

According to the admitted axle pressure this type of refrigerator wagon has a loading capacity of 23,6—39,4 Bt.

On the strength of experiences learnt from the refrigerator trains as a further new construction of a "Movable Freezing Station" was set about and

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finished with much success. Such stations shall complete the capacity of stationary freezing plants and load the goods to be frozen in immediately at the place of production. Such plants are used for the freezing in of fishes, fruits, and vegetables. The freezing capacity amounts to 20 Bt per day approximately for fishes at a working time of 21 hours and 10—18 Bt daily for fruits and vegetables according to the sort of the product. The power of the Diesel-electro-aggregates installed in the Diesel wagon amounts to altogether 485 HP.

This movable freezing station consists of:

1 Diesel-electro-wagon 1 refrigerating machine wagon	each 55,8′ long
1 freezing wagon 1 supply wagon with staff compartment	each 62,5′ long

In the refrigerating machine wagon two vertical 4-cylinder ammonia-compressors are mounted working, on demand, in single stage or two stages according to the degrees of outside temperatures.

The freezing wagon is subdivided in :

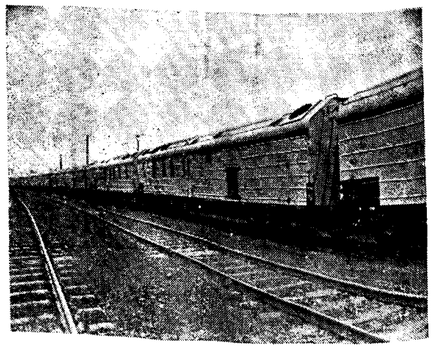
(a) A preparation room where the goods to be frozen in are put in layers in basins and then set in freezing trestles.

(b) Two freezing tunnels through which the goods to be frozen in are transported to the freezing trestles by means of a mechanic conveying device and are frozen in at a temperature of —31°F. Between the two freezing tunnels a further tunnel is placed serving for the return of empty freezing trestles to the preparation room. Furthermore, the freezing wagon contains

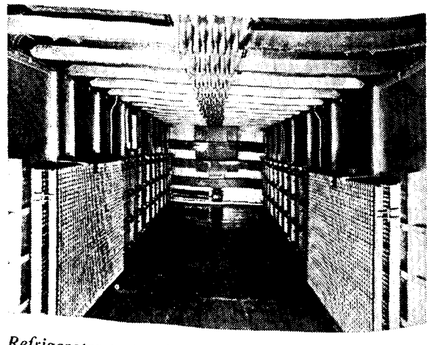
(c) an unloading room in which the frozen goods are taken out of the freezing trestles and forwarded through insulated communicating gangway-bellows over a slide to the supply wagon which has an own refrigerating machine plant. There the frozen goods are packed in boxes or cardboard boxes and stored in this wagon up to their carrying off at + 5°F. The first series of such movable freezing plants are actually to be found in service in the south of the Soviet Union.

Due to the experiences made with refrigerator trains being in operation in the Soviet Union and in China, the development and the construction of refrigerator trains were carried out for the European transit-traffic by units of 11 or 12 wagons—one combined Diesel and refrigerating machine wagon and one staff wagon or one combined Diesel refrigerating machine and staff wagon as well as 10 refrigerator wagons. These are also in service in a considerable number since years.

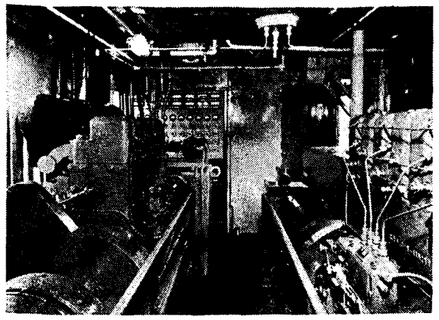
According to the claims towards these trains regarding climate, the installation of refrigerating machine plants with one or two stages was effected. These trains, as indicated already, were delivered in two constructions. Each of the refrigerating wagons is 49,2′ long. The capacity of these types of trains amounts to about 246 t to 315 t. The attainable temperatures of the loading rooms are about +9°F to +53,6°F according to the sort of goods at outside temperatures between +95°F and —31°F.



Total view of the refrigerator train of 11 wagons.



Refrigerator train of 11 wagons Loading room with upward-tilted floor grates.



Refrigerator train of 11 wagons, engine room.

Bogies without axle guards with roller bearings, double spring mounting, and cradle suspended in pendulum fashion are used as running gear for wagons of all types of refrigerator trains and mechanical refrigerator wagons, in order to be able to admit high driving speeds on long distances run by these vehicles and to spare sensible goods to be loaded as far as possible.

The big number of refrigerator trains being in service in the Soviet Union, the PR of China, and in some States of South Europe since years, took the goods forwarded by them practically without losses and of excellent quality to their places of destination. Their profitableness was proved unobjectionably; there is no more any doubt about their excellence. Only by their services there was the possibility to take certain fruits from the south, as e. g. in the PR of China from southern parts of the country to northern regions, where such fruits were entirely unknown to that date.

The works for further improvements of the construction and modernization of plants and installations of mechanically cooled rail vehicles are indefatigably continued in Dessau.

SIZES OF METAL STRIP, SHEET, BARS, FLATS AND PLATE

The decision of the Government of India to adopt the metric system as the only recognised system of weights and measures has made it necessary that the preferred sizes of metal product should be standardized in metric units to serve as a guide for evolving standard metric sizes.

With this aim in view the ISI has issued an Indian Standard for Sizes of Metal Strip Sheet, Bar (Round and Square), Flats and Plate (IS: 1138-1958), specifying nominal sizes for metal strip, sheet, bars (round and square), flats and plate, in millimetres, for structural and general engineering purposes.

In the standardization of preferred sizes in metric units, the following aspects have been kept in view :

(a) Taking maximum possible advantage of the inherent qualities of the metric system,

(b) Keeping the range and gradation of sizes sufficient to meet consumer requirements efficiently and economically,

(c) Making the changeover of Indian Industry to the metric system as early as possible,

(d) Achieving international co-ordination to as great an extent as possible, and

(e) Ensuring that the standard does not impose difficulties on the producers by prescribing too many standardized sizes.

*** *** ***

SPECIFICATION FOR ANTIMONIAL LEAD

An Indian Standard Specification for Antimonial Lead [Doc : SMDC 12 (108)], prescribing the requirements for four grades of antimonial lead for use in accumulator batteries, has been drafted by the Indian Standards Institution.

The utilization of antimonial lead in storage battery manufacture serves the largest single market for lead in the country. These alloys are used for making grids, posts and connecting lugs in the battery. Repeated charging and discharging of a battery cause prohibitive corrosion of grids, if the alloy is of inadequate purity.

This Standard lays down the detailed chemical composition of four grades of antimonial lead and the requirements for sampling, freedom from defects and marking.

Railway Wagons at Dudley, Worcestershire, England

By G. A. Turner

QUALITY and outstanding design are the keynotes of the rolling stock produced by M. & W. Grazebrook Ltd., at Netherton Ironworks, Dudley, Worcs., England.

Concentrating their production on small quantities of special purpose vehicles, they have produced wagons for the conveyance of most minerals, chemicals and liquified gases on many of the worlds railways. Much of the work is to Class I requirements but aluminium, stainless steel and stainless clad steels are also employed on this work.

The largest type tanker produced is being used to carry 9,200 gallons of petroleum products on metre gauge track in West Africa. It has a light tare weight and is to A. A. R. Standards, with cast steel bogies. Grazebrooks have built a variation of this design to carry different products in three compartments, the compartment heads are dished and a special sealing device is incorporated to obviate any chance of leakage. Also, to ensure that equal loads are applied to the underframe, internal balance pipes are fitted between the two end compartments.

Bogie type wagons have been produced for 5' 6" gauge Ceylon railways. These are 36' 7" long over buffers and carry 5,800 gallons of petrol. Still another type is operating in Peru carrying water and general freight on the Peruvian Railway System.

A contract at present in the maker's works is for the production of 10-Liquid Chlorine Wagons for Indian Railways. The barrel holds 14 tons of Chlorine at a working pressure of 348 lbs. per square inch and is to Lloyds Class I requirements. Lagging and a sunshade is provided, whilst the running gear includes roller bearing axleboxes.

Another order in hand from India is for a 20 ton Transfer Car for the Durgapur Steelworks Foundry. The car runs on four wheels along a 60 ft. length of track and is driven by a 15 h. p British Thomson Houston slipring motor mounted under the main frame.

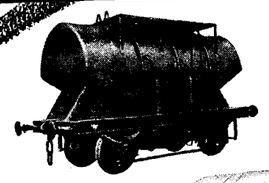
The field of light weight rolling stock has been investigated and two prototypes have been built for service on British Railways, one being fitted with steam coils for heavy oils the other being designed to carry petrol. On both wagons the tar weight has been cut down to allow more than one ton extra payload to be carried. This has been accomplished by constructing the tank and underframe as one load bearing unit, the tank itself replacing the heavy centre sections of the underframe. The wagons are fitted with roller bearing axleboxes and vacuum brakes for running in fast traffic under the British Transport Commission's modernisation scheme.

Hopper wagons for various powders are another speciality of this firm, which celebrated its 200 years of existance recently. These have taken the form of Salt Wagons for I. C. I. Ltd., amongst others, and development work is at present in progress on a cement wagon of light weight design in which it is expected that over 1¾ tons of cement per minute will be discharged, via a patented outlet, using compressed air.

The Wagon Shops are laid out for flow production work proceeding from the first bay where underframes and details are drilled via the underframe assembly bay and tank assembly bay where the sections of the tanks are welded on automatic arc welding machines to the fitting bay where the running gear and in the case of overseas tankers, lagging sheathing and sunshades are added.

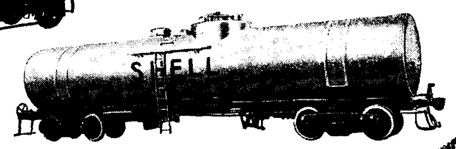
The final stage is the painting where the finishing coat of paint is applied and the barrel is sign written with the name of the customer, commodity and railway. Here also, if the vehicle is to be exported, packing for shipment is carried out, sometimes involving the partial dismantling of a wagon and the packing of various items in wooden cases all suitable marked for re-erection at the port of ation.

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Three-tier Wooden-bodied Third Class Sleeper Coaches for Indian Railways

By A. C. Bhattacharya, A.M.I.P.E.

THE Indian Railways have again demonstrated their progressive spirit and strong determination in providing increased comfort to passengers travelling in Third Class. The Construction of two prototype three-tier Sleeper Coaches in Eastern Railway Workshops at Kanchrapara, stands as emphatic proof of this fact.

The Coaches which are of the vestibule type, have been built to Indian Railways basic dimensions. They retain the standard arrangement of transverse seats divided by a central gangway 22½ in. wide which runs the length of the Coaches. The seat spacing has been designed to give increased comfort and each coach has accommodation for 64 passengers.

BOGIE DESIGN

The Bogies, which have a wheelbase of 10 ft., are of riveted construction using rolled steel sections and fabricated sub-assemblies. The side plates are carried on laminated steel springs with rubber auxiliary bearing springs, while the bolster is mounted on nests of helical springs carried on suspension bolts hung from the bogie frame. The wheels are rolled steel disc type 3 ft. 7 in. dia. on tread. Inside and outside brake blocks act on wheels.

The underframe is of riveted construction with truss rods. The brake gear comprises the automatic vacuum brake and has two standard 24-in. dia. cylinders; the brake on each bogie being operated by one cylinder.

The underframe which is 68 ft. long over headstocks, is 9 ft. 3 in. wide over solebars and the body overhang is reduced by fixing body brackets on the sides, ends and corners of the underframe so as to extend the width over the body brackets to approximately 10 ft. 6 in.

Rolled-steel channel and angle sections have gone into the manufacture of underframes used with a number of gusset plates riveted to provide extra strength and rigidity.

CARRIAGE BODY DESIGN

The Coach body structure is of strong timbered construction, with the following main members in Burma teak—(a) Bottom Sides, (b) End bars, (c) Longitudinals, (d) Cross bars, (e) Door and end pillars and (f) cant rails. It has straight sides and is 10 ft. 7.3/16 in. wide over panels.



Skeleton body of the coach.

The outside panelling is of 3/32 in. aluminium for the sides and ends. The interior is finished with 1/4 in. plywood sheets. Bodyside lift-to-open type windows are fitted all throughout except in the lavatory portions which have lift-cum-Banjo windows.

The roof is made of wooden boards with tongue and groove joints covered with standard coach roofing materials like roofing cloth and asphalt compound, and supported by carlines of flat steel section 1¾ in. × ½ in. Ceilings are made up from 1/8 in. plywood with a raised centre.

Entrance to the coach is by four doors, two on each side and they hinge inwards. The body is fixed to the underframe by holding down bolts. The floor board

are of seasoned hardwood and the intermediate pillars, seat frames, wooden roof sticks, roof boards and packings are of seasoned C. P. Teak.



Interior view showing the Gangway and single seats converted into berths for night use.

The interior design provides for two lavatories at each end of the Coach. A small baggage compartment is located adjacent to one of the lavatories. The baggage compartment which is 6 ft. 2 in. long and 3 ft. 8¼ in. wide, is arranged to carry 1 ton of luggage in 2—tier racks provided for the purpose. A collapsible gate is fitted at its entrance. The intention of providing this compartment is to take charge of the passengers' baggage at the time of entraining and return it on completion of the journey. Flooring in this Compartment as well as in the coach itself, consists of oxy-chloride flooring composition laid on wooden floor boards. The partitions for the luggage compartment and the lavatories and the transverse partitions are of blockboard construction.

ACCOMMODATION

The Coaches have a seating capacity of 64 passengers with the sleeping accommodation for all of them during night. The sleeping accommodation for 48 passengers is provided in transverse berths in three tiers and that for the rest in longitudinal berths arranged in two tier. The upper and lower transverse berths are of the fixed type, while the middle ones fold down to form the seat backs for day use.

The longitudinal upper berths are of the folding type and the two opposite facing seat backs below them drop down over the seats to be converted to a berth suitable for one passenger at night. The upper berths are reached by ladders, nine of which have been provided in each coach.

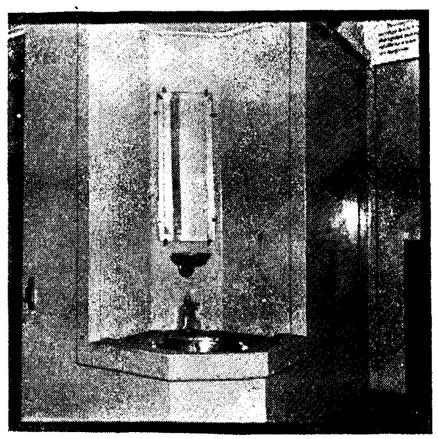
All berths are of equal dimensions being 6 ft. 2 in. long and 2 ft. wide. A knee space of 2 ft. 2 in. has been provided between the seats. A box type seat for the luggage attendant with lockers below and top of it has been provided.

LAVATORY ARRANGEMENTS

Each car has four lavatories located at its ends. They are designed with the aim of tidiness and simplicity of maintenance. The inside walls of the lavatories are lined with Eternit Granite Sheets. The equipment in the lavatories includes 'D' type wash basins, squat pans, wall protector, mirror with frame, swing arm towel rail, coat hooks, bottle openers, toilet racks, lotah shelf, receptackle for lotah and hand hold. The fittings are either of stainless steel or chromium plate finish.

Two octagonal shaped wash basins with frameless mirrors above and fitted with lever type self-closing cocks are provided in the lavatory walls of two lavatories, one at each end, on the compartment side.

A water supply of 240 gallons is provided by two overhead tanks, made of aluminium alloy, each having a capacity of 120 gallons.



Octagonal shaped wash basin with frameless Mirror above fitted on the Lavatory wall on the compartment side.

LIGHTING AND VENTILATION

The electric lighting is by twenty-three 20-watts roof lamps with four 15 watts blue lights for night use. There are sixteen 16 in. sweep fans of close mesh guard type.

Power is supplied by an axle-driven link suspended Tonum generator of 100 amperes capacity, 24/32 Volts output. Accumulators are of the standard Indian Railways of double battery parallel block system, the battery is of the lead acid type of 300 amp. hour capacity. Control of lights is by magnetic switches and that of fans by ironclad switches. All power and lighting circuits operate on a 24 V system.

Ventilation for the coaches is provided by Oriental type V-3 Ventilators fitted in sufficient numbers in the roof. Lavatory ventilation is by means of the expanded metal frame in the lavatory flat ceiling and louvre frame with air vent above the lift-cum-Banjo window.

The cross upper berth partition is constructed of B. R. C. netting of 3 in. × 1 in. rectangular mesh framed in timber to provide for free circulation of air.

The outside of the coach is finished in gulf red enamel with the railway crest at the bottom panel on both the sides while the interior is in a pleasing shade contrast of light buff and light brown enamel paints.

The Ceiling has been given a white matt finish. The seats and berths are finished in brown enamel. The seat partitions are in light buff enamel.

ACKNOWLEDGEMENT

The author thanks Sri A. K. Mullick, Chief Mechanical Engineer, Eastern Railway for his permission to publish this article.

Indian Railway Experts in Australia

Australia's industrial potential, with special reference to railways, is the subject of intensive study by two Indian railway experts.

One is Sardar Karnail Singh, Engineering Member of the Indian Railway Board, and the other Sri H. M. Chatterjee, Chief Director of Stores and Industrial Adviser for the development of railway equipment to the Ministry of Commerce and Industry. They are visiting this country as guests of the Australian Government.

The two men, who arrived in Sydney on May 16, had preliminary discussions with the commissioner for Railways in New South Wales, and met the Governor General in Canberra.

Their programme in Melbourne included a luncheon given by Mr. R. G. Casey, Minister for External Affairs, at which they met senior industrialists, Members of Parliament, Department of Trade officials, the Commonwealth Railways Commissioner and the Chairman of the Victorian Railways Commission.

They held discussions with the Victorian Railways Commissioners, and attended a reception given by the Timber Merchant's Association before flying back to Sydney to begin an inspection of industrial plants there and at Newcastle and Port Kembla (both big steel-making and engineering centres).

They are to return to Melbourne on May 28 in the course of a tour through New South Wales, Victoria, South Australia and Western Australia. They will leave Australia on June 3.

At a press conference in Melbourne, Sardar Karnail Singh said that they wanted to see as much as possible of the railway system in Australia and talk "shop" to as many railwaymen as possible. They had already seen a number of trains, and were looking forward to rail travel on those sections of the journey where the schedule permitted.

Sardar Singh spoke of the satisfactory performance of Australian railway equipment supplied to India under the Colombo Plan.

"I have known, and have had a high regard for Australian railways for many years", he said, "and now it is my pleasure to be in Australia".

Shri Chatterjee spoke of what he called the obvious industrial efficiency in Australia, and the capacity of Australians to earn the standard of living he had observed.

Railway vehicles of the German Democratic Republic

By Siegfried Büttner
Berlin

IN design, development and construction of railway vehicles the German Democratic Republic has many years experience to look back to. This experience, together with a thoroughly skilled staff enable our works to cover the most highest productions, when needed.

The constant increasing of railway vehicles export proves that more and more countries learn to esteem our productions. Out of numerous types which at the time are being produced, some of them are recognized from the international point of view as peak output and have found appreciation everywhere.

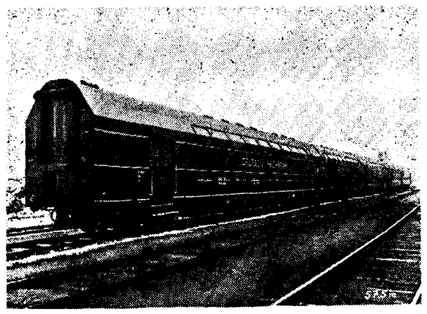


Fig. 1. Double-deck articulated train of the VEB Waggonbau Görlitz.

Several years ago our VEB Waggonbau Görlitz developed a new double-deck train (fig. 1). After comprehensible tests over a couple of years the result was an eleven-coach double-deck articulated train, consisting of two five-coach sets and a buffet car. The intermediate part between the coaches comprises of four-wheel bogies with three pivots. The outer two pivots support the ends of two neighbouring coaches and the third the intermediate part. A five-coach set has an overall length of 104000 mm, a service weight of 131 tonnes and accommodates 640 passengers. The last value corresponds to a seat-weight of only 205 kg. This surprising low seat-weight, until now unknown in the world, was reached mainly through a new constructive idea, i. e. a self-supporting all-steel construction with trellis-type body panels. The cars are comfortably equipped and provide passengers with all

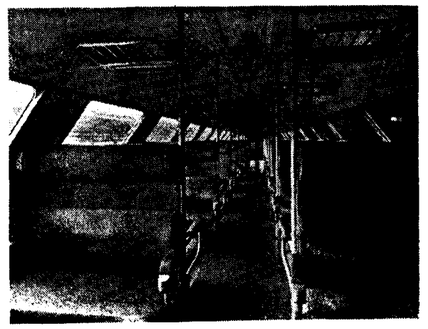


Fig. 2. Interior of second floor in double-deck articulated train.

conveniences. They are suited mainly for holiday and suburban service and assure highest economical advantages.

The next two cars of international interest are to be produced in the same works.

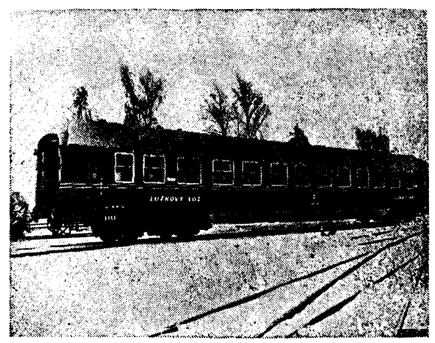


Fig.3. Sleeping car RIC of the VEB Waggonbau Görlitz.

These are the bogie sleeping car (fig. 3) of RIC design and the bogie dining car. The interior fittings of the last one may be seen from fig. 5. The light-weight construction and the interior fittings are two main features, sufficient to meet highest international demands, which found great approvement at the World exhibition in Brussels



Fig. 4. First-class compartment in sleeping car RIC.

(fig. 4). The car with 22 first-class or 33 second-class berths has a length over buffers of 24,900 mm and consists of eleven compartments, train crew compartment, a small kitchen, two lavatories and a heating boiler room. The service weight of this car is 42 tonnes, and by using modern running gear the maximum service speed could be increased to 160 km/hour. The inside panelling is carried out in wood such as mahagony, teak and walnut. The beds are crepe-rubber padded and on the floor are perlon carpets. Closet-like washing accommodation is provided with running hot and cold water, mirrors and wall sockets for electric gadgets accomplish the outfit.



Fig. 5. Interior of dining car RIC (VEB Waggonbau Görlitz).

The dining car (fig. 5) is built along the same line of structural features as the above mentioned sleeping car and accommodates 42 passengers. The very modern kitchen can cater even for guests with pretentious desires. The suburban traffic problems has the VEB Waggonfabrik Ammendorf solved by developing a new electric four-car train (fig. 6) with 224 seating and 494 standing places. Gangways between the cars serve to accelerate the passenger flow, especially during rush-hours. Upholstered seats are arranged two and two on each side of the central gangway (fig. 7). Extra wide, compound-glass tightly fitted windows protect against draught and give a good view. The cars are air-conditioned. The eight 800-V d. c. tractions



Fig. 6. Four-car electro train for suburban service (VEB Waggonbau Ammendorf)



Fig. 7. Interior of suburban four-car set.

motors have a continuous rating of 115 kW each and give the train a top speed of 90 km/hour. Overall length 74,600 mm and total service weight of 97,5 tonnes.

On account of increasing need for economy of secondary lines the Railway Administration was induced to order some light-weight power vehicles. VEB Waggonbau Bautzen developed a railbus (fig. 8) in light-alloy construction with two driving positions.

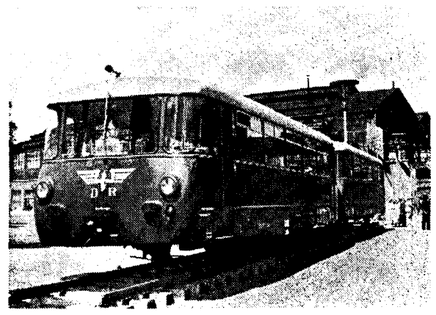


Fig. 8. Railbus of the VEB Waggonbau Bautzen.

The underframes and sills are welded, whereas the car body and the connections between underframe and main cross bars are riveted. Power for the railbus is provided by a 180 PS underfloor Diesel engine. A six-speed axle drive is geared to the engine. The top speed (without trailer) is 100 km/hour and 80 km/hour with trailer. Both vehicles can seat 114 passengers. Weight with supplies but without any pay load is 14 tonnes for the railbus and 9, 4 tonnes for the trailer. Each two-car set has an overall length of 13,530 mm.

For inspection and maintenance of overhead lines one of the most important and indispensable auxiliary railway vehicles is the inspection motor car (fig. 9) with the same power equipment as the railbus, but with a different gear ratio, reducing the top speed to 70 km/hour. The interior of the cars are divided in two driving cabs, one room for the superintendent of the crew and one workshop with an observation dome over one car-end. Over the other car-end are a pantograph and two hydraulic controlled platforms placed on insulators to protect the workmen. The turning range of these platforms to both sides is 90° and their side extension 2700 mm. These cars are turned out in great numbers by the VEB Waggonbau Görlitz.



Fig. 10. Automatic eleven-car refrigerator set of the VEB Waggonbau Dessau.

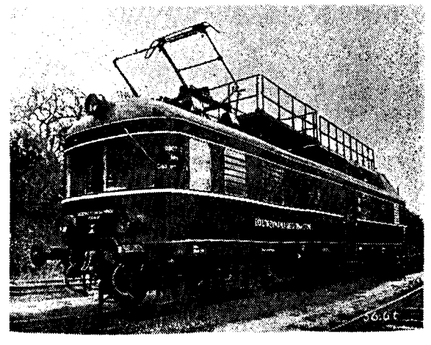


Fig. 9. Overhead-line inspection railcar built by the VEB Waggonbau Görlitz.

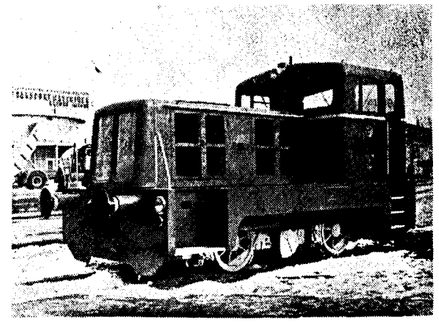


Fig. 11. Diesel-mechanical 150-PS locomotive of the VEB Lokomotivbau Babelsberg.

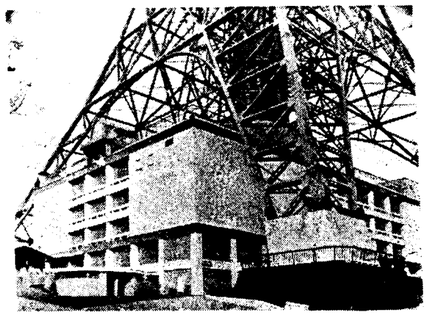
(Continued on page R.C.14)

SUZUKI'S RANGE OF MANUFACTURE

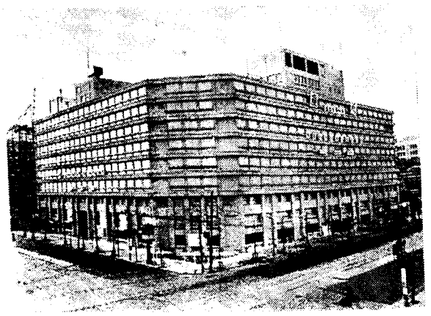
By an Engineering Correspondent

SINCE 1903, when the company was established, we have been about the only manufacturer in Japan specializing in rolling doors and shutters. At present we supply over 80% of the domestic demand. Most of the important buildings throughout Japan, including the principal buildings in the capital city of Tokyo, are equipped with Suzuki's Rolling Doors and Shutters. This testifies to the high quality of our products with respect to their mechanism and efficiency.

The functions of rolling doors and shutters are to protect against fire and wind as well as burglary, and are so designed moreover, they are equipped with very



efficient and easy to use operation devices. As the slats with which doors and shutters are made of great strength, they will withstand effectively fire, wind and other hazards. They are constantly tested for fire and mechanical strength and the results are excellent.



The Suzuki's Rolling doors and Shutters are installed with all openings of the new "Sumitomo" building (Tokyo).

Experiments on the best ways of plating and painting as a means of preventing rust are being carried out, as the rolling doors and shutters are made of steel and are constantly exposed to wind and rain.

Besides our main product, which is Rolling Shutters we make various other kinds of shutters and doors. Slide Rolling Shutters (or so-called vertical rolling shutters in India), Plane Rolling Shutters, Rolling Grilles, Rolling Net-wire Doors, Yard Crane Rolling Doors, Overhead Doors, Canopy Doors, Swing-up Doors, Multiple Vertical Lift Doors, Stage Steel Curtains (which separate spectators from the stage of theatres) and pyroventors (installed to smoke and fire vents of the theatres) are some of the more important ones.

(Continued from page R.C.13)

To complete the production program of the above mentioned works, following types must be mentioned: all classes of carriages and wagons, saloon cars and trains, refrigerator cars, refrigerator cars for wine transport with built-in cisterns, automatic refrigerator trains (either with one machine car and ten refrigerator cars (fig. 10) or according to buyer's wishes) as well as other special cars.

For the conversion from steam to Diesel traction the locomotive building industry of the German Democratic Republic developed some efficient specimen. At the time there are on the scale: one 100-PS diesel-mechanical and another unit of 180-PS with hydraulic transmission. A 600-PS Locomotive with hydraulic transmission of own design will be introduced in short time.

The 100-PS unit embodies an aircooled six-cylinder four-stroke engine with four-speed gearbox, friction clutch, and constant-mesh gear. The gear change proceeds through multiple-disc clutches, corresponding to 5—10—15 and 30 km/hour, service weight 18 tonnes and tractive effort around 4000 kg.

The 180-PS locomotive has the same superstructure, but a hydrodynamic transmission, service weight 22 tonnes, maximum speed 45 km/hour and tractive effort approximately 6000 kg.

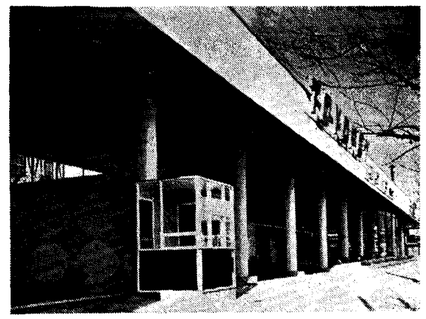
SUZUKI'S ROLLING SHUTTERS

The Rolling Shutters made by the company can be classified into two large divisions: The standard type which uses steel hoops of # 18, # 17 and # 16 B G.; and the light gauge type which usrs steel hoops of # 24 or # 22 B. G. The latter are not quite as strong as the former.

SLATS

Except for special cases, slats are made of iron. Steel hoops in general, are made of # 24, # 22, # 18, # 17 or # 16 B. G. For special purposes, tainless steel or aluminium used; these must, however, e of light gauge type. Steel hoops having vinyl coating n both faces are sometimes used.

Slats are made by fabricating hoops using a high speed cold roll forming machine. The section of slats

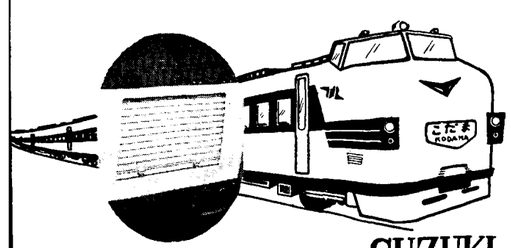


The Suzuki's Rolling Net-wire Shutters are installed on the Toyopet Service Station in Tokyo.

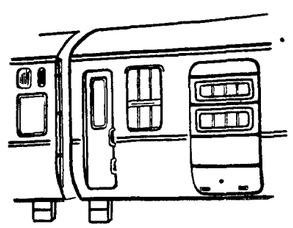
is designed so that the width of hoops will have the greatest strength, that is, of the maximum value of section modules.



For
Locomotive-houses
Warehouses
Power-stations
Factories
and All kinds of
Buildings



Push-up Door
of Japan's Special
Express
"KODAMA"



Suzuki's Overhead
Door of Japan's
Special Express.
"ASAKAZE"

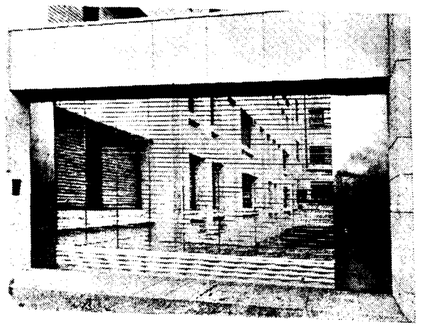
SUZUKI SHUTTER KOGYO CO., LTD.
Head Office: 1545, 7-Chome, Sugamo, Toshima-ku
TOKYO JAPAN
Cable Address: SUZUKISHUT TOKYO

Steel hoops for slats for light gauge type of rolling shutters are galvanized and bonderized while in hoop form and then finished by baking on a coat of paint.

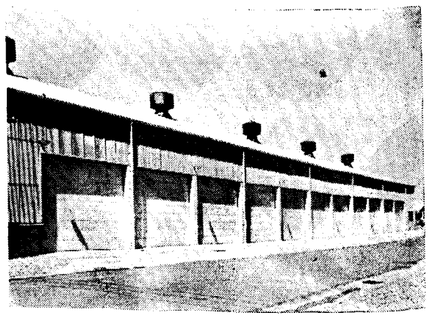
TYPES	No.	THICKNESS (B. G.)	PITCH (mm)	MAX-WIDTH (ft)	MATERIAL
K	No. 1 No. 2	#24,22	50	10	
IMPROVED TYPE & HOLLOW TYPE	1 2 3	# 18 # 18,17,16 # 16	50 70 100	10 17 39	STEEL
SIMILAR FACE TYPE	2	# 18,17	70	17	
IMPROVED TYPE	1 2	# 20 # 18,17,16	50 70	10 17	
SIMILAR FACE TYPE	2	# 18	70	17	ALUMINIUM

The Suzuki's Improved slats are a single type and are most popular. Similar Face slats look similar when viewed from either side. This type is patented. Hollow slats are double-face and have a hollow space between faces. This hollow space prevents conduction of heat and is very effective in preventing fire. The company has patent on Hollow Slats in Japan, and formerly had patents in United States and England. The company also possesses patents on Hollow slats containing asbestos or other heat resisting materials in the hollow space. This type of slats makes the highest grade of fire-proof slats.

Rolling shutters which have a width of 20 feet or exceed the total area of 300 sq. ft. or which are installed in places to withstand strong wind are called Typhoon Slats. This type have a end-locks on end of the slats coming in contact with wind-locks so built as to prevent the ends from leaving the guide rails. Thus, they can withstand extra-ordinarily strong wind pressure.



The Suzuki's Rolling Link Grilles, Side Doors and Wicket Doors are made by stainless steel.



The Suzuki's Overhead Doors are installed on a factory building.

Flat end Slats have both slat ends that go into the guide rails flat end and therefore can narrow the width of the guide rails.

There are other shutters besides those for fire prevention, such as Hole-punched Slats and Ventilator Slats.

OPERATIONS

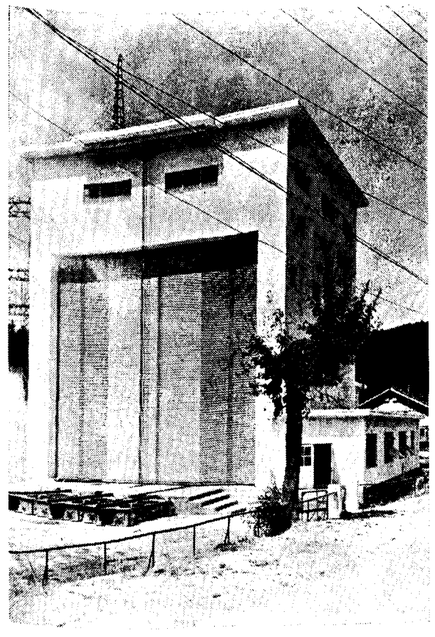
A. Hand Driven Type
Hand crank type
Improved hand crank type
Gear and chain type
Tape type
Push-up type
Semi-automatic type

B. Electro-motor Driven Type

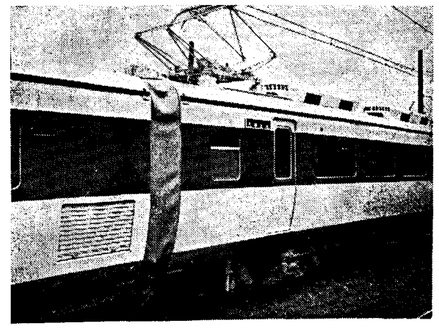
Gear box type
Spur gear type
Worm gear type
Semi-automatic type

C. Accessories and Special Arrangements

Interior and exterior operating type
Multiple operating type
Remote control type (electro-motor driven type)
Fuse metal arrangements (automatic closure)
V-drum type
Safety device for closure
Wicket door type
Side door type
Double shutters type
Movable post type
Hoods (or so-called Top cover in India)



The largest Suzuki's Rolling Shutter is installed at a substation in Japan
Height = 12.000m
Width = 12.400m



The Suzuki's push-up type Overhead Doors are used on the special express train "ASAKAZE" of the Japanese National Railways.

USES AND VARIOUS EXAMPLE OF APPLICATION

Standard type rolling shutters are used in many ways, such as entrances and exits to buildings, windows, partitions inside buildings, factory buildings warehouses, garages, locomotive-sheds, power stations and substations. The largest rolling shutter that we have built in Japan was for Power station and has a height of 40 ft. and a width of 41 ft. A big rolling shutter like this one requires a Worm-gear type of operation.



The Suzuki's Rolling Shutters of light gauge and push-up type are used on the Japanese National Railway's special express train "KODAMA".

Crane Shutters and Doors are used in harbour warehouses and in big factories equipped with a top running crane. Only the rolling shutter type or this type in combination with steel hinged doors are applicable for openings that must be completely closed. When the shutters or doors are opened, goods may be freely transported by a top running crane into or to outside the factory.

Where doors must be opened quickly, for example in a car-shed of a fire-engine station, a Semi-automatic type is used. For banks which use cars for cash delivery, or for special trucks, shutters which can be operated from the back seat can be installed.

Slide or Plane Rolling Shutters can be installed on openings which are curved horizontally or vertically. Plane Rolling Shutters are installed mainly at openings for escalators; Slide Rolling Shutters are installed on curved show-windows as in department stores. The most unusual example was the installation of Slide Rolling Shutters on the score board of the Tokyo National Stadium where The 3rd Asian Games were held last year.

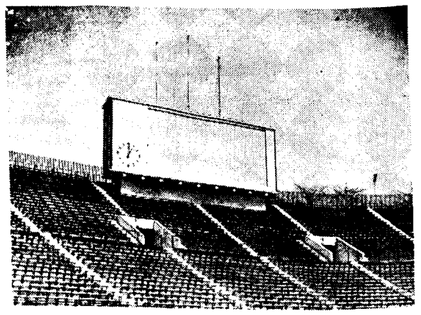
Light Gauge Rolling Shutters are almost all push-up type. A small example of this type is being used in the special express "KODAMA", the pride of the Japanese National Railways. Shutters are installed on storerooms and can be easily operated from both inside and outside; moreover they do not in the least mar the appearance of the exterior of the train.

SUZUKI'S OVERHEAD DOORS

Slats for Overhead Doors have a pitch of $16\frac{1}{2}$" and are made of # 16 B. G. steel hoops. Guide tracks are installed at both ends of the door extending upward to and along the ceiling. The doors can be easily operated because rollers on both ends of the slats run along the guide tracks.

For operation devices, there are a push-up type, a gear and chain type and a worm gear type (which is operated by a motor). They all have a shaft at the top of the opening with a wire-rope pulleys on both ends. A wire-rope connects the bottom bar with the pulley and when the shaft is turned it winds the wire-rope and opens the door. As there is a helical springs inside the shaft to balance the weight of the door, the operation is made easy and smooth.

Overhead Doors, like Rolling Shutters, have a very wide use. Though not quite as strong, it has the



The Suzuki's Slide Rolling Shutters are installed on the score board of the Tokyo National Stadium.

advantage of being able to operate quickly. A fast-rising, semi-automatic type can open a 17 ft. high Overhead Door in 11 seconds (18 inch per second). Overhead Doors are mainly used in garages, factory buildings and warehouses.

The Japan National Railways has started using this Overhead Doors for their rolling stock from last year. The first of its kind was installed on both sides of the cars the special express train "ASAKAZE", the pride of the National Railways. This experiment proved to be a success as Overhead Doors are easy to operate and is self-locking. It can only be opened from outside by a key. The door is raised along the ceiling so that the interior can be fully utilized.

By this success, the National Railways realized that the utilization value of Overhead Doors was more than what they had at first imagined. In their second special express train, they decided to try Overhead Doors on the entire surface of both sides of one of the wagons. On one side of the wagon of total length 46 ft., five Overhead Doors 75 inch by 91 inch were installed. Formerly, wagons were installed with sliding doors but the use of Overhead Doors raised the efficiency so that one side of the wagon can be almost completely opened. Slats are interlocking and joined together and there is no danger of rain getting inside. This wagon is now being built at the National Railways factory. It will shortly be completed and there is no doubt that it will draw much attention.

The National Railways undoubtedly will install Overhead Doors on other coaches and wagons. The most recently completed special express train "SAKURA" was installed with the same kind of Overhead Doors which were used in the "ASAKAZE".

Air Conditioning of Railway Cars

WHILST in the United States of America air conditioning of railway cars was started already 25 years ago, in Germany the first attempts in this field were not made until just before the outbreak of the second world war. During the years 1936 and 1937 a number of saloon cars were equipped with air conditioning for the government of that time. Moreover, different air heating and air conditioning systems were installed for trial into a lot of about 10 passenger coaches. This development, necessarily interrupted in Germany by the second world war, was continued with the air conditioning of the Henschel-Wegmann Train and the two light metal multiple unit sets, which were presented to the public in 1953 at the Traffic Exhibition in Munich. The different types of air conditioning equipments installed into these cars resembled each other in their structure and above all in their air distribution.

In 1954 when air conditioning 10 sleeping cars of the German Sleeping Car and Dining Car Company (DSG), Messrs. LUWA GmbH vorm. Lahmeyer-Etna adopted a completely new method in the air distribution with their JETTAIR system which seemed to be especially suitable for smaller rooms. The basic conception of this method was maintained by them up to the present day, and in the meantime more than 200 railway cars were air conditioned on this approved JETTAIR basis.

Apart from the above mentioned 10 cars the JETTAIR air conditioning equipment was for instance installed into:

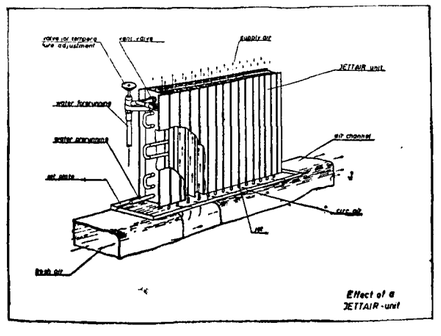


Fig. 1

- 40 sleeping cars of the International Sleeping Car Company, Paris
- 45 cars of the Trans Europ Express Trains of the German Federal Railways
- 63 cars of different types for the Iranian State Railways

the Saloon Train for H. M. the Shah of Persia and another

- 20 sleeping cars of the German Sleeping Car and Dining Car Company (DSG), Frankfurt/Main

The purpose of air conditioning railway cars is to improve travelling comfort and thus to make a long journey more agreeable to passengers. Last not least

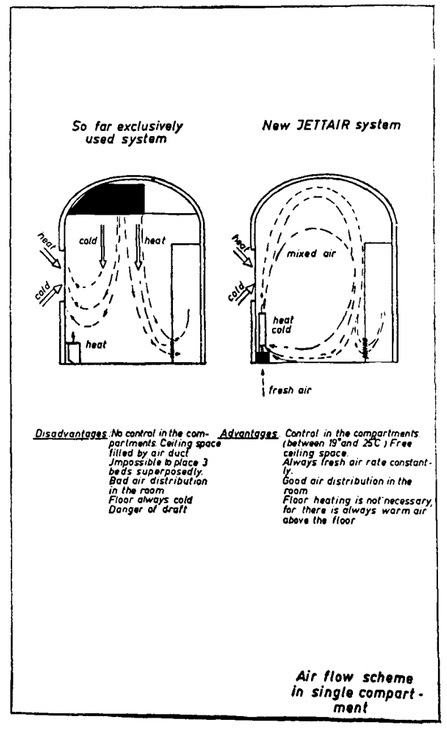


Fig. 2

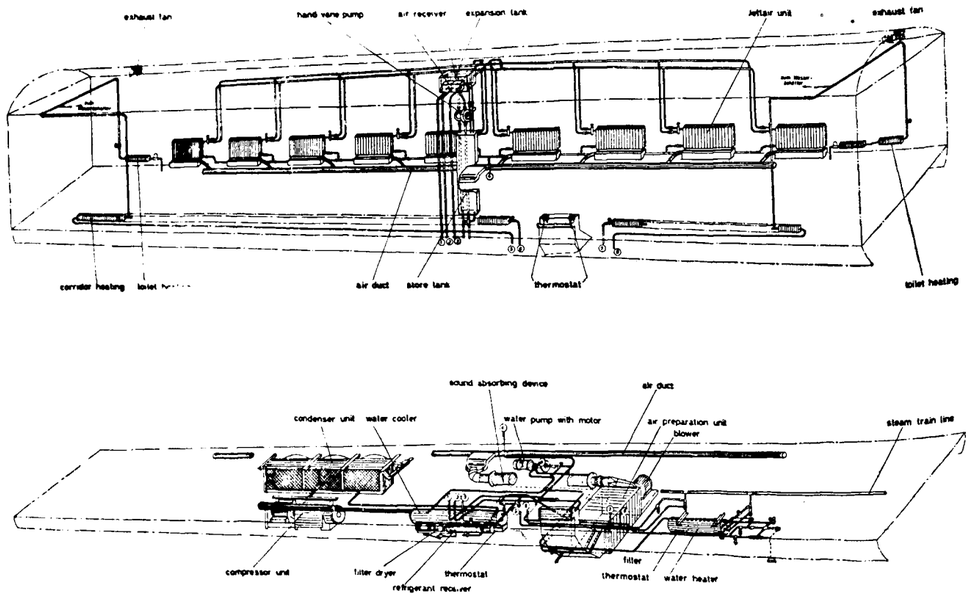


Fig. 3. Perspective representation of the structure of the JETTAIR equipment.

railway administrations have to offer this comfort to their passengers especially in long distance trains in order to prevent their going rather by airplane or choosing a road traffic means or in order to win back those who had already been lost for the railroad service.

In this connection we should like to draw your attention especially to several papers appeared in German and giving detailed information on this subject :

Baur, Die Klimaanlagen der Deutschen TEE-Zuge, Glasers Annalen 81 (1957) 10, S. 343—353

Klimaanlagen in Verkehrsfahrzeugen, Rationalisierungskuratorium der Deutschen Wirtschaft, Auslandsdienst, Heft 36, Karl Hanser-Verlag, Munchen, 1955

Die Bundesbahn, 2. Beiheft, Reisezugwagen in den USA-Klimaanlagen, Beleuchtung, elektrische Stromversorgung.

Karl Rohrig-Verlag, Darmstadt, 1956

Dr. Bohm, VDI-Berichte, Heft 34, 1959

Intention of this essay is to point out above all the merits of the JETTAIR system of Messrs. LUWA GmbH. Figure 1 shows the structure of a JETTAIR unit, whereas Figure 2 is a confrontation of the conventional equipment blowing the air from the roof and the method of air distribution in the JETTAIR system.

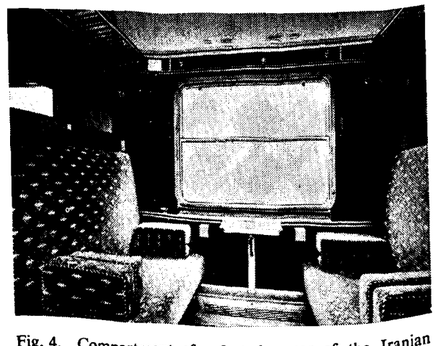
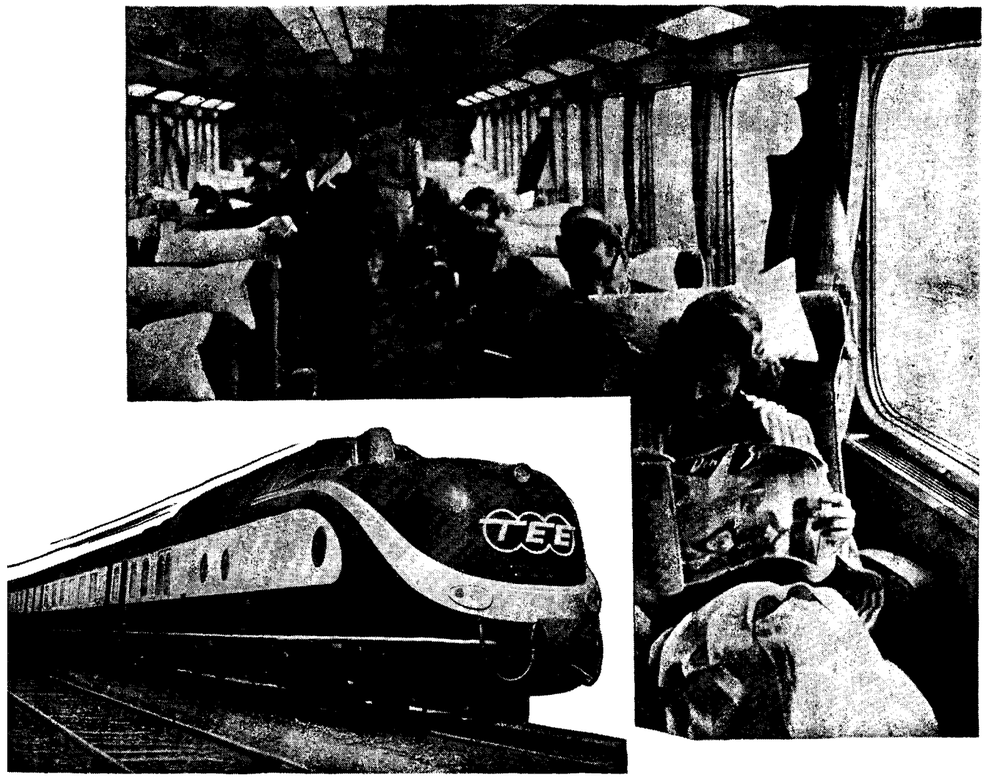


Fig. 4. Compartment of a first-class car of the Iranian State Railways with JETTAIR air-conditioning equipment.

TRAVELLING COMFORT IN MODERN EXPRESS TRAINS



The present standard of comfort makes travelling in the modern express trains a special pleasure. It is, above all, the dust-free, temperature-controlled air that gives travellers great ease. This comfort is made possible by air-conditioning equipment running through the whole train and hidden from the eye—a marvel of technical development.
For instance, all Trans Europ Express Trains of the German Federal Railways (TEE) are equipped with **Luwa** air-conditioning plants, system **Jettair.** For the air-conditioning equipment shown at the International Exhibition in Brussels we were awarded the Silver Medal. The passengers of the German Sleeping Car Company (DSG) and the Compagnie Internationale des Wagons-Lits et des Grands Express Europeens (CIWL) enjoy the advantages of this proved air-conditioning equipment.
Among other overseas railways the Iranian State Railway for their modernization programme have equipped all 1st and 2nd class passenger and dining cars with the **Jettair** system. The saloon train of H.M. the Shah, also, is being equipped with the **Luwa** system.
Top quality and continuous technical progress characterise the air-conditioning and pressure ventilation equipment built by us.

Luwa GmbH *(VORM. LAHMEYER-ETNA,) FRANKFURT / MAIN, GERMANY*

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The great advantages when using the JETTAIR equipment are before all the individual temperature control in each air conditioned compartment, the development of an air curtain in front of the compartment windows, a thorough and even spreading of air in the compartment at an almost constant temperature all over the room, no special fundamental heating, free ceiling space because of no roof ducts (thus in sleeping cars it is possible to arrange 3 beds on top of each other), and no draughts. Moreover, the special construction of the JETTAIR equipment ensures that the air is circulated only in one and the same compartment. Therefore, no unpleasant odours will be carried into other rooms and this prevents also bacteria from spreading.

The main components are the same for both the JETTAIR system and the conventional equipment, i. e. compressor unit, condenser unit and air preparation unit. The difference, however, between the two is that in the *conventional system*—as shown on figure 2—the conditioned air is supplied to the compartments through distributors from the roof whereas with the *JETTAIR system* the air is blown out from underneath the window. The advantages offered by this latter method are already mentioned in detail above. In this connection it may however, be worth mentioning that at a given fresh air rate the conventional equipment requires 3 to 4 times more air to be carried in the ducts which, consequently, have to be designed much larger. The ducts including the air preparation unit can only be mounted in the roof, where they take up very much valuable space and in addition they are relatively expensive.

The JETTAIR equipment provides for all components to be mounted in the bogie. The supply air duct, a round steel tube of about 120 mm. dia. arranged under the coach floor, is easier to manufacture and to mount and less expensive.



Fig. 6. Compartment of a Trans-Europ Express Train of the German Federal Railways with JETTAIR air conditioning equipment.



Fig. 5. Dining room of a dining car of the Iranian State Railways with JETTAIR air conditioning equipment.

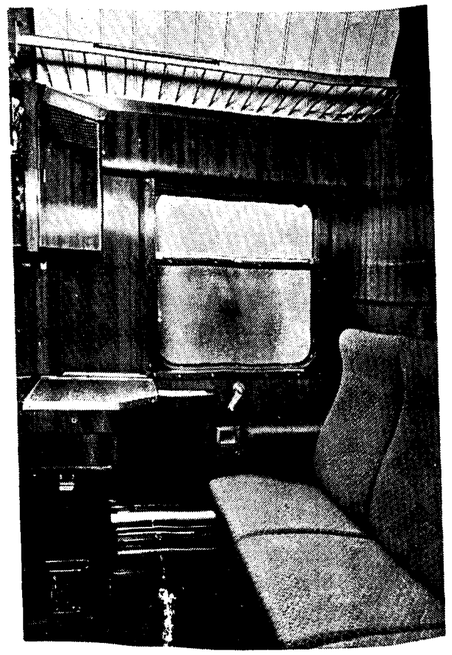


Fig. 7. Compartment of a sleeping car in day position of the Compagnie Internationale des Wagons-Lits et Grands Express Europeens, Paris, with JETTAIR air conditioning equipment.

Rumania — A Traditional Railway Car Producer and Exporter

By An Engineering Correspondent

RUMANIAN railway car manufacture is about 70 years old having started simultaneously with the development of the railway system in the country.

The talent and skill of Rumanian workers and technicians employed in the manufacture of railway cars were recognized and highly thought of at the time by many buyers in Serbia, Greece, Bosnia, Herzegovina and Turkey, and later by the International Sleeping Car Company, etc.

After the Second World War and especially after 1948, the Rumanian railway car industry has developed substantially owing to a wide programme of capital investments, to the systematization and modernization of production processes, to the endowment of factories with highly technical equipment and to the gradual introduction in the production plans of modern railway cars of ever higher technical-economic indices.

The rate of development of rolling stock production was stepped up, as may be seen from the figures below (1954 = 100) :

1954	1955	1956	1957	1958	1959 (planned figure)
100	238	264	315	336	560

It should be observed that railway cars are manufactured in Rumania not only by the Arad "Gh. Dimitrov" works—a plant thoroughly rebuilt and modernized which is a main railway car producer—but also by other plants as, for instance, the "23 August" works in Bucharest.

With its modern equipment and increased production capacity, the Rumanian railway car industry has been turning out a wide range of cars of many types ever since 1948.

From among the main varieties of railway cars made by the Arad Works after 1948, the following are well-known : covered freight cars on 2 and 4 axles (8 different types) ; open freight cars on 2 and 4 axles (8 different types) ; self-discharging cars (in about 5 models) ; 40 m³ dumping cars ; modern iron and steel carrying cars (10—12 types) ; passenger cars ; saloon cars and special cars (approx. 7—8 types) etc.

Concurrently, the Bucharest "23 August" works has turned out new types of 50 m³ tank cars on 4 axles in 4 models, and, in the last 2 years, new types of Diesel electric railcar trains, with 4—6 power cars and a variable number of trailers according to traffic requirements.

Here are the types of rolling stock designed mostly for export :

- 28 ton open freight car on 2 axles, UIC type
- 28 ton covered freight car on 2 axles, UIC type
- 50 ton self-discharging car on 4 axles
- 50 ton covered freight car on 4 axles
- 50 m³ tank car with pressed steel bogies
- 2nd class passenger car with 72 seats
- Diesel electric railcar trains

(Continued from page R.C.22)

Figure 3 is a perspective representation of the whole structure o the JETTAIR equipment for a car comprising 10 compartments. The names of the principal components are marked so that everybody can easily understand the construction.

As will be seen from figures 4, 5, 6 and 7 the JETTAIR units installed under eath the windows match very well with the interior fitting of the compartment, so that the passenger enjoys a well conditioned room temperature, however, the equipment itself is hidden from his eye.

Messrs. LUWA GmbH, vorm. Lahmeyer-Etna, Frankfurt/Main, (Germany), will be pleased to supply detailed information as well as technical particulars and catalogues to any reader interested in the problems of air conditioning of railway cars.

From the aforementioned, the conclusion may be drawn that the Rumanian railway car industry is in a position fully to meet the requirements of foreign clients who can be supplied with a wide range of rolling stock of irreproachable workmanship, with high technical-economic indices and up-to-date installations.

And now the Rumanian rolling stock industry has in addition set itself the task of further bringing down production costs through standardisation and the adoption of set types of rolling stock.

Rumanian industry shows a trend for developing the following types of cars :

- OL 52 low alloy steel freight cars of 60 ton capacity now being tested ;
- international standard (ORE) covered freight cars on 2 axles ;
- a new type of tank cars of increased capacity, with the usual bogie ;
- tank cars provided with insulating lining for the transport of bitumen ;
- large capacity passenger cars ;
- Diesel hydraulic railcar trains now being manufactured at the Bucharest "23 August" works ;
- 2100 HP Diesel electric locomotives.

Measures have been taken with a view to steadily improving the quality of the rolling stock and bringing the new types abreast of modern requirements so that Rumanian production may be maintained at the level of world technique.

From among the main measures that have been or are to be taken, the following should be mentioned :

- Reduction of tare weight
- Switch over to construction of freight cars according to UIC—ORE international forms and standards
- Modernization of passenger cars and railcars

The considerable all-round development of the Rumanian rolling stock industry and the care taken to meet the foreign clients' requirements have brought in steadily increasing orders from abroad. In 1958, the "Gheorghe Dimitrov" works of Arad alone supplied for export approx. 26 times more railway cars than in 1955, while the increase planned for 1959 is to be about 33.5 times above 1955.

At the same time, the Bucharest "23 August" works in turning out a considerable number of railway cars for export. Over 80% of its 1958 output went abroad.

At present, various cars such as dumping cars, tank cars, covered freight cars on 2 axles and others, are being manufactured against orders from abroad.

Moreover, other orders are shortly to be put in hand : covered freight cars on 2 axles, open OREKY freight cars with metal walls, Diesel hydraulic railcar trains of 600 HP installed power, and others.

Concurrently, negotiations are being carried on with several clients for the sale of 50 ton covered freight cars ; passenger cars ; 28 ton freight cars ; 50 m^3 tank cars ; type 2—OTDR platform cars on 2 axles ; railcars, etc.

Rumanian railway cars are in use today in over 12 countries including the USSR, the German D. R., the Czechoslovak R., the Chinese P. R., the United Arab R., Greece, the Hungarian P. R., the Polish P. R., the Korean P. D. R., the Albanian P. R.

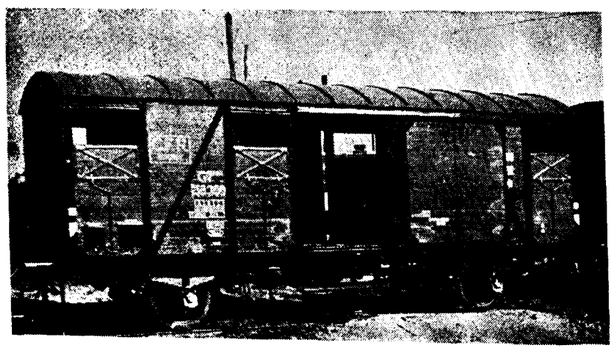
Rumanian railway cars are greatly appreciated by foreign clients.

Prompt and high quality manufacture, as well as the co-operation between Rumanian and foreign research institutes have enabled the Rumanian rolling stock industry to develop steadily.

The Rumanian rolling stock industry will consequently continue to meet its home and foreign clients' most exacting requirements.

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Hard Rubber Containers for Lead Acid Storage Batteries

Containers for a majority of types of lead-acid storage batteries are made of hard rubber, except in some special types such as stationery accumulators, aircraft batteries etc. These rubber containers are being progressively manufactured in India to meet the demands of the growing battery industry. The Indian Standards Institution has drafted a specification for Hard Rubber Containers for Lead Acid Storage Batteries [Doc : ETDC 11(62)], which lays down the tests and requirements of hard rubber containers used in the construction of lead-acid storage batteries for motor vehicles, motor cycles and for similar purposes.

Three groups of tests viz. physical, chemical and electrical, have been included in this draft standard, along with their corresponding requirements. Also included in the draft is a simple sampling scheme for acceptance of lots, covering ranges of purchases of containers of 1000 to 5000 pieces.

* * * * * * * * *

NEEDLE BARS FOR SEWING MACHINES

The Indian Standards Institution has undertaken the formulation of a series of Indian Standards for sewing machines and their components, on the recommendation of the Tariff Commission and at the instance of the Development Commissioner for Small Scale Industries, Ministry of Commerce and Industry. The institution has already issued the following standards in the series.

IS : 1294—1958	Bobbins for Sewing Machines.
IS : 1296—1958	Pressure Feet for Sewing Machines.
IS : 1297—1958	Pressure Bars for Sewing Machines.

Latest in the series is an Indian Standard Specification for Needle Bars for Sewing Machines (IS : 1295—1959), which covers the requirements for needle bars for sewing machines of the so-called household pattern.

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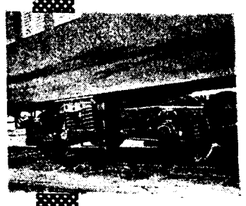
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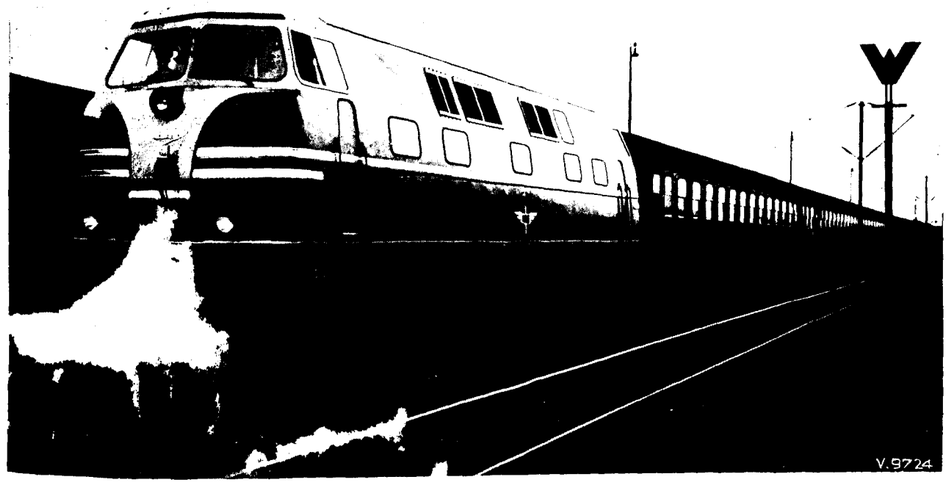
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WE have great pleasure in anno ncing to all our readers and advertisers that we are incorporating a special supplement entitled INDIAN RAI WAYS CHITTARANJAN LOCOMOTIVE WORKS SUPPLEMENT along with our ry 1960 lition. We need not very much stress the international rtance o gigan locom ive building unit of the Indian Railways, in ne whol A The ent will contain inte g articles specially contrib ted by ment engineers about this largest engineering works in the public sector.

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