

THE
INDIAN RAILWAY ENGINEER
©
VOL 6- APR - 1959

32
PAIS MR INSIR
NS 64
177283



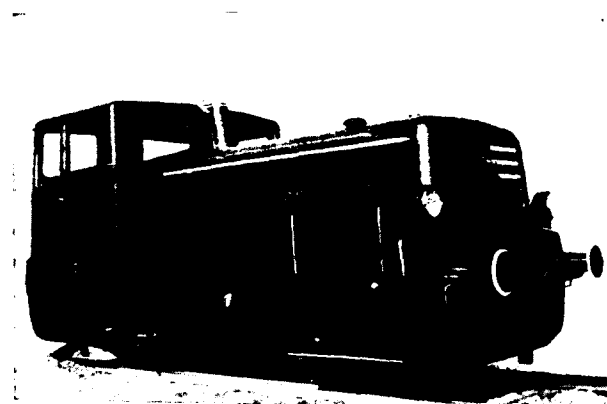
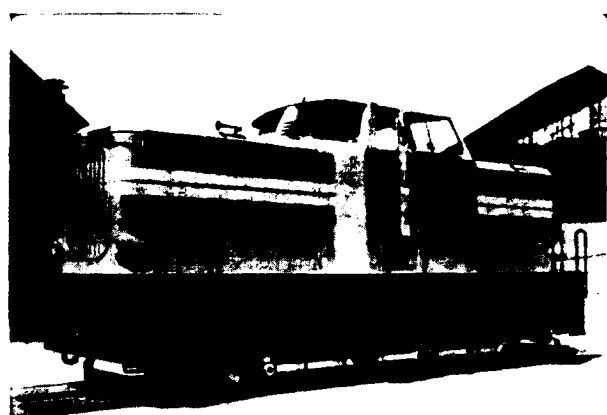
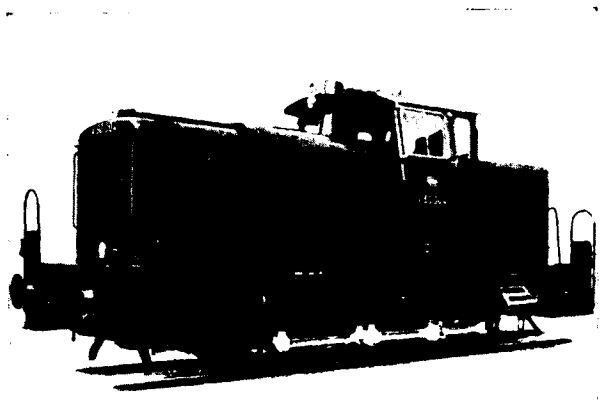
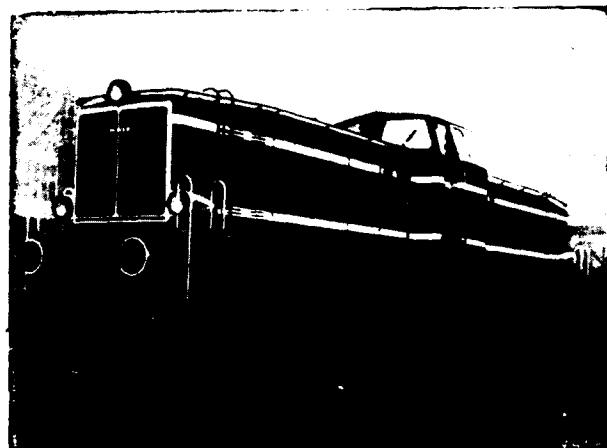
CONTENTS

	PAGE		PAGE
1. Railways and Welfare Work	1	19. New Engineering Equipments	78
2. Systems of Working Trains	5	20. Route Relay Interlocking at Churchgate	81
3. Automatic Operation of Railway Facing Points	11	21. Rail Transport in Rourkela Steel Plant	89
4. 45 New Nohab-GM Locomotives to the Danish State Railways	16	22. Corrosion with some Reference to Railway Materials	93
5. The Growth of the Nation's Life-Line	19	23. "Copy-Turning" on a General-Purpose Type Lathe	101
6. C.T.C.—a Means of Improving the Competitive Power of Railways	24	24. A Rumanian Factory with an old tradition in Rolling Stock Production "The G.H. Dimitrov" Factory	105
7. Need for Earthquake Engineering Research in India	31		
8. Diesel Locomotives for the Indonesian State Railways	36		
9. Efficient Working on Air	39		
10. The Spiramatic Jigmill	44		
11. SPE "WALTER" Type Split Bushes for use on Railway Signalling Equipment	46		
12. Compressed Air Equipment in Railway Maintenance	48		
13. Range of Eumuco Machines	54		
14. Essentiality of Productivity	63		
15. Double Line Block Signalling	66		
16. Diesel Rail Bus for British Railways	70		
17. British Railways Second Type of Railbus	75		
18. Ferrous and Non-Ferrous Electronics	76		

RAILWAY WEEK SUPPLEMENT	
1. The Place of Railways in our Life	R.1
2. New Line will join up North-South M.G. Rail Systems	R.3
3. First year's Achievements on N.F.Railway—Life-line of North-east India	R.6
4. More Goods, at Better Speeds, over Longer Distances—Northern Railway's Performance	R.10
5. The Job India's "Steel Plants Railway" is Doing	R.13
6. Promoting Greater Operating Efficiency	R.17
7. Southern Railway—Some Problems and Achievements	R.20
8. Western Railway is building up capacity to meet Industries' Demands	R.22
9. Eastern Railway delivers the Goods	R.25

JE
D415m2 N531R
N58.6.4
1772.88

B. Amruta



VOITH

TURBO TRANSMISSIONS IN DIESEL SHUNTING LOCOMOTIVES

The excellent experience of many years with VOITH TURBO TRANSMISSIONS fitted in thousands of diesel-hydraulic shunters, both at home and abroad, is convincing evidence that the VOITH TURBO TRANSMISSION is the drive of first choice not only for branch-line and main-line applications, but also for the specific requirements of heavy marshalling and general shunting work.

The VOITH TURBO TRANSMISSION based on the automatic filling and emptying of independent hydraulic converters in multiple or of a combination of hydraulic converters and couplings in multiple is characterized by:

- absence of wear and tear
- reduction in maintenance
- simplicity of operation
- smooth taking up of the load

The VOITH TURBO TRANSMISSION has now been fitted with a converter filling control which for shunting work provides such added desirable features as:—

- most precise and sensitive control of shunting operations,
- vigorous pushing off of the wagons

Because of its large inherent heat-absorbing capacity and the efficient means provided to dispose of any amount of heat, the VOITH TURBO TRANSMISSION enables diesel-hydraulic shunters to master effectively hardest shunting jobs, such as starting and pushing heaviest train over the 'hump'.

To this day we have delivered or on order about 7,150 Turbo Transmissions with an aggregate output of 2,500,000 HP.

Illustrations:

1,600-b.h.p. -Deutz-diesel shunting and line locomotive fitted with 2 VOITH TURBO TRANSMISSIONS and 2 VOITH COOLING UNITS.

650-b.h.p., V60 diesel-hydraulic shunter of the German Federal Railway. More than 350 of such locomotives have been equipped with VOITH TURBO TRANSMISSIONS and VOITH TURBO TRANSMISSIONS for another 350 shunters are on order.

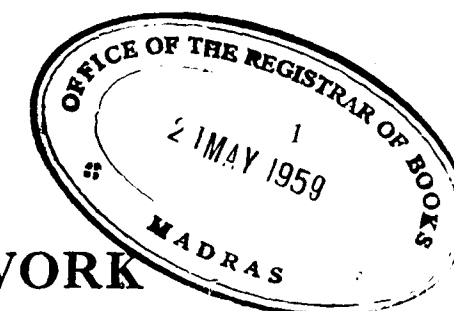
350-b.h.p. diesel-hydraulic shunter with VOITH TURBO TRANSMISSION.

200-b.h.p. diesel-hydraulic shunter of the Austrian Federal Railway, equipped with VOITH TURBO TRANSMISSION.

© J.M.VOITH GMBH · HEIDENHEIM (BRENZ) · GERMANY

April 1959

THE INDIAN RAILWAY ENGINEER



RAILWAYS AND WELFARE WORK

UNDOUBTEDLY the Administrative and Executive Officers of the Railways and their wives are most favourably placed for doing welfare work among their staff and thereby earning their gratitude and goodwill. This type of work will tend to create better understanding between workers and their superiors and thereby foster real co-operative working which is set out as a 'desideratum' in the railway service of to-day.

Housing Colonies

The enormous housing programmes at the cost of many lakhs and even crores of rupees already implemented and still being implemented by all Railways under sanctions of the Railway Board from year to year, have the tendency of congregating large bodies of their staff, especially the lower paid ones, in housing colonies, which, as a result provide the right field for undertaking Welfare Work on a wide scale.

Scientific Welfare Work

Sociology and its most important branch 'Human Welfare' has grown so rapidly these days that it has now developed into an exact science and regular courses of studies in various aspects of it are available at University Degree level or Diploma level of various Schools of Social Science, in Bombay and in some of the larger cities. Social Welfare Work to-day should not be undertaken in a haphazard manner, but only after following a regular course of studies at the various institutions, so that practical work could be introduced with a thorough background of scientific knowledge for its application.

Suitable Personnel

The most suitable persons to undertake this type of work are the wives and grown-up sons and daughters of Railway Officers and Senior Subordinates. It may be that some of these ladies or men already have a degree in Sociology or a Diploma in Welfare Work which would indeed be a great asset. Others who are graduates in Arts or Science and are really interested in Welfare Work could be encouraged to follow regular courses if they are young enough to do so, at the University of Bombay, Poona, or elsewhere and such well known institutions as the Tata School of Social Studies, Nirmala Niketan in Bombay and their counterparts elsewhere in the Country. Those who are older, could be induced to read books on Welfare from the enormous amount of excellent literature available to-day on the subject.

With Housing Colonies, springing up in various Divisions or Districts of Railways, this type of work would provide golden opportunities to Railway women to do a considerable amount of good to their railway staff and their families, living in their vicinity or one or two stations away and so provide them with an outlet to exercise their maternal instinct and also save them a lot of boredom and ennui which is usually

Usually in Railway Centres of this sort, there is a considerable amount of latent talent and it should be given an outlet by having periodically singing and instrumental musical concerts, dramatics, conjuring and acrobatics. These, while providing diversion to many would encourage people to come forward and develop their talents.

5. *Literacy Classes* : One of the curses of India is illiteracy and any effort made to eradicate it is a step in the right direction. There is no reason at all, why there should not be adult literacy classes as a part of the Welfare Scheme, with prizes and certificates to those who persevere and are able to read and write any of the vernacular languages of their choice, or English, should they desire to learn it.

6. *Sewing Classes* : If the Railway will provide each Centre with a couple of sewing machines, sewing and embroidery classes could be started and the women folk and older girls taught to make their own clothes and pants and shirts for men folk.

7. *Library* : A library with cupboards and simple books to suit the taste of the working class people could be started by the Railway at capital cost and then supplemented by the staff themselves by subscribing to one or two daily or weekly newspapers in vernacular or English, as they decide among themselves.

8. *First Aid and Home Nursing* : Practically all supervisory staff in the Railway to-day have to pass in First Aid and many of them and the workmen too, are members of the St. Johns Ambulance Brigades. Here is therefore a golden opportunity to disseminate that knowledge to others in the Railway Colony.

The field of Welfare is indeed large and with the combined effort of the Railway Management, Supervisory Staff and the workers, much could be achieved if sufficient interest is taken and maintained and this type of liaison would bring the Officers, their wives, supervisors, their wives and workers and their wives closer together and further that 'esprit de corps' so necessary to-day.

New Locomotives for Italian State Railways

The Italian State Railways have placed an order with Breda Electromecannica e Locomotive, Milan for 15 large diesel locomotives to follow two already on order.

These diesel electric locomotives will each be powered by a 1320 H. P. Paxman 12-cylinder Vee type diesel running at 1,000 revs per minute, built by Fabbrica Automobili Isotta Fraschini e Motori Breda at Saronno under licence from Messrs. Davey, Paxman & Co. Ltd., of Colchester, England.

The manufacturing agreement between Breda and Paxman was only signed 3 years ago. That the two engines in the first order have been built in Italy and successfully tested there in this short period is a measure of the initiative and energy put into this project.



(Photograph by courtesy of
Breda Electromecannica e Locomotive, Milan.)

SYSTEMS OF WORKING TRAINS

By T. S. Parthasarathy,

Divisional Superintendent, Southern Railway, Hubli.

MOST railwaymen in India will be familiar with the Train Control System, commonly known as 'Control' which has been installed on all important sections of Indian Railways. In some other countries of the world, it is known as 'Dispatching' and was introduced in Europe by the Transportation Corps of the U. S. Army during the First World War. It was first tried out by the Belgian Railways, who, while continuing normal block working and holding Station Masters responsible for the safe working of trains, used the Dispatcher (Controller) for

- (i) keeping a record of the actual running of the trains by maintaining a graph ;
- (ii) taking timely action when traffic jams threatened to occur ;
- (iii) scheduling of extra trains ;
- (iv) making the best use of motive power and train crews, and
- (v) supervising wagon distribution.

It was the Belgian system that was later introduced widely in other countries, notably Burma, India, etc.

During the early stages of the introduction of Dispatching, many railways limited its scope to the recording of actual train running and hesitated to give the Dispatcher much power. This led to the appointment of dispatchers of rather low rank. Even with the taking over of more responsibilities as listed under the Belgian system, the rank of the dispatcher was not sufficiently raised in many countries till about ten years ago.

DIFFERENT SYSTEMS

A comparative study of the different systems of Dispatching in the various countries of the world will be found interesting by railway operating men. Under the American system, the Dispatcher is responsible for safety of train working and is not therefore overburdened with stock matters. The record of train running is mostly done in tables and seldom in graphs. Americans, like the British, are great believers in the

tabular form of presenting figures while, on the European Continent, everything, including time-tables, is represented graphically.

In Belgium, a Central Dispatcher controls the movement of extra trains, use of motive power and crews and wagon distribution while all other Dispatchers have direct lines with the former's office. In areas where large numbers of loaded wagons are expected (mines, harbours, etc.) a continuous record is kept of loadings to be expected and requirements for empties, in order to obtain a most economical and regular flow of traffic.

The French system (Poste de Commandement) differs from the others in that locomotive running and train working belong to different departments and the Dispatchers' office is composed of a representative of each of these services. To get over the difficulty of dual control, the Chief Dispatcher of the train working service (Exploitation) has powers to overrule the agent in charge of locomotive running (Traction).

The German Railways have introduced dispatching mainly on heavily loaded double lines. The whole railway system is divided into two central dispatching areas (Oberbetriebs Leitungen) which are mainly occupied with unravelling and prevention of traffic jams. Little work is done regarding wagon distribution. On heavily loaded double lines, the Dispatcher can order signal cabins to show the driver the K or L board. The K board (Kuerzeste/Fahrzeit = shortest timing) asks the driver to speed up and the L board (Langsam = slow) asks him to slow down. This method prevents signal stops of trains closely following each other.

THE AMERICAN SYSTEM

Two concepts universally accepted on American Railways must be kept in mind for a proper understanding of the methods of controlling train movements in that country :

1. All train movements on main lines, loop and other running lines are under the supervision and direction of the railway officer in charge

of the district or sub-division in which located. The actual work of directing and recording train movements is performed by his authorised representative called the Train Dispatcher. His orders to a train to move in a prescribed direction may be subject to restrictive indication of signals and superiority of other trains, but orders to remain at, stop at or not pass beyond a specified point on the line of railway are absolute and must be obeyed by trains without question or exception.

2. Each train at any given moment has a definite status in its relation to all other trains as to its authority to occupy the main track or a passing siding and to proceed in a given direction. Superiority of one train over other trains may be inherent as in the case of regular trains authorised by time-table or superiority may be conferred by 'train order' issued by the Train Dispatcher or it may be conferred by block signal indication where such indication supersedes superiority of trains.

LINES NOT EQUIPPED WITH BLOCK SYSTEMS

The builders and administrators of the first railways a century ago considered their new facilities as nothing more than improved highways on which stage-coaches and goods wagons could be hauled by the 'iron horses' at a profit. Stations or depots were established along the line and rough schedules published of the times the passenger and goods trains running over the line would likely arrive at these stations. Just as goods vehicles on the highway, when overtaken or met by stage coaches, had to allow the latter to pass them, so did the goods trains give way to passenger trains on the new railway. Thus was born the idea of class applied to trains; regular scheduled passenger trains were of the highest and more important class and regular scheduled goods trains, naturally, were considered of the second class.

The first major problem in the control of movement of these trains was concerned with avoiding collisions and delays when trains in opposite direction were run on the same track. On the highways opposing vehicles could meet and pass each other without much difficulty or danger. But on the railway provision had to be made for one train to clear the main line to allow the train moving in the opposite direction to proceed. It was solved finally by the adoption of a plan of operation based upon a set of principles which were so

sound that they have continued to this day to support what is distinctly an American method of controlling trains. One of these principles is that each train must be scheduled to arrive at specific stations at specific times and must not depart before the specified times. A second principle is that all times shown on schedules must be synchronised so that all clocks and watches used in connection with the operation of trains by such schedules will show the same time at any given instant. A third principle is that each train must have a definite status as relates to all other trains as to its relative superiority.

To take a concrete example, let us suppose that we have a single line section A to M with intermediate stations B, C, D, E, etc. at which there are loop lines where trains can be berthed to clear the main line. We want to provide passenger service twice a day and also two goods trains each way daily. The section runs east from A and it happens it is more important for eastward trains to get to M on time than for westward train to get to A on time, so we give the eastward trains superiority by direction. Passenger trains are more important than goods trains and so they are called 'First Class' and the latter 'Second Class'. We have now to set up the schedules of the eight trains and determine with precision the places where each train would meet opposing trains.

The eastward passenger train (first class) has superiority by class and direction and therefore it goes right along, on time or late, because all other trains are inferior and have to keep out of its way. Westward passenger train likewise moves over the line and is not interfered with by any other train except that it has to be clear of the main line wherever it is when the opposing eastward passenger train is due as shown on the schedule. The inferior trains (second class) in like fashion respect each other's superiority.

TRAIN ORDERS

When Morse built his first telegraph line in 1844, the railways were ready to adopt this system of instantaneous communication to suit their requirements. At first it was used merely for communication between stations and headquarters and the railways were most cautious in using it actually to direct the movements of trains. Later it came to be extensively used for the issue of 'special orders' now commonly known as 'Train Orders' to control the movements of trains by restricting the superiority of some trains, conferring superiority on others, holding trains, authorising movements of extra trains and so on. It is needless to

add that with the introduction of telephone, the Morse system has been completely superseded by the former.

DOUBLE LINES

All the foregoing applies to single track lines where the major problem concerns the handling of trains in opposing directions. As soon as double lines were laid, the difficulties of controlling train movements were greatly reduced by assigning one track for one direction of traffic and the other for the opposite direction.

In many respects, the American system resembles the system adopted by Indian Railways for train working on non-controlled sections, where crossings of trains are arranged in accordance with the time-table and the precedence of trains laid down in the rules. The differences, however, are:—

1. In India the system is adopted only on non-controlled sections while in America it is used even on sections where all stations are connected by telephone.
2. In India, the train Dispatcher (Controller) decides the precedence of trains on controlled sections while in America, he just watches the movement of trains as they take place in accordance with the time-table and interferes only when the superiority of a train is to be changed or a 'meet' (crossing) shifted away from the original station shown in the time-table.

The time-table system combined with permissive working which permits of goods trains following passenger trains into the same section at time intervals, enables American railways to get the maximum capacity out of their single line sections while in certain countries the combination of the Absolute Block System with token working restricts capacity to a considerable extent.

TELEGRAPH BLOCK

A few years after Morse, in 1844, perfected the telegraph, it was being used on many railways as the basis for a block system supplementary but not superseding superiority of trains. Just as was the case in the development of controlling trains without block signals there was a good deal of experimentation before sound underlying principles for block systems were

developed. In 1857 the Camden and Amboy Branch Railway in Pennsylvania started a practice of using the telegraph for blocking trains. Some of the practices will be of particular interest to persons familiar with European railway practices because they were based upon the principle that trains could be controlled locally, as for example, by the guard who would himself arrange for the blocking of opposing trains at the next station ahead. This was accomplished by the guard writing a message for the Station Master to transmit to the next station ahead asking the Station Master there to hold all opposing trains until his train arrived. The operator did this by telegraph and when the reply was received, the guard arranged for his train to proceed to the next station.

TRAINS IN THE SAME DIRECTION

The experiment conducted by the above American railway was typical of the activities on railways generally at that time in their efforts to use the new telegraph in railway operation. As soon as telegraph offices were installed along a railway, numerous uses were found for them. One of these was the solution of a problem of keeping trains apart while moving in the same direction. Rules could be devised for keeping opposing trains from colliding with each other but when it came to trains running in the same direction, the fact that each was ignorant of the whereabouts of the others made it impossible to devise rules to cover. About all that could be done was to require trains to keep a specified number of minutes apart based upon times shown in schedules and see that each train protected itself against following trains by flagging. As soon however as telegraph was available for communication between successive telegraph offices, the telegraph operators were able to find out what trains had passed the next office ahead and generally to keep in touch with movements in their vicinity. It was a natural development, therefore, for rules to be devised to require the operator to hold trains at his station until trains ahead had passed the next station or to warn trains when passing his station that there was a train ahead. On many railways this use of a telegraph block was all that seemed necessary because the requirement that inferior trains clear the line for opposing superior trains provided all the safeguards required for safe operation.

CONCEPT OF ABSOLUTE BLOCK

On many other railways, however, it was decided that the new telegraph block system should be used to provide the greatest possible degree of safety and the

concept of 'absolute block' was developed. Absolute block came to mean a 'block from which all but one train were excluded'. The idea finally took the shape that absolute block would be used on single track as related to opposing trains and on single and double tracks as related to trains following passenger trains. On both single and double lines it was not applied to trains following goods trains but the following trains were required to proceed with caution when they were advised that there was a train in the block. Thus emerged in the 1860s a set of principles for a telegraph block system, which, although unsatisfactory in some respects and not providing all the safeguards desired, was the best that could be devised with telegraph as the sole means of communication. In view of the fact that the length of trains was short, movements were made at low speeds and leisurely, that station masters at almost every crossing station acted as block operators during their duty hours and there were exceptions in the rules to cover lack of communication, the new telegraph block system worked pretty well in the beginning. But when telephones became available, the modern manual block system came into its own. Telephones were substituted for telegraph between block stations and between them and dispatchers, but much more important, telephones connected with the block stations were installed at all points where trains would require them to obtain permission conveniently to do many things which, under the old telegraph system train crews had to handle without contact with anyone else. One of the important improvements of this kind was the practice requiring that passenger trains would not follow other trains in a block. By the time the new telephone operated manual block system had become available, conditions as to length of trains, train speed and many other things, had so changed that the new system rapidly supplanted the old telegraph block. But in some countries in the Far East like Indonesia, the telegraph block is still in use even on main lines and as a result of years of practice and excellent discipline on the part of staff, the railways are able to run a surprisingly large number of trains with very few accidents.

AUTOMATIC BLOCK SYSTEM

Even before the telephone block system described above had assumed the final form, the railways were developing an automatic block system. In fact this development started about 1800 on the Pennsylvania Railway. As was the case with the development of manual block it was assumed that the new block system would supplement the superiority of trains.

This assumption is valid today except that where automatic block signals are arranged and their operations are guarded in accordance with quite restrictive requisites, they are used to supersede superiority of trains in a system called the Centralised Traffic Control (C. T. C.) which will be described later in this article.

The new automatic block system progressed by a number of steps and many different methods had to be tried out and discarded before the present standard system was finally adopted. Suffice it to say, the underlying principles follow those of manual block with some exceptions where safeguards inherent in the system take the place of more cumbersome ones; for example, the shorter blocks and requirement that trains must stop before entering occupied blocks made unnecessary the continuance of absolute block.

The Automatic Block System is a series of blocks defined by automatic block signals whose indications govern trains upon entering and moving within the block. The block signals usually may display any one of three different signals: Clear, Approach or Stop-and-proceed.

The clear signal means that the block is clear and that the next signal is either Clear or Approach. In other words, it shows that at least two blocks ahead are clear.

The approach signal means that the next signal is Stop-and-proceed and that the next block is occupied. Trains receiving an Approach signal must reduce speed to one-half the speed authorised for passenger trains but not exceeding 30 m. p. h. and approach the next signal prepared to stop.

The Stop-and-approach signal means that the block section ahead of it is occupied by a train or that a point is occupied by a train or that a point is improperly set or that a rail is broken. Trains must stop and then proceed at not exceeding 20 m. p. h. looking out for the conditions described.

The signals are controlled electrically by a current of electricity in the rails or by the absence of current in the rails. This current in the rails is carried by a track circuit. When the current is flowing, it affects certain relays which operate a separate current which holds the signal to show clear unless the next signal in advance is stop-and-proceed, when it will show Approach. This is accomplished by connecting

together each succeeding pair of signals with an electrical pair of signals with an electrical circuit so that when one signal displays stop-and-proceed, the first signal in the rear will display Approach.

The most important characteristic of the track circuit is that it is arranged so that if the flow of current in the track is interrupted, the signal at the entrance of the block section immediately displays Stop-and-proceed. In like manner, this 'fail-safe' principle applies to the arrangement of circuits between each pair of signals so that if the circuit is broken the signals display their most restrictive indication.

Thus, if the track circuit is shunted through the wheels of engines or carriages or a point is open or a rail broken, there is no current flowing back to the signal at the entrance of the block and therefore nothing to hold the signal at proceed, it immediately displays Stop-and-proceed.

CENTRALISED TRAFFIC CONTROL

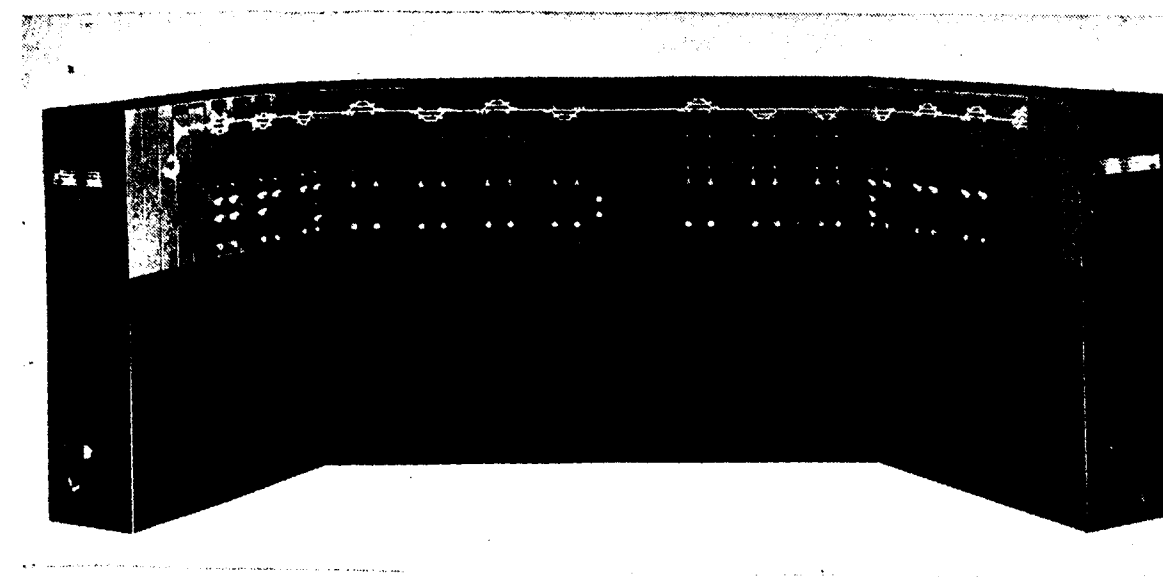
Centralised Traffic Control is the most modern method of train operation and enables long stretches of track to be under the direct control of a single dispatcher. He has continuous visual indication of the position of trains, points and signals and operates all points and signals himself as required. This undoubtedly produces the highest possible capacity on the single line but the installation is very expensive as it

necessitates continuous track circuiting or axle counters, electrically operated signals and similarly operated or released points. The controlling circuits and apparatus are complex and a steady power supply is essential. The cost of installing C. T. C. can only be justified as an alternative to doubling a line which has reached its saturation point.

C. T. C. has been claimed by many to be among the outstanding developments in the railway field. One, two or more tracks can be signalled in both directions and there is no established current of traffic on a double line with C. T. C. Trains may be run on either track in either direction.

Instead of trying to remember a lot of rules, the driver need obey only the indications of signals which he gets just prior to and near the point of execution. In other words, he gets his orders by signal indication at the time and place where they are to be executed.

The circuits are so arranged that should the dispatcher err and attempt to authorise conflicting movements, the machine will not function. In the same manner, should a train disregard signal indication and overrun a signal, stop signals are automatically displayed in advance for opposing movements to prevent a collision. As the entire track is track-circuited, any portion of a train left behind in a section in case of a parting will prevent the section from being cleared and signals taken off for another train. The system is, therefore, one of the safest in the world.



Centralised Traffic Control Machine.



Control desk in new signal box at Camden Town Station, London Transport.
(Photo courtesy: London Transport Executive)

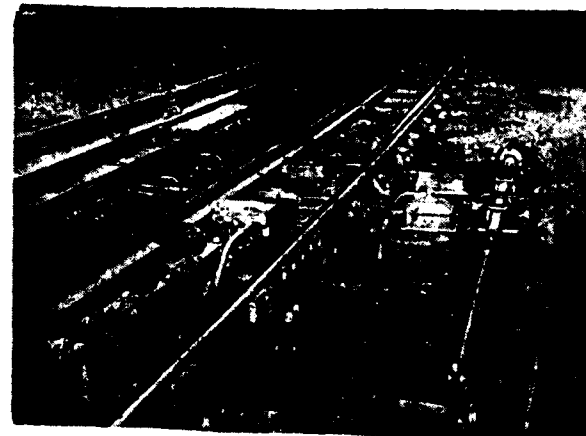
the trains is sent forward by the signalman at the last junction point, for example Kennington, in the case of northbound trains. The descriptions are stored at wayside stations, for operating the platform signs, and at Camden Town for both platform signs and interlocking apparatus.

TRACK CIRCUIT OPERATION

For example, consider two trains approaching the junction one after the other, from Charing Cross. The destination of the first is Edgware, the second High Barnet. The junction points and signals are already set for the Edgware line. The first train having arrived, the operation of the track circuits cancels off the first train description and the second, for High Barnet, appears. This sets the points for the High Barnet line and clears the signals. This system

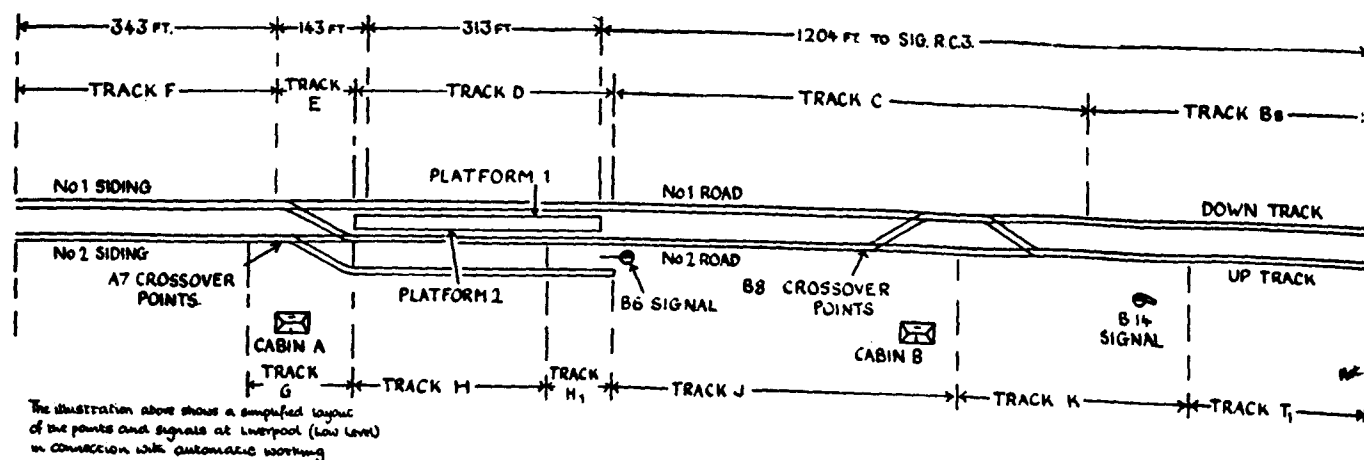
of signalling and interlocking is the first of its kind in the country and it is novel and ingenious.

The first installation of automatic points in the United Kingdom, and perhaps the world, was put down at Liverpool (Low Level) Station, Mersey Railway, and handed over to traffic on February 4, 1923. Until quite recently this remained the only example of such working in the country and the layout and operation is the same today as when it was installed. Automatic signalling had already been installed between Liverpool (Low Level) and Hamilton Square (Mersey Railway) but mechanical signalling remained at Liverpool (Low Level) with "SYX" lock and



Electro-pneumatic facing point lock and driving mechanism on No. B 8 Crossover (facing end) at Liverpool (low level) station, Mersey Railway. This equipment is provided with an electric lock on the locking plunger which locks the points through an independent circuit when a train is passing over them.

(Photo courtesy: Westinghouse Brake & Signal Co. Ltd.)



block signalling between A and B signal boxes. In order to meet traffic requirements it was decided to completely track circuit Liverpool (Low Level) and provide power-operated signals and points. It was also resolved to automatically operate a crossover and catchpoints, electro-pneumatic operation being adopted. The layout of the station, and position of points and signals is shown in diagram and operations are as follows:

No. B 8 crossover points automatically throw from the normal to the reverse position when a train arrives at No. 2 platform, i. e. when occupying H and H. 1 track circuits, and track circuits J, K, C, and D are clear, and provided that the down line is clear up to and including track circuit A. c. (the overlap track circuit to James Street down home signal), signal B. 6 display a green aspect. The crossover points revert to the normal position as soon as a departing train has cleared C track circuit, and providing the track circuits, K, J, C, D, H, and H. 1 are unoccupied, Signal B. 14 shows a green light. When a train is standing at No. 1 platform, i. e. on D track circuit, the automatic working of No. B. 8 crossover cannot be used.

All running signals concerned with the automatic working are provided with automatic train stops, electro-pneumatically operated, so that a train overrunning a danger signal is stopped independent of any action on the driver's part. For the purpose of switching in and switching out the automatic working of A. 7 and B. 8 crossover special levers are installed in signal boxes A and B.

The Waterloo and City Tube railway, part of the Southern Region of British Railways, installed automatic point operation at the Bank Station when the line was modernised towards the end of the Second World War. The original signal box at the Bank was abolished and panel apparatus installed in a new relay interlocking room near by. This installation can be worked by hand at any time should circumstances necessitate, but is normally arranged so that the crossovers and signals work automatically as trains arrive and depart. A three-position master switch on the panel selects the type of automatic working required. When it is turned to the left No. 2 platform line only is in use. One minute after an incoming train has passed into it, clear of the crossover road, the points reverse and the starting signal clears, provided of course that the section of line which that signal governs is clear. When the

(Continued on page 16)

A
CENTURY OF

EXPERIENCE

IN

WIRE ROPES

AND

GENERAL CORDAGE

DIXON CORBITT LTD.

GATESHEAD-ON-TYNE
ENGLAND

(ESTABLISHED 1840)

Messrs. J. C. Coondoo & Sons,
22, Raja Woodmunt Street,
CALCUTTA, INDIA.

Telegram: "IRONMONGER"

Telephone: Bank 3548



Section Controller's Desk—British Railways.

This is one of the reasons why even the British Rail-

ways, which are among the most conservative railway systems, have included the provision of C. T. C. in their modernisation plan.

CONCLUSION

Railway systems must keep abreast of the latest developments in the field of railways signalling and replace their out-moded appliances to increase their line capacity without enormous capital out-lay. The Indian Railways are already investigating the possibility of introducing 'tokenless block' on congested single-line sections and also the provision of controlled manual block on the lines of the system obtaining in Japan. The proposal to have C. T. C. on heavily worked single-line sections has also not been given up completely and may be revived when the foreign exchange position of the country improves.

PROMPT DELIVERY AVAILABLE

OF

"DALMIA" SPUN IRON PIPES

Conforming to B.S.S. No. 1211 of 1958 Plain Spigot and Common Socket Joints with centring ring range of 6" to 24" nominal bore in 18' lengths in B, C and D Classes.

Local and Export Enquiries solicited :—

DALMIA IRON & STEEL LTD.,

Stephen House, 4, Dalhousie Square,

CALCUTTA-1

Phone : 23-5192

Gram : DALMIAIRON

AUTOMATIC OPERATION OF RAILWAY FACING POINTS

By H. C. Towers, M.I.E.E., M.I.R.S.E., M.Inst.T.

A train identification system has been developed by The Union Switch and Signal Company of the USA. With this system trains can identify themselves and their location for the purpose of setting automatically junction facing points as the train approaches them or alternatively operating platform destination signs. The apparatus was primarily designed for use on rapid transit railways but it can be used on other types of railways and with any type of power or automatic signalling. Known as the Indentra system it operates on the inductive principle and no power supply or moving apparatus is carried on the train. Train-carried equipment consists of an inert turned coil so mounted on the car or locomotive that it is inductively coupled with wayside coils when passing track locations. Means of quickly changing the identity of the tuned coil attached to the train are provided.

WAYSIDE EQUIPMENT

Equipment at the side of the line includes coils at each location where trains are to be identified mounted to inductively couple with the train coil as the train passes the location. The wayside coils are connected by cables to electronic equipment housed in a case at the wayside location. This equipment consists of a power supply unit, amplifier unit, frequency selective network unit for each identification frequency and is plug connected and mounted on a shock-resisting rack. Each selective network is provided with high speed relay which is used to initiate the desired functions. When the inert coil carried by the train encounters the inductive field of the wayside coils, an amplifier operates at a frequency determined by the tuning of the train-carried coil. This oscillation frequency is "identified" by an appropriate frequency selective network and a corresponding relay is energised. The system operates at any train speeds and in all kinds of weather.

No system of this type has yet been introduced in this country but quite recently London Transport

introduced something not far short of it with the closing of the old Camden Town signal box. At this junction southbound Northern Line trains are routed to Morden via Bank or Charing Cross and northbound trains to Edgware or High Barnet. The new installation is a development of an entirely different method of remote control which was introduced shortly after the end of the war.

There are systems where an area could be remotely controlled from one central cabin but in case of emergency part of the area could be controlled on the spot. In such cases an ordinary power frame is provided which works as a slave to the central frame. For example, if a movement had to be performed from the central frame the appropriate levers would be operated and similar levers in the slave frame would also respond, these levers actually controlling the signal and point circuit. Each lever on the slave frame is fitted with tiny air motors one for reversing the lever and the other for setting it to normal. Each motor is controlled by an electric air valve. The electrical control comes from the lever in the central frame. If the slave is required to be operated by hand, a switch disconnects the control from the main power frame and a cock turns off the compressed air to the miniature lever motors.

This system was followed by an entirely new one, which, although dispensing with the power frame as a source of operation, has not utilised either a panel or console as used on the main line railways. This installation is at Ealing Broadway where both the Central and District Lines terminate. The Central Line has two platforms, the District three and there are some stabling sidings. The original signalling comprised an electro-mechanical frame for the District Line signalling and in the same box a power frame for the operation of the Central Line signalling. Generally two signalmen have been employed for these two frames. Modernisation had become necessary and a new cabin was constructed. The signal box is equipped with the usual strip light diagram but in place of a lever frame or a panel with thumb switches, a control desk equipped with push buttons has been

provided. The layout of the control desk is such that it can be operated by one signaller seated in a chair and all operations can be carried out without moving from his seat.

PUSH BUTTON OPERATION

An important feature of the push button operation is that the buttons automatically return to their normal positions after being pushed and, therefore, the signaller's effort, both physical and mental, is appreciably reduced. Only one operation of the push button is necessary to replace it which is not the case if a lever or thumb switch is employed. The push button operation is carried out on the route system so that a minimum number of buttons have to be pushed for each train movement. Pre-selection is provided for on all push buttons and it is always possible for the signaller to operate buttons for a route ahead of the train movement actually taking place. This has two features. One results in elimination of the signaller's operating time so far as traffic movement is concerned. The signaller pre-sets the next movement prior to the completion of the train movement already in hand and the setting of the points for the clearing of the signal then becomes entirely automatic, the time occupied being only that for actually throwing the points and clearing the signal after the appropriate fouling tracks are cleared.

MENTAL EFFORT REDUCED

The other advantage is a distinct reduction in the mental effort demanded of the signaller as he is not required to remain in a state of mental tension to operate the buttons within a split second of track circuits clearing. He can, with care and deliberation decide what the next movement shall be, and operate the buttons accordingly. The buttons have been specially designed and act as a visual indicator. They are made of Perspex and by arranging three coloured lamps below, can be illuminated in either red, green or yellow. The red illumination of the button indicates to the signaller that the route is normal; yellow illumination shows that the route has been pre-selected but that it is waiting for the clearing of fouling tracks before the route can be set up and the signal cleared; and green indicates that the route has been correctly set and that the signal is clear. The buttons are provided with two movements, one being the press movement, which is all that is usually

required but in addition the button can be pulled, this being purely an emergency operation for use should the signaller require to replace a signal to danger after he has set a route.

The control circuits follow the arrangements which have been used in several previous installations on London Transport, adopting the power-operated lever system described earlier. A power frame with mechanical interlocking is installed at the end of the relay room on the ground floor of the signal box building. Access is provided to the levers of this frame by the operating staff so that, in the event of a failure of any of the control circuits, the actual levers can be manipulated. Provision is made on the desk for automatic working of the two bay roads used for the reversing of the Central Line trains. There are three choices, all trains reverse in one or the other, and trains reverse alternatively. An automatic time recording clock is provided for this service which stamps the time of departure of trains by printing figures on a strip of paper.

The new remote control system was taken a stage further with the closing of Aldersgate signal box on the circle line and the remote control of this interlocking from Farringdon. Instead of using a remotely-controlled power frame at Aldersgate an entirely new arrangement was provided termed an interlocking machine. Although it contains all the features of the power frame it is fixed vertically against the wall. The shafts bearing the contacts for the various circuits are operated by the air cylinders which are at the bottom. The electric locks are fixed at the top of the shafts with the electric contacts and mechanical locking in between. Each shaft is provided with a small handle so that the machine can be operated manually in cases of emergency. An illuminated diagram is provided on which the position of all trains can be seen. At Farringdon, the control panel containing the push buttons operating the interlocking machine at Aldersgate, is also fixed vertically, immediately beneath the illustrated track diagram.

The new route control arrangement at Camden Town junction has three of these new interlocking machines controlled from a push button panel. The panel is normally out of use, arrangements being provided for the signalling and interlocking to function automatically. Manual operation is only resorted to in cases of emergency. The junction points are set automatically, according to information received by the train description apparatus. The description of



**Machine for burnishing
axle journals
type TBG and TBG/U**

Rafamet have many years experience in the construction of heavy special purpose machines for railway workshops.
Rafamet supply machine tools for all types of wheels sets.
Rafamet guarantee full and prompt service to customers.
1000 Rafamet - machines are working in numerous railway workshops and repair shops all over the world production programme.
Semi-automatic lathes for machining railway wheel sets.
Special boring and turning mills for tyres and wheel centres.
Machines for burnishing axle journals and burnishing attachments to be used with universal lathes for machining locomotive piston rods and short shafts.
Heavy universal boring and turning mills.
Special purpose machines for the production of axles for wheel sets of all types.
Machines for metallurgical works.



Sole Exporters
METAEXPORT
Poland, Warszawa, P.O. Box 442
Telegrams: METALEX WARSZAWA

For particulars please apply to Agents

THE EAST ASIATIC CO. (INDIA) PRIVATE LTD.

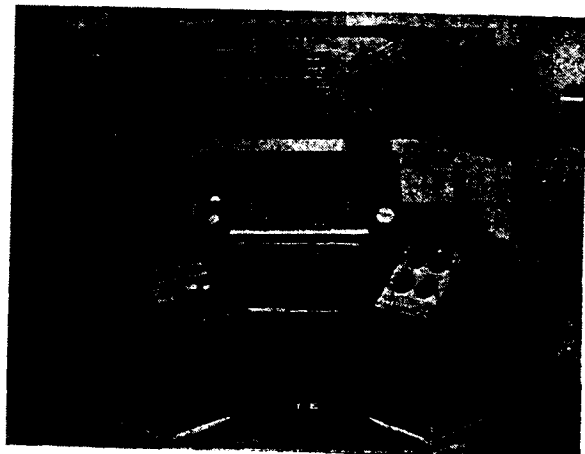
BOMBAY
Shree Nivas House,
Waudby Road

MADRAS
Bharat Building,
Mount Road

NEW DELHI
Delite Cinema Building,
P. O. Box 656

SECUNDERABAD
Jeera Corner,
Rashtrapathi Road

BANGALORE
42, Silver Jubilee Park
Road



Control desk in new signal box at Camden Town Station, London Transport.
(Photo courtesy: London Transport Executive)

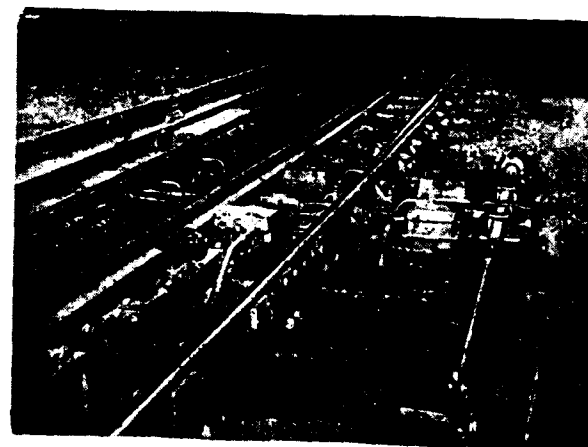
the trains is sent forward by the signalman at the last junction point, for example Kennington, in the case of northbound trains. The descriptions are stored at wayside stations, for operating the platform signs, and at Camden Town for both platform signs and interlocking apparatus.

TRACK CIRCUIT OPERATION

For example, consider two trains approaching the junction one after the other, from Charing Cross. The destination of the first is Edgware, the second High Barnet. The junction points and signals are already set for the Edgware line. The first train having arrived, the operation of the track circuits cancels off the first train description and the second, for High Barnet, appears. This sets the points for the High Barnet line and clears the signals. This system

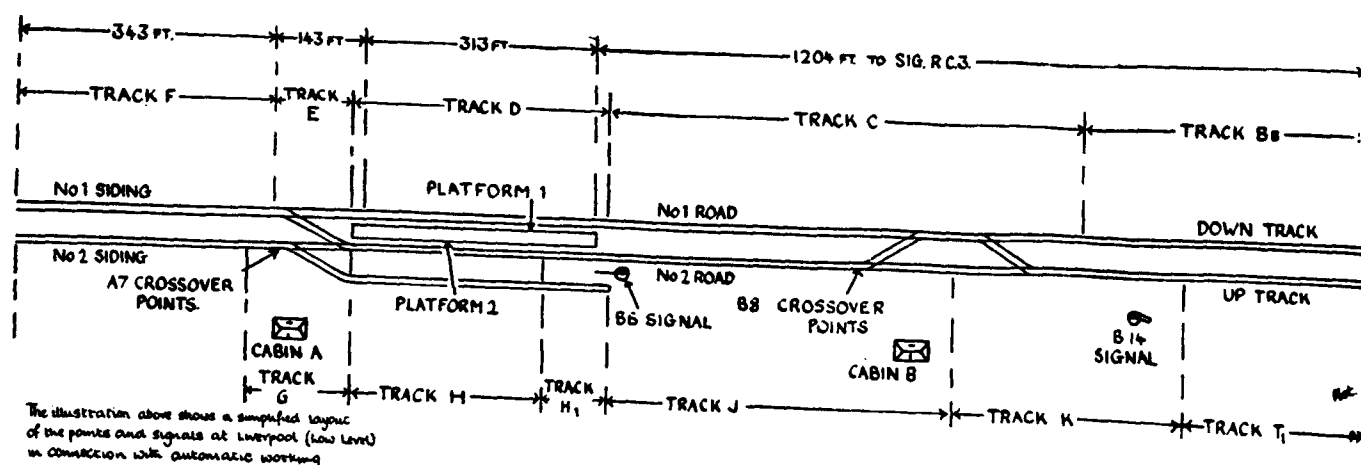
of signalling and interlocking is the first of its kind in the country and it is novel and ingenious.

The first installation of automatic points in the United Kingdom, and perhaps the world, was put down at Liverpool (Low Level) Station, Mersey Railway, and handed over to traffic on February 4, 1923. Until quite recently this remained the only example of such working in the country and the layout and operation is the same today as when it was installed. Automatic signalling had already been installed between Liverpool (Low Level) and Hamilton Square (Mersey Railway) but mechanical signalling remained at Liverpool (Low Level) with "SYX" lock and



Electro-pneumatic facing point lock and driving mechanism on No. B 8 Crossover (facing end) at Liverpool (low level) station, Mersey Railway. This equipment is provided with an electric lock on the locking plunger which locks the points through an independent circuit when a train is passing over them.

(Photo courtesy: Westinghouse Brake & Signal Co. Ltd.)



The illustration above shows a simplified layout of the points and signals at Liverpool (Low Level) in connection with automatic working.

block signalling between A and B signal boxes. In order to meet traffic requirements it was decided to completely track circuit Liverpool (Low Level) and provide power-operated signals and points. It was also resolved to automatically operate a crossover and catchpoints, electro-pneumatic operation being adopted. The layout of the station, and position of points and signals is shown in diagram and operations are as follows:

No. B 8 crossover points automatically throw from the normal to the reverse position when a train arrives at No. 2 platform, i.e. when occupying H and H. 1 track circuits, and track circuits J, K, C, and D are clear, and provided that the down line is clear up to and including track circuit A.c. (the overlap track circuit to James Street down home signal), signal B. 6 display a green aspect. The crossover points revert to the normal position as soon as a departing train has cleared C track circuit, and providing the track circuits, K, J, C, D, H, and H. 1 are unoccupied, Signal B. 14 shows a green light. When a train is standing at No. 1 platform, i.e. on D track circuit, the automatic working of No. B. 8 crossover cannot be used.

All running signals concerned with the automatic working are provided with automatic train stops, electro-pneumatically operated, so that a train overrunning a danger signal is stopped independent of any action on the driver's part. For the purpose of switching in and switching out the automatic working of A. 7 and B. 8 crossover special levers are installed in signal boxes A and B.

The Waterloo and City Tube railway, part of the Southern Region of British Railways, installed automatic point operation at the Bank Station when the line was modernised towards the end of the Second World War. The original signal box at the Bank was abolished and panel apparatus installed in a new relay interlocking room near by. This installation can be worked by hand at any time should circumstances necessitate, but is normally arranged so that the crossovers and signals work automatically as trains arrive and depart. A three-position master switch on the panel selects the type of automatic working required. When it is turned to the left No. 2 platform line only is in use. One minute after an incoming train has passed into it, clear of the crossover road, the points reverse and the starting signal clears, provided of course that the section of line which that signal governs is clear. When the

(Continued on page 16)

A
CENTURY OF
EXPERIENCE

IN

WIRE ROPES

AND

GENERAL CORDAGE

DIXON CORBITT LTD.

GATESHEAD-ON-TYNE

ENGLAND

(ESTABLISHED 1840)

Messrs. J. C. Coondoo & Sons,
22, Raja Woodmunt Street,
CALCUTTA, INDIA.

Telegram: "IRONMONGER"

Telephone: Bank 3548

45 NEW NOHAB-GM LOCOMOTIVES TO THE DANISH STATE RAILWAYS

AS may have been seen in the press the Danish State Railways have for a long time planned to procure diesel-electric locomotives of a new type.

After having obtained a loan from abroad, the pre-requisite conditions were reached for the purchase of a large number of locomotives of this type, and after long negotiations with the companies interested including their workers, etc., the Danish State Railways have signed a contract with Nydqvist & Holm Aktiebolag (NOHAB), Trollhattan. According to this, 45 diesel-electric locomotives will be delivered, which have been given the type designation MX No. 1001-1045.

The result of the MY locomotives (the NOHAB-GM locomotives previously delivered) during 5 years service was so satisfactory that it was natural to choose the same contractor for the MX locomotives as for the previous MY locomotives. To this can be added the great advantage of the two types of loco-

motive getting a large number of common spare parts. There is further the importance of securing the most modern foreign design, and at the same time Danish subcontractors are participating in the delivery.

The MX locomotives will be built with diesel engines and electric equipment from General Motors, USA. Main generators and traction motors will be delivered by Thomas B. Thrige, Odense, Denmark, these electric machines being manufactured on licence from General Motors according to American stipulations and standards. The diesel engines are of the 567C type, as for the MY locomotives, but with 12 cylinders instead of 16, the motive power thereby being 1425 HP, instead of the 1950 HP for the MY locomotives.

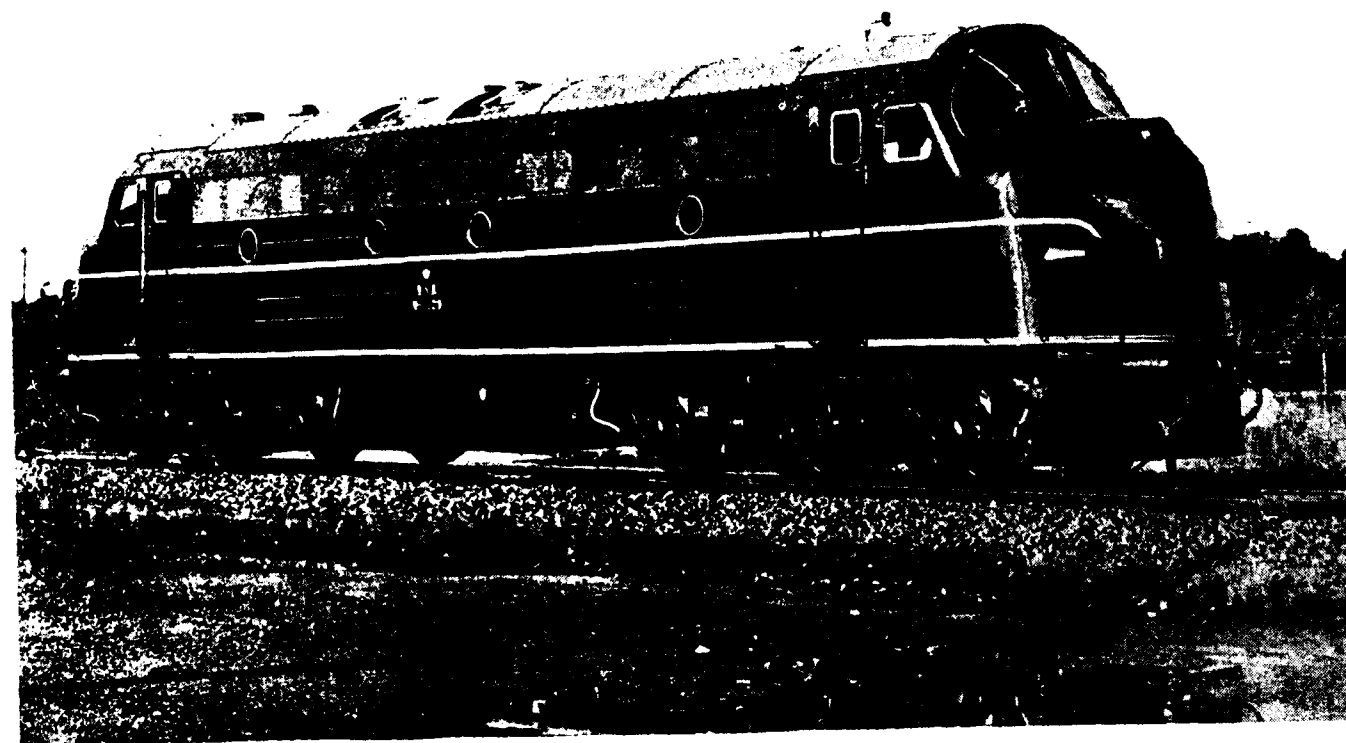
In the same way as for the MY locomotives, A/S Frichs, Aarhus, Denmark, will build the bogies and the essential part of the superstructure. The total weight of the locomotive with tanks holding 2800 lit. of fuel oil and 2800 lit. of water for heating, will be

(Continued from page 15)

train has left and passed completely over to the down line the points are restored to normal and the home signal is again cleared for the next up train. This sequence continues as long as the master switch remains in the left hand position. Should it be turned to the right then both platform lines are brought into use, the sequences of automatic movements being similar in principle to those just described, except that after a train has arrived in No. 2 line the next is admitted into No. 1, after which the train in No. 2 line is signalled out, and so on. Manual working is thus only necessary when it is desired to depart from the automatic sequence. The panel also has an emergency push button, which will put all the Bank signals and train stops to danger, should some mishap or irregularity require it.

The alternative platform working has been provided to facilitate handling of traffic under differing conditions of morning and evening peak periods. During the former, the main flow of passengers is towards the Bank and No. 2 platform only is used, as the short time passengers take to detrain permits a train to

reverse and clear the station without checking the following one. During the non-peak hours this working is also satisfactory. For the homeward evening period both platforms are used, in order to ensure that a train is found waiting ready to receive passengers. The panel apparatus has a hinged cover over the thumb switch portion, which may be left closed while automatic working is in force, the illuminated diagram being then alone visible. There is single-stroke bell communication for both lines, with the usual telephone facilities. To guard against the remote contingency of a point mechanism control valve being operated irregularly the drive rod of the mechanism is locked by a plunger controlled by an entirely separate circuit. This safety feature is also installed on the automatic points at Liverpool (Low Level) station. Should a signal lamp fail, or a signal itself not go to danger behind a train, or a train stop fail to return to the tripping position, the signal in the rear is held at danger until the fault is rectified or the section ahead of the failed apparatus is proved clear also. Train stop and point mechanisms are of the latest compact design used on other London tube lines.



One of the NOHAB-GM diesel-electric locomotives delivered to the Danish State Railways

Repeat orders for NOHAB-GM locomotives

They pay for themselves within 3 years

NOHAB-GM diesel-electric locomotives, delivered to the Danish State Railways, showed savings amounting to £ 35,300 per locomotive per year, compared with steam locomotives. According to the latest figures obtained from the Danish State Railways regarding the 44 locomotives we have delivered the savings on the fuel budget alone have been approximately £ 25,000 per locomotive per year.

NOHAB has collaborated for several years with General Motors, USA, in the production of diesel-electric locomotives.

Repeat orders

Thanks to the good results obtained with the NOHAB-GM diesel-electric locomotives on the Danish State Railways we have received repeat orders. The latest order was given in February this year and was for not less than 45 locomotives of a somewhat smaller size than those, previously delivered. The new locomotives will have an output of 1425 HP, and the weight in working order will be 89 metric tons.

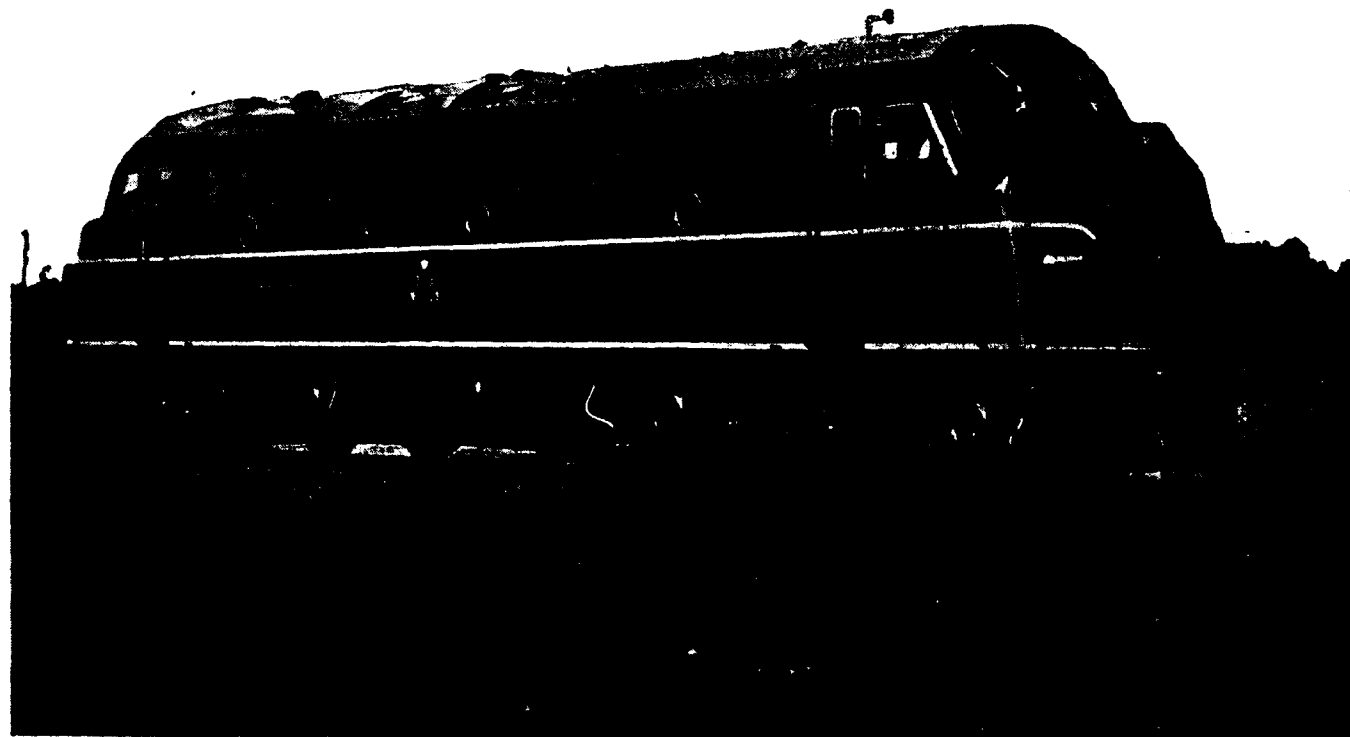
Delivery

The locomotives now ordered will be delivered during the years 1960-1962.



NYDQVIST & HOLM AKTIEBOLAG

TROLLHÄTTAN • SWEDEN • Cables: NOHAB • Telex: 5284 • Telephone: 180 00



A 1950 HP NOHAB-GM diesel-electric locomotive, delivered to the Danish State Railways.



Manufacturing NOHAB-GM diesel-electric locomotives in NOHAB's shops.

about 89 metric tons, and the axle load for the driving shafts of the 3-axle bogies will be 16 tons.

The MX locomotives are designed with two driver's cabs and with front parts of the same shape as those of the MY locomotives. SKF journal bearings are being used and the locomotives are being equipped with automatic steam heating system from Vapor International in USA. The Danish electric industry will be allotted certain deliveries beyond those mentioned above.

The contract price per locomotive is about 1.4 million Danish Crowns and the payment is divided up in the following manner: About 28% to be paid in Swedish Currency, about 34% in US dollars, and about 38% will be paid to Danish firms. The contract covers also various spare parts (spare bogies etc.) for which payment is mainly made to Danish firms.

The first locomotive will be delivered in August 1960, and the whole delivery is to be completed by the end of June 1962.

The MY locomotives have already superseded the main part of the steam locomotives in the daily traffic on the Danish State Railways' (DSB's) main lines. When the MX locomotives in the course of a few years begin to be put into service, the development will take place as on the DSB's other lines.

For the management of the State Railways it is a great satisfaction that the authorities have shown such a readiness to meet the State Railways' wishes for modernization of the railway traffic that the above-mentioned procurement of locomotives can be accomplished within a relatively short space of time. The new MX locomotives will mean a considerable advantage for the traffic, owing to the superior tractive effort of these locomotives, as compared with that of the steam locomotives which they are going to replace. They will further contribute to great savings in the service with regard to fuel expenses.

THE GROWTH OF THE NATION'S LIFE-LINE

By P. C. Mukerjee
Chairman, Railway Board.

Since the turn of the present century, more particularly since the end of the last war and the achievement of independence, the work of the Railway Ministry has grown out of recognition. The size of operations has multiplied in all directions. In this article, the top executive of the Indian railways has highlighted a few aspects of the railway system where the developments have been most significant.

BY 1903, the Indian railways had spread over the country covering 27,000 route miles in undivided India. This gave an average of 540 miles of new line construction per year in the first 50 years since the railways in this country were established, construction being done by a number of private companies as well as some Indian States, the former being guaranteed interest on capital on behalf of the Central Government.

Naturally, the private companies connected mostly centres of activity where there was possibility of traffic. In undertaking the construction of these lines practically all the equipment had to be obtained through imports—rails, fastenings, girders, carriages, wagons, locomotives, etc.

Since the turn of the present century, but more particularly since the end of the last war and the achievement of independence, the work of the Ministry of Railways has grown virtually out of recognition. Up to 1925, the Government of India managed only three Railways—the Eastern Bengal, the North Western and the O. & R. Railways, with a total route mileage of 9,000. By 1950, all the railways including those of the Princely States had been brought under Government management and, even though 7,000 miles of the old undivided Indian railway system had gone to Pakistan, the Indian Government had to be responsible for the management of 34,000 miles of railways.

PUBLIC INTEREST IN RAILWAYS

It is gratifying that the interest displayed by the public in the working of the railways has continually been growing; evidence of this is found in Parliament. While in 1948 the number of questions answered on railway subjects was only 271, the figure rose in 1958 to 1928—more than sevenfold. This number is approximately one-ninth of all the questions answered in Parliament in 1957/58 on behalf of all the



Shri P. C. Mukerjee

23 Ministries and Departments at the Centre.

Similarly, correspondence as gauged by receipts in the Railway Board's office stood at 543 receipts per day in 1952, and increased more than five times to 1,710 per day in 1958.

HOW RAILWAYS HAVE GROWN

Enough has been said about the railways' two Five

Year Plans to call for detailed comments here. The need for increasing rail capacity has been urgent, and much has been done during the first Plan and the second Plan so far. The developments that have occurred can best be summed up in the following figures :

CLASS I/GOVERNMENT RAILWAYS					
	1938-39	1948-49	1951-52	1956-57	1957-58
Works Machinery and Rolling Stock Programme (crores of rupees)	9.41	54.01	59.08	178.95	250.66
Total Staff	6,41,099	8,56,795	9,23,069	10,56,692	11,11,026
Total gross receipts (crores of rupees)	103.5	225.7	291.8	348.9	381.4
Total working expenses (crores of rupees)	68.8	178.0	225.8	278.8	309.3
Tons originating (million)	84.4	78.5	96.7	124.1	132.1
Ton miles (million)	21,878	22,387	28,966	40,186	44,861
Passengers originating (million)	499	1,114	1,204	1,360	1,410
Passenger miles (million)	17,988	37,129	39,030	41,878	43,043
Total stores purchases (crores of rupees)	9.38	100.4	97.7	171.4	221.8

Rolling Stock as on 31st March :

No. of locomotives	7,919	7,761	8,411	9,601	10,025
No. of passenger carriages (units)	16,620	12,665	14,486	17,402	17,599
No. of wagons including special wagons (units)	205,017	198,863	206,496	256,076	275,970

RESEARCH DESIGN AND TECHNICAL DEVELOPMENT

Side by side with all this increase in the activities of the railways, there has been a significant change in another direction. A reversal of trend has taken place from a system under which most of the designing and supply of equipment came from abroad, and technical work in India was confined merely to the construction of lines and the maintenance and operation of the railways. The position has now radically altered. In consequence, the railways have had to concentrate on research, testing and standardization work to a far greater extent than before. They have had to undertake considerable new technical work, too.

It has not been possible to expand the research and designs organisation to the extent necessary because work of this nature calls for considerable experience. Care has also to be taken to confine research activities to matters of immediate necessity in order to make the best use of the limited trained manpower and money. Since it would be a waste of resources to undertake here work which is already being done in other countries, considerable attention is being paid to a study of the research and design work being done abroad in

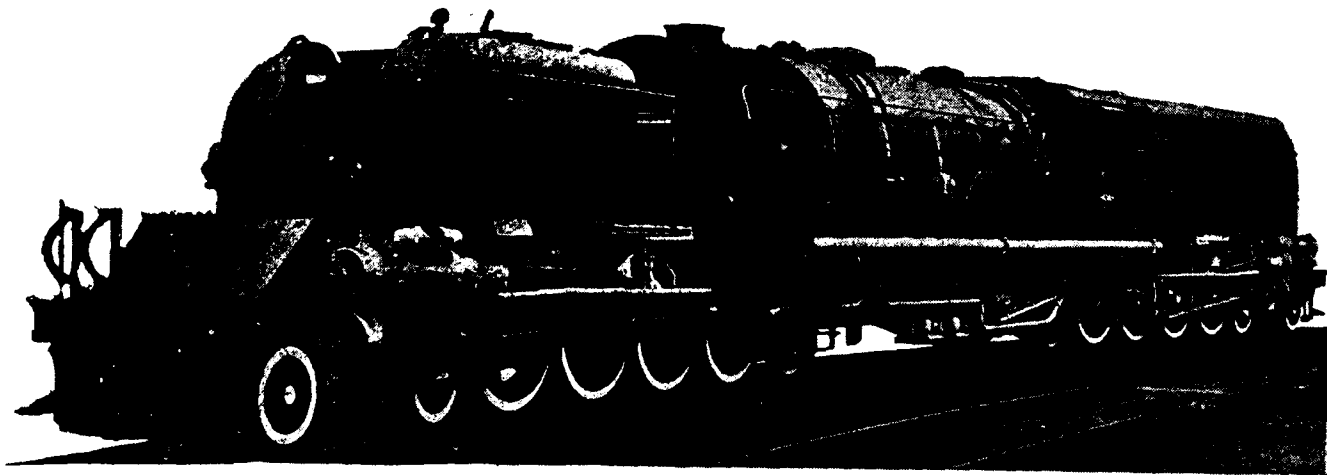
order to derive the maximum advantage from it.

SELF-SUFFICIENCY DRIVE BEARS FRUIT

The railways have also played a leading role in developing capacity for the manufacture of their requirements within the country. Items where increases have been most significant are :

Items	(lakhs of rupees)	
	1947-48	1957-58
Engineering plant and components	5.63	35.84
Workshop machinery and tools	7.70	89.65
Permanent way material	379.4	2400.9
Steam locomotives and parts	60.88	1359.23
Wagon underframes and parts	275.73	1450.64
Signalling equipment	15.6	201.9
Electrical, train lighting, telegraph and telephone equipment	33.37	735.46

MAXIMUM LINE CAPACITY
AT MINIMUM COST



A MODERN BEYER - GARRATT LOCOMOTIVE

MODERN BEYER - GARRATT LOCOMOTIVES are often the most economical form of motive power. They provide high and sustained tractive effort on local fuel.

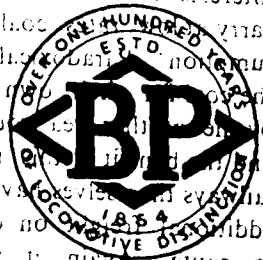
All refinements are incorporated, contributing to simple maintenance, which requires no special facilities and high availability is ensured.

BEYER - GARRATTS are an effective and relatively low-priced solution to operating problems. They are

BEST AND CHEAPEST IN THE LONG RUN

BEYER PEACOCK & CO. LTD.
MANCHESTER, ENGLAND.

Represented by:
QUEST, KEEN, WILLIAMS, LTD.
CALCUTTA BOMBAY MADRAS NEW DELHI



Notable work has been and is being accomplished in the field of long-term planning. Heavier wagons, more powerful locomotives, electrification, dieselisation, improved track standards—all these and many other types of work have been undertaken.

THIRD PLAN

The third Plan is yet to be formulated, but with even the very little that can be foreseen at this stage, it appears that an annual freight capacity of 260 million tons may be required to be built up by the end of 1965. The railway third Plan can be formulated in more precise terms only after a clearer picture is obtained of the major industrial and agricultural developments to be undertaken in the third Plan period.

There are vast tracts in the country which have still to be opened up. Most of the easier terrain having already been covered, new construction will largely be in the more difficult areas. It will, therefore, necessarily be costlier, even apart from the increases that have occurred in the costs of materials.

HAVE RAILWAYS OUTLIVED USEFULNESS?

Sometimes there is a feeling that the railways have outlived their usefulness. In the ultimate analysis, even in countries where rail capacity exceeds their needs, the railways are and will remain their lifelines. No large area can maintain its economic life without railways.

In India, such a feeling should not exist.

The pressing transport needs of a developing economy, combined with the need for spreading the benefits of this economy throughout the country, cannot be met without the railways.

The Indian railways help in many ways, may be not strictly commercial in nature, but in the larger interests of the country. For instance, the railways carry at low rates coal to the south for public consumption. Paradoxically, they have to carry some of the coal for their own use (by the Southern Railway) by the costlier sea route. Rail transport is cheaper and the benefit of this is given to the public, while the railways themselves have to pay about Rs. 3 crores in additional freight on carrying their own coal by the sea route. Again, it is well-known that the railway freight structure provides for special low rates for the transportation of industrial raw materials in the

larger interests of the national economy. These are but two instances of policies adopted by the railways in national interest, which cannot be expected from any other transportation organisation.

INDIAN RAILWAYS CHEAPEST

The Indian railways provide about the cheapest form of transport as will be apparent from the table below:

Average fare per passenger per mile and average rate charged per ton per mile on Indian and selected foreign railways 1956-57).

Railway	Average rate (pies)	
	Per Passr. mile	Per ton mile
Indian	5.33	11.3
British	15.5	33.9
Canadian National	29.1	13.9
Canadian Pacific	57.5	13.2
French National	21.4	27.0
German Federal	13.4	26.1
Italian State	11.1	18.0
Japanese National	5.4	11.2
Swedish State	18.8	24.7
Swiss Federal	17.2	48.1
U. S. Class I	24.5	12.7

Source: Annual Reports of Indian, British, Canadian National and Canadian Pacific, Japanese and U. S. Railways. Figures for other railways extracted from International Railway Statistics, 1956.

While comparing Indian figures with those of Japan or other industrially advanced countries, allowance should be made for the fact that there are many items of railway equipment which are still not made in this country. Steel supplies, too, have had to be imported to an appreciable extent. Imported items naturally raise the cost of transportation.

NEED FOR ECONOMICAL TRANSPORT

The need for providing transport in the most economical way can hardly be over-emphasised, as this has an important bearing on the economic development of the country. In many areas the railways will have to face big tasks in increasing capacity on some of the existing lines or in opening

up new lines. For all this, railwaymen must be suitably equipped so as to enable them to make the best use of modern technological advances.

In the past railway assets have been allowed a very much longer life than will be possible now or in the future. The changing pattern of traffic in a developing economy calls for yard alterations and remodeling and other line capacity works, and often buildings

have had to be removed to make room for new works. With heavier trains, electric or diesel locomotives, greater speeds, rail renewal programmes will also have to be accelerated.

DENSITY OF TRAFFIC

The following figures showing density of traffic will be read with interest:

CLASS I / GOVERNMENT RAILWAYS

	Density of traffic				
	1938-39	1948-49	1-52	1956-57	1957-58
Train miles per running track mile per day					
B. G.	13.8	14.9	17.1	19.5	20.0
M. G.	11.5	10.1	10.8	12.0	12.7
All gauges	12.3	13.0	14.0	15.5	16.1
Passenger miles per running track mile per annum					
B. G.	502,008	1,339,185	1,357,792	1,426,724	1,489,384
M. G.	403,145	863,581	821,360	841,785	816,698
All gauges	445,917	1,105,767	1,057,804	1,103,717	1,127,309
Net ton miles per running track mile per annum					
B. G.	749,287	1,023,160	1,304,043	1,726,828	1,902,756
M. G.	240,572	217,276	254,625	388,394	447,674
All gauges	542,359	666,736	785,422	1,059,109	1,174,935

NEED FOR TRAINED PERSONNEL

Rolling stock when it is used more intensively and at greater speeds will need greater attention. All this will result in replacement programmes having to be accelerated and a heavier load of work in maintenance and repairs. Due to all this the need for highly trained personnel will be increasingly felt.

The very heavy programme of work has imposed a severe strain on the resources of technical personnel for the execution of works. In earlier days, the average service of assistant officers before they were promoted to district ranks was 8 to 10 years in the

Traffic Department, 10 to 12 years in the Mechanical Engineering Department and 12 to 14 years in the Civil Engineering Department. The position now is that in many cases technical officers have to hold district and executive charges after barely 3 to 4 years of service as assistant officers in a working post.

Although in spite of this handicap the record of the railways in regard to the Plan targets is an enviable one, it would be desirable to plan ahead now so that future Plan requirements of technical personnel can be met with officers adequate in number and experience.

DOUBLING OF TWO RAIL SECTIONS APPROVED

The Planning Commission has approved the partial doubling of the Bina-Bhopal section of the Central Railway and the Anuppur-Katni section of the South Eastern Railway, a total aggregate length of just over 104 miles.

The doublings have become necessary due to the anticipated increase in the pressure of traffic on account of higher production in the central India coal-fields.

C.T.C.—a Means of Improving the Competitive Power of Railways

I BOBERG, LM ERICSSONS SIGNALAKTIEBOLAG, STOCKHOLM

The first C. T. C. (Centralized Traffic Control) system developed by L M Ericssons Signalaktiebolag in the middle 1930s employed rotary selectors. A new system based on relays alone, without any mechanical selectors, has since been designed by Signalbolaget. The system is described in this article, which also presents some points of view on the use of the C.T.C. system and the developments it has undergone up to the present time.

GENERAL

THE term C. T. C. (Centralized Traffic Control) originated in America, but is now generally accepted everywhere. It is defined by the Association of American Railroads as "a term applied to a system of railroad operation by means of which the movement of trains over routes and through blocks on a designated section of track or tracks is directed by signals controlled from a designated point requiring the use of train orders and without the superiority of trains."

The advantages of C. T. C. on a railroad system will be best appreciated by comparing the conditions where C. T. C. does not exist. It must be assumed, however, that there are local safety arrangements—interlocking plants at the stations and automatic blocks on the lines—since they are an essential factor in the use of C. T. C. Their purpose is to ensure the safety of railroad operation, which implies that a signal cannot be set to "Go" unless the route is free and the points are locked. The installation of C. T. C. neither adds to nor detracts from this primary safety condition.

Under the normal operations of a station's local interlocking plant, the station master is the person who passes a message to the train crew. The station master also issues communications in the form of written orders and timetables. If, however, as the situation is in Sweden, the train movements of an entire traffic region are under centralized supervision, the station master must contact the traffic dispatcher by telephone in any emergency such as delays, putting in an extra train etc. On the receipt of the station master's message, and from the graphic timetables and other information at his disposal, the dispatcher must assess the situation and decide what action is to be taken.

He communicates his decisions to the station masters at the stations concerned, who put them into effect by the operation of the interlocking plants and by written orders to the train crews on specially prepared forms.

This elaborate procedure may result in serious traffic delays. A station master may be unable to get through to the dispatcher at an early stage—the station master has other jobs to attend to as well, or the dispatcher may be engaged on another call. While the dispatcher is deciding what action to take, the situation may have changed to such an extent that his decision is in fact not the best one. Even when the dispatcher has arrived at a decision, he may have difficulty in getting into contact with the station masters. The station masters must then issue written orders, which involves extra delay. Thus even if there are no misunderstandings and no wrong action is taken, much time may be lost by ringing the trainmaster into the picture, and his action may prove to be inappropriate.

Under a C. T. C. system the C. T. C. office receives complete, immediate and continuous information regarding positions and categories of trains and, as far as is required, the states of points and signals. The dispatcher, whose place is taken to be in the C. T. C. office, is thus constantly in touch with the up-to-the-minute traffic situation and can plan the necessary action in good time. The dispatcher's decisions can be carried into immediate effect without being passed through subordinates. Apart from the direct saving of time in the receipt of information and carrying out orders, C. T. C. enables the dispatcher to make better decisions, resulting in an additional saving of time.

The time saving afforded by C. T. C. implies fewer and shorter stops for trains and, consequently, greater average speeds, furthermore a greater traffic capacity.

Model railway with

C.T.C.



LM ERICSSONS
SIGNALAKTIEBOLAG

Represented by:

ERICSSON TELEPHONE SALES CORPORATION AB

(Incorporated in Sweden with limited liability)

P. O. B. 669
NEW DELHI

P. O. B. 2324
CALCUTTA

16, Old Custom House Road,
FORT, BOMBAY

L M Ericsson has delivered a model railway equipped with signalling and CTC to the Railway Staff College at Baroda. The railway has three stations and each station has a relay interlocking plant. Between the stations there is an automatic block system. The signalling for the whole railway is controlled from a "CTC office".

The CTC has a keyset and a track diagram. The CTC operator sends controls to the stations by punching a 4-digit number on the keyset and he receives information on the states of signals, positions of points and positions of trains on the track diagram.

The trains respond automatically to the signal aspects, stopping in front of a stop signal and starting when the signal switches to clear.

on existing tracks. Thus when the track capacity is rather low, the installation of C. T. C. may avoid the considerable cost of laying a new track. The fact that, with C. T. C., the dispatcher obtains continuous information and can therefore make rapid decisions regarding the movement of traffic, leads to greater flexibility—for instance, express trains can be given superiority in the assurance that they will run to time without needing to delay other trains to any great extent.

The result of C. T. C. is that part of the station crew's job is transferred to the dispatcher. Admittedly this may put such a burden of work on the dispatcher that he must have an assistant, but this small expense is insignificant compared with the savings involved in reducing the station crews. The saving in personnel is thus an important argument for the installation of C. T. C.

The C. T. C. office can exercise a periodical or continuous check that train drivers obey the signals. With any luck, too, broken rails may be discovered in advance.

DEVELOPMENTS

The first experiments with C. T. C. were conducted in the USA at the end of the 1920s, but it was some time in the 1930s that the system became of practical importance. It was at that time, too, that L M Ericssons Signalaktiebolag developed its first C. T. C. system, and in 1938 the company had the opportunity of installing a plant for the Stockholm—Saltsjön Railway Co. This first "child", based on rotary selectors, is still functioning admirably after 16 years of service. It was described in this journal No 2, 1936, and No 1, 1944.

Knowing the many advantages of C. T. C., it may well be asked why no systems were installed in Europe until the last few years. The reason must be, of course, that developments were held up firstly by the war and then by the post-war restrictions on capital investment. It is not impossible, moreover, that the comparative prosperity of many European railways after the war removed some of the incentive for progressive measures. In the last few years, however, a few European plants have come into being. Signalbolaget has delivered two minor plants to Sweden and Norway, and a larger one to Poland. The company has also received orders this year for a large installation for the Swedish State Railways and another for the Danish State Railways. The Swedish

installation will be on the single-track section Ange—Bracke, and the Danish on the double-track section Nyborg—Tommerup.

SIGNALBOLAGET'S C. T. C. SYSTEM JAE 300

During this long period of waiting for the acceptance of C. T. C. in Europe, Signalbolaget has developed a new C. T. C. system based on the use of relays alone without any mechanical selectors. A brief description of this system follows (fig. 1).

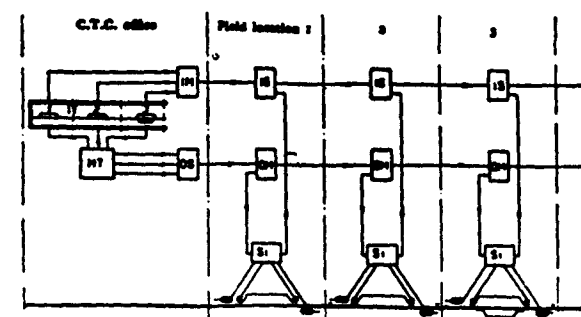


Fig. 1. Block lay out of C.T.C. system

The controlled track system is reproduced in miniature on an indicating panel IT in the C. T. C. office. The control of points and signals is exercised from the operating panel MT in the control room, the information passing through the control transmitter OS in the control room and control receiver OM at the field location to the local signal installation Si, which executes the order. Changes of conditions in the signal installation are transmitted to the indicating panel via indication transmitter IS and indication receiver IM.

Local Signal Plant

As was mentioned in the introduction, a C. T. C. system depends upon the existence or installation of local safety arrangements—interlocking plants and automatic blocks. These local plants must be of the relay interlocking type, that is to say that all lockings and interlockings must be effected by relays. The various plants can have their own local control apparatus from which, in an emergency, signals and points can be operated within the station area. Local control apparatus is not essential, however.

C. T. C. Office

The C. T. C. office must be equipped with a panel for indicating train positions etc. and apparatus for operating signals etc.

The indicating panel—the track diagram—is a schematic representation (see figs. 2 and 3) in

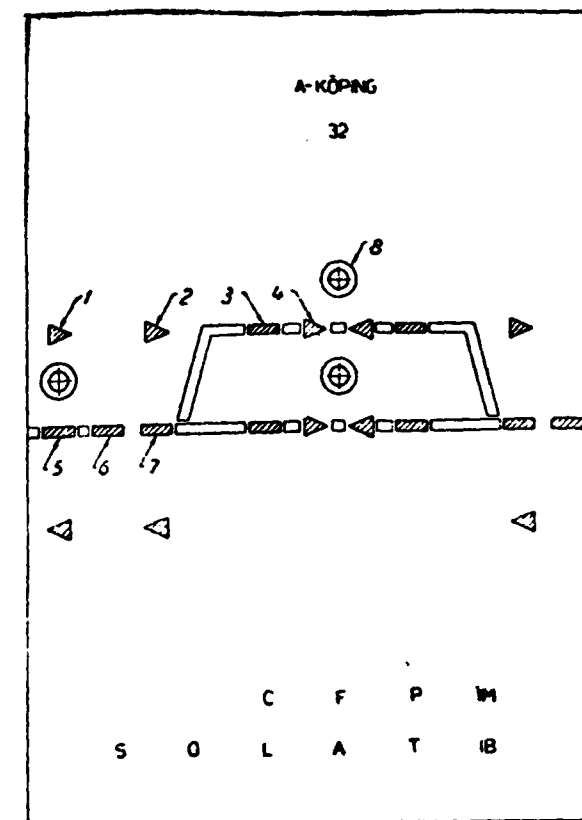


Fig. 2. Section of C.T.C. indicating panel designed for a station on the Ange—Bracke line, Swedish State Railways

Lamp 1 indicates the direction of movement at the block between stations 31 and 32, lamps 2 and 3 indicate the route from the line into the siding, and lamps 5, 6, 7 and 4 the position and possibly the category of the train. Lamp 4 also indicates the direction. Letters C, F, P etc. are normally unlit, but light up to indicate certain operating conditions such as centralized control, local control etc. When a plug is placed in jack 8, routing orders affecting the siding cannot be transmitted.

miniature of the track system to be supervised from the control room. Lamps of various colours and shapes on the track diagram show the positions and category of trains and, as far as is required, the states of points and signals, locked routes, train directions etc. The category of train is shown, for example, by lamps lettered S, P and G—express, passenger or goods train—or by a common lamp which flashes different codes. The track diagram is made up of units, each of which represents one station. Thus any unit can be easily altered and extended without requiring to change other parts of the diagram.

Another operation performed in the control room is the recording of train times. The Signalbolaget traingraph is equipped with hammers, operated by

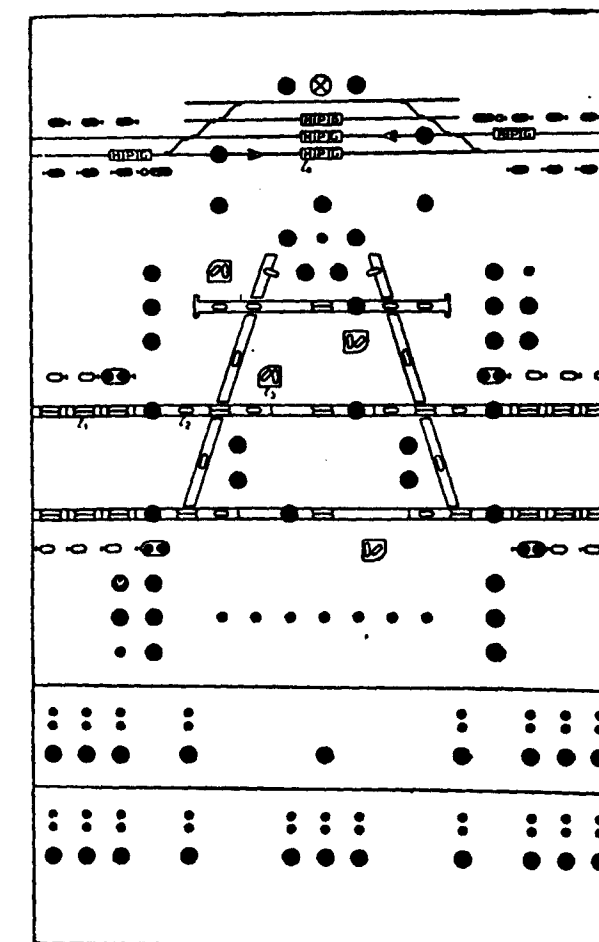


Fig. 3. Proposal for section of control panel for the Danish State Railways C.T.C. plant Nyborg—Tommerup.

The dark circles are control buttons, and those with crosses are indicating lamps. There are also indicating lamps of type 1 for train positions, 2 for state of points and 3 for state of signals. The letters H, P and G light up to indicate the category of train—express, passenger or goods.

relays, which indicate the passage of trains over certain points on the line. The paper has space for making notes both before and after stamping. The traingraph may have 100 hammers and more, train passages can thus be recorded at a large number of points along the line, resulting in a graphic chart of train movements. If the graphic timetable is printed on the paper in advance, a continuous and automatic control is obtained of whether trains are following the timetable (fig. 4).

In the conventional type of C. T. C. offices the control cabinet is often combined with the track diagram (fig. 3), which is thus fitted with the necessary control buttons and levers. Signalbolaget, however,

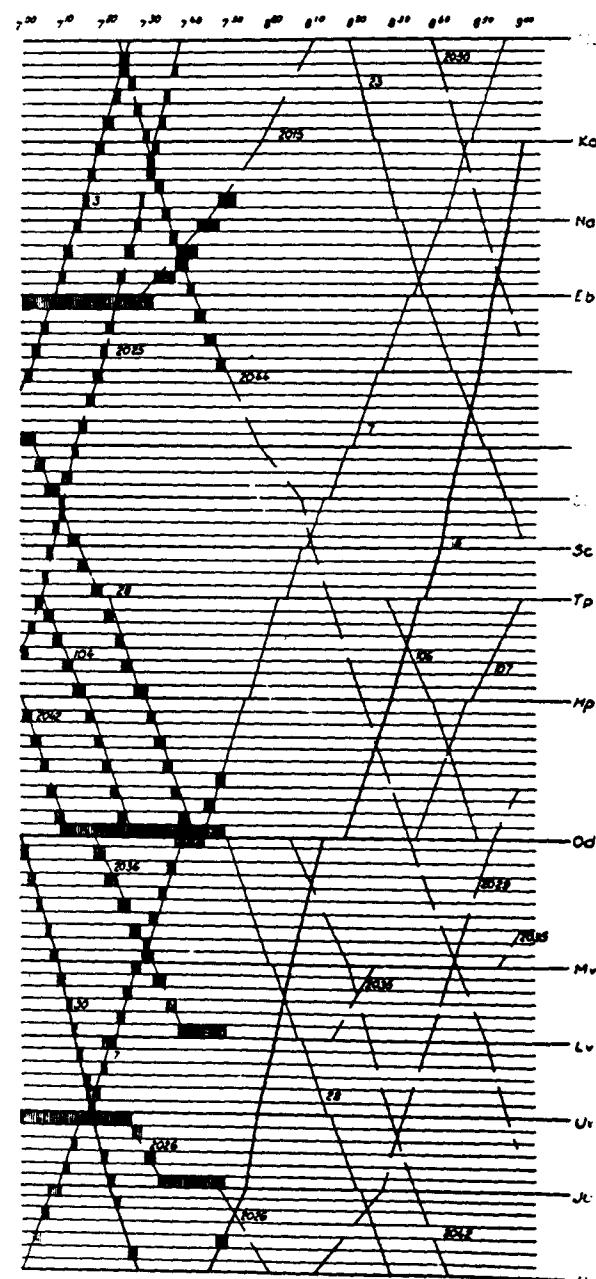


Fig. 4. If the graphic timetable for the C.T.C. section is readyprinted on the trairaph chart, an immediate visual control of how trains are following the timetable can be obtained from the marks recorded on the trairaph

In the illustration the trairaph has recorded movements up to 7-50 a.m. The directions of the trains are marked in different colours.

can now supply a control apparatus consisting of a small keyset (fig 5). A keyset of this kind has the advantage that the dispatcher can sit in one position (fig 6) from which he has a good visual control of

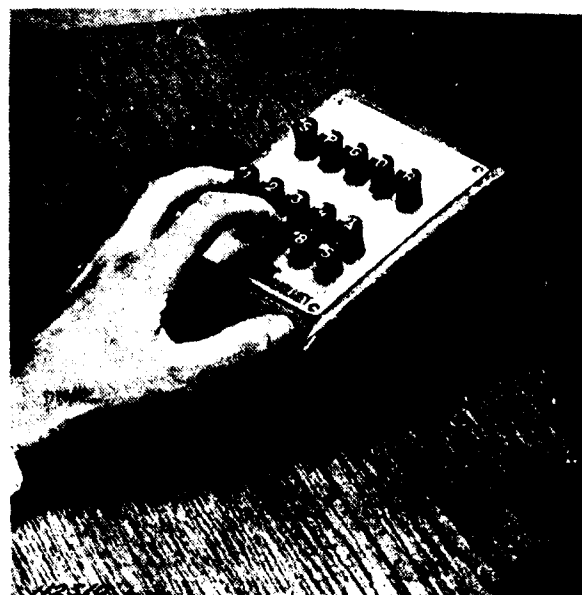


Fig. 5. The control panel or keyset in Signalbolaget's C.T.C. system is made for operation with the left hand

The panel shown here was made for the Swedish State Railways C.T.C. plant Ange-Bracke. It has eight numbered control buttons, buttons A and S for cancellation and transmission of orders respectively, and buttons S, P, G and O for marking up the categories of train on the indicating panel. (O signifies that no category of train is to be indicated.)

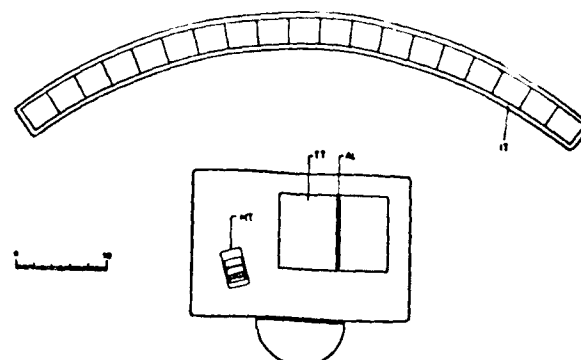


Fig. 6. Indicating panel IT in a C.T.C. office should preferably be semi-circular to give the C.T.C. operator a good view of the whole panel from his desk. At the left of the control desk is the small control panel MT, and at the right the trairaph with its impact ruler AL. The ruler is fitted with a large number of hammers, and the paper moves continuously from right to left.

the traffic situation within the entire track system under his supervision. He gets a less good view if he stands close to the track diagram, which he should do when the keys are on the diagram.

Exchange of Information

The exchange of information between C.T.C. office and the local interlocking plants requires a number of relay equipments and pairs of line wires. The control room equipment consists principally of a control transmitter and an indication receiver, and every field location has a control receiver and an indication transmitter. The number of pairs of line wires along the line depends on the traffic density and on the number of indications at every station. The system caters for the use of only one pair of line wires for indications and controls, but the use of two or perhaps more pairs of line wires may be advisable or necessary. Cables or bare wires may be employed.

The capacity of the basic system for sending controls is 36 stations and 36 controls per station; one control may cover the establishing of an entire train route. For indications the capacity is 49 stations and 49 indications per station. The reason why the indication capacity has been made greater than the control capacity is that more indications than controls are usually required per station.

Information is transmitted in the form of groups of D.C. impulses. Four groups of six impulses each are used for controls, one impulse in each group being negative and the last impulse in each group being a long one. The first group of impulses selects a group of stations, and the second a station within the group. The third group of impulses selects a group of controls, and the fourth a control within the group. Thus one control requires twenty-four impulses. Using Signalbolaget's keyset the four groups of impulses are obtained by keying a four-digit number. When operation is carried out on the track diagram, an operation is translated into four groups of impulses. A check is made in the case of every control that short impulses are short and not long, that every sixth impulse is long and not short, and that there is one—and only one—negative impulse in every group. This check ensures that there is exceedingly small likelihood of a control being so distorted under transmission to a field location that it gives rise to faulty execution. If a field location does find, however, that a control is distorted it replies by lighting a fault signal lamp in the C.T.C. room. If the impulsing is correct on the other hand, but the control cannot be executed for local reasons, the field location replies by lighting another lamp in the C.T.C. room. The advantage is thereby gained that the train director is immediately advised—i. e. without awaiting an indication—whether a control is impossible to carry out.

For sending indications the sending station transmits two groups of impulses of seven impulses each. The first group of impulses identifies a group of stations, and the second a particular station. In each group of impulses there is only one negative impulse, and the last impulse is a long one. The different indications are divided into seven groups with seven functions in each group. During indication sending, which starts automatically as soon as a change occurs in any function at the station, all devices in the groups in which a change has taken place are indicated successively, but not in the other groups. An indication sending thus does not call for more impulses than are required to record the change, by which the advantage is gained that the line wires are not engaged on sending indications for longer than is necessary. Every time

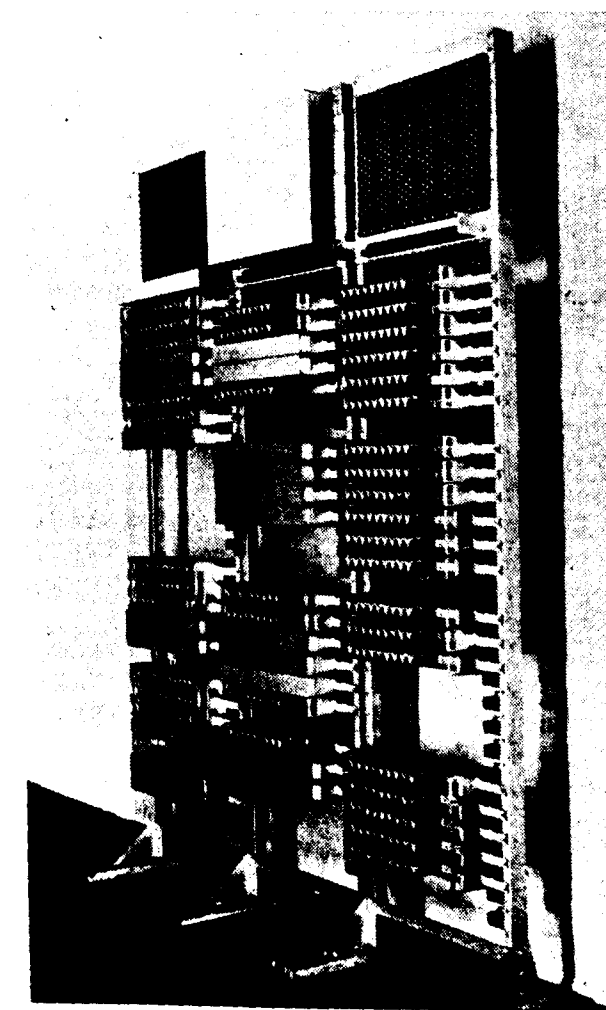


Fig. 7. The relay stands at control room and field locations

consist to the greatest possible extent of standardized relay groups which, being 'plug-in' units, are easy to replace individually.

an indication is transmitted a check is made, as regards the identification of the station, that short impulses are short and not long, that every seventh impulse is long and not short, and that there is one—and only one—negative impulse in every group. As regards the actual indication a check is made simply that short impulses are short and not long and that every seventh impulse is long and not short.

The relay equipment is made up in units of as small a number of types as possible. The advantage of this is that the stock of spare units can be kept to a minimum. Every unit is of the plug-in type (fig. 7) and is thus easily removed for repair or maintenance.

Examples of Control and Indication Operations

Fig. 2 shows part of the track diagram in a C. T. C. room, comprising station No. 32 and a half section of line westwards and eastwards. It is assumed that a train is coming in from the west (from the left in the figure) and is to be taken into the siding. The dispatcher orders the route to be cleared for entry into the siding by keying number 3213 on the keyset. The information is sent direct to the track diagram, on which lamps 2 and 3 start to flash green and white respectively as a reminder to the dispatcher that the control has been transmitted but not executed. As soon as the line wires—or any of the line wires—to the field locations are free, the control is transmitted to station No. 32. If the control can be carried out, it is executed by the local interlocking plant. As soon as the control has been put into effect, an indication is sent to the C. T. C. room and passed on to the track diagram where the flashing light from lamps 2 and 3 is replaced by a steady green and white light respectively.

The movement of the train along the line operates relays in the local interlocking plants. Information of the train's movement is sent to the C. T. C. room and forwarded to the track diagram, on which the positions along the line are marked by red lamps. Thus in the case illustrated lamps 5, 6, 7 and 4 light up successively in red, and the latter lamp, by its shape,

also shows the direction of the train. If the category of train is indicated by flashes, quick flashes may be used to show the position of an express train, rather slower flashes a passenger train and still slower a goods train. The marking up of new or changed information on the track diagram is done by pressing button S (express), P (passenger) or G (goods) on the keyset in the C. T. C. room. All indications of train categories are arranged within the C. T. C. room and are not dependent on special impulses from the field locations. The traingraph stamps the passage of every train past given points on the line.

Deviations from Signalbolaget's Basic System

The orders from the Swedish and Danish State Railways have stipulated certain modifications to Signalbolaget's basic C. T. C. system. Swedish Railways will use eleven impulses for transmission of controls, of which the first five are employed to identify the station and the last six the control. The smaller number of impulses results in quicker transmission of controls. On the other hand the Swedish State Railways do not require checks to the extent allowed for in Signalbolaget's basic system that an impulse is not distorted in transmission. As to the transmission of indications the Swedish State Railways will use five impulses for station identification, but adopt Signalbolaget's basic system in other respects.

Danish Railways will have controls on the track diagram and will thus not use Signalbolaget's keyset.

FUTURE DEVELOPMENTS

The European railways, like all other public and private enterprises, are successively modernizing their systems in order to operate on a more efficient and economical basis. It would seem inevitable, therefore, that they must make use of the advantages offered by C. T. C. to a growing degree. Indeed it is hoped that C. T. C. will prove a valuable means of aiding the railways in their efforts to maintain and increase their competitive power.

The Chairman and Directors of BEYER PEACOCK & CO. LTD. regret to announce the death on March 5th, after a brief illness, of their colleague MR. W. CYRIL WILLIAMS. He was an Executive of the Company for 31 years until his retirement in 1954, and remained a Member of the Board until his death at the age of 69.

We convey our sincere condolences to the members of the bereaved family.

Need for Earthquake Engineering Research in India

By S. L. Kumar,

Director, Research, Railway Board

Ever since the thirties of this century buildings and bridges on the Indian Railways have been built where warranted to resist earthquake forces. This article indicates how the present methods of design of earthquake-resisting structures on the basis of "rule of thumb" methods do not take into account the dynamic characteristics of the ground motion in earthquakes and how important it is to obtain confirmation or otherwise of conclusions and inferences, albeit controversial, drawn from field and laboratory data of other countries for the Indian conditions. An effort has been made to outline some of the unsolved problems in connection with the effect of earthquakes on structures, but before a departure from the existing design practices is made in this country, it is imperative that extensive earthquake engineering research must be carried out to justify any modifications thereto.

INTRODUCTION

THE sub-Himalayan region extending from Assam to Kashmir and the Indo-Gangetic plains of India are noted for some world shaking earthquakes which though not so frequent have been very destructive. On reference to the book 'Seismicity of the Earth' by Gutenberg & Richter which lists all world earthquakes between 1904 and 1952, it would be noticed that no earthquake has ever exceeded the Assam earthquake of 1950 in its intensity and only one or two, the Bihar earthquake of 1934.

Ever since the thirties of this century, the Engineers have been designing and constructing all structures located in the seismic areas to be earthquake resistant. The notable examples of such constructions on a large scale are those undertaken after the earthquakes of 1934 in Bihar and of 1935 in Quetta (now in Pakistan). The fact that earthquake resisting quarters built by the railway in 1932-33 at Quetta withstood the earthquake shock of 1935 even without a crack showed that the Engineers could successfully meet the challenge of violent earthquakes. The details of the type of construction adopted are given in the author's paper no. 165 entitled "Theory of Earthquake resisting design with a note on Earthquake resisting construction in Baluchistan" which was presented to the Punjab Engineering Congress in 1933.

Recently, in the design of the Bhakra dam and the Mokam Ghat bridge over the Ganga, allowance has been made for seismic forces. Many years ago, the Central Standards office for railways issued a Code of practice for the design of Earthquake-resisting structures. More recently the I. S. 875-1957 has made

provisions for the design of buildings in earthquake-affected areas in India. In all cases, the codes and specifications follow mainly the practices in Japan & America who are the leaders in Earthquake Engineering.

Past experience and observed damage data indicate that whereas in the epicentral region, the vertical component of motion is as prominent as the horizontal one (though no allowance is needed for the vertical component since its effect is covered by the factor of safety), it is the horizontal component which causes the greatest destruction to buildings and structures. The horizontal force for which a structure is designed to withstand an earthquake is assumed to be static and the ratio of the acceleration caused by it to that due to gravity is called the seismic factor or seismic co-efficient. In the design of many structures in the past a seismic co-efficient of 0.1g has been adopted.

ABSENCE OF INSTRUMENTAL DATA

The present design practice is not based on any experimental or instrumental observed data collected in the country during earthquakes. As a matter of fact, till recently the instruments called seismographs used for recording earthquake motion used by the Meteorological Department were suitable only for recording distant earthquakes. They usually went out of commission in violent earthquakes. Only a couple of years ago, a couple of 3-component strong motion seismographs or what are also called accelerographs were installed at Shillong in Assam and at Chatra in the Kosi river catchment.

In the absence of instrumental data, the acceleration due to an earthquake in the past has been estimated in this country from the overturning of walls, pillars and monuments, from the seismograms wherever available on the assumption that the earthquake force was harmonic (which it is not in the epicentral region) and by the use of some empirical formulae. Further, the data provided by the available seismograms in this country, although useful, do not meet the needs of the structural engineer as the seismographs which recorded them were located on a rigid concrete foundation or rock to eliminate the effect of local ground motions which exactly are the ones in which the engineer is vitally interested.

It is clear from the above that, in the absence of instrumental data useful for the structural engineer, there was no recourse possible other than that the design of the anti-seismic construction should be based on the "rule of thumb" methods based on foreign practices. The imperfections of this procedure are well illustrated by the classic example of the Marunouchi building in Tokyo. This steel frame building was designed to resist earthquake stresses. Even so, a severe earthquake in 1922 caused serious damage to the floor slabs and walls. It was then reconstructed and provided with stiff diagonal bracings. Yet its performance as indicated by serious cracking was much poorer than that of the buildings in the locality not specifically designed for earthquakes. Again, the rule of thumb methods, besides involving higher cost of construction, have to be used irrespective of the soil conditions and without any knowledge of the prevalent spectra of ground movements and accelerations.

PROBLEMS TO BE SOLVED BY RESEARCH

Quite many of the unsolved problems in earthquake engineering are those of soil mechanics. As earthquakes cannot be had to order, useful observational data cannot be collected till there is a strong earthquake. To make up for this, it is the duty of the engineering profession in this country to start earthquake engineering research as soon as possible. The following are some of the problems which are awaiting solution:—

- (a) Statistical probability of earthquakes in various regions of India, their future likely trends,
- (b) Effect of soil properties on the intensity and characteristics of ground motions during an earthquake,

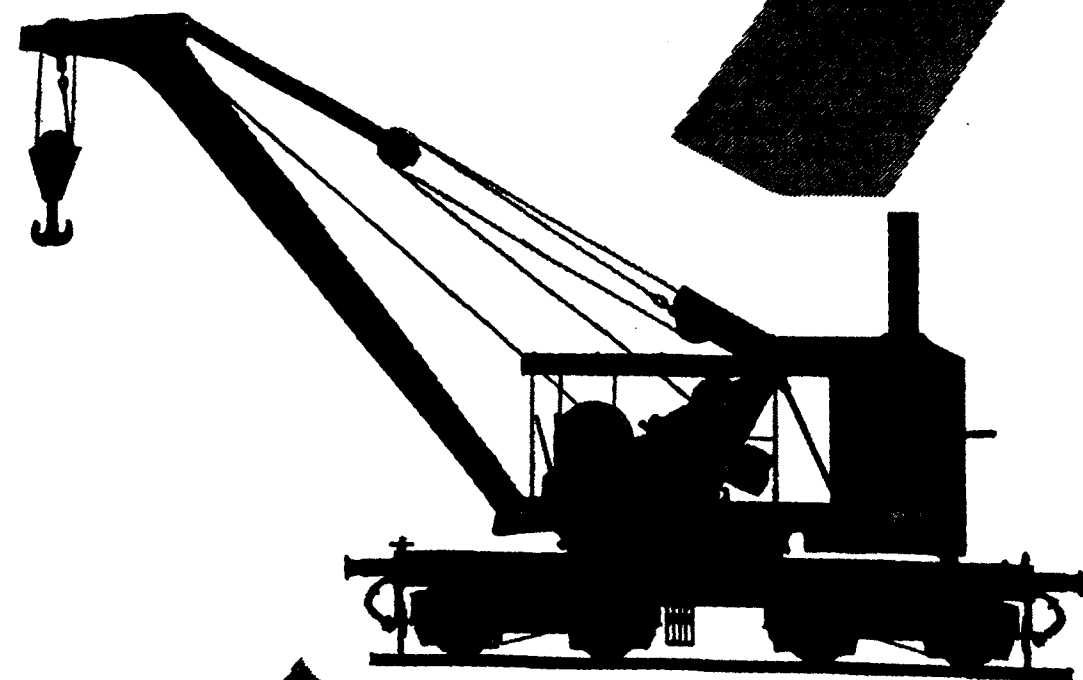
- (c) Changes in the soil structure and properties during an earthquake and the effect of such changes on the buildings standings thereon,
- (d) Performance or behaviour of different types of construction located in various types of soils and the effect of different types of foundations,
- (e) Seismic factor for design, allowable stresses and mode of analysis of structures for seismic forces,
- (f) Development of suitable instruments for seismic research and their installation in adequate numbers in seismic zones.

SEISMICITY AND STATISTICAL PROBABILITY OF EARTHQUAKES

Due to the Sedimentary nature of the rocks in the unstable and 'young' Himalayas, the sub-Himalayan region has been subject to violent earthquakes in the past. On the other hand the Deccan peninsula with its stable igneous rock formations has been notably free from strong earthquakes. Study of data on Indian earthquakes leads to the conclusions that earthquakes of moderate to great magnitudes have their epicentres generally located in the sub-Himalayan region along the Himalayan boundary faults or have generally aligned themselves along lines of gravity anomalies or are located at points of sudden change in the curvature of the Himalayan ranges. By and large, the active seismic zone from Kashmir to Assam can be divided roughly into three distinct equal regions differing significantly in their seismicity, the central part being the least seismic. The north-west region including Kashmir and parts of the Punjab had more frequent though less destructive shocks. The eastern region had, on the other hand, been visited by world shaking earthquakes which were felt over areas exceeding 1.5 million square miles.

The relative assessment of the seismicity of the sub-Himalayan region and the frequency of earthquakes as indicated above, though useful, does not serve fully the purpose of the engineering seismology which requires detailed data for spectra of ground accelerations and displacements and correlationship that may exist between the prevailing geology of a region and the location of active fault zone on one hand and the occurrence of moderate to violent earthquakes on the other.

NAVALMECCANICA O.M.F.
NAPLES - ITALY -



STEAM/DIESEL RAILWAY CRANES
O. H. TRAVELLING CRANES
HARBOUR CRANES
MOBILE CRANES



FINMECCANICA

(ROME - ITALY)

DELEGATE IN INDIA-144, GOLF LINKS-NEW DELHI-3

sphinx-56

SOIL PROPERTIES & GROUND MOTION

When the soil is homogeneous, it behaves elastically during the passage of earthquake waves but there is a considerable disagreement among engineers regarding the behaviour of soil if it is non-homogeneous. Studies of Omote & others indicate that the damage due to earthquake increased with the depth of the alluvium over the bed rock, becoming critical for depths of about 115 ft. In general, measurements indicate that the intensity of the ground motion doubles almost when the earthquake waves travel from the basement rock to the alluvium. On the other hand, there is demonstrable evidence to show that, in some cases, soft soil filters out the destructive high frequency waves. The problem of the relative intensities of ground motions and accelerations on hard and soft soils therefore remains still unsolved and no comprehensive solution is possible unless all countries visited by violent earthquakes carry out instrumental observations during earthquakes and pool their knowledge.

Firm soils may remain unaffected by the passage of the earthquake waves but in soft soils earthquake vibrations have the effect of liquefying of soil masses leading to spouting of mud and sand as also bring about sudden compactions resulting in settlement of banks accompanied by heavy cracking and fissuring. These facts point to the necessity of making extensive soil explorations at the site of important structures and of estimating possible future settlements.

The Joint Committee of the A. S. C. E. reported that the dominant period of ground motion on the basis of Italian & American earthquake is of the order of 0.25 sec. The Japanese experts say that this period holds true for intermediate soils in their country and that in the case of firm soils it would be about 0.1 sec. and that soft soils have a primary period of 0.6 sec. and a secondary one of 0.3 sec. As soon as earthquake research starts in India, the measurement of the dominant periods of soils in different active seismic zones should be given a high priority.

INTERACTION OF STRUCTURE & GROUND

The problems associated with the interaction between the ground and the structures particularly of those located on soft soils deserve a careful study. The intensity with which a building vibrates during an earthquake depends on the intensity of the ground motions, the natural period of vibration of the building and on the dissipation of energy during the vibra-

tions of structure which sends stress waves through the ground. The effects of all these factors have to be evaluated. If the soil is firm, the building would perhaps react as if it has a fixed base whereas a rigid building on a soft soil is believed to rock like a piece of pebble on a mass of jelly.

Then there is the problem of establishing a correlation between the length of the seismic wave and the safe relative length of the building in the direction of the shock waves. Some seismologists believe that the effect of shock waves is likely to be less if the building is 300 ft. long than in one of 60 ft.

The effect of different types of foundations has to be studied in connection with the interaction of the structure and the ground during an earthquake. Screw piles in the foundations of bridge in the Bihar earthquake gave a better performance than other types. It is possible that piles in soft soils protect the overlying structure against seismic waves as if acting as vibration isolators. It is conceivable that the link the foundations provide between the ground and the superstructure has a significant effect. It is necessary also to investigate whether the coincidence of the natural period of vibration of a building with the primary period of vibration of the soil would make it more vulnerable to shocks. There are two reasons against this view. In the first place, the natural period of the soil varies with intensity of the earthquake and tends to elongate, the elongation depending on the type of material used in the construction. Secondly, there is the known difficulty of the transfer of the free period of vibration of a soft soil to the building. It is for these and other reasons that the period consideration in the design of a structure has been abandoned in Japan but not yet in America. Research on an extensive scale is necessary in India to enable suitable modifications to be made to our building codes to suit the Indian conditions.

SEISMIC FACTOR & DESIGN METHODS

An important question in the design of an anti-seismic construction relates to the choice of the seismic co-efficient. There is good deal of evidence to show that many buildings with less lateral resistance than that for a seismic factor of 0.02 withstood major earthquakes. The brevity of the earthquake motion, the infrequency of violent earthquakes, the complexity of the ground motion during an earthquake preventing resonance and the rapid increase in cost of construction with an increase in the seismic factor all point to the necessity of adopting a low seismic factor for design.

Experts, however, differ in their views. Research only can resolve these differences.

Another ticklish problem which awaits solution is whether only the fundamental mode of vibration of a structure should be considered when the base shears due to an earthquake are to be determined or should the influence of secondary or tertiary modes of vibration be taken into account also. Experiments with simplified models of structures or even prototypes exposed to artificial earthquakes would give a clear insight into these questions.

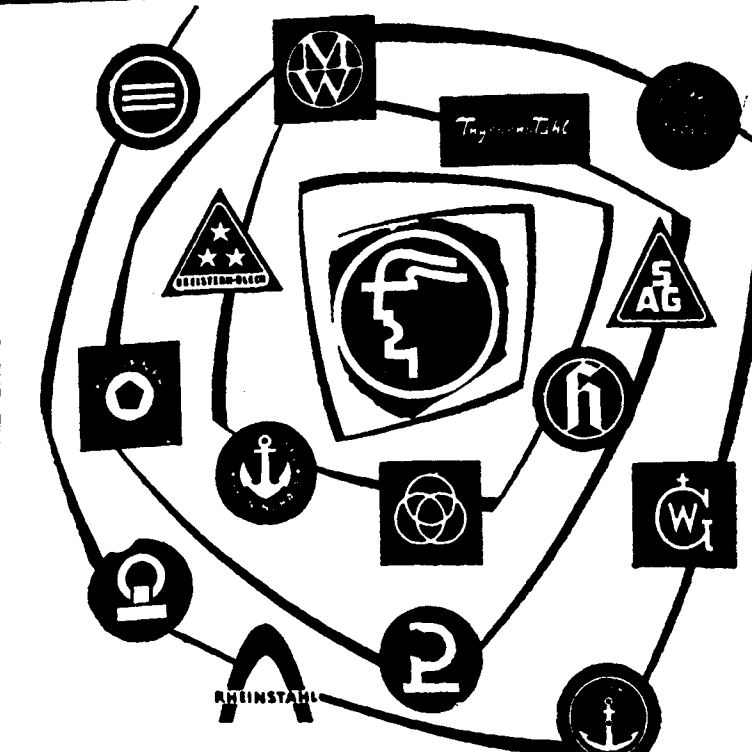
INSTRUMENTATION FOR RESEARCH & PROGRAMME OF WORK

Accurate & reliable instrumentation is the first requisite of a successful engineering research. It is necessary to install at once at least two dozen accelerographs in different regions. Some of these may be imported and others similar to the imported ones can be manufactured in this country. The data provided by the accelerographs can be supplemented by the use

of earthquake recorders which can be easily manufactured indigenously. For experimental work, mechanical vibration generators, a couple of shaking tables, and a spectrum analyser would also be needed.

As is obvious, the research work will not only be carried out in a well equipped structural laboratory but would also include extensive field investigations, prototype and scale model testing of structures as also collection of damage data after a destructive earthquake including its analysis from the structural engineering point of view. Regular precise level and triangular surveys should be carried out. The data collected therefrom would show if any region is tending to rise or to subside relative to the other, thus enabling prediction of an impending earthquake.

In this article, an attempt has been made to give an indication of the problems of earthquake engineering. It is strongly recommended that the Central Government should take immediate steps to sponsor fundamental earthquake engineering research work at a University and applied research at a National Research Laboratory.



15 FIRMS OF THE

IRON AND STEEL

producing Industry will be exhibiting in

HANNOVER

GERMAN INDUSTRIES FAIR
26 APRIL-5 MAY 1959

Information and Catalogues from:

Ajanta Advertising, 3rd Floor, 56-57, Lakshmi Bldg., Sir P. M. Road, Bombay-1
12, Dalhousie Square East, Calcutta-1
Agurchand Mansions, 35, Mount Road, Madras-2

DIESEL LOCOMOTIVES FOR THE INDONESIAN STATE RAILWAYS

By Heinrich Herrmann

THE 60 diesel locomotives booked by Fried Krupp Maschinenfabriken at Essen from the Indonesian State Railways were delivered partly in the course of 1958 and partly at the beginning of 1959. This batch of locomotives comprises 30 of a lower and 30 of a higher range of power, both classes being fitted with the hydraulic power transmission advocated by Krupp.

The locomotive of the lower range of power (fig. 1), designed for a top track speed of 50 km. p. h., is capable of developing 340 b. h. p. under the climatic conditions of Indonesia. To get a sufficiently high adhesive weight, the locomotive has four rigid frame-mounted-driving axles, as bogies would mean too great an expenditure considering the low power. With an axle load of 8.5 tons, the service weight of the locomotive is therefore approx. 34 tons. The Daimler-Benz (Mercedes) diesel engine of the MB836B type, used for powering the locomotive, is a naturally-aspirated 4-cycle engine of the 6-cylinder vertical model, developing its rated power output at 1500 r. p. m. Preference was given to this type of engine particularly on account of its light weight. From the engine rigidly mounted on the locomotive frame, the power is transmitted over a flexible coupling to the hydraulic transmission. This Krupp type hydraulic transmission, driven through a step-up gear, is followed by two speed steps in the form of gear wheels, and the reversing gear for the two travelling directions. All parts are mounted oil- and dust-proof inside a housing of welded structure. A remarkable feature of the locomotive is the fact that the transmission is not provided with a jackshaft to drive the wheels by means of rods. The drive from the above-mentioned transmission box is rather by a cardan shaft acting on an axle gear of the second driving axle, the wheels of which driving those of the other axles by means of side rods. This driving method has been adopted for two reasons. With respect to permissible load on bridges according to the regulations of the Indonesian State Railways the distance between two axles must not be below 1500 mm. As, on the other hand, the total wheelbase should not be too large so as to enable the loco-

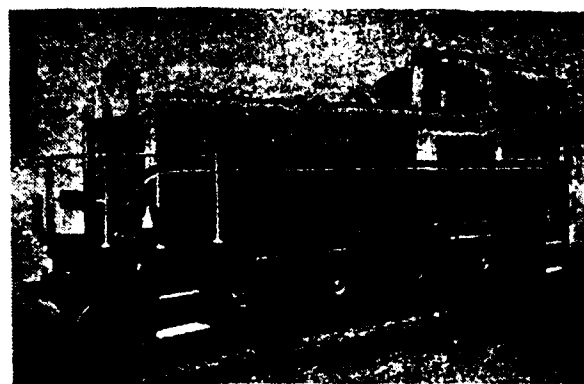


Fig. 1. Krupp diesel-hydraulic locomotive 340 PS, with Krupp transmission gear, axle arrangement D, gauge 1067 mm.

motive to negotiate with ease curves of a radius of 75 m., there is no possibility of arranging a jackshaft between two axles. A jackshaft outside the wheelbase would result in a heavy end overhang and a bad total arrangement. This was one reason to abstain from applying a jackshaft drive. Another reason was that the driving method adopted enabled a considerable number of transmission parts to be used on this locomotive which are interchangeable with those on the larger locomotive of 680 b. h. p. dealt with below, thereby beneficially influencing the stocking of spare parts. The axle gear arrangement is altogether unusual, in that the bearings for the transmission are at the same time the axle boxes for the frame.

The cooling equipment is arranged at the front, ahead of the engine, with a fan belt-driven off the engine to keep the equipment simple. The temperature of the engine cooling water is under thermostatic control, a short-circulation line in the cooling water system being connected to the thermostat in the well-known manner.

The locomotive developing 680 b. p. h. is a double-bogie unit (fig. 2), the top track speed of which being 75 km. p. h. Power is furnished by a Daimler-Benz (Mercedes) model MB820B; its 12 cylinders are in



Fig. 2. Krupp diesel-hydraulic locomotive 680 PS, with Krupp transmission gear, axle arrangement B' B', gauge 1067 mm.

V-position and are dimensioned as those of the 340 b. h. p. engine. This engine equally attains its rated power output at 1500 r. p. m. From the engine rigidly mounted on the frame, power is transmitted over a flexible coupling to a bilinear Krupp type hydraulic transmission. The step-up gear

of the latter is connected to two torque converters working in parallel, each taking half of the engine power output. Each of the two torque converters is followed by the two-speed gear with the reversing gear. These two transmission lines are mechanically separated from each other, but are placed in one common housing, from which one cardan shaft each leads to each of the two bogies. As the transmission power of the gear parts is in conformity with that of the smaller type of locomotive, the dimensions and rotational speeds of the gear parts are alike. With respect to the track speeds of both types of locomotives varying from each other, the axle gears are arranged to compensate for the difference in the gear, enabling the various top track speeds to be attained. The outer axles of both bogies are driven through cardan shafts arranged about symmetrically to the bogie pivot, thus safeguarding a uniform transmission of power on to the axle gears of the outer axles. From the latter the inner axles are equally driven by cardan shafts and axle gears. In this way the two axles of each bogie are mechanically coupled with each other, but the transmission lines of both bogies are separate. This arrangement therefore enables the two bogies to run

**Steel Castings
Manganese &
Carbon**

KUMARDHUBI ENGINEERING WORKS LTD.
 Managing Agents:
BIRD & CO. (PRIVATE) LTD.
 Chartered Bank Buildings, Calcutta-1

independently from each other without giving rise to any undesirable reactions reciprocally.

The cooling equipment is separated from the machinery casing through the cab. The radiator fan is driven hydrostatically and its speed is under thermostatic control in such a way that the temperature of the engine cooling water is kept constant.

The weight limits of 9 tons per axle and the resulting service weight of 36 tons only, called for the locomotive being built very light in all its components. The weight of the smaller locomotive corresponding approximately to that stated above, the starting tractive efforts of about 10 to 11 tons, depending upon the adhesion, are also in conformity with each other,

but the locomotive of 680 b. h. p. is capable of developing this tractive effort at higher track speed. Furthermore both locomotives have only two speed steps each, sufficient to cover the whole of the speed range. Thanks to automatic gear change of both speed steps, the locomotives are capable of starting invariably with max. tractive effort and continuing to run without a break in the tractive effort up to top track speed. There are no speed steps to be operated at standstill.

It is of the utmost importance that thanks to the order of the Indonesian State Railways an opportunity has been offered to supply for the first time a large number of hydraulic power transmission units to the Far East.

Full Marks for Non-Metallic Railway Brake Blocks

The annual report of the New South Wales Commissioner for Railways for the year ended June 30th, 1958, published recently in Sydney, contains favourable comment on the Ferodo non-metallic brake blocks which have been supplied since 1956 for electrified suburban lines.

The relevant section of the report reads as follows:—

"Considerable progress was made with the fitting of non-metallic brake-shoes to electric rolling stock. As a consequence, at the end of the year 98 per cent of these vehicles had been equipped with this efficient and economical brake-gear.

Considerable savings in the cost of brake-shoes have been effected, and in addition, the mileage obtained from the non-metallic brake-shoe is at least five times that obtained from the cast-iron shoe".

Statement about "The Indian Railway Engineer" under Rule 8 of the Registration of Newspapers (Central) Rules 1956

- | | |
|--|--|
| 1. Place of Publication | Tanjore. (but issued from Bombay) |
| 2. Periodicity of Publication | Quarterly |
| 3. Printer's name | S. Sundaram (alias T. S. Sundar Rao) |
| Nationality | Indian |
| Address | 2235, Bhutgoswamy Vattaram, Manojappa Street, Tanjore. |
| 4. Publisher's Name | |
| Nationality | do |
| Address | do |
| 5. Editor's Name | T. S. N. Rao |
| Nationality | Indian |
| Address | 2235, Bhutgoswamy Vattaram, Tanjore. |
| 6. Names and address of individuals who own the newspaper and partners or shareholders holding more than 1% of the total capital | T. S. Gopal Row
T. S. Krishna Rao
S. Sundaram (alias T. S. Sundar Rao) |

I, S. Sundaram hereby declare that the particulars given above are true to the best of my knowledge and belief.

(Sd.) S. Sundaram
Signature of Publisher.

EFFICIENT WORKING ON AIR

By A. C. Bhattacharya, A. M. I. Prod. E.

"MANKIND lives at the bottom of an ocean of air compressed by the weight of the air above it. Ever since man blew his breath on a smouldering wood to start his fire, and later fashioned a crude bellow of animal hide, man has been constantly endeavouring to add to the uses and applications of compressed air".

Muscle power is behind the times now. Today industrial muscle is provided by air that gives life to the earth and its people. The science of pneumatics and its application to almost every phase of our everyday life, owes its development to the progress from the crude bellows of the village blacksmith to the modern blower type air compressor.

Railways today are in the midst of a vast change brought about by increasing mechanization. One of the developments in line with present day mechanization has been the use of pneumatic tools. Their applications are not confined to workshops alone where they are used for riveting, chipping, drilling, reaming, tapping, grinding, lifting, spray painting, etc., but extend to works of the civil engineers for tamping of railway tracks, concrete vibration, stone working, concrete breaking, spray painting the bridges and structures, etc.

Versatile as compressed air is, it is equally important to ensure that efficient use is made of the energy provided by it. Theoretically the ideal thing should be to utilise every ounce of the energy produced, but in practice, this is not possible as a certain amount of the energy produced by the power plant gets lost before reaching its ultimate destination.

In the case of compressed air plants, such losses are, within limits, unavoidable as certain inflexible physical laws are involved, but a certain amount of wastage can be prevented by increasing the efficiency of the distribution system. It is in fact upon the efficiency of this system that the satisfactory operations of a plant largely depends.

Wasted air is costly and even very small cracks and defective seals can prove expensive. The table above shows the approximate amount of free air that is lost per minute through various size leaks.

Diameter of leak in inches.	Receiver Gauge Pressure lb./sq. inch.				
	20 lbs.	40 lbs.	60 lbs.	80 lbs.	100 lbs.
1/64	0.119	0.19	0.26	0.33	0.40
1/32	0.485	0.77	1.05	1.33	1.61
1/16	1.93	3.07	4.2	5.32	6.45
1/8	7.7	12.27	10.8	21.2	25.8
1/4	30.8	49.09	67.0	85.0	103.0

Assuming that the sum of the diameter of all leaks in the air lines and connections amounts to only 1/16" and the working pressure is 80 lbs. per sq. inch. the quantity of free air that is lost per minute is 5.32 cu. ft. This figure will come to 76608 cu. ft. in a month of 30 days at 8 hrs. shift (5.32 × 60 × 8 × 30).

A double acting compressor with a 12 in. dia. cylinder and having 12" stroke, while running at 240 r.p.m. and operating at 80 lbs./sq. inch pressure would take approximately 4.½ hours of continuous operation to deliver the quantity of compressed air wasted in a month, and a machine of this size requires about 60 B. H. P. continuous at 80 lbs. pressure.

If the above wastage is eliminated obviously the riveters will drive more rivets, the drills will put through a greater number of holes and the capacities of all the pneumatic equipment will be increased. Therefore in planning a distribution system every precaution should be taken to limit such wastage to a minimum.

CAUSES OF WASTAGE

The causes of compressed air wastage are as follows:— (a) Inefficiency of the machinery for compressing and expanding the air; (b) Frictional resistance of pipes, bends, valves, etc.; (c) Leakage in pipe joints and valves; (d) Presence of moisture or water in the air transmission line.

As regards item (a), a considerable thought has already been given for improving the design features of the present day machinery after careful research and a wide variety of efficient machinery is now available.

Items (b), (c) and (d) are however largely neglected as a result of which it is not possible to make the most of the air power in circulation.

To avoid undue friction losses, the air mains should be of adequate diameter, such as for example, pipes of at least 2" diameter or more should be used for pressures up to 350 lbs./sq. in. Presence of artificial restrictions like objects left in the pipe; joints badly cut so that they protrude inward; pipes "nipped" into a non-circular shape in bending; sharp bends or elbows, will cause friction losses.

Whenever possible streamline bends should be used. Square elbows or Tees create resistance equal to 0.027 lb./sq. inch each. Bends having a radius twice the bore of the pipe create resistance equal to 0.005 lb. per inch each.

The valves in an air system should offer a minimum of frictional resistance to the air flow and remain perfectly tight even after long service. Valves of the globe type are particularly obstructive with frictional resistance equal to 0.080 lb./sq. inch each and should always be avoided.

The valves to be used in this connection should have the following features: (a) Leak tightness, (b) Low flow resistance, (c) No leakage to or from atmosphere, (d) resistance to corrosion from oily and humid air as well as to abrasion, (e) Long useful life, (f) Absence of pockets to collect grit etc., to avoid jamming, (g) Free working and tight closing and (h) Easy maintenance.

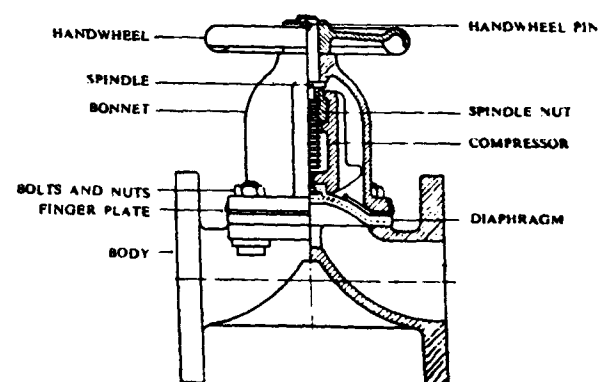


Fig. 1. Sectional view of Saunders type rubber diaphragm valve.

Rubber diaphragm valves of the Saunders type, as depicted in Fig. 1 in section, are particularly suitable for compressed air. In these valves, instead of metal-to-metal closure parts, which depend for their

tightness upon machined and lapped surfaces, a flexible diaphragm is employed. The diaphragm can be easily replaced without removing the valve from the pipe.

LEAKAGE IN PIPE JOINTS AND VALVES

An efficient pipe system should be as tight as possible while the pressure drop from the receiver to the outlets should be as small as possible, even at maximum flow. Pneumatic tools in general, are designed to operate at 85 to 100 lb./sq. in. pressure. If this pressure cannot be maintained the power of the tool will fall in greater proportion than the pressure. For example, a pneumatic tool operating at 70 lb./sq. in. pressure has only 55 to 60% of its full power obtainable at 100 lb./sq. in. pressure.

The causes of leakage are :—

- (i) When air is passed directly from the compressor into pipe lines, the heat causes the lines to lengthen. This is followed, when the compressor is shut down, by cooling and contraction. This movement of the pipe induces leaky joints.
- (ii) Leakage through the jointing material.
- (iii) Straining the joints either due to weight of material which has either fallen on the main or has been heaped on it or the pipes becoming buried to a considerable depth.
- (iv) From joints not made carefully.
- (v) Pitting taking place with numerous pinholes on the pipes when placed in a damp corrosive position.
- (vi) Improperly designed fittings like valves, taps, hose pipe couplings, etc.

The provision of an after-cooler before passing the air on to the transmission will arrest the movement indicated in item (i). As regards the troubles arising out of leaky joints, the remedies suggested are that the joints should be made tight in the first instance and should be made with red lead, and pipes once laid should not be disturbed; where their frequent repositioning is called for, the use of flexible joints or provision of sufficient outlets in the system to allow for subsequent remodelling, is recommended. Application of anti-corrosive paints at regular intervals will stop pitting of pipes. Selection of proper fittings should be given a special consideration to obtain better results.

PRESENCE OF MOISTURE

When compressing air, heat is generated, but as soon as this air cools down; moisture in it is condensed. The fact that air loses its temperature rapidly explains the presence of water in compressed airlines.

It has been said that like sand in oil, moisture in compressed air means ruin. Unless removed, the water that is liberated, is carried along through the line into the tools or machines where the air is being used and washes away the lubricating oil. This results in their excessive wear with consequent high maintenance charges. Deprived of adequate lubrication, these tools and machines run sluggishly and their efficiency is considerably reduced. It produces "water hammer", reduces the carrying capacity of the line, causes loss of power by accumulation at low points.

In addition to the direct effects of water, it loosens pipe scale, rust and dirt from the inside of pipes and carries these gritty materials into the equipment being operated.

MOISTURE REMOVAL

The most satisfactory way of preventing moisture circulating through the pipe lines is by removing it, as compression takes place in stages, by means of inter-coolers. For larger inter-coolers, baffle type separators are often directly fitted to the shell of the cooler and the water is drained out by means of automatic water traps.

The next point to get hold of moisture is the after-cooler as depicted in Fig. 2. It should be fitted at a point near the compressor outlet. With efficient after-coolers, sufficient moisture is removed to satisfy most applications of air. The third point is the air receiver i. e. before the air enters the distribution system. The receiver as shown in Fig. 3, acts as an efficient moisture trap and equalizes pulsations in the pipe line.

It will be wrong to presume that the last point of moisture accumulation is a certain point in the piping system. In fact water is liable to accumulate in several points and specially in all low lying portions of the pipe system. Moisture traps should be fitted at suitable points in the distribution line for collecting the water with automatic draining arrangements. The guiding factors in selecting the points should be (a) where the air is cold and the vapour is condensed into water and (b) where the piping system is at the lowest points.

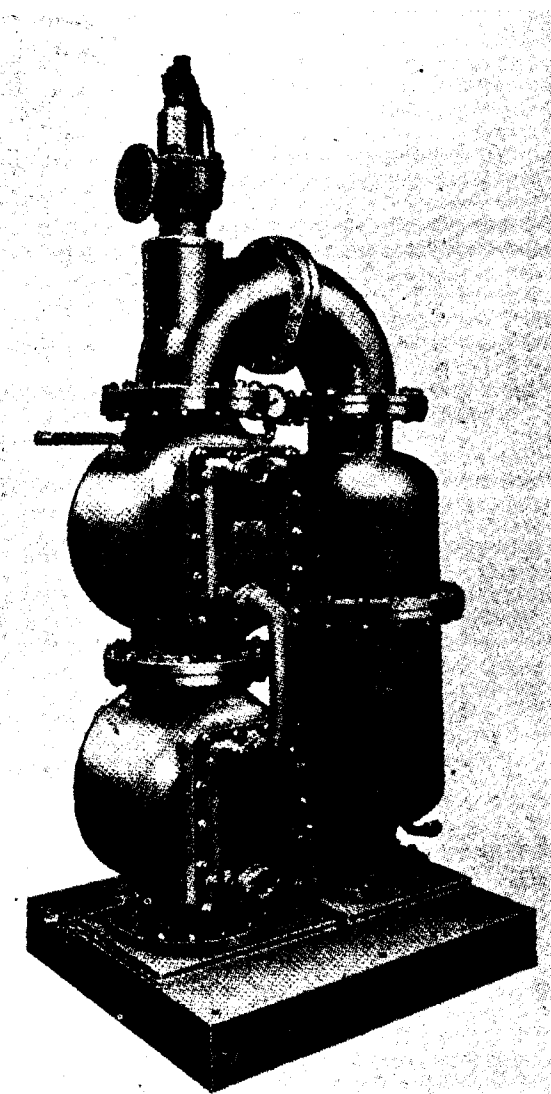


Fig. 2. After-cooler fitted in Atlas Compressors type AR.

In order to obtain better results before fitting the moisture traps it should be ensured that the pipes are sloping towards them at about 0.5 or 1 in 100. For avoiding too frequent drainage of moisture, in case of the trap fitted with hand operated drain cock, its volume should be at least 3% of the volume of the line it serves.

SEPARATORS

Designed as an essential unit of a compressed air pipe system, where greater volumes of water in droplet form are present in the air-stream, the separator has set a high in clean dry air supplying to tools and other pneumatic equipment.

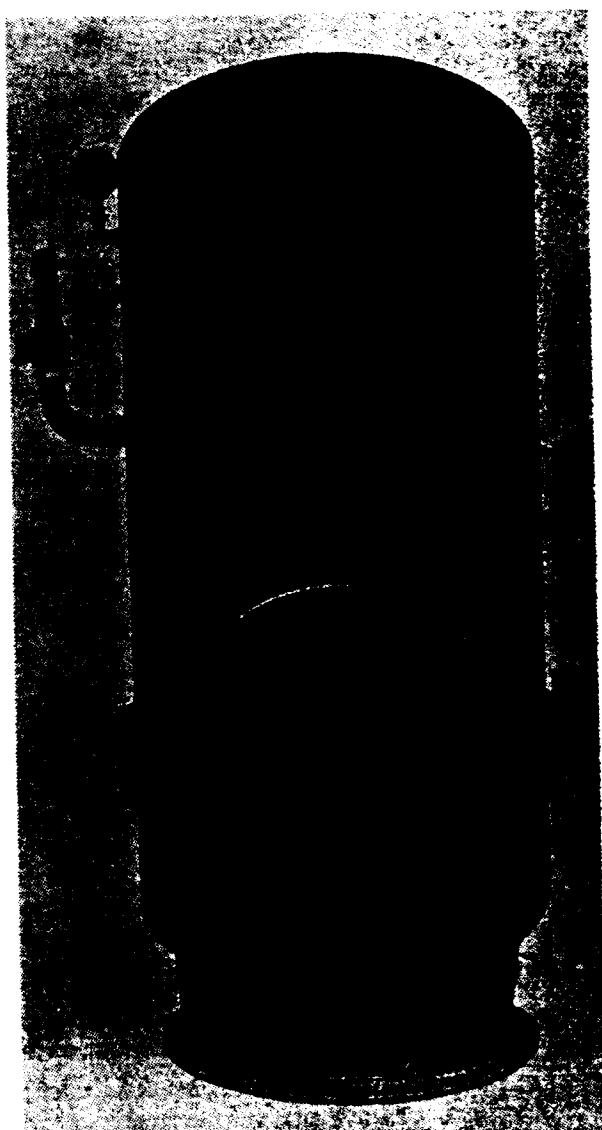


Fig. 3. Receiver.

The following mechanical means have been applied in the design of separators: (i) Reduced velocity and sudden change of direction of the air-stream to produce separation of liquid droplets from air, (ii) Application of centrifugal force for that purpose, and (iii) Splitting up of the air stream and filtering droplets out.

Illustrated in fig. 4, is a separator incorporating the method described in item (iii). Air in this separator strikes deflector (2), and is impinged against sides of housing (1). Oil, water and heavy dirt particles drop to bottom and are drawn off through drain (5). Fine dirt particles are removed from air by positive action of the dry-type filtering medium which covers the radial fin insert (4). Louvred housing (3) evenly distributes air over surface of insert.

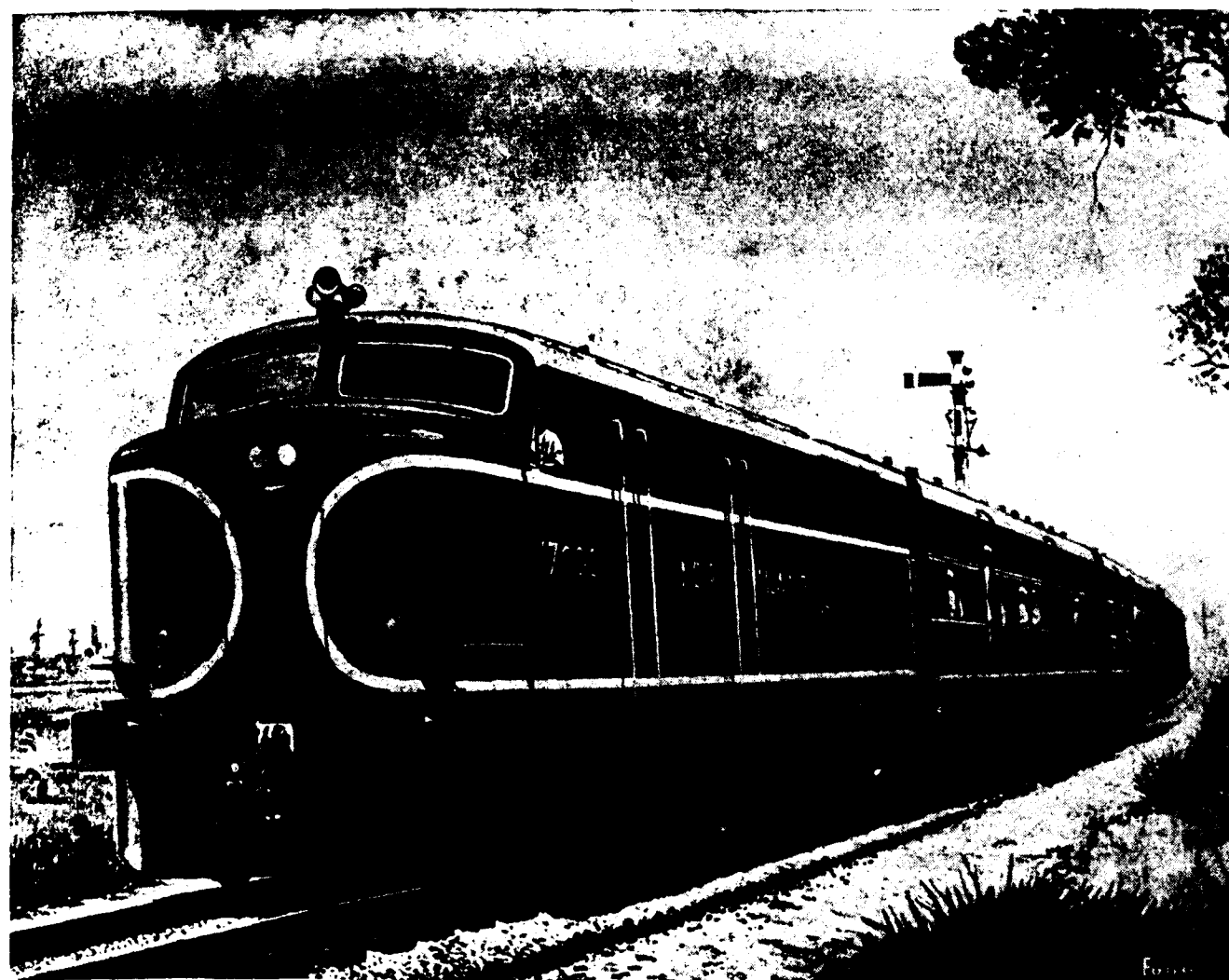


Fig. 4. Air Separator for splitting the air stream and filtering droplets out so as to deliver a clean dry air to pneumatic tools and equipment.

CONCLUSION

In the big drive for increased productivity, efficient working on air is a vital necessity. Not only does it improve production methods but it also eliminates worker's fatigue and lowers operating costs. The economies are thus passed on to the user.

The applications of compressed air to-day are being expanded into every conceivable field which has ever been increasing. In that context the importance of a concerted effort to minimise air losses and put the air, wasted in several ways, back to work needs no greater emphasis.



From the ALCO collection—write for \$9 x 12 1/2 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

THE SPIRAMATIC JIGMIL

The Lutterworth Works of Alfred Herbert's in the U.K. have been extended for the production of DeVlieg Spiramatic Jigmils—machines in which accuracy is the keynote

A product which is highly accurate and simultaneously capable of modification to design changes—this is the keynote of the manufacturing technique of the Spiramatic Jigmil now being turned out by Alfred Herbert Ltd. at its Lutterworth works.

It is the smallest of the range of DeVlieg Jigmils, known as the Herbert-DeVlieg No. 2B/36 Spiramatic Jigmil and it is being manufactured under license from the DeVlieg Machine Co. of Detroit, U. S. A.

Apart from minor exceptions, it is an exact copy of the American-made machine, to ensure interchangeability between components for both manufactures. Alfred Herbert's are using the Unified Thread System throughout manufacture and have adopted the DeVlieg standards for such components as splined shafts.

The manufacturing processes are identical to those which have proved satisfactory in the DeVlieg works.

The Jigmil has a general assembly accuracy of .0001" per foot. All major castings are stress relieved and to ensure that stress is not re-introduced, clamping of the component in subsequent machining operations is kept to a minimum.

The weight of the component and side and end locating blocks provide the necessary rigidity, whilst machining at low cutting speeds. Stresses set-up by heavy metal removal are also avoided. Invariably the extended machining times are offset by the time saved in subsequent fitting.

After machining, the castings are stored singly to minimise risk of unnatural deflections; special pallets are provided for such components as the saddle.

Precision block levels, auto-collimator and master bedding plates are used in the scraping of the bed and columns.

Boring of all the castings is carried out on DeVlieg 2B/36 and 4B/60 Jigmils. Certain milling operations are also done on these machines.

A point of interest is that the feed box is produced in two parts—each is bored separately and then bolted together—the dowel holes being produced at the same time as the bores. This procedure saves time and eliminates the need for long and complex boring bars with their attendant difficulties of tool setting and bar flexing.

This method of production however, is dependent on the inherent accuracy of the Jigmil itself. The 4B Jigmil is used for milling such parts as the lead screw nut guide channels on the upper side of the saddle and various tenon slots. It is also used for boring the locating holes in the index tables. These operations exemplify the ability of a Jigmil to perform relatively heavy machining and maintain alignments for extremely accurate boring operations.

The whole of the manufacturing technique of the Jigmil is based on the belief that high accuracy of machining with the minimum of special tooling can produce economically a product which is itself highly accurate, but at the same time readily capable of modification to design changes which are bound to occur with ever increasing development in the application of programme control systems in the modern machine tool.

The Microbore

The new production line for producing Microbore tools also serves to show how a new manufacturing technique can ensure a better quality product and effect economies.

Previously the Microbore cartridge was turned from the bar and threaded in one operation on capstan lathes. Thus for subsequent operations the thread was liable to be damaged especially as on certain operations the thread was used for locating and clamping.

The new sequence of operations for machining the cartridge is as follows—

1. Machine cartridge from bar on Herbert Capstan Lathe.
2. Centreless grind thread diameter.

(Continued on page 46)

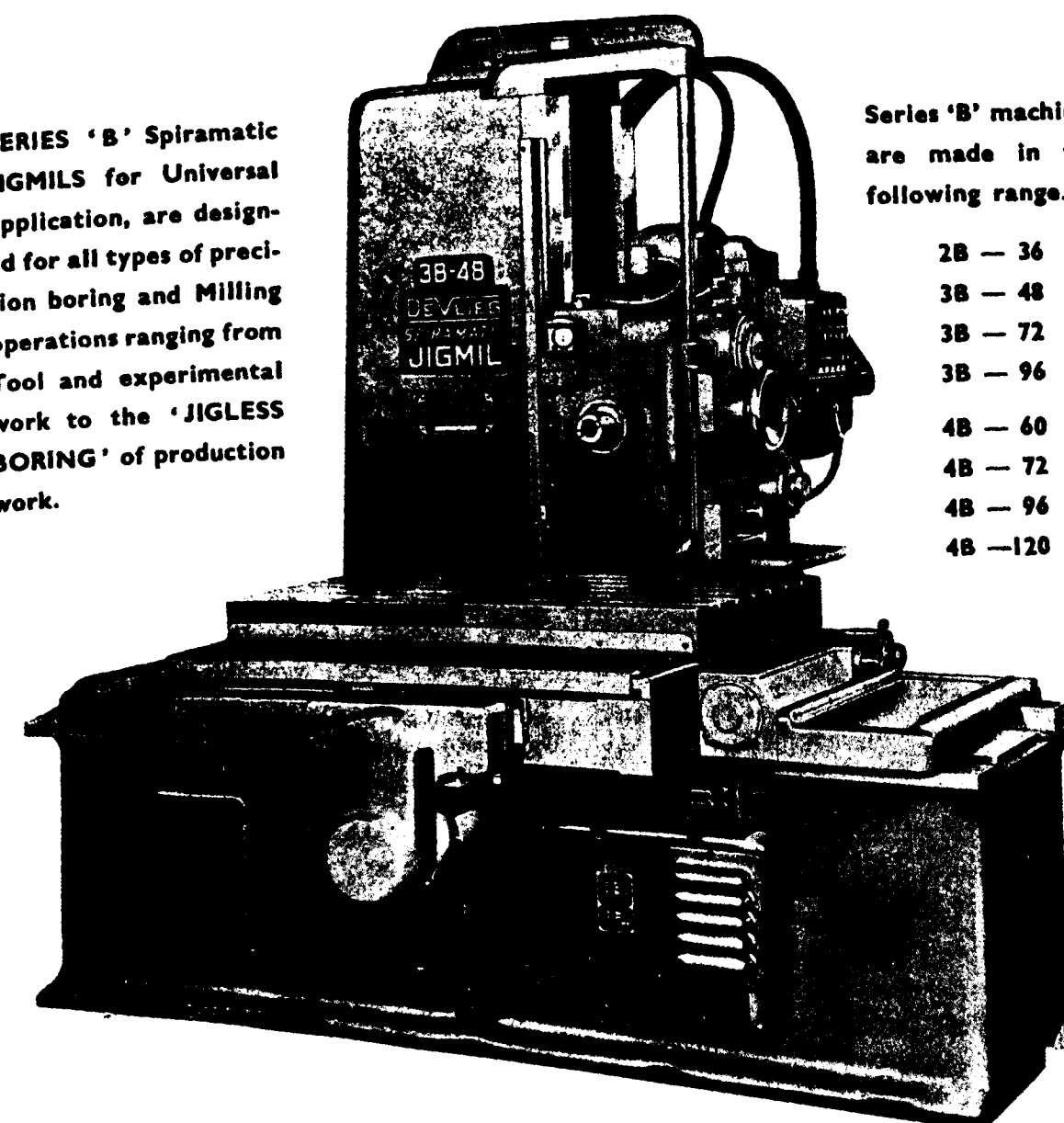
"DE Vlieg" spiramatic JIGMIL

for Ultra precision Boring and Milling

SERIES 'B' Spiramatic JIGMILS for Universal application, are designed for all types of precision boring and Milling operations ranging from Tool and experimental work to the 'JIGLESS BORING' of production work.

Series 'B' machines are made in the following range.

2B — 36
3B — 48
3B — 72
3B — 96
4B — 60
4B — 72
4B — 96
4B — 120



Sole Agents for India

ALFRED HERBERT (INDIA) PRIVATE LTD.,

13-3, STRAND ROAD, CALCUTTA-1

Grams: 'MACHINE' Calcutta

Post Box 681

Phone: 23-4801-2-3

Branches at: BOMBAY — MADRAS — BANGALORE — SECUNDERABAD — NEW DELHI

SPE "WALTER" Type Split Bushes for use on Railway Signalling Equipment

SIGNALLING equipment with its multiplicity of potential wearing points—for example, compensators, cranks etc.,—presents an appreciable problem for railway maintenance staff if the inevitable wear is to be kept within the limits necessary to maintain efficient operation.

To meet this situation most railways have now adopted the policy of bushing components so that wear is confined to a renewable steel bush rather than allowing it to develop on a component expensive to repair. Such a policy necessitates (a) the accurate machining of bushes to provide the required interference fit - (b) the provision of oversize bushes and pins to suit holes which for various reasons subsequently need enlarging and ultimately (c) the scrapping of components when the maximum hole diameter is exceeded. It also implies the existence of hydraulic or pneumatic presses for fitting and removal, and transportation of components to and from such presses.

A simplified and economical method of bushing various components using normal hand tools only can be carried out by using Walter Patent Split Bushes as manufactured by SPE Company Limited, Edinburgh Avenue, Slough, England.

The split bush is tapped into place and positively locked into position by the application of a tapered key firmly driven home, the protruding ends of the key being finally cut off and the edges left smooth. To remove such a bush when worn is equally simple, and as the Walter bush is case-hardened it ensures utmost resistance to wear even when positive lubrication is absent. It is also supplied in stainless steel and bronzes.

As such a bush does not have to withstand the pressing-in stresses normal to a plain bush, it is not necessary for it to have a wall thickness of more than $\frac{1}{8}$ in. and therefore for the same size pin a smaller hole in the component is required. This if the Walter bush is embodied in new designs opportunity may be taken to reduce the cross section of the component without reducing strength and so obtain a reduction in material resulting in a light component.

The Walter Bush can be worked to close tolerances. The tolerance is actually only the variation in the wall thickness of the bush. During manufacture of these bushes they are placed into a definite outside diameter hole and the bore is sized, thus controlling the wall thickness to within $-.000"$ to $+.002"$ for normal applications. For example a 1" outside diameter bush,

(Continued from page 44)

3. Form ears.
4. Mill tip seat.
5. Roll-engrave tip grade identification.
6. Induction braze Ardoloy tip.
7. Vapour blast.
8. Roll thread.
9. Grind and lap Ardoloy tip.

This sequence of operations ensures that the accuracy of the thread is closely controlled.

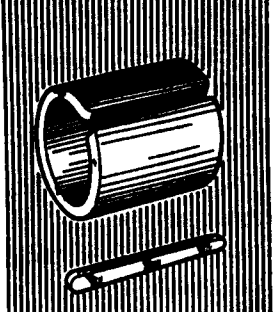
The dials are also being produced from the bar on Herbert Capstan Lathes.

Alfred Herbert's are installing a new type of tool grinding machine for semi-automatically grinding an accurate tool profile. This machine, developed by the DeVlieg company, enables a very accurate radius blended with the cutting edges and relative to the clearance angles, to be ground. It is also possible to grind either conical or cylindrical radii by offsetting the axis of the work-holding arrangement.

Alfred Herbert (India) Private Ltd. the sole selling agents will be pleased to deal with enquiries.

(With acknowledgment to and by courtesy of the Machine Tool Review and Alfred Herbert Ltd., Coventry).

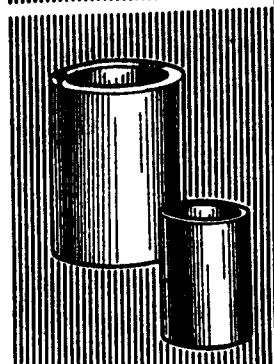
BUSHES



**WALTER PATENT
SPLIT BUSHES**

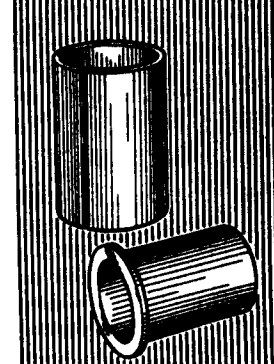
in
CASE-HARDENED STEEL
**NON-CORRODIBLE HARDENED
STAINLESS STEEL**
NON-CORRODIBLE BRONZES

Manufactured in other materials
to customer's specification
Supplied with taper keys in size
range $\frac{1}{8}"$ to 12" internal diameter



PLAIN BUSHES

in
HARDENED & GROUND STEELS
HARDENED STEELS
(Burnished finish)
**NON-CORRODIBLE HARDENED
STAINLESS STEELS**
(Ground or Burnished Finish)
BRONZES - Thin or thick walled



**WRAPPED
BUSHES**

in
STEEL
BRONZES - Thin or thick walled

**FLANGED
BUSHES**

in
STEEL
BRONZE

- Manufacture of Bushes in other materials to customer's specification
- Large or small quantities


COMPANY LTD.
SLOUGH BUCKS ENGLAND
TELEPHONE: SLOUGH 22277 TELEGRAMS: PPHSL SLUGH

when fitted to a normal 1" hole can be supplied to give the following bore tolerances.

"A"	$+.006"$
	$+.010"$
"B"	$+.002"$
	$+.004"$
"C"	$+.002"$
	$-.000"$

The difference between the Walter Bushes and a solid bush is that the variation in outside and inside diameters is dictated ONLY by the exactness of the holes in which these bushes are fixed.



Where, however, they are required to replace plain bushes in stock already in service the wall thickness or outside diameter can be increased to meet existing conditions.

In specifying such bushes for new stock the question of standardisation is most adequately dealt with, since future renewals call simply for the replacement of bushes of the original size, and no question of stocks of oversize bushes arises, nor consequent renewal of main components.

Wagon Output Rises Six-Fold in 10 Years

Production of railway wagons in India has increased nearly six-fold since independence.

During 1947-48, production totalled approximately 3,100 units. Five years later, in 1952-53, it increased to 6,388. Production rose faster during the subsequent five year period, and 17,390 wagons were turned out during 1957-58.

At the initial stages, only general purpose wagons were manufactured in the country, and most of the special purpose wagons were imported. The manufacture of the latter types has since been developed in the country, and all requirements of the railways can now be met entirely from indigenous production.

In addition to the established wagon manufacturers, educational orders have also been placed on 10 new manufacturers in different parts of the country.

COMPRESSED AIR EQUIPMENT IN RAILWAY MAINTENANCE

IN recent years compressed air has become a more and more utilized aid in almost all branches of industry and communication. This development is manifested not least in railway operation. Much of the heavy and time consuming work which was earlier carried out manually—in workshops as well as on the railway tracks—has nowadays been taken over by rapid and cost saving pneumatic tools.

For example, in workshops pneumatic drilling and grinding tools, impact wrenches, riveting and chipping hammers, and air hoists are used for sundry purposes. Earlier electric tools were used for certain purposes on almost the same scale as pneumatic tools. During the last 15 years the former have to an increasing extent lost ground to the in many ways superior, pneumatic counterpart.

PNEUMATIC TOOLS VERSUS ELECTRIC TOOLS

A comparison between these two categories of tools shows that the air tools are for many reasons the most advantageous. For example, compared with electric tools they are considerably simpler and more reliable and require very much less maintenance. A pneumatic tool cannot be damaged by overloading. On the other hand, if an electrically operated drill steel should become stuck the consequences can easily be that the tool becomes overheated and damaged, especially if the drill becomes stuck on frequently repeated occasions. A pneumatically operated drill is, on the other hand, absolutely unaffected in this respect and can therefore be considerably more overloaded. (This feature of the tool is, of course, of great advantage when the tool is operated by unskilled workers).

As a rule the pneumatic tools are considerably lighter in weight than electric tools of a corresponding capacity. As an example can be mentioned that for a pneumatic 6" grinder of a certain type the relation between weight and capacity is 5 lb. per hp. For an electric tool having the same capacity the corresponding figure is 15 lb. per hp. Consequently, when powerful, but nevertheless easily handled tools, are needed pneumatic tools are the best solution.

Different types of pneumatic tools

DRILLS

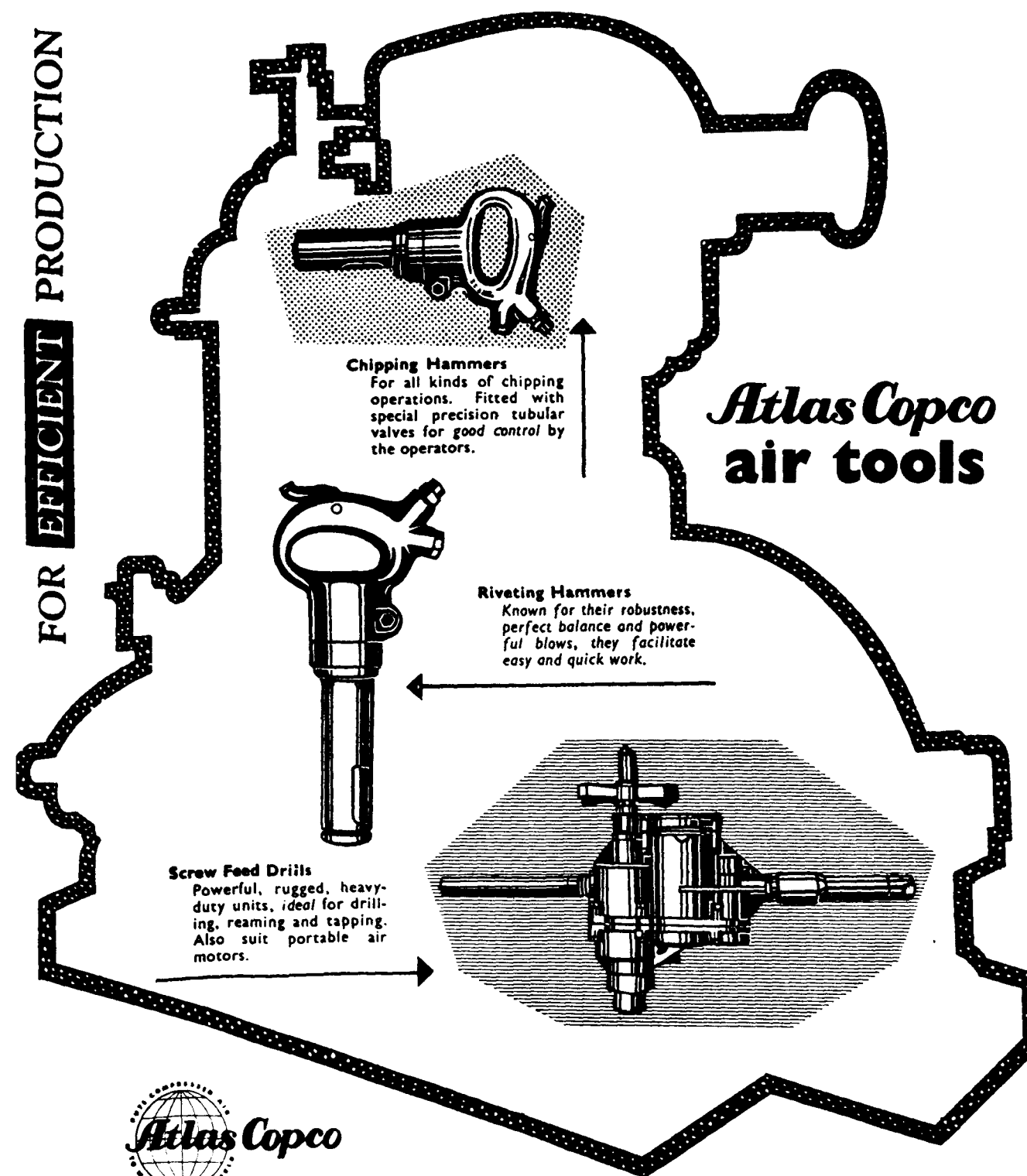
Pneumatic drills are made in many different types and sizes. The smaller types (designed for drilling holes up to 1/2" in diameter) have usually a straight handle or piston-grip handle and are made for either straight drilling or close quarter drilling. These tools are available for a large number of different speeds suitable for various material and operations.



Used as a rock drill the Cobra has a net drilling rate of 8"/min. and an overall rate of 26 ft./hr. in hard granite.

The larger types, for holes up to 3" in diameter, have a lower speed—from 100 r. p. m. to 600 r. p. m.—and are designed for two-handed operation. The weight ranges from 15 lb. to 60 lb. The tools are delivered either reversible or non-reversible and can be used for drilling as well as reaming.

FOR EFFICIENT PRODUCTION



Chipping Hammers
For all kinds of chipping operations. Fitted with special precision tubular valves for good control by the operators.

Riveting Hammers
Known for their robustness, perfect balance and powerful blows, they facilitate easy and quick work.

Screw Feed Drills
Powerful, rugged, heavy-duty units, ideal for drilling, reaming and tapping. Also suit portable air motors.

Atlas Copco
air tools



For All Pneumatic Tools Consult:

VULCAN TRADING COMPANY PRIVATE LIMITED

Bombay • Calcutta • Madras • New Delhi

ADVERTS



An Atlas Copco air drill RAB-12 fitted with a special device for drilling holes in rails.



The Atlas Copco LSR-61 straight grinder weighs 12 lbs. and develops 6,750 rpm with a 5" grinding wheel.



A grinder fitted with a reinforced hub wheel which allows peripheral speeds of up to 250 ft./sec.

SCREWDRIVERS AND TAPPERS

are in principle of the same design and construction as the smaller types of drills. The screwdrivers are, however, fitted with an adjustable clutch between the motor and the driver for different torque moments and the tappers are provided with an automatic mechanism for reversing the direction of rotation.

GRINDERS

In addition to the grinding of metals—casting, welded joints, etc.—the pneumatic grinders can be used for sundry purposes and instead of grinding discs they can be fitted with cutting discs, rotary files, wire brushes, polishing discs, etc. By means of the embodied speed regulator it is possible to obtain a large number of different speeds for various grinding discs and operations.

IMPACT WRENCHES

have a vane type motor as the power source for the special impact mechanism. These tools have a very powerful torque whilst at the same time the reaction moment affecting the operator is relatively negligible.



A heavy duty impact wrench (Atlas Copco LMS-62)

Impact wrenches are reversible and can thus be used for loosening and tightening nuts as well as for other purposes such as thread cutting, drilling, etc.

RIVETERS

The larger types of riveters, which produce from 800 to 1900 blows a minute, are as a rule used for hot riveting. The smaller types have usually a higher impact rate and are used with light alloy rivets or small rivets of soft steel. By means of a special regulator it is possible to adjust the power and rate of the blow of these tools.

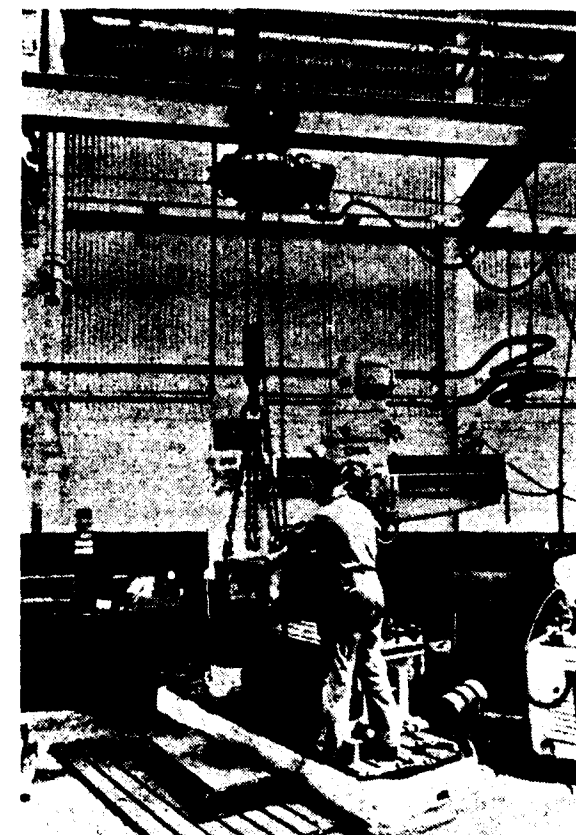
Rivet Busters are of the same design as riveters, but use a steel chisel instead of the rivet set. They are used for cutting off the heads of driven rivets and for backing out of the remaining positions.

CHIPPING AND SCALING HAMMERS

are used for many different purposes, such as weld descaling, fettling work, caulking, removing rust and scale from boilers. Weighing from 4 lb. to 15 lb. they produce from 1700 to 3000 blows per minute.

COMPRESSED AIR FOR TRACK MAINTENANCE

Also when it is a question of working on the railway track, compressed air has a wide field of application. When it is a question of rock drilling the pneumatic equipments used are reigning supreme and are so universally known that they can be overlooked in this connection. Some other fields of application shall be mentioned instead.



AIR HOISTS which are made with capacities ranging from a few hundred pounds up to 5 tons, have proved invaluable when handling heavy equipment in workshops.

PAVING BREAKERS, PICKS AND DIGGERS

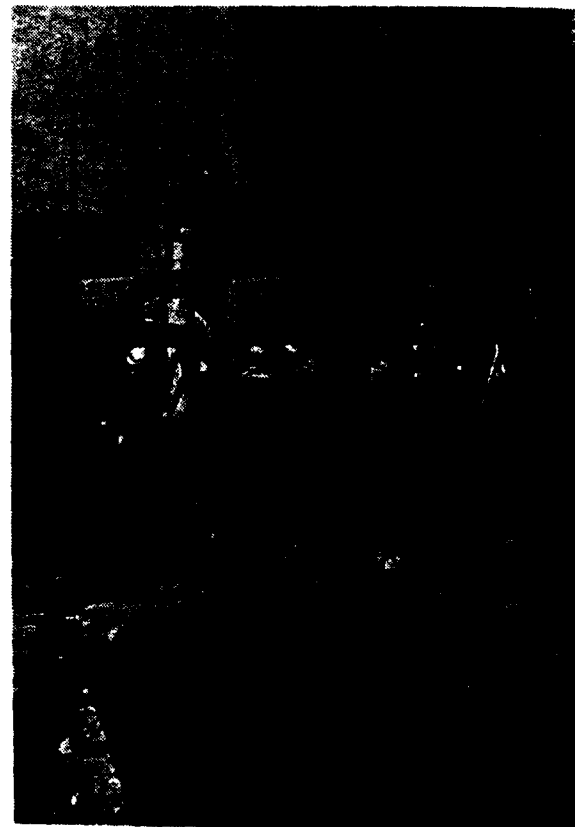
have a very wide range of applications and be fitted with various tool steels such as spike drivers, tampers, clay spades, asphalt cutters, moil points and chisels. The weight of the various types ranges from 20 to 80 lb.

PNEUMATIC PILE AND SHEETING DRIVERS

are designed for pile diameters up to 14". The larger types are operated by means of a crane whereas the smaller types can be handled by one man. The impact rate varies from 1150 blows per minute for the smaller types to 200 blows per minute for the larger types.

SUMP PUMPS

Compressed air driven centrifugal sump pumps are very simple and robust in design. In spite of their



The Atlas Copco E20 paving breaker at work.

small dimensions and light weight they have a high capacity and can also pump very dirty water, sewage and moderately heavy sludge. Different types with heads up to 240 ft. are manufactured.

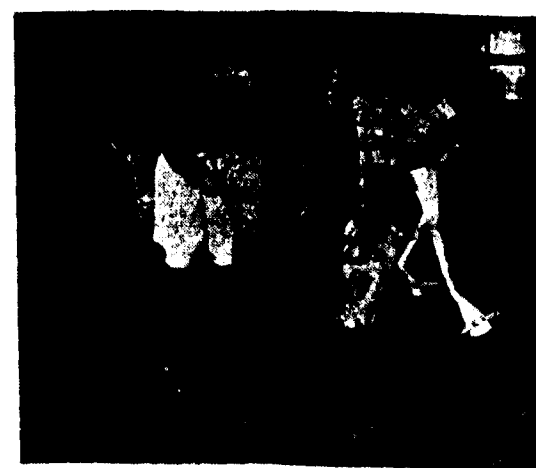
TIE TAMPING

When it is a question of working economy there is no doubt that compressed air is without competition as an operating method for the types of tools described above. As sites where it is not possible to acquire a compressed air source at a reasonable cost there is an excellent alternative to this power source in internal combustion engine driven machines. These have proved particularly suitable for tie tamping.

Mechanical tie tamping is more economical than manual tie tamping and, moreover, it gives a better result in the way of more even packing and better durability. For this reason tie tamping tools of different types are being employed to an increased extent: (1) large railbound machines and (2) hand-held tie tampers which can be either pneumatic,



Picture shows the driving of wooden sheeting using Atlas Copco pile driver type P-60EP.



Tie tamping with the Atlas Copco "Cobra"

electric or internal combustion engine driven. It is principally on sidings and railway lines having a high traffic intensity—where the rails cannot be blocked during the work but the traffic must be allowed to run uninterruptedly—that internal combustion engine driven tie tampers have proved to be superior to other types. Contrary to these other types it is

entirely independent of compressors, air hoses, electric cables, etc. which must be moved out of the way when a train is to pass. Furthermore, the internal combustion engine driven machines have the advantage that they can be used for a number of different purposes; rock drilling, breaking, driving rail nails, etc.

These machines have found a wide field of application especially at the German railways. A recent example from Germany reveals that the costs of tie tamping can be reduced by 40% by employing internal combustion engine driven tie tampers. In this particular case an Atlas Copco "COBRA" was used, which has weight of only 53 lb.

PROTOTYPE TRACK RECORDING COACH FOR BRITISH RAILWAYS

INCREASED ACCURACY AT HIGHER SPEEDS ACHIEVED WITH NEW DESIGN

The decision has been taken to introduce a prototype track recording coach to British Railways, capable of giving a highly accurate record of the condition of track at speeds considerably higher than has been possible with existing recording equipment.

A specification for a two-axle self-propelled vehicle was drawn up by the British Railways Civil Engineers and circulated to manufacturers in this country, concentrating on the two most important features of curvature and cant, and in particular, the measurement of their relationship on transition curves.

This specification stated that the coach was to be capable of travelling at speeds up to 30 m. p. h. on a rising gradient of about 1 in 100, and to have an i. e. engine, and suitable transmission, driving and braking controls, and conform to British Railways requirements in general design. The individual axle load was not to be less than 8 tons, and the coach was to be capable of accommodating ballast to give axle loads up to 12 tons to obviate voids under sleepers.

CONTINUOUS RECORDING

The apparatus to be provided was to record continuously the various readings of cant, and average curvature on a chord length and so on, with a required accuracy. Amongst other items, the coach was planned to be completely self-contained as regards power supplied for instrumentation and other purposes such as lighting and heating, and suitable for testing from an external power supply; the importance of simplicity and reliability of the vehicle and equipment being stressed.

PRELIMINARY INVESTIGATION

Before asking the manufacturers to proceed with the

development of the apparatus necessary it was thought desirable to prepare a design study, to show whether it was, in fact, possible to meet the specification. A report was later produced which indicated that it appeared possible to do so.

Consequent on this the British Transport Commission placed a development contract with Elliott Bros. (London) Ltd., for the manufacture of a prototype coach for service operational trial, with D. Wickham & Co. Ltd., as sub-contractors for the mechanical parts.

MEASURING SYSTEM

The problem of measuring cant, to plus or minus $\frac{1}{4}$ in. called for in the specification, is achieved by gyroscopic equipment, similar to that used in guided weapon fields, though disturbing forces in a railway vehicle are generally more vicious than those found in these spheres.

Curvature is measured by using a system of three probes bearing against the inner face of the rail, the distance between the centre probe or slipper and the line connecting the two outer slippers, giving the offset and a measurement of curvature.

Preliminary experiments on a trial probe system over a distance of some 1,800 miles have indicated that the required probe accuracy can be achieved, and that the wearing life is satisfactory.

With the vehicle it will be possible to pin-point specific defects in the track which can be rectified in conjunction with present maintenance methods or possibly combined with new principles of maintenance.

These are matters which will arise out of the extensive trials to be made with the prototype coach when the complete equipment is available.

RANGE OF EUMUCO MACHINES

Spring Buckle Expansion Press provided with hydraulic or oil-hydraulic drive

DESCRIPTION OF PRESS

The press is suitable for all other types of work within its capacity, and each must be performed vertically. Both table and press cylinder are attached by powerfully proportioned steel plates. The press cylinder also carries the return cylinder. Press and return pistons move simultaneously and are connected by two traverses and tie rods in longitudinal guides. The water chambers are sealed by means of leather gaskets which are secured by sealing bush flanges, easily accessible from the outside.

The return cylinder is directly connected with the pressure water line and is under constant pressure. A twin valve control is provided between the pressure cylinder and the pressure water line.

The press is constructed of carefully chosen materials subjected to thorough works inspection. For example, both cylinder and table are manufactured of annealed cast steel, and the plunger is manufactured from forged steel. All wearing parts are of generous proportions.

The drive to the press is via a three-stage three-plunger pump. Should an accumulator unit be available the Press may be connected to this. We construct this machine also equipped for hydraulic drive.

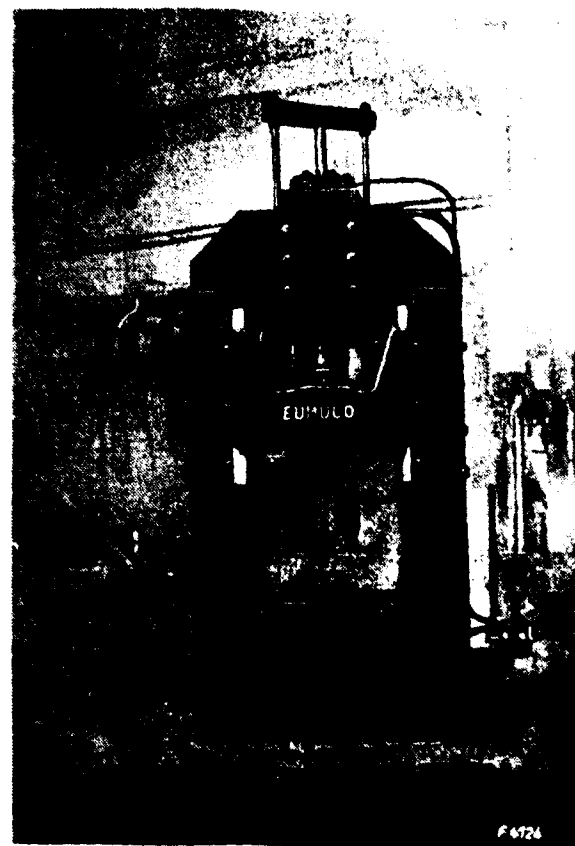
PERFORMANCE OF PRESS

A vice, mounted on the press table, serves for the insertion of spring buckles. The expansion tool is

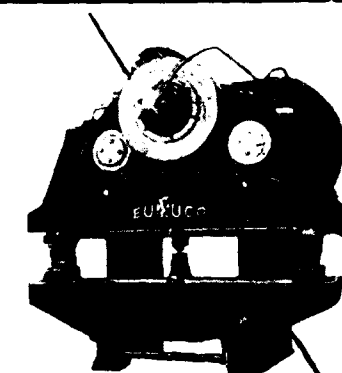
Principal Dimensions

pressure	approx. 100 ts.	
return capacity	" 30 ts.	
working pressure	" 200 kg/cm ²	= 2845 lbs/sq. in
daylight between frames	" 570 mm	= 22 7/16"
bottom area of press table	" 500 × 500 mm	= 19 11/16" × 19 11/16"
top area of press table	" 460 × 460 mm	= 18 1/8" × 18 1/8"
closed height between press area	" 600 mm	= 23 5/8"
stroke of press piston	" 250 mm	= 9 7/8"
maxi. size of spring buckle	" 120 × 70 mm	= 4 3/4" × 2 3/4"
weight of machine	" 3650 kg	= 8030 lbs.
HP required of pump	" 5, 2	
HP required of motor	" 7	
RPM	" 1500	
weight of pump	" 600 kg	= 1320 lbs.

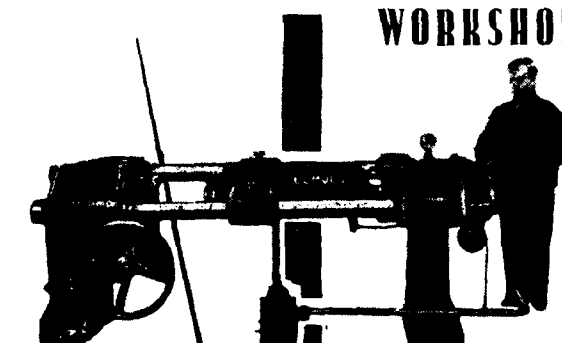
clamped to the upper pressure plate. By simply switching the lever provided on the control body, the expansion stroke and return of the press plunger are actuated. According to requirements, the working speed and press is automatically regulated by delivery of the pump.



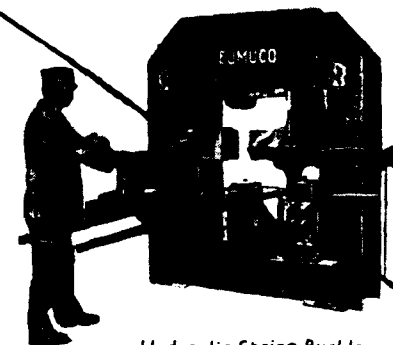
**MACHINES
FOR
RAILWAY
WORKSHOP**



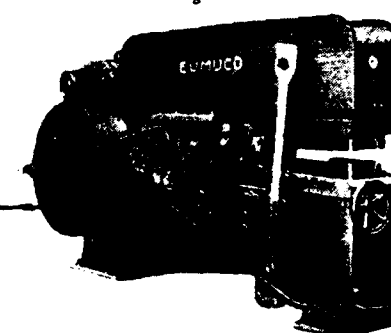
Eccentric Press for Springs



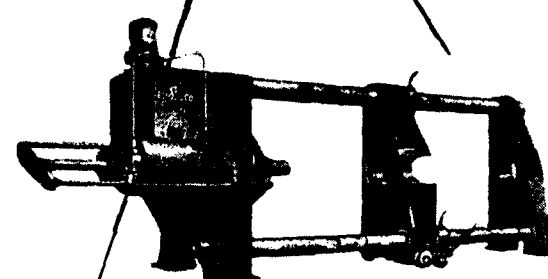
*Hydraulic Spring Buckle
Pulling-off Press*



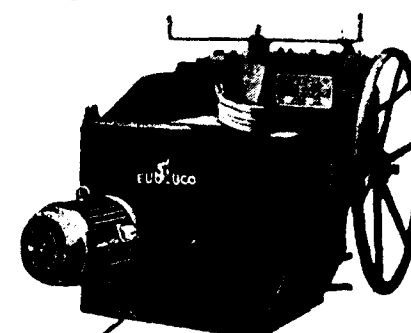
*Hydraulic Spring Buckle
Mounting Press*



*Tube Reducing and Expanding
Machine*



*Oil-Hydraulic Wheel-Mounting
and Demounting Press*



Spring Bending Machine

EUMUCO

**EUMUCO AKTIENGESELLSCHAFT FÜR MASCHINENBAU · LEVERKUSEN I
GERMANY**

Spring Buckle Demounting Press suitable for carriage springs provided with hydraulic or oilhydraulic drive

DESCRIPTION OF PRESS

The open, horizontal construction of the press permits of rational and comfortable operation. The press consists mainly of one abutment and a press cylinder securely connected by two powerful anchors. The pressure slide with its long bushed guides moves smoothly on accurately machined tie rods and is firmly connected to the press piston. The slide return is effected by means of counter-weights.

The water pressure chamber is sealed by leather gaskets which are easily interchangeable.

A slide, which is vertically adjustable by means of a hand wheel, is provided within the abutment which can be locked in any position. The press is made of carefully chosen materials subjected to rigid inspection. For instance, the abutment, press cylinder, and slides are of annealed cast steel. The press cylinder and anchor are of forged steel. All wearing parts are of generous proportions.

It is advantageous to provide a crane or hoist above the press to facilitate the positioning of spring buckles and to ensure a rational utilization of the Press. Operation of the Press is via twin-step three-plunger pump. Should an accumulator unit be available the Press may be connected to same. We construct this machine also equipped for oilhydraulic drive.

PERFORMANCE OF PRESS

The operation of the press is extremely simple.

Principal Dimensions

pressure	approx.	100 ts	
stroke of piston	"	350 mm	13 3/4"
working pressure	"	200 kg/cm ²	= 2845 lbs./sq. in.
weight of machine	"	1850 kg	= 4070 lbs.
HP required of pump	"	7, 2 kg	
HP required of motor	"	9	
RPM	"	1500	
weight of pump	"	600 kg.	= 1320 lbs.

**

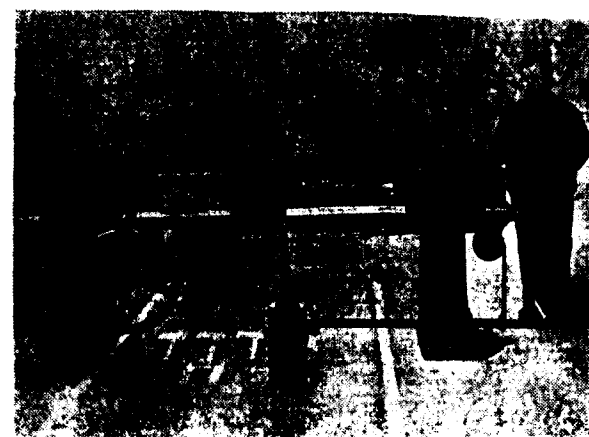
**

**

After having placed the spring buckle on the Press from above with the buckle against the face of the abutment, the operator is able to regulate the height with one hand by means of the hand wheel, while he actuates the press control lever with the other. The working speed of the press is automatically regulated by the pressure of the delivery pump.

First the wedge is removed from the spring buckle, after which the mere removal of a leaf or two will suffice to dismount the complete spring assembly. The operation of the EUMUCO Spring Buckle Dismounting Press requires only one man for the dismounting of *box carriage* or *carriage springs*.

Experience has proved that the EUMUCO machine is capable of handling up to 320 *box car springs* per shift of 8½ hours.



Spring Buckle Mounting Press suitable for carriage springs provided with hydraulic or oilhydraulic drive

DESCRIPTION OF MACHINE

The machine is totally enclosed but easily accessible from all sides. The frame is of robustly dimensioned steel plates in which the two abutments and both horizontal and vertical cylinders are housed.

The piston return is effected by counter-weights.

The press is provided with a track and carriage on which to advance and return the spring buckle. The abutment is extendable, allowing for unhindered advance and return of carriage and is easily adjusted by means of a lever and locking device. A two-stage three-plunger pressure pump is provided for the driving of the press. Should an accumulator unit be available, the press may be connected to same. The machine is also constructed for oilhydraulic drive.

Built into this machine is our vast experience obtained in various Railway Workshops. With a minimum of time and labour accurately fitting spring buckles can be produced.

PERFORMANCE OF MACHINE

The heated spring buckle is mounted onto the leaf assembly without, however, firmly tightening the wedge. It is then mounted on the carriage in front of the press. The spring assembly is then revolved into the correct position on the carriage and advanced to the press where the wrist pin enters a recess at the bottom of the pressure plate. Having adjusted the

upper abutment over the spring – ensuring that the spring leaves are in the exact position – one mounts the buckle. The tightening of the wedge is possible by a few blows with a hammer. The pressing operation is then initiated. Each cylinder is provided with a separate control, thus permitting the operation of either cylinder independently, or the simultaneous operation of both cylinders. The carriage carrying the completed spring assembly can then either be returned to its original position or pushed through to the other side as required for subsequent operation. The press is normally equipped to suit the former process, but may also be supplied with rails extending to the other side.

Experience has proved that the machine is capable of handling about 250 accurately fitting spring buckles per 8½ hour shift.



Principal Dimensions

maxi. horizontal pressure	approx.	90 ts.	
maxi. horizontal stroke	"	200 mm	= 7 7/8"
maxi. vertical pressure	"	90 ts.	
maxi. vertical stroke	"	200 mm	= 7 7/8"
service pressure	"	200 kg/cm ²	= 2845 lbs./sq. in.
weight of machine	"	3200 kg	= 7040 lbs.
HP required for drive pump	"	7, 2	
HP required for motor	"	9	
RPM	"	1500	
weight of drive pump	"	600 kg	= 1320 lbs.

**

**

**

Bilateral Straightening Roll suitable for the straightening of spring leaves upon tempering

DESCRIPTION OF MACHINE

The machine body is of welded steel plates and the continuous bottom roll is fixed. The two upper rolls are housed in eccentric bearing housings and are adjustable. The outside journals of the roll shafts support 4 slightly tapered straightening rolls. The distance between the rolls is independently adjustable for each pair of rolls. This is effected by two hand wheels at the front of the machine.

The machine is provided with a reversible pole electric motor giving two working speeds. The rolls are driven by the electric motor via V-belts, worm gear, and a pair of spur gears. The latter run in an oil bath. The other working parts and gears are automatically lubricated by means of a central lubrication pump.

The machine is portable being mounted on swivel rollers. The V-belt drive is protected by a cover. The straightening rolls are provided with guards for the operator.

PERFORMANCE OF MACHINE

The machine serves to straighten and rectify spring leaves which have been distorted during the tempering

process. Formerly such distortions were corrected with a hammer. For the purpose of straightening, the spring leaves are fed obliquely into the straightening rolls which take over the stretching of the spring roll. Since the rolls are slightly tapered the roll is easily fed and again released by a horizontal swinging movement. One can therefore also straighten very short workpieces. It is possible to operate each pair of rolls independently. By varying the spacing of the rolls and their pressure, it is possible to regulate the straightening effect. The straightening roll is particularly suitable for the straightening of high duty springs which have to be absolutely free of surface irregularities.



Principal Dimensions

Diameter of rolls	approx.	180 mm	=	7 1/8"	
width of roll	"	80 mm	=	3 1/8"	
maxi. pressure of roll permissible	"	25 ts.			
RPM of roll	"	15 and		10, respectively	
roll speed per second	"	140 and		95, respectively	
range of adjustment	"	3	—	16 mm	1/8" — 5/8"
HP required	"	9, 5			
RPM motor (pole reverser)	"	1500/1000			
weight of machine	"	3500 kg.	=	7700 lbs.	

**

**

**

Spring Leaf Bending Roll suitable for the straightening and bending of carriage springs

DESCRIPTION OF MACHINE

Both outer supporting rolls are firmly housed within the generously proportioned bed. They are driven by one reversible motor by a worm gear and 3 spur wheels. The bending roll proper is housed within a slide and is engaged by a hand wheel via spur wheels and a threaded spindle directed inside the rugged guides of the bed. The axle of the bending roll is provided with eccentric pinions and is quickly adjusted by a twin lever. This rapid adjustment is locked also by a twin lever, thus eliminating idle time when loading or unloading the spring leaf.

The surface of the bending roll is smooth whereas the surface of the two driving rolls is serrated. Nevertheless they leave no marks on the spring leaves. When reversing it or switching it off the self-braking motor is automatically braked.

All moving parts of the machine are generously dimensioned and special attention has been paid to efficient lubrication.

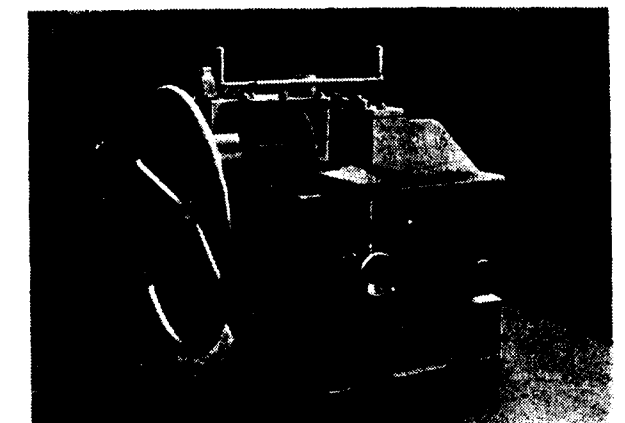
By loosening toggle (a) and revolving hand wheel (b) the table head can be adjusted vertically.

PERFORMANCE OF MACHINE

The machine serves for the straightening and bending

of old or new locomotive, tender, carriage, or box car springs, with or without eyes, which are usually hot processed. The vertical and open construction of the machine facilitates the loading of springs.

The spring leaf is mounted in the machine and pressed against the supporting rolls by the twin lever. The lever is then locked. With one hand the operator is able to manipulate the push-button which provides left and right return movements of the spring leaf during bending. With the other hand he operates the hand wheel providing precise adjustment of the bending roll. When the spring has sufficient bow the starter is disconnected and the spring is removed from the machine.



Principal Dimensions

Length of spring leaves	approx.	180—1400 mm	=	7 1/8" — 55"	
cross-section of spring leaves	"	120 × 16 mm	=	4 3/4" × 5/8"	
	and	150 × 13 mm	=	5 15/16" × 1/2"	
strength of springs	"	65— 85 kgs/mm	=	41	— 54 ts./sq.inch.
number of bending rolls	"	3			
bending speed per second	"	165		— 6 1/2"	
HP required	"	10			
RPM	"	1450			
weight of machine	"	2100 kg	=	4620 lbs.	

**

**

**

Double Frame Press suitable for the handling of spring leaves in the cold state

DESCRIPTION OF MACHINE

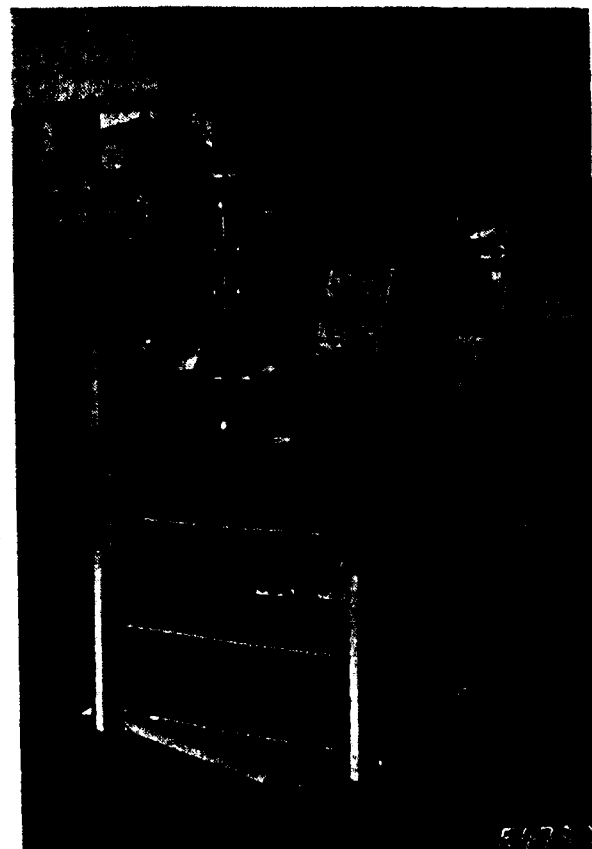
The ram is actuated by means of two push rods arranged longitudinally on an eccentric shaft. The crankshaft is electrically driven via spur gears and V-belts. Our proven pneumatically operated single disc friction-clutch is incorporated into the fly-wheel, the pneumatically operated single-disc brake being assembled on the opposite end of the shaft. Both clutch and brake are controlled electro-pneumatically. The control can be set for single-stroke-operation, "setting", and continuous running. The machine is engaged by a foot switch. When setting for single-stroke-operation the danger of a second stroke, i. e. "running through", has been eliminated even if the operator maintains a pressure on the foot switch. With the control at "setting" the ram can be "inched" as is necessary when adjusting new tools.

The clutch and brake require an air pressure of 71 to 85 lbs. per sq. inch.

PERFORMANCE OF MACHINE

The machine can be equipped with various types of tools depending on the type of spring leaves to be processed. For example, they can be arranged for the cutting of leaves, the pointing of leaf ends, the punching of circular or oblong holes, and the punching of centre nipples. With the exception of the latter which requires heating of the leaves, all operations can be performed on cold springs. Each tool is

provided with an adjustable length stop. The tools are arranged one after the other and the machine is engaged for each operation by means of the pedal. After each working stroke the ram comes to a stop at the dead centre.



Principal Dimensions

maxi. pressure of machine	approx.	200 000 kgs.
maxi. cross-section of spring leaf	"	130 x 16 mm = 6 5/16" x 5/8"
daylight between frames	"	950 mm = 37 3/8"
maxi. distance between table and ram	"	400 mm = 15 3/4"
stroke	"	65 mm = 2 9/16"
number of strokes per minute	"	35
HP required	"	10
RPM	"	1 000
weight of machine	"	6 500 kgs = 14300 lbs.

standard accessories :

- 1 set of tools comprising:
- 1 set of shear knives
 - 1 circular punch with die
 - 1 slot punch with die (for oblong holes)
 - 1 pointed punch with die (for nipling)
 - 1 tool for the pointing of leaves

**

**

**

Open Gap Double Frame Press suitable for handling hot spring leaves

DESCRIPTION OF MACHINE

The machine frame, table, and ram are of cast steel. The ram is actuated by two push rods each driven by transversely arranged eccentric shaft. Both eccentric shafts are connected with the fly-wheel by a common set of gears. Our proven pneumatically operated single-disc friction-clutch is incorporated into the fly-wheel, the pneumatically operated single-disc brake being assembled on the opposite end of the shaft. Both clutch and brake are controlled electro-pneumatically. The control can be set for single-stroke-operation, "setting", and continuous running. The machine is engaged by a foot switch. When setting for single-stroke-operation the danger of a second stroke, i. e. "running through", has been eliminated even if the operator maintains a pressure on the foot switch. With the control at "setting", the ram can be "inched" as is necessary when adjusting new tools.

All moving parts of the machine are of generous proportions. Both Bearing and sliding faces are automatically lubricated.

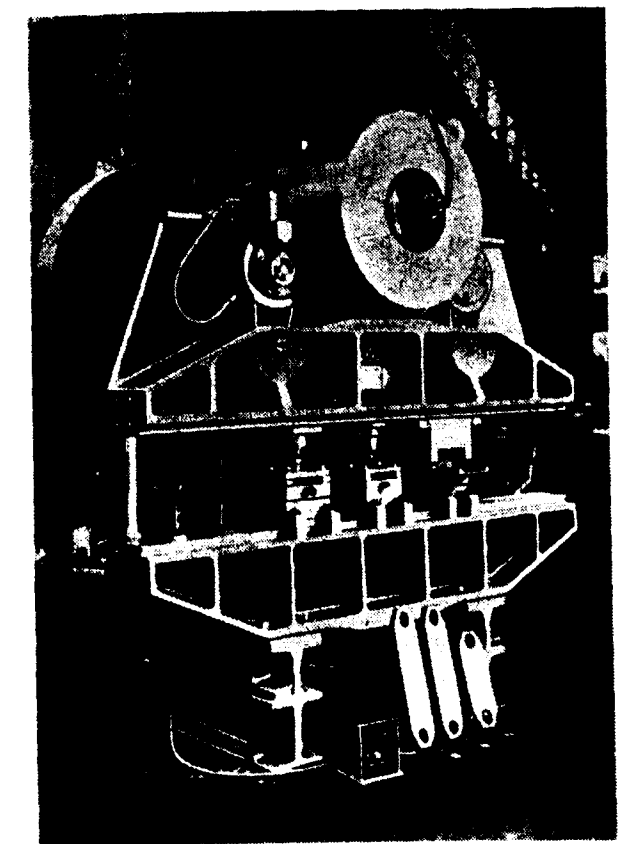
The clutch and brake require an air pressure of 71 to 85 lbs. per sq. inch.

PERFORMANCE OF MACHINE

The machine can be provided with tools whereby spring leaf ends are simultaneously cut or pierced and at the same time the nipple is punched: or alternatively using separate

tools for the cutting and piercing and punching of the nipple.

Special length stops or centering devices are provided for each operation. By using a common adjustment for various spring leaf lengths tools can be arranged. After cutting, piercing, etc. the leaves can be bent on a spring leaf bending roll in the same heat.



Principal Dimensions

maxi. pressure	approx.	100 t
maxi. cross-section of spring leaf	"	160 x 16 mm = 6 5/16" x 5/8"
maxi. length of spring	"	2100 mm = 82 3/4"
stroke	"	65 mm = 2 9/16"
number of strokes per minute	"	35
dimensions of table and ram	"	300 x 2300 mm = 11 13/16" x 90 1/2"
maxi. distance between table and ram	"	400 mm = 15 3/4"
overhang	"	150 mm = 5 15/16"
HP required	"	5
RPM	"	1500
weight of machine	"	5800 kgs = 12 750 lbs.

**

**

**

Forging Roll with attached Side Press suitable for pointing, cutting-off and swaging spring leaf ends

DESCRIPTION OF MACHINE

The gear housing of the machine is of cast iron with a cast-on base of grey iron. The mounted roller bearing columns are of cast steel. The upper roll is driven by electric motor via V-belts and back gear. The lower roll is coupled to the upper roll by spur wheels. An eccentric trunnion on the upper roll serves to drive the side press. Our well-proven pneumatically operated single-disc friction-clutch is incorporated in the fly-wheel. The opposite end of the back gear shaft carries the single-disc friction brake. Both clutch and brake are controlled electro-pneumatically. The control can be set for part or complete revolution of the rolls; continuous running or for tool setting. Engagement of the roll is by foot pedal or stop switch. The operation of the clutch and brake requires compressed air of 78 to 85 lbs. per square inch. All wearing parts of the machine are generously proportioned.

The back gear shaft revolves in self-oiling bearings with ample oil reserves. Other bearing points are automatically lubricated by a central grease pump.

PERFORMANCE OF MACHINE

Forging Roll Model RW 0 is suitable not only for the pointing of the normal multi-leaf springs, but also for the rolling-down of high-duty spring leaves whose thickness decreases parabolically. The roll is provided with a side press

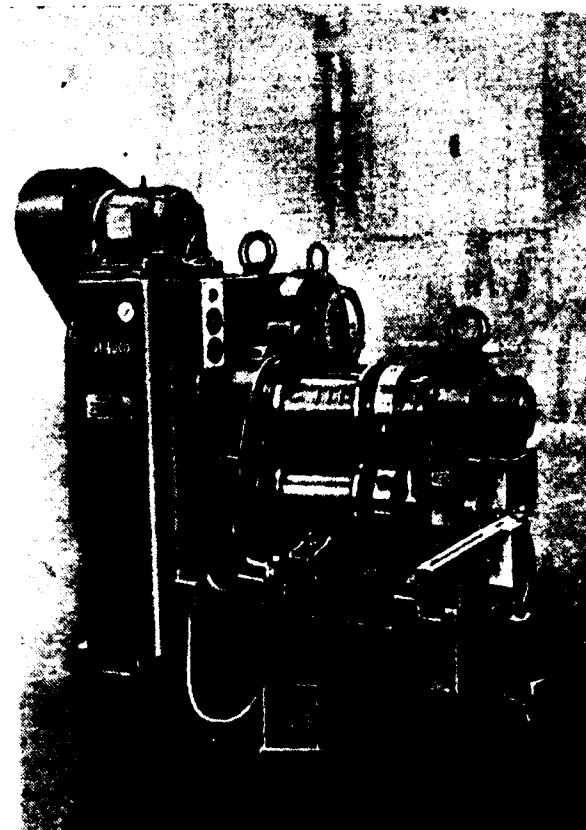
When rolling-down the parabolic spring leaf ends, two passes are sufficient, i. e. one upsetting pass and one flattening pass. On effecting the second pass the spring leaves are of the initial width at the rolled end and require only to be cut down at the front end.

In cases where multi-layer spring leaves are to be pointed the upsetting pass is unnecessary.

Principal Dimensions

model		RW 0
diameter of rolling segments	approx.	300 mm = 11 13/16"
usable width of roll	"	400 mm = 15 3/4"
maxi. rolling length	"	460 mm = 18 1/8"
roll adjustment	"	12 mm = 1/2"
RPM of roll	"	110
capacity of side press	"	30 ts.
stroke of side ram	"	35 mm = 1 3/8"
maxi. distance between table and ram	"	200 mm = 7 7/8"
table adjustment	"	20 mm = 13/16"
HP required	"	15
weight	"	4120 lbs. = 1870 kg.

Rectangularly cut and centrally pierced spring leaf blanks are (I) unilaterally heated and rolled-down on the forging roll. (II) In the same heat the spring leaf is cut to size on the side press whilst at the same time the recess is pressed. (III) In this process guides and adjustable rear stops are used. When cutting to size and punching, the adjustable pinion serves as a stop, in which the centre hole of the spring leaf is placed. Since the pointing of spring leaves requires only one rolling tool, it is possible to place the segments side by side to cater for the various kinds of spring leaves. Frequent changing of tools is thus eliminated.



ESSENTIALITY OF PRODUCTIVITY

By B. S. Ganesh, B. E.

PRODUCTION and Productivity are two words much spoken off by the Industrialists particularly when their industries manufacture similar types of products. Though the two words appear to convey same idea, there is a vast difference in reality. Production refers to the output of any concern without reference to the capital spent and the number of persons employed. But Productivity refers to the output of a factory taking into consideration the different resources that are utilised, Viz, Men, Materials, Money, Machines, Power etc. This can be explained better with reference to examples. For this purpose consider any two similar factories, say manufacturing fountain pens, A and B.

	Factory A	Factory B
Capital outlay	Rs 1 Lakh	Rs 1.8 Lakhs
Persons employed	200	300
Annual outturn	50,000	60,000

In the above two instances, so far as the annual production is concerned, factory B has more outturn, but as far as the productivity is concerned, factory A is more productive and efficient. For comparing the productivities of two or more factories, it is highly essential that the quality of raw materials, quality of workmanship, and the quality of inspection must be fairly similar.

In the modern industries, the word Productivity is gaining more importance and the increased productivity is one of the essential factors for their prosperity and in view of this, every administration is very anxious to increase the productivity. In a broad sense, the productivity can be expressed in terms of National level also. This is how the work of two different Nations are compared.

There are different ways of increasing productivity and particularly in India, in the present day circumstances, increase of productivity is highly essential and to promote this, different productivity councils are set up. The different ways of increasing productivity are acquired more by experience and study than by mere reading and attending lectures. Some of the main ways of increasing the Productivity are explained below :—

1. Every worker must be given the basic education pertaining to his sphere of work.
2. The spirit of service: Every worker irrespective of his or her status must develop the spirit that he or she is one of the essential workers and his or her main work is to serve the administration efficiently with a sense of duty.
3. Every worker must have a thorough knowledge of his or her work and he or she must be able to visualise the effect of bad workmanship on the economics of the Administration, Viz,
 - (a) The target dates for the completion of assemblies get affected if the components are not completed before the prescribed dates and this will have a cumulative effect of not being able to execute the orders before the delivery dates.
 - (b) There will be wastage of precious hours.
 - (c) If the rectification of the defective parts is not possible, there will be wastage of Raw Materials.
4. The worker must be made to feel that the Administration looks after the Pay, promotion, transfer etc. and redeems his or her grievances, so that he or she may feel that it is his or her duty to work efficiently.
5. The administration must encourage employees and they must recognise the experience and qualification of the workers and reward suitably.
6. Human relationship. There must be a good human relationship between the employees and employers and employers should not feel that the employees are meant only to work and the employers are meant only to get the fruit of labour and fame. The employers must treat the workers with the similar kind of courtesy which they expect from others.

7. Paper work. Correspondence is one of the essential requirement of any progressive administration. But this must be reduced to the absolute minimum to increase the productivity. Paper work must be resorted to only when the documentary evidence is necessary, and unnecessary endorsing of copies must be reduced. Wherever possible instead of writing letters for getting clarifications, personal contacts and telephonic conversations must be encouraged.

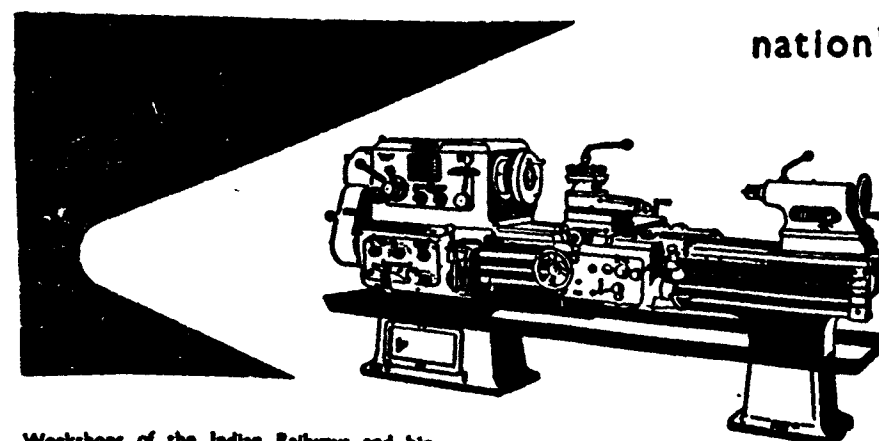
8. Inter factory or inter office visits. Every worker must realise that his or her particular way of work may not be perfect and there might be better ways of doing the same work, and he or she must learn them. Better ways of work can be learnt by inter factory visits and inter office visits and discussions with the employees of similar status.

9. Group discussions. Group discussions between the employees and employers is one of the best ways of keeping personal contacts. The ideas of each other get exchanged and new ideas develop and this enables employers to gauge the standard of the employees.

10. Suggestion scheme. As we are all living in a world, which is constantly on the road of prosperity, new ideas are necessary and new ideas are obtained from the experience of the workers. Though many persons have good ideas, they will not have interest to explain them and put them into practice. So in order to make them interested and to come forward with new ideas, there must be incentive in the way of cash rewards, merit certificates etc., to encourage them.

In view of increasing productivity, punishments should not be ignored. Whenever an employee commits a mistake, he or she must be made to realise the mistakes, and after exploring the possibilities of rectifying the employee without punishments suitable punishments must be awarded depending on the propriety of the case.

The ways of increasing productivity specified above are only a few typical ones, and if every worker works with heart and soul, with the particular object of increasing the productivity, many more new ideas might crop up, and the productivity of the industry can be increased, which ultimately reflects on the nation.



nation's workshops

rely on RL

lathes

1, 2 & 3

Workshops of the Indian Railways and big Industries depend upon RL Lathes for meeting to-day's heavy production demands. Scarcely built from first-rate materials by experienced technicians RL Lathes are guaranteed to give continuous, efficient service for many years of trouble-free operation. The Inspection Wing of the Government of India has First Graded these machine tools after thorough tests. Full details available from the manufacturers.

Manufacturers:

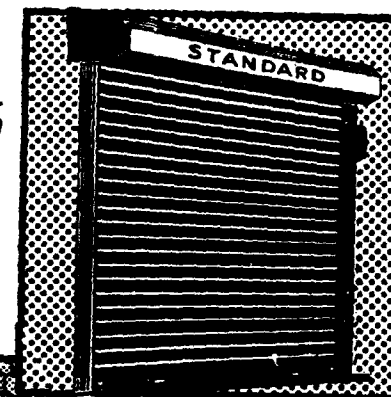
THE MYSORE KIRLOSKAR LIMITED

YANTRAPUR P. O., MARIHAR, (INDIA).

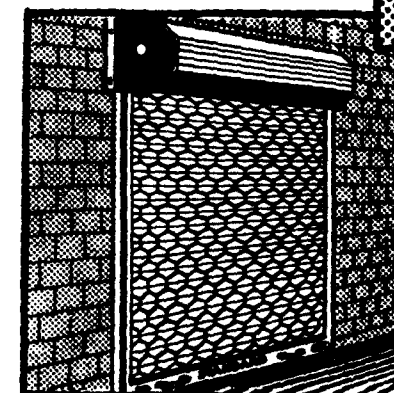
Sole Agents:

BATLIBOI (PRIVATE) LTD., SILVER JUBILEE PARK ROAD, BANGALORE 2.

ROLLING SHUTTERS (ELECTRICALLY AND MECHANICALLY OPERATED)



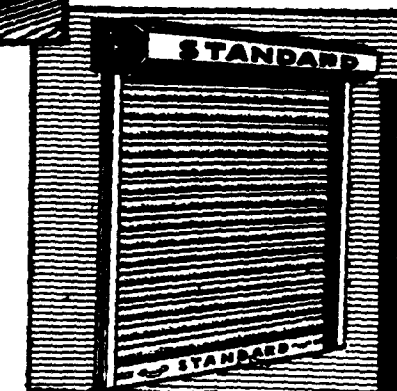
VENTILATED ROLLING GRILL



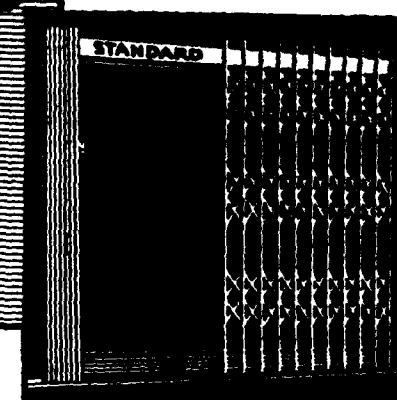
STANDARD

for Security

"STANDARD" has adopted the world-wide standard of 3" steel laths which is now accepted as a suitable specification by architects and engineers of repute.



ROLLING SHUTTERS



COLLAPSIBLE GATES

STANDARD'S ROLLING SHUTTERS

THE STANDARD ROLLING SHUTTERS & ENGINEERING WORKS

Opp.: Jai Hind Cinema, Next to Byculla Goods Yard, BOMBAY 12

Tel.: 41624

Gram: 'Rols shutter'

DOUBLE LINE BLOCK SIGNALLING

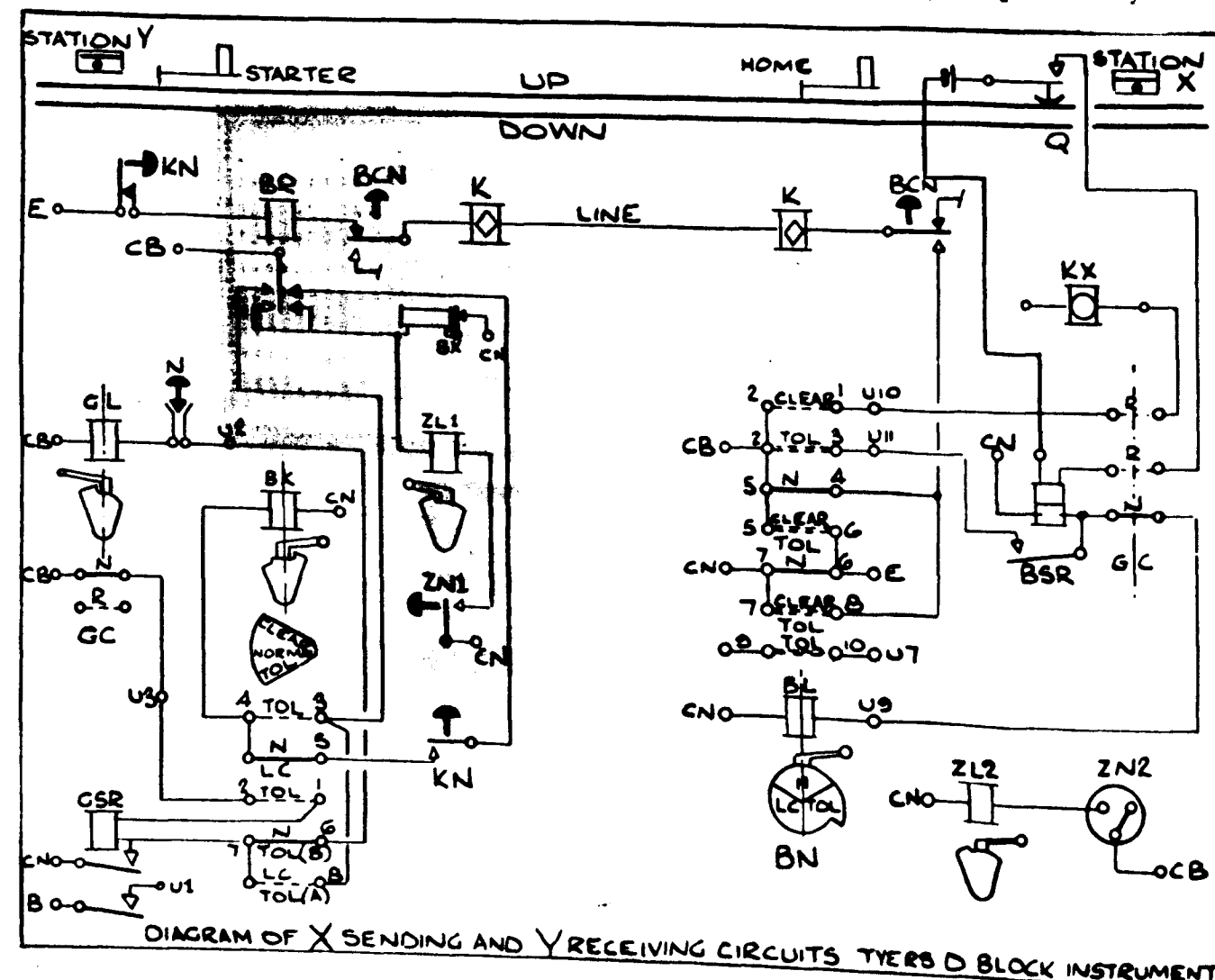
THE control of double line block sections over a single line wire by means of a self contained shelf mounting instrument embodying traffic indications for both UP and DOWN lines, is a well established practice. Tyer's Style 'D' instrument has found favour with many Railways for this purpose because of its ease and economy of operation, the comprehensive range of controls provided and also because the all metal casework of the instrument and the robustness of its controls, safeguard it against hard usage and ensure long life with low maintenance charges.

The instrument which is securely padlocked to prevent unauthorised interference, occupies 35 centimetres X 35 centimetres shelf space and is 43.7 centimetres high. Power is usually provided by means of primary batteries and a typical section would require

approximately, 12 volts for operation, the line current required being about 0.1 ampere.

In addition to ensuring the sequential operation of both instruments in a block section, controls are made available to ensure that the last stop signal is not pulled until permission has been given by the Station in advance and that a second release cannot be obtained until the train has passed the first stop signal of the Station ahead, the lever for this signal has been replaced to "Normal" and the commutator of the block instrument returned to the "Normal" position.

A special feature of the instrument is the interlock provided between the commutator and bell key which ensures that the commutator cannot be moved a second time without first operating the bell key.



T Y E R ESTABLISHED 1851

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 without connecting links.

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

TRAFFICORDER MK IV E, for 7 day hourly record of road traffic.

ANTE-RATTLE FASTENER for Rail and road vehicles also Sea and Aircraft.

TYER'S SERVICE continues to include for the supply of replacements for most of its older equipment.

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 without 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.

TYER & CO. LTD., ASHWIN STREET, DALSTON, LONDON E. 8. ENGLAND

Telephone: CL1 1407/8 (A member of the Southern Areas Electric Corporation Group.) Telegrams: Switchmen. Easphone. London.

METHOD OF OPERATION

The method of operation for a pair of instruments is as follows. Reference should be made to the diagram for identification of the components referred to.

To obtain permission to send a train from Station 'Y' to Station 'X', the operator at Station 'Y' calls operator 'X' by coding on bell key BCN.

To accept the train operator 'X' turns the handle of his commutator BN and so causes the bottom indicator on the instrument to change from NORMAL to CLEAR, at the same time reversing the polarity of current fed to line over key BCN. It should be noted that each movement of the commutator BN to the 'Clear' position is registered on the digital counter fitted alongside and to the left of the bottom indicator. The number appearing for each acceptance of a train can thus be recorded in the Train Register.

Operator 'X' now calls Station 'Y' by coding on key BCN, and holds down the key on completion of coding. The current sent over the line is received at Station 'Y' by polarised relay BR causing the coding buzzer BX to sound continuously.

Operator 'Y' must now press switch key KN which will cause the upper indicator BK of his instrument to show 'Clear.'

It should be noted that the use of a buzzer for coding has the added advantage of providing a continuous warning if a standing current should appear on the line from extraneous sources. With both instruments showing 'Clear' for this line the train can now be despatched from Station 'Y'.

To do this operator 'Y' must first press the top right hand lever of his instrument which raises the flag of the top indicator BK to display 'Train on Line.' With the indicator showing T.O.L. and with the starting or last stop signal at 'Normal' the starting signal relay GSR is operated and this will permit the release of the starting signal lever to pull off the signal and allow the train to enter the section. On despatching the train the operator at Station 'Y' must then send the code for 'Train Entering Section' on his bell key BCN. On receiving this code the operator at Station 'X' must turn his commutator handle BN to display 'Train on Line' on his bottom indicator and then pull off his home or first stop signal to permit the train to enter the Station.

In the arrangement shown the failure of the operator at Station 'X' to turn his commutator to the T.O.L. position will cause warning bell KX to ring continuously until this operation has been carried out. When the commutator is in the T.O.L. position it is electrically backlocked and is only freed by the operation of a treadle 'Q' or similar contact after the train has passed the first stop signal the release being taken



through a reverse contact on the signal lever GC. After being released by the passage of a train the Commutator of the instrument at Station 'X' must then be turned to the NORMAL position and this will again reverse the polarity of battery current fed over key BCN to line. The operator at Station 'X' will now send "Train Out of Section" by coding on key BCN and by doing so will release the latch of the top indicator BK of the instrument at Station 'Y' causing this indicator also to show NORMAL, thus completing the operation.

A number of ancillary features are provided including a press button switch at the bottom right hand corner of the instrument front shown KN on the diagram which is used to interrupt current being received from the other station, such interruptions being shown on each

current indicator marked 'K' in the diagram and appearing at the top of the instrument front.

CANCELLING

In order to cancel a 'Line Clear' release made on commutator BN, or to restore it to 'Normal' if the treadle 'Q' has failed after a train has passed out of the section, a Cancelling button is provided and can be seen in the illustration immediately above the bell key. It is used to operate a release lock shown as ZL2 on the diagram and its operation is controlled either by a switch ZN2 in the Stationmaster's Office or by means of a sealed release switch. Each operation of this button is registered on the digital counter fitted immediately above the switch. This counter is shuttered in order to avoid confusion with the commutator register on the left hand side of the instrument.

BLOCKING BACK

In order that blocking Back past the first stop signal may be permitted a special key is provided which is released by a lock marked ZL1 on the diagram by means of Switch ZN1 and can be seen on the front of

the instrument immediately above the switch key. This special key can only be extracted from the instrument to hand to the driver of the train Blocking Back if the commutator is in the 'Normal' position and a release current is received from the Station in the rear. Press button switch marked ZN1 on the diagram and fitted at the bottom left hand corner of the instrument front is used to operate the lock controlling the release of this key. When the key is extracted the commutator is mechanically locked and the bottom indicator shows BLOCKED. After giving permission to the Station ahead to Block Back, the operator at the Station in the rear should as a reminder set his top indicator to show BLOCKED also which he can do by depressing the lever which is fitted at the left hand side of the indicator.

The circuit arrangement shown illustrates the basic features of the instrument and may be varied to meet the special requirements of the user. It will, of course, be understood that 'Send' and 'Receive' circuits as shown in the diagram, are repeated in each instrument in order that the operator at Station 'Y' can control the despatch of trains from Station 'X' on the other line.

DOUBLING OF TWO RAIL SECTIONS

The Planning Commission has approved the partial doubling of the Bina-Bhopal section of the Central Railway and the Anuppur-Katni section of the South Eastern Railway, a total aggregate length of just over 104 miles. The doublings have become necessary due to the anticipated increase in the pressure of traffic on account of higher production in the Central India Coalfields. On the Bina-Bhopal section, a total of 38.50 miles will be doubled—from Bhopal to Salamatpur 22.75 miles, Pabai to Bareilly 11.75 miles and Bina to Bina Bridge 4 miles.

On the Anuppur-Katni section, it is proposed to double fully the track between Anuppur and Sahdol, a distance of 25.50 miles, and to double partially the Sahdol-Katni section, 40.25 miles.

COACHES FOR ELECTRIC TRAINS

In order to develop the manufacture of electric

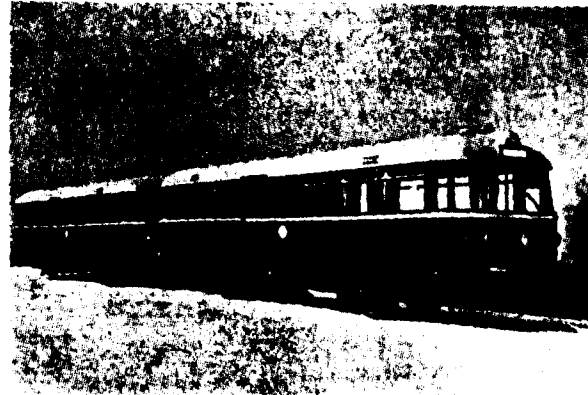
multiple unit coaches in India, a prominent Calcutta firm have been given an order for part manufacture of 104 coaches. This firm is expected to develop manufacturing capacity for 50 to 60 coaches per year. This was stated by Shri S. V. Ramaswamy, Deputy Minister of Railways, in reply to a question by Dr. A. N. Bose in the Rajya Sabha.

The Deputy Minister further said that the manufacture of electric traction equipment for these coaches at the Heavy Electrical Project, Bhopal, was under consideration.

Asked whether coaches for electric trains were built in India or were imported from abroad, the Deputy Minister replied that these were at present being manufactured partially in India by M/s. Jessop & Co., Calcutta. In the past these coaches had been imported. The Deputy Minister said that no order was placed during 1957-58 for import of these coaches. Foreign exchange consumed in 1957-58 against orders placed earlier was Rs. 4.35 crores.

DIESEL RAIL BUS FOR BRITISH RAILWAYS

THE British Transport Commission has entrusted to Messrs. Waggon- und Maschinenbau GmbH, Donauwörth, the design and construction of five Diesel Rail Buses. The cars which are equipped with only two pairs of wheels are, it is understood, to be put into service in rural and suburban services. The bodies of the cars have been designed in accordance with British railway requirements and the underframe and power equipment, transmission and brake gear are generally of similar design to cars at present running on the German Federal Railways. The cars will all pass the BR Standard C1 loading gauge.



In the design of the cars attention has been given to light weight construction principles. Wherever

possible standard production components have been used in order to facilitate the supply of replacement parts as necessary.

The main characteristics and dimensions are as follows:

A) Car body	Length over buffers	appr. 45'—9½"	13950 mm
	Length of car body	41'—10"	12750 mm
	width over body panels	8'—8½"	2650 mm
	inside width of body	8'—4"	2539 mm
	height from rail to top of roof	11'—9½"	3587 mm
	height of floor above rail	4'—0"	1220 mm
	interior height, floor to ceiling	7'—6"	2286 mm
B) Bogie	Gauge	4'—8½"	1435 mm
	wheelbase	19'—8½"	6000 mm
	wheeldiameter	3'—3½"	1000 mm
C) Power Unit	Diesel underfloor engine ("BUESSING") 150 HP (150 PS) at 1900 r.p.m.		
	Power transmission: a) ZF electro-magnetic 6-speed gear box b) Final drive and reversing gear ("GMEINDER")		
D) General	Max. speed	55 mph	88 km/h
	Tare weight of car (ready for service)	15 tons	15 to
	Power weight ratio	10 HP/ton	10 PS/to
	Seating	56 persons	
	Standing accommodation	40 passengers	
	Compressed air disc brakes ("KNORR"—BSI) Hand brake — lever operated from driver's cab		

BODY

The body contour has been designed to comply with the British Railways C1 loading gauge. To meet the requirements of the body design and for absorbing buffer shocks, a through length underframe is provided constructed of longitudinal girders made up from wel-

ded flanged plates. The cross beams are of Standard Channels NP14, the other cross beams being of channels of the NP 10 type. To increase the rigidity, a corrugated plate floor is connected to the underframe. This corrugated plate is welded to the longitudinal and cross beams by means of plug and stitch welding, and design produces a car body of light and

Trolley-wire inspection car VT 55 of the German Federal Railway

**DIESEL
AND
ELECTRIC
RAIL CARS**

**EXPRESS TRAIN
AND TOURING COACHES**

**COMBINATION
ROAD-RAIL VEHICLES**

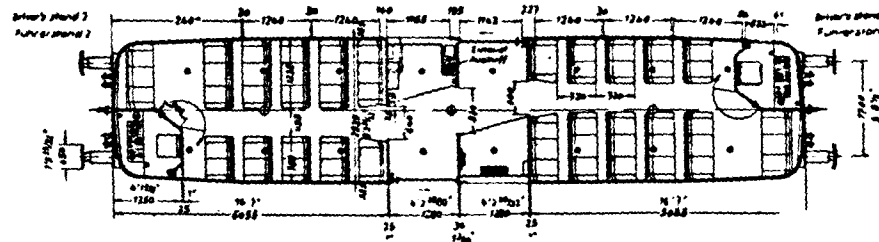
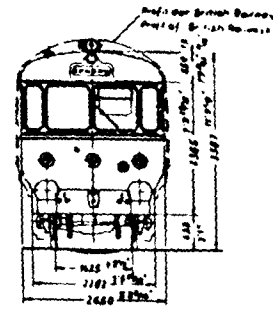
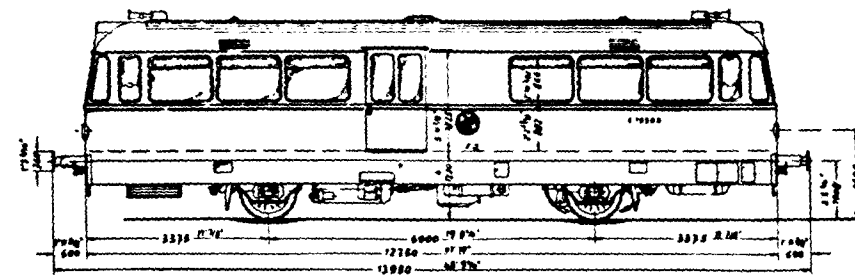
HEAVY DUTY ROAD TRAILERS

GOODS WAGONS **RAIL BUSES**

SPECIAL-PURPOSE VEHICLES

WAGGON-UND MASCHINENBAU GMBH DONAUWÖRTH

April 1959



56 Sitzplätze
40 Stehplätze
• 96 Personen
Gewicht d. Hoppers 15 t
Dead height of the car about 15 tons

modern welded construction. The exterior and roof sheeting are of light metal. The ends are of light gauge steel plate.

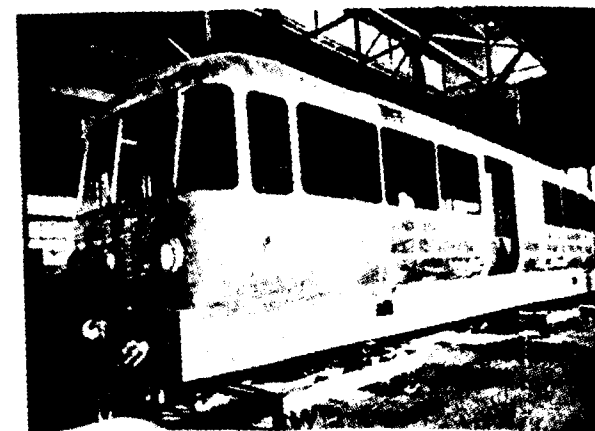
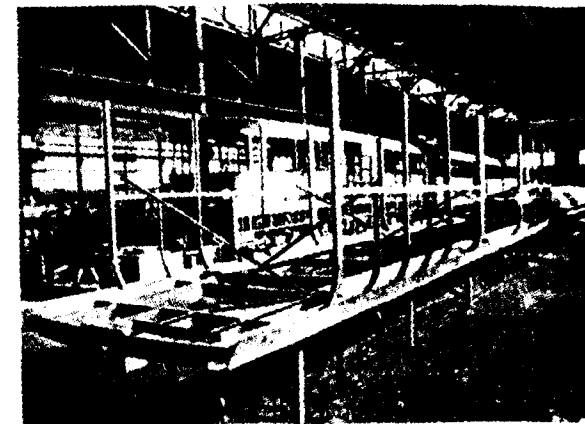
A side apron 425 mm. deep is welded to the sole-bars and provides an extension to the body side panels.

The underframe consists of channel-shaped cross-beams (NP 14 and NP 10) which are welded to the longitudinal girders. Traction stresses produced by the Power Equipment are transferred into the longitudinal girders by means of parallel and transverse braces consisting of flanged plates. To absorb compression stresses and maintain rigidity, the floor has been constructed of corrugated steel sections attached by welding to the underframe longitudinal and transverse members.

The body framing is formed as a light steel structure fabricated by welding together flanged plate channels. The body side pillars are "Zed" section pressings. The side and roof panels of non-corrosive light metal sheets have been riveted to the body framing. The roof plates have been crimped longitudinally in order to provide maximum rigidity. To achieve a balanced light weight structure the steel has been used for the underframe and body framing members whilst aluminium sheets form the body side panels.

UNDERFRAME

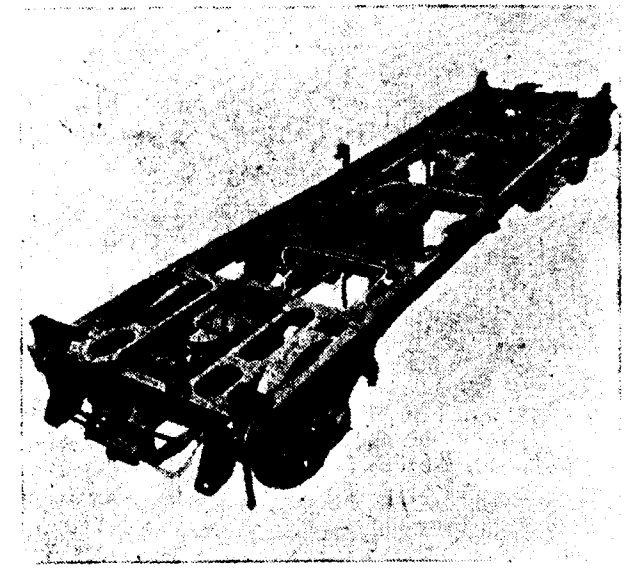
The underframe is a rectangular constructure comprising two longitudinal side girders (or sole-bars) and



two headstocks of rolled sections and welded together. In addition longitudinal and transverse members are fitted as necessary to carry the Diesel-mechanical

power unit and give ample rigidity to the frame. The axle boxes for roller bearings of the "SKF" type are carried in adjustable guides of the "FERROZELL" type, having a longitudinal clearance of 0.5 mm. and a transverse clearance of 0.5 mm. "FERROZELL" is a wear-resisting synthetic material which does not require lubrication and has been used successfully on the German Federal Railways for a number of years. The axle clearance of 2×0.5 mm enables—in contrast with a rigid axle—smoother running when negotiating curves.

During trial runs with the cars riding has proved to be very good with an absence of any appreciable oscillation or undue vibration, irrespective of the fact that the wave length of the sine curve is so much shortened by the clearance of the axles. The longitudinal clearance of the axles is kept constant by wedge adjustment, but this adjustment is necessary only after long periods in service due to the use of "FERROZELL" which has high wear-resistant qualities. The light wheel sets with double waved wheel discs and solid axles are carried by 6-plate lami-



POWER UNIT

The supply of fuel to the diesel engine is pneumatically regulated by a foot-operated valve installed in the driver's cab and by a governor fitted to the engine. In case of failure of the pneumatic throttle motor, the engine can be controlled by a hand lever. A governor at the injection pump ("BOSCH") limits the speed when running idle. A push button fitted on the driver's panel enables the driver to cut out the engine electro pneumatically. The cooling water of the engine is passed through a cooling unit with hydraulic fan drive of "BEHR" type mounted in the underframe and is automatically kept within a limit of $72/80^{\circ}\text{C}$.

The air intake to the engine is via an exchangeable filter element of the "DELBAG" type fitted in an accessible position in the vestibule. The exhaust gases are carried away by an exhaust pipe rising through the roof of the car, the pipe being insulated against heat and sound.

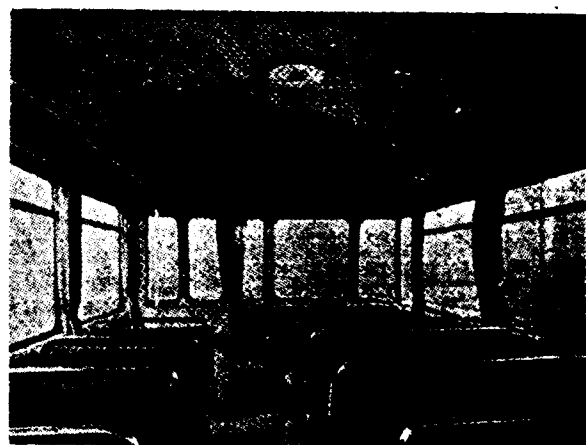
The engine-driven fluid flywheel operates automatically depending upon the speed of the engine and is locked when either shaft exceeds, appr. 800 r. p. m.

Drive to the 6-speed gear box is by conventional cardan shaft. This gear box is of an electro mechanical type, the 6-speeds being electrically selected by the driver, drive being by means of electro-magnetic multiple disc clutches. The 6-gear ratio allows full utilization of the engine power curve.

Final drive torque is transmitted to the frame by means of flexibly mounted torque arm. Drive from the gear box to final drive is again by conventional cardan shaft. Forward and reverse gears are mounted in the



nated springs via adjustable spring screws on the underframe. The wheel diameter of 1000 mm. permits 24 mm. of tyre wear. Each axle has two brake discs of the "BSI" type by which the brake is applied through brake shoes having a lining of synthetic material.

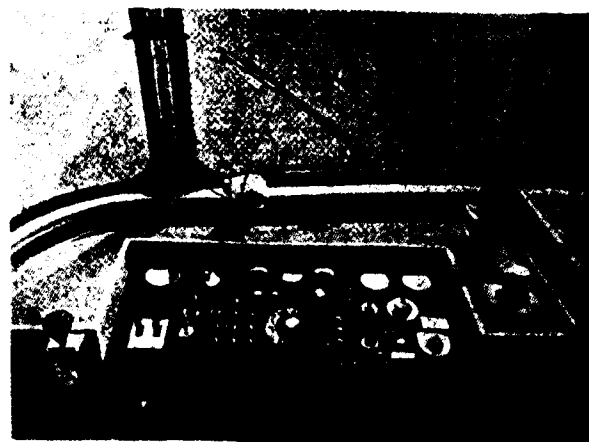


final drive unit and selection is operated pneumatically by driver controlled valve. In the event of loss of air pressure the design allows for selection by hand, access to this being by means of trap in floor.

INTERIOR FINISH

The floor, body sides and roof are fitted with special insulation materials to provide thermal and sound efficiency. The interior of the car is lined with plywood panels having a clear LIMBA polish whilst the ceilings are painted ivory finish. The front and body side windows of safety glass are secured by rubber glazing material. The upper parts of the body side windows are hinged to provide a limited ventilating opening. Curtains are provided at the body side windows and sun visors are fitted at the driver's front window as protection against direct sun rays. The saloons are equipped with luggage racks running lengthwise above the windows and are of light metal construction with hemp mesh netting. The seating arrangement is 2x3 giving a seating capacity of 56 seats (i.e. 18 in each saloon). The seats are constructed with spiral springs covered by rubberised hair and trimmed in artificial leather of green colour. The seats are padded with rubberised hair and trimmed with an artificial leather. The doors which are situated almost centrally on each side of the body are power operated and under the control of the driver, but a push button is fitted above the doors to enable passengers to operate the opening of the doors. In case of emergency the doors can also be opened and closed by hand. A luggage room is provided at each side of the car in the entrance vestibule.

The header tank for the cooling water, engine air inlet and filter, fire extinguisher and tool medical cupboard are located in the luggage room through which the exhaust pipe also passes. A letter rack and emergency ladder are fitted in the second luggage room. All operating and driving controls are located in the driver's cab which is separated from the passenger



accommodation, and is fitted with a door.

The driver's window is fitted with an electrically operated windscreen wiper and a suitable type of sun visor. The driver's window has a defroster, which is heated from a nozzle. For the driver an upholstered folding seat is provided. The rear windows are fitted with curtains to prevent ingress of light from the passenger compartments; a small extinguisher is provided in each driver's cab.

ADDITIONAL EQUIPMENT

Apart from the windows of the hinged opening type, special electric turbo fans (to be operated by the passengers) and automatic fans have been provided.

In the cooling water circuit four radiators are interconnected with the engine cooling system, as well as a "WEBASTO" oil heater for preheating and keeping warm the cooling water.

The electric equipment consists of 4 batteries (12 volts, 180 Ah Din 72 311) and of 2 generators ("BOSCH") of 1000 watts, driven by the diesel engine. The engine's starter and the magnetic valves for the door operating device are of 24 volts, all other equipments, incl. 16 ceiling lamps, of 12 volts.

At both ends of the car, on the roof, a three-tone typhoon (alternate tone) horn is fitted. The signal buzzers are operated electrically from the driver's stand.

The rail buses are equipped with automatic compressed air disc brakes, of the "KNORR" type; in the event of failure causing reduced pressure of the brake pipe, the brakes are automatically operated.

In addition to the compressed air brake equipment, an electro-pneumatic "dead man's handle" is fitted.

The sanding gear is air-operated controlled from each driver's stand. The sand boxes are fitted on the driving axle in accessible positions.

British Railways Second Type of Railbus

W.M.D. 15-ton Design Can Carry 96 Passengers at Peak Periods

THE W.M.D. railbuses are of the two-axle type, following in many respects the design of the VT95 cars which have been working for some years on German Federal Railways. Examples for this country will, of course, pass our standard CI loading gauge and, to facilitate servicing, will make use of standard production components wherever practicable.

In general layout, there is a half-width driving cab at each end. Doors are provided centrally on each side, and seating accommodates 56 persons, with room for some 40 standing. Luggage space is provided on each side of the car, adjacent to the doorways. Four radiators and two de-frosting devices are connected to the engine cooling system to give space warming and clear vision. The car body is 41 ft. 10 in. in length, compared with a length over the buffers of 45 ft. 9½ in. Overall width is 8 ft. 8½ in., and the height from rail to top of roof 11 ft. 9½ in.; wheelbase is 19 ft. 8 7/32 in., whilst the wheels are of 39½ in. diameter. Ready for service the car weighs 15 tons and should have a brisk performance as there are 10 b.h.p. for each ton of weight. Maximum speed is 55 m.p.h.

The basis of the car body is a channel framework, above which is a corrugated plate floor, attached by welding. End panels are of light-gauge steel plate, whilst side panels and the roof are of light metal. The frame is generously braced to withstand traction stresses: pillars are of Z-form.

The axleboxes have SKF roller bearings and are carried in adjustable guides of a wear-resisting

synthetic material that requires no lubrication, known as Ferrozell. In order to give smoother running on corners, clearances of 0.5 mm. are allowed longitudinally and transversely in the axlebox mountings. These clearances can be adjusted at occasional intervals, as wear takes place. Leaf springs connect the axles to the underframe, and each axle has two disc brakes.

Power is provided by a single Bussing (type U9A) underfloor pre-combustion-chamber engine developing, in six cylinders of 115 mm. by 140 mm., 150 b.h.p. at 1,900 r.p.m. Control of the Bosch fuel-injection pump is by a pedal in each driving cab, using compressed air, but manual means are available in the event of emergency. Heat dissipation by the radiator is controlled by a hydraulic fan drive of the Behr type. The air intake filter is mounted in the car vestibule and so is isolated from track dust, whilst the exhaust gases are discharged upwards above the car roof.

Drive passes through a fluid flywheel, which goes "solid" above 800 r.p.m. Six ratios are provided in the Z.F. gearbox, selection being by electro-magnetically controlled multiple-disc clutches. Final drive is by shaft from the gearbox to the one "live" axle, in which are forward and reverse gears pneumatically controlled. Braking is by compressed air on the Knorr system. Sand boxes serve the driven wheels, and a three note horn mounted above the roof gives audible warning.

WAGON OUTPUT RISES SIX-FOLD IN 10 YEARS COUNTRY NOW ENTIRELY SELF-SUFFICIENT

Production of railway wagons in India has increased nearly six-fold since independence.

During 1947-48, production totalled approximately 3,100 units. Five years later, in 1952-53, it increased to 6,388. Production rose faster during the subsequent five-year period, and 17,390 wagons were turned out during 1957-58.

At the initial stages, only general purpose wagons

were manufactured in the country, and most of the special purpose wagons were imported. The manufacture of the latter types has since been developed in the country, and all requirements of the railways can now be met entirely from indigenous production.

In addition to the established wagon manufacturers, educational orders have also been placed on 10 new manufacturers in different parts of the country.

Formation of Bharat Electronics

SOON after Independence, the National Government declared its Industrial Policy according to which the specialised requirements of Electronic equipments and component parts were to be met by State Enterprise. The Ministry of Defence therefore, undertook the establishment of a State Industry and Bharat Electronics was formed as a Limited Company in April 1954, in Jalahalli which is 8 miles north of Bangalore. The factory building, the construction of which was completed in 1956, has a floor area of over 5 lakhs sq. ft. The building has been designed to permit a convenient flow system for materials from raw stage to the finished product stage.

To start with, a fully equipped machine shop and tool room were first put into operation. In planning the machinery ordered, every effort has been taken to make the factory as modern and upto date as possible. All facilities essential for the production of prototypes of electronic equipments from initial design and for the manufacture of jigs and tools

required for bulk manufacture were provided. As an adjunct to the tool room, the heat treatment shop was next equipped for heat treatment of all metal parts that go into the manufacture of tools, gauges and small cutting tools.

An electroplating shop which is also essential for an electronic industry was also set up. In a specially designed building facilities have been provided for copper, chromium, Cadmium, Nickel, Silver and Gold plating. Provision for anodizing aluminium has also been made.

A sheet metal shop with all modern machineries has also been set up.

A measuring instruments section supplies and maintains complete range of instruments required for alignment and testing of electronic equipment.

A climatic and durability laboratory takes care of the severe climatic and durability tests formulated

particularly by the Defence Services for electronics equipment.

TECHNICAL TRAINING

One year before the factory went into operation a few carefully selected Indian Technicians were sent to France for advanced training in manufacturing techniques. In addition, a Technical Training Centre was set up in October 1954 to train workers with the skills required in this new industry. The Centre is equipped to train about 60 mechanics (fitters, tool makers, and machinists) and radio mechanics at a time. The trainees are given training under conditions very similar to those that would obtain in the factory. The period of training normally is between six to nine months.

RESEARCH & DEVELOPMENT

From the very beginning BEL has been conscious of the need to reduce our dependence on foreign assistance in the design of equipment. The first few items taken up for production were basically of French design but subsequently the problems of modification arose due to the peculiar conditions under which the equipments are required to function in our country. In view of this, a Research and Development Department of the factory came into existence and it will be progressively developed with the expansion of the factory. This department works in close co-ordination with leading research institutions like the N. P. L. Delhi, Indian Institute of Science, Electronic Research Institute, Pilani, and the L. R. D. E. and the ILE of Bangalore.

A tiny 3 oz. transmitter which is sent up in a balloon by meteorological department for upper air observations was the first item of indigenous design in the factory. 20,000 numbers of these transmitters have since then been manufactured and supplied to the Meteorological department and another 10,000 are in production. BEL has also designed and developed a light weight air borne Twin channel VHF Transceiver for use by the Indian Air Force. The prototype of this set has been successfully tested on the ground and in the air and the set will go into production soon.

PRODUCTION PROGRESS

A communication receiver and a medium power transmitter suitable for wireless telegraphy and telephony were first scheduled for production

followed by a light weight walkie-talkie set and a mobile transceiver. These are required in large numbers by the Police, Railways, Civil Aviation, Fire Brigades, Iron and Steel Works etc. The rate of production now exceeds Rs. 6 lakhs per month.

Various other lines of production will be established in the near future. A 25 watt transmitter-receiver, 1 KW Transmitter, HF Transceiver, preamplifiers, loud hailer are some of the many items under investigation.

We have recently signed an agreement with Pye Telecommunications of Cambridge for the manufacture of Pye equipment in the factory.

In order to assist the domestic radio receiver industry, production of radio receiver valves is being considered. The valves division is also considering the manufacture of high power transmitting valves and other special type of valves.

Peak production is expected to be reached in the course of 3 years. The factory will then have 5000 workers on its pay roll and equipment worth more than four crores of rupees will be the annual output.

Manufacture of electronic equipment is a complicated process. It may be broadly divided into 7 parts.

- (1) Design and development of equipment.
- (2) Manufacture of tools.
- (3) Manufacture of mechanical parts such as chassis, cabinet, dial assemblies, nuts etc.
- (4) Manufacture of electrical parts such as wires, cables, resistors, capacitors coils, transformers, crystals, valves, relays etc.
- (5) Manufacture of meters, such as ammeters, voltmeters, decibel meters etc.
- (6) Assembly and wiring of the various mechanical and electrical parts and meters to arrive at the final product.
- (7) Testing of the completed equipment according to specifications.

The foundation of an electronic industry has been laid and it is hoped that in the not too distant future it will render the country self-sufficient in respect of wireless and electronic equipments.



A Government of India undertaking
Manufacture Quality Electronic Equipments

- RU-536 — GENERAL PURPOSE COMMUNICATION RECEIVER
- ET-402 — MEDIUM POWER HF TRANSMITTER
- SAFI-456 — MOBILE HF TRANSRECEIVER
- MF-833 — MOBILE VHF TRANSRECEIVER
- MF-713 — MANPACK VHF TRANSRECEIVER
- MF-753 — 50 WATT STATIC VHF TRANSRECEIVER
- RAWIN (BELWIN) TRANSMITTER
- BROADCAST STUDIO EQUIPMENTS

Further details from :

BHARAT ELECTRONICS (PRIVATE) LIMITED
JALAHALLI P.O., BANGALORE

New Engineering Equipments

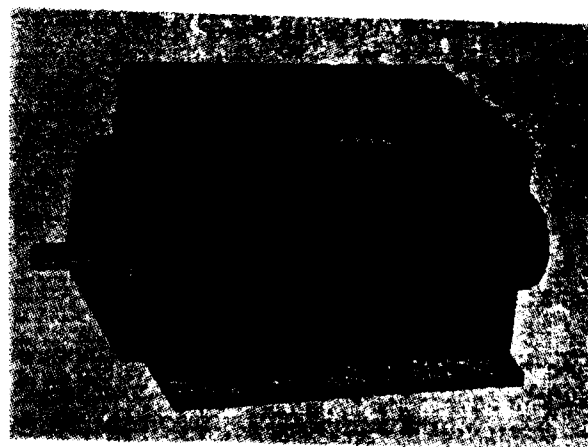
IMPROVED SERVO FOR INDUSTRIAL APPLICATION—LIGHT AND POWERFUL SERVO USES NEW POWER TRANSISTORS—IMPROVED AID TO INDUSTRIAL AUTOMATION—SOLUTION TO MANY CONTROL PROBLEMS

SERVO Units Ltd., the new subsidiary of Harvey Electronics Ltd., have produced an improved version of their servo units incorporating all the features of the earlier Harvey servos namely light weight, accuracy and high torque with the absolute minimum of moving parts.

The previous version relied upon a vibrating relay to provide high torque without overshoot. In the new series the motor is fed via power transistors controlled either from a DC transistor amplifier or a thermionic amplifier supplied from a transistor H. T. supply all fed from the original D. C. supply. Mains A. C. supply units are also available.

The size of the smallest, type O.TR-6v, of these servos is 3.0" x 2.2" x 2.25", has a stalled torque of 1.0 lb.-ft. with a rate of response of 35° per second, a repeatability of $\pm 0.3\%$ full scale on the light load and on 90% full torque 2.5%. Type 1. TR-12v is 4.10" x 2.55" x 2.50", stalled torque 5.0 lbs.-ft. rate of response 50° per second, repeatability $\pm 0.3\%$ and under 90% full load 2.0%. 360° rotation can also be provided.

The servos are available with various gear ratios giving up to twenty times the above speed of response with proportionately less torque. Gears are also avail-



Servo Type 1. TR-12v.

able separately for experimental work in conjunction with a standard unit. The gear box unit is also available separately.

The replacement of the vibrating relay by power transistors makes these units considerably more attractive for industrial applications and for fields where minimum servicing is essential, e. g. computers, handling of radio-active materials, spinning and weaving, paper manufacturing, rubber processing or any automatic or semi-automatic process.

* * * * *

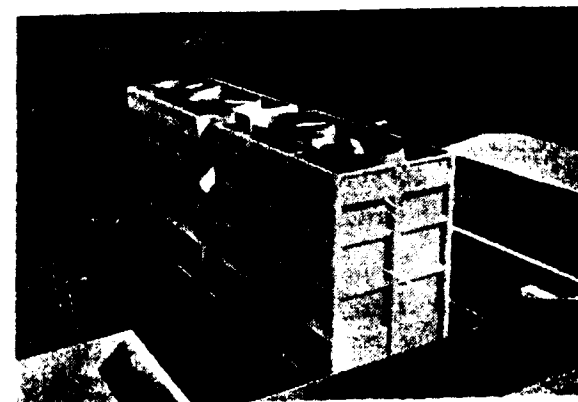
MECHANICAL COOLING TOWER

An important part of modern factory design is the provision of a means of water cooling which is efficient, economical to operate and which occupies the smallest possible space. A type of cooling plant which combines these requirements and which is becoming increasingly popular is the Mechanical Cooling Tower of the induced draught type.

In this type of structure the fans are situated at the top and cause the air to enter the base of the tower at a relatively slow speed and to leave from the top at high velocity. The advantages of this method are that the incoming air is circulated more evenly through the packing and that recirculation is not likely to occur. Recirculation is a difficulty which sometimes occurs with mechanical towers of the forced draught type, as in these structures the air is forced into the base of the tower at high velocity causing a depression into which the saturated vapour emerging relatively slowly from the top is sometimes drawn and recirculated through the tower, thus greatly lowering its cooling efficiency.

One of the leading British designers of this type of plant Film Cooling Towers (1925) Limited, has developed a system of packing for induced draught cooling towers which provides the greatest possible degree of heat transference with a low capital outlay. This system, known as "Film Flow", distributes the liquid evenly over the packed area of the tower and gives the cooling air unimpeded access to all parts of the packing.

The water is led to the tower either in a closed pipe



Induced Draught Cooling Tower at
Shahpur Power Station, India.

or in an open culvert from which it is discharged into secondary troughs through orifices specially designed to prevent splashing. From the secondary troughs it is fed into weir type spreader troughs running the entire length or breadth of the tower at a pitch of 6 inches. The spreader troughs, which have specially shaped notches at 2 or 4 inch intervals, rest on the top layer of the tower filling. The filling is composed of a number of horizontal trays of parallel laths, the direction of each layer of laths being at right angles to the trays above and below it. The effect in plan view is of a grid composed of 2-inch square network and the water upon being discharged through the trough walls flows down the grid packing in an even film changing direction through 90° in every 2 inches down the whole depth of the stack.

This method of distribution ensures that the entire surface of the packing is evenly wetted, providing a very high heat exchange co-efficient, which together with the fact that the cooling air has a relatively unimpeded flow throughout, effects an economy in the cost of the power to drive the fans. Also, by completely avoiding the formation of water drops, there is a smaller loss of water by entrainment and the use of baffle plates and drift eliminators is unnecessary.

The salient feature of the Film Flow system, however, is the saving in space, as the packing depth can be reduced in some cases by as much as 50% of the space required by the normal drip bar packing system. This is reflected in both lower capital costs and in considerable saving of the power required to obtain the pumping head.

Induced Draught Towers incorporating the Film Flow packing system can be constructed with shells of

reinforced concrete, asbestos cement tile, steel or timber according to clients' requirements and local conditions.

The system is entirely of British design and further details may be obtained from the manufacturers at Lionel Road, Kew Bridge, Brentford, Middlesex, England. The firm is represented in India by their agents Messrs. I. A. E. C., Industrial Development Corporation, 43, Forbes Street, Bombay-1 (India).

* * * * *

A NEW BARREL DISPENSER

A new, economic, air operated barrel dispenser, fully automatic in operation and requiring virtually no attention, has been developed by a specialist engineering concern in Surrey.

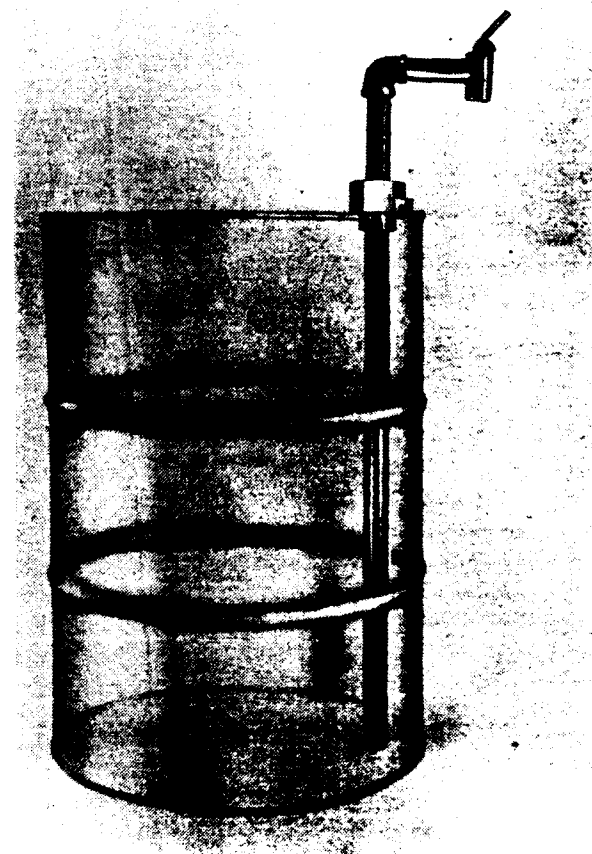
The instrument will deliver liquids without fluctuation or pulsing at the rate of 15 gallons per minute, dependent on the type of the vessel and the viscosity of the liquid.

Other than the delivery valve, which is manually opened and closed, there are no moving parts and thus deterioration through wear is negligible. There are no vanes, rotors or pockets where contamination could take place and consequently all that is required when changing from one liquid to another is one simple flush out.

Easy to handle, the dispenser consists of a solid drawn steel tube riser pipe with aluminium valve body, air regulator body and barrel adaptor. The valves, stems and air regulator piston are made in brass, and the delivery valve is designed to give minimum drip after serving. The barrel adaptor on the standard model fits 2" B.S.P. thread; the air regulator has a $\frac{1}{4}$ " B.S.P. female thread.

The air control valve ensures that the storage vessel (40 gallon drum, etc.) is not subjected to more than 5 lbs. per square inch pressure. In addition, an excess pressure safety valve is fitted to bleed away excess air pressure in the unlikely event of the air control valve not functioning.

In operation, the barrel cap is opened, the dispenser screwed in and connected to an air supply. No priming is necessary and the instrument will never dry out. Being pressure operated, it will deliver over long factory lines.



Hydraulics, 142/4, Carshalton Road, Sutton, Surrey, from whom further information is available.

The photograph shows the new Suba Barrel Dispenser in a drum with air line detached.

* * * * *

DU PONT ADDITIVES FOR DIESEL FUEL HELP REDUCE TRUCK MAINTENANCE COST

The tendency of some fuels to cause injector sticking and filter plugging in diesel tractors might be overcome by adding small amounts of two Du Pont chemicals to the fuel, according to tests conducted in the United States.

In one field test, Du Pont's Petroleum Chemicals Division reported, the addition of 1.5 pounds of Fuel Oil Additive No. 2 (FOA-2) and 0.05 pound, or a little less than an ounce, of Metal Deactivator (DMD) per 1,000 gallons of diesel fuel solved an injector sticking problem in several different makes of tractors. Half that amount of additive ended injector sticking and filter plugging in a second test with another group of trucks under similar conditions.

Perhaps even more significant, from the standpoint of savings due to reduction of the amount of time equipment was out of service for repairs, was the experience of a company operating high speed, heavy duty, diesel trucks in cross-country service in the western half of the United States. The firm found the service life of injectors in its diesel engines was doubled and sometimes tripled, by use of about a pound and a quarter of Du Pont FOA-2 per 1,000 gallons of fuel.

Cost of treating diesel fuels with the Du Pont additive is a fraction of a cent per gallon of fuel.

For further information, write to: FRANK R. ZUMBRO, Du Pont Information Service, Public Relations Department, Wilmington 98, Delaware, U. S. A.

Preventing expensive waste and the manhandling of heavy barrels, the dispenser does not require a continuous supply of air. Once charged, it will maintain its own pressure until an appreciable drop of level is reached.

Known as the Suba Model 108 Air Operated Barrel Dispenser, the instrument can be manufactured in stainless steel or other suitable materials when contamination has to be avoided, i. e., edible oils, etc. It can also be used as an integral part of a closed circuit system in conjunction with dial meters, float level control systems and pressure distribution circuits.

At a cost of £ 7.10 s. o d ex works, this new industrial aid is being manufactured and marketed by Suba

MK Lathe Attracts Big Crowds at Singapore Exhibition

The Foreign Officer of the Engineering Export Promotion Council stationed at Singapore reported recently that the MK Harihar MB Lathe displayed at the Indian Pavilion in the Exhibition organised by the Singapore Chinese Chamber of Commerce created

great interest among the visitors and that this machine was constantly surrounded by admiring crowds throughout the period of Exhibition. This Exhibition was organised some weeks back to celebrate the Independence of Singapore.

Route Relay Interlocking at Churchgate

By

Siemens Engineering & Manufacturing Co. of India Private Ltd., Bombay

(Photographs by courtesy of Western Railway)

INTRODUCTION

THE first installation of Route Relay Interlocking in India was brought into operation at Churchgate Station on the Western Railway on the 9th of June, 1958. The supply of materials and the erection work was done by Messrs. Siemens Engineering & Manufacturing Co. of India Private Ltd. The entire imported equipment was manufactured by Messrs. Siemens & Halske A. G., West Germany. Some equipment was manufactured locally in Bombay at the Worli Workshops of Siemens Engineering & Manufacturing Co. of India Private Ltd. The present article proposes to briefly describe the salient features of Route Relay Interlocking with special reference to the Siemens & Halske system and the installation at Churchgate.

RETROSPECT

A quantitative change in the traffic, or the number of trains dealt with per hour at a station necessitates a qualitative change in the type of signalling provided. In course of time, non-interlocked stations were replaced by partially and fully interlocked stations. Local operation of points and signals was replaced by operation from central cabin by means of levers. The mechanical lever frames requiring human effort were replaced by power operation. Back in 1894, Messrs. Siemens & Halske developed the first power signalling installation. The locking box was designed on the lines of that for a mechanical frame, and the points and signals were operated by power with miniature levers.

The endeavour was to control larger areas from a central cabin. Even miniature lever frames require a relatively large space, the locking becomes fairly intricate and the cabinman has to mentally transfer the geographical layout as shown on the track diagram to the levers arranged in a row and vice versa. This naturally sets a limit to the amount of traffic which can be dealt with by a power frame.

The demand, therefore, arose to replace the miniature lever frame and the mechanical locking box by a "All Relay Interlocking" system and have a

method of manipulation which afforded a true exact reproduction of events taking place in the yard and resembled these in logical sequence.



Fig. 1 Control Desk at the New Churchgate Cabin

Out of the joint efforts of the German Federal Railways and Messrs. Siemens & Halske arose the "DrS" system of Route Relay Interlocking. "Drs" is an abbreviation for the German words "Druckastenstellwerk Siemens", which literally means "Pushbutton Cabin Siemens". Such a cabin does not have any lever frame or the mechanical locking associated with it. There is instead a control desk with an illuminated geographical track layout showing signals, points & track circuits and has push-buttons as operating members.

All interlocking, control, operation and indication effects are carried out by relays.

The Railway signalling at Churchgate has followed the outlines given above. An all electric miniature lever frame at Churchgate has been replaced by the "DrS" system of Route Relay Interlocking. Figure 1 shows the control desk at the new Churchgate Cabin.

DESCRIPTION

Figure 2 is a schematic representation of a Route

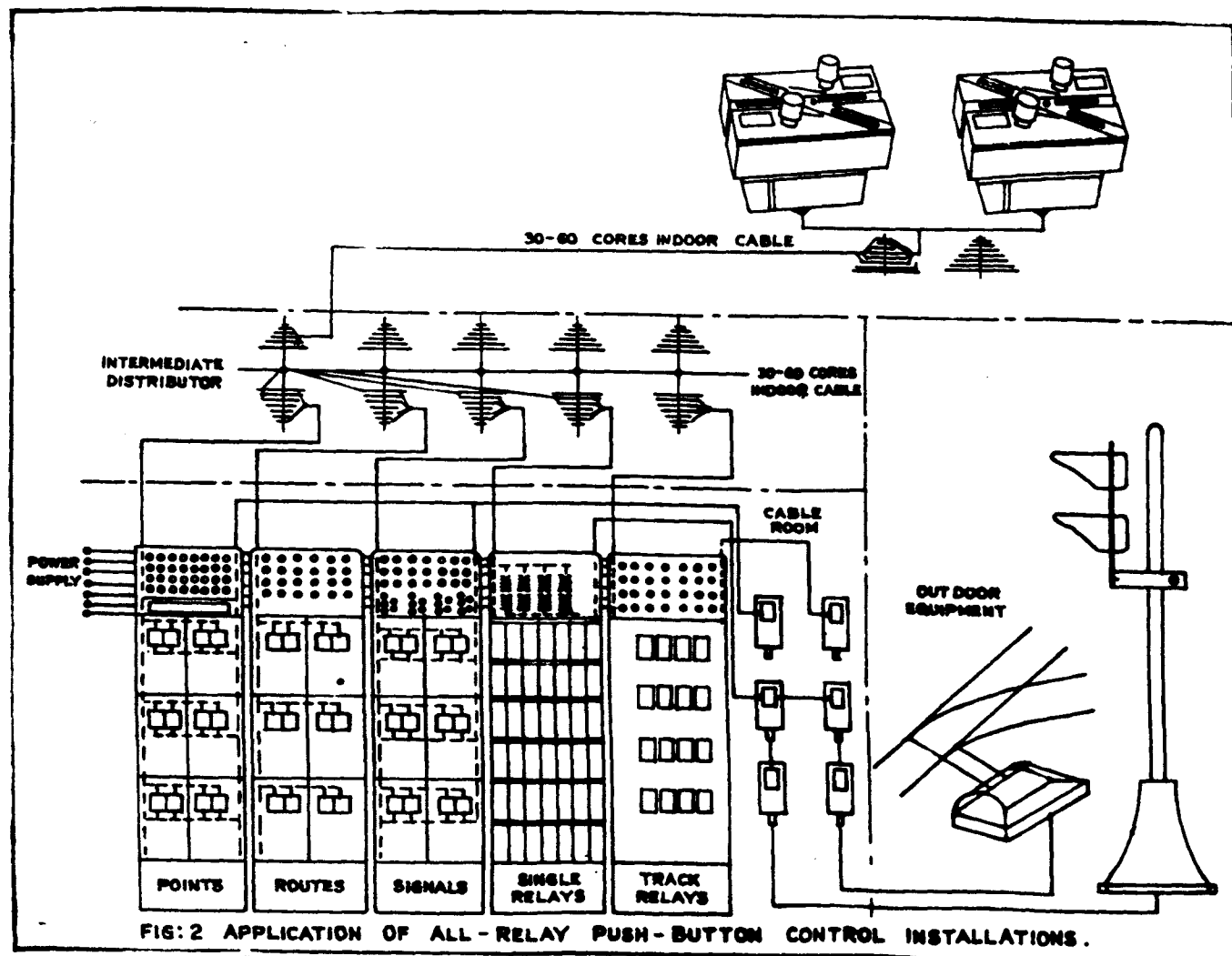


Fig. 2 Schematic Principle of a Route Relay Interlocking Installation.

Relay Interlocking installation. Like any other installation, it consists of the Outdoor equipment, Cabin equipment and the Power supply.

OUTDOOR EQUIPMENT

The Outdoor equipment comprises point machines, signals, track circuits and the cables. The Outdoor equipment of a Route Relay Interlocking installation does not in any way differ from that of an ordinary power signalling installation. The difference between the two systems, as will be seen later, lies in the Cabin equipment.

Since there is 1500 V. DC electrification, single-rail AC track circuits were installed in the Churchgate yard. The non-insulated rails are all cross-bonded and they form the return path for the traction current. By this method and also because of the relatively short track circuits, it was possible to dispense with costlier impedance bonds.

With the "DrS" system, all relays, including track relays, are housed in the cabin. At each end of the track circuit there is a small track connection box housing the feed and relay-end transformers. Figure 3 shows track connection boxes with the track feed resistance and the transformer. The other transformer seen in the picture is a relay-end transformer of the neighbouring track circuit.

The track feed-end transformer receives a supply at 110 V. AC from the cabin. It steps the voltage down to a value between 1.5 & 10 V. and feeds it to the insulated rail of the track circuit. At the relay-end the transformer steps up the track relay-end voltage upto 18-20 V. and this voltage is conveyed to the track coil of the track relay in the cabin. The local coil of the track relay is fed at 110 V. on a different phase.

The track relay which works on the principle of

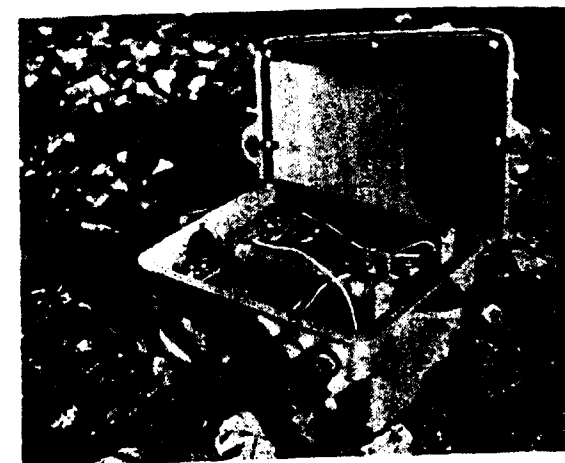


Fig. 3 Track Connection Box with Track Feed Resistance.

two-phase induction motor is of the plug-in type and can be seen in figure 4.

No shielding impedance is necessary since the track transformers have an airgap in the magnet circuit which affords sufficient protection against saturation due to stray traction return current.

It is obvious that maintenance becomes much simple when track relays are housed in the Cabin.

The cables used in the Churchgate yard are manufactured by M/s. Siemens & Halske in Germany. They are steel armoured, plastic insulated signalling cables of the P. V. C. type and bear the trade name "PROTODUR". These cables are a technical advancement over rubber sheathed and paper insulated cables. PROTODUR cables can be laid

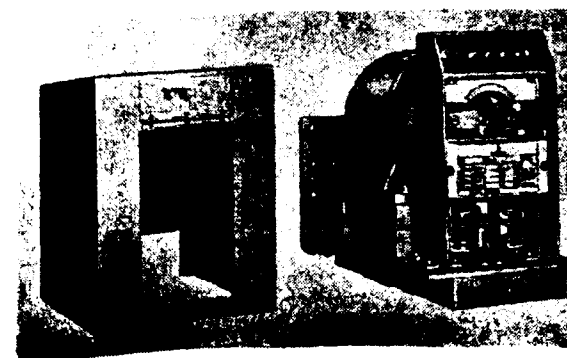


Fig. 4 Motor Type Double Element Track Relay.

underground, are moisture-proof, fire-proof, are not affected by chemical soil conditions and are immune to attacks by insects. The types used are able to carry any voltages upto 400 V. and are standardised

for use as signalling cables by the German Federal Railways. Relatively, PROTODUR cables are cheaper than other cables, and are more efficient, and yet render the same service.

Figure 5 shows the Siemens & Halske point machine in service at Churchgate.

The points at Churchgate are operated at 110 V. by DC motors. 4 cable cores are necessary for the operation of every point and these are run from the cabin to the points. The same cores are used for operation as well as indication. The point operating circuit is so designed that all the 4 cores are continuously detected when the points are lying at rest



Fig. 5 Siemens & Halske Point Machine.

along with the detection of the position of points. The operating time for these points is about 2.5-3 seconds.

The signals used in the Churchgate yard are of the double-unit multi-aspect type and are phantom indication proof. Where necessary, indication of the route to be followed by the driver is given by means of 4 lights mounted on top of the signal post. Figure 6 shows signal No. 18 for a train to come in at Churchgate. The route indicator is seen clearly on top of the signal post and the associated shunt signal is mounted a few feet above the ground on the same post. In the same figure can also be seen signal No. 19.

CABIN EQUIPMENT

The Cabin equipment consists of the control desk which is situated in the control room on the first floor in the cabin, and the relay room equipment located in the cabin basement.

A reference to figure 1 shows the control desk with push-buttons for the various operations. The control desk reproduces the layout in the yard showing the various track circuits, signals, points and position of the various points and signals. The complete track layout is reproduced by assembling the different panel sections. There are given number of small panel sections and one can by assembling these in a suitable manner reproduce the layout of any yard whatsoever on the control desk. The control desk affords excellent visibility and it is so designed that each push-button is within easy reach of the cabinman. As a general rule, the desk surface is inclined towards the position of the Cabin A. S. M. just like a writing desk. The surface is painted in a mat finished grey colour to avoid undesirable reflections reaching the operator's eye. The illumination on the control desk can be easily controlled by means of push-buttons. It can be raised in bright surroundings and lowered at night so as to avoid glare.

To set up a route all that the Cabin A. S. M. has to do is to press simultaneously two push-buttons and then release them. One of these buttons will be the button situated near the signal from which the train is to proceed and the other button will be the one where the train is to go. Failures of points or signals



Fig. 6 Colour Light Signal with Route Indicator.



Fig. 7 Intermediate Distributor Rack, Relay Groups in the background.

are indicated on the control desk by means of flashing light and also audibly by means of an alarm bell. Arrangements are provided for the individual operation of points. This is done by pressing the relative point button and the group points push-button.

The route is set and released within the shortest possible time. There is no time lost for initiating the desired train movement. This fact alone considerably increases the capacity of the track which is a very desirable feature in as much as it leads to the maximum utilisation of the capital invested. This automatic working in the setting up of routes may be compared to the automatic working in telephone engineering. There the connections are made and broken far more quickly than is possible in a manual system. The better utilisation of the telephone cables corresponds in a way to the better use of the track layout.

The control desk as used in the Siemens & Halske system combines the operation and the indication in the control desk. In some other systems, which have not fully departed from the old practice of miniature

lever frame and an illuminated track diagram, the operating push buttons or switches are not arranged in the track diagram, but in rows underneath it, which means that the cabinman has to attend to two things and thus has a limit placed on his capacity. Siemens & Halske system of combining the operation and indication on the same control desk facilitates operation to a great extent and increases the horizon of the cabinman. With the introduction of alternating current for the control of signals and 3-phase current for the operation of point machines, it is possible to extend the distances of operation quite considerably, so that all traffic requirements can be satisfactorily met with. The application of the control desk has so to say considerably extended the cabinman's "eye" and "arm".

The general layout of a route relay signal cabin with push-button control is shown in figure 2. There are separate racks for points, signals, routes, track etc., on which the relays are mounted either individually or in units, consisting of a group of relays. The various relay racks are connected to the intermediate distributor, which can be seen in figure 7, by means of 60-core indoor cable. The intermediate distributor is also connected to the control panel and constitutes the heart of the wiring system. It considerably shortens the time taken for erection. It permits racks of the same kind being placed side by side, which facilitates the orientation in the relay room as well as the location of any failure. The intermediate distributor also constitutes a certain reserve so that alterations and extensions which may be necessary in course of time can be easily effected on the intermediate distributor.

The relays used at Churchgate are standard signalling relays adopted by the German Federal Railways. They are accommodated on pre-fabricated racks as mentioned earlier, in the Cabin basement and are not accessible to the Cabin A. S. M. Relays are mounted on the racks so that both sides can be easily reached by the maintainer. The front part of the rack serves to accommodate the relays and the back is used for the wiring. The upper parts of the racks contain the terminal boards, fuses, resistances etc. All relays are the plug-in type. This permits the relays being quickly exchanged in case of a failure.

All relays used for continually recurring circuit combinations constitute one unit or group. Thus all relays required to throw points have been grouped together to form a point relay unit and are mounted on a common base plate. By means of plug-in

connections these groups can be connected to the relay rack and its wiring. In other words, the unit assembly method has also been used for the circuit combinations, a single relay being the smallest unit and a relay group (points relay group, signal relay group, route relay group etc.) the next larger unit. A Signal control group is shown on Figure 8. These

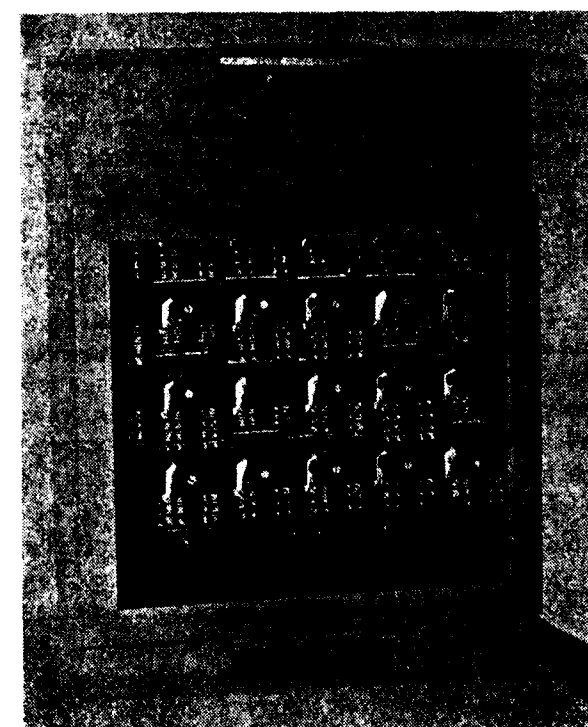


Fig. 8 Signal Control Relay Unit.

different types of relay groups are, in turn, assembled to form the point racks, signal rack, route racks etc., which is to be regarded as the largest unit. With the help of standardised components, all relay racks are assembled to constitute the over all circuit arrangement.

Figure 9 illustrates a plug-in type relay (and its base plate) at the rear of which can be seen the plugs. These are inserted into the base plate which is fixed and wired in the relay rack. Special measures ensure that, when exchanging relays, only an exactly similar relay can be substituted. The changing of a relay cannot cause a wrong wiring connection.

Figure 10 illustrates an interlocked latched relay, an indispensable component in modern signalling equipment. Once the relay has been energized, its armature is maintained in the picked-up position by means of mechanical support. The armature will drop away only when this support is removed with the aid of a second magnet system. Latched type relays are installed

wherever the armature must be prevented from dropping away as soon as the power supply ceases, i. e. one working current is required to release the relay and another working current to pick up the armature. The supply of these two currents is made, depending upon the fulfilment of different conditions.

A further special type relay is the so-called normal and reverse position latched type relay. The contact bank changes its position each time the armature is picked up. It is used for point control circuits. Contrary to the conventional latched type relay, it has only one magnet system which acts over a mechanical rocker latch on the contact pin carrier so that the latter is picked up once the magnet has been energised and drops away after the magnet has become energised a second time and so on, for instance, if the magnet has been connected to a current source by pressing of a point operating push-button—with the aid of an alternating bank of contacts—a throwing over of the points results. This does not require any further relays to be cut in for the preparation of the circuit combinations needed for the reverse movement. With the help of this relay the circuit arrangements for the operation of points can be devised very simply and economically.

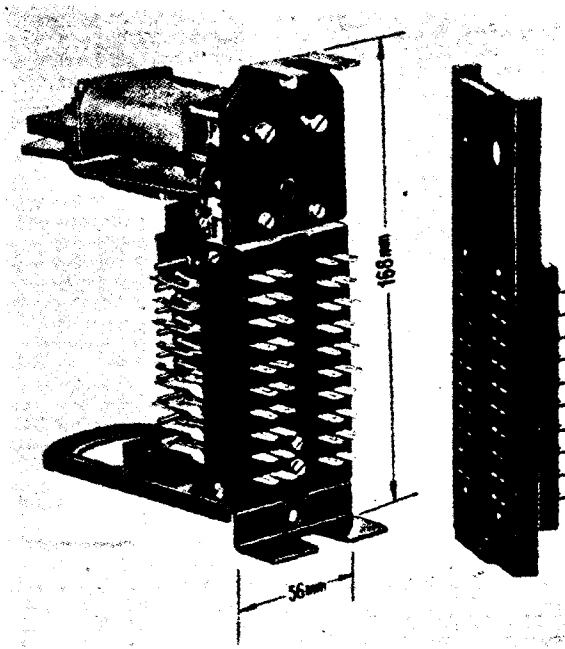


Fig. 9 Plug-in Type Signalling Relay

The basic principle to be followed in the design of Railway signalling circuits is the "fail safe principle" which means that any failure of the system shall result automatically in a more restrictive control, i. e.

blocking of tracks, routes, signals, points etc. For this reason, the circuits have been so devised that the more restrictive control is always given with the armature in the down position while the release is given with the armature picked up. This is so because the de-energised condition can be more easily attained than the energised one, but the fact that only the relay winding has been cut-off from the power supply is insufficient in case the relay does not drop on account of any failure. A faulty insulation of a wire or a stray current can energise the relay in spite of the contacts ahead being broken and consequently the relay would not drop away. Hence it is absolutely necessary to check the relay in the dropped position. This is a special feature of the German method of designing signal circuits. The principle of operation for this checking procedure is that with the armature in the down position, a contact is closed and the sequence of the successive circuit arrangements is made dependant upon this contact being closed. Thus a failure of the relay will cause a disturbance, but will never jeopardise the operating safety.

For obvious reasons this check is of value only if it is guaranteed that, with the closing of this detecting contact, all other relay contacts have followed the movement of the armature. This is why signal relay contacts are mechanically and rigidly linked with each other. From the figures, in particular figure 11, it can be seen that silver pins have been fixed to both sides of the contact pin carrier located between the contacts, each serving to bridge two contact springs. Thus the contact movements are enforced. It will be seen that what is usually understood by a contact consists in the Siemens & Halske type relays of 2 contacts in as much as the current flows from one contact surface to the silver pin and then to another contact surface, the two together constituting one contact.

A relay contact may only close and initiate a release action after it has been ascertained that all conflicting relays, i. e. relays permitting conflicting train movements, have been definitely cut off from the power supply. Consequently, provision must be made for conflicting contact positions to be rendered impossible. In case the dependency were to be insured in such a manner that energising the releasing relay is made dependent upon the contacts of conflicting relays, that are closed when de-energised, this would mean checking the relay in the dropped position for the purpose of which, as explained above, the provision of a contact coupling is a pre-requisite. In other words, the mechanical coupling is to be regarded as the essential

feature to obtain the required operating safety, electric interlocking being basically a mechanical one with electrical means. The great safety given by all electric relay interlocking rests on the fact that it can be used at the decisive point of the circuit, i. e. it can be effected in several cases whilst the mechanical interlocking can only be employed at one certain point.

It will be seen that the Siemens & Halske type signal relay contact is such that always two contacts are connected in series. Hence, the contact opening—so important in modern signalling equipment—is especially safe.

The relay groups have plug-in connections and can be exchanged as quickly as single relays. The advantage of this group arrangement is that two-thirds of the circuit elements can be built from pre-assembled standard stock components. 75% of the relays are components of relay groups. The internal wiring-up of the groups is especially safe since it is tested in the factory by means of very carefully designed testing instruments, so that no wiring faults can occur or escape detection.

Instead of the conventional screw type terminals use has been made in the Churchgate installation of soldered terminals. The soldered terminals had stood the test in telecommunication engineering. In signal engineering, however, the screw type terminal was preferred before for quick removal of faults or ease in making wiring changes. Also, one feared that while making wiring changes or changing a relay one might touch a live wire by the soldering bit. These objections, however, are fully met by the introduction of plug-in type relays and plug-in type relay groups with a considerable distance between the soldering tags.

Before completing this article, it is necessary to make mention of the method used for forming train routes. This is necessary because it makes maximum use of the yard capacity, is economical and insures perfect safety of the installation. It is indeed a feature which makes use of an electric locking more fully as compared with the mechanical system and utilises all possibilities offered by the electric locking. The designers have not confined themselves to imitate the mechanical locking box by electric means, i. e. to provide a route selecting relay, an electric route locker and a section route locking relay—serving to lock the aforementioned lock—for each individual route, but the entire points area with all relevant routes has been sub-divided into several small point areas with correspondingly short route

sections. Each of these route sections has been provided with the same electrical apparatus (route selecting relay, electric route locker and a section route locking relay to lock the abovementioned lock) which

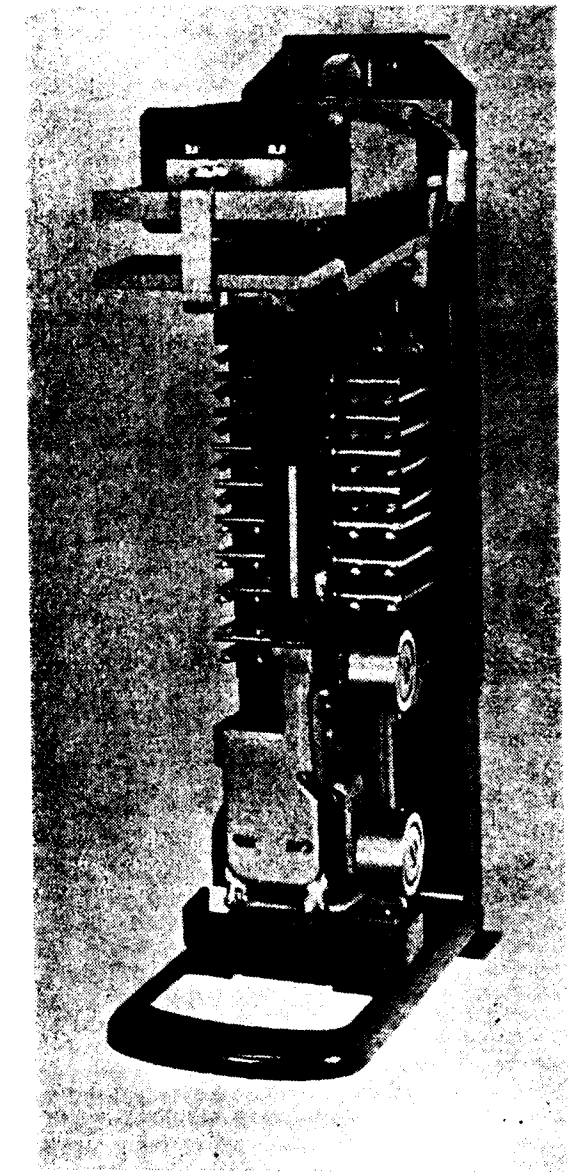


Fig. 10 Interlocked Latched Relay, D.C.

is used for the ordinary route. A complete route is obtained by grouping together the individual route sections and the routes so obtained differ considerably from each other, while the individual route sections equal each other completely. This sectional route locking system affords the decisive advantage that any desired type and number of routes can be set up from identical route sections as far as signals and points are concerned. Route relay groups have been used in Churchgate. The structural details of the

route relay groups are similar to those of the point and signal relay groups with the result that the proportion of pre-assembled circuit elements is considerably increased and the proportion of circuit elements to be adopted to the local track layout is decreased. The advantages of this arrangement from an economical and safety point of view and saving in the maintenance cost are obvious.

The establishing of routes consisting of several route sections permits also the sectional release of the complete routes. In other words, a train as it clears each section of the route, releases the locking affecting that section. Thanks to the adoption of this system, the operating flexibility and efficiency in utilising the track capacity is materially increased.

Further, the sectional route system can also be applied to shunting routes so that nearly any desired number of shunting routes can be set up without additional circuit elements being required. Thus, all shunting movements are made over locked shunting routes.

As a general rule, the lengths of the route sections are so selected as to comprise not more than 3 points. Conflicting route sections are provided with common route locking and route releasing relays, while each individual route section has its own route selecting relay, route supervising relay and isolation point selecting relay. The route selecting relay selects and locks only the points to be passed in a train or shunting movements, and the isolation point selecting relay locks only the isolation point. Thanks to the separation of these two selecting relays having different functions, it is possible to dispense with locking the isolation point when setting up shunting routes.

All relays can be used for both running directions, the actuation of the route release is also independent of the running direction. For this reason, special directional relays have been provided. Adequate

safety measures have been taken to avoid any route being released erroneously, and one distinguishes between an ordinary route locking function and a second subsequent route locking action. Thus, the first route locker of a shunting and train route can be released at any time by the cabinman while the second additional locking can be released only by actuating an auxiliary release push-button, the pressing of which is registered by a counter.

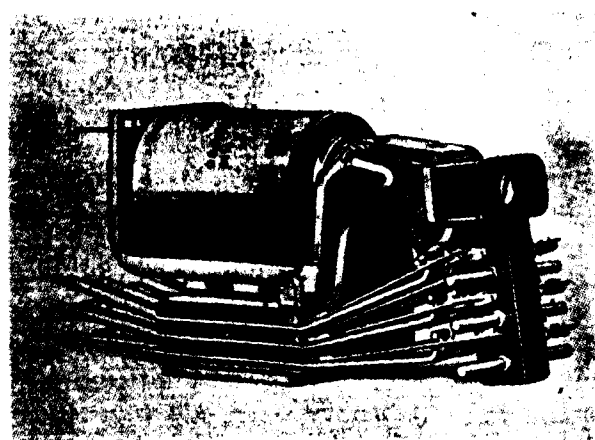


Fig. 11 Relay Type K 50 as used in Relay Groups

In conclusion, it may be mentioned that the cabinman can sit comfortably on a chair and do his work. The limit to the yard which he can operate from the control desk is not to be sought in the equipment, but in his mental capacity. Every facility is afforded to him to work the traffic efficiently and expeditiously.

It is hoped that the Route Relay Interlocking Installation at Churchgate, which is the first of its kind in India, will convince the Indian Railways of the advantages of this new type of signalling and will assist them in solving their traffic problems. More and more installations of this type are to be looked forward to in the time to come.

DIESELISATION ON INDIAN RAILWAYS

The target for dieselisation on Indian Railways by the end of the Second Plan period is to have a fleet of 125 main line diesel locos and 99 diesel shunters on the broad gauge, 20 general purpose and six shunting diesel locos on the metre gauge and eight general purpose diesel locos on the narrow gauge. There are at present 66 diesel locos on the broad gauge, 26 on the metre gauge and eight on the narrow gauge in operation.

This information was given by Shri Shah Nawaz Khan, Deputy Minister of Railways, in a written reply to a question by Shri M. Valiulla in the Rajya Sabha. Replying to another part of the question, the Deputy Minister said that nearly 50 per cent of the existing fleet of diesel locos were engaged in yard shunting work and a straight comparison of percentage of railway transport handled by these locos was not possible.

Rail Transport in Rourkela Steel Plant

By M. Ganapati

Resident Director, Hindustan Steel Limited, Rourkela Steel Project

IF our State Railway is being rightly called the backbone of India's industrial development, the Rail transport of modern Steel Plant like the one at Rourkela can be considered the heart of the whole plant. The architects of this Rail Transport system have had before them the aim of creating a transport system which will not merely handle huge quantities

systems is being forged at the Rourkela Steel Project.

It becomes the primary function of the Transport system to transfer the raw materials needed for operating the Steel Plant, from their places of origin to their respective places of consumption. In this respect our State Railways have volunteered to shoulder a part of the responsibility by offering to deliver the various Raw materials at their marshalling yard at Bonda-munda which is about 4 miles from the heart of the plant. These materials will then be further moved into the Plant and distributed to the various consuming points by the works Railway system. Further to this movement of Raw materials in the form of Iron ore, Coal, Limestone etc. the works Railway has to handle wide varieties and huge quantities of work processed Raw materials like molten Iron, Steel ingots etc. from one production unit to the other, and finally send the finished products back to the Railway Marshalling Yard to be further moved to different destinations by the State Railways.

The following figures will illustrate the variety and magnitude of the internal traffic that will be handled by our Works Railways.



Sri M. Ganapati

and varieties of material but handle them efficiently and economically. In addition, the fact, that a good percentage of material handled in an integrated Steel Plant of a million ton capacity is of special nature, calls for greater skill and care on the part of the designers to give shape to this system. Towards achieving this objective the wide knowledge and experience of those connected with such industries in India and abroad have been fully utilised. It may be said that one of the most up-to-date Rail Transport

MATERIAL	QUANTITY TONS/DAY	REMARKS
<i>Raw Materials</i>		
Iron Ore	6,000	Calculated on the basis of 300 working days per year.
Coal	5,400	
Limestone	2,400	
Others	460	
	14,260	
<i>Work Processed Raw Material</i>		
Hot metal	2,590	Calculated on the basis of 365 working days per year.
Steel Ingots	2,820	
Scrap	575	
Others	230	
	6,215	

MATERIAL	QUANTITY TONS/DAY	REMARKS
----------	----------------------	---------

Finished Products

Rolling Mill Products :

Benzol, Tar

Distillation etc.

2,620

2,620

Calculated on
the basis of 300
working days
per year.

LAYOUT

The Works Railway will consist of nearly 100 Km. of track spread over the whole area of the Plant. There are approximately 350 switches of which nearly 100 are situated in the Works marshalling yard. The marshalling yard consists of a reception siding, holding siding, Raw material siding, empty wagon and finished products sidings. Approximately 18 train

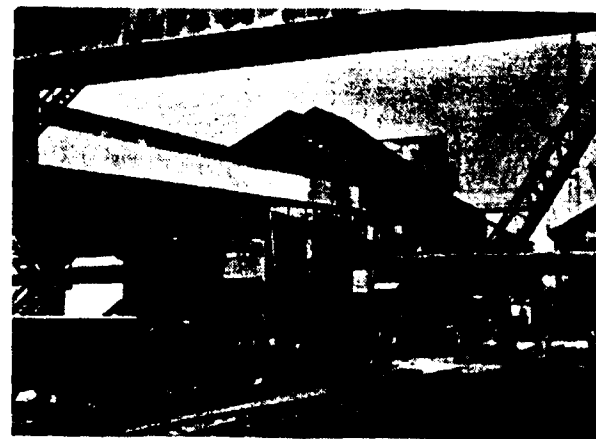


850 H.P., 115 Ton Diesel Electric Locomotive.

hauls per day will be made between the works reception siding and the Railway marshalling Yard. Practical difficulties experienced by Steel Plants in facing intermittent and irregular arrivals of train loads, while consumption is reasonably constant have been taken into consideration in the planning of various sidings. These different sidings help to convert such irregular arrivals of loads into a steady flow.

Nearly half the quantity of incoming Raw materials will be consumed in the Blast Furnaces and will be taken over the high line having a gradient of 1 in 90 and emptied into different bunkers through self-emptying hopper wagons. Some of the special features incorporated in the layout are worth mentioning here. The materials will be moved to the different consuming points in an unidirectional way and the empty wagons will be returned to their respective sidings in the marshalling yard over a Ring track encircling the plant. Crossing of tracks are virtually absent and busy tracks are shielded from Road traffic by providing over-

bridges at crossings. These factors help faster movement of trains. Delays due to slowing down of trains



80-Ton capacity Hot Metal Ladle Cars.

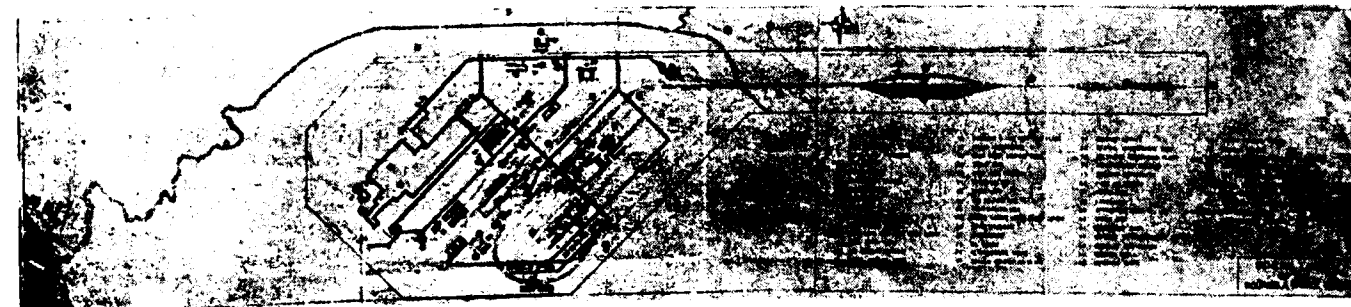
and waiting at crossings are thereby avoided. A minimum radius of curvature of 120 meters has been adopted throughout the system except at a few places. As movement is almost restricted to 20 mph. this curvature is considered ample and suits almost all type of rolling stock that will be used inside the plant.

LOCOMOTIVES

24 Diesel Electric Locomotives manufactured by the International General Electric Co. of U. S. A. are in operation at Rourkela Steel Plant since a year. They consist of the three following types of locomotives 275 HP (35-Tonner); 550 HP (80-Tonner) and 850 HP (115-Tonner). The 4 Nos. of 850 HP Locomotives are being used as pilots between the works marshalling yard and Bondamunda Yard, and also for pushing ore and Limestone wagons on the high line. All these Locomotives can be fitted with either I RS type screw



BOBS wagons ready to empty iron-ore on the high line.



GENERAL LAYOUT OF THE ROURKELA STEEL PLANT

- | | | |
|-------------------------------------|-------------------------------------|---|
| 1. Blast Furnaces | 20. Grey Iron Foundry | 39. Apprentice Shop |
| 2. Iron Ore Yard | 21. Stripping Bay | 40. Signal Box |
| 3. Ramp-Blast Furnaces | 22. Ingot Yard | 41. Locomotive Shed |
| 4. Gas Holder | 23. Hot Rolling Mill | 42. General Superintendent Office |
| 5. Power Plant | 24. Cold Rolling Mill | 43. Hirakund Sub-station |
| 6. Switchgear Station | 25. Scale Laden Water Clarification | 44. Guradih Nulla |
| 7. Gas Cleaning | 26. Scull Cracker | 45. Brahmani River |
| 8. Repair Shop | 27. Storehouse | 46. Intake Pumping Station |
| 9. Pug Mill | 28. Oil Depot | 47. Holding Sidings |
| 10. Coke Oven Plant | 29. Refractories Store | 48. Empty & Finished Product Sidings |
| 11. By-Products Plant | 30. Oxygen Generating Plant | 49. Incoming Raw Material Sidings |
| 12. Coal Yard for Coke Oven Plant | 31. Building Service | 50. Raw Material Empty Wagon Sidings |
| 13. Fuel Department | 32. Central Maintenance Shop | 51. H.S.P.L. Marshalling Yard |
| 14. Pig Casting Machine | 33. Acetylene Generating Plant | 52. Reception Sidings |
| 15. Steel Melting Shop | 34. Administration Building | 53. To S.E.R.L.Y. Bondamunda Marshalling Yard |
| 16. Dolomite & Lime Calcining Plant | 35. Security Department | 54. Ring Road |
| 17. Mould Preparation | 36. First Aid Station | 55. Diverted Road to Bisra |
| 18. Ramp-Steel Melting Shop | 37. Motor Pool | 56. To Rourkela Rly. Station |
| 19. Scrap Yard | 38. Laboratory | |

couplings with side buffers or with AAR type F centre buffer couplers. Rolling stock having either of these couplers can be handled by these Locomotives. In addition to facilitate handling of both types of Rolling stocks in quick succession match cars having combination couplers and side buffers have also been purchased.

The factors that lead to the selection of Diesel Locomotives are no longer a matter for discussion as the overall superiority of Diesel traction over that of steam has been universally accepted. However much has to be said to the credit of the sponsors, who inspite of India's tight foreign exchange position, have encouraged this means of traction.

A Loco maintenance shed incorporating many of the modern maintenance facilities as used in U. S. A. and Germany is under construction. A batch of trainees were sent to U. S. A. for advanced training in the latest maintenance techniques.

ROLLING STOCK

Varied types of Rolling stocks are already in use in this Steel Plant, few of them like ladle cars etc. being

not common to the Railways. These special wagons have been designed to economic carrying capacities with arrangements for quick disposal of their contents thereby increasing availability and reducing overall expenditure on the transport of these materials.

The Steel project has ordered nearly 190 special type wagons and approximately 200 conventional type of wagons with different manufacturers in Germany and in India. All these wagons are to be fitted with automatic couplers to facilitate quick formation of trains and easier shunting. A fleet of self-emptying hopper wagons for the transport of Iron Ore and Limestone from the mines upto the Plant have been ordered by the State Railways. An interesting addition to the variety of Rolling stock procured by this project is a 14 axle well wagon of carrying capacity 180 Ton specially designed and built by the well known German firm of Krupps. for the transport of mill-housings of the Rolling mills from the Calcutta Port to Rourkela.

TRAFFIC CONTROL

Efficient and economic operation of Rail Transport largely depends on the best utilisation of tracks and Rolling Stock. Delays in setting points, derailments

due to faulty setting of points, accidents caused by imperfect signalling, unco-ordinated movements of trains and the like greatly hamper marshalling yard operation. The modern Railway signal technique has come the closest to meet this challenge. It has been proposed to install at the marshalling yard of the Works Railway a control cabin which will effectively supervise and direct the various train movements



Blast Furnace Slag Ladle Cars emptying Blast Furnace slag at the dump.

through remote controls. M/s. Siemens & Halske of West Germany have been asked to design and erect at

Rourkela Steel Plant one of the most modern control systems of the day. The All-Relay Push button control station proposed to be installed consists of a control desk with a panel showing an illuminated Works Track Layout diagram. All points, totalling approximately 100, and, the various other signals are controlled by means of push buttons located appropriately on the diagram of the panel. By such a system a number of interlocked or protected train routes may be formed within the shortest time, simultaneously assuring almost safety. The advantages of this signal technique are too many to be covered in a short space here.

The finishing touch to this up-to-date Rail transport system briefly explained above, is given by providing Wireless communication facilities between the different control stations and the Locomotives. This will enable Traffic control men getting into direct touch with the Locomotive drivers or vice versa and guide the movement of trains. A press-to-talk Radio telephone capable of operating from at least two stationery units and 20 more mobile units fitted to locomotives and operating at VHF is also proposed to be installed.

Ganga Bridge Project -- Last Span Erected

The fourteenth, and the last, main span of the Ganga Bridge Project, near Mokameh, in Bihar, has been erected.

When the bridge is opened, traffic will flow freely across the river Ganga to North Bihar, West Bengal and Assam and quota restrictions on account of transhipment at the ghats will disappear.

With the opening of the Ganga Bridge, a 50-year old dream will come true. The construction of a bridge across the Ganga has been under consideration since 1907. Actual field work, however, commenced only in October 1955. Within three years, the Project Administration has been able to complete not only the river training works and well foundations, but also the erection of all the 14 main spans of 400 feet each.

Each of the 14 main spans weigh nearly 950 tons. Economy in weight has been achieved by the use of high tensile steel for main members and welded fabrication for floor systems. The girders have been erected by the cantilever method, used for the first time in a railway bridge of this size in India.

Approach lines, nearly 18 miles in length, are ready and the construction of a broad gauge-metre gauge marshalling and transhipment yard including loco sheds and other ancillary works are going ahead with speed. More than 1,000 staff quarters are nearing completion with amenities like electricity filtered water supply and water borne lavatories.

SUPPLY OF COAL TO RAILWAYS

To a certain extent, the coal supplied to the Railways has been found inferior to the desired quality, said the Deputy Minister for Railways, Shri Shah Nawaz Khan, in a written reply to a question by Shri Rameshwar Tanti in the Lok Sabha.

Replying to another part of the question regarding the extra expenditure that had to be incurred by the Railways during 1957-58 due to the supply of inferior quality of fuel, the Deputy Minister said that it was not possible to give exact figures as only about one per cent of the coal wagons consigned to the Railways were checked at receiving ends.

Corrosion with some Reference to Railway Materials

By A. M. Edwards, A.Met.,

Senior Assistant, Corrosion Laboratory,
Research and Development Department, United Steel Companies Limited.

INTRODUCTION

THERE is little doubt that failures due to corrosion have been observed by most readers and that all, at some time, have devoted their attention to offsetting this most natural hazard, which has been defined as 'The deterioration of a substance (usually a metal) or its properties because of a reaction with its environment'. This hazard, which in the opinion of all corrosion engineers calls for primary consideration at the design stage, is extremely costly and it has been estimated that the cost of prevention and replacement is approximately £ 200,000,000 per annum in the United Kingdom and 10 times this amount in the United States.

In view of this enormous loss, preventative measures are desirable in almost all cases where corrosion is likely to occur. However, before embarking on a programme of prevention it is necessary, if the best results are to be achieved, to understand the processes which are primarily responsible for the deterioration.

THE MECHANISM OF CORROSION

Corrosion is essentially an electro-chemical phenomenon. That is, it is associated with the flow of electric currents and the tendency for a metal to corrode may be expressed by the amount of energy liberated during the change from metallic to oxidised state.

In any corrosion reaction there must be two electrodes, an anode and a cathode which are connected, and an electrolyte for completion of the electric circuit. The positively charged anode corrodes, metal ions going into solution, whilst negatively charged electrons remain in the metal and travel to the cathode where they meet positively charged hydrogen ions and form bubbles of hydrogen gas which is evolved. This is characteristic of attack by acids. However, in neutral electrolytes hydrogen evolution is slow and gas bubbles collect resulting in *cathodic polarization* and subsequent slowing down of the reaction. Oxygen dissolved in the electrolyte will, however, react with the hydrogen to form water and allow the reaction to proceed. This is an important

factor in the corrosion process where oxygen is known as a *cathodic depolarizer*.

The identification of anodes and cathodes in two metal systems is obtained from the Galvanic Series, Table I, which may be considered as the practical form of the 'electromotive series'.

It will be seen that if iron is connected to zinc then zinc will be anodic and corrode whilst iron will be cathodic and protected. The corrosion of a single metal such as steel might appear more difficult to understand but its chemical heterogeneity alone can be responsible for differences on the surface leading to the setting up of very localised anodic and cathodic areas. Numerous factors not mentioned above can affect either the onset of corrosion or the rate at which it proceeds, amongst these it may be necessary to consider the following :—

1. *Salts*—neutral salts may increase electrical conductivity, alter the solubility of corrosion products or produce local concentration cells.

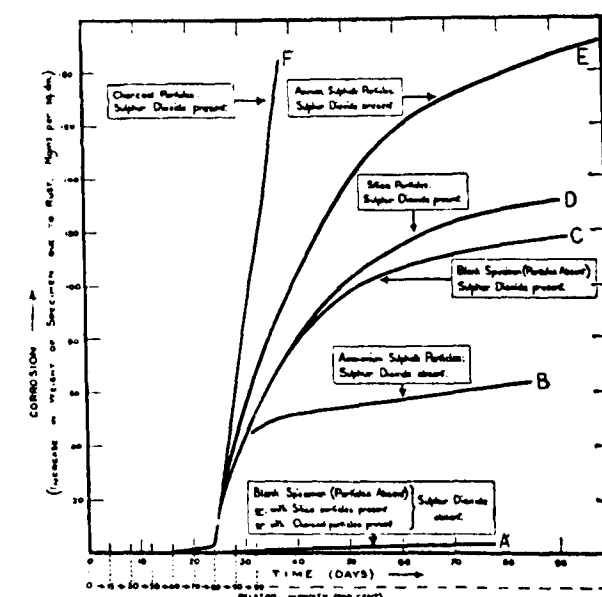


Fig. 1. Influence of particles on rusting of iron, and without presence of sulphur-dioxide. Relative humidity increased in steps, as shown, to maximum of 99%.

part due to the inherently thicker dry film produced by linseed oil paints. Although red lead in linseed oil has shown good results it has been surpassed by others in the same medium, and one (40 per cent. Wt. each of red lead and white lead and 20 per cent. asbestine) has been incorporated in B. S. 2532 1954 as Type C for use on structural steelwork. Certain other paints are also considered to be equal to or better than red lead and are worthy of practical trials. The main drawback to lead base paints is their toxicity which in company with their consistency precludes their application by spraying. However, other inhibitive primers which do not contain lead in any form are available for spray application and owe their inhibitive properties to other additives a typical example being the chromate types. Irrespective of the finishing coats selected it should be ensured that a good primer with inhibitive properties is next to the metal. It is better to apply expensive inhibitive primers and cheaper top coats than invest in an inferior neutral or non-inhibitive primer. This is illustrated by Hudson and Stanners:—

TABLE II

The Effect of Inhibitive and Non-Inhibitive Priming Paints on Light Gauge Steel Exposed Llanwrtyd Wells (Wales)

Paint Scheme	Life
3 coats red iron oxide	3.1 years
1 coat red lead in linseed oil+ 2 coats red oxide	5.0 years

A second method of protection of structural steelwork is the application of metallic coatings, after cleaning by a sand or shot blasting process, followed by the application of a neutral paint scheme which acts as a sealer in the case of sprayed coatings. Tests are in progress at The United Steel Companies Limited on railway wagon under-frames, in which this type of scheme has been incorporated and although conclusive results are not yet available, inspections carried out by the author indicate that, for industrial use, wagons so treated will give a better life than that obtained by normal painting methods.

ALLOY ADDITIONS TO STEEL

Although atmospheric corrosion cannot be completely prevented by the addition of small amounts of

alloying elements to steel the magnitude of the metal loss can be markedly reduced. Again, the most important work in this field has been carried out, in Great Britain, under the auspices of The British Iron and Steel Research Association Corrosion Committee and the most recent publication⁴ clearly indicates the value of low alloy steels. The most useful elements for the reduction of atmospheric corrosion are Cr, Cu, Ni. Other additions such as P, Si, Al, and Be, also show some advantage. The principle of protection brought about by these elements has not been fully explained but it is believed that their presence results in a denser corrosion product and subsequent stifling of the corrosion reaction occurs due to a reduction in permeability. Other investigators in this field⁵ also stress the importance of the elements mentioned above.

The merits of alloy additions are shown in Fig. 3 where composition of the Cor-Ten steel is

C	Mn	Cr	Cu
.23 max	.2/.5	.5/1.25	.25/.55
Si	P	S	
.25/.75	.07/.15	.05 max	

and illustrates a combination of some of the most useful elements referred to previously.

TABLE III

Losses of Weight of Steel Test Panels inserted in Ore and Coke Wagons

Type of Steel	Average loss (in ounces) after exposure for the time stated	
	Ore Wagons after 4½ years	Coke Wagons after 4 years
Mild Steel (no alloy addition)	38.7	106
Kuplus Steel (Copper Steel)	18.4	81
HTK (Cu Mn steel)	13.5	45
Cor-Ten (Cr, Cu, P Steel)	10.7	39

TABLE IV
Results of Corrosion Tests on Rail Steels*
Atmospheric Exposure Tests

Steel No.†	Analysis%							Total Corrosion, mils		
	C	Mn	Si	P	S	Cu	N	1 Yr.	2 Yr.	5 Yr.
1	0.1	0.7	0.2	—	—	0.01	—	9.0	12.0	26.9
65	0.61	0.80	0.13	0.015	0.042	0.24	0.004	4.0	7.8	18.0
66	0.58	1.14	0.13	0.052	0.031	0.03	0.004	4.3	8.5	18.9
67	0.49	1.09	0.10	0.061	0.052	0.04	0.012	4.7	9.8	20.1
68	0.60	1.10	0.19	0.049	0.047	0.06	0.004	4.3	8.8	19.1

* The specimens measured 3 in. X 2 in. X ½ in.

† Steels 65 and 66 were normal rail steels of U.S. and U.K. manufacture respectively and steels 67 and 68 had been sorbitised. All four steels contained 0.02 per cent. of nickel and a trace only of chromium.

The work of Reeve⁷ has not only demonstrated the corrosion resistance of such steels but has also indicated their superiority under conditions of corrosion plus abrasion. Certain results from steel test panels built into wagon bodies at the Appleby-Frodingham works, where the steels are manufactured, are presented in Table III

Due to difficulties in maintenance or severe service conditions in certain locations, normal paint schemes and low alloy steels may not be satisfactory. Marshall and Sinclair⁸ have shown that in certain very severe conditions, e. g. smoke ducts and stacks of a locomotive maintenance shed both vitreous enamelled mild steel and uncoated stainless steel are satisfactory. Materials such as these could well be adopted in other similar locations, particularly tunnels or on those parts of any structure subject to the direct impingement of funnel blast.

The most susceptible component of the railway system to atmospheric corrosion, which due to its function is not protected, is the permanent way. Hudson and Stanners⁹ have shown (Table IV) that the atmospheric corrosion resistance of rail steels is unaffected by a heat treatment such as sorbitising and is better than that of low carbon (0.1 per cent.) mild steel.

The atmospheric corrosion experienced on a rail is a major factor affecting its ultimate wear resistance and Dearden's observations⁹ suggest that 'in the case of a busy line carrying 2,000,000 axles per annum the wear per axle of the rails is increased by a factor of 3 in the

best rural conditions and by a factor of 12 in the worst industrial conditions, taking the London underground railway system as a basis. With infrequently used branch lines, 100,000 axles per annum, factors in the order of 12 and 50 respectively can be expected'.

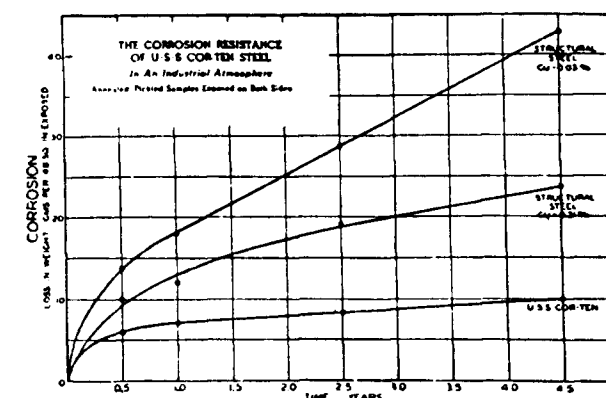


Fig. 3. The comparative atmospheric corrosion resistance of three structural steels

A further example of the effects of corrosion on rail life is the incidence of corrosion fatigue cracks starting from small corrosion pits in the region of the upper fillet radii. In one instance when heavy locomotives were being operated over rather light rails, this has resulted in the development of cracks up to 6 ft. long completely separating the rail head from the web. This suggests that some protection of all but the bearing surfaces would be advantageous. However, surface preparation would probably have to be carried out on the whole of the rail and subsequent handling and installation damage to the protective may be so great as to make this suggestion prohibitive.

part due to the inherently thicker dry film produced by linseed oil paints. Although red lead in linseed oil has shown good results it has been surpassed by others in the same medium, and one (40 per cent. Wt. each of red lead and white lead and 20 per cent. asbestine) has been incorporated in B. S. 2532 1954 as Type C for use on structural steelwork. Certain other paints are also considered to be equal to or better than red lead and are worthy of practical trials. The main drawback to lead base paints is their toxicity which in company with their consistency precludes their application by spraying. However, other inhibitive primers which do not contain lead in any form are available for spray application and owe their inhibitive properties to other additives a typical example being the chromate types. Irrespective of the finishing coats selected it should be ensured that a good primer with inhibitive properties is next to the metal. It is better to apply expensive inhibitive primers and cheaper top coats than invest in an inferior neutral or non-inhibitive primer. This is illustrated by Hudson and Stanners :—

TABLE II
The Effect of Inhibitive and Non-Inhibitive Priming Paints on Light Gauge Steel Exposed Llanwrtyd Wells (Wales)

Paint Scheme	Life
3 coats red iron oxide	3.1 years
1 coat red lead in linseed oil+ 2 coats red oxide	5.0 years

A second method of protection of structural steel-work is the application of metallic coatings, after cleaning by a sand or shot blasting process, followed by the application of a neutral paint scheme which acts as a sealer in the case of sprayed coatings. Tests are in progress at The United Steel Companies Limited on railway wagon under-frames, in which this type of scheme has been incorporated and although conclusive results are not yet available, inspections carried out by the author indicate that, for industrial use, wagons so treated will give a better life than that obtained by normal painting methods.

ALLOY ADDITIONS TO STEEL

Although atmospheric corrosion cannot be completely prevented by the addition of small amounts of

alloying elements to steel the magnitude of the metal loss can be markedly reduced. Again, the most important work in this field has been carried out, in Great Britain, under the auspices of The British Iron and Steel Research Association Corrosion Committee and the most recent publication⁴ clearly indicates the value of low alloy steels. The most useful elements for the reduction of atmospheric corrosion are Cr, Cu, Ni. Other additions such as P, Si, Al, and Be, also show some advantage. The principle of protection brought about by these elements has not been fully explained but it is believed that their presence results in a denser corrosion product and subsequent stifling of the corrosion reaction occurs due to a reduction in permeability. Other investigators in this field⁴ also stress the importance of the elements mentioned above.

The merits of alloy additions are shown in Fig. 3 where composition of the Cor-Ten steel is

C	Mn	Cr	Cu
.23 max	.2/.5	.5/1.25	.25/.55
Si	P	S	
.25/.75	.07/.15	.05 max	

and illustrates a combination of some of the most useful elements referred to previously.

TABLE III
Losses of Weight of Steel Test Panels inserted in Ore and Coke Wagons

Type of Steel	Average loss (in ounces) after exposure for the time stated	
	Ore Wagons after 4½ years	Coke Wagons after 4 years
Mild Steel (no alloy addition)	38.7	106
Kuplus Steel (Copper Steel)	18.4	81
HTK (Cu Mn steel)	13.5	45
Cor-Ten (Cr, Cu, P Steel)	10.7	39

TABLE IV
Results of Corrosion Tests on Rail Steels*
Atmospheric Exposure Tests

Steel No.†	Analysis%							Total Corrosion, mils		
	C	Mn	Si	P	S	Cu	N	1 Yr.	2 Yr.	5 Yr.
1	0.1	0.7	0.2	—	—	0.01	—	9.0	12.0	26.9
65	0.61	0.80	0.13	0.015	0.042	0.24	0.004	4.0	7.8	18.0
66	0.58	1.14	0.13	0.052	0.031	0.03	0.004	4.3	8.5	18.9
67	0.49	1.09	0.10	0.061	0.052	0.04	0.012	4.7	9.8	20.1
68	0.60	1.10	0.19	0.049	0.047	0.06	0.004	4.3	8.8	19.1

* The specimens measured 3 in. $\times$ 2 in. $\times$ $\frac{1}{4}$ in.

† Steels 65 and 66 were normal rail steels of U.S. and U.K. manufacture respectively and steels 67 and 68 had been sorbitised. All four steels contained 0.02 per cent. of nickel and a trace only of chromium.

The work of Reeve⁷ has not only demonstrated the corrosion resistance of such steels but has also indicated their superiority under conditions of corrosion plus abrasion. Certain results from steel test panels built into wagon bodies at the Appleby-Frodingham works, where the steels are manufactured, are presented in Table III

Due to difficulties in maintenance or severe service conditions in certain locations, normal paint schemes and low alloy steels may not be satisfactory. Marshall and Sinclair⁸ have shown that in certain very severe conditions, e. g. smoke ducts and stacks of a locomotive maintenance shed both vitreous enamelled mild steel and uncoated stainless steel are satisfactory. Materials such as these could well be adopted in other similar locations, particularly tunnels or on those parts of any structure subject to the direct impingement of funnel blast.

The most susceptible component of the railway system to atmospheric corrosion, which due to its function is not protected, is the permanent way. Hudson and Stanners⁹ have shown (Table IV) that the atmospheric corrosion resistance of rail steels is unaffected by a heat treatment such as sorbitising and is better than that of low carbon (0.1 per cent.) mild steel.

The atmospheric corrosion experienced on a rail is a major factor affecting its ultimate wear resistance and Dearden's observations⁹ suggest that 'in the case of a busy line carrying 2,000,000 axles per annum the wear per axle of the rails is increased by a factor of 3 in the

best rural conditions and by a factor of 12 in the worst industrial conditions, taking the London underground railway system as a basis. With infrequently used branch lines, 100,000 axles per annum, factors in the order of 12 and 50 respectively can be expected'.

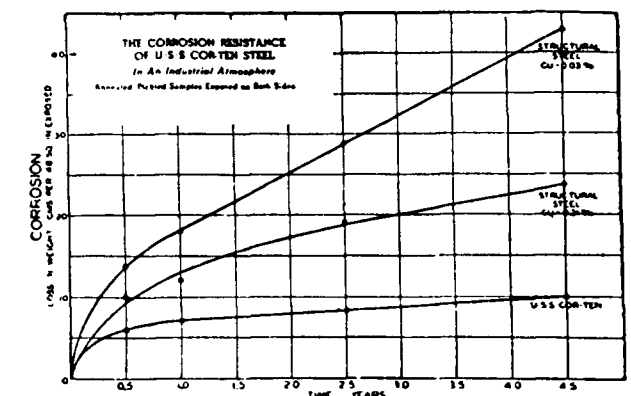


Fig. 3. The comparative atmospheric corrosion resistance of three structural steels

A further example of the effects of corrosion on rail life is the incidence of corrosion fatigue cracks starting from small corrosion pits in the region of the upper fillet radii. In one instance when heavy locomotives were being operated over rather light rails, this has resulted in the development of cracks up to 6 ft. long completely separating the rail head from the web. This suggests that some protection of all but the bearing surfaces would be advantageous. However, surface preparation would probably have to be carried out on the whole of the rail and subsequent handling and installation damage to the protective may be so great as to make this suggestion prohibitive.

BOILER CORROSION AND WATER TREATMENT

As the most expensive and important component of the railway system, the steam locomotive is also that which is probably most susceptible to corrosion. In addition to its susceptibility to external deterioration its fundamental objective of steam raising gives rise to other internal corrosion problems. The selection of alloy steels or other metals is limited and generally speaking, in Great Britain, the fire tubes are of plain carbon steel fitted to a copper firebox. It is therefore these components of the boiler which are of greatest concern and for their well-being a knowledge of water chemistry is essential. A comprehensive paper on the subject of boiler tube corrosion has been presented by Turner¹⁰ and his recorded observations are to be noted. Minor investigations at these laboratories^{11,12} although not so extensive as those of Turner have led to similar conclusions.

The boiler tube which invariably has on it a discontinuous oxide film, produced during fabrication, will corrode by pitting when brought into contact with water containing copious amounts of oxygen as the millscale will become cathodic and the steel, exposed at discontinuities, will be anodic. Increase in temperature will, of course, increase the corrosion by increasing the electrical conductivity of the water until the oxygen is driven off by boiling. There appears, therefore, to be two obvious cures to this problem. One is to remove the millscale and thus remove the highly susceptible anodic areas, and spread the attack over the metal surface; or alternatively to remove the oxygen which, as the cathodic depolariser, allows the corrosion reaction to proceed.

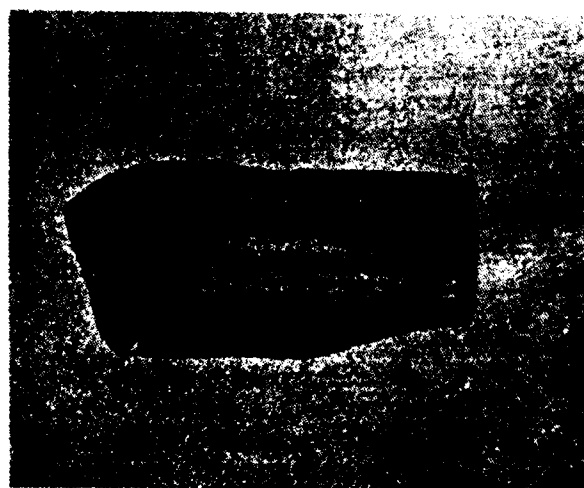


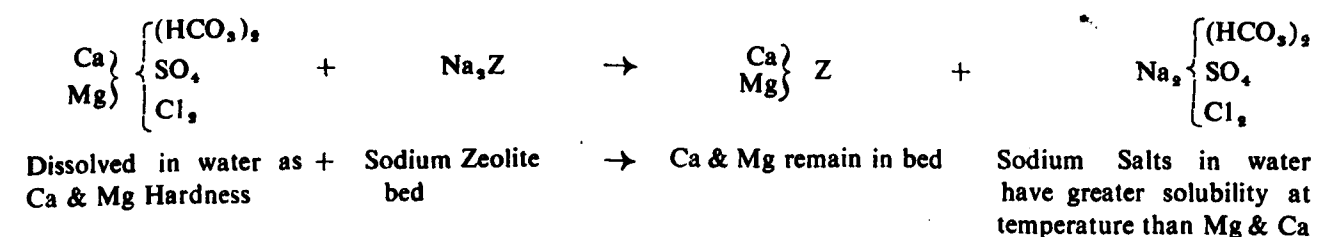
Fig. 4. 0.4 in. thick deposit removed from a fire-tube boiler using untreated hard water.

However the removal of both these undesirables will lead to a greater degree of efficiency and longer life. Millscale removal can be achieved either chemically or mechanically and the choice between the two would appear to be one of economic consideration. Chemically the steel is descaled by acid pickling preferably followed by a phosphating treatment which imparts to the metal surface a degree of corrosion resistance superior to that of an unphosphated surface. Mechanical descaling on the other hand depends on either blasting the millscale from the surface by shot or sand or alternatively, subjecting the steel to a mechanical deformation process when the scale will be detached due to its lack of elasticity. Although all these methods are equally effective in removing the scale Turner¹⁰ has suggested that shot peening has an added advantage as compressive stresses are produced on the surface thus reducing the tendency to any subsequent cracking in service.

Oxygen is present in normal aerated waters in the order of 5 to 8 c.c./litre and in locomotive practice this should be reduced to less than 1 c.c. per litre. The methods available for oxygen removal are numerous and can be carried out either outside or inside the boiler. External treatments are not normally applied in locomotive practice as oxygen removal can be achieved either by introducing the softened feed water above the water line in such a manner that the majority of the dissolved gases flash off in the steam phase, or alternatively by chemical treatment in the boiler itself. Tannin compounds, referred to later or additions of sodium sulphate have a great affinity for oxygen and are therefore attractive in their ease of application. Many proprietary formulations which incorporate this latter method of oxygen removal are available but advice on their use should be obtained from the suppliers.

Oxygen removal alone is insufficient for the continuous safe operation of a boiler since water has dissolved in it many salts particularly those of magnesium and calcium which produce Hard Waters. When the water is heated these salts are thrown out of solution and deposit hard scales on the heat transfer areas (see Fig. 4) resulting in reduced heat transfer and subsequent failures due to overheating. A process which has been used extensively on the railways for softening these hard waters is the Cold Lime Soda Process. The lime added reduces the bicarbonate hardness by precipitation of calcium as carbonate and magnesium as hydroxide, the lime added also being precipitated as calcium carbonate. Soda ash additions reduce the non-carbonate hardness and produces

readily soluble sodium salts. The water after such treatment has a low hardness and due to the use of excess chemicals (lime and soda ash) a high pH value. The high pH value is important in reducing corrosion as it means that the solution is alkaline and has a low hydrogen ion concentration. Referring back to the mechanism of corrosion it will be observed that a low hydrogen ion content will reduce the corrosion as,



A further method of water softening is that known as base exchange or Zeolite softening in which the hard constituents, calcium and magnesium, are exchanged for the more soluble sodium salts by passing the water through a bed of sodium zeolite.

Base exchange water softening as applied to the railways is discussed in greater detail by Walter.¹³

Increase in alkalinity or pH value referred to above for the reduction of corrosion of steel can be achieved by additions of caustic soda. However, caution is necessary with the use of this chemical for corrosion inhibition as a dangerous situation can arise due to the onset of caustic embrittlement and for locomotives with copper boiler components (fire boxes) the corrosion of copper becomes most marked. Walter¹³ investigated this effect and in order to prevent corrosion of both steel tubes and copper boxes a tannin extract addition, on the basis of ½ lb. per one thousand gallons of water, has been found to produce excellent inhibitive properties.

The foregoing paragraphs have only briefly outlined the causes and the prevention of corrosion but it must be remembered that numerous failures in service can be attributed to the initiation of corrosion during the storage period. The need then is not only for adequate preventative measures during service but also for protection during storage and adequate inspection before the actual service life begins so that corrosion sites may be eliminated. Corrosion prevention during storage and transit is a whole field of study which will have to be omitted from this paper but it is reassuring to know that it is now receiving much more attention than hitherto and will contribute to the reduction of the figure quoted in the opening paragraph.

ACKNOWLEDGMENTS

The author is indebted to Dr. W. H. J. Vernon, Dr. L. Reeve, Dr. J. C. Hudson and Mr. J. F. Stanners for their permission to reproduce certain of their previously published figures and tables.

REFERENCES

- ¹ ANTON DE S. BRASUNAS, 'An approach to the corrosion Problem', *Corrosion Technology*, August 1956.
- ² VERNON, W. H. J., 'The Atmospheric Corrosion of Metals', *Soc. Chem. Ind. Symposium on Atmospheric Corrosion* (Manchester), February 5th, 1937.
- ³ (i) The 'Granodising' Process of I. C. I. Ltd., (ii) The 'Bonderizing' Process of The Pyrene Co. Ltd., *Corrosion Prevention and Control*, Vol. 3, No. 8, August 1956.
- ⁴ HUDSON, J. C., and STANNERS, J. F., 'The Formulation of Priming Paints for Structural Steel', *Journ. Applied Chem.*, April 1955.
- ⁵ HUDSON, J. C., and STANNERS, J. F., 'The Corrosion Resistance of Low Alloy Steels', *J. I. S. I.*, Vol. 180, Part 3, July 1955.
- ⁶ FRENCH and LAQUE, 'Alloy Constructional Steels', Pt. VIII, pp. 140-206, *A. S. M.*, Cleveland, Ohio, 1942.

- ⁷ REEVE, L., 'The Corrosion of Mild and Copper-Bearing Steel Panels in Iron-ore Wagons', *J. I. S. I.*, Vol. II, 1940, pp. 191-198.
- ⁸ MARSHALL and SINCLAIR, 'Corrosion of Materials subject to locomotive smoke and funnel blast', *Corrosion*, Vol. II, No. 9, September 1955.
- ⁹ DEARDEN, J., 'The Wear of Steel Rails—a review of the factors involved', Paper No. 53, *Inst. of Civil Eng.*, October 1954.
- ¹⁰ TURNER, T. H., 'The Corrosion of Boiler Tubes', Paper No. 438, *J. I. Locomotive Eng.*, 170, November-December 1942.
- ¹¹ Internal Report, Ref. No.C. 3031/1 20.2.1948.
- ¹² Internal Report, Ref. No. COR 3961/—/54 9.6.1945.
- ¹³ WALTER, A. J. R., 'Brief History of the application of Base exchange water softeners to Railways', Paper No. 463, *J. I. Locomotive Eng.*, 195, February 1947.

(Republished with permission from *Railway Steel Topics*, published by *The United Steel Companies Limited*).

COMBATING CRIME ON RAILWAYS—CHIEF SECURITY OFFICERS DISCUSS PROBLEM

A conference of Chief Security Officers of the Indian Railways was inaugurated in New Delhi by the Railway Minister Shri Jagjivan Ram, on January 17, 1959.

Present at the conference were the Deputy Minister for Railways, Shri Shah Nawaz Khan, Chairman and Members of the Railway Board and other officers.

Addressing the Chief Security Officers, the Railway Minister said that the Railway Protection Force had a difficult task to perform, particularly in view of the fact that their field of operation covered railway properties or public properties entrusted to the railway, scattered all over the country.

The Minister said that he was glad that marked improvements had been effected in certain pockets noted for crime but the task was big and it would take all the effort which the Railway protection Force could put in to tackle it successfully.

The Minister said that he was anxious that emphasis should be laid on adequate training arrangements and asked the chief Security Officers to pay special attention to this matter.

PUBLIC CO-OPERATION ESSENTIAL

The nature of the Railway Protection Force's duties, the Minister said, was such that satisfactory results could never be achieved unless public co-operation was forthcoming in full measure. The railways should

take steps to mobilise public co-operation. There should, of course, be complete co-operation with the State authorities.

The Minister drew attention to the importance of adequately recognising good work done by men of the Railway Protection Force. A suggestion he made was that medals and other rewards in kind may be awarded for gallantry.

The Deputy Minister for Railways, Shri Shah Nawaz Khan, referred to certain organisational matters. He said that the drive to combat crime would yield better results if public co-operation was utilised in greater measure.

PROTECTION FORCE'S ACTIVITIES

Addressing the conference earlier, the Inspector General of the Railway Protection Force, Shri S. Parthasarathi, gave a detailed account of the activities of the Railway Protection Force, the contribution it had already made in arresting crime on the railways, the lines of future work and certain problems which the Force faced.

The conference then proceeded to discuss various matters aimed at increasing the effectiveness of the Railway Protection Force as a whole and at achieving greater co-ordination among the Railway Protection Force units on the different Zonal Railways and also between the Railway Protection Force on the one hand and State Governments on the other.

“Copy-Turning” on a General-Purpose Type Lathe

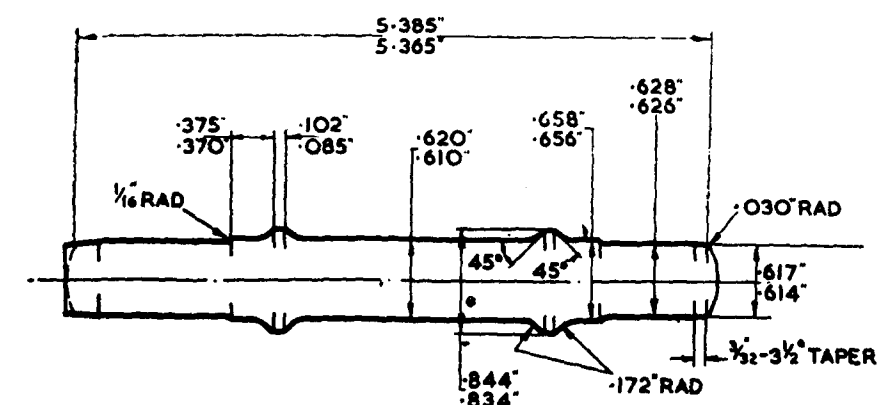


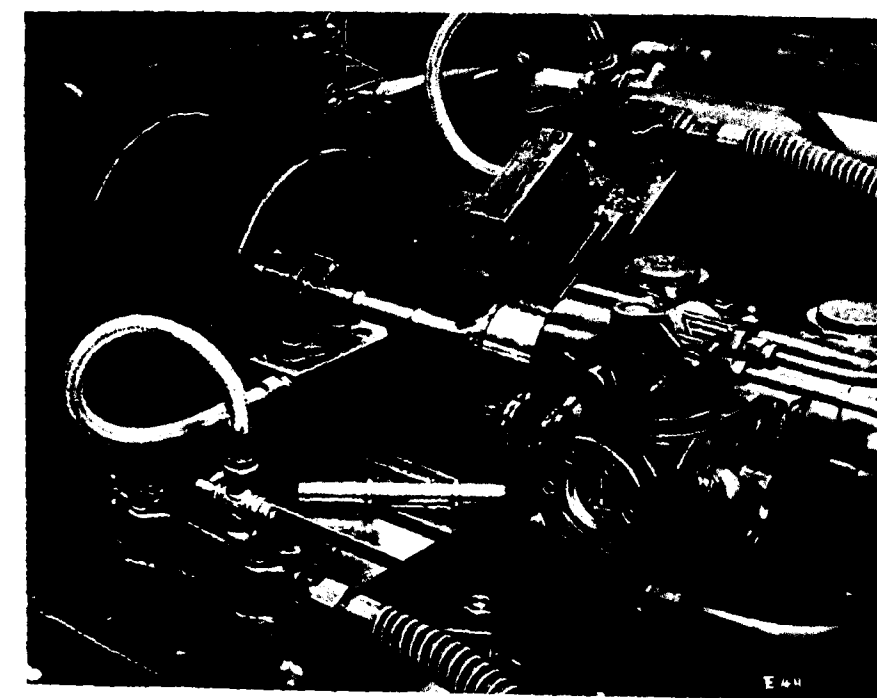
Fig. 1. A bicycle bottom bracket axle copy-turned from a steel forging on a Herbert/Smallpeice Multi-cut Production Lathe in a floor-to-floor time of 35 seconds.

THE copy-turning lathe, undoubtedly, ensures economical production of formed shafts required in batches, particularly if the operation involves heavy metal removal, good finish and long traverses. The automatic cycle is a time saver, reduces operational fatigue and ensures repetition of tolerances in batch production.

Efficiency of the process, under appropriate conditions, is without equal, but the economics necessitate

careful consideration of the extent to which the machines can be maintained in continual production. The ratio of idle time to production time over a period could be costly. Very often, work which would normally be produced on a centre lathe is allocated to a copy-turning lathe, irrespective of cost, merely because the latter machine is available; masters for subsequent copy-turning are sometimes produced on the same machine. Both are expensive processes which should be avoided.

Fig. 2. The traverse of the front slide on the Herbert/Smallpeice Multi-cut Production Lathe is controlled from a steel former. The fully automatic cycle from starting the machine to tool retraction, return and stop ensures high production consistency in batch production, close tolerances and good surface finish. Heavy cutting with multi-tooling or finish turning with diamond-tipped tooling are within the capabilities of this general-purpose lathe.



The Herbert-smallpeice Multi-cut Production Lathe is a typical inexpensive general-purpose lathe, which, with suitable simple attachments can ensure economical copy-turning of a wide variety of formed shafts. Not only can the shaft be turned, but also faced, grooved or bored in the same set-up, but these additional operations obviously depend upon the work-piece and particularly on its length.

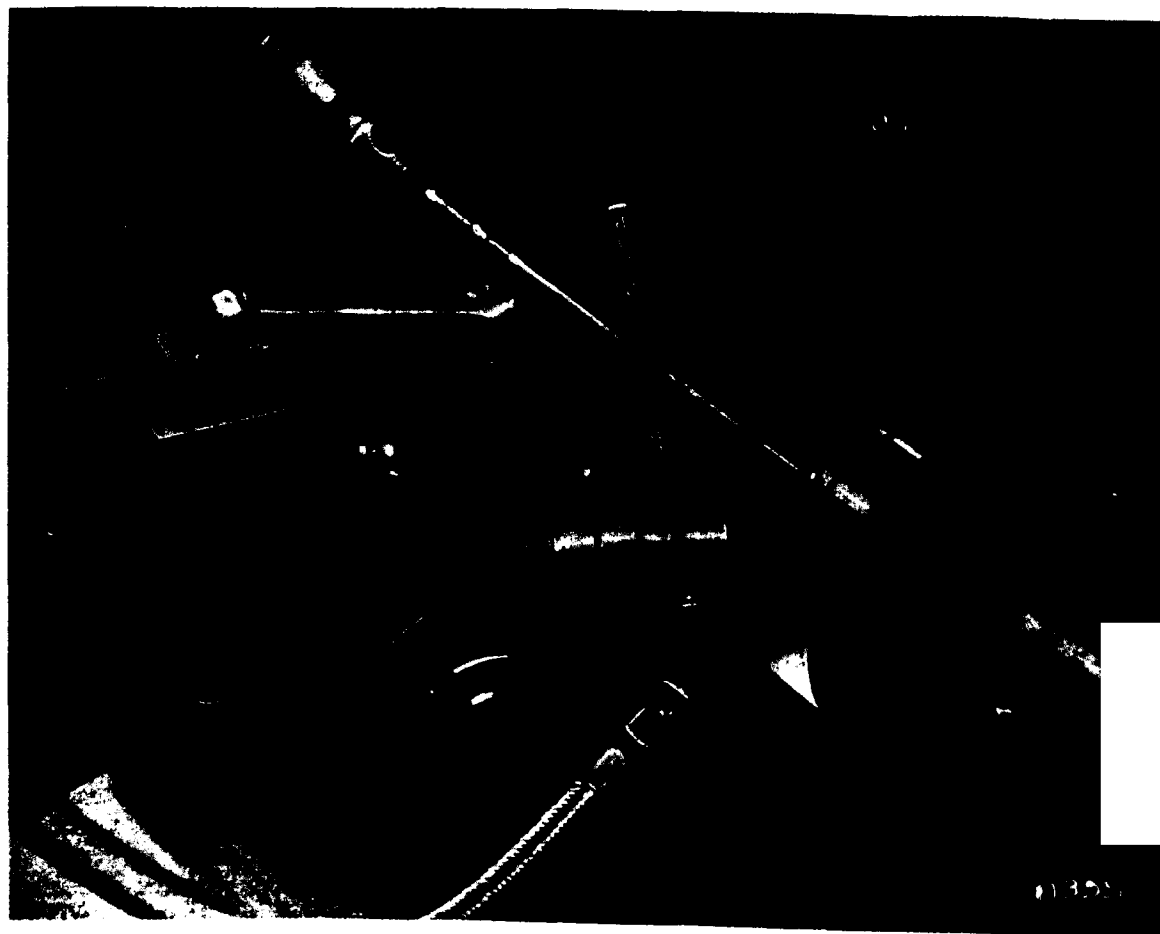
The accompanying illustration is a typical example of how copy-turning operations can be successfully performed on this machine equipped with a simple attachment, instead of on the more expensive copy-turning lathe. The component is a bicycle bottom bracket axle made from a steel forging. The axle is completely turned in one operation in a floor-to-floor time of 35 seconds. Stock removed is .062", cutting speed 400 ft./min. and feed .0076" per rev.

The axle, centre drilled and machined at both ends, is mounted on centres and is driven by a "KOSTA" work driver fitted to the machine spindle. An air-operated tailstock ensures quick loading and removal of the work.

An Ardoloy-tipped tool located on the front profiling tool slide, traverses under the control of a steel former. The .030" radius at the end of the component is formed by an Ardoloy tool located on the rear cross-slide.

Users have found that the Herbert-smallpeice Lathe, by virtue of its heavy cutting capabilities and all round flexibility, can be used as a general production lathe. It is, however, as a Multi-Cut Lathe that this machine has excelled. It is of unit construction, the tooling for any suitable work, simple or complex, can be quickly arranged by means of slides, overarms and attachments in any combination, thus it has the advantage of versatility. The finish obtainable is exceptionally good; on some components it has been found possible to dispense with a subsequent grinding operation.

Other features include a choice from two types of headstocks—either belt-driven (Type M) or worm-driven (Type W). The bed and base are identical for both types and each can be arranged for either automatic or manual cycle operation.



EDITORIAL NOTICE

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.

All contributions intended for publication in any particular issue should reach the Editor at least 30 days prior to the scheduled date of the publication. The Publishers reserve the copyright of contributions published in the journal and reproduction either in full or in part will be permitted only with the previous permission of the Editor.

Manuscripts should be typewritten, double spaced or legibly written on thick paper on one side only with sufficient margin on either side, with the sheets numbered in order. The name and full address of the author should appear on the first sheet of the contribution. The Editor cannot undertake to return unused Mss. but will make every endeavour to do so. Accepted Mss. are not returned. All photographs accompanying the contribution will be retained by the Editor unless there be special reason or request for their return to the writer.

ALL ACCEPTED CONTRIBUTIONS ARE PAID FOR AT OUR USUAL RATES.

Editor

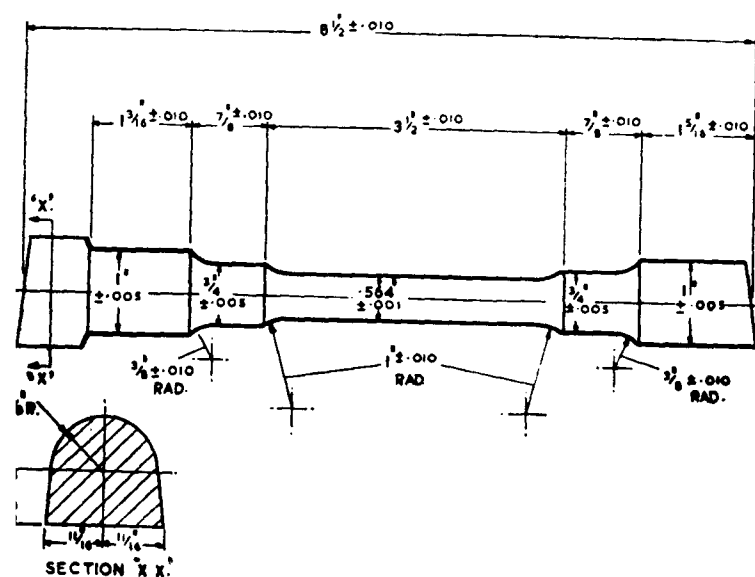
AN IMPORTANT ANNOUNCEMENT

WE have great pleasure in announcing to all our readers and advertisers that we are incorporating the following Supplements on various aspects of Railroad Engineering in our ANNUAL NUMBER to be released by the end of July, 1959.

Advertisers desirous of buying advertising space in any one of the Supplements should intimate the fact to the Advertisement Manager on or before 10th July, 1959. We can accept only a limited number of advertisements due to space restrictions.

1. Castings Supplement
2. Signalling, Interlocking & Telecommunications Supplement
3. Cranes, Traversers, Hoists, Conveyors, Lifting & Handling Equipments Supplement
4. Permanent Way Engineering Supplement
5. Diesel Engines, Steam, Electric, Diesel-Electric, Diesel-Mechanical, Diesel-Hydraulic and Industrial Locomotives Supplement
6. Buffers, Brakes, Bushes, Couplers and Shock Absorbers Supplement
7. Wheels, Tyres, Axleboxes, Ball-Bearings & Springs Supplement
8. Air-Compressors Supplement
9. Welding Supplement
10. Machine Tools & Pneumatic Tools Supplement
11. Railcar, EMU Coach, Carriage & Wagon Supplement
12. Alloys, Metals, Ferrous & Non-Ferrous Metals Supplement
13. Railway Electrification Supplement
14. General Engineering Supplement

Technical Editor



The maximum length admitted between centres is 29".

Form turning a steel test piece on a Herbert/Small-

peice 6" Multi-cut Lathe arranged for manual cycle operation. The tool is traversed to the cutting position by a handwheel, the automatic feed lever is then actuated; the profiling slide is fitted with automatic trip and tool retraction. The slide is returned to the starting point by the handwheel.

The headstock is worm-gear driven from a 5 h. p. motor. Drive is through vee belts and pick-off gears to the worm shaft.

Details of the operation are as follows :-

Stock removal	.. 1 5/16" approximately
Cutting speed	.. 195 ft. per minute on the 0.564" diameter
Feed	.. 0.0062" per rev.
Floor-to-floor time	7 minutes (five cuts)

For high-speed turning the lathe can be supplied with a belt-driven headstock from a 5 h. p. motor.

A Rumanian Factory with an old tradition in Rolling Stock Production "The GH. Dimitrov" Factory

MORE than sixty-five years have elapsed since the first railway car factory was set up in Arad. In that factory many generations of workers have become specialized in railway car construction in the course of years, and many of the present engineers and technicians are sons or grandsons of the first workers.

After World War II, the Rumanian railway network having expanded, rolling stock production was laid on new foundations. In the years of the first Five-Year plan the "Gh. Dimitrov" railway car factory in Arad was rebuilt and endowed with modern equipment: high productivity machines imported from the USSR, Czechoslovakia and the German Federal Republic are built in the country.

Gravity die casting, centrifugal casting, as well as bakelite mould casting equipment were introduced.

Owing to the subsequent increase in production capacity at the "Gh. Dimitrov" railway car factory in Arad, by 1956 the enterprise was able to raise its output by 300 per cent. over the 1949 figure, the production steadily increasing in the following years.

* * * * *

At present the Arad works manufacture passenger railway cars, motor coach trailers, 50 ton covered and open freight trucks, 25-28 tons covered and open freight trucks, 50 ton self-discharging freight trucks, dump trucks, etc.

The Second Class Passenger Railway Car with 9 compartments has an all-metal body which, together with the frame, form a rigid construction affording sufficient resistance and safety even in case of accidents. The bogies are of the soft-sprunged Gorlitz type to ensure a smooth and comfortable run. The automatic brakes are supplemented by a handbrake. The lavatories are located at both ends of the car. The benches in the compartments are semi-upholstered and covered with artificial leather or plastic material. The car has a good lighting (Dick system): the generator is coupled to the wheels, and a voltage regulator provides clear and uniform light throughout

the car. Woodwork of best quality—tegoform covered plywood—ensures durability and pleasing appearance within the car.

The 50 ton Open Truck on 4 Axles is a freight truck with high sidewalls and bogies of either cast steel or of pressed steel plates.

Maximum axle pressure and suspension of loaded truck is approximately 20 tons. The frame is all-welded. The side members designed as beams of approximately equal resistance permit concentration of load in the middle of the truck platform, making it suitable for the transport of heavy, bulky machinery.

The buffing, coupling and traction gears, as well as all other parts of the truck, correspond to the latest U. I. C. prescriptions.

Automatic braking equipment is of the Hildebrand Knorr type. Two kinds of trucks are made: with and without hand-brake. The latter is operated from a platform above the buffers.

The truck box is made of steel stanchions and sidewalls made either of wood or of sheet steel. The sidewalls are removable to permit conversion into a platform truck. The side stakes made of pressed sheet-iron are also removable.

The 50 ton, 4 Axle, Covered Freight Truck, has an all-welded frame. The H. K. brake is supplemented by a handbrake operated from the brakeman's cabin. Being provided with a through steam line, the truck may at any time be coupled to passenger trains. The box is built with steel stanchions and solid wooden walls; it is provided with two sliding doors, which can be completely or partially closed or quite open. There are also eight ventilation shutters provided with gratings. Prop bars may be lowered in the door openings.

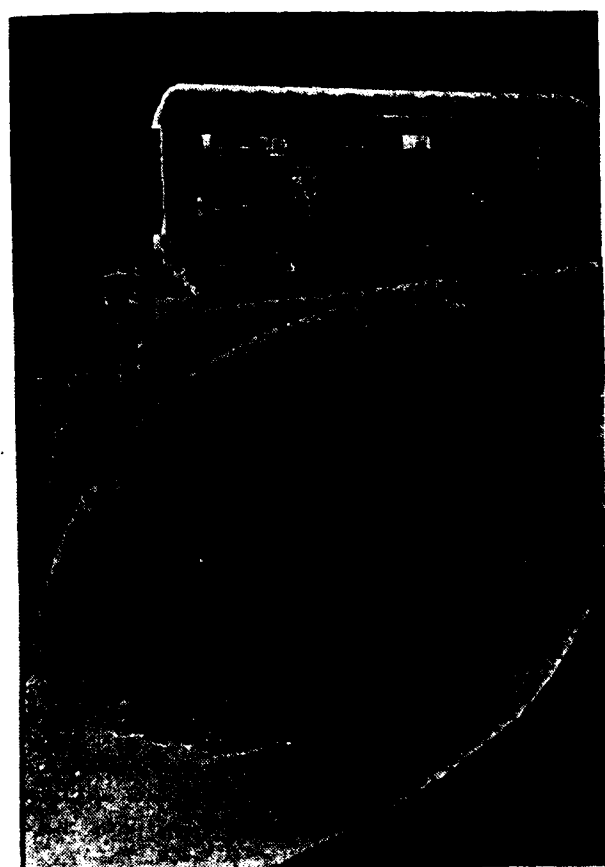
The 25-28 ton Open and Covered Freight Truck has an all-welded frame and is built according to U. I. C. Standards. The body is made of steel stanchions over which wooden boards are mounted, forming the sidewalls and roof. The truck has side doors. For



Members of the Iraqi Railway Delegation, now on a study tour of Indian Railways, at a meeting with the Railway Board in New Delhi on April 27. Shri K.B. Mathur, Member, Railway Board is seen welcoming the Iraqi Delegation.

INDUSTRIALEXPORT

2, Gabriel Peri Street,
BUCHAREST, ROUMANIA



Supplies :

- * Steam Locomotives
- * Electric Mine Locomotives
- * Diesel Mine Locomotives
- * Covered and Open Freight Trucks
- * Tank Cars
- * Tipping Waggons

transport of grain, the trucks are provided with a "Rinfuza" device.

The 50 ton Self-Discharging Freight Truck is of welded all-steel construction, capable of loading 50 cu. m. of bulk goods (coal, coke, ores, gravel, etc.)

To obtain self-discharge, the floor is raised to form a saddle and the traps provided along the sidewalls and opened the load thus running out without manual intervention.

On return trips, the floor may be put into horizontal position and the truck used like any conventional open truck for the transport of machinery, logs, etc.

The 80 ton dump car is of welded all-steel construction and has a capacity of 40 cu. m. The truck is unloaded through side tilting of the box, which is done by aid of a compressed air device.

Railway-cars of various types occupy an increasingly prominent plan in Rumanian foreign trade, already 35% of the country's railway car production is going abroad. The orders received from abroad by the "Gh. Dimitrov" works of Arad alone have increased by 573% in 1957 over 1950 and continue to increase year by year.

Shri Shah Nawaz Khan visits Western Railway

Shri Shah Nawaz Khan, Union Deputy Minister for Railways, had a busy programme of inspection on the Western Railway in Bombay on 3-2-1959. He was accompanied by Shri M. M. Khan, Senior Deputy General Manager, Western Railway.

In the morning, Shri Shah Nawaz Khan visited the Sports Ground and the new stadium at Mahalaxmi, where the Railway Protection Force presented a Guard of Honour. After the presentation, he inspected the Armoury, Barracks and the residential quarters of the Railway Protection Force. He then visited the Staff Dispensary and Workshops at Parel and also the 150-bed Hospital for the railway staff under construction at Bombay Central.

Later, at Churchgate, the Deputy Minister inspected the new terminal station and the Departmental and Contract Catering arrangements for the travelling public. He also inspected the working of the Route Relay Interlocking Signalling System in the Churchgate station yard.

In the afternoon, Shri Shah Nawaz Khan met the Heads of Departments at an informal conference at the General Offices of the Railway, at which matters of administrative interest were discussed.

April 1959

THE INDIAN RAILWAY ENGINEER

R.3

New Line will join up RAILWAY WEEK SUPPLEMENT North-South M. G. Rail Systems

By V. S. Sathe

Engineer-in-Chief, Central Railway

Meandering through the wild and mountainous Melghat of the mighty Satpuras, the 187.23-mile Khandwa Hingoli rail line when completed will, for the first time, link up the metre gauge system of the north with that of the south, providing a through metre-gauge connection from far off Tinsukia in the north-east to Trivandrum and Tuticorin in the extreme South. The Rs. 12.39-crore project which involves heavy engineering works with deep rock cuttings, high embankments, bridges and tunnels, is likely to be completed by 1961.

THE Indian railways having a route mileage of over 35,000 comprise mainly of the broad gauge and metre gauge lines with a few narrow gauge branch lines. While the broad gauge is a well-integrated system, the metre gauge system of northern India is separated from that in the south. The northern metre gauge system, about 10,000 miles, covers mainly the Rajasthan, Uttar Pradesh, Bihar and Assam, while the southern system of about 4,900 miles spreads mainly over Andhra Pradesh, Mysore, Madras and Kerala.

The existing gap of about 200 miles separating the two metre gauge systems is a serious operational disadvantage and during an emergency, the problems presented by these two far flung systems become worse. The transshipment of traffic which is necessary at the break-of-gauge points hampers the free movement of goods and passengers.

PROPOSAL 75 YEARS OLD

The history of providing a north-south link dates back to 1882, when a proposal for constructing a railway line of about 62 miles between Akola and Hingoli, to be called the Berar Light Railway, was first considered. This proposal, however, was kept in abeyance till 1899, when the Government of India ordered a preliminary survey for connecting the metre gauge systems of southern and central India with the Hyderabad Godavari Valley Railway owned by the Nizam. A survey was then carried out for a link extending from Khandwa to Basim and the project was estimated to cost about Rs. 1.16 crores.

In 1900, owing to acute famine conditions in this area, relief works had to be undertaken and earthwork was actually started at some places on this alignment.

No progress, however, was made in the subsequent years.

The necessity, from a strategic point of view to provide a link between the northern and southern metre gauge systems, was emphasised very strongly in 1903 by Lord Kitchner, the then Commander-in-Chief.

The next step forward in the history of the 'Link' was taken in 1911, when the final location survey for the route from Khandwa to Hingoli was carried out under the orders of the Government of India. The proposed alignment touched Akot, Akola and Basim before reaching Hingoli. The estimated cost of the line up to Penganga, a distance of 168 miles, in British India was Rs. 1.48 crores. In the "battle of the gauges", the project, however, passed into partial oblivion.

The proposal was again revived in 1924 and 1927, but no headway was made in actual construction for lack of funds. The acute transportation problems during the last world war again focussed attention and high-lighted the proposed link between the northern and southern metre gauge systems. In 1942, a rapid survey of the four alternative alignments was undertaken, but no start was made on the construction of any of the routes surveyed.

In the post-war period, the Ministry of Railways ordered fresh engineering and traffic surveys. The route of the proposed link from Khandwa to Hingoli followed more or less the alignment set out in the final location survey of 1911. The possible alternative route from Khandwa via Jalamb and Khamgaon was also investigated. Ultimately, it was decided to link Khandwa and Hingoli via Akot, Akola and Basim.

The work of construction on this vital rail link between Khandwa and Hingoli, 187.23 miles long, was inaugurated by Shri Lal Bahadur Shastri, the then Minister for Railways and Transport, by turning the first sod of earth at a ceremony held at Khandwa on March 17, 1954.

Thus was launched one of the biggest post-war construction projects on the Indian railways.

FEATURES OF NEW LINE

The new line will pass through the Nimar district of Madhya Pradesh and Akola/Parbhani districts of Bombay State. From Khandwa the line runs through the most fertile area in Nimar district for the first 21 miles. The line then ascends the Satpura ranges rising from 1007 feet above M. S. L. at Khandwa to 1250 feet at Mile 27. There are deep cuttings and high embankments in this region. Further on, the line crosses the Tapti river over a 7-span bridge, 980 feet long. Tukaitar Station is the last railway station in Madhya Pradesh and then the line enters Bombay State.

Thereafter, the line majestically meanders through a wild and mountainous country known as the Melghat of the mighty Satpuras, where it negotiates around the precarious slopes of the numerous spurs in serpentine curves and at one stage, the line winds round itself in a complete spiral. The Melghat will thus involve heavy engineering works with deep rock cuttings, high embankments, large major bridges and viaducts with two tunnels having a combined length of half a mile. At Talai summit, a maximum height of 1610 feet above M. S. L. is attained. Further on, between Akot and Akola, the river Purna is crossed by the longest bridge in the link with 7 spans, 1050 feet long. The piers of this bridge are founded on wells sunk more than 50 feet deep in the river bed.

Akola will be a junction between the broad gauge and metre gauge lines. The metre gauge line will cross the Akola-Nagpur line just east of the Akola station by an overbridge. After Akola, Basim will be an important station on this section with a cool and salubrious climate throughout the year. Beyond Basim, the line crosses Chandrabhaga and Penganga rivers before reaching Hingoli at the other end of the link, a terminal station on the metre gauge branch line from Purna, which is a junction on the Manmad-Secunderabad section.

In all, there will be 546 bridges on the new line, 51 of which will be major bridges. Twentyfive station buildings will be constructed. The new station buildings will all have airy third class waiting halls, lavatories and drinking water facilities. About 1.150 quarters will also be constructed for the staff who will work the new line.

MAGNITUDE OF TASK

The task before the engineers is stupendous. The construction of this link will involve about 2,270 lakh cubic feet of earthwork, 59 lakh cubic feet of cement concrete and masonry, involving use of 50,000 tons of cement and about 4,100 tons of steel.

Apart from intricate technical problems, the engineers will have to work under great handicaps in Melghat area due to unhealthy climatic conditions, dearth of building materials and acute scarcity of water during summer months, and thus construction of this railway line will indeed be an engineering marvel when completed.

So far, a section of about 51 miles—33 miles from Khandwa and 18 miles from Hingoli—has been opened for traffic. The construction work is in full swing on other sections, where the works are nearing completion or are in an advanced stage of completion except for 16 miles in the Melghat area, where the works were started only in October 1958. It is expected to link Akola from Hingoli and open further section of 62 miles for traffic by early 1960. The entire project is likely to be completed by 1961.

The project is estimated to cost Rs. 12.39 crores. An expenditure of about Rs. 6.8 crores has so far been incurred.

ERA OF PROSPERITY

When this link is completed, it will be a landmark in the history of the development of Indian railways. A through metre gauge connection from far off Tinsukia in the north-east corner of India to Trivandrum and Tuticorin in the extreme south will thus be established, eliminating transshipment at intermediate points. It will also open an alternative shorter route for certain traffic between the northern and southern systems. This relief will be welcome in the context of the expected heavier traffic movements on the Central Railway by the end of the second Five Year Plan.

(Continued on page R.6)

RAILWAY WEEK SUPPLEMENT

THE PLACE OF RAILWAYS IN OUR LIFE

By A. C. Mukherji

General Manager, Southern Railway

THE Indian Railways will be celebrating their 106th anniversary on the 16th April. There may be many ways of observing an anniversary but I can recall two different ways in which the centenary of Faraday's discovery of the principles of generation of electricity was celebrated a few years ago. While London did it with brilliant illumination, in New York the current was switched off for two minutes and the entire city was plunged in darkness: a very effective way of bringing home to the people the state in which the world would have remained had not Faraday made his momentous discovery.

No one can, of course, think of highlighting a Railway's anniversary by stopping all traffic even for the brief period of two minutes in the way New York celebrated Faraday's discovery, but let us only contemplate the dislocation that would be caused by a complete cessation of railway traffic say on the Southern Railway for the space of a day. 612 thousand Passengers will not find a train to take them to their destinations, 4200 tons of foodgrains, mostly rice and paddy, will not be loaded, which is food for about 14 million persons for the day, 2600 tons of cement will not be loaded, 5500 tons of coal will not be delivered not only for the use of Railways but also for much essential industries like mills, thermal stations etc. Besides these, the movement of textiles, hides and skins, steel and other materials will be affected to a considerable extent. During the mango season 40 wagons of mangoes will not move from the South to North Indian cities. Fish, eggs, fruits, betel leaves, potatoes and many other perishable traffics will not find a market. These figures bring to light the extent to which vital necessities of life are carried by the Southern Railway through its vast network spread over the peninsula, just as the arteries in a living body carry the life giving blood stream. The arteries cannot afford to stop functioning even for a minute, nor can the Railways.

The Southern Railway with its 6,159 miles of railway line is ever busy in its task of transporting passengers,

parcels and goods. 1286 stations serve as the entrance and exit points for this traffic, and at these stations various amenities for the convenience of railway users have been and are being provided on a progressive scale. Priorities for such works are assigned by an Advisory Committee on which there are members drawn from representative public bodies such as Passengers and Trades Associations. Periodical adjustment of train timings is another matter vitally concerning the travelling public and here again an Advisory Committee helps the Railway by giving valuable advice. Thus it will be seen that the public whom we serve exercise considerable influence on the railway's decisions and participate in its deliberations.

From the small beginnings made in 1853 the railway system in India has gradually and steadily spread itself over the entire country. It was started as small private enterprises and today it is the largest national undertaking in the country. The chequered history of the Railways in India can well constitute an interesting chapter in the history of the social and economic development of the country. Most of the railway lines were originally constructed with a view to tapping the resources of rich fertile tracts but a few were constructed as famine relief measures and a few again as strategic lines. The construction of a new Railway line today is no doubt an arduous task but it is not fraught with any danger. It was not so in the pioneering days of Railway construction. The men had to fight against very heavy odds such as unhealthy climate, danger from wild animals and bandits. Sickness and even loss of life were not uncommon. Transport of materials for construction such as rails and bridge girders was a problem, and pack animals were the only available means of transport. Work proceeded slowly but with determination even under these adverse conditions. The story of railways construction is an adventurous and heroic one, and let us not forget, while celebrating the Railway anniversary, the countless millions to whom we owe a deep debt of gratitude for giving us the Railways.

Railway development in those far off days was left to private enterprise and the Government exercised only a limited control. As a result, a uniform policy on the question of gauge was not adopted, unlike in Western Europe where even different nations accepted a standard gauge common for all. There have developed three gauges in this country not all in contiguous lengths, with the inevitable result that transshipment from one gauge to another remains a major problem even today and hinders the quick and smooth flow of traffic. On the Southern Railway alone there are 20 transshipment points. I cannot recall any other country except perhaps Australia where the problem exists in such magnitude.

The Railways started as commercial enterprises, the initial objective of the promoters being to open up the countryside and connect it to the ports by providing a fast and ample means of communication. But eventually the Railways achieved much more. The recurring famines of the Eighteenth and Nineteenth centuries, about which we have read in our history books and which brought desolation and pestilence in their wake, causing untold miseries, were only controlled with the advent of the Railways. We have also heard how in Nineteenth Century gangs of marauders known as Thugs infested a very large part of the countryside and made journeys perilous. Determined attempts made by the Government to eradicate this evil met with only partial success. It was only with the spread of the Railways that the evil was completely checked and peace restored to the country. It was only after the advent of railways that a free intermixing of the people of different parts was possible. In order to see an ethnic cross-section of India one has only to see the passengers travelling by a long distance train.

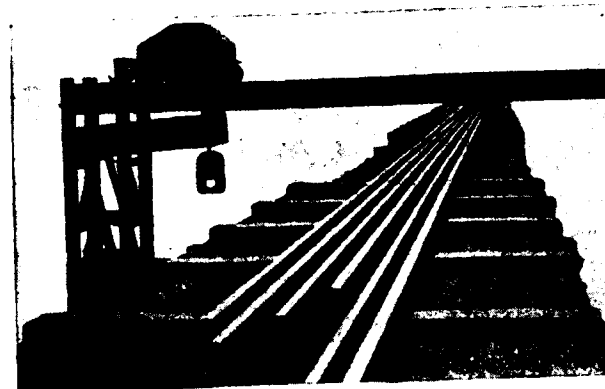
The Southern Railway employs today over 1,60,000 men. These include highly skilled artisans, specialists who have received training in their particular vocations in colleges and universities before joining the Railway, trained workers who have been taught their trade entirely on the railway and an army of other work of several categories. Some of the categories require long periods of training, both theoretical and practical, before the employee becomes proficient in his trade and can be entrusted with a particular job. There is a very wide field in Railway employment for skill and talent, requiring high ingenuity and the cultivation of diverse faculties of the

intellect. The Railway offers ample opportunity to a wide range of citizens, from those possessing a basic education to those who have highly specialised knowledge, for showing their proficiency and of rendering valuable service to the nation.

In the initial developmental phase the Railway may have been the subject of grandmother's lore but it is not so today. It is no longer looked upon with awe and aloofness, and has been accepted as a familiar, integral part of our life. A railway time table is not only a common household possession but some people take a delight in comparing the timings of trains in far off places. Perhaps the sight of such a time table brings to their minds' eye visions of happy visits to those places, accomplished or yet to be accomplished. Some even have developed the hobby of collecting old time tables just as they collect postage stamps. Many pursue with interest the detailed working of the Railway and surprise railwaymen with their well-informed remarks. There is profuse reference to railways in the modern literature of our country. Poets who love to deal with abstract Nature could not, at one time, think that an artificial creation of man such as the Railways could at all form the subject matter of poetry. This attitude has changed and poets and writers have no hesitation today in weaving a romantic or a pathetic tale against a railway background. One of Rabindranath Tagore's famous poems describes an incident full of pathos the scene of which is laid in the Railway waiting room at Bilaspur.

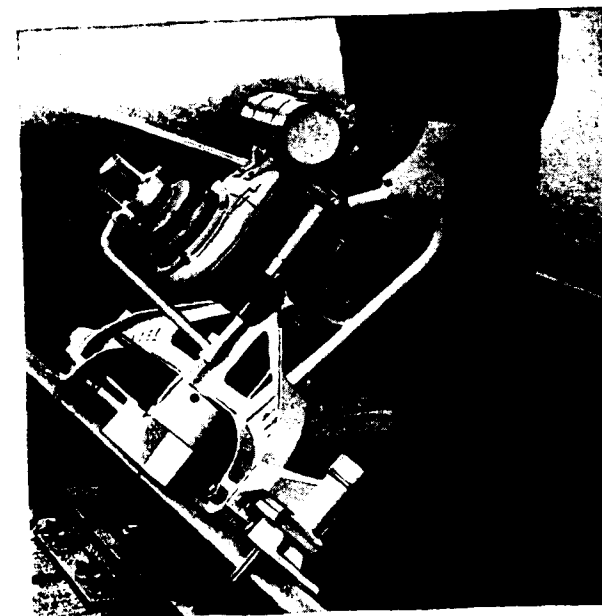
Fighting against Nature, conquering superstition, experimenting at every step, the railroad spread mile by mile throughout the country. Beginning as an object of wonder for the wide-eyed villager, it has so integrated itself with the landscape that a prospect without a railway line seems somewhat unreal. Starting as a private property of a few share holders it is today the valuable property of the entire nation. It is needless for me to stress how vital the Railways are for the prosperity of our country. On the occasion of the celebration of the 106th anniversary of our Railways may I express the fervent hope that our people whom the Railways serve will take ever-increasing interest in the well-being and progressive development of the Railways so that, in the years to come, they may become the symbol of our country's march towards progress.

(Courtesy: All India Radio, Madras.)



Rail Loader Robel 42

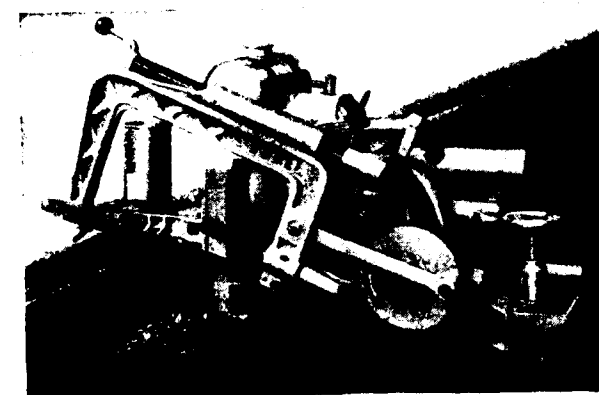
for the safe loading and unloading of rails, approved in Germany, England and many other countries.



Rail Head Adjustment Grinding Machine

for grinding welded rail joints or welded parts of flat bottom rails. Grinds running surfaces, sides of the rail head and rounded parts of the head. The mounted feeler device ensures completely even grinding without checking with a straight-edge, and prevents overgrinding.

Model Robel 33 with petrol engine
Model Robel 35 with electric motor



Rail Saw Robel 27

cuts rails up to 200 mm height and up to 200 mm base width.

ROBEL & CO.

Manufacturers of machines for track maintenance and construction
(founded 1901)

MUNICH 25 GERMANY

Sole Agents for India :

ASSOCIATED CORP. OF INDUSTRIES (INDIA) PRIVATE LTD.

BOMBAY
P.O.B. 46A

NEW DELHI
P.O.B. 574

CALCUTTA
P.O.B. 2294

MADRAS
P.O.B. 731

First Year's Achievements on N. F. Railway—Life-line of North-east India

By D. C. Baijal

General Manager, North-east Frontier Railway.

The North-east Frontier Railway is only a one-year old toddler in the Indian railway family, but it has already cut its teeth. In just 14 months, it has made considerable progress in strengthening and stabilising the Assam link route, started work on the giant bridge over the Brahmaputra, strengthened or rebuilt several bridges, taken strong measures against flooding dangers, increased wagon movements substantially and cut down passenger rail journey times.

THE North-east Frontier Railway was carved out of the North-eastern Railway on January 15, 1958 to accomplish two main tasks: paying particular attention to the transport problems of the strategic frontier area in the north-eastern parts of the country and strengthening the Assam rail link route to make it dependable, continuous and an all-weather line between Assam and the rest of India.

The link route traverses difficult sub-mountainous terrain and cuts across the natural drainage of the country. In this area, torrential rains dislodge massive boulders and uproot trees, which often block channels, clog bridge openings and tend to divert streams from their courses. In the past, damage of this type occurred frequently during the rainy season, causing dislocation of traffic, sometimes for a considerable length of time.

To increase dependability in all weathers, large-scale works have been undertaken. Embankments are being regraded and raised. Bridges are being rebuilt with deeper foundations, increased waterways and enlarged spans. Guide bunds, aprons and other river protection works are being strengthened and constructed as required. The scheme, estimated to cost Rs. 6.01 crores, includes major works on 37 bridges, replacements of five dips, and realignment of

the section between Mal and Nagrakata to eliminate 1 in 100 grade and to achieve a single crossing on the Hathinala and Jaldhaka rivers.

CUT IN JOURNEY TIME ENVISAGED

Any one travelling by train from Katihar to Amingaon would be able to see for himself the extensive and difficult nature of the works in progress. Temporary diversions have been made at places on which trains crawl slowly, to enable work of regrading, rebuilding of bridges, etc. to continue.

When all the planned works are completed by 1959-60, it will be possible to cut down the Katihar-Amingaon journey by over four hours. Work at most places is being done round the clock, temporary electric generating sets having been installed to provide light at night.

REBUILDING OF DAINA BRIDGE

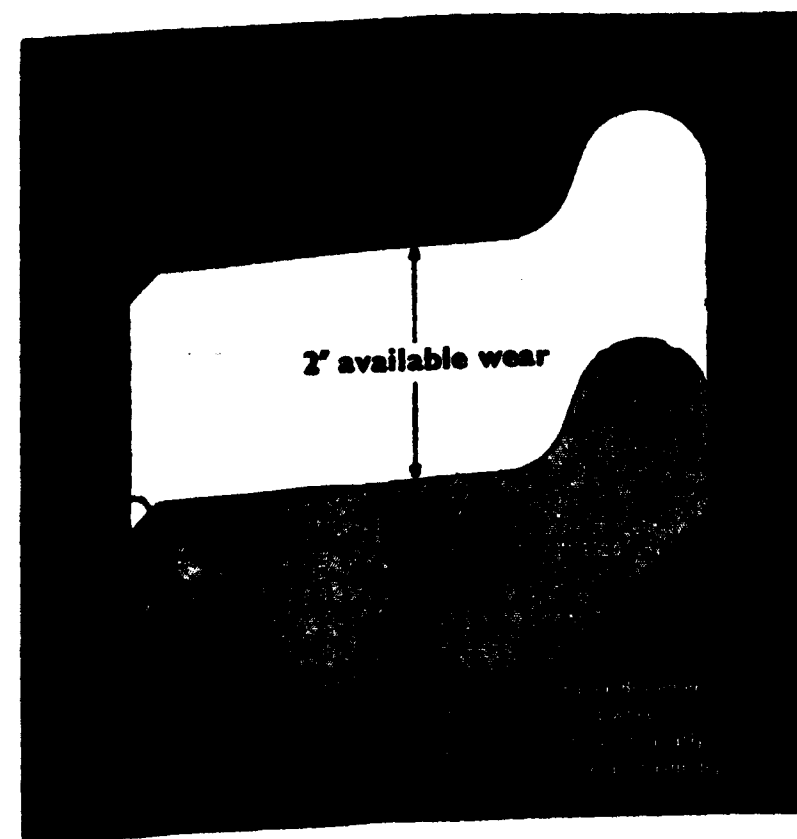
This Railway crosses river Daina between Chengmari and Banarhat stations. Originally constructed in 1903 with 10 spans of 60 feet, the approaches of the bridge were badly damaged in 1904, 1906 and again 1910 and some of the piers were washed away. Five spans were added in 1911 and three more in 1912. Various

(Continued from page R.4)

The formation of an all-India metre gauge wagon pool with free transfer of stock and power between the northern and the southern metre gauge systems will ensure greater flexibility and economy in operation.

This link will also serve as a life-line to the people

residing in the backward areas of the Nimar district of Madhya Pradesh and Berar, with the fertile tracts of black-cotton soil having considerable potentialities for development of industries, mainly of cotton and oil seeds, and thus will no doubt usher an era of industrial development and prosperity in the onward march of our country under the second Five Year Plan.

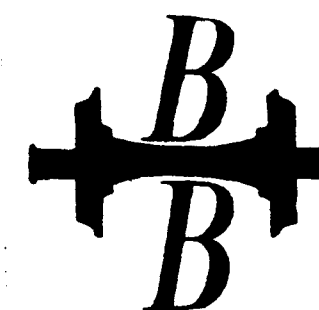


The solid wheel has an initial life 20% greater than the corresponding type of tyre wheel. This is fully illustrated by a comparison of the solid wheel, I.R.S. Drawing No. WA. 22, and the built-up wheel to I.R.S. Drawing No. WA. 23.

More than 20% increase in life



Agents for the whole of India,
Samuel Osborn (India)
Private Limited,
Third Floor, 24, Chittaranjan Avenue,
Calcutta-12.



JOHN BAKER AND
BESSEMER LIMITED

OVER 80 YEARS OF RAILWAY SERVICE

KILNHURST STEEL WORKS
ROTHERHAM

PHONE MEXBRO 2154-5-6 GRAINS TYRES MEXBROUNH

types of protective measures continued to be taken with partial success, but repeatedly in 1942, 1952, 1954 and 1955 approaches and protection works suffered severe damage and some piers again got washed away.

Due to continued trouble and frequent interruptions to traffic, it was decided to rebuild this bridge with larger spans on deeper foundations as part of the Link route strengthening programme. A new bridge has accordingly been constructed 70 feet away from the old bridge, with seven spans of 150 feet girders founded on wells taken 45 feet below low water level. The approaches have been protected with adequately armoured guide bunds.

AIR LOCKS USED

Due to the presence of massive boulders, foundation wells could not be sunk in the normal manner and pneumatic process had to be resorted to. In this process, the well is made into a closed air tight chamber by fitting an air lock of fabricated steel. Water from the well is driven out by compressed air, the pressure being adjusted to counterbalance the depth of water so as to keep the well dry.

The air-lock has generally two chambers. Workmen are first taken to the outer chamber and then the air pressure is raised gradually to that of the inner chamber. On equalisation of pressure, the communicating door between the two chambers is opened and the workmen go inside the lock, and through a ladder to the bottom of the well. They dig out hard material with picks, shovels and pneumatic tools and the dredged material is removed by buckets. As dredging progresses, the well goes on sinking until it reaches the required depth. Stones of 6' to 8' diameter were found in course of sinking of wells of this bridge and these had to be removed by blasting them or breaking them with pneumatic tools.

About 181,000 cubic feet of concrete and 825 tons of steel have gone in the construction of the foundations of this bridge. Construction of the armoured guide bunds has entailed 79.5 lakh cubic feet of earthwork, 6.55 lakh cubic feet of cement concrete in block, 6.47 lakh cubic feet of boulders in wire crates, and 2.51 lakh cubic feet of ordinary boulder pitching.

TAMING THE Torsa

Torsa is another river which gives continuous trouble. The Railway crosses it between Hasimara

and Madarihat on a bridge with nine spans of 150 feet girders on 55 feet deep wells. Here the problem has been to keep the river flowing through the bridge and to prevent it from spilling over, or changing its course into Hollong—one of the abandoned courses of the Torsa. On account of the heavy spill of Torsa, the bridge over the Hollong was washed away in 1950, and again in 1952. Also in 1954, the bridge and approaches were extensively damaged. As part of the strengthening programme, a retired bund nearly five miles long is being constructed on the right bank of the Torsa, tying it on to high ground. Groynes or projections with adequately armoured heads are being provided at suitable intervals to protect the retired bund. Altogether 24 such groynes are proposed. The protection works for the Torsa will involve 1.30 crore cubic feet of earthwork, 6.50 lakh cubic feet of cement concrete in blocks, 5.30 lakh cubic feet of boulders in sausage wire crates, and 1.50 lakh cubic feet of ordinary boulder pitching.

FLOOD OPENINGS

During rains, most of the rivers in the region flood over their banks and the railways have to provide a large number of flood openings to let out this water. The rivers also carry huge amounts of silt and deposit it on entering the plains. As a result, rising of beds and change in river courses is a common phenomenon. Even major water courses sometimes take entirely new courses through minor channels miles away.

To guard against this, flood openings for spill water are provided at selected places by means of dips. These are depressions created by steeply regrading the railway lines down to a level sufficiently low to allow passage of water in high floods—the railway formation in the dipped portion being adequately protected by boulder filling. In high floods, spill water flows over these dips and train services are continued as long as the level of water is within a foot above rail level. Traffic is, however, stopped when depth of water exceeds a foot.

To avoid interruptions in traffic and to guard against the danger of formation of new channels, some of these dips are being rebuilt as viaducts. The floor of the viaduct is kept at the same level as the top of the dip and is heavily protected with stone pitching. The railway line is raised and taken over reinforced concrete slabs, allowing uninterrupted traffic during floods. One such viaduct consisting of 28 spans of 10 feet R. C. Slabs was constructed in 1957

between Nalbari and Goreswar, and functioned satisfactorily during the floods.

This Railway's efforts to strengthen the link route are already bearing fruit. Since 1956, there has been no major interruption to traffic. Previously, in 1950, traffic remained suspended for 57 days, in 1952 for 54 days, in 1954 for 110 days, and in 1955 for 64 days.

BRIDGING THE BRAHMAPUTRA

Another major project undertaken on the Railway is the construction of a rail-cum-road bridge over the Brahmaputra, which at present is the only unbridged major river in the country. This river divides the Assam railway system into two, and passengers and goods are, at present, ferried across at Amingaon-Pandu. The bridge has been sited at a short distance downstream of the existing ferry, and will consist of ten spans of 403'—4½" and 2 approach spans of 108'—11", with a double metre gauge track on the lower deck and 23' wide road-way with two footpaths 6' wide on either side of the upper deck.

The foundation wells will be sunk to approximately 160 feet below low water level, the bottom of wells being about 30 feet below mean sea level. About 3,700 tons of steel and 27.0 lakh cubic feet of cement concrete will go into the foundations of this bridge. The height of each of the main wells and the piers will be about 228 feet—almost as much as the height of the Kutab Minar in Delhi. The work on the bridge is going on round the clock and the whole place is humming with activity. Sinking of the shore well at the Amingaon end and well for pier No. 2 is in progress.

NEW LINK LINE

Extensive works are in hand to increase the line capacity to meet the increased transport requirements of the area, and to provide an overall capacity on the main trunk route of 400 wagons each way per day east of Siliguri, and 500 wagons west of Siliguri. The capacity of the hill section between Lumding and Badarpur is being increased from 50 to 125 wagons per day. In furtherance of this aim, yards are being remodelled, additional crossing stations are being provided, loops are being lengthened, and signalling and tele-communications are being improved.

To provide relief to the Katihar-Barsoi section, now running to capacity, a new 17.79-mile long link, from

Kumedpur in the Katihar-Malda section to Barsoi is being constructed at an estimated cost of Rs. 1.17 crores. The work was commenced in January 1959 and with the erection of temporary pile bridges, efforts are being made to open it for traffic in June 1959.

TRAFFIC OFFTAKE UP

During its first year of existence, the Railway has greatly improved its traffic offtake. The number of wagons moved over Siliguri-Alipurduar section in 1958 were 23.6 per cent more in the up direction and 27.2 per cent in the down direction as compared to 1956. The increase on Lumding-Badarpur section in the corresponding period has been 36.9 and 42.3 per cents respectively.

The percentage increases in loadings in 1958 as compared to 1957 in respect of some of the major commodities were: tea 4.6, jute 14.5, petroleum and allied products 15.2, timber and sleepers 21.8.

9 STATIONS ELECTRIFIED

Attention is also being paid to the improvement of passenger amenities. The following new works have been completed since the formation of the Railway:—

- Covering over platforms at 12 stations,
- Foot/road overbridges at 2 stations,
- Waiting rooms/halls at 7 stations,
- Refreshment rooms/stalls at 4 stations,
- Raised platforms, asphaltting and surfacing of existing platforms at 9 stations, and
- Electrification of 9 stations.

From October 1, 1958, the journey time between Pandu and Dibrugarh by Express trains has been curtailed by two and a quarter hours. It will also be possible to reduce the journey time between Katihar and Amingaon when the strengthening works in progress are completed. To accelerate the trains, some of the branch lines are being relaid with heavier rails.

Although the youngest member of the Indian railway family, the North-east Frontier Railway has shown all the signs of steady and sturdy growth in its brief existence. It has already built up a tradition and is forging ahead to meet efficiently the special transport requirements of the north-eastern parts of the country—the *raison d'être* of its creation.

More Goods, at Better Speeds, over Longer Distances—Northern Railway's Performance

By B. B. Mathur

General Manager, Northern Railway

The first six years of Northern Railway's existence have been years of many-sided progress. Despite its limited resources, the Railway has moved considerably more traffic by carrying wagons with heavier loads at better speeds over longer distances. The future holds promise only of greater burdens, but the Northern Railway's Chief asserts that the nation's development will not be allowed to suffer for want of adequate rail transport.

AS a result of the regrouping of railways, the Northern Railway was formally inaugurated only in 1952. But for its origin, one has to go back nearly one hundred years—to March 1859—when the railway line between Allahabad and Kanpur was opened.

In 1864, the line was extended to Ghaziabad. The same year, the Indian Branch Railway Company, later known as the Oudh and Rohilkhand Railway, commenced construction in the areas now served by Lucknow and Moradabad railway divisions.

Other important landmarks in the growth of the present Northern Railway were: the completion of Amritsar, Atari section in 1862, the construction of the Yamuna bridge near Delhi in 1866, the formation of the Delhi-Ambala-Kalka Railway Co. in 1889, completion of Lhaksar-Hardwar-Dehradun section in 1900, and the merger of the Bikaner and Jodhpur State Railways in the Indian Government railway system in 1950.

Though the boundaries and the nomenclature of the railway companies have undergone numerous changes in the course of the century, one can detect an unmistakable trend toward consolidation and transition from company to State management.

There are now eight zonal railways in India. Not only the development of these railways is planned as an integral organism, but also a high degree of day-to-day co-ordination is maintained to keep the streams of traffic flowing smoothly across the country. The economy of the various parts of India is interdependent; the siting of a factory in the far south may call for facilities for receiving the finished goods in the extreme north. And for that matter, an accident in the east can have immediate repercussions on railway operations in the west.

India's national effort, since the formulation of the first and second Five Year Plans, has been geared to the attainment of continually rising targets of output in agriculture, trade and industry. Indian railways have naturally to play a vital part in the achievement of these targets, by ensuring transport for the traffic as it increases, and by planning ahead for future requirements.

PHENOMENAL TRAFFIC INCREASE

Never before have the Indian railways worked at such high pressure and for so long, as in recent years. The feverish activity during the last war mostly covered specific movements directed to particular theatres of war, and was not reflected in all spheres of operation, construction, and management.

There has been a phenomenal increase in both passenger and goods traffic during the last 10 years all over the railways.

During the first Five Year Plan, it had been expected that goods traffic would increase by 10 per cent; but the actual increase was 25 per cent. During the period covered by the second Five Year Plan, the Indian railways are required to develop an additional carrying capacity of 48 million tons. The bulk of this increase in traffic, comprising steel, coal and cement, will originate on the Eastern and South Eastern Railways. The Northern Railway, however, has to build up capacity for receiving from the Eastern Railway additional traffic at Moghalsarai. Besides, it has to arrange for its transit to destinations on this Railway as well as to stations on the Western and Central Railways through junctions situated on the Northern Railway.

The main stream of traffic from the coalfields and industrial areas of Bengal and Bihar reaching

Moghalsarai takes two routes, that is (a) the northern route via Lucknow-Moradabad, Saharanpur-Amritsar, and Ghaziabad and (b) the southern route via Allahabad, Kanpur, and Tundla, to the Central and Western Railways as well as to Ghaziabad on the Northern Railway.

Besides feeding eastern Uttar Pradesh and north Bihar through Manduadih—the largest transshipment point in India—the northern route caters for the requirements of such important towns as Varanasi, Lucknow, Bareilly, Dehra Dun, Saharanpur, Ludhiana, Amritsar, Pathankot and Delhi. The southern route serves an even larger area and feeds the power houses, the textile mills and industries concentrated at Delhi, Ghaziabad, Kanpur, Agra, Ahmedabad and Bombay.

The traffic handled at Moghalsarai has steadily grown from a daily average of 1,467 wagons in 1952-53 to about 2,300 wagons at present and is expected to increase to 3,000 wagons per day by 1960-61. In other words, within eight years, the traffic interchanged between Northern and Eastern Railways would more than double itself. While this is a heartening sign, reflecting as it does the measure of economic development in the country, it is obvious that a colossal effort is required on the part of the railways which have to load, carry and handle this traffic.

EXECUTION OF WORKS

On the Northern Railway, as on other Railways, a very large number of works are in progress to increase the transportation capacity by doubling portions of certain single line sections, remodelling yards, renewing old or weak track, expanding work-yards, renewing old or weak track, expanding work-yards, renewing old or weak track, expanding work-yards for maintenance of rolling stock, improving tele-communications and raising standards of signalling for greater safety and speed of operation.

However, these works have to be executed under peculiar limitations. Not only have trained personnel and material to be found for a number of works at the same time, but the works must be executed without slowing down traffic. The regirdering of a bridge, the remodelling of a yard, or the replacement of signalling gear have to proceed without a visible effect on the flow of traffic.

And since on most of these sections, traffic has already developed ahead of capacity, only a supreme effort on the part of those entrusted with planning and executing movements from day to day has made

it possible for the railways to carry on. Obviously, under such conditions, better results can be achieved only by intensive utilization of available capacity through ceaseless vigilance.

OPERATIONAL EFFICIENCY

A few statistics of operation on the Northern Railway will explain how problem of operational efficiency has been tackled.

Between the years 1952-53 and 1957-58, for which comparative statistics of this Railway are available, while goods traffic increased by 53 per cent on the broad gauge, the daily average number of wagons on the line increased by only 4 per cent. The average lead of revenue traffic—the distance travelled by a ton of goods—also increased during this period from 245 to 252 miles on the broad gauge.

Similarly, on the metre gauge, the originating traffic went up by 99 per cent, while the number of wagons on the line improved by 46 per cent and the lead increased from 140 to 148 miles.

In other words, both on broad and metre gauge, more traffic was moved by carrying wagons with heavier loads at better speeds over longer distances.

The number of "sick" wagons—wagons under repair—has also been brought down. In 1952-53, on this Railway, almost eight per cent of the wagon holdings were out of commission for repairs. This has steadily been brought down to less than three per cent, which compares favourably with what is being achieved on railways in other countries such as Canada and the United States.

WAGON MOBILITY UP 30 PER CENT

Again, during these years, the mobility of wagons, as represented by wagon miles per wagon day, improved from 43.6 to 57.3 miles—by almost 30 per cent. And the index of net ton miles per wagon day (weight of goods carried multiplied by distance travelled per wagon day) which refers specifically to wagons for revenue earning operations, improved by 47 per cent from 422 in 1952-53 to 621 in 1957-58.

Since wagons spend about 19 hours of the day in marshalling and terminal yards, special efforts were made, with encouraging results, to bring down these detentions. The following table illustrates the performance in some of the major yards:

Name of the Yard	Increase in workload as represented by number of wagons dealt with		Operating economies as represented by reduction in average detention in hours to a wagon in the yard	
	1953-54	1957-58	1953-54	1957-58
1. Chheoki	14,289	19,477	22.3	14.0
2. Kanpur (Juhi)	26,592	34,108	30.9	17.9
3. Ghaziabad	31,699	37,474	23.9	17.9
4. Rewari	11,320	15,462	21.0	14.5

These are indicative of some of the measures which have been adopted to secure better results from existing resources. They have made it possible on the Northern Railway to handle about 42 per cent more traffic in 1957-58 as compared with 1952-53, with less than 10 per cent increase in the number of wagons and an even smaller increase in the number of locomotives.

There is no doubt that traffic will further increase. As already stated, the traffic from the Eastern Railway at Moghalsarai thanks to the development of coal, steel and other industrial traffic in that region, would go up to 3,000 wagons per day by 1960-61.

FOODGRAINS TRAFFIC UP

In addition, the local traffic on the Northern Railway is also expanding.

COMMERCIAL METRIC CARAT WEIGHTS

Following the Standards of Weight and Measures Act, 1956, the Indian Standards Institution has been taking steps to help the industry in their smooth changeover to the metric system. Since the existing weights and measures, in use in all parts of the country, are to be replaced by metric weights and measures, within a period of 10 years, the institution has already issued the following Indian Standards, which have been prepared at the instance of the standing Metric Committee of the Government of India :

IS : 1056—1957 Commercial Metric Weights
IS : 1058—1957 Commercial Metric Capacity Measures

Between 1952-53 and 1957-58, the loading of foodgrains and pulses on Indian railways rose from 8,345,000 tons to 11,077,000 tons, representing an increase of 33 per cent. More than half of this increase was accounted for by the Northern Railway. Already, out of every four maunds of foodgrains and pulses loaded on Indian railways, one maund is loaded on the Northern Railway.

As the full benefits of the Bhakra-Nangal canal system are realised, foodgrains traffic will increase still further. Northern Railway is, therefore, building up capacity to deal with increased traffic from other railways as well as traffic originating locally on this system.

PROMISE TO DELIVER THE GOODS

A number of industries are growing in States served by this Railway. New enterprises have sprung up at Kanpur. A fertiliser factory is under construction at Nangal. With an increase in the acreage of sugarcane, the capacity of several sugar mills has been expanded and new sugar mills are also being set up. The cement factories at Surajpur, Churk and Dalmia Dadri are increasing their production.

The handling of the increased traffic will certainly present difficult problems, particularly in the transitional period before additional facilities can be built up. But whatever the calls on their resources, human and material, the railways are resolved that so far as it lies in their power national economic development will not suffer for want of adequate rail transport.

IS : 1059—1958 Commercial Metric Length Measures (Non-Flexible)
IS : 1160—1957 Metric Dispensing Measures
IS : 1269—1958 Metric Woven Metallic Tape Measures.

The latest in the series is the Indian Standard Specification for Commercial Metric Carat Weights (IS : 1057—1958), which has just been issued by the Institution.

The standard prescribes the requirements for commercial metric carat weights intended for use in weighing pearls, diamonds and other precious stones.

The Job India's "Steel Plants Railway" is Doing

By G. P. Shahani

General Manager, South Eastern Railway

Individual or corporate life in India today would be inconceivable without the railways, and the author draws upon a wealth of data to show in this article how trade, commerce and prosperity have followed closely in the footsteps of the railways over the past century. In the current planned development, the railways in general, and the South Eastern Railway in particular, are playing a vital and indispensable role.

TO all of us, who have tasted the benefits flowing from the existence of the railways, life without them is just inconceivable. The food we eat, the clothes we wear, the houses we live in and the hundred and one articles of every day use at home, in offices or elsewhere would not be there but for the railways.

To the individual as well as to the community, therefore, the railways render an essential service in a variety of ways. The benefit is, however, not unilateral. The railways are also a part and parcel of the community, and by carrying agricultural produce from the fields, raw materials to the factories and finished products to the consuming centres and by providing direct employment to over one million and indirect to many more millions, the railways help in the economic prosperity of the country and they in turn sustain themselves by drawing their vitality from this general pool of prosperity.

DECADES OF PROGRESS

From a mere 20 route miles or so in 1853, the route mileage exceeded 5,000 in 1871, 16,000 in 1890, 32,000 in 1910 and 41,000 in 1929-30. With the partition of the country Indian railways were left in 1947-48 with about 34,000 route miles, which in 1956-57 grew to about 35,000 miles.

In 1871, freight originating on Indian railways stood at 3.5 million tons and passengers at 1.92 crores. In 1890 these figures were 22.6 million tons and 11 crores. By 1929-30 these figures went up to 87.3 million tons and 63 crores. In 1950-51 the goods traffic was 92.3 million tons and the passenger traffic 130 crores. In 1956-57, the first year of the second Plan, the figures were 125 million tons and 138 crores.

The capital at charge went up from Rs. 37 lakhs in 1853 to Rs. 90 crores in 1871, Rs. 213 crores in 1890,

Rs. 439 crores in 1910, and ultimately to Rs. 1,078 crores in 1956-57. Similarly, gross earnings and working expenditure went up from Rs. 90,000 and Rs. 41,000 respectively in 1853 to over six crores and three crores in 1871, 20 crores and 10 crores in 1890, 116 crores and 75 crores in 1929-30 and ultimately to Rs. 350 crores and Rs. 280 crores in 1956-57.

In the beginning Government had agreed to pay to the railway companies a minimum guaranteed interest on their investments. For a number of years, the India Government had to meet the loss of railways from general revenues. But from 1924-25 onwards, the railways are making substantial contributions to the general revenues. In 1950-51 the railway dividend to the general revenues amounted to Rs. 32 crores, in 1953-54 to Rs. 34 crores and in 1956-57 to Rs. 38 crores.

FIVE YEAR PLANS

From a study of the statistics for the period from 1947-48 to 1956-57, it becomes obvious that increase in the holding of rolling stock, namely, locomotives, coaches and wagons as compared with the increase in the traffic carried, has been very little.

This has been due to the heavy and prolonged strain during the war years, when traffic in quantities undreamt of in pre-war years, was moved to meet war requirements. Some of the railways' assets were removed from service and sent abroad to different theatres of war. Timely replacement of assets was not possible. The first Five Year Plan, therefore, rightly concerned itself with rehabilitation works.

The railways' second Five Year Plan is nearly three times the size of the first Plan. As against Rs. 400 crores allotted in the first Plan, the railways have been allotted Rs. 1125 crores in the second Plan. Within this amount, they are developing a capacity to

lift 168 million tons of freight traffic and also cater for an increase of 15 per cent in the passenger traffic. In this brief interval of five years, they are planning for an increase in freight traffic of as much as 50 per cent of what was generated, earlier, in the course of over a century.

How big this railway allotment is may be gauged from the fact that it is 22 times the total revenue receipts of Bihar State according to the revised estimates for 1957-58.

This vast expenditure on construction and other works on the railways is leading to the growth of a large network of industries in the country and is creating employment opportunities for thousands of persons.

BETTER OPERATIONAL METHODS

Besides new works, the railways propose to meet the challenge of the ever-increasing freight traffic by adopting more efficient and better operational methods. The South Eastern Railway is already moving heavier trains consisting of 3,200 tons gross weight with double-headed diesel locomotives recently purchased from USA. This is in place of the 1,600 tons gross weight trains with steam traction a few months ago. This has reduced the number of trains on the section and yet increased the carrying capacity.

The length of loops is being increased to the standard of 2,250 feet to enable movement of block loads of seventy four-wheeler wagons. With the four-wheeler wagons, load intensity is about 14 tons per foot length of track, whereas with the new bogie stock which has been designed to move the heavy mineral ores to the steel plants, the intensity of load is 2.3 tons per foot length, so that with the same length of loops, trains of about 4,500 tons gross weight each may be moved.

INDUSTRIES FOLLOW RAIL DEVELOPMENT

For industries to flourish, they have to be assured of a regular supply of raw materials, quick distribution of finished products, and availability of labour, both skilled and unskilled. No individual region can be self-sufficient in all these demands of the industry. If one, therefore, emphasizes that over the past century industrial development has followed in the footsteps of railways, one would only be making a factual statement.

Bombay got its first textile mill in 1854—a year after it had its first railway communication. In the Calcutta area, the railways came in 1854, and later in that very year followed the first jute mill. The history of the former East Indian Railway, now part of the present Eastern and Northern Railways, may be said to be the history of the growth of the coal industry. As soon as the East Indian Railway started the construction of a line in the centre of the Jharia coalfield, coal companies were formed, railway sidings were asked for faster than they could be laid, and traffic developed very fast.

With the network of railways in the Jharia coalfields, coal traffic increased from about 35,000 tons in 1894, to 1.3 million tons in 1899, and over 2.8 million tons in 1905.

About 90 per cent of the coal raisings in India today are moved by rail to distant parts of the country at cheap freight rates. That the ever-increasing movement of coal means a steady growth of Indian industries is a fact that can hardly be over-emphasized.

Oil was struck at Makum in Assam in 1867, but the first oil well was drilled in 1889 at Digboi after the then Assam Railways and Trading Company had completed their railway track in 1882.

In 1881, the tea planters requested the then Government of Bengal to extend the railways to the tea districts to facilitate the movement of tea to Calcutta and to connect the tea producing areas in Assam and Bengal with the labour centres in Bengal and Bihar. The steps taken by Government in subsequent years have built up the tea industry to its present magnitude. The first tea transit shed at Calcutta jetties was opened on July 1, 1897, and they were soon after connected with the Eastern Bengal Railway.

RISING TRADE DEMANDS

With the expansion of the railways, commerce was usually increasing, wages were rising, factories springing up and social barriers of caste and prejudice were breaking down gradually. Total imports through the Bombay and Calcutta ports increased from £ 25 million in 1855-56 to £ 55 million 1864-65; similarly, total exports from those two ports also went up from £ 22 million to £ 71 million during the same period.

Thanks to the railways, the overall foreign trade increased through the ports. Whereas the total

imports and exports of India were valued at Rs. 58 and Rs. 67 crores respectively in 1878, they increased to Rs. 105 and Rs. 121 crores respectively by 1901. By 1956-57, India's imports and exports of merchandise exceeded Rs. 800 crores and Rs. 600 crores respectively.

The development of the steel industry in this country is recent history and the South Eastern Railway is very intimately associated with its growth. For a million tons of steel, it is necessary to move about five million tons of raw materials. In addition, railways have to meet the day-to-day requirements of the big townships that have grown up around the steel industry and the many subsidiary industries that spring up in the area.

LOW FREIGHT AIDS GROWTH

The low rates for carriage of wheat, oilseeds, hides and jute to Calcutta originally quoted for encouraging export led to the establishment of flour, oil and jute mills as also tanneries in and around Calcutta. Similarly, the low rates for transport of cotton and wool to Bombay were instrumental in developing Bombay as a textile manufacturing centre. Later, numerous station-to-station rates came to be used as a stimulus for the development of other industries like coal, iron, sugar, cement and paper. But a general appreciation of this was shown by most of the railways in 1922, when the new classification and scales were introduced.

The foundation for a progressive rates policy may be said to have been well-laid with the introduction of the revised rates system from October 1948. Under this system, telescopic rates, that is, charges decreasing with the increase in distance, on the basis of the mileage of the railways of the country as a whole, replaced the old varying rates of the different railways based on discontinuous mileage. For the first time in the history of the Indian railways, traffic could move by the shortest route at the cheapest rates levied on a uniform basis.

Government's decision on the recommendations of the Railway Freight Structure Enquiry Committee announced in 1958, follows the basic objective that the distribution of the freight burden as between different commodities and different distances for haulage should be such as to take cognisance of the ability of the different commodities to bear freight rates and to serve the broad national economic tenets.

SELF-SUFFICIENCY DRIVE

Railways have to make large purchases of stores and equipment every year. They have seized this opportunity to encourage indigenous industry. Indian railway purchases of stores manufactured within the country doubled during the seven-year period ending 1956-57. While the indigenous purchases during 1950-51 totalled Rs. 62 crores, during 1956-57 they touched the record figure of Rs. 126 crores.

The self-sufficiency drive of the Indian railways has already had good effect on the country's economy.

The State-owned Integral Coach Factory at Perambur, near Madras, is today the largest of its kind east of Suez; the Hindusthan Aircraft Factory at Bangalore also builds coaches for the railways. The Chittaranjan Locomotive Works have helped the country in saving large amounts of foreign currency by cutting down imports. A number of railway workshops manufacture passenger coaches, while Tata Locomotive and Engineering Co. builds metre gauge locomotives.

The wagon-building industry is entirely in the private sector and now manufactures about 17,000 wagons a year.

The railways have substantially contributed to the development of other ancillary industries, including those producing wheel castings, vacuum brake fittings, train lighting equipment, paints and brushes etc.

INDIA'S "STEEL RAILWAY"

The erstwhile Bengal Nagpur Railway started in about 1880 as a "famine relief" Railway in Central India. The pioneers who had built this metre gauge railway about 80 years ago could not have foreseen that it would in course of time become the steel plants railway of the country. The South Eastern Railway now links the Calcutta and Vizagapatnam ports with their vast and rich hinterlands in the six States of West Bengal, Bihar, Orissa, Madhya Pradesh, Andhra Pradesh and Bombay.

The South Eastern Railway passes through areas rich in minerals, forest wealth and agricultural produce. The richness of this region first attracted the attention of pioneers like Jamshedji Tata who, 52 years ago, laid in the obscure village of Sakchi the foundations of what is today Jamshedpur or Tatanagar. Another major steel plant was started

in 1918 at Hirapur, now called Burnpore, near Asansol.

The South Eastern Railway already serves these two existing steel works in the private sector, which have doubled their production. Two of the three steel plants in the public sector, with one million ton capacity each to begin with, but capable of expansion to two million tons each, have also been located on this Railway at Rourkela and Bhilai.

For the third steel plant at Durgapur on the Eastern Railway, this Railway will have to carry all its requirements of iron ore, limestone and dolomite. Besides iron and steel other industries served by this Railway include coal, copper, cement, paper, glass, aluminium, sugar and textiles.

While all these existing industries are planning substantial expansion, some of the other important developments envisaged in the areas are a new cement factory at Bhilai, a fertiliser factory at Rourkela and ferro-manganese plants at Joda, Tumsar Road and Garividi.

In the third Plan, we hope to open up the Dandakaranya area to rehabilitate refugees from East Pakistan. Survey for a railway line from this area to Vizagapatnam port has been sanctioned. This line when constructed, will also help in transporting iron ore from the Bailadilla area for export through the Vizagapatnam port.

MEETING PLAN'S CHALLENGE

When all the expansion schemes are completed by the end of the second Plan, it has been estimated that the South Eastern Railway will be called upon to load about 6,900 wagons a day against 3,200 wagons a day in 1956-57. The Bhilai steel plant, for instance, will require annually 2.5 million tons of iron ore, 2 million tons of coal, over 7.6 lakh tons of limestone and sizeable quantities of manganese ore and dolomite.

The immensity of the task facing this Railway will at once be realised from the fact that for the steel

industry alone some 3,260 wagons of raw materials and 630 wagons of finished steel will have to be carried daily by this Railway by 1961.

To meet this challenge, this Railway has been allotted a sum of Rs. 207 crores for its second Plan development works nearly one-fifth of the total allotment for all Indian railways, although in route mileage South Eastern Railway is only about one-tenth of the total. In other words, it has been assessed that this Railway alone will have to lift half of the total increase in freight traffic during the second Plan period.

In order to meet this increase in traffic, the South Eastern Railway has programmed to double over 450 miles of single line track, construct over 250 miles of new lines, introduce electric traction on nearly 350 route miles and renew over 1,200 miles of track. Besides, many yards are being remodelled, bridges repaired and workshop facilities improved. Already in the first two years of the second Plan, two new branch lines totalling 71 miles have been opened and doublings of 178 miles completed. During peak periods in its construction work, this Railway engaged over 80,000 workers daily including contractors' labour.

CO-ORDINATED TRANSPORT EFFORT

The railways are doubtless the biggest carriers in the country. It is significant that while the railways aim at increasing their capacity to 168 million tons of goods by 1961 from 114 million tons carried in 1956, (50 per cent increase) coastal shipping capacity is being increased in corresponding years from three million tons to only four million tons and the roadways are left with the problem of carrying only an additional 22 million tons.

But the days of cut throat competition between different modes of transport are over, the railways are now pledged, in co-operation with the roadways, waterways, and the airways, to follow a co-ordinated transportation policy so that their collective efforts bring overall progress and prosperity to the country.

A CORRECTION

In our January 1959 edition we published an article entitled "Extension of the Use of Microwave Telecommunications in the U.S.A." specially contributed by Mr. H. C. Towers, former Chief Signal & Telecommunications Engineer, Western Railway, Bombay. Photographs published on pages 12 and 13 of this article relate to "Thornton Marshalling Yard" and have nothing to do with Mr. Towers article. We sincerely regret for the error and inconvenience caused to our readers.

EDITOR

Promoting Greater Operating Efficiency

By S. S. Ramasubban

General Manager, North Eastern Railway

THE North Eastern Railway extending from Achnera in the west to Katihar in the east, with a route mileage of 3,076 and 582 stations, serves the eastern portion of U. P. and North Bihar. It joins the broad gauge system on the Northern and Eastern Railways at 14 points and interchanges traffic with the metre gauge systems on the Western Railway and N. F. Railway at Achnera and Katihar and Purnea respectively.

Lying at the foot hills of the Himalayas, the railway track crosses a large number of torrential rivers and waterways which debouch into the plains during the monsoons. Amongst the various waterways which dislocate the train services, mention may be made of the Kosi—the river of sorrow of Bihar—and Kamla, Bhagmati, Gandak and Gogra. During the monsoons the rail connections are cut off at many places on account of the vagaries of the rivers.

The N. E. Railway, which is basically an amalgamation of the various company-owned and company-managed railway systems has had an unfortunate past. The Bengal and North Western Railway, R. & K., Tirhut State and Lucknow-Bareilly Railways which formed the basis of the O. T. and then the N. E. Railways were managed by companies whose main interest was in earning larger returns for their share-holders. The managements were not directed towards primarily rendering satisfactory service to the public. Scales of pay of the staff were poor and recruitment was not always made on considerations of merit. In short, the traditions that existed on those railways were not conducive to an efficient and honest set up. The O. T. Railway was taken over by the State in 1943 and the companies which were aware of Government's decision to take over these railway systems had neglected the maintenance of the railway track and the rolling stock. The result of the combination of these circumstances was an inheritance of depleted assets—an extremely unenviable position.

Even after the State took over the line, the war and the post-war periods prevented rehabilitation of the rolling stock and the track. Immediately thereafter the partition of the country followed and situated next to Bengal, which was divided, the resources of

this Railway were strained still further. This Railway also lost a number of experienced personal and had to absorb staff from the old B. A. Railway who had to be transferred to India as a result of the partition.

PECULIAR OPERATING FEATURES

The N. E. Railway is a completely metre gauge system and has necessarily to have a large number of break-of-gauge points with the adjoining broad gauge systems of the Northern and Eastern Railways. Serving the north of the Ganga this Railway also caters to the heavy volume of passenger and goods traffic originating from the areas in the South of the river to the north and *vice versa*. This traffic has to be ferried across the Ganga whose course varies from year to year and whose vagaries during the same year are well-known, and this presents problems in the handling of traffic at the riverine points. Ferry points exist at Mokameh-ghat-Semariaghat, Bhagalpur-Bararighat and Monghyr-Monghyrghat where goods wagons are ferried across the river.

The rise and fall in the water level, the shifting of the banks and the course of the river frequently, are constant problems in the handling of the riverine traffic. The transshipment problem, one of the most important problems of this railway, is inescapably bound up with the river crossings where the vagaries of nature have to be dealt with. Steps have been taken to adequately increase capacity at the various transshipment points.

Mention may be made here of Bareilly, Barabanki, Shahganj, Manduadih, and Bhagalpur where necessary work providing additional facilities required in this connection are expected to be completed shortly. In the meantime, measures have also been taken to maximise transshipment at these points with the existing facilities by intensifying supervision.

RELIEF AFTER GANGA BRIDGE OPENING

Problems associated with ferrying goods and passengers across the Ganga will be partially solved by the completion of the bridge across the Ganga at Mokameh which is expected to be ready for traffic use

within the next two to three weeks. The bridge provides at its north end a broad-cum-metre gauge marshalling and transshipment yard designed to cater for the immediate needs and the anticipated increase. At present the quota for the transshipment of traffic at Mokameh is 125 broad gauge wagons and at the new yard at Garhara across the Mokameh bridge, provision exists for handling 350 broad gauge wagons per day to be ultimately increased to 500 broad gauge wagons in the future.

Serving the long and narrow strip of the country between Ganga and the foot of the Himalayas, the N. E. Railway has a junction at intervals of about 40 miles on an average. The large number of branch lines and junction points render the time-tabling of trainings and the provision of connections both for passenger and goods traffic exceedingly difficult. The comparatively short leads of traffic between junction points and the large number of directions in which the traffic distributes itself at frequent intervals, present problems which are rendered more difficult by sudden fluctuations in the various streams of traffic.

These problems are now solved by imposition of detailed quotas for movement but with the provision of additional facilities for the handling of traffic and with an increase in the volume which would enable long distance goods trains to be run, it is hoped that a substantial improvement in the operation of goods trains would be achieved.

INADEQUATE TRAFFIC FACILITIES

A prerequisite of carrying increased passenger and goods traffic is adequate line capacity and proper facilities in marshalling yards. The tremendous increase in the number of passengers and in the volume of goods traffic carried would be apparent from the fact that in 1943—44, 500 lakh passengers and 4.8 lakh goods wagons were moved, as against 939 lakh passengers and 8.6 lakh goods wagons during 1957—58.

The increase in traffic having completely outstripped the increase in the capacity to carry this additional traffic resulted in a large number of sections on the trunk and main line routes having to be worked to full capacity. Besides, the old inheritance from the company days of track poorly designed and maintained did not provide the safety devices and facilities for reception and handling of trains, thus there were practically no facilities for simultaneous reception of trains even at watering and junction stations; the

signalling and interlocking arrangements did not permit trains to be run through on high speeds. In many branch lines the track was of poor poundage necessitating very severe restrictions in speeds and in loads of trains. All these factors resulted in making operation extremely difficult.

Priority was given to work connected with increase in line capacity. During the Second Five Year Plan, Rs. 9 crores have been earmarked, out of which Rs. 3 crores are being spent during 1958—59.

In addition, a large number of major yards such as, Gorakhpur, Gonda, Chupra, Samastipur, Bareilly City, Narkatiaganj, Aishbagh, Barauni Junction, Varanasi, Kasganj, Manduadih, Muzaffarpur and Darbhanga are already in an advanced stage of progress. Over 30 crossing stations either newly provided or by converting flag or halt stations into crossing stations have been designed.

With the introduction of heavier engines and longer trains, the loops provided at stations on this railway which were far too short to meet the present-day length of trains, are being extended to 2250 feet on certain routes and to 2700 feet on certain other routes. Additional loops are being constructed at 36 stations when the provision of the additional facilities for crossing of trains would be available. The doubling of track between the Sonapore and Hajipur sections including the new bridge across the Gandak, Lucknow and Aishbagh, Lucknow City and Daliganj and Khagaria and Katarreah sections totalling a distance of 54 miles have also been catered for.

It is to the credit of the N. E. Railway staff that inspite of the large number of works which they have been undertaking, they carried very heavy traffic during the busy season of 1958—59 without very serious dislocation.

STEPS TO PROMOTE GREATER EFFICIENCY

To provide additional rolling stock during the second Plan, Rs. 40 crores are being spent. The addition of 11,299 wagons, 3,236 coaches and 300 locomotives will to an extent enable the withdrawal of some of the rolling stock which is overaged. As for improvement to track, 337 miles of trunk and 518.75 miles of main line track is being renewed completely. Rails are being renewed on 40 miles of trunk and 683 miles of branch line track. Strengthening or rebuilding of bridges is also being undertaken and 180 bridges are expected to be regirdered.

Expansion and modernisation of loco sheds is progressing satisfactorily. Apart from remodelling 9 mechanical and electrical workshops and 16 loco sheds, a new loco shed in replacement of the one at Barauni has already been provided and it is proposed to have a new loco shed in replacement of the existing one at Varanasi. Improved carriage washing facilities are being provided at a large number of stations including Bareilly, Barauni and Saharsa Jn. stations.

Extensive remodelling of the Gorakhpur and Izatnagar workshops at an estimated cost of Rs. 3.03 crores is progressing satisfactorily. While the Gorakhpur workshops will be completely remodelled by the end of this year, the latter will be completed by the end of the second Plan. The periodical overhaul capacity of rolling stock will be substantially increased after the remodelling of these workshops.

To permit running of faster trains and to provide simultaneous reception facilities, the standard of interlocking is being raised at 90 stations. The section between Katihar—Lucknow Jn. is being provided with multiple upper quadrant signalling. In order to increase safety and permit speedy operation, 155 stations are being provided with token instruments and 122 busy level crossing are being provided with suitable interlocking arrangements. Interlocking of 251 stations, 5 catch and slip sidings, 14 outly sidings and provision of detectors at 216 non-interlocked stations are other important signalling works in hand.

CARING FOR THE WORKERS

Increased amenities relating to almost all aspects of a railway employee's life are being provided. On an average Rs. 60 to 80 lakhs are being spent each year for providing additional quarters equipped with modern amenities. Besides providing basic amenities like education including grant of 75 scholarships for post education studies in professional subjects, medical facilities including mobile dispensaries, hospitals and stationery dispensaries and various other amenities have been provided.

These include co-operative consumer stores, co-operative credit banks, canteens, well-equipped running rooms for the running staff, recreational activities through institutes, sports, scouting, cultural activities and holiday camps. A new amenity recently provided is the mobile library service for railway staff posted at wayside stations. Another amenity which has become extremely popular is the setting up of a

handicrafts centre at Gorakhpur, where the families of railwaymen spend their spare time usefully and also benefit financially.

Amongst other amenities which would be provided shortly are 50 primary schools by July 1959, a subsidised hostel, a holiday home and a convalescent home.

TRAIN PUNCTUALITY

There has been a substantial improvement in the punctuality of passenger trains and in the movement of goods trains; but there is no room for complacency as despite the improvement that has been effected the quality of service to the public both in regard to movement of passengers and of goods has not yet reached the requisite standard.

PUBLIC CO-OPERATION SOLICITED

Vandalism has been posing a serious problem to the N. E. Railway administration. Refusal on the part of railwaymen to collaborate in fulfilling unreasonable demands of certain rowdy elements has very often resulted in railwaymen being assaulted.

Thefts of railway property, particularly carriage fittings have been causing considerably concern. The measure of dislocation caused may be gauged from the fact that the value of electrical goods stolen from passenger coaches during a year is more than Rs. 2,50,000. This includes a large number of imported items of train lighting equipment which are stolen for the value of the small quantity of metal inside these fittings. Apart from the loss involved, thefts make maintenance of electrical equipment exceedingly difficult.

Misuse of alarm chains is another serious problem; every hour, on all days of the year, one train is stopped out of course somewhere on the N. E. Railway, bringing in its trail dislocation of train services and avoidable delays.

Another problem is ticketless travel. This anti-social evil is rampant in many sections of this railway. Intensified supervision and intensified ticket-checking arrangement have been made but a substantial measure of success can be achieved only with public co-operation in assisting the railway administration both in catching the culprit and in preventing thefts, ticketless travel and other activities of unsocial elements.

Southern Railway—Some Problems and Achievements

By Shri S. N. Barua

Senior Deputy General Manager, Southern Railway, Madras

THE Southern Railway, which emerged in April, 1951, as a separate Zonal Railway with the merger of the former Madras and Southern Mahratta, South Indian and Mysore Railways, serves the States of Madras, Andhra, Kerala, Mysore and a part of Bombay with its 6,159 miles of railway, which also includes 96 miles of Narrow Gauge. The Broad Gauge section with 1,807 miles fans out of Madras in three directions and leads to the three principal cities of Bombay, Delhi and Calcutta. The Metre Gauge comprising 4,256 miles spans from Masulipatam in the east coast of Andhra Pradesh to Poona in the North and Trivandrum and Dhanushkodi in the South and feeds the Broad Gauge through several tranship points such as Poona, Bangalore, Guntakal, Tadepalli, Arkonam and Palghat.

The general pattern of traffic on this Railway is the heavy flow of a large volume of consumer goods from the North to the South, with comparatively little traffic moving from the South to the North. The bulk of this traffic moves through the Broad Gauge system which, although less than 30% of the total route mileage, is called upon to carry more than 75% of the Railway's total net ton miles. Some commodities like coal, foodgrains, sugar, etc., which used to move by sea from the North, were also diverted to rail transport since the last War. The surplus produce of the South, namely, iron and manganese ore, tobacco, tea, groundnut and groundnut oil generally move only as local traffic to Madras, Cochin and other ports in the area for export by sea.

IMBALANCE IN FLOW OF TRAFFIC

Thus there is a heavy imbalance in the flow of traffic from the North to the South and vice versa which creates an important operational problem of taking over more and more loaded wagons at the inter-change points of Waltair, Vijayawada and Raichur and returning a large percentage of empty wagons in the opposite direction. This inflow of traffic from the North is bound to swell further when iron and steel plants in Bihar and Orissa and other industries start full production. Besides, in

the South itself, we have felt the impact of the growing mining industry with its dollar earning potential which is bound to develop further. The Southern States have also shown keen interest in setting up in recent years, large, small and medium size industries, chief among them being textiles, cement, sugar, iron and steel, and lately automobile rubber and bicycles. Additional transport capacity is required for all this, and our position at the time we gained Independence was far from happy. The intensive use made of the Railways during the last War left them in a very low and exhausted condition. The task of equipping our Railway to cope with the increased traffic was colossal, but no time was lost in setting about it in a business-like manner. The immediate task was rehabilitation, and the First Five Year Plan, primarily a Rehabilitation Plan, was accordingly drawn up with an outlay of Rs. 30 crores.

SECOND PLAN OBJECTIVES

The Second Five Year Plan is much more ambitious with an outlay of Rs. 134 crores, and the primary object of the Plan is to provide adequate transport capacity for the ever-increasing traffic on this Railway. The traffic intakes at the three important inter-change points will considerably increase at the end of the Second Plan period, from 350 to 400 wagons at Waltair and Vijayawada, and from 210 to 300 at Raichur. The daily movement of wagons over the arterial sections is also expected to increase cent-per-cent with 700 wagons moving on the section Vijayawada to Madras, 550 between Arkonam and Jalarpet, 450 between Jalarpet and Erode and 700 between Ranigunta and Arkonam. It will be easily appreciated against this background why so much emphasis has been laid on building additional transport capacity. More than 75% of the Plan provision of Rs. 134 crores has been earmarked for essential things line capacity works, renewal of tracks and additional locomotives and rolling stock. Adequate sums have been also earmarked for ancillary works such as additional capacity in workshops, sick lines, etc., besides making provision for passenger amenity works, staff welfare works and other works of a minor nature.

PROJECTS COMPLETED

Mention of some of the important works undertaken in the First Plan and completed in the Second Plan period may not be out of place. The first project that comes to my mind is the 96½ miles Quilon-Ernakulam Railway opened for traffic in January last year. This line linking up Cochin, the industrial capital of Kerala, with Quilon and Trivandrum, the capital city of the State, opens out an under-developed country of surpassing beauty skirting the sea practically from one end to the other. This outlet to the Port of Cochin will act as a fillip to commerce and industry and fulfil a long felt need which will usher in an era of infinite possibilities of agricultural and industrial prosperity to this fertile region.

The second important project is the conversion of the 52 miles Metre Gauge line from Renigunta to Gudur into Broad Gauge which was opened for traffic in August 1957. This provides a direct connection to the West Coast from the North via Arkonam without touching Madras, thus saving a lead of 32 miles for traffic moving to and from the West Coast. The conversion which included rebuilding of 141 bridges and regrading of the line, was carried out under traffic conditions, without interruption to running of Metre Gauge trains. These two projects involved very heavy responsibilities and meticulous planning, and credit is due to our Engineers who successfully accomplished these tasks in record time.

A Signals Workshop set up at Podanur at a cost of Rs. 26 lakhs has already started producing essential signal and interlocking equipment, thus contributing handsomely to conserving the much-needed foreign exchange.

Doubling of track has also been programmed to increase the line capacity where the existing single line has reached the point of saturation. This programme provides for doubling 101 miles between Vijayawada and Madras, 31 miles between Rajahmundry and Samalkot, 62 miles between Arkonam and Tirupattur and 23 miles between Arkonam and Renigunta. So far, 29 miles on the North-East line and 18 miles between Arkonam and Tirupattur have been completed and opened for traffic. These works involve heavy bridging and sinking of a large number of wells. The present rate of progress has been stepped up to opening one block

section every month and this pace will be maintained with a view to complete the entire doubling work within the Plan period, namely, March 1961.

The proposed conversion of the Metre Gauge section between Gudivada and Bhimavaram and Vijayawada and Masulipatam into Broad Gauge will give the advantage of double line between Nidadavolu and Vijayawada.

The Vijayawada Yard is also being remodelled at a cost of Rs. 88 lakhs to relieve congestion and facilitate the handling of the enormous traffic that will have to pass through this yard.

Simultaneously with this all-round, increased activity we have the problem of looking after 1,60,000 staff who are employed on the Southern Railway. The Second Five Year Plan has made adequate provision for staff welfare works which include construction of 10,000 quarters, 40 additional dispensaries, holiday-homes, recreation facilities, etc., and a sum of Rs. 729 lakhs has been exclusively set apart for this purpose.

NEYVELI AND PATTERN OF MOVEMENT

The Second Five Year Plan will be over in another two years, but there may be many more Five Year Plans to suit the needs of additional traffic and pattern of movement side by side with further developments and industrial expansion in the country. One noteworthy development which is expected to play an important role in the future pattern of movement in this area is the exploitation of the lignite deposits in the Neyveli area. The rich reservoirs of the brown coal are being harnessed under a Rs. 68-crore multi-purpose project to produce the much-needed electricity for industrial development, to manufacture fertilisers for agriculture and lignite briquettes for use as domestic and industrial fuel. Besides providing extensive sidings in and around Neyveli, it will be necessary for the Railway to go in for various line capacity works to cater to this traffic of vast potentialities. The function of the Indian Railways is to serve the transport needs of the country, and it is our ambition and hope that, by sustained hard work and with the co-operation and goodwill of the public, we shall never fail in this great task of giving satisfactory service to the nation and the country.

(Courtesy: All India Radio, Madras)

Western Railway is Building up Capacity To Meet Industries' Demands

By M. M. Khan

General Manager, Western Railway

The Western Railway serves one of the most highly industrialised regions of the country, where further industrial expansion is planned. To cope with consequently increasing traffic loads, the Western Railway has been pushing ahead with execution of an ambitious development programme which includes laying of new lines, greater line capacity, yard remodellings, extension of repair facilities and works to provide additional users' amenities.

EASY mobility of raw material and finished goods is the *sine qua non* of rapid industrial development. Railways are the most developed form of transport in the country, and they alone can move millions of tons of heavy machinery and other requirements to the construction sites and later carry the finished goods to the far-flung markets.

The nation's planners know this, and have accordingly given nearly a fourth of the total public sector Plan allotment for the development of the railways. The share of the Western Railway is Rs. 170 crores out of the total second Plan allotment of Rs. 1,125 crores for the entire railway system.

The first plan, which gave Western Railway Rs. 31.05 crores, mainly dealt with the expansion of repair facilities for locomotives, carriages, wagons, track renewals, increase in line capacity works, remodelling of yards, and the construction of a few new lines.

The most important construction was the Kandla-Deesa rail link, connecting the larger hinterland of Rajasthan and Central India with the new Kandla port in Kutch.

This Railway fulfilled all the first plan targets and carried 11.40 million tons of goods traffic and 305 million passengers in 1955-56 against 8.76 million tons of goods traffic and 286 million passengers carried in 1951-52.

SECOND PLAN TARGETS

The second Plan targets for this Railway have been set at lifting about 17 million tons of goods in 1960-61 as against 11.40 million tons at the commencement

of the Plan. Also it has to meet the challenge of the increasing passenger traffic. The average daily loadings on the broad gauge have to be stepped up from 1,955 wagons per day in the busy season of 1955-56 to 2,100 wagons per day in 1960-61. On the metre gauge also a large increase in daily loading is anticipated, that is, from 2,586 wagons per day at the start of the five year period to 3,600 wagons per day in 1960-61.

In other words, it will be necessary to run 804 goods trains and 698 passenger trains daily in 1960-61 against 506 goods and 558 passenger trains per day in 1955-56.

These rather ambitious figures have been set up as targets because this Railway serves one of the most industrialised regions of India, where further large-scale industrial expansion is planned.

This Railway serves two of the major ports, that is, Bombay and Kandla, besides catering to a number of major industries like textiles at Bombay, Ahmedabad, Indore, Rajkot and Bhavnagar, cement at Lakheri, Sevalia, Sawai Madhopur, Dwarka, Sika and Porbunder, chemicals at Dhrangadhra, Mithapur and Baroda, and salt works at Kharaghoda, Dhrangadhra, Sambhar Lake and Kandla.

Big irrigation projects are also in progress, for which not only construction materials have to be transported but also transport will have to be provided in the near future for the increased yields of grains and other commodities.

MORE TRAFFIC LIFTED

The results of the growth of industry and agriculture as well as of the Railway's simultaneous expansion to

meet the increase in traffic is already evident from the rising loading figures. During 1956-57 and 1957-58, this Railway lifted 12.25 and 14.28 million tons of traffic respectively as against 11.40 million tons in 1955-56.

Passenger traffic has also increased. As against 305 million passengers carried in 1955-56, the Western Railway carried 312 million passengers in 1956-57 and 359 million in 1957-58. The suburban service which plays an important role in the daily life of Bombay city, contributes a large portion. This traffic registered a phenomenal rise from 48 million passengers in 1939-40 to 207 million in 1957-58. About five lakhs of passengers travel every day on the suburban section of this Railway alone.

To relieve overcrowding, consequent on this colossal increase in the number of passengers, the number of trains has been steadily increased, though it must be admitted that overcrowding in the peak hours still continues.

DEVELOPMENT OF CAPACITY

To mitigate this, intensification of traffic on the Bandra-Borivli section has been taken in hand—the portion between Bandra and Andheri having been already completed. Further, to augment the frequency of trains, extra terminal facilities of three lines against the former two lines have been provided at the Churchgate terminus. The remodelling of the station yard has also been completed.

A feature of special interest for the quick reception and despatch of trains is the modern route-relay interlocking system installed at Churchgate. This provides simultaneous route-setting for up and down movements to enable a larger number of trains to run safely. With these active measures in hand and the procurement of additional electric stock, this Railway has been able to augment its suburban train service from 273 trains per day in 1952-53 to 357 trains in 1957-58.

The car shed at Bombay Central which was originally designed for attending to running maintenance and periodical inspection of 20-25 rakes, has been remodelled and extended. A mechanical washing plant, which washes double the number of rakes per day for the same staff, has been installed. Incidentally, it may be mentioned that this is the first mechanical coach-washing plant to be installed in India. The plant was designed, fabricated and installed departmentally.

To meet the needs of the second Plan, an extensive programme of providing more traffic facilities has been drawn up, and works over a number of new sections on the line have been set up. This includes remodelling of important yards like Churchgate, Bandra, Bombay Central, Godhra, Ratlam, Mehsana, Jaipur, Kishangarh, Ahmedabad, Viramgam, Sabarmati, etc.; opening of new crossing stations; the lengthening of loops at stations, and improvements in transshipment facilities at most of the yards. Many of these works have already been completed.

NEW LINES

Besides, works of intensification of traffic, construction of new lines for under-developed areas and provision of new rail links in the interests of industrial development have been carried out. The Fatehpur-Shekhawati-Churu line and the Bhildi-Raniwara line on the metre-gauge and the Indore-Dewas-Ujjain link on the broad-gauge have already been constructed and opened to traffic. Works on three more new lines: Udaipur-Himmatnagar, Ujjain-Guna, and Kandla-Jhund are proposed to be taken up during the next two years.

Also, expansion of workshops for maintenance and manufacture of stock has been taken in hand. Among the major works are the remodelling of the locomotive repair shop at Dohad, wagon shop at Mahalakshmi, and the construction of a new wagon repair shop at Kotah. On the metre gauge, the remodelling of the locomotive repair shop and the carriage repair shops at Ajmer are in full swing—the former almost nearing completion. The signalling workshop and the bridge, points and crossing (civil engineering) workshop are also nearing completion.

NEW TRAINING SCHOOL

To increase efficiency, staff training facilities have been increased. A full-fledged training school has been set up at Udaipur to provide training to transportation, commercial, engineering and signalling staff. The school has training facilities for initial recruits and also for refresher courses for staff working on the line, particularly those connected with the safety of the track and trains. It is a residential institution with a capacity for 600 trainees. A technical school has also been set up at Ajmer to provide training courses to the mechanical engineering staff. Another technical school has been set up at Mhow for training the civil engineering staff of both the Western and Central Railways.

The railway development plan has certainly not overlooked the need for improving passenger amenities. With traffic continuously on the increase, the old station buildings have become totally inadequate. New, bigger and modern station building have been built at Jaipur, Godhra, Mehsana and Indore during this Plan period. On the suburban section the spacious new Churchgate station has replaced the old building. Considerable headway has also been made in the provision of other amenities such as waiting halls, coverings over platforms, foot-over bridges. Watering and sanitation arrangements have also been greatly improved.

STAFF WELFARE

Meanwhile, conscious of the fact that a contented staff is a major asset to any organisation, the Western Railway has spared no efforts to organise more and more staff amenities. A number of institutes, welfare centres, *bal mandirs*, hospitals, dispensaries, canteens, schools, co-operative societies and staff colonies have been opened for the benefit of the staff. Before the end of the current Plan period, the existing strength of 230 general beds (excluding 45 maternity beds and 12 beds for T. B. cases) will be increased to 698 general beds. The new divisional hospitals under

(Continued on page R.25)

New General Manager for Western Railway

Shri M. M. Khan has been appointed as the General Manager of the Western Railway vice Shri M. K. Kaul.

Shri Khan who was born on 10th February, 1908, belongs to the first batch of Indian officers who were recruited for the Mechanical Department of the Indian State Railways under the scheme of recruitment promulgated in 1926 according to which persons of Indian domicile recruited for the Mechanical Department of the Superior Revenue Establishment of Indian State Railways were to be given training initially at Jamalpur and finally in the United Kingdom. He joined service on 14-2-1927 and after completing the training in India proceeded to the United Kingdom in 1931 for further training. On return he was appointed as an Assistant Officer in the Mechanical Engineering and Transportation Department in February 1933 and was posted to the then East Indian Railway. He was first promoted to officiate in the senior scale in 1937 and subsequently held charge of important senior scale posts such as District Mechanical Engineer, Asansol Division, Works Manager, Locomotive Shops, Charbagh (Lucknow) and District Mechanical Engineer (Operation), Headquarters before being promoted to the rank of Deputy Chief Mechanical Engineer on the ex. East Indian Railway in June 1948. He worked as Deputy Chief Mechanical Engineer at the headquarters until 1953 when he was transferred as Deputy Chief Mechanical Engineer in charge of the Carriage & Wagon Workshops, Lilloah. In early 1955 he was transferred to the North Eastern Railway and in July of the same year he was promoted as Chief Mechanical Engineer in which capacity he worked upto June 1958.



SHRI M. M. KHAN

In the same month he was transferred to the western Railway as Senior Deputy General Manager and he has now taken over as the General Manager of this Railway.

Eastern Railway Delivers the Goods

By Kripal Singh

General Manager, Eastern Railway

Since the start of the second Five Year Plan on April 1, 1956, the Eastern Railway has made remarkable progress. Today, it is loading about 15 per cent more wagons than in 1956-57, and by the end of 1960-61, the average daily loadings will go up to 7,000 wagons, that is, about 54 per cent more than at the beginning of the second plan.

IN 1955-56, the last year of the first Plan, the Eastern Railway loaded an average of 4,272 wagons every day, that is, 2,427 wagons of coal, and 1,845 wagons of other goods. This amounted to a total of 29.86 million tons of goods in 1955-56. The same year 171.49 million passengers originated on this Railway.

Coal is the principal item of freight traffic on this Railway. And most of the 22 million tons of additional coal production in Bengal, Bihar, Karanpur and Kathara coalfields will have to be carried by this line.

The other main items of increase in traffic during the current Plan are: raw materials and finished products to and from the new one-million-ton steel plant at Durgapur; the new Bengal Government coke oven plant and other industries at Durgapur; expansion of fertilisers, cement and paper factories; increased production of foodgrains resulting from the execution of the D. V. C. and Mayurakshi river valley projects; growth of imports and exports through the Calcutta port; increased movement to and from North Bihar as a result of the completion of the Ganga Bridge at Mokameh; additional movement of raw materials and finished products as a result of the expansion of the Indian Iron and Steel Co. at



SHRI KRIPAL SINGH

(Continued from page R.24)

construction at Pratapnagar, Rajkot, Bhavnagar, and Kotah as well as the central hospital (150 beds) under construction at Bombay are expected to be opened shortly. Holiday and convalescent homes for staff have been established in Bombay.

This Railway continues to maintain, as a measure of staff welfare, a number of schools and has converted the railway high school at Bandikui into a multi-purpose higher secondary school in June 1958. This school, besides imparting instructions in general art subjects, also provides arrangements for teaching shorthand, typing, general engineering, carpentry, fitting, smithy, foundry and machine-shop practices. The school admits not only the children

of railway employees, but also outsiders, subject to the number of vacancies.

To mitigate the difficulties of the staff who have to send their children away from their headquarters for the purposes of education, it is proposed to start in July 1959 two subsidised hostels—one at Ajmer and another at Anand. These hostels will accommodate about 200 students. Also, it is proposed to start 90 primary schools on austerity standards from the current academic year.

With these achievements already accomplished, the Western Railway looks forward with confidence to the implementation of the rest of its expansion programme.

Burnpur; and greater out-turn from the various works and factories in the industrialised area around Calcutta.

FIVE WAGONS PER MINUTE

In terms of wagons, it has been anticipated that at the end of the second Plan, the Eastern Railway would have to load daily about 4,300 wagons of coal and about 2,700 wagons of general goods or a total of 7,000 wagons daily in the six busy months and a little less in the generally slack monsoon season.

The principal purpose of the railway's second Plan has been to create sufficient capacity for carrying this increased freight traffic, besides effecting a 15 per cent increase in passenger train/vehicle mileage.

To achieve this objective, this Railway is implementing a big programme.

Electrification of the Howrah-Bandel-Burdwan and the Sheoraphuli-Tarakeswar branch has already been completed and both suburban and through passenger trains on these sections run on electric traction. Electrification, however, was done under the 3,000 volt D. C. system which has since been given up in favour of the cheaper and more modern 25 KV single phase A. C. system.

Work has already started on the Durgapur-Gaya section, and this line would be electrified by 1960. Before the end of the current Plan, electrification work would start on the Gaya-Moghalsarai, Sealdah-Ranaghat, and Dum Dum-Bongaon sections.

DIESEL-ELECTRIC ENGINES

In the meantime, 43 diesel-electric engines have already been purchased and put into service for hauling the heavy coal trains on the very difficult gradient section Dhanbad-Gomoh-Gaya as well as on the Gaya-Moghalsarai and the Barkakana-Barwadih-Sonenagar-Moghalsarai sections. These locomotives have broken the bottleneck on the Gomoh-Gaya section where more trains are being run today than could be done under steam traction. At present, Eastern Railway is meeting the traffic demands fully and the loading is current.

LONGER TRAINS

To clear more tonnage per freight train it was decided to run 70 wagons per train in place of the

present 60 wagons on all trunk routes of the Eastern Railway. However, these longer trains, which had a gross load of about 2,300 tons, could not be accommodated at crossing stations where loops of only 60 wagons capacity existed. Extension of loops was, therefore, programmed at 132 stations. Out of these, work has already been completed at 105 stations and 70-wagon trains have already started running on Asansol-Jhajha-Dinapore-Moghalsarai, Asansol-Dhanbad-Gaya-Moghalsarai, and Asansol-Chitpur-Naihati sections.

Trains to and from Calcutta docks still run with 60-wagon loads because the work in the east dock junction yard, although programmed, has not yet been completed by the Calcutta Port Commissioners. But work is expected to be started soon.

Additional loop lines have been programmed at 22 stations, and out of these, 14 have already been completed. These extended and additional loops will also suit the 3,000-to-4,000-ton trains which will be run when the 55-ton bogie wagons are received.

MORE CROSSING STATIONS

Twenty-two new crossing stations have so far been opened mainly on the Barkakana-Barwadih-Son Nagar section to cater to the heavy coal traffic from the Karanpura coalfields. One crossing station has been opened between Dinapore and Patna, four between Kiul and Jamalpur, two between Sahibganj and Ramporehaut, two between Ondal and Sitarampur via Barabani, and one between Dum Dum and Bongaon stations.

Two block huts will soon be opened between Asansol and Jhajha to increase the capacity of this section for diverting trains from the Grand Chord to the Main Line. This would be necessary since soon 4-hour no-train blocks will be enforced on the Grand Chord for the execution of electrification works.

Three additional block huts have already been opened on the Son Nagar-Moghalsarai section and three more would soon be provided on the Gurpa-Gujhandi section, where the ruling gradient is one in 80. Two more crossing stations are under construction on the Sahibganj loop and one on the Dum Dum-Bongaon section.

With the completion of these crossing stations and block huts and the electrification of the Durgapur-Gaya-Moghalsarai section and dieselisation of the

April 1959

Barkakana-Barwadih-Son Nagar section, sufficient line capacity would be available for moving all the coal and goods traffic as well as passenger traffic that is likely to develop by the end of the second Five Year Plan on this Railway.

The single line between Ukhra and Ondal was found to be wholly inadequate to move the heavy coal production in Ukhra-Pandaveshwar area and, therefore, an additional six-mile long line has been programmed to be built between these stations. The work is well advanced and the new line is expected to be ready by the end of April 1959. Another four-mile length of additional line between Ratibati and Sarsole sidings of the Ranigunge coalfield is under construction to facilitate coal movement.

NEW LINES FOR STEEL PLANTS

The 90-mile Chandrapura-Hatia line constitutes only a part of the 183-mile long line from Chandrapura on the Eastern Railway to Bonda Munda, near Rourkela, on the South Eastern Railway. This line will be used for the movement of coal from Bokaro and Jharia coalfields to the Bhilai and Rourkela steel plants. Later this line would help supply iron ore and limestone to the proposed steel plant in the Bokaro area on the south bank of the Damodar river.

For the present, the line would end at Hatia near Ranchi where a new heavy machine building plant and a heavy foundry and a forge are being set up. The Chandrapura-Muri section covering 45 miles of this new line is expected to be opened in June 1959. On the Muri-Ranchi line, of the work is already complete and the line is expected to be opened early in 1960. The five extension work from Ranchi to Hatia is yet to be taken in hand.

THREE COAL LINES COMPLETED

Three of the five coalfield lines, namely, Kathara, Saunda, Sayal, Gidi and Bachra, are well on their way to completion. The line to Kathara colliery has been completed up to the Kathara yard. Saunda and Bachra colliery lines are expected to be opened in the near future. Coal loading facilities have already been provided at Saunda.

The line to Gidi involves construction of another major bridge over the Damodar river. The bridge is under construction and the line is expected to be opened by the end of the current year. The construc-

tion of the Sayal line will begin soon. Construction of a new big yard at Patratu for dealing with all the coal wagons from the area is in hand. In addition, to release the large quantity of coal locked up under the Barkakana loop between Phusro and Jarangdih stations, it has been proposed to divert the existing railway line. Survey work for this seven mile diversion is already in hand.

DUGDA WASHERY LINE

A coal washery is being installed by the Hindusthan Steel Ltd. at Dugda near Chandrapura station. This plant will supply washed coal to the Bhilai and Rourkela steel plants. A new eight-mile line and a yard are being provided for this purpose.

A new thermal power station is also being set up by D. V. C. in this area. Two more washeries are to be installed in the Bengal and Bihar coalfields—one has already started functioning at Kargali and the other is expected to be set up near Pathardihi yard which is being remodelled for the purpose.

The Eastern Railway has already completed new exchange yards at Hiraipur for IISCO Works, at Ondal for Durgapur Steel Works, and near Durgapur for the coke oven plant. Only a few more sidings remain to be constructed for other industries near Durgapur.

The Damodar-Kaliphahari avoiding line is being constructed to facilitate the movement of ores and limestone trains from the South Eastern Railway to the Durgapur steel plant. This line, when completed, will avoid the use of the busy Asansol yard.

The Bakhtiarpur-Rajgir Line is largely a replacement work. The estimate for this line has yet to be sanctioned by the Railway Board, and the work will be started as soon as the sanction is received.

Survey work on the Tildanga-Farakka line has already been completed and work will start in 1959-60. This will give the long asked for rail connection to North Bengal via a ferry across the Ganga to meet a new metre gauge Khejuria Ghat-Malda line on the other side.

REMODELLING OF MAJOR YARDS

The principal yards which are being expanded remodelled are Moghalsarai, Sitarampur, Asansol, Ondal, Pathardihi, Barwadih, Patna, Chitpur, and

Howrah. After remodelling, the Moghalsarai yard would be the most modern and the biggest yard in India and will have the capacity to deal with 3,600 to 4,000 wagons daily in each direction. Already this yard is dealing with about 2,400 wagons in each direction and by the end of the current Plan period, it is expected to deal with more than 3,000 wagons per day each way. Work here has made satisfactory progress and global tenders have been invited for equipping it with modern power points machine and electro-mechanical retarders.

The work at other yards also has made good progress and will be completed according to schedule.

OVERHAUL FACILITIES

At the beginning of the Plan, Eastern Railway had 1,458 steam locomotives, three diesels, 5,212 four-wheeler units of passenger and other coaching stock, and 53,753 four-wheeler units of goods stock. Today, these holdings have increased to 1,510 steam, 43 diesel and 15 electric locomotives, 29 electric multiple units (three coaches each), 6,350 four-wheeler units of passenger coaches and 61,600 four-wheeler units of goods stock.

To provide for the repair and overhaul facilities of this additional stock, it has been necessary to expand the mechanical and electrical shops at Lillooah, Jamalpur and Kanchrapara. A new diesel engine shed has been constructed at Gaya for overhauling and servicing of diesel engines.

The signal shop at Howrah is also being expanded and about 90 per cent of the work is complete. After completion, the out-turn of this shop will be greatly increased.

The engineering plant depot at Moghalsarai has had to be expanded and work has been completed except for the provision of a few machines which have to be imported.

BETTER SIGNALLING AT 152 STATIONS

Interlocking facilities are proposed to be provided at 29 stations had already been done, at 56 non-interlocked stations, and 67 stations are being arranged for interlocking.

Large stations dealing with heavy traffic is also included

in the Plan. The work at Bandel station is in progress. Arrangements are being made to provide automatic signalling on the D. C. electric suburban section between Belur and Sheoraphuli.

Colour light signals have replaced the ordinary semaphore signals between Howrah-Bandel and Saktigarh-Burdwan and arrangements are in hand for similar replacement between Bandel-Saktigarh.

Block instruments for giving line clear to trains are being interlocked with appropriate signals at 62 stations of which work at 32 stations has been completed. On the single line sections where telegraphic paper line clear system is in force, token block instruments are planned to be provided at 82 stations including new crossing stations. Nineteen stations on the new Chandrapura-Muri-Ranchi line will also be provided with token instruments. Work has been completed at seven stations and is in progress at 13 stations on the Berkakana-Barwadih loop. As more token instruments become available, work at other stations will be progressed.

The remodelled Moghalsarai yard will have automatic electrically-operated sorting yard points and the electro-mechanical wagon speed retarders in the up yard. Route relay interlocking at the Howrah terminal will be installed on completion of the electrification of the whole of Howrah yard and the Howrah-Burdwan chord line. Improved signalling is being provided between Son Nagar and Dehri-on-Sone so that the heavy traffic passing on this busy section may move more expeditiously.

BETTER COMMUNICATIONS

Two new telephone exchanges have been installed at Kanchrapara and Jhajha. Old and worn-out telephone exchanges have been replaced by more modern exchanges at two places and wireless communication with the divisional headquarters and the headquarters office has been provided at a number of new points requiring control and regulation of traffic.

The Plan provided for the primary relaying of 355 miles, secondary relaying of 251 miles, tertiary relaying of 190 miles, through rail renewals of nine miles, and spot rail renewals of 40 miles. Up to the end of 1958-59, 222 miles of primary relaying, 43 miles of secondary relaying, 34 miles of re-railing, 70 miles of through rail renewals and 75 miles of thermite welding have been done. A flash butt welding plant has been installed at Bandel so that in future new

rails are welded into lengths of 210 ft. each before being put into the track for renewals. The rest of the track work will be done in the next two years.

RS. 49 LAKHS FOR BRIDGES

About Rs. 21 lakhs have been spent on the rehabilitation of old and weak bridges in the first three years of the second Plan. Another Rs. 28 lakhs are expected to be spent during the next two years. Additional flood openings have been provided on the main line and the Grand Chord sections which were heavily breached during 1956 floods. A number of bridges have been constructed for the Damodar Valley canals.

EXPANSION OF GOODS SHEDS

Extension of goods, parcels, transshipment sheds and goods wharfs has already been completed at eight stations, including Patna Junction, Gaya, Pathardihi, Sainthia, Gushkara, Monghyr and Asansol. Work is in progress at another 16 stations, including Patna City, Patna Junction, Gaya, Buxar, Dhanbad, Asansol, Rajmahal, Sahibganj, Ramporehaut, Rishra and Howrah (goods and parcel). Construction will soon start at a few more goods and parcels sheds at Moghalsarai, Jasidihi, Dehri-on-Sone, Cossipore, Chitpur, Naihati, Dinapore. Weigh-bridges are also being provided on replacement and additional account at 21 stations.

RS. 182 LAKHS FOR PASSENGER AMENITIES

It is the railways' desire to provide basic minimum amenities at all stations, and improved amenities at more important stations. Accordingly additional flag stations and halts have been opened and passenger coaches have been provided with improved fittings and fans. Fifty-nine stations have been electrified and 56 more will be electrified in the next two years. Twenty electric-water coolers have been installed for the public at various stations. The total amount spent on these works during the first three years of the second Plan has been about Rs. 102 lakhs. About 200 stations on this Railway have been covered by these amenities. The total planned expenditure on rail users' amenities during second Plan period is Rs. 182 lakhs.

5,700 NEW STAFF QUARTERS

Up to 1958-59, 5,700 new quarters costing Rs. 3.8 crores have been programmed. It is proposed to

spend Rs. 170 lakhs in the next two years to provide more housing facilities.

About Rs. 75 lakhs have been spent on the provision of additional staff amenities in the first three years of the Plan. Another Rs. 60 lakhs will be spent in the next two years.

Schemes for improved water supply are being executed at Asansol, Ondal, Madhupur, Kanchrapara, Bongaon, Jamalpur, Bally, Burdwan, Dakhineswar, Sahibganj, Lillooah, Howrah, Nabadwip, Panagar, Maghalsarai, Barwadih, Nawadah and Gaya railway colonies.

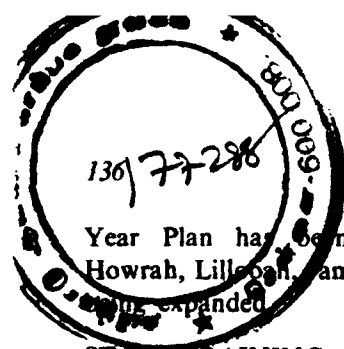
Health centres at every 100 miles, whole-time specialists in railway hospitals, honorary consultants in central hospitals, extra lady doctors, midwives, provision of chest clinics and dental clinics, extra beds for T. B. patients in recognised sanatoria, provision of beds in the chest clinics for isolating infective. T. B. cases and rendering such patients financial assistance through the Staff Benefit Fund, removal of distinction in the matter of medical attendance between class III and IV staff, facilities for eye testing in divisional hospitals, domiciliary maternity facilities by midwives at places where there are no maternity beds in railway hospitals, setting up of birth control clinics, etc. are the main directions, in which medical aid to staff and their families is being provided.

MORE SCHOOLS

A large number of additional primary schools are being constructed and opened at railway expense. This is in addition to the five high schools, four middle schools and 41 non-railway schools where the railway pays grants-in-aids. The annual expenditure by the railway on the education of staff children comes to about Rs. 9 lakhs.

Co-operative movement is being encouraged both for affording reasonable credit facilities as well as for consumers stores and canteens. The contribution to the Staff Benefit Fund has been raised from Rs. 2 to Rs. 4 per railway employee and all the money from this fund goes for scholarships for the education of staff and their children, relief of distress, aid in sickness and recreation, games and amusement for the staff and their families.

One new stores depot at Belur to handle materials for the large number of works in the second Five



THE INDIAN RAILWAY ENGINEER

April 1959

Year Plan has been built. The stores depots at Howrah, Lillo, ... expanded

STAFF TRAINING

A new training school has been opened at Madhupur for giving technical training to raw recruits for posts of assistant inspector of works, works supervisors, draftsmen and tracers. A central technical

school for the transportation, commercial, engineering and signal departments will be opened near Mokameh Ghat at Hathidah. A Railway Protection Force training school has been opened at Dhanbad.

PASSENGER TRAFFIC DECLINES

The traffic that has been handled by the Eastern Railway in each of the first three years of the Plan is as follows:

Year	Average daily loading of coal wagons	Average daily loading of general goods wagons	Average daily total wagon loadings	Total tons originating (in thousands)	Passenger originating (in thousands)	Passenger train mileage (in thousands)	Passenger vehicle mileage (in thousands)
1956-57	2,596	1,878	4,474	32,168	182,818	13,213	240,458
1957-58	2,784	1,937	4,721	33,874	186,554	13,421	250,621
1958-59	3,052	2,024	5,076	35,635	182,000	13,754	257,017
(estimated)							
Expected traffic in 1960-61	4,300	2,700	7,000	48,600	190,000	13,900	263,500

The passenger train mileage has been increased by 8.6 per cent and passenger vehicle mileage by 15.1 per cent over the respective 1955-56 mileages during the first three years of the Plan. Efforts continue to put in more coaches on the existing trains so as to increase passenger coach mileage as well as to introduce extra trains wherever possible and thus reduce overcrowding.

The average daily number of originating passengers and passenger miles on the Eastern Railway have, however, shown a decline in 1958-59 as compared with the previous year, despite increased passenger trains and passenger coach mileage.

WELL SET TO FULFIL TARGETS

The Eastern Railway is well set to fulfil its obligations under the Plan. Up to the end of December last year there was a little lull in goods traffic, but business during the first three months of

1959 has been brisk. The last two years of the second Plan are likely to bring a heavy burden with the commissioning of the three new steel plants and the expansion of steel plants in the private sector. The burden will also increase with the fulfilment of coal production targets and the additional agricultural production which is expected to materialise from the present vigorous campaign to grow more food.

It has been possible for the Eastern Railway to keep Calcutta port clear in spite of heavy imported traffic during the past two years. With more bogie rail trucks and special type wagons for moving heavy machines and other goods, there is likely to be no difficulty during the remainder of the Plan period.

As in the past, so in the future, the Eastern Railway will continue, with the co-operative efforts of its 170,000 workers and with the goodwill of the railway users, to deliver the nation's goods.

PROTECTION OF RAILWAY PROPERTY

It is a fact that the Minister of Railways met the Chief Ministers of States in Delhi in November 7 last year, said Shri S. V. Ramaswamy, Deputy Minister of Railways, in a written reply to a question by Shri P. N. Rajabhoj in the Rajya Sabha. The Deputy Minister further said that there was a general discussion at this conference on several matters. The problem of combating crime on Railways was also generally discussed. It was agreed in this connection that further steps would be taken to ensure effective co-operation and co-ordination between the Railway Protection Force and the State Police in all possible ways.

Handwritten notes: JL, D41582, 0153K, 1158-5-1

JUNG

JUNGENTHAL

Since 1885

Manufacturing Locomotives

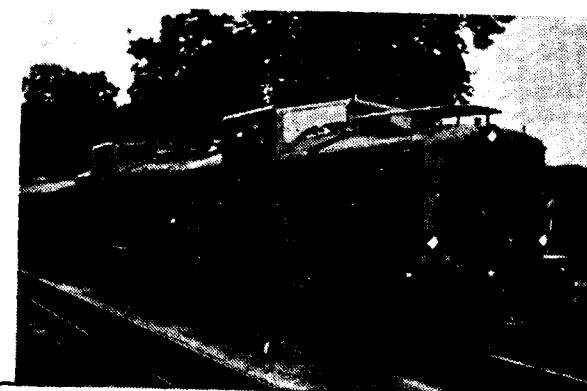
Diesel-Hydraulic Articulated Locomotive—280 h.p.

for Indian State Railways

with two 4-wheeled driven bogies (cardan drive), central driver's cab with three-point suspension, for gauges of 600 to 1,000 mm., suitable for smallest curve radius. Equipped with two MWM diesel engines Type RHS 518 S and two Voith hydraulic transmissions L33.

Supplied: 8 units for mountain lines of India State Railways, South African Railways, similar type to German Federal Railways 4 units (Serial No. V. 29) and n.g. Railways with difficult track of the line.

Type: LC 24 B + B

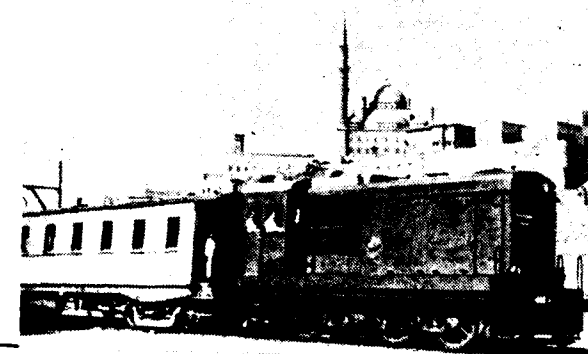


0-6-0 Diesel-Hydraulic Locomotive—360 h.p.

gauge 1435 mm., for service in tropical climate on desert railways, driver's cab at the end, remote control, equipped with MWM diesel engine Type RH 335 S and Voith hydraulic transmission L37.

Supplied: among others, 42 units to Egyptian Republic Railway

Type: R 363 C



2-8-2 Superheated Steam Locomotive — 900 h.p., oil burning.

with 8-wheeled tender, 3' 6" gauge

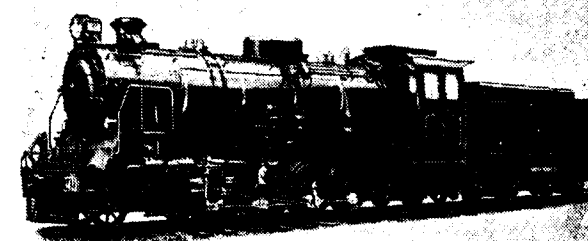
Weight empty of the locomotive, 48.7 tons.

Weight empty of the tender, 17.7 tons.

Weight in service order of the locomotives, 54.1 tons.

Weight in service order of the tender, 42.7 tons.

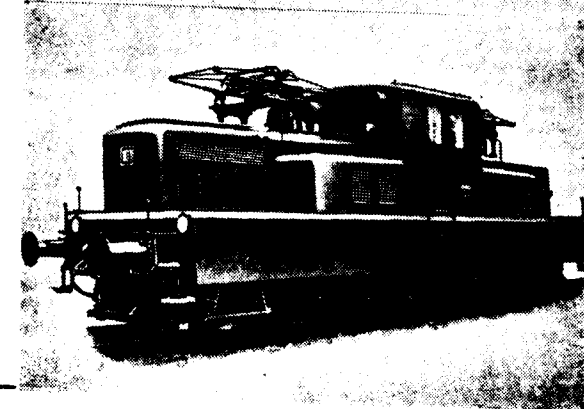
Supplied: 8 units to Caminhos de Ferro de Mocamedese do Congo (Angola).



BoBo Two-Power Electric-Diesel Locomotive — gauge 1435 mm.

Weight in service order 80 tons, rated output of the traction motors 4 x 148 kW, 592 kW, trolley wire voltage 600 V.

Supplied: up to now 13 units to Western German metallurgical works and mining enterprises.



JUNG

JUNGENTHAL

ARN. JUNG LOKOMOTIVFABRIK G.M.B.H., JUNGENTHAL bei KIRCHEN-SIEG (GERMANY)

For Sustained Efficiency & Reliability
only  **POPPET VALVE GEAR**

will meet the specification



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.

Approved & specified by Railway Authorities in many parts of the world for practically every design and condition of service.

ASSOCIATED LOCOMOTIVE EQUIPMENT LTD
LOCOMOTIVE ENGINEERS

Agents in India:—

GUEST, KEEN, WILLIAMS, LIMITED

CALCUTTA
755

6

BOMBAY

MADRAS

NEW DELHI
AL 198

Printed and Published by S. Sundaram at S. R. Press, 10, 11, 12, for
"The Indian Railway Engineer", 62, Jayprakashnagar, Goregaon, BOMBAY-44.
Managing Editor: T. S. N. Rao