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RAILWAYS AND THEIR STORES

12/94

IT was said by the great General Napoleon Bonapart that "the Army marches on its stomach". What he meant was that if the soldiers are well fed, then they would be able to fight properly, and there would therefore be a greater chance of winning a battle.

A statement somewhat similar could be made regarding the Railways. If they are well supplied by the Stores Department with raw and finished materials and ample spare parts for their rolling stock, then they would be able to keep going without any serious breakdown in their working and thereby deal with a greater amount of passenger and goods traffic and thus make a good profit.

As it is the Stores Department on which the Railways depend for the supply of all their materials, the success or failure of a Railway is dependent on the correct functioning of that department more than on anything else.

The Organisation of the Railway Stores Department is a matter of prime importance and the Controller of Stores who makes that department "tick", should be a man of very high qualities, such as absolute integrity, far-sight, prudence and drive.

Although he is the policy maker of the department, his eagle eye should encompass the working of the whole Stores Organisation and he must see to it that each one of his officers and senior subordinates perform the duties allotted to them with intelligence and a high sense of responsibility. The Controller of Stores by his own conduct should be able to inspire in his staff a deep sense of loyalty to the administration and a keen desire to emulate in all respects his own example. Efficiency should be the keynote of the working of the whole department and each section should of its own accord work as a team without fear or favour and give of its best and be proud to do it.

It is a moot point whether the Controller should be a technical man or a lay man with no technical knowledge at all. There are protagonists of each of the opposing views and each side has sufficient points in their favour to win an argument. Some say that a Technical man or Engineer given charge of a Stores Department as a Controller is likely to be a square peg in a round hole. He is likely to use his technical knowledge to the detriment of the working of the department. He may adhere so rigidly to specification and quality of materials to be purchased that in the long run delay the purchase to such an extent that the materials do not become available when required and so hamper the working of a technical department. On the other hand because of his intimate technical knowledge of the requirements he may pass stores at his discretion which are not hundred per cent to specifications and of poorer quality to that demanded, just to keep the consuming department going. The crux of the position then boils down not to whether a Controller of Stores should be technical or not, but rather how he makes use of that technical knowledge in the exercise of his functions as a Controller. On the other hand a non-technical Controller may vacillate because of his lack of technical knowledge in dealing with base problems and so cause equal damage. What is wanted therefore is the Head of a balanced mind prudent in his judgment and a high sense of integrity and responsibility together with a highly developed business acumen.

Having said this much of the Controller we must also assess the calibre of his deputies who undoubtedly aspire one day to occupy his chair. Their experience and dealings in matters of purchase and supply of stores and the knowledge of various stores codes and procedures should be both broad and deep. As it is the Deputy Controller of Stores who deal with the Deputies of other departments, their attitude should be one of helpfulness and compromise. They should be able to fathom the urgency of demands of other departments and arrange for supplies both expeditiously and generously. The best test of the value of a deputy of any department not necessarily the Stores Department is his ability to deal with routine and general matters and so leave their Controller to deal with superior matters and matters of policy. They should be able to guide and direct their senior and junior officers in their day to day problems.

Senior and junior officers will have their normal burdens to shoulder and these vary from day to day, depending on the nature of the work undertaken. The tone of the whole department depends upon the high or low ethical standards which these officers set for themselves and adhere to.

The Senior Subordinates and heads of section are really the key men of the department and because of their long association with a particular section they become experts, provided of course they are highly intelligent to start with. The Controller and his various officers depend and lean heavily on these hard working knowledgeable and dependable men. Because of intensity of their knowledge and experience, they usually get promoted to the official rung of the ladder towards the fag end of their service.

Every Stores Department has rules and codes, which must be observed religiously and every officer's powers and responsibilities are usually covered by these codes. Intimate knowledge of the Stores Code and procedure is the surest ground for carrying out the duties faithfully. As a matter of fact departmental examinations and promotions depend to a large extent on the knowledge of the code and stores procedure.

In the code each officer's powers are clearly indicated, whether these powers are in financial and personnel matters. On some Railways a Controller has the power to purchase materials upto Rs. 10,000/- for a single item, and for anything more costly he has to obtain the sanction of the General Manager who is given powers upto Rs. 1,00,000/- provided a sound justification exists.

For materials costing over 1 lakh of rupees these have to be bulked and sent to the Director General, Supply & Distribution These demands refer to such items as timber, paints, steels, boilers, rails, sleepers etc. The D. G. S. & D. bulks the demands of all the railways and places his orders for bulk supply accordingly. If he so desires he can place one order or split the orders into several parts and call for global tenders and select the supplier who gives value for money.

Unfortunately one of the most difficult hurdles to cross is that of placing orders on the lowest tenderer. Financial pundits who have the last word in the expenditure of money are often an hindrance than a help. Many times materials are purchased at the lowest price which often cost the Railway more in the long run.

As a case in point we might cite the case of bulk purchase of synthetic paints to specifications. Now to buy synthetic paints to specification is a fallacy, because unscrupulous manufacturers know how to manipulate the ingredients and satisfy that the paint is up to specification. Yet in truth the paint may be of poor quality. It is therefore false economy to purchase synthetic paints to specification because their quality is so poor that additional paint has to be applied to keep the coaches in a reasonably presentable condition.

Brand paints on the other hand are paints by which manufacturers wish to make a name for themselves and therefore to produce a high quality of paint they cannot sell it below a certain fixed price. When we talk of I. C. I. "Duco" or "Dulux" we immediately become aware of quality and hence should be prepared to pay the price if we can afford it.

Normally a coach is given a burn off and a fully coat of paint once in three years, while a varnish coating is given every year in between. To keep the coaches reasonably attractive paint has to be mixed with varnish when it is synthetic paint and so more quantity is used and therefore painting costs go up in the long run.

Let us now examine the materials in demand on the Railways and their number in a legion. It will be possible to cover a small number of these items and to indicate the procedures adopted to obtain them.

As said earlier, some of the larger items as indicated are bulked for all the railways and are dealt with on a global tender basis by the D. G. S. & D. and these include such items as locomotive boilers, locomotives (steam, diesel and electric), timber, sleepers, coal and such like whose total annual values run to many lakhs and sometimes crores of rupees.

Besides these there are items which are within the power of the Controller of Stores to purchase such as manufactured and fabricated items whose value per item does not exceed Rs. 10,000/-. These items are generally obtained indigenously and thereby help the development of trade and manufacture on the railway zonal basis. Much could be said of these items both from the manufacturers and purchasers points of view but this would be outside the scope of this editorial.

Then there are items in demand such as bolts, nuts, screws, pins, glass, leather, oil, waste, fuel etc. etc. Each one of these are obtained on a weekly or monthly basis on tenders. Then there are items obtained on a petty purchase basis from day to day and a stores man is constantly scouring the market to see from where these can be obtained.

Apart from materials required for the maintenance of railways, there are materials wanted to meet the Building Programme of coaching stock. These items are more or less the same as the items for maintenance but they are budgetted for separately and purchased and issued as the building work proceeds—may be coaches, may be buildings, bridges, signal equipment; electrical material equipment etc.

The purchase and issue of material demands an accurate accounting system with proper checks and controls. In addition to accounting there are the problems of storage and security. Take the case of steels alone. There are so many varieties of steel ranging

from ordinary mild steel to the highest quality of spring steel, tool steel, alloy steel that the system of storage, recognition and issue should be fool proof. Where such large and valuable materials are stored the question of security and the devising of ways and means to prevent large scale thefts or petty pilferages requires careful and constant attention.

Fortunately the Railway Stores are fairly well organised in all its ramifications and all that is necessary is to get the machine to work efficiently expeditiously and without a major break down.

SENIOR RAILWAY APPOINTMENTS

Shri D. C. Baijal, and Shri Kripal Singh, General Managers, Northeast Frontier Railway and Eastern Railway, have been appointed Members of the Railway Board, Government of India. They will take charge of their new offices by November 3, 1959.

Shri Baijal will be succeeded by Shri Y. P. Kulkarni, Additional Member (Staff), Railway Board, and Shri Kripal Singh by Shri M. M. Khan, General Manager, Western Railway, Shri Khan's place will be taken by the General Manager of the Northern Railway, Shri B. B. Mathur. Shri M. K. Kaul, on return from leave, will take over as the General Manager of the Northern Railway.

Shri B. Mazumdar, Chief Commercial Superintendent of the South Eastern Railway, has been appointed as the new Additional Member (Staff), Railway Board, and he will be succeeded by Shri G. S. Khosla, Regional Superintendent of the South Eastern Railway.

RAILWAY ENGINEERING UNDER THE SOVIET SEVEN-YEAR PLAN

By E. Khrakovsky
Engineer

MORE freight than in any other country in the world is shipped by rail in the Soviet Union today. The growth of production, envisaged by the 1959—1965 seven-year economic development plan of the USSR, will call for a 39—43 per cent. increase in freight turnover. This is to be carried out by reconstructing the existing railroads, introducing progressive types of equipment on a big scale, and building new tracks.

NEW HAULAGE

The transition of railways from steam locomotive haulage to electric and diesel haulage is to be completed, in the main, within the seven years. By the end of 1965 the extent of electrified lines will total 30 thousand kilometres. The length of lines serviced by diesel locomotives will have increased from 10 to 70 thousand kilometres.

The Soviet Union has surpassed all foreign countries as to the mileage of its electrified lines. Electric locomotives perform approximately 16 per cent of all railroad transportations.

Trunk lines with complex profile are now serviced by eight-axle 5700 h. p. electric locomotives, Type N-8, which are capable of hauling trains weighing upto four thousand tons over sections with steep grades. Railways with an easier profile are serviced by 4200 h. p. electric locomotives, Series VL-23.

ALTERNATING CURRENT

Electric haulage with alternating current will find extensive application. This will permit, when erecting the contact network, to cut down the consumption of copper 2–2.5-fold to reduce the number of haulage substations to a third, and to transform them from complicated converter plants into ordinary transformer stations.

The Novocherkassk Plant produces direct current electric locomotives the performance of which is far superior to that of similar D. C. machines. The designers of the plants are already busy designing an eight-axle alternating current locomotive, which is to be one of the most powerful electric locomotives in the world.

SPEED—130 KM AN HOUR

Suburban passenger electric trains, developing a speed as high as 130 kilometres an hour, are built at the Riga Plant. Now the designers at this enterprise are working on the construction of still more up-to-date electric trains. These trains are equipped with devices for recuperative braking. When braking on a steep slope or on the approaches to a station, the driver can switch the haulage electric motors over to generator duty, and the electric power produced will start returning into the circuit. It may be used by other trains whose motors at that time operate on haulage duty.

Work involving the construction of suburban electric trains operating on alternating current is also nearing completion.

46 KILOGRAMS PER HORSEPOWER

Soviet diesel locomotive designers are creating powerful machines. The performance indices of the 3 thousand h. p. diesel locomotive, recently produced by the Kharkov Plant, are superior to those of the best foreign machines of this type. The locomotive has the comparatively small axle load of 23 tons and is capable of developing high power rating. The ratio is 46 kilograms of weight per each horsepower of its rating.

Till recent years diesel locomotives were built in the USSR with electric transmission. Diesel locomotives are now built with a more economical, hydro-mechanical transmission. Such a locomotive has been recently built by the Lugansk Plant.

Parallel with the output of diesel locomotives, the first gas-turbine locomotives—machines of greater power rating, that operate on low-grade fuel—are being constructed in the USSR.

100-TON FREIGHT CAR

The USSR produces now only heavy-duty freight cars equipped with automatic coupling, roller bearings, devices for rapid unloading, and automatic brakes. The Nizhni-Tagil Plant has built a car with a 100-ton load-carrying capacity this year. In the very near future such cars will form the main rolling stock on the Soviet Union's railroads.

By 1965 the load-carrying capacity of the USSR's fleet of cars will have increased by one and a half times. Specialized cars—refrigerator and tank cars, fish and cattle transportation cars, etc. — will find ever-increasing application.

AUTOMATION

The first in the world electronic device which controls the movement of an electric train without human interference was successfully tested last year in the vicinity of Moscow. The device selects the most efficient locomotive operation duty and ensures the train's travel in conformance with a strict schedule.

Another electronic device which makes it possible to automatise the sorting of trains at shunting yards is now undergoing tests successfully. Electronic machines which will help dispatchers in organising in a most rational way the traffic of trains over railways are to be constructed in the nearest future.

Television devices are being installed at major stations, to help the dispatcher on duty in controlling train traffic without leaving his office.

Soviet scientists and engineers have recently created a new contactless system of remote control, which permits a single person—the power dispatcher—to control six or seven haulage substations. Such devices are to be put into operation at most electrified lines within the coming seven years.

Assessment of Rolling Stock Requirements

By T. V. Srinivasan
Divisional Traffic Superintendent (Planning & Projects), Central Railway.

RAIL transport plays an essential role in equalising the price structure all over the country and eliminating the imbalances in the economy of the country. Rail transport determines to a large extent the trade channels, and when adequate capacity for movement by rail is not available, the normal trade channels get blocked. This can give rise to serious repercussions on the economic stability of the country, as goods essentially required at a place may not be made available there, giving rise to a high price level, whereas on the other hand, the same commodities might have slumped in the producing centres for lack of movement. By and large, it is the rail transport that keeps the channels of trade open and provides the essential stabilising factor.

If the Railways are to play their role in stabilising the economy of the country, it is obvious that the resources of the Railways should be adequate to meet the peak requirements of traffic. In this context, the need for a correct assessment of the rolling stock requirements would require no emphasis. There is invariably considerable time lag between the placing of order for rolling stock and their procurement, either from abroad or from indigenous resources. This time lag, while often unavoidable, makes it necessary to anticipate as accurately as possible, the rolling stock requirements and to provide for them in the Rolling Stock Programme. Failure to make a correct appraisal of the requirements might give rise to shortage of rolling stock when they are most needed for carrying traffic.

An attempt has been made in this article to indicate how the rolling stock requirements are being assessed and programmed for on the Central Railway. The programming of rolling stock requirements on replacement account has not, however, been dealt with in this article. Rolling stock has to be condemned on the basis of their age or condition and then replacement is programmed in time and included in the Annual Rolling Stock Programmes.

PASSENGER STOCK

It is comparatively easy to work out correctly the additional passenger coach requirements. Passenger coaches are required for either strengthening the existing rakes or introducing additional trains on sections where considerable overcrowding exists.

It is necessary to work out the rake requirements of additional trains that are proposed to be introduced or strengthened. The number of rakes required for a service would depend on the turn-round of the rake. If the time taken by a rake for making a round trip is 5 days and the rake is available for working a train on the sixth day, then 5 rakes would be required for maintaining the service, as a rake will have to be provided for each day during the period the rake sent out on the first day, is not available. As an instance in point, a rake employed on the Bombay-Calcutta Mail Service (via. Nagpur) takes 5 days to complete its round trip and is available for the second trip on the 6th day. The number of rakes required for maintaining the service is 5.

Having determined the number of rakes, it is easy to assess the additional requirement of coaches. If it is merely proposed to strengthen the existing services with additional coaches, then the requirements are calculated by multiplying the number of coaches by which a service is proposed to be strengthened, with the number of rakes required for the service. As an instance in point, if the Bombay-Calcutta service is to be strengthened with two additional coaches, the number of additional coaches required would be, $2 \times 5 = 10$ coaches.

If, on the other hand, it is proposed to introduce a new service between Bombay and Calcutta, say with a 12 coach rake consisting of 2 TLRs, 2 Upper Class coaches and 8 Third Class coaches, then the additional requirements would work out to :—

TLRs	$2 \times 5 =$	10
Upper Class coaches	$2 \times 5 =$	10
Third Class coaches	$8 \times 5 =$	40
Total		60 coaches

This would represent the bare requirements of the service, and an allowance of 10% is usually made on the bare requirements, including 5% for repairs and

periodical overhaul and 5% spare for meeting mela and other requirements.

REQUIREMENTS OF GOODS STOCK

An assessment of the requirements of goods stock is not so simple, as a correct estimate of the additional traffic requirements is an essential pre-requisite. The methods adopted for calculation of the wagon requirements are also not by any means uniform and would seem to vary with the Railways.

General Service Wagons.—It is usual to base the wagon requirements on the additional traffic that will have to be carried, expressed in terms of the number of additional trains that will have to be run, and the sections over which they will have to be run. Let us assume that the additional wagon requirements have to be calculated for providing for two additional trains each way on a 100 mile section. The additional daily train miles arising out of running these additional trains would work out to $4 \times 100 = 400$ train miles. The approximate additional wagon miles are then calculated for the additional trains, on the basis of the average load of trains on the section, expressed in terms of the average number of wagons per train. If the average load of trains on the section is 40 wagons per train, then the additional wagon miles accruing out of the movement of the additional traffic would work out to $40 \times 400 = 16{,}000$ wagon miles per wagon day. The additional wagon requirements are derived from the wagon miles, by dividing the wagon miles, by the average wagon miles per wagon day for the section or the division.

Let us assume that the average wagon miles per wagon day of the division on which the additional traffic movement would take place is 60. The additional wagon requirements would work out to :—

$$\frac{16000}{60} = 266.6 \text{ or } 267 \text{ wagons.}$$

Sometimes it becomes necessary to calculate the additional wagon requirements, solely on the basis of an estimate of an increase of ton miles. Let us assume that an increase in the net ton miles to the extent of 48,000 tons is estimated. The equivalent of loaded wagon miles for effecting the movement of 48,000 ton miles is then calculated by taking into consideration the average wagon load on the run over the section where the additional movement has to be catered for. Let us assume that the average wagon load on the section is 16 tons. The loaded wagon miles would work out to :—

$$\frac{48000}{16} = 3{,}000 \text{ wagon miles.}$$

Traffic is not always balanced, and a certain amount of empty haulage is essential for effecting movement of traffic. No estimate of additional wagon requirements would be complete if this empty haulage is not taken note of. In order to provide for this, it is the usual practice to take into consideration the percentage of empty to total wagon miles on the section.

Let us assume that the percentage of empty wagon miles to total wagon miles on the section is 40. Then the equivalent of 3000 loaded wagon miles would be = $\frac{3000 \times 40}{60} = 2000$ empty wagon miles.

The total wagon miles would be the sum total of the loaded and empty wagons miles = 3000 plus 2000 = 5000.

From this, it is easy to derive the additional wagon requirements, taking into consideration the average wagon miles per wagon day.

Let us now examine how the requirements of wagons for effecting the current clearance of originating traffic, are estimated. The expeditious and current clearance of traffic depends on prompt and adequate supply of wagons, and it is usual to assess the additional wagon requirements for clearance of originating traffic, on the basis of the average daily outstanding registrations during the statistical month. Let us assume that the daily average outstandings, during the representative month of say 30 days, chosen for investigation is 450. This traffic could have been cleared if the daily average loading had been stepped up by $\frac{450}{30} = 15$ wagons. Let us assume that the turn round of wagons on the section or division where the increased loading has to be catered for is 6 days. Additional wagons necessary for effecting an increase in the daily average loading by 15 wagons would work out to $15 \times 6 = 90$ wagons.

Having determined the number of wagons required for meeting the demands of originating traffic, the nature of wagons required, i. e. opens, covereds or special types like BFRs or tank wagons, is decided on the basis of the nature of traffic offering for movement.

After the bare requirements have been worked out, suitable allowances have to be made for periodical overhaul and repairs. It is the usual practice to provide 3% of the bare requirements for this purpose.

Brakevans.—It is important to make a correct assessment of brakevan requirements and to programme for them. Failure to provide for the requirements of brakevans while making substantial additions to the fleet of wogons, would bring about a shortage of brakevans and give rise to cancellation or putting back of trains for want of brakevans.

Two alternative methods are usually employed for assessing the requirements of brakevans.

One method is to programme the brakevan requirements directly on the additional wagon requirements. Every additional train requires a brakevan and if the average load of trains (in terms of the number of wagons) on the division or the Railway is 40 wagons, then one brakevan is required for every 40 additional wagons programmed for. If the additional wagon requirements are say, 1600, the additional brakevan requirements would work out to $\frac{1600}{40} = 40$.

An alternative method is more generally employed for estimating the brakevan requirements. Here, the requirements are based on the round turns on the various sections, and suitable allowances are also made for the detentions in the terminal yards, while the brake vans are being connected from the incoming to the outgoing train. The turn round would depend on the scheduled run of trains on the section, while the detentions in the terminal yards would depend on a variety of local factors, including the layout of the yard. These will have to be carefully assessed while estimating the requirements of brakevans.

Necessary allowances have to be made for repairs and periodical overhaul after the bare requirements have been worked out. It is usual to provide 3% of the bare requirements for this purpose.

POWER REQUIREMENTS

Passenger Power

Two alternative methods are employed for calculating the passenger power requirements.

One method is to work out the daily additional passenger engine miles that will be incurred on the proposed additional services and to divide this by the average passenger engine miles per passenger engine day on the Division. This would give the additional passenger engine requirements. This method is not altogether reliable particularly when it is proposed to introduce additional trains on short sections or branch lines. Under these circumstances, the utilisation of passenger engines on the additional services would normally be poor and if the requirements are worked out on the basis of the locomotive user statistics for the entire railway or division, the assessment would be on the low side.

The alternative method is to work out the requirements on the basis of the links actually prepared for the passenger services, including the additional trains, proposed to be introduced. While framing the links, adequate allowance is made for the time required for servicing at the home and outstation sheds.

After the bare requirements have been worked out, a suitable allowance is made for repairs and spare. This is usually 17.6% of the bare requirements.

Requirements of goods Power

An assessment of goods power requirements calls for considerable planning. For one thing, it is not possible to work out the firm requirements of power for catering to the additional goods traffic on the same basis as for passenger trains where the additional trains and their lead are both definite and fixed. A correct appraisal of the power requirements for goods trains necessarily envisages a meticulous calculation of the additional goods traffic that will have to be catered for. In making an assessment of additional goods traffic that will materialise, it is the usual practice to take into account the throughput that will have to be catered for on each section. This would depend on the junction quotas for the various sections, the increase in the originating traffic anticipated on the section and the flow of empties that should be necessary in the light of the interchange quotas subsisting with the contiguous Railways or the Divisions. After making a correct assessment of the throughput, the number of goods trains that will have to be run for effecting this throughput is calculated, by taking into consideration the average load of trains on the section.

Let us assume that the throughput to be secured on a section is 800 wagons and the average load of trains on the section is 50 wagons per train. The number of trains that will have to be run to achieve this throughput would work out to :—

$$\frac{800}{50} = 16 \text{ trains.}$$

Having calculated the number of trains for which power has to be provided, it is usual to follow one of the two methods for assessing the power requirements.

The train miles are calculated for the number of trains to be run. If the length of the section is 100 miles, the daily average train miles would work out to $16 \times 100 = 1600$ miles. The power required for producing these train miles is calculated on the basis of the locomotive user statistics, the engine miles per engine day in use. The best results achieved in the locomotive user statistics are usually employed in assessing the power requirements.

Let us assume that the best results achieved on the division where the movement has to be catered for is 125 engine miles per engine day. The power requirements would work out to :—

$$\frac{\text{Train Miles}}{\text{Engine Miles per engine day in use}} = \frac{1600}{125} = 12.8 \text{ or } 13 \text{ engines.}$$

This method of calculation of power requirements is by no means accurate as the figures are based on the engine miles per day per engine in use, for the entire division or a Railway. This figure is not a reliable index as far as individual sections are concerned.

A more accurate method would be to base the power requirements on the round turn of power on the various sections where the movement has to be catered for. The round turn of power would consist of the following factors :—

(i) Time taken by an engine from the shed (Bhar Line) departure to the yard departure. This time would depend on the relative location of the shed and the yard and other local factors, including the need, if any, to cross one or more running lines and consequent detentions for passage.

(ii) Time taken on the road from the starting yard to the terminal yard. This time represents the time taken on the road. Two methods are usually adopted for calculating the time taken on the road. One is to divide the length of the section by the average speed of trains on the section. The other method is to plot out the paths of goods trains on the master chart and to calculate the average time on the road on the basis of the charted run. Either of these two methods can be adopted with advantage.

(iii) Time taken at the out-station shed, including the time taken for the passage of the engine between the yard and the shed, and the time required for servicing. This would again depend on the relative position of the shed and the yard, the lead separating them, and the need to cross the running lines where the layout provides for this. The facilities available at the outstation shed for servicing and running repairs, would determine the out-station detention to power.

(iv) Time taken on the road for the return trip.

(v) Time taken by the engine from arrival in the yard to arrival in the shed.

The sum total of the detentions to power under each of these items constitutes the turn round of power. This is distinct from the *shed turn round* of power, which is the time taken at the *home* station shed between two successive trips of the engine. The shed turn round does not enter into the calculations of power requirements.

Once the turn round of power has been estimated, it is easy to work out the power requirements. Let us assume that the round turn of power on the section where 16 trains have to be catered for is 36 hours, the break-up of this turn round being as follows :—

(i)	Time taken from bhar line departure to yard departure ..	2 hours
(ii)	Time spent on the road on the outward trip ..	15 hours
(iii)	Outstation detention ..	5 hours
(iv)	Time spent on the road on the return trip ..	13 hours
(v)	Time taken from yard arrival to shed arrival ..	1 hour
		36 hours

Power requirements for working 16 trains each way on this section would be $= \frac{16 \times 36}{24} = 24$ engines.

This does not, however, straightaway give the power requirements, as what is made available is only

the working requirements of power. In other words, this would represent the number of engines required to be in service. This has to be correlated to the engines that would be required for giving this service, and this is done with the help of a statistical result known as the engine hours per engine day in use. This figure reflects the useful time spent by a locomotive in working outside the shed, the remaining hours of the day being spent on unproductive though essential duties, such as, servicing, periodical washouts, attention to the booked repairs, etc.

Let us assume that the engine hours per engine day for the division under examination are 18. Each engine provides useful service for only 18 hours in a day and for providing 24 engines in service at any time, the power requirements would work out to $\frac{24 \times 24}{18} = 32$. The bare requirements have been worked out to 32 engines. It is usual to provide 17.6% of the bare requirements for shop repairs, periodical overhaul, spares, etc.

INFERIOR SERVICES

The basis adopted for working out the requirements of power for the train services has been indicated so far. Secondary or inferior services form an essential part of Railway operation. The inferior service consists of yard shunting, banking on graded sections and service spent on departmental trains, such as, ballast or material. No assessment of the power requirements will be complete unless adequate provision is made for inferior service, as failure to do so, would bring about the employment of power intended for main line service on inferior services. In working out the requirements for inferior services, it is usual to adopt the following basis :—

Banking Engines:—The requirements of banking engines are worked out on the basis of the number of trips that each banker can perform, based on the turn round. The turn round would again depend on the distance for which banking is necessary. The number of trains that have to be banked is carefully assessed and the strength of bankers necessary for banking these trains is worked out on the basis of the number of trains that each banker can cater for.

Shunting Engines :—As regards yard shunting, the requirements are actually worked out on the basis of the number of engines employed in the various yards and important stations. Relief is suitably provided where necessary. It is, for instance, the usual practice to allocate one engine solely for relief in major yards where a large number of engines are employed and to stagger the servicing of the shunting engines suitably so that the relief engine can relieve one by one the regular shunting engines requiring servicing. Relief of staff also takes place when the shunting engine is being serviced.

As regards shunting at roadside stations by the train engine, this is usually reflected in the turn round and is, therefore, automatically provided for. The time taken on the road by a section or work train is often twice as much as the time taken on the road by a through train, in view of the additional time taken for shunting at roadside stations. In order to provide for this, each section train is equalised to two through trains in estimating the turn round for power.

Departmental Services :—It is also necessary to make a correct assessment of the engines required for departmental service including the requirements of ballast and material trains. The practice on the Central Railway is to allot inferior power for ballast trains on the basis of one power for each Assistant Engineer and one power for the Divisional Engineer. Where large scale relaying is undertaken, additional power is allotted to facilitate relaying. The power requirements for departmental services cannot be worked out with great accuracy, as the requirements fluctuate with the progress of relaying during the working season, while during the non-working season, the power requirements are less. However, the spare power allotment usually included in the locomotive programme, comes in handy for meeting the spurt of departmental requirements during the working season.

Before concluding, it may be stressed that in view of the large capital outlay involved on the rolling stock, every endeavour should be made to avoid overcapitalisation and this again spotlights the need for an accurate assessment of rolling stock requirements. No amount of care spent on this can be regarded as too great.

KAMANI GROUP OF INDUSTRIES

By An Engineering Correspondent

INTRODUCTION

FACTORY premises of the *Kamani Group of Industries* comprising of *Kamani Metals & Alloys Ltd., Kamani Engineering Corporation Ltd* and *Kamani Metallic Oxides Private Ltd.* wore a festive appearance on the morning of the 4th October, 1959. For, that morning the Prime Minister was visiting these factories for laying the foundation stone of the "KAMANI COMMUNITY CENTRE" meant for recreation, education and welfare of the community which comprises of many industrial workers. He was also to receive a handsome purse of Rs. 1,00,001/- made up of spontaneous contribution from the workers, staff and the management. A silver replica of Transmission Line Tower was also to be presented to the Prime Minister in commemoration of the KAMANI ENGINEERING CORPN. LTD. having reached the production of 51,000 tons of Transmission Line Towers.

Hon'ble Shri Y. B. Chavan, Chief Minister of Bombay State presided over the function attended by over 4,000 people including the Ministers, Mayor, Judges, Members of the Consular Corps, Rotarians, Industrialists, Businessmen, Engineers, prominent citizens of Bombay and the Factory workers of KAMANIS.

The Prime Minister who arrived at 9.41 A. M. with Shri Chavan, was taken round all the three factories in a special jeep and the various operations were explained to him by the Managing Director Shri P. R. Kamani.

Visit of Prime Minister, Shri Jawaharlal Nehru, to the factories of Kamani Group of Industries.

Shri Nehru showed special interest in the Non-ferrous Exhibition, the Galvanising Plant and the novel 'Tractamount' Road Roller deriving its motive power from a tractor mounted on it. He also was pleased to learn about the export promotion efforts made by KAMANIS.

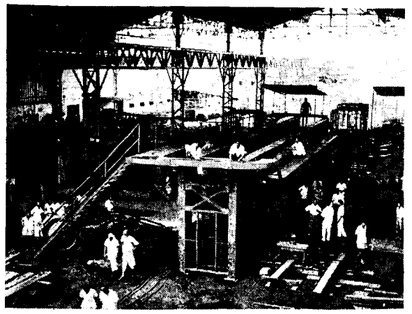
Shri R. H. Kamani, Chairman of the Board of Directors of the KAMANI GROUP of Industries welcoming the Prime Minister recalled Shri Jawaharlal Nehru's visit to KAMANI'S Jaipur Factory in October 1945 when he said that that factory was a further proof of what could be done in India without outside help provided there were opportunities for work and progress. Shri Kamani said that this had been a source of inspiration to them ever since.

He briefly reviewed the progress of these factories from a humble but pioneering effort in 1939 in Non-ferrous Metals. Subsequently various production lines were added. During the war, difficult, specialised items like Arsenical Copper Rods, Cupro Nickel Strips, White Metals, Naval Brass, Leaded Brass, Muntz Metal etc. were manufactured for defence Organisations. Later on, Copper and Cadmium Copper Conductors and Rods, Brass Rods, Sheets, Strips in coils, Transmission Line Towers, House Service Meters, Zinc Oxide and Tractamount Road Rollers were added.

They have secured very recently technical collaboration with Messrs. SIEMENS the world renowned Electrical Engineering firm of W. Germany for a new type of House Service Meters.

They are the pioneers in the manufacture of (i) Arsenical Copper Rods (ii) Transmission Line Towers (iii) Cadmium Copper Rods and conductors (iv) House Service Meters (v) Tractamount Road Rollers.

Shri Kamani said that this was the first and only Factory having facilities for Designing, Fabricating,



Testing, Galvanising and erecting Transmission Line Towers all by cent percent Indian Technicians.

They had been able to secure technical co-operation from Japan, Germany, U.K., New Zealand and Belgium for House Service Meters, Tractamount Road Rollers, Pigments and handling Railway Electrification Projects respectively.

These factories have a most up-to-date Quality Control Department. They have always been of service to the various power, Irrigation and Industrial Projects under the FIVE YEAR PLANS.

Shri KAMANI referred to the Community Centre donated by the Management for recreation, education and welfare of the worker community.

He announced the presentation of the purse of Rs. 1,00,001/- as a humble tribute to the Prime Minister's efforts at building a healthy, prosperous and a progressive India.

This occasion also marked the achievement of production of 51,000 tons of Transmission Line towers.

Shri Chavan, Chief Minister of Bombay before formally requesting the Prime Minister to address the gathering made a very brief and a concise speech. He complimented KAMANIS by saying that there was hardly any Power Project in India with which KAMANIS were not associated. He also made a special reference to the cordial Management/Labour Relations maintained in Kamani Factories.

Shri Jawaharlal Nehru complimented KAMANIS for their contribution to the Industrial Progress of the country under the Five Year Plans and added that the progress of a country could be judged from the quantum of electrical products produced by it. It was the man operating the machine who was more important and he was happy that the industrialists were realising that and were providing amenities to him. He was pleased to note that cordial relations existed between the Management and the Labour.

The cheque for Rs. 1,00,001/- was presented by the oldest employee of the KAMANI GROUP while the Silver Replica of Transmission Line Tower was presented by the oldest employee of the Kamani Engineering Corporation Ltd.

ACTIVITIES OF THE COMPANIES OF KAMANI GROUP OF INDUSTRIES

Jaipur Metals & Electricals Ltd. With operations starting in 1942, this Company was incorporated as a Public Limited Company in 1943, with the following activities.

Activities:—Refining, Alloying and casting of Non-ferrous Metals, casting, rolling and drawing of Rods, Bars and Sections.

Special Products:—Arsenical Copper Rods, Leaded Brass, Muntz Metal, Phosphor Bronze, White Metal, Tin Solder etc. for Defence and Railway Requirements. It was renamed as Jaipur Metals & Electricals Ltd. in 1952 and is now engaged in the manufacture of Arsenical Copper Rods, Copper Bus Bars and Conductors, Cadmium Copper Rods and Conductors, Brass Rods and Strips and House Service Electric Meters. It has a rated capacity of 250 tons for Conductors, 750 tons for alloys and about 9,000/10,000 number of Meters per month.

These activities are resulting into saving of Foreign Exchange to the tune of Rs. one crore approximately.

Kamani Metals & Alloys Ltd.—It commenced operations in 1943 and was incorporated as a Public Limited Company in 1944. At that time import of Non-ferrous Sheets, Strips and other Semis was to the tune of 35,000 tons. At present with the Factory's capacity 10,000 tons per annum, this import figure has been reduced to about 800 tons. They are manufacturing Brass and Copper Sheets, Strips and coils as also those of Phosphor Bronze and Zinc according to world accepted standards, for industrial use. It has resulted into a saving of approximately seven crores of rupees per year, the share of this factory being in the vicinity of Rs. 2½ crores.

It has also explored the export markets and is catering to the requirements of several countries including Ceylon, China, Iran, Iraq etc. having already exported products worth about 12 lakh of rupees. At home it is catering to the needs of 32 industries in the Private and about 13 Industrial and Power Projects in the Public Sector.

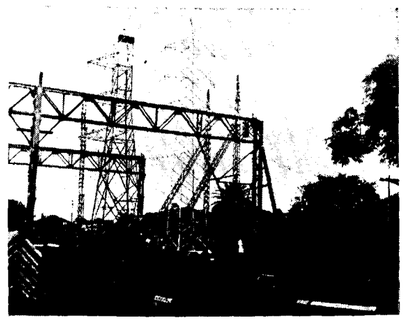
This factory can be easily converted for defence production. It has well advanced plans for the manufacture of Non-ferrous Tubes, Pipes, Rods and Sections by extrusion method.

KAMANI METALLIC OXIDES PRIVATE LTD.

Established in 1952, this factory in technical collaboration with a New Zealand Firm of repute, Messrs. Pacific Chemical and Mineral Development Co. Ltd. is producing pigments such as Zinc Oxide, Red Lead, Litharge etc., used by Paint, Plastic, Rubber, Glass, Ceramics, Rayon and Pharmaceutical Industries.

KAMANI ENGINEERING CORPN. Ltd.

Incorporated in 1945 as a Public Limited Company, this Company was mainly engaged in fabricating



Aluminium, Brass, Copper and Stainless Steel Utensils. Towards the end of 1950, the Tower Factory was decided to be put up and by middle of 1954 over 17,000 tons Transmission Line Towers were fabricated, Galvanised and supplied. Today the total production has reached the mark of 51,000 tons ranging from 22 KV to 220 KV—all designed, tested, fabricated and Galvanised under the same roof. Facilities also exist for erection jobs for these towers as well as for other Structures, Communication and Aerial Masts. Important among the power and other Projects served by these Towers are Bhakra Nangal, Damodar Valley, Sarda Hydel, Machkund, Tungabhadra, Jog Karnatak, Duduma, Rayaghuda, Rihand, Chambal, North & South Gujerat Grid, Tata Hydro Electric, Neria Mangalam Korba Bhilai and Koyna.

In order to cater for the requirements of the various Power, Irrigation and Industrial and Railway Projects, this Company has a separate section to look after the import and supply of Heavy Electrical, Hydraulic and Industrial Machineries and Plants manufactured by world renowned Engineering Firms of United Kingdom, Italy, W. Germany, Austria, Yugoslavia, Japan etc. whom the Company represent in India.

The cost of the shell manufactured now at the Integral Coach Factory including overheads is about Rs. 85,000 while cost of a similar shell in design and equipment ex-works from Switzerland is about Rs. 1.07 lakhs, and, according to the Swiss experts, the quality of the indigenous coach is in no way inferior to that of the imported one.

An individual shell at the Integral Coach Factory consists of 1,200 components. For the manufacture of some of these Rs. 18,000 worth of raw materials and fittings are being imported. By 1960-61 when steel plates and sheets will be available within the country, the coach will be 95 per cent indigenous.

A lightweight coach weighs 35 tons as against 42 tons of the conventional type. This is a factor which minimises overcrowding as more passengers can be hauled with the same power.

Recent Developments in Railway Telecommunications

By P. Prabhakar
Lecturer/Telecommunications, The Indian Railways School of Signal Engineering & Telecommunications, Secunderabad.

IT was in 1837 that Cooke & Wheatstone entered into an agreement with the Great Western Railway in England to operate an experimental telegraph circuit between Paddington and Slough—a distance of about 18 miles. The inauguration of this first telegraph circuit in railways caused a local sensation due to Tawell, a murderer, who travelled by the same train to escape from Paddington, being promptly arrested by sending a telegram to Slough. Even though it was an elementary mode of electrical communication, it was a historic moment but Tawell stole the headlines. After nearly 2 decades, the French Railways provided headline news by remotely controlling an electric locomotive, which did a regular run between Paris and Lemans at a speed of 75 M. P. H. The remote control of a passenger train has but a limited practical significance but, on the other hand, it has set up a number of unsolved problems. Nevertheless, it is an index of the progress made in the field of telecommunications.

Of all the major organisations, railways have been the most reluctant to adopt electronic methods for the main reason that they had to rely initially for safety equipments on mechanical and electro-mechanical aids. These were later developed to a fair degree of perfection so that there had been no paramount necessity to switch over to the advanced techniques offered by electronics. The French Railways who have made considerable headway in the application of modern techniques, readily adopted electronic methods when they were faced with the problem of rehabilitation of their railways after the Second World War. And in advanced countries with their rapidly developing economies, like U. S. A. and West Germany, a faster modernisation programme of their communication networks is evident.

Among the recent discoveries, the transistor is the most outstanding invention, which in a decade has surpassed its counterpart, the vacuum tube, in its applications. The characteristic property of the transistor is the absence of a heating element, unlimited life and the great reduction in size. It can be used as an oscillator, amplifier or rectifier like an ordinary electronic valve. Transistor oscillators have been adopted for generating high voltage high frequency currents from train lighting battery to light fluorescent tubes which provide better illumination in carriages than the ordinary electric bulbs. Another significant application of great importance is in signalling circuits for safety. Automatic signalling has been accepted as the safest system for the control of trains, since the trains themselves control the signals protecting blocks. Basically the principle consists of using the rails as conductors for feeding current for the operation of the relays, which control the signals. Originally DC current was used for tracks with steam locomotives. The introduction of DC traction led to the adoption of AC current of commercial frequency for this purpose, but with the changeover to AC electrification, AC currents of commercial frequency can no longer be used, since the rails are used as return conductors for the traction current. This problem has been overcome by using currents of audio frequencies generated by transistor oscillators, so that the signalling relays are entirely independent of the effects of the traction currents. The transistor in view of its unlimited life and compact size, is finding a wide application for the generation of high frequencies in the audio range.

Transistors have also been successfully utilised in ordinary telephone units for the amplification of speech and also in electronic exchanges, utilising its property as a switching device. The conventional electro-mechanical switches have limited capacity and if the traffic is dense, the wear and tear is also greater. Transistor switches are rapid in action and also have the added advantage of compact size and higher sensitivity, compared to the mechanical relays. They can hence be made to operate over longer lengths with greater leakage loss at higher pulse rates, i. e. circuits over which mechanical relays cannot operate. Long distance dialling thus becomes a practical possibility. In foreign railways, direct dialling over long trunk lines has been accomplished using transistor devices. A large number of transistors are required for an electronic exchange, which would mean an equally large number of circuit elements. What is hence gained by the compactness of the transistor would be lost if the other components are not small. This problem has in turn developed the technique of miniaturisation by which the condenser, resistor,

Television Monitor "Grabbing" Wagon Numbers.

transformer etc., have also been made very small due to the very low current requirements of the transistor The conventional wiring system is being replaced by printed cards, where the wires are substituted by sprayed copper lines. This process eliminates the defects due to soldering and wiring mistakes.

The entire unit is a compact assemblage of "printed cards" mounted with transistors. Maintenance and repair is hence made easy.

Transistor rectifiers provide an easy method of stepping up to high voltages, and the absence of any moving part renders this device quite rugged. Mobile wireless equipments in locomotives which till now depended on vibrators or rotating machinery for stepping up the low voltage DC from battery to the high voltages necessary for operating the equipment are now switching over to transistorised power packs.

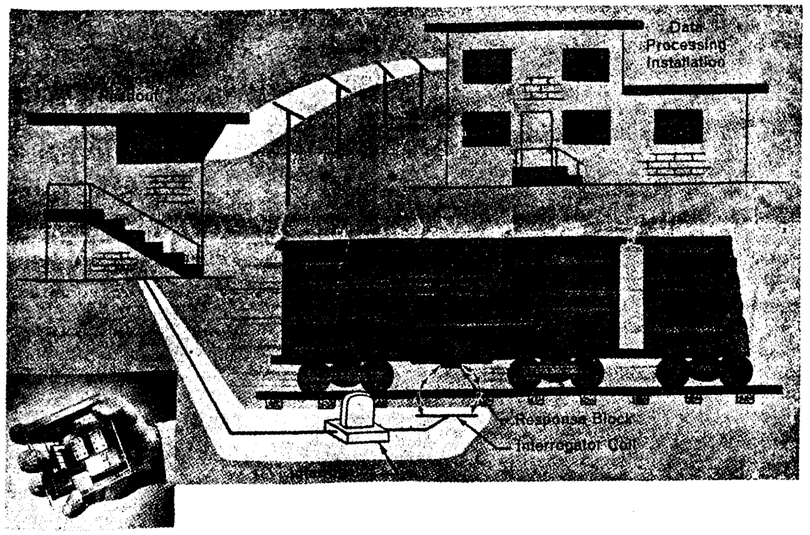
But the most interesting application is in the computer devices. The computer technique is not in itself new, and formerly data processing machines were being manufactured with electronic valves. The computer programme machines are electronic aids to solve mathematical problems. Programming is hence essentially translation of the data in computer language so that the machine performs the desired calculations. But these "electronic brains" as they were called, pose many designing problems, the main factor being the huge size due to multiplicity of the valves and the special cooling arrangements to be provided to radiate the heat from these valves. The absence of heating element and the compact size of the transistor have been of immense advantage to the designers of the computers. One of the recent applications of the computer in the railway operations is for the prediction of the operating performance of trains.

In the train control system the controller moves the trains according to a preset programme plotted in a master graphical chart. These are basically time distance curves for the various trains in the section. The computer has not only been commissioned for obtaining these time-distance graphs for trains in a particular section but also for finding out the economical arrangement to move additional trains for hypothetical changes in the signalling system, track layout, motive power, time scheduling etc. This facilitates solution of the problems relating to the line capacity, where right decisions can be taken without the risk of committance to costlier systems. It is claimed that a computer can perform 60,000 operations per minute without error. Inspite of the versatility of the transistor, it should be said that there are certain handicaps in its rapid adoption, the main factor being the cost. But it is to be remembered that in 1953, the cost of transistor was Rs. 105 which has dropped to Rs. 7.50 in 1958. The corresponding output has increased from 1.3 millions in 1953 to 13 millions in 1958 and if the price variation is an index of the output and the improvement in manufacturing technique, the prices are bound to come down even lower than that of the electronic

valve in 1965 with its proposed target of 300 million.

Printing telegraph systems are not finding wide acceptance due to the critical requirements of circuitry and skilled personnel for maintenance as well as operation. This has led to a reappraisal of the use of the facsimile equipment, which originally was used mainly for radio photo service. The application of facsimile in the general field of communication is well-known, especially in the case of transmission of hand written or typed information, filled-in forms, way bills and tabulated statements and stencilled drawings. A beginning has been made by utilising the facsimile equipment in place of pneumatic tubes in yards since this equipment saves the expenditure on tubes and compressor equipments. Cut cards are despatched to the hump tower by facsimile. Wagon reports have been successfully transmitted by wireless facsimile between marshalling yards. One of the reasons for the restricted use of facsimile equipment has been the utilisation of photo sensitive paper, which is not only costly but also has limited shelf life. Recently an electro-mechanical system of printing has been developed, which permits the use of ordinary paper in place of the photo sensitive paper.

With the increasing traffic, the available physical circuits have been changed over to carrier circuits to permit simultaneous transmission of a number of messages both ways. But the problem is not merely to have additional capacity, but also to provide a reliable means of communication without any interruptions. The carrier channels provide additional capacity but all the channels fail in the event of interruption in the physical line. Hence many foreign railways have been switching over to wireless systems operating in the microwave band between 900 and 6000 mega-cycles. In view of the very high frequency, the band width of the channel is greater so that it has been possible to introduce as many as 240 circuits with a single frequency. Microwaves, exhibit the properties of light as reflection and refraction and permit focussing into narrow beams over long distances by means of highly reflective parabolic antennas. It is hence described as a virtual pole line in the sky. Its frequencies are free from fading and do not suffer from the atmospheric disturbances, as in the case of high frequency wireless waves. But like light, the range is limited by line of sight considerations. By suitable surveys of the terrain and installation of repeaters at suitable locations, the spans of the microwave systems have been extended over hundreds of miles. The landline which now covers vast distances spanning the entire country is costlier to maintain and staff have also to be distributed over



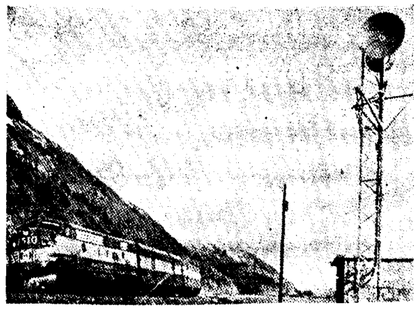
Wagon identification equipment. Response block is shown in inset.

a wide area. Interruptions due to storm cannot be avoided and there is always inevitable delay in the restoration of failures. In the case of microwave systems, the maintenance staff are located only at the terminal and repeater installations so that maintenance is easier and fault rectification quicker. The provision of repeaters has been a discouraging factor in the wider use of microwave systems. Recently a new technique has been developed for the transmission of microwaves, by which the tropospheric layer of atmosphere, which is at a height of 7 miles from earth is used for reflecting these high frequency waves. Ranges upto 100 miles have been obtained by this method and these " Micro-Scatter systems " have now been adopted in a few places.

Wired television is widely used in all modern marshalling yards. A television camera is mounted near the main line of the reception yard so that the wagon numbers of incoming trains are " grabbed " before the train stops in the yard. It is also used for the remote control of level crossing gates from cabins, to enable a full view of the traffic at the gates being obtained by the cabin operator. But an important application that will have to be examined in future especially in India, will be its utility in yards, which are now equipped with Route Relay Interlocking systems. Even though the operation is centralised in a single cabin with a variety of controls to cover the large yard, the operator is unable to find out the details of the trains occupying a particular track, especially when there is a slight change in the timings of the train, and the regular time table is upset. Television cameras mounted at strategic locations may provide an answer to this problem.

The research on semi-conductors, has resulted in equally far reaching progress in the field of metallurgy, so that it is now possible to manufacture very small permanent magnets with strong magnetic fields. This is of special importance to railways, for automatic train control devices utilise the magnetic fluxes from a permanent magnet and an electro-magnet coupled to the signal to enable the brakes of the locomotive to be automatically applied when the driver inadvertently passes a signal in its " Danger " aspect. A method has also been devised to identify individual wagons by a coded number, automatically, and the information is relayed directly to the recording apparatus capable of being fed into a computer. The system consists of two main units, " Wayside Interrogator " and the " Response Block " of very small dimensions, which is installed in the train. The interrogator transmits a signal to the response block in the moving wagon or the locomotive, which returns an identifying signal back to the Interrogator unit, which is relayed to a recording device or Computer for processing. This has been employed to locate engines in big yards and also to identify trains entering the station.

An idea of the variety of communication equipments will be obtained if the communication facilities in a modern marshalling yard are considered. Walkie-



A Typical Microwave installation.

Talkie sets for the ground crew, special VHF equipment for the locomotive staff, fixed VHF equipment for the Yard Master, television camera and tape recorders for the number taker, a network of automatic telephones for the yard staff, facsimile equipments for the hump operator and retarder operators, talk back and paging speakers for Yard Master and outdoor staff, comprise the list of the minimum equipments. The hump operator is also provided with controls for the automatic operation of retarders. For automatic working, the idiosyncrasies of the wagons have to be taken into account so that the system basically depends upon two principal elements, the control equipment and the prediction equipment. The wagon is made to pass through a test section, ahead of the last point of retardation, where the following information is recorded.

(1) Entering velocity

(2) Exit velocity

(3) Curve factor

(4) Weight

(5) Rolling resistance

The velocity is determined by a Radar transmitter unit utilising the 'Doppler effect' principle. The data is then fed into 2 computer units, one known as " Rolling Resistance Computer " and another the " Release Speed Computer ". It is claimed that the retarders are operated with a high degree of precision.

The loudspeakers are not for the marshalling yard alone, but are also used in railway stations where the arrivals and departures of trains have to be broadcast to the passengers. Unfortunately the architectural details of stations do not conform to accepted principles of accoustical engineering, so that the tonal quality and the articulation efficiency is often below par. A new technique has hence been developed in U. S. A. and it is reported that the results have been encouraging. The loudspeakers are housed in wooden colums or pillars about 9 feet high with an open slot in the centre for the diffusion of sound in a narrow vertical beam. The distribution is more uniform, sound less jarring and the clarity better due to the improved fibelity.

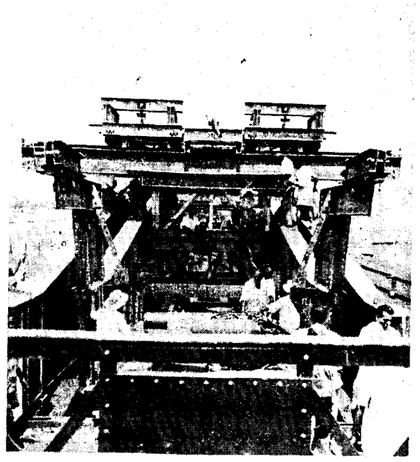
This review will not be complete if the significance of these developments to Indian Railways is not considered. A fresh reappraisal of the telecommunication facilities has to be made in the light of the dual programme of AC electrification and dieselisation. This would mean application of new techniques in signalling and telecommunications. Automatic signalling in AC electrified area cannot be conceived without electronic track circuits. VHF communication between engine and brake van will be necessary to exploit, in full, the haulage capacity of diesel electric locomotives. Traffic train control telephone circuits have to be made not only efficient but also free from breakdowns if section capacity is to be fully utilised. There is again the urgent need for additional communication circuits. Even though the initial outlay is slightly greater, microwave communication affords the best media, in view of its flexibility of accommodating channels from a minimum of 4 to a maximum of 240 based on " Building Block " principle, the additions being made by auxiliary equipments without major alterations to the original equipment.

AN INTERESTING REGIRDERING METHOD

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

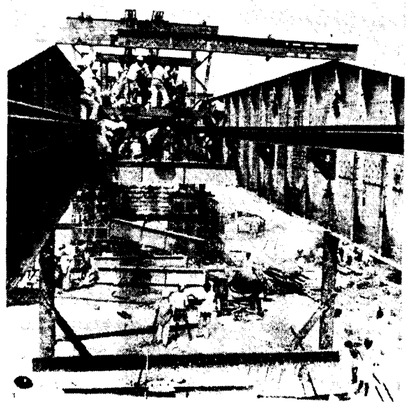
PREAMBLE

THE Gadag-Hotgi metre gauge branch line (172 miles) of the Hubli Division of the Southern Railway was originally constructed in 1879 and was extended up to Sholapur in 1927, the 10 mile extension running almost parallel to the Central Railway's broad gauge line. The track was originally laid with 41¼ lbs. rails but in view of the growing importance of the line and the need for increasing the loads and speeds of trains, it was relaid with 50 lbs. rails in the years '48 to '55. There are, however, four major bridges on the section comprising in all 35 spans of 150 feet and 20 spans of 100 feet the girders of which were found to be weak even for the present-day loads. The railway administration has, therefore, decided to regirder them to branch line standard to enable heavier types of locomotives to be run on the section.



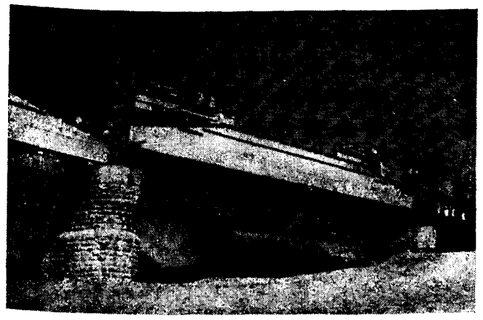
A view showing the top carriages from which pulley blocks are suspended and by which new girders are picked up and lowered.

The original girders were of wrought iron and of semi-through Warren type trusses and it was decided to replace them with plate girders of semi-through type. The new girders were fabricated and supplied by Duro Dakovic, a Yugoslavian firm, to whom the contract was awarded after calling for global tenders. The steel used, however, conforms to the Indian Railway Standard specifications.

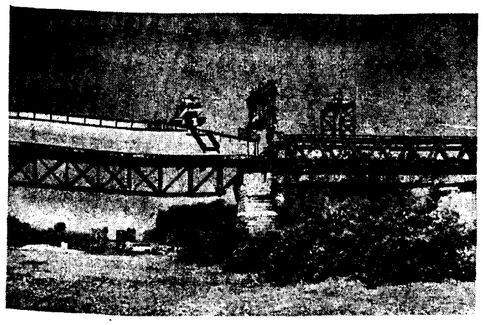


The new floor system being fitted in on new cross girders. The cross girders being lifted from the bed of the river.

The regirdering works were commenced from the Gadag end so that, after each bridge was finished, heavier engines might be allowed to run up to the station preceding the next bridge The first bridge to be regirdered was, therefore, the one across the Malaprabha river between Hole-Alur and Badami stations. This bridge comprises of 12 spans each 100 feet long. This article describes the simple but interesting method by which the regirdering of this bridge was done economically and with the minimum interruption to the running of trains.



New girders being lowered over a span.



New girders almost completely lowered.

THE METHOD

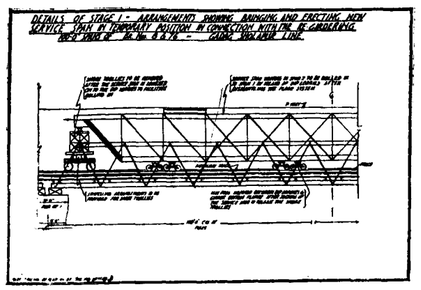
The bridge is a high one with the maximum height of the pier about 36 feet in the centre spans and about 20 feet in the two approach spans. The floods in the Malaprabha river are high during both the monsoons, especially during the southwest monsoon, and the river flows practically from bank to bank with the water about eight feet below the bed block level. Sudden floods during the dry season are also not uncommon.

In view of the above, it was considered inadvisable to reduce the waterway and hence the proposal to use semi-through type plate girders. The water in the river also made it impossible for cribs to be erected and the " slewing-in and slewing-out " method to be adopted for the regirdering.

The essential feature of the scheme adopted to overcome these difficulties was the use of a ' service span ' to carry the traffic while each old span was removed and the new span was inserted. The service span, which was an old underslung type span, with just the required strength, was utilised and this was aligned on the centre line of the bridge. This girder was 5 feet wide and 10 feet deep. The width also ideally suited the casting of the R. C. C. bed blocks on either side after removing the old girders and the existing bed stones. After the first span was completed, the service span was moved to the second span and the process was repeated.

CYCLE OF OPERATIONS

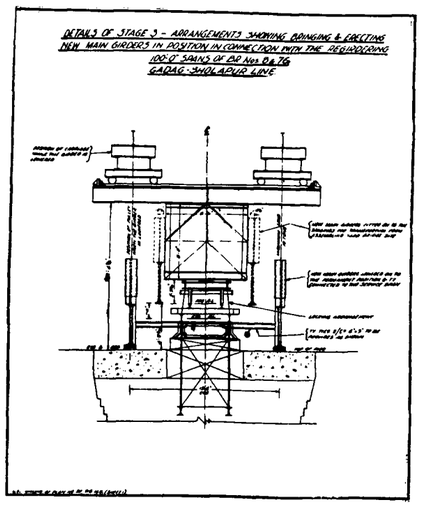
In the first stage, the service span was taken to the bridge on special trucks (see drawing) and kept on span No. 2. These trucks had swivelling arrangements so that the span transported by them could easily negotiate the points and crossings and the curvature of tracks in the assembly yard. An auxiliary track was fitted up on brackets on the bottom boom of the old girders in the first and second spans, and the special trucks which brought the service span were released by mounting the span on dip lorries placed on this auxiliary track. Another auxiliary track was fitted up at the top of the old girders and the floor system of span No. 1, consisting of cross girders and stringers was dismantled, picked up by means of pulley blocks hung from dip lorries running on the auxiliary track and removed to the yard. The service span loaded on dip lorries and waiting in span No. 2 was dragged over span No. 1 by means of a winch and the dip lorries were released by lifting the service span from overhead fixed gantries, erected one on the abutment and the other on pier No. 1. It was then lowered on to wooden packings kept over the pier after dismantling 3 feet of masonry.



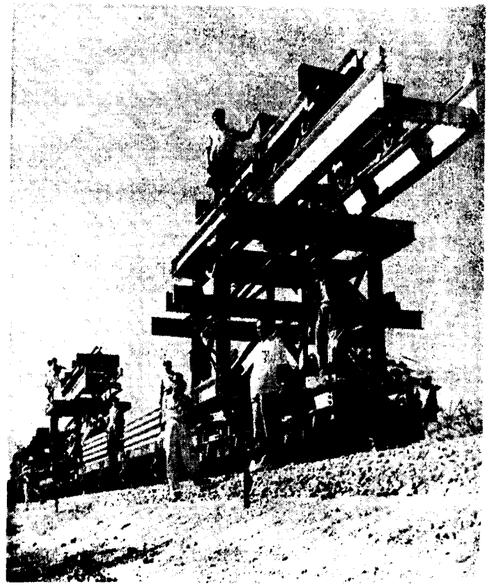
The second stage consisted of the removal of the old girders which were also picked up from the pulley blocks from the same gantries and these girders were then traversed inwards to clear the moving dimensions required, hung on to a special truck and removed to the yard.

For the traversing of the girders inwards, the pulley blocks, which were hung from the gantries, were suspended from beams mounted on rollers and by pulling inwards the beams with small pulley blocks fixed at the centre of the gantry beam, the traversing was effected.

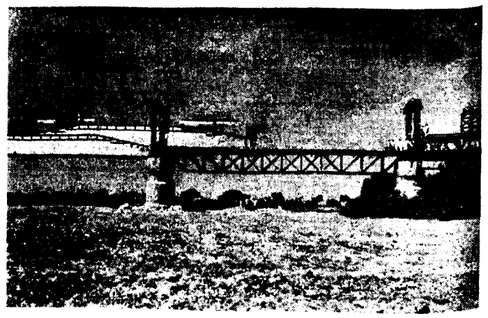
Once the old girders were removed, space was available for removing the old bed stones and casting new R. C. C. bed blocks and when the bed blocks were cured, the next stage of operation of bringing the new girders was taken up. This formed the third stage of the operation.



This stage consisted of taking the new main girders without the floor system attached to the same truck to the new bridge and lowering and traversing them outwards into their correct positions. On the special trucks carrying the girder, beams were fixed on the top and on each, two small carriages were mounted on either side worked by a central gear which could push the carriages outwards or inwards. When the girders were taken to the bridge, they were suspended from pulley blocks hung from the



Special trucks used for transporting released girders.

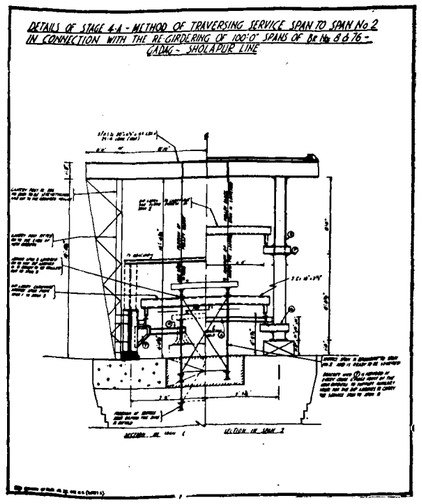


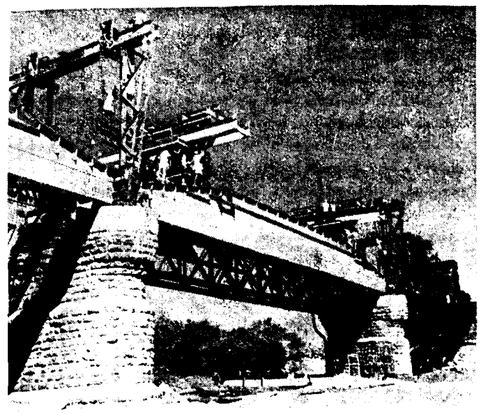
Transport of new girders on special trucks.

carriages and by working the gears, the girders were pushed apart to the correct centres and then finally lowered. The method of bringing in the new main girders is illustrated in the drawing reproduced in this article. The new main girders were then provided with temporary ties to keep them in position. The top beams which carried the carriages and from which

the girders were suspended by pulley blocks were also mounted on a central pin so that these could also be swivelled round while taking the girders to site and also to prevent their infringement against signal posts and other fixtures on the line. The truck itself consisted of two underframes supported on 4 axles each and was designed to take a load of 10 tons on each axle. The axles were mounted on bearings with springs similar to the bearings and springs in a W. D. type locomotive.

In the fourth stage, the service span was lifted up and hung from dip lorries on a 12'—6" gauge auxiliary track fixed to the new girders and extended on to the old girders in the second span. The method of traversing the service span is illustrated in the sketch. The floor system in the second span of the old girders was removed by a similar process as was done during the insertion of the service span in the first span. Thereafter, the service span was dragged on to the second span by means of a winch fixed on the third span. When the service span was in the second span, it was lifted by means of pulley blocks suspended from two small gantries fixed on to the old girders themselves at 1/3 points and then lowered in to its final position. While lowering of the service span was being done in the second span, the floor system of the new girders in span No. 1 was fitted up. For this, two sets of dip lorries fitted with winches on top running on the same auxiliary track were utilised and the cross





New girders in position.

One span completely re-girdered.

girders were lifted either from the ends or from the bed of the river, traversed to their positions and fitted up. The stringers were then brought completely assembled with track rails etc., picked up by the pulley blocks from the same dip lorries and lowered on to the cross girders. The bracings of the floor system etc., were fitted up later.

THE LAST STAGE

The fixed gantries were then shifted to the next span. For shifting these, special trucks with steel cribs mounted on dip lorries were used.

The same cycle of operations was then repeated for the other spans also till the last span was regirdered.

Finally, the service span was lowered on to the bed from the fixed gantries and the floor system was put in for the last span.

Actually, the work was carried out with two service spans, one working from the southern end and the other from the middle of the bridge, and the line blocks were so arranged that while work was in progress on one span, the R. C. C. bed blocks cast for another span were being cured. By this method, in the normal 14-day period for the regirdering of each span, two spans could be completed by utilising the same set of staff.

INTERESTING FEATURE

The most interesting feature of the whole process was the transport of the girders in special trucks, their lowering and spreading on the spans. The special truck designed for the purpose was found extremely serviceable.

The weight of the old girders was about 55 tons and eight 10-ton pulley blocks were used to lift the same. The weight of the new spans was about 40 tons and for these, only four 10-ton pulley blocks each hung on the carriage on top of the special trucks were used.

MINIMUM INTERRUPTION TO TRAFFIC

By adopting the method described above it was possible to complete the regirdering of the bridge with the minimum interruption to the running of trains on the section. There was practically no interruption to traffic normally but on the days on which the service spans were shifted and the floor system was put in, one pair of passenger trains was cancelled to secure a 9 hour interval. To avoid inconvenience to the travelling public, this was usually done on a Sunday.

With the completion of the regirdering work on the other three bridges on the section across the rivers Krishna, Don and Bhima, the Southern Railway hopes to run heavier types of locomotives on the Gadag-Sholapur Section and thus cater to the growing needs of towns like Bijapur and Bagalkot situated on this Branch line.

Specifications for Stationary Cells and Batteries (Lead-Acid)

The Indian Standards Institution had brought out in 1954 a tentative Specification for Stationary Accumulators (Lead-Acid Type)— IS : 541—1954—incorporating plante type positive plates. With the advent of development in the technique and design of Stationary Cells, a new type of battery with tubular positive plates has been brought out in the market and is being used in lieu of the batteries with plante type positive plates.

With a view to take advantage of the development of this new type of battery, revision of IS : 541—1954 was undertaken. However, because of certain differences in the characteristics and design of these two types, it was considered desirable to bring out two separate specifications. The following two drafts have, therefore, been prepared and put in wide circulation for eliciting comments from manufacturers, users, technologists and other concerned parties :

1. *Stationary Cells and Batteries, Lead-Acid Type (With Tubular Positive Plate)—Doc : ETDC 11(66)* which covers the dimensions, capacities and performance requirements of stationary cells and batteries using tubular positive plates, as well as those of elements of such cells and batteries.

2. *Stationary Cells and Batteries, Lead-Acid Type (With Plante Positive Plates)—Doc : ETDC 11(67)*, which specified the dimensions, capacities and performance requirements of stationary cells and batteries using positive plates of pure lead of plante type construction, as well as those of plates of such cells and batteries.

Copies of the drafts are available, free on request, from the office of the Indian Standards Institution 'Manak Bhavan' 9, Mathura Road, New Delhi and from its branch offices at Bombay, Calcutta and Madras.

Torque converters for Railway Traction Applications

By Lt. Col. L. F. R. Fell

As projects involving torque converters are now becoming more numerous and wide-spread, so more and more people in Service and Sales departments throughout the world are finding themselves concerned with this new equipment. Whilst it is obviously impossible to circulate detailed design and experimental reports to all who might be interested, it was felt that a need could be served by publishing at regular intervals a Newsletter giving a brief resume of the work which has been carried out, or is in progress, in the various departments at Crewe.

It will be assumed that the reader is familiar with our publication TSD. 710 and hence can appreciate the distinction between the CF, DF and CO types of converter. These machines are, in general, similar to the original Twin Disc converters; Twin Disc adhere to the same nomenclature of designation as ourselves.

CONVERTERS FOR RAILCARS

Design Work

Fig. No. 1 shows a modified direct drive type of unit known as the D. F. R. converter. This machine was designed originally for use on British Railways railcars. It is based on the Twin Disc DF design and is similar to the DF machine back to the rear turbine bearing.

The double freewheel assembly was designed by Rolls-Royce. Examining Fig. No. 1 it will be seen that the forward freewheel serves the same purpose as the freewheel in the DF machine, that is to say it allows the turbine member of the converter to remain stationary when running in direct drive, the rear freewheel is in the output drive and permits the output shaft to over-run the engine and converter. The freewheel units themselves are of robust design and are of the cam and roller type, having eleven individually sprung rollers each. The ordinary DF machine has one freewheel only; this has twenty-two rollers set in a sprung cage.

Since our first entry into railway business we have fervently advocated the use of the double freewheel for the following very good reasons. It allows economical operation through judicious coasting, it prevents engine damage due to overspeeding down gradients, it provides a safety disconnection in the unlikely event of engine failure or seizure and finally it enables a much easier change to be made from hydraulic to direct drive. The change can be made with the engine at idle and with the output freewheel over-running, hence the duty demanded of the clutch plates is mild in the extreme.

As a result of both our own running experience and the experience of operators, we have made some detailed design changes to the DF and DFR types of machine. In the main these consist of niceties such as changes of hardness and material and reducing stress raisers wherever possible. Whilst such alterations are not spectacular in themselves they contribute to the increased reliability of our products. Experimental work has shown that it is desirable to maintain the clutch application oil pressure at about 140 p. s. i.; thus ensuring a slipfree drive at very low engine speeds and also providing a rapid take-up of the clutch during changes from converter to direct drive. The increase pressure was achieved by making a modification to the relief valve in the clutch oil pump supply line.

In applications where a reverse gearbox is attached to the rear of the converter we now install an oil cooler to ensure that the clutch oil is not heated to an abjectionable temperature by the gearing. The converter has been modified to provide an inlet and outlet to an oil cooler and the cooler itself can be supplied as an appendage to the main converter fluid heat exchanger.

Reverse Gearbox

It has become clear that operators are by no means agreed on the most suitable type of reversing gearbox for railcar use. For those adherents of the frame mounted reverse box we have recently designed a unit which can be bolted directly on to the back of a converter. The prototype box has been built and is undergoing test at the Crewe factory.

In the design of this new reverser we have sought to produce a robust and reliable unit. Before the design was commenced a close study was made of the failures experienced by users of similar reversers by other manufacturers.

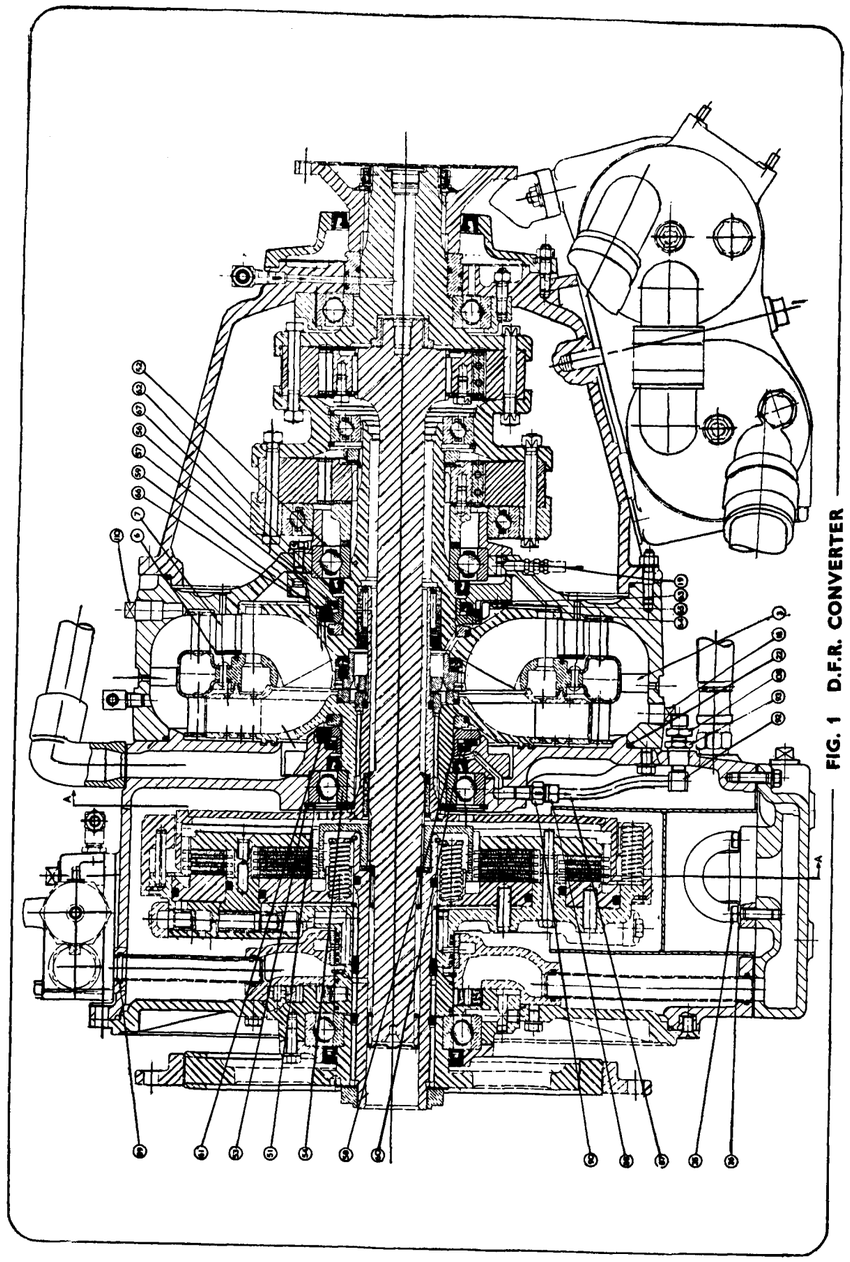


FIG. 1 D.F.R. CONVERTER

The designed capacity of the box is 300 h. p. at 2000 r. p. m. Lapped spiral bevel gears are mounted in pressure lubricated bearings. Large diameter pinions have been used so as to give modest rotational speeds. At the rear of the box gear drives are provided for a Woodward Governor and tachometer.

Output Shaft Governor

In applications using the F, CF or CO types of converter where the vehicle has a low rolling resistance there is a danger that the converter might be run at an output speed beyond the upper 70% efficiency limit with the engine rack fully open. There are cases where this could occur and it would be difficult for the driver to appreciate that anything was amiss. In conjunction with C. A. V. we have designed an output shaft governor which will begin to close the engine rack at some predetermined output speed and hence prevent damage by overheating. The governor is essentially a gear type oil pump driven by the output shaft of the converter. Oil from this pump is fed to a unit mounted on the engine fuel pump governor and is arranged so that at some predetermined pressure the rack will begin to close.

This governor is being designed so that it can be used as an output shaft speed controller. A duty could arise where it would be desirable that the driver should be able to select a fixed output shaft speed regardless of the fluctuating load. In this case the driver would control the governor setting and the governor would adjust the rack to give a constant output speed within the capacity of the engine. Such a device could be useful on a hump shunting locomotive.

The first output shaft governor unit received from C. A. V. is now running on the test beds at Crewe.

Clutch Development

Much work has been done in testing the clutches of the DF converter. Continuous periods of "Hot Shifting" have been carried out in order to ascertain the effect on the clutch plates. Tests have been very encouraging and are continuing.

As a result of this development work we have now increased the maximum torque ratings for our DF and DFR machines as follows:—

For the 10,000 series DF machine we now limit the maximum input torque to 750 lb. ft. This limit is subject to the proviso that the clutch oil is cooled if a reverser is fitted and that some indicating device is used to ensure that clutch oil pressure is always present. Further, for the DFR machines we are prepared to raise the limit to 800 lb. ft. for 10,000 series coverter and to 900 lb. ft. for an 11,500 converter provided the machine is protected from torsional vibrations by a suitably damped spring drive.

We have for some time been rnnning experimental converters at 1000 lb. ft. input torque.

We are now able to consider individual applications which require 'Hot Shifting' of the converter clutches. However, these must be referred to the Railway Traction Department for consideration by our engineers at Crewe who will deal with each case on its merits.

*** *** ***

PROTOTYPE RAILCAR

We have now had a torque converter railcar in regular passenger service for some months. This vehicle was built as the prototype to a production batch of railcars. On completion, it was made available to Rolls-Royce for a specialised development and to allow us to gain some running experience. As a result of this, several modifications have been made. The control system has been modified in details and further attention was necessary to achieve a desirable degree of silence and smoothness. The engine mountings were changed and the exhaust system modified.

Throughout the initial projecting stages of the prototype vehicle, we kept in mind the high vertical accelerations imposed at railjoints and crossings. Later, we were able to measure these accelerations, together with the effect they had in inducing torque variations in the prop-shaft.

A maximum vertical acceleration of 40g was obtained at the bearing cap of the driving axle. A propeller shaft fitted with strain gauges was used to measure the torsional variations within the shaft. It was found that a very high torsional of constant frequency was excited at each rail joint. Damping in the system was small and the whole transmission vibrated at the one node natural frequency. The vibration persisted almost without decay between impulses, and its frequency was of course, independent

(Continued on page E.S.28)

A New 204 h. p. Diesel Hydraulic Locomotive

By An Engineering Correspondent

THE first 'Hunslet' standard 204 h. p. diesel locomotive with mechanical transmission was supplied in 1944 to Sir Robert McAlpine and Sons Ltd., for duty on constructional work. It has since proved to be one of the most successful shunting and general purpose locomotives available, such that production now totals 156 units employed on a wide variety of duties both at home and abroad.

Based on this very popular locomotive 'Hunslet' have now introduced a most carefully developed new model incorporating hydraulic transmission.

This new locomotive is of 0-6-0 type with a weight in working order of 30 tons. It is powered by a Gardner type 8L3 diesel engine and 'Hunslet' patent hydraulic transmission has been adopted in place of the four speed mechanical gearbox previously employed. By this means a starting tractive effort of no less than 20,700 lbs. is achieved with an attractive performance through two speed ranges up to a maximum of 12 m. p. h. The torque converter is of a simple, single stage type, requiring virtually no maintenance. Designed for a relatively low torque multiplication it is capable of long continuous slow speed working with heavy loads. This feature, combined with the smooth starting characteristics of the hydraulic drive, makes the locomotive ideal for wagon weighing, hump shunting and other duties of this nature.

The driver, is considered at every stage of design and construction. He is provided with a roomy, comfortable cab, which is mounted towards the centre of the locomotive. This, combined with the provision of generous window space, ensures first class all round visibility; a valuable safety feature which also increases the speed of working. The central position of the cab enables the floor to be completely flat giving unobstructed movement between the driving positions on either side. It also provides admirable maintenance accessibility, the engine and transmission being situated entirely within the two end compartments.

The controls, which are duplicated on both sides of the cab, are power assisted and are conveniently mounted on a desk facing the short end of the locomotive. They include a powerful straight air brake actuating cast iron brake blocks on all six wheels. Control of the train is not, however, solely dependent on the air brake, a converter/fixed drive control is provided so that use of the converter can be dispensed with at will and the full power of the diesel engine used to assist braking. Tests of 'Hunslet' diesel hydraulic locomotives in service have proved that the smooth operation of engine braking gives a vast reduction in stopping distances particularly under greasy rail conditions. This is of great importance in view of the immense loads which can be started by a diesel hydraulic locomotive where the initial tractive effort is limited solely by adhesion.

(Continued from page E.S.27)

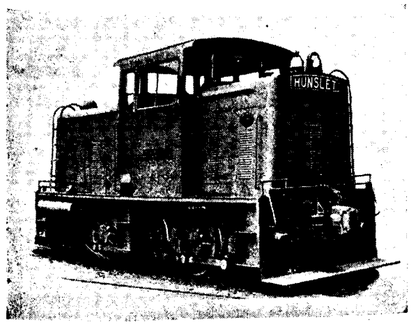
of railspeed, although its magnitude increased as the railspeed increased and hence the forcing impulses became greater.

It was immediately apparent that a means of isolating the impulses from the clutches and free-wheels of the converter unit must be sought.

A flexible rubber coupling was introduced at the end of the prop-shaft. This reduced the stiffness of the system and hence the frequency, but had little damping effect. Weights were added to the final drive in order to move the centre of percussion over the axle. This had little effect.

Finally, a propeller shaft of very low stiffness was used. The shaft was a torsion bar surrounded by unstressed tube; The relative angular movement between the shaft and its sheath was used to provide the required amount of damping by filling the annular space with a viscous fluid.

This reduced the amplitude of the vibration to 20% of its original value and was considered to be a satisfactory solution to the problem and will be used in a refined production form on future installations.



Hunslet 204 h. p. 0-6-0 Type Diesel Hydraulic Locomotive.

Gauge of Railway	4 ft.	8½ in.
Dia. of Coupled Wheels	3 ,,	4 ,,
Wheelbase	9 ,,	0 ,,
Height Overall	11 ,,	6 ,,
Width Overall	8 ,,	3 ,,
Length over Buffer Beams	22 ,,	0 ,,
Maximum Power and Speed of Engine	204 h.p. at 1,200 r.p.m.	
Speed 1st Gear	6 miles per hour	
,, 2nd Gear	12 ,, ,,	

Fuel Capacity	350 gallons
Weight in Working Order	30 tons
Maximum Axle Load	10½ tons
Maximum Tractive Effort 1st Gear (Limited by adhesion)	20,400 lbs.
Tractive Effort 1st Gear at Maximum Speed	10,850 ,,
,, ,, 2nd ,,	5,450 ,,
Ratio Adhesive Weight ÷ Tractive Effort	3.3 to 1
Minimum Radius of Curve Engine will traverse with ease	120 ft.
Weight per yard of Lightest Rail advisable	50 lbs.

	Level	1 in 100	1 in 50
Load Engine will start in 1st Gear	1,100 tons	465 tons	295 tons
,, haul in 1st Gear at maximum speed	875 ,,	285 ,,	160 ,,
,, 2nd Gear ,,	420 ,,	128 ,,	65 ,,

Loads hauled are based on 18 lbs./ton Starting Resistance and 12 lbs./ton Running Resistance

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NEW GENERAL MANAGER OF CHITTARANJAN LOCOMOTIVE WORKS

Short, genial and soft-spoken, Shri Kenneth Chandu Lall, took over as General Manager, Chittaranjan Locomotive Works, from Shri Ramachandran, who has retired from railway service.

Shri Lall had hitherto been working as Director, Standardisation, Railway Board.

Born on October 7, 1907, he joined the Jamalpur Workshops on February 14, 1927, as a special class apprentice for mechanical engineering. After completing his course at Jamalpur, he was sent to England in February 1931, for further training. On return from England he joined the ex-N. W. Railway as A.M.E. on April 27, 1933.

Shri Lall was promoted to the senior scale on November 29, 1938. In 1944, he was transferred to the Railway Board as Deputy Director (Mechanical).

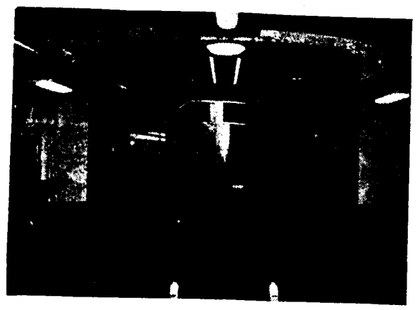
When the E.P. Railway was formed following partition, he was posted as first administrative head of its Mechanical Branch. He was subsequently transferred to Northern Railway, and was posted as Deputy Chief Mechanical Engineer.

He was elevated to Chief Mechanical Engineer on Northern Railway in 1954. In February 1958, he was transferred to the Ministry of Railways and was posted as Director, Standardisation.

BETTER TRAVEL

By Shri K. Swarup
Chief Mechanical Engineer, Integral Coach Factory, Perambur.

IN the middle of the 19th century when railway trains came to be introduced, the main purpose was to haul passengers and freight traffic. The design of passenger coaches was more or less built on the pattern of hackney carriages developed upto that period. With the development of larger locomotives and higher standards of living, the demand for better amenities for passenger carriages gradually increased.



View from lower level of chair car looking toward stairway to dome.

Lower level cocktail lounge located underneath the dome.

Observation lounge looking toward rear end.→

Floor plan of observation lounge car. Total seating capacity including dome 68 passengers.
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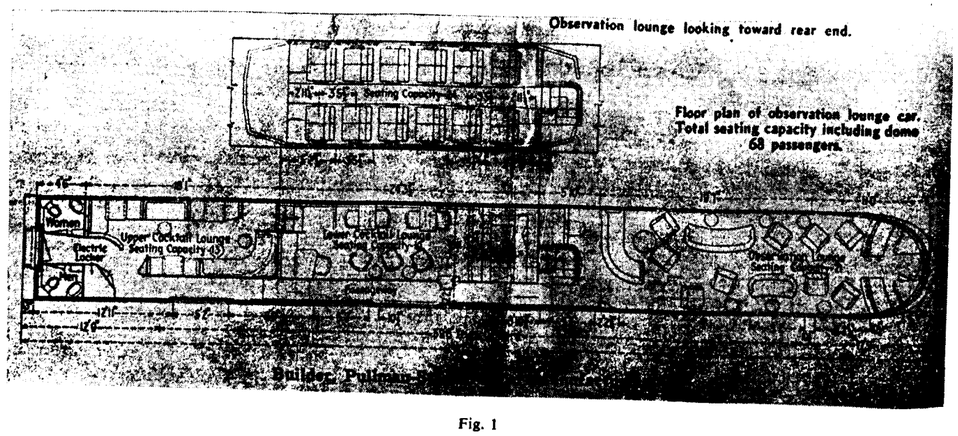


Fig. 1

The designers of the passenger carriages, therefore, had to meet with this demand and started providing better and more comfortable carriages for the convenience of passengers.

The body, instead of being only a shelter against weather, had to cater for comfortable seats, better riding and so on. This process of evolution was further accelerated after the first Great War when competition from Road Transport and from air had developed.

In the advanced countries there are different types of carriages to cater for the demands from the public. They vary from the ordinary chair-cars to De Luxe coaches where more or less the house comforts are provided. In America, almost all the passenger carriages are now air-conditioned. In Europe and England, they have all been provided with heating arrangements against bitter cold of winter. An illustration of a typical De Luxe Car running on the American Railroads is shown in Fig. 1 to show how much care and thought have been given to the convenience of passengers. In India, before Independence, we had also different types of carriages to cater to the needs of the public. Our Imperial Mail which used to connect Bombay and Calcutta with P. & O. Boats could be compared with the best in the world. Our tourist cars also provide the household comforts to the travelling public who are in a position to pay. The layout of the popular tourist cars is shown in Fig. 2. It will be seen that these tourist cars have a kitchen, an office room, bed rooms, drawing and dining room and have also an observation end from which we can see the scenic beauty of the country.

For tourists in the advanced countries, they have also built dome cars with plastic roofs, so that the tourists can seen the scenic beauty of the country better than from an observation end. These have not yet been adopted in India, but with the increase in tourist traffic, I am sure the day is not far when such tourist dome cars with suitable modifications will also be built in India. Illustrations of such a dome car are shown in Fig. 3. The air-conditioned coaches on the Indian Railways can be compared to the best in the world.

The traffic on the Indian Railways is mainly third class. Very little attention was paid to the design and layouts of third-classes before Independence. Since then great stress is being laid to improve the amenities and comforts in the third class coaches.

With that object in view, a Passengers Amenity Committee was formed in the year 1957 and after carefully studying the Indian habits and Indian conditions, this Committee laid down certain minimum amenities standard to be provided for different classes

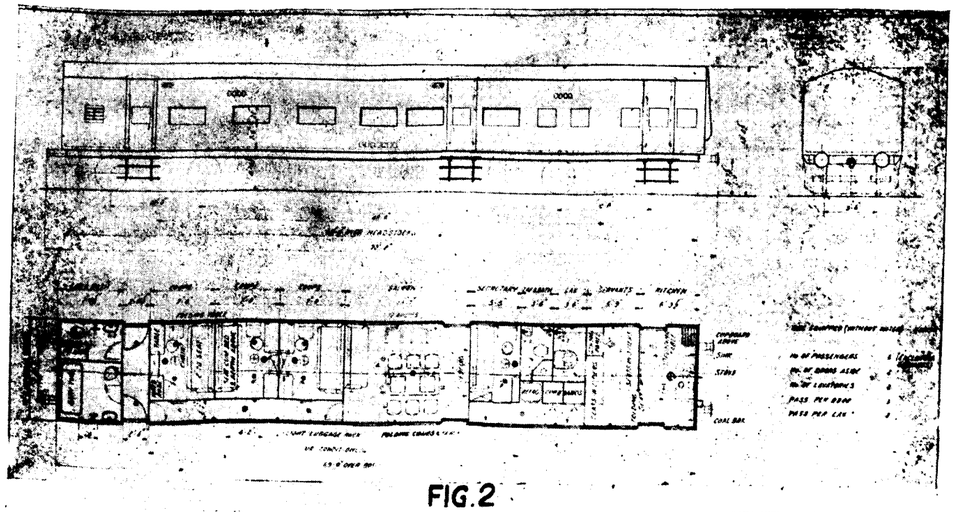


FIG.2

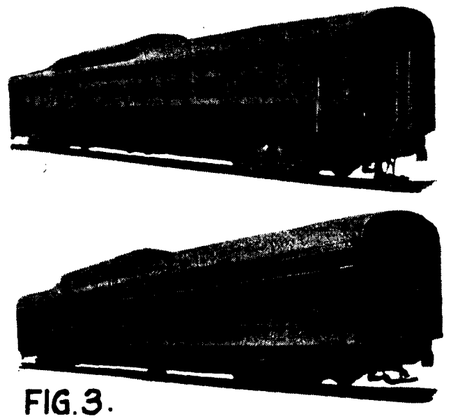


FIG. 3.

of coaches to be built on the Indian Railways. These standards now form a basis for the designer to show his ingenuity in improving the comforts of travelling public in India.

Within the limits of the Broad Gauge 70′ length, and clearance requirements, a lot of things can be done with the railway passenger car. The opportunities challenge the imagination, but it should be controlled imagination which develops forms and designs of permanent and wide-spread usefulness. When this obtains, progress is made to a degree of standardisation of specification which results in manufacturing and operating economies. In our every activity in the field of railway passenger transportation, I. C. F. would try to build so much better than has been done hitherto.

With the increased competition from railroad in India, the lure of luxury and convenience provided in railway passenger cars will be one of the surest ways to catch customers. Satisfying the travelling whims of Mr. & Mrs. India will be the job of I.C.F. The comfort that I. C. F. carriages would provide, would turn the drudgery of the longest journey into a pleasant interlude.

The first step that I. C. F. has taken in this direction is to build modern III class coaches in light-weight all-welded steel construction. This coach has anti-telescopic ends and, therefore, provides the necessary amount of safety for the passengers travelling in this coach. Unlike the previous III classes, the coach has been split up into 8 compartments, each compartment providing seating capacity for 10 passengers. The upper luggage rack provides enough room for carrying luggage that our passengers are accustomed to carry. On the top is a light luggage rack where small articles could be kept. Similarly, luggage racks have been provided on the side. The provision of these extensive luggage racks would ensure that the floor and the seats will be free for occupation and moving about, thereby giving more comfort to the passengers.

Each compartment has been provided with two fans to give sufficient air to all the passengers. The compartments are well-lit to enable passengers to read at night time if so desired.

The seats and back rests were originally well curved to provide comfort to long distance passengers but have now been made flat increasing the width from 19″ to 22″ to enable passengers to spread their bedding and make themselves more comfortable. According to our Indian customs and conditions, this is more profitable.

Lavatories are also well equipped and have all the modern amenities like wash hand basins, mirrors, squatting pans, lotah holders, towel racks, etc. etc.

Not satisfied with this, our Railway Minister has recently decided to provide sleeping accommodation for all long distance passengers and has approved of the three-tier third class coaches. The carrying capacity of the coach has been reduced from 80 to

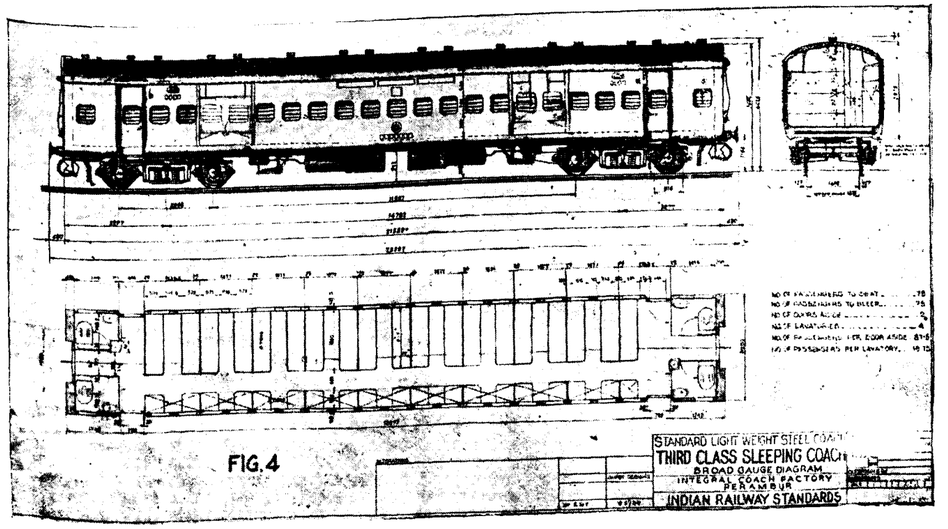
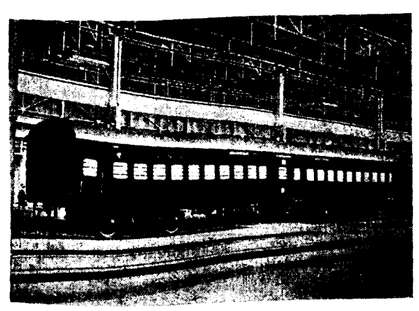


FIG. 4

75/76. Each compartment will provide sleeping accommodation for eight passengers. During the day three passengers could comfortably sit on each of the two traverse seats in a compartment, while the remaining two can sit on the chair seats. At night the two back rests in each compartment could be folded to make additional sleeping berths while the seats and upper berths could be used for sleeping as they are. The two chair seats could be converted to make one berth in the night while the upper berth will provide accommodation for the other passenger. Twelve such coaches have already been put into service from 2—10—1959. During the course of next year, 200 more such coaches will be introduced in service. A layout diagram of such a coach is reproduced in Fig. 4. From this it will be noted that two alcoves with wash hand basins are being provided at the two ends for the convenience of passengers. It is understood that an attendant in these coaches would see to the convenience and safety of passengers.



First Classes that will be produced from this Coach Factory will also cater for better amenities and comfort to passengers.

The conclusion from the above would be that the Railways are fully alive to the growing demand for

better and more comfortable travel and the manufacturers of passenger coaching stock are doing their best to produce coaches which will be more comfortable and attractive. In course of time, we from I.C.F. are anxious to produce coaches which will compare favourably with the best in the world.

Co-operation from the Public—Maintenance of these coaches is causing great headache and the Railways are asking I.C.F. not to provide and fit expensive and better-looking fittings which act as attraction to be pilfered and pinched. It is also a matter of great pity that even covered seats, looking-glasses and other things are not only wantonly damaged but removed from the compartments. The story of the well-equipped E.M.U. stock received from abroad and running in the Calcutta area is widely known. It will be a source of great encouragement to the coach builders to provide more amenities and better-looking fittings, if the public would co-operate by maintaining these fittings in good condition and by desisting from pilfering them even though they may be attractive and goodlooking. It is only by such co-operation that we in India will be able to produce, in the long run, coaches which would compare with the very best in the world.

Indian Standards Convention—1959

The programme of the Indian Standards Convention 1959, being held at Hyderabad from 27 December 1959 to 2 January 1960, which has just been circulated to various delegates includes 9 technical sessions, namely (1) Implementation of Indian Standards, (2) Certification for Small Industries Products, (3) Standardization as a Pre-requisite to Productivity, (4) Preparation of Standards in Terms of Metric Units, (5) Design for Industrial Experimentation, (6) Tropicalization of Electrical and Electronic Equipment, (7) Latest Techniques in Chemical Analysis, (8) Non-Ferrous Metals Industry and Standardization and (9) Documentation and Communication. A number of visits have also been organized ; these include various factories, organizations, industrial concerns, Salar jang Museum, or trade exhibition and places of historical interest. The Convention will conclude by an Excursion to the famous caves of Ajanta & Ellora.

The Convention will be inaugurated by Shri Lal Bahadur Shastri, Union Minister for Commerce & Industry on 28 December 1959.

TURNING MACHINE TOOLS

By An Engineering Correspondent

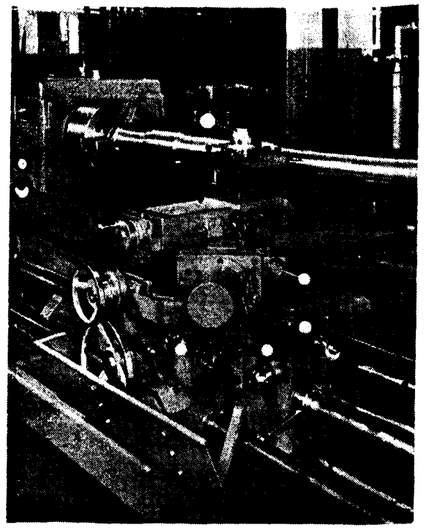
CHURCHILL-REDMAN are specialists in the manufacture of Turning Machine Tools. It is natural, therefore, that machines of their design have been used in the machining of components for railway equipment. In addition to the supplying of standard Machine Tools for Railway Workshops, the Company manufacture Special Purpose or Production Machine Tools to meet specific turning problems, an example of this being a number of machines recently delivered for the turning of railway axles. Two of these were installed at the Axle Works of Taylor Bros. Ltd., Manchester, and a further five were sent to their subsidiary Company in South Africa.

The specification of the machines had to be such that a wide range of different types of axle could be turned, but in such a way that versatility did not prevent the achievement of low production times. The following specification was, therefore, decided upon.

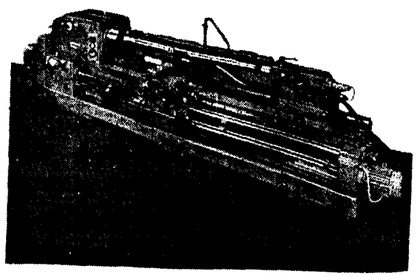
The basic machine was a 28″ Swing Churchill-Redman 'L' Series Heavy Duty Centre Lathe on a 15′—9″ bed arranged to admit 9′—0″ between centres. The saddle was constructed with an integral hydraulic profile turning slide located at 45° and with the tracer valve in stylus mounted at the rear. At the back of the machine a template slide and supports were provided for mounting the axle shaft template which we used for copying. To ensure maximum rigidity, the normal swivel slide was eliminated and a fixed top slide was fitted, mounted centrally. This also had the advantage of limiting the overhang of the tailstock ram, an important point with heavy cutting on large components. On the top slide was mounted a steel square turret of the self-indexing type.

With a profiling slide set at 45°, it is essential to control the feed rate when the tool is turning from a larger to a smaller diameter. The apron was fitted with a special 2 : 1 ratio feed reduction control for this purpose and this was operated from a shaft which replaced the leadscrew normally fitted to this type of machine.

Since the machine was to be used exclusively for turning axle shafts, a special gearbox was provided



28L Series Profiling Lathe



28L Profiler

which gave 10 changes of feed from 0.010″ to 0.019″ per rev., it being possible to halve these with the control previously mentioned. In order to ensure adequate power, the headstock was fitted with a 25 H. P. main drive motor and given a range of spindle speeds from 12 to 800 R. P. M.

Positive driving of the components was vital, in view of the heavy cuts, and this had to be achieved without an excessive loading time. To do this, a special version of the Churchill-Redman patented self-compensating Chuck was developed which was capable of gripping rough work up to 10″ diameter. An adjustable built in centre was used, so that it was possible to position the centre by means of a gauge, after the depth of centre in the forging to be machined had been checked. Since the Chuck was operated automatically by a hydraulic rotating cylinder mounted at the rear of the spindle, loading proved exceptionally simple. To further assist this, the tailstock which had a 6″ dia. ram was also hydraulically controlled.

The machines were used for both the roughing and finish turning of axles, covering a wide range of types and sizes, the method proving economical for smaller or large batches. Obviously production times vary from job to job, but on a typical axle of 7½″ maximum diameter the roughing speed was 220 R. P. M. with 0.010″ per rev. feed and ¼″ depth of cut.

RAIL LINE TO CHINGLEPUT

The scheme for electrification of Tambaram-Villupuram line will be implemented and during the Second Plan period, electrification will be done up to Chingleput. Mr. S. V. Ramaswami, Union Deputy Minister for Railways, told Pressmen during his recent visit to Madras.

In regard to electrification of the railway line from Chingleput to Villupuram, Mr. Ramaswami said that civil engineering works had been completed to the extent of 70 per cent and the remaining 30 per cent was expected to be completed before the end of the Second Five-Year Plan period. With regard to electrification from Tambaram to Chingleput in the first stage and beyond it in the second stage, Mr. Ramaswami said there were certain technical difficulties.

Mr. Ramaswami said high tension A. C. induces heavy voltage in the telegraph and telephone wires running along the railway line which could be overcome only by laying underground cables. It would be economic to have D.C. for short distances. But, for long distances, A.C. was more economic. Therefore, in the context of the proposed line up to Villupuram, and, possibly, up to Vriddachalam in view of the Neyveli Project, A. C. had to be preferred for the line from Tambaram onwards. The problem might be solved by having a dual system as they had in Japan. It would mean, Mr. Ramaswami said, that the existing D. C. would remain up to Tambaram and from Tambaram onwards, it would be A. C., the trains being pushed from one section to the other. Technical problems connected with it were being considered and it was hoped a solution would be found in the near future.

REMODELLING OF CENTRAL STATION

In regard to electrical signalling at the Central Station, the Union Deputy Minister for Railways said that it was part of the work of remodelling the Central Station. He added that signalling would be on the A. C. system so as to fit in with the future plan for electrification of the Madras-Arkonam line. Remodelling of the Central Station, he said, was well on hand. The sick lines and the washing lines were being shifted to Basin Bridge. The Parcel Offices had been already shifted to Salt Cotaurs. Four additional platforms were in the process of being laid out. The whole work, the Union Deputy Minister for Railways said, was expected to be completed before the end of the Second Five-Year Plan period.

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STEEL WIRE FOR MANUFACTURE OF MACHINE SCREWS

While recommending the continuance of the protection to the machine screw industry, the Tariff Commission had recommended, *inter alia*, that the Indian Standards Institution should give high priority to the formulation of standards for iron or steel rods and wire for the machine screw industry.

The Institution has accordingly drafted a specification for Steel Wire for Manufacture of Machine Screw [Doc: SMDC 5 (72)] which covers the requirements for cold drawn mild steel and free cutting mild steel wire suitable for the manufacture of machine screws supplied in the ¼ hard and 1½ hard conditions. For eliciting the views of the manufacturers, consumers, and technologists, the Institution has circulated the draft standard.

Polish Tools used in Railroads

By An Engineering Correspondent

TOOLS are fundamental means, indispensable in any production as well as in keeping up efficiency of ready products and equipment. Therefore increasing industrialisation and development of railroads caused great increase in tools production and their high specialization for various purposes.

The Polish tool production having many years of tradition and a rich experience, has been after World War II remarkably extended and modernized. This made it possible not only to supply home market with necessary tools but also to start export in a wide range of assortments. Nowadays it would be really hard to find a country to which Poland does not export its tools. This fact that Polish tools succeeded in getting on such numerous markets prevailed by the world greatest producers of tools—is the best proof of their superior quality.

The assortment is being constantly extended in order to meet all the needs and requirements. Besides constructional offices by the particular manufacturing plants, there are also special institutions working upon development of tools industry, construction of new kinds of tools and implements and improvement and modernization of traditional tools.

Due to systematic efforts of Polish scientists, constructors and producers, Polish tools enjoy the satisfaction of their users at home and abroad and they are often higher appreciated, than those of the many well-known trade marks.

One of the many branches where nearly all our assortment of tools is being applied—are the railroads. The building-up of steady railroad equipments, tracks, rolling stock and signalization and the keeping-up of necessary background varranting normal and economical exploitation of these sets of equipment require great amounts of various tools. Railroad workshops are little factories equipped with an adequate machine tool park and full set of tools. Machine tools require great amounts of turning tools, cutters, twist drills, reamers, taps, dies, die heads, saws and grinding and polishing wheels. For holding fast vices, turning chucks, drill chucks, lathe centers, milling mandrils etc., are being used. To get the proper dimensions of the details being worked at, various measuring tools are used such as pocket and workshop vernier calipers, micrometers and passameters, tail gauges and comparators, parallel and angle slip gauges, edges and squares, measuring plates, various patterns, surface gauges and many others.

Such workshop tools as hand saws of all kinds, circular saws, bit bracers and augers, chisels, planes, plane irons, end spanners, ring spanners, socket wrenches, adjustable wrenches for screws, nuts and tubes, tube expanders, various pliers and nippers, tin shears and screw drivers, drills and grinders etc., are applied in assembling work and in joiner's workshops.

Besides, assembling work requires also electrically driven tool such as electrical drills and grinders of hand and bench type. Bigger workshops are usually equipped with the most efficient and most economical of all tools, namely with pneumatic tools.

The fitting of workshop with central pneumatic installation is of course connected with some capital outlay, but it gives in effect substantial exploitation advantages. Pneumatic installation allows the use of numerous types of pneumatic tools highly comfortable and economical and absolutely secure. There is no electric cable getting in the way, no damage in electric motorinsulation, no danger in working on wet places,—none of these dangers that threaten the life and health of a man working with electrical tools. And yet the wide range of pneumatic tools makes possible mechanization of many hard and time-eating jobs.

Polish manufacture of pneumatic tools is producing a wide assortment of types that have passed their examination and proved to be good at home and abroad.

No foundry can get along without pneumatic sand rammers. Our types MU10a, MU16a and UA18 are comfortable and efficient tools that enable the quick, easy and even beating down of moulding mass in cases, making thus the work more efficient.

For cleaning of casts, equalling of jointings and cutting off of unnecessary constructional details our chipping and caulking hammers of MS series are being used, and their weight ranges from 4 kos for MS-8 type up to 6, 7 kos for MS-19 type. These hammers can be also applied when riveting is concerned, though rather special riveting hammers of various efficiency are here recommended.

The smallest riveting hammer NA4 of only 1 kg weight is used for hot rivets of 4 mm. diameter ; whilst the greatest, NA34 one, weighing 11,5 kos can deal with hot rivets of 34 mm. diameter.

To get the proper pressing on the rivet head during riveting, PP-series holders-on are being used while scalling hammers MR22 and MR25/one and five finger/are recommended for cleaning of steam boilers and rusty sheets.

Almost unlimited application have pneumatic rotary drills of various shapes and sizes. For instance W6 type—straight, drilling capacity in steel up to 6 mm, W10 type with the gun handle, drilling capacity up to 10 mm, WZ10 type with the closed handle, drilling capacity up to 10 mm, WK15 angle type for drilling holes of the diameter up to 15 mm in places hard to reach etc.

For casts and jointing cleaning, assembling of bodies and many other works our S65, S100 and S150 type grinders of respective wheel's diameter of 65 mm. 100 mm. and 150 mm. are indispensable.

The application of pneumatic tools in railroads is not only limited to railroad workshops. They are used also in building up and maintenance of rails.

Especially recommended is here MK-8 type plug drill designed for plugging and hewing of stone lumps. It is highly useful because of its small weight of 8, 3 kos and high efficiency of 1500 blows per minute. Nearly the same advantages can be obtained by using PK-1 type track tamping machine weighing 18 kos and giving 1500 blows/min while air consumption is as low as 0,45m ^{3}/min. Rail brigades equipped with such tamping machines are able to speed up their work several times and the rails are laid very accurate and well tamped allowing thus to enlarge axle pressure and speed of the trains.

In building up of railbed there are very important such pneumatic tools as paving breaker MP-26A type weighing 27 kos and having 3, 5 kgm power of blow and 800 blows per minute, and rotary rock drill WUP-28 of 3, 2 HP strength, 29, 5 kos weight and 1400 blows per minute.

All these pneumatic tools can be connected with rolling compressors composing thus very motionable setups of tools that can be transported and set in motion in every point of the rails varranting high efficiency of the work of brigades that are building and maintaining the rails as well as of collision brigades for which quick moving is very important.

As the same compressors are also used for supplying with energy the spray-guns, produced in Poland in several types—it is quite clear that application of pneumatic tools becomes just necessary and unavoidable.

Railroads are but one of the economical branches where substantial quantities of tools are used.

But anywhere where something is being produced used or maintained—tools are indispensable—and there Polish tools can be found.

Steel Conduits for Electrical Wiring

An Indian Standard Specification for Steel Conduits for Electrical Wiring [Doc : ETDC 7 (5)], specifying the material, dimensions and other general requirements, has been drafted by the Indian Standards Institution for eliciting comments from the interested manufacturers, consumers, testing laboratories etc. before *9 December 1959*.

Though conduits and fittings are very closely related with respect to dimensions, screw threads etc., since these two items are manufactured by different producers, it was felt desirable to have two separate specifications—one on steel conduits and another on conduit fittings and accessories.

In persuance of Government of India's decision to adopt metric system the dimensions in the draft standards have been given in the metric system with the corresponding FPS sizes in brackets, since the latter represent the practice followed by the trade at present. The dimensions are based on ISO recommendations.

RICHARDS MACHINE TOOLS FOR RAILWAY WORKSHOPS

By An Engineering Correspondent

FOR many years Richards Machine Tools have proved themselves invaluable in Railway Workshops throughout the world both in the machining of new components and the reconditioning of used parts to fine precision limits.

"Electrabore" Horizontal Boring and Facing Machines, embodying great rigidity of construction and producing work to a high degree of accuracy, are used on a wide variety of work in railway shops.

The adaptability of this type of machine, which in addition to boring and facing, is capable of milling, drilling and tapping, enables several operations to be carried out at one setting, without loss of operational time and with complete accuracy.

Probably one of the most important functions which Richards Horizontal Borers perform in railway workshops is the machining of locomotive cylinders and the machine generally supplied for this and other railway work is the No. 5. size machine illustrated in

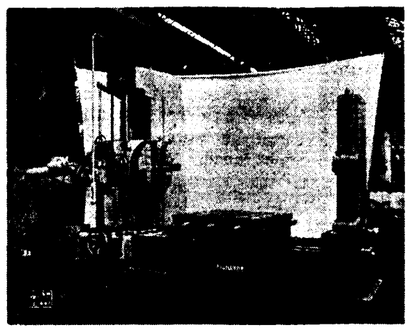


Fig. 1
Richards No. 5 Size "ELECTRABORE" Universal Boring, Facing, Milling, Drilling and tapping Machine, with traversing spindle and Automatic facing head.

fig. 1. This machine has a 5" diameter traversing spindle and automatic facing head with a capacity of 54" diameter.

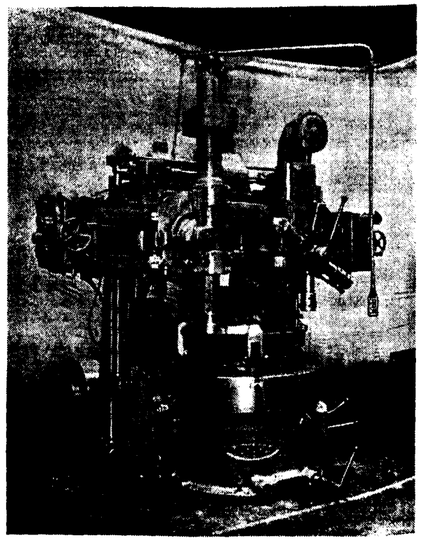


Fig. 2

Richards Vertical Boring and Turning Mills are in popular demand for operating upon railway tyres, wheel centres, etc., and a 4 ft. machine specially arranged for machining tyres is shown in Fig. 2.

This machine has a 4-jaw independent chuck table which runs on a white metal bearing, the spindle being mounted on roller bearings. Twelve table speeds are available ranging from 6.16 to 130.35 r. p. m., and the table jaws are provided with special swivel clamps for holding the tyre.

The left-hand head is of the standard swivelling type, which can be swivelled to any angle up to 30 degrees from the vertical for taper work, when required. The right-hand six-sided turret head is released, revolved and indexed, then relocked by a single lever, thus greatly facilitating tool positioning.

The mill is illustrated with a tool set-up for the machining of carriage tyres. The left-hand ram has a tool bar for finish boring, whilst the turret head is loaded with tool-bars for carrying out rough boring and rough and finish grooving operations.

The "AB" type Patent Axle Box Boring, Facing and Radiusing Machine illustrated in Fig. 3 is specially designed for dealing with axle boxes and has been supplied in large numbers to the Railway Workshops of the world and in particular to India.

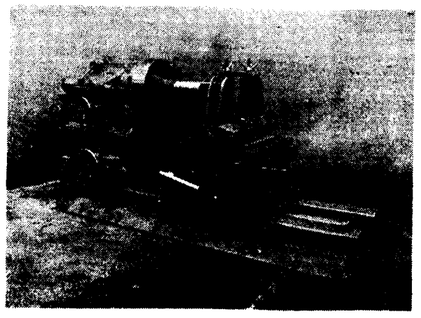


Fig. 3. RICHARDS No. 2 size "AB" type, Patent Axle Box Boring, Facing & Radiusing Machine.

The machine is fitted with a main table, having hand cross movement, and this is mounted on two inclined saddles which provide vertical and horizontal adjustment to accommodate different sizes of axle boxes. On top of the main table a square revolving table is fitted, incorporating Richards Patent Squaring Lock, by means of which the table can be set square to the spindle with absolute accuracy. The axle box is held on the revolving table by a specially designed fixture.

With adjustments provided in the longitudinal, transverse and vertical directions the machine is fully capable of dealing with new and repair boxes of various sizes and furthermore, by simply extending the length of the bed, the machine can be used with equal success on radial axle boxes.

A very valuable feature of the machine however, is that with these various adjustments and the range of speeds and feeds provided, it can be adapted for use on other work should the whole of its time not be occupied on the production of axle boxes.

In Great Britain to-day the electrification of the railways is one of the major undertakings, and to this end many works are engaged in the manufacture of diesel and diesel electric locomotives.

On some of the drives the motors are mounted adjacent to the axle housing. The Richards TH2 machine shown in Fig. 4 has been specially designed for the purpose of machining the axle bores of these motor casings.

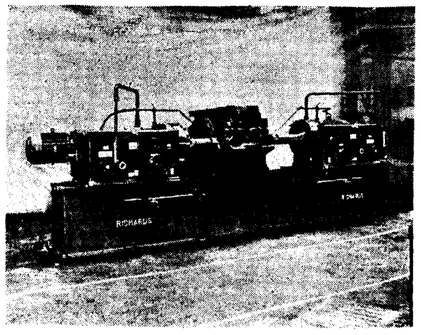


Fig. 4

The machine has been supplied to a world known electrical concern to their requirements, and it consists of three separate bed castings two supporting the facing and boring heads and the centre section is used to support the work which is mounted in a suitable fixture.

Each head is arranged to bore the axle bore approximately half way through, the tool running out into a cast relief in the centre.

The end faces of the axle bore are machined by means of a tool suitably mounted on the facing slide.

The workpiece is stationary and is set on the fixture in order to obtain the correct centre distance between the main and axle bores.

Twelve speeds are provided to the main spindle in geometrical progression, the speed range being 5/160 r. p. m., obtained through a change gearbox by means of a flange mounted motor situated at the rear of the traversing heads. Both motors are controlled by means of pendents, the buttons provided being "forward", "reverse", "inch forward", "inch reverse", and "stop"; in addition the forward and reverse push buttons control the rapid power traverse motor.

Six feeds are provided and these are common to the longitudinal traverse of the head, and the radial traverse of the facing slide. The feeds are obtained through a change gearbox manipulated by two levers, the feed range being 0.005 to 0.050 inches per revolution of the main spindle. Rules and verniers are fitted to the head and facing slide in order to bore or face to a set dimension, "knock offs" are also provided.

For boring operations, a 6" diameter boring bar, suitably mounted on the facing head, is provided, and to the bar interchangeable boring heads are secured.

Two heads are supplied to bore from 6.1/2" to 9.1/2" diameter, and they are arranged to carry three roughing tools and one finishing tool all of 3/4" square section. The three roughing tools are stepped both radially and longitudinally, so allowing a complete roughing operation to be completed in one pass. The finishing tool which is provided with a fine screw adjustment allowing settings of 0.001 to be made is then inserted for the finishing cut.

Extra large bores up to 24" diameter can be machined with special tool holders.

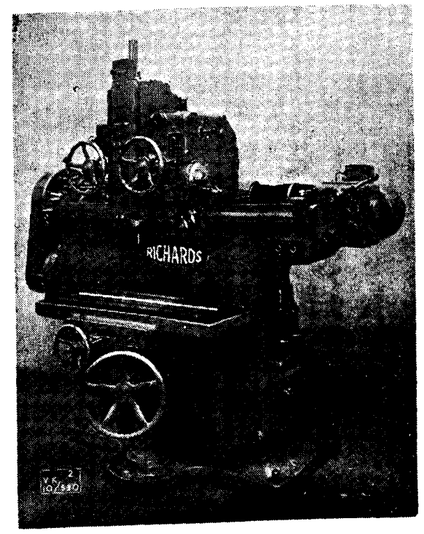


Fig. 5. RICHARDS No. 2 Size "VK" Type Vertical Slot, Drilling and Keyway Cutting Machine.

In the production of keyways the Richards Keyseater is well known and finds favour in many railway workshops. Fig. 5 shows the VK2 model which has a range of speeds suitable for most conditions, namely 155—1055 r. p. m. in nine steps. The machine illustrated will cut a maximum keyway of 30" long × 2" wide but may be obtained as a larger model with a capacity of 54" long × 2.3/4" wide. Hand feed vertically and horizontally is provided also rapid power motion, the machine being gear driven throughout. No previous drilling is required during operation, the cutter sinks to depth and is automatically changed to horizontal feed in one motion.

New C. L. W. Engines for Suburban Traffic

It is a fact that Chittaranjan Locomotive Works have started manufacturing a new type of engine for heavy suburban passenger service. Cost of a WT Loco is expected to be about Rs. 4 lakhs. Shri Shah Nawaz Khan, Deputy Minister of Railways gave this information in the Lok Sabha in reply to a question by Shri Raghunath Singh.

The Deputy Minister added that the performance of this proto-type locomotive would be known after the dynamometer car tests had been conducted and the results were available.

Integral Coach Factory produces a coach every six working hours

TREMENDOUS SUCCESS AS AN INDUSTRIAL ENTERPRISE

THE most vital and decisive element in any organisation, whether it is business or government, is neither the machines nor the amount of capital, nor again the quality of material used—but the men.

This has been the basic approach of the management of the State-owned Integral Coach Factory at Perambur from the day it started in October 1955—even earlier, since the day the construction of plant started in 1952.

Most of the skilled workmen in the Factory were taken as apprentices after careful selection and trained at the staff technical training school. The standard of training imparted is high which fits them very well for high quality work in the Coach Factory. Provision of avenues for promotion, a large number of amenities and a general attitude of sympathy and interest shown by the supervisory staff towards the workmen make it very worthwhile for them to serve the institution with skill and loyalty.

Add to this a well-equipped and beautifully laid-out plant and sound leadership, and the result is a number of remarkable achievements.

From the very first year of production the Factory has been consistently exceeding stiff targets. In the first year it produced 43 unfurnished coaches against the original target of 20 and the increased target of 40. In the second year, against the increased target of 120, 150 shells were produced. In the third production year, ending October 1, 1958, 308 shells were produced against the target of 240. In the fourth year till March 1959, the target was 170; production went up to 201. From May this year the Factory is producing 35 coaches every month—one every six working hours—at the rate of 420 per year.

Secondly, the planning of production has been carried out with all the restraint and economic forethought necessary to make full use of every rupee spent on the plant. Though the Factory was planned to manufacture 350 unfurnished coaches a year, working single shift, as a matter of financial prudence machinery just sufficient to manufacture 250 unfurnished coaches only was ordered in the first instance. The intention was to assess the capacity of the machinery and plant already ordered, and based on their performance, to order the inescapable balance that would be required for stepping up the out-turn to 350 unfurnished coaches a year. Now the 350 shell-capacity plant, by careful planning and the skill of the workers, is producing at the rate of 420.

Third, in addition to exceeding the target, the Factory has been able to reduce the cost of the shell to nearly half of the landed cost of the imported shell. The cost of the shell manufactured now at the Integral Coach Factory including overheads is about Rs. 85 thousands, while cost of a similar shell in design and equipment ex-works from Switzerland is about Rs. 1.07 lakhs, and according to the Swiss experts, the quality of the coach produced at the Integral Coach Factory is as good as that of the imported one.

Fourth, manhours needed for manufacturing a shell—a shell consists of about 1,200 components—have been gradually brought down from 19,600 to about 9,000. With the incentive system shortly to be introduced, the manhours needed would be brought down further to 7,500. For a similar shell manufactured in a Swiss factory manhours needed are 7,500.

Fifth, because of increased and satisfactory production the Factory has been able to wipe off the initial development expenditure of Rs. 79 lakhs within the first 2½ years of operation. Now the credit side shows over Rs. 50 lakhs. This development suspense account was created to absorb a portion of the development expenditure and to accommodate the excess in production costs in the initial stages over the fixed selling price of Rs. 1.75 lakhs per shell.

Sixth, whereas in the earlier batches raw material and fittings worth Rs. 37,000 per coach had to be imported (including steels of requisite weldable quality costing Rs. 19,000), in the latest batches the imported items have been cut down to Rs. 18,000 only per coach. This is the result of vigorous efforts at locating and developing indigenous capacity of various items through 'educational tenders' by providing necessary incentives and technical guidance to Indian manufacturers.

With steel plates and sheets available within the country in 1960-61, the coach will be 95 per cent indigenous in its raw material content. So far, except for roller bearings, capacity for all the other finished and semi-finished items has been developed within the country.

Lastly, with 6,400 workers on its pay rolls, the Factory has had no labour trouble since it started. A sense of partnership—in fact, a sense of belonging to one family—prevails.

WORKERS' PRIDE IN THE FACTORY

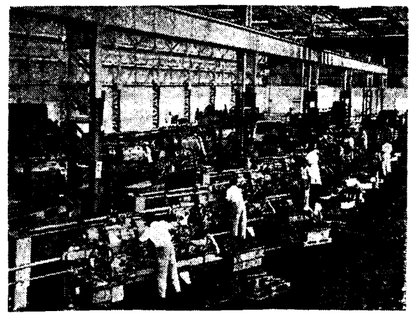
So, quite understandably, people at the Factory take great pride in taking a visitor around. On what was barren stretch of wasteland in 1952, you find, as you enter, well laid-out concrete roads bordered with flower-beds, flowering trees and creepers. The huge Factory sheds are laid out in a regular geometrical pattern. The Factory has the finest industrial gardens in the region.

Spotlessly clean workshop sheds, airy and well-lighted, have placed in them machines, big and small, in neat rows. All service lines, such as compressed air, water-supply and electricity, are taken through underground channels, neatly covered with chequered plates flush with floor.

The design of foremen's offices is a unique one, of cantilever construction, with glass shuttering all round, and commanding full view of the shops. Tools are stored in neat and attractive looking tool cribs designed for efficient storage and easy accountal. Tea trolleys noiselessly move about, providing tea on the work spot to workmen. Canteens are neat and cheerful places.

The Factory produces a new type of coach now adopted as standard for all broad-guage coaches in future. This coach combines three major factors—smooth running, light weight and strength—ensuring comfort and safety of the travelling public.

The design of the coach incorporates an all-welded trough floor, integral with the body, enabling the forces sustained by the coach to be borne by the entire body including the skin. It is this feature of the coach that gives it the name 'Integral Coach'.



At the Integral Coach Factory, spotlessly clean workshop sheds, airy and well-lighted, have placed in them machines, big and small, in neat rows. Photo shows a view of the Machine Shop.

The Integral coach also incorporates what is known as the anti-telescopic end construction. This reduces the possibilities of the coaches telescoping when an accident takes place. The coach incorporates several new features such as window frames and shutters of aluminium fitted as complete windows. They do not get jammed like the old wooden ones. Further, shutters and doors are fitted with rubber sealing at the edges—just like those in modern motor cars—to prevent dust and rain from seeping into the compartments.

The operating costs of hauling of such a light-weight coach are much less, its weight being 35 tons against 42 tons of the conventional type. This means economy in use of steel and economy in motive power, with the result that more passengers can be hauled with the same power—a factor for reduction of overcrowding. As the unsprung weights have been reduced to the minimum, the wear and tear on the track is also much less than in the case of the conventional coach.

STEADY EXPANSION

The Integral Coach Factory, which was initially producing only third-class coaches, has already started manufacturing third-class-cum-luggage vans and will soon be starting manufacture of complete first-class coaches.

In the remaining two years of the Second Plan the programme is to produce 355 third-class-cum-luggage coaches, 305 first-class coaches, besides 460 third-class ones. By the end of the Second Plan the Factory will have produced 1,822 coaches against the original target of 1, 137. Production is likely to be doubled when the second shift which is being gradually introduced, gets into full swing.

The first third-class-cum-luggage van was launched early this year. Soon the manufacture of the first-class coach will be taken in hand too. By the end of the current year, the Factory plans to turn out a first-class coach. The Factory has been entrusted with the manufacture of four prototype all-welded bogie wagons for the movement of iron are for export. These are now under construction. Later, the Factory will be designing postal vans and air-conditioned coaches. An all-coiled bogie for the power cars of de-luxe trains has also been designed. And this design has made possible a great reduction in the weight of bogies.

Though the permanent furnishing annexe, costing Rs. 3.7 crores, is in its early construction stage, furnishing of the shells has been started at the Factory with temporary arrangements and 20 coaches are now being turned out per month. When the permanent furnishing unit is ready, production will be stepped up to 350 per year and it has been decided that all the 305 first class coaches produced will be furnished at the Factory by 1960-61.

Paying a tribute to the Factory at the tremendous success achieved in the manufacture of broad-gauge integral coaches, the Ministry of Railways have now decided not to seek foreign technical collaboration in the establishment of the meter-gauge coach factory and that the Integral Coach Factory should act as the technical consultants.

With steady expansion in volume and range of production, specially after the introduction of the second shift, large potentialities of employment will open up at the Factory for engineering graduates, engineering diploma holders and other technical and non-technical personnel.

Training facilities are being rapidly expanded at the technical training school. Apart from training skilled workers and graduate apprentices, a new foundation course has been started for unskilled staff to open avenues of promotion to them. There is a refresher course for supervisors where lectures are arranged on production-planning and control, time and motion study, and principles of supervision.

To attract good workers and to keep up their enthusiasm and loyalty as happy members of the Integral Coach Factory family, amenities are being expanded too. The housing colony is being expanded. Two thousand of the workers have been confirmed on the 15th August, Independence Day, this year giving them security of service.

There is a staff council with elected members for suggesting improvements in working conditions and production methods. There is a suggestions and inventions scheme by which workers are encouraged to put up practical ideas for better production. There is a guardianship scheme by which supervisory staff take personal interest in batches of workers after working hours. To encourage team spirit and camaraderie, playgrounds have been provided at the Factory and there is a regular sports coach. The Factory has already first class hockey, football and athletics teams.

Taken all round, the Integral Coach Factory has conclusively proved that given sound training, equal opportunities and facilities, our workmen in India are second to none.

A. I. R. to train Railway Announcers

Announcers of the Indian railways are to be trained at the Bombay, Calcutta, Madras and Delhi stations of All India Radio.

The railways employ announcers at all major stations to make announcements relating to train arrivals and departures. They also make announcements calculated to develop civic conciousness amongst passengers. The object of the training is to ensure that these announcements are really effective. General Managers of all the Zonal Railways have been asked by the Railway Board to contact the A.I.R. authorities for starting the training of railway announcers early.

Temple Mills Marshalling Yard

Hump classification yard with two stages of retardation and two subsidiary yards

TEMPLE Mills Marshalling Yard, British Railways, Eastern Region, is situated between Stratford and Lea Bridge Stations on the former Cambridge main line from Liverpool Street via Stratford. During the latter part of the last century several yards were added to accommodate an increasing volume of freight wagons.

When, in 1954, it was decided to reconstruct Temple Mills as a new freight marshalling centre there were 10 yards at Temple Mills itself, and some five satellite yards in the outer London area. Reconstruction had become essential because the old layout caused a great deal of trip working between yards; many wagons having to be shunted several times before eventually leaving the final yard on the correct trains. The new layout was expressly designed to eliminate this and thus speed up the movement of freight wagons.

TWO-DIRECTIONAL WORKING

The new hump yard is designed for two-directional working and equipped with Westardair primary and secondary retarders. It consists of one main yard and two subsidiary ones. In the old layout the main lines ran through the middle of the existing yards, and to make room for the new layout they had to be diverted onto a new alignment on the south side of the site.

Towards the middle of the site the new main lines pass through the area which was occupied by the Temple Mills wagon repair shops. To clear the area for the realignment of the running lines the wagon repair shop had to be reconstructed on a new site. The wagon and lifting shop is built on piles and is 455 ft. long and consists of two low roof bays, each 75 ft. wide for the repair of wagons and one high-roof bay 50 ft. wide which serves the lifting shop. The building is constructed with side glass curtain walling and corrugated asbestos roof insulation. Roller shutter doors are fitted with air curtains which operate automatically when the doors are open. The shop is equipped with two wheel lathes, two journal lathes, an axlebar washing machine, an axle-journal turning and grinding machine, and a layout for the repair of vacuum cylinders.

RECEPTION SIDINGS

At the Lea Bridge or western end of the site there are 12 reception sidings on a straight alignment with wagon capacities varying between 42 and 75 wagons, giving a total standage capacity of 680 wagons. The sidings are laid at 12 ft. 2 in. centres to give an interval of 7 ft. 5⅛ in. between running edges, with a wide space of 14 ft. 5½ in. between the upper and lower groups for the installation of lighting masts.

The gradients of the sidings are rising at 1 in 1,615 for the first third of the length, rising at 1 in 460 for the middle third, and 1 in 40 up to the summit of the hump. Seven of the southernmost sidings can be entered from either direction.

Trains entering from the down direction come into the reception sidings on a special arrival road alongside the main hump, but at a lower level. The 13th siding on the south side serves as an engine line so that the hump shunting engine can return to the Lea Bridge end of the yard where there is a hump engine spur.

The arrangement of the connections at this end of the yard is such that the hump engine can return to its spur without interrupting the flow of trains from the running lines into the reception sidings. All these connections are power operated from Temple Mills West Signalbox.

SORTING SIDINGS

The sorting sidings are arranged in eight groups each of six sidings with a brake siding on the two outermost groups and a transfer road on the northernmost group. The groups are lettered A, B, C, D, E, F, G and H, from south to north, and the sorting sidings in each group are numbered from one to six in the same direction. The shortest siding accommodates 51 wagons, and the longest 82. The total standage capacity of the 47 sidings is 3,044 wagons.

The sidings are laid at 12 ft. 2 in. centres giving a 7 ft. 5⅛ in. clearance between running edges with 14 ft. 5½ in. spaces between the fans for lighting masts.

The hump cabin and its associated relay room are situated at the summit of the hump on the right hand side, and the control tower is on the centre line of the yard between the primary and secondary retarders.

DEPARTURE SIDINGS

At the Stratford end of the yard there is a group of eight departure sidings with capacities ranging between 55 and 71 wagons, and with a total standing capacity of 499 wagons. Departure is possible from all eight departure sidings in both the up and down directions.

The two subsidiary yards are known as the West and East Yards. The West Yard is situated to the north of the hump area and sorting sidings. It consists of 16 dead end sidings with a wagon standage capacity of 1,024 wagons and two reception lines accommodating 60 and 63 wagons. The yard has a small gravity hump 5 ft. high. The point assembly is connected to a ground frame housed in a building at the summit of the hump. This yard is used for secondary sorting and as a reservoir. The East Yard is situated to the north of the departure sidings and like the West Yard is used for secondary sorting and as a reservoir.

RETARDERS

The two stages of retardation are provided by two primary retarders and eight group retarders. The hump layout comprises a king turnout followed by the two primary retarders, two queen turnouts and four jack turnouts, immediately followed by the eight secondary retarders.

The retarders are Westinghouse electro-pneumatically operated Westardairs. The primary retarders are 75 ft. long overall, they have 22 operating cylinders each, and are automatically controlled. The group retarders are 49 ft. long overall, with 16 cylinders each. They are manually controlled.

Westardairs are of unit construction. The beams extend from one cylinder unit to the next, and are built together to form an articulated and flexible retarder. The brake shoes are arranged with their joints in the centre of each beam, so that when the retarder flexes at the beam joints, the shoes, which are continuous over these joints, allow the wagon wheels to pass the joints smoothly without any variation in breaking effort. The shoes are of special steel to provide flexibility and a good co-efficient of friction with durability.

The retarders operate on the nut-cracker principle. A pair of levers are mounted on a fulcrum below the rail, the levers extending outside the track, with the cylinder attached to the upper lever and the piston rod to the lower lever. The upper lever carries the outer beam and the lower lever the inner beam. When the cylinder operates the upper lever is raised and the lower is depressed so that the beams are thrust towards each other and the shoes grip the wheels of the wagons as they pass through.

Should a wagon be rocking from side to side there is no variation in grip on the wheel, for the whole lever assembly can swing on the fulcrum to follow the sideways motion of the wheel. Because of the articulated construction any variation in wheel width in a cut of wagons does not affect the grip on individual wheels.

CONTROL OF RETARDERS

Control of the primary retarders is automatic with overriding manual control. Each of the retarders is divided for control purposes; the first five pairs of cylinders are controlled by one valve unit and the remaining six pairs of cylinders are controlled by a second valve unit. These valve units are specially developed for use with the automatic control.

The track through the primary retarders is divided into three rail circuits; the first controls the application of the automatic control to the first valve unit, and the last two perform the same function for the second valve unit. Two rail circuits are used in the second part because the queen points are immediately after the retarders, and point protection must start in the retarder to be adequate. The last rail circuit of the retarder, therefore, performs two functions. First, in conjunction with the second retarder rail circuit it controls the retarder; secondly, in conjunction with the rail circuit over the switches of the queen points it forms the point protection rail circuit and thus controls the route setting over these points.

The automatic control of the retarders is effected by making use of the Doppler effect to measure the speed of the cuts by three R. F. units, the first measuring speed to give the rolling resistance of the cuts. The cuts are classified accordingly and each classification has a leaving speed allotted to it. The remaining two R. F. units are used to measure the speed of the cuts in the first and second parts of the retarder respectively, and take part in controlling the retarder application.

These speed measurements determine the leaving speed from the retarder so that cuts arrive at the group retarder correctly spaced, that is the better running cuts are so retarded that they do not close up on preceding poorer running cuts between the primary and group retarders and so prevent correct routing nor do the cuts enter the group retarders before a preceding cut has left the retarder, unless the preceding cut had been stopped due to some emergency.

In addition, for each primary retarder there is a "weigh rail" which classifies the cuts into three categories: light, medium, and heavy. This information is passed to the automatic control gear and selects the maximum pressure to be applied to the retarder for the cut concerned. The leaving speed having been selected, pressure is applied should the speed be in excess of this. When the cut speed has fallen to the required value the retarder is released, so that the cut leaves at the correct speed Should the cut accelerate whilst still in the retarder after being released, then the pressure will be reapplied to correct the speed of the cut. By this means the leaving speed of the cut is controlled to within very small limits.

SECONDARY RETARDERS

The group retarders are controlled as one unit, although there are two standard simplex valves per retarder which operate in parallel under the control of push buttons on the control desks in the control tower. There are five push-buttons for each group retarder; off, 1st pressure, 2nd pressure, 3rd pressure, and 4th pressure. Also on the control desks there are similar sets of push-buttons for each valve unit of the primary retarders. On each control desk in the control tower there are therefore, two sets of five push-buttons above a primary retarder and four sets of five push-buttons along the lower edge of the desk directly below each group of sidings, one for each group retarder. In addition each primary retarder has an auto/manual switch mounted above its control buttons, to select automatic or manual control.

Indications of weight and rolling resistance are shown on the desks, in illuminated panels adjacent to the primary and group retarders. These indications are incorporated in the cut indication panels. For the weight, "H" indicates heavy and "L" indicates light, and "HL" indicates medium, similarly for rolling resistance, "G" indicates a good roller, "B" a bad roller, "BG" an average roller. The combinations "HL" and "BG" were used because of space considerations, as this arrangement avoids the use of separate indicating lamps for medium weight and average roller.

The retarders are powered by compressed air at a maximum pressure of 120 lb. per sq. in. which is produced by three electrically driven air-compressors housed within the control tower building. Two of these compressors are selected as duty compressors at any one time whilst the third acts as a stand-by.

Lighting for night working in the yard is by colour-corrected mercury-vapour lamps mounted on 72 50-ft. tubular steel towers installed throughout the yard.

SIGNALLING

The signalboxes have been equipped with panel keys for operating signals on the entrance-exit principle. The control panel at Temple Mills East signalbox has on illuminated operating panel showing the layout of the lines and connections located within the control area of the box. Rotary keys for each signal or group of signals are located on the diagram. These are the "entrance" keys. At the remote end of each signal route on the panel layout is a push-button key, known as an exit key. The method of operation is similar in the Temple Mills West box, although a different type of electro-magnetic "point set" indications are provided.

TELECOMMUNICATIONS

The telecommunications network throughout the yard comprises a 100-line private automatic branch exchange. All signalboxes and offices have an automatic telephone. There is also a two-way radio network which provides constant radio communication between shunting engines and the hump cabin and control tower. A loudspeaker system has also been installed to enable the control tower operators to speak to shunters and other staff in the yard or departure areas by throwing the appropriate keys on the control panel. Construction of the yard was under the general direction of Mr. A. K. Terris, Chief Civil Engineer, Eastern Region. Mr. K. J. Cook, Chief Mechanical & Electrical Engineer, was responsible for the supply and installation of mechanical and electrical equipment, and Mr. R. A. Green, Signal Engineer, for the resignalling and telecommunications. Earthworks and track laying was carried out under the direct supervision of the District Engineer, Stratford, whose labour forces were augmented by those of Tersons Limited.

The principal sub-contractors are :—

Retarder and signalling equipment associated with the hump cabin and control tower, wagon counting equipment, and the wagon description system	The Westinghouse Brake & Signal Co. Ltd.
Domino panel indications for the control tower	Tyer & Co. Ltd.
Signalling equipment associated with the Temple Mills West and Copper Mills Signal-boxes	Metropolitan—Vickers G.R.S. Limited
Signalling equipment associated with Temple Mills East and Manor Yard Signal-boxes	The Siemens & General Electric Railway Signal Co. Ltd.
P. A. B. X. telephone equipment	The Reliance Telephone Co. Ltd.
V.H.F. radio telephone equipment	Marconi's Wireless Telegraph Co. Ltd.
50-ft. lighting towers	Tubewrights Limited
Yard lighting equipment	General Electric Co. Ltd.
Transformers	Metropolitan—Vickers Electrical Co. Ltd.
High-voltage switchgear	British Thomson-Houston Co. Ltd.
High-voltage cables	Johnson & Phillips Limited
Yard lighting installations	Clough Smith & Co. Ltd. Johnson & Phillips Limited
Control tower and main buildings	Kirk & Kirk Limited
Shunters' cabins, etc.	J. & J. Dean Limited
General engineering	W. & C. French Limited
Piles	Holmpress Piles Limited

Diesel-Electric Mixed-Traffic Locomotive for Overseas Service

Prototype 1,100-h.p. Co-Co design to meet a wide range of specification requirements

INTENDED primarily to meet the light axle loading requirements of many railways overseas, a prototype diesel-electric mixed-traffic Co-Co locomotive, named "Explorer," has been produced as a joint venture by the British Thomson-Houston Co. Ltd. and Lister-Blackstone Rail Traction Limited. It will be shipped shortly to Kenya for service testing on East African Railways & Harbours, including some steeply graded lines.

The power equipment is a turbo-charged 12-cylinder Blackstone Type ERS 12T. diesel engine, driving, through a speed increasing gear, a B. T. H. 675-kW. generator. At the B. S. rating of 1,100 b. h. p. at 800 r. p. m. an ample power reserve is available to meet the operating altitude and tropical temperature conditions. Separate motors are fitted to each axle of the two six-wheel bogies.

Leading particulars of the prototype recently completed are as follow :—

Gauge	Metre
Wheel arrangement	Co-Co
Maximum speed	55 m. p. h.
Weight	72 tons
Tractive effort—maximum	42,000 lb.
Tractive effort—continuous	24,000 lb.
Fuel tank capacity	500 gal.
	ft. in.
Length over headstocks	49 0
Height overall	12 9
Width overall	9 9
Bogie wheelbase	12 0
Bogie pivot centres	30 0
Wheel dia.	3 0½
Minimum radius of curve	300 0

The design allows of simple modification to meet alternative specification requirements. The gauges for which the basic design is intended range from metre to 5 ft. 6 in. with a standard frame. Provision is made for multiple-unit working, right-hand or left-hand driving positions, reductions in overall width or height, alternative braking equipment, and different axle loadings. The maximum speed is 55 m. p. h. and continuous tractive effort 24,000 lb. The "Explorer" is intended for mixed traffic working on main and branch lines. The bonneted type of construction was chosen to facilitate servicing in tropical conditions.

MAIN AND AUXILIARY EQUIPMENT

The main bonnet, forward of the cab, is divided into three compartments. In the leading compartment are the cooling group, one traction motor blower, one motor-driven exhauster, and two forced-draught cooled dynamic brake resistor units. In the central compartment are the engine, two shaft-driven air compressors, two air receivers, and the engine coolant header tank. The engine inlet air filters are in the bonnet sides and the twin exhausts discharge through the roof. In the generator compartment, adjacent to the cab, is an air receiver.

At the rear of the cab is a short bonneted compartment which houses the main electrical control panel, dynamic brake control panel, one traction motor blower, one exhauster, and one air receiver. This compartment and the engine compartment are slightly pressurised with filtered air to prevent the entry of dust.

The bonnet casings are carried on a welded structure of steel angles. A considerable area of each side is occupied by removable louvred panels covering the panel type air intake filters. Access to the main equipment for servicing is by hinged doors. Inspection hatch covers are fitted over the engine, and also give access to auxiliary equipment. At each corner of the frame are steps, with a continuous handrail between the steps and the cab.

CAB

The cab is over the centre of the rear bogie. It contains duplicate driving controls and instruments for travel in either direction. The driving seats are upholstered and adjustable. At the left of the seat is the power handle of the master controller, with the reverser handle immediately below. These two controls are interlocked to prevent movement of the reverser when the power is switched on. The straight

air brake control is on the right. In front of the seat are the dynamic brake, vacuum brake, and automatic air brake controls.

Above the controls is a panel carrying the ammeter, speedometer, and the air brake and vacuum gauges. The engine instrument panel is fitted in the centre of the front bulkhead above the handbrake. Laycock pneumatic wipers are fitted to the driving screens.

The cab also includes a warming plate, lockers for food and clothing, and a ventilating fan. The cab roof and sides are insulated with glass wool. There are access doors from the front and rear platforms behind each seat, and Beclawat sliding windows at each side of the cab.

POWER UNIT

The Lister-Blackstone 12-cylinder engine is rated at 1,100 b. h. p. at 800 r. p. m. It is a double-bank version of the makers' six-cylinder unit. The two vertical banks are bolted back-to-back on a common base, with an output gear on each crankshaft meshing with a main drive gear.

This construction facilitates acceleration from 800 r. p. m. to 1.125 r. p. m, which allows a lighter generator to be used. The bore is 8.75 in. and stroke 11.5 in. Each bank has a Napier turbo-charger.

Each set of six cylinders is a self-contained unit, with fuel injection equipment, governor, oil and water circulating pumps, and valve gear camshaft. This makes possible a considerable degree of standardisation in manufacture. In an emergency, the drive from one crankshaft can be disconnected and the locomotive run on reduced power.

The cylinder block is a welded steel fabrication fitted with cast-iron wet liners. In servicing the aluminium alloy pistons may be withdrawn upwards through the bore or downwards through the crankcase side covers.

The ensure even loading and a smooth drive from the two crankshafts to a common output gear, the drive from each shaft is taken through a Blackstone flexible coupling and nodal damper. The latter is a grease-filled multi-plate clutch arranged to impose a viscous drag on the oscillation of the flexible coupling. Rubber, bonded to the input and output members, ensures a high degree of twist under load. This prevents any torque reversal from being transmitted to the gear teeth. At the front end of each crankshaft is a hydraulic type torsional vibration damper.

Protection equipment stops the engine if the oil pressure drops in the engine or gearbox and if overspeeding occurs.

The combined engine-generator set is flexibly mounted on eight rubber mountings.

COOLING

The cooling group at the forward end of the bonnet is a twin fan unit, drawing air through radiator side panels and discharging through the roof. Each panel is built in sections, which are mounted on Silentbloc rubber bushes.

Two-speed electric motors with thermostatic regulation drive the axial flow fan. Coolant circulation, under thermostatic control, is by two engine-driven centrifugal pumps. Separate sections are provided in the radiator for the cooling of the engine lubricating oil and the output gear oil. The total coolant capacity, including the header tank, is 50 gal.

In the construction of the Alsthom bogie rubber cone pivots are used for body suspension. The bogie frame members are welded steel fabrications of box form,with fixed bolsters. There are four spring-loaded side bearers and two rubber cone pivots. The pivots are supported on the fixed bolsters on rubber pads, which allow side movement in shear.

To permit maximum articulation the inner pivot assembly of each bogie is free to slide as a unit. The periodicity and lateral damping of the suspension can be varied by adjustment of the side bearer springs. Primary springing is by underhung equalising beams and coil springs.

The guideless Skefko roller bearing axleboxes are carried on rubber bushed radius rods, so eliminating horn guide wear.

The main underframe is a welded structure of rolled sections and plate, with diagonal bracing in the end panels to transfer the loading of the central buffers. Extensive lightening holes are cut in the vertical webs of the main longitudes and cross-members.

BRAKING

Equipment is provided for the brake operation of both vacuum and air-braked stock. In addition, an electro-dynamic brake is fitted on the locomotive. The mechanical braking is Westinghouse equipment. Two brake, cylinders fitted on each bogie operate single shoes on each wheel. When hauling unbraked stock braking is controlled by a self-lapping straight air brake valve. With vacuum-braked stock the locomotive air brakes are controlled through the vacuum brake valve. The hand brake, operates on four wheels of one bogie.

DYNAMIC BRAKE

The dynamic brake is a non-friction brake applied to the axles instead of the wheels. When it is applied, by a normal type of control in the cab, the six traction motors are switched to act as generators driven by the wheels. The control is not interlocked with the mechanical brakes, and both systems may be used together if required. Further details of this equipment are given below.

ELECTRICAL EQUIPMENT

The B. T. H. Type RTB 14440 main generator is single-bearing and self-ventilated, flange mounted to the engine. The continuous ratings at 1.125 r. p. m. are 675 kW. 1,310 A. 515 V. and 670 kW. 2,310 A. 290 V. The generator is 10-pole with class "B" insulation. It incorporates a starting winding for motoring the engine.

At the frame end the field windings are retained by leaf springs. The armature spider, on which the laminated core is assembled, is bolted direct to the engine drive, and at the rear end is supported by a self-aligning roller bearing.

Through cooling ducts in the spider a steel fan draws filtered cooling air over the commutator and brush gear. This air is discharged through a division bulkhead into the engine compartment. A feature of B. T. H. machines is the use of B. T. H. Pollack type commutators, in which each segment is retained by a locking key giving a continuous support over the full length.

AUXILIARY GENERATOR

The auxiliary generator is a B. T. H. machine type RTB 7428 with a continuous rating of 48 kW., 110 V., 700-1,125 r. p. m. Voltage control is by a Brown Boveri automatic voltage regulator. This generator is flange-mounted to the main generator. A belt-driven exciter is saddle mounted on the auxiliary generator.

The traction motors have a continuous rating of 385 A. 290 V. at 440 r. p. m. These are of the B. T. H. Type 138, force-ventilated, and axle-hung on plain bearings. The reduction gear is cushioned by a torsionally resilient gear in the drive. Class B insulation is used and the motor bearing arrangement is designed to facilitate armature removal.

CONTROL OF BRAKING

When the electro-dynamic brake is used the motors are switched to act as generators driven by the wheels. The current produced is dissipated through banks of resistances. Control of the braking is by varying the field current in the motor, which is performed by pilot contacts and a rheostat on the brake control in the cab. Switching is effected by contactors on the control panel in the compartment behind the cab. The resistors are force cooled by a motor-driven fan.

In the control cubicle electro-magnetic contactors are used for the auxiliary and control circuits and electro-pneumatic contactors for the motor circuits. One step of field weakening is automatically introduced, dependent upon the speed and load.

Contractors include :—

Joint main contractors Electrical equipment	British Thomson-Houston Co. Ltd.
Diesel engine	Lister Blackstone Rail Traction Limited
Principal Sub-contractor Mechanical parts including bogies	Clayton Equipment Co. Ltd.
Other sub-contractors Axle boxes	Skefko Ball Bearing Co. Ltd.
Battery	Chloride Batteries Limited
Bogie pivots and axlebox links	S. G. de Constructions Electriques & Mecaniques Alsthom
Brakes, compressors and exhausters	Westinghouse Brake & Signal Co. Ltd.
Cable	Siemens Edison Swan Limited
Conduit	Simplex Electric Limited
Engine cooling equipment	J. W. Lawrence Limited
Filters	Air-Maze Limited
Oil and fuel pumps	Varley-F. M. C. Limited
Fuel injection equipment	C. A. V. Limited
Traction motor blowers	Aerex Limited
Voltage regulator	Brown, Boveri & Co. Ltd.
Wheels and axles	Taylor Bros. & Co. Ltd.

India Big Market for Refrigeration and Air Conditioning

A continuously expanding market for industrial air conditioning and refrigeration equipment in India was forecast recently by Ram D. Malani of Blue Star Engineering Co. (Bombay) Prvt., Ltd.

Refrigeration and air conditioning sales for industrial uses could well double over the next five to ten year period, according to Malani, Managing Director and Chief Engineer of the Air Conditioning and Refrigeration Division of Blue Star.

The Indian executive made this prediction while attending Worthington Corporation's (U. S. A.) second international air conditioning conference in San Juan, May 14-16. The affair was attended by Worthington distributors and representatives from 14 countries.

The representative from Worthington's Indian distributor based his prediction on the fact that many of the industrial plants presently under construction in the country will require air conditioning or refrigeration because of the nature of the various production processes and the products involved.

The drug, textile and food industries were all cited as examples of growing industries that require process air conditioning or refrigeration.

The future of comfort air conditioning for office buildings and the like was described by Malani as being uncertain at this time because of foreign exchange problems and government policies regarding the importation of products regarded as luxuries.

Malani noted, however, that India's own air conditioning industry is undergoing an expansion. In 1955, only 4,000 room units were assembled and manufactured in India. This production has since risen to more than 12,000 units.

Blue Star's executive noted that imports of all types of air conditioning and refrigeration equipment from the U. S. have gained close to 50 per cent in the past five years and now stand at about 1.6 million dollars (US). This, he said, attests to the vitality and the potential of the Indian market for these products.

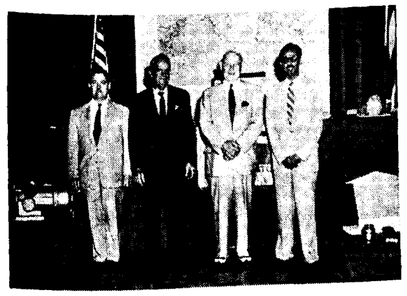
He went on to say that any industrial expansion helps to make India more self-sufficient and that industrial air conditioning and refrigeration equipment is making an important contribution to such expansion.

"One can hardly find a more vital industry from a local point of view than Alembic Chemical's Baroda penicillin plant where two Worthington centrifugal compressors installed by Blue Star are supplying 600 tons of process air conditioning," Malani said, emphasizing the fact that without the air conditioning equipment the plant "just could not exist at all."

During his stay in San Juan here in the Caribbean, Malani attended a number of engineering discussions and exchanged views and marketing information with Worthington distributors from points as far apart as Santiago (Chile) and Karachi. He also heard talks by Worthington board chairman Hobart C. Ramsey and S. Riley Williams, Worthington vice president in charge of international operations.

Chairman Ramsey's speech in itself had important implications for India. At one point he said: "....the time is within sight when we can contract for a major installation in such a nation as India, for example, and the compressor would be built at a Worthington plant in the United States, the condenser would be built by our Italian affiliate and the air handling unit would be made in Brazil by our associated company there. All of this would be co-ordinated by the sales, design, installation and service know-how of our distributor in India, Blue Star."

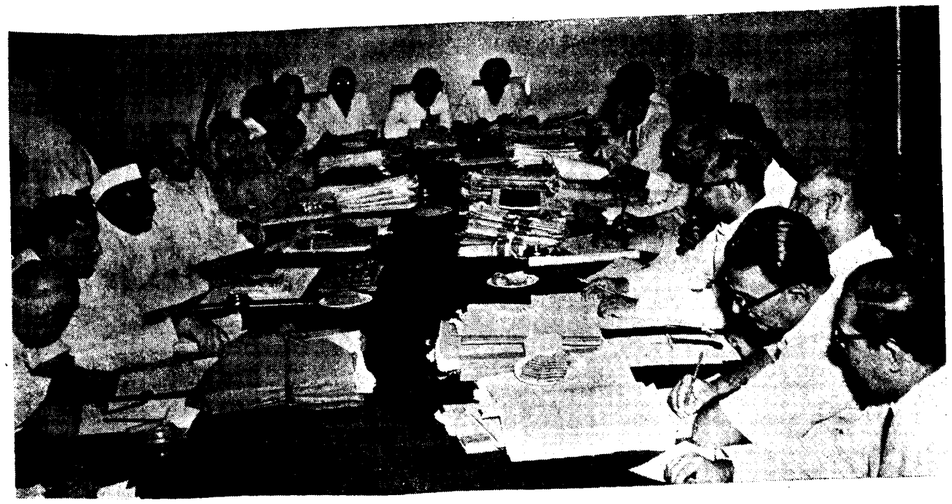
This, chairman Ramsey said, would result in a product priced in a currency that "makes most practical sense in a given international market."



Ram D. Malani, chief engineer of Blue Star Engineering Co. (Bombay) Prvt., Ltd., (right) is shown with (left to right) N. A. Gardner, manager of Worthington (U.S.A.) international air conditioning and refrigeration sales, S. R. Williams, Worthington vice president in charge of international operations and H. C. Ramsey, chairman of the Worthington board of directors, during recent international air conditioning and refrigeration conference in San Juan, Puerto Rico. The three-day conference was attended by Worthington distributors and representatives from the Far East, Mid East, Australia, South America, the Caribbean area, Mexico and the U.S.

Kashmir-born Brij M. Chharbra, Worthington specialist in industrial refrigeration who works in the Worthington international operations department, also addressed the conference—speaking about commercial and industrial refrigeration. Chharbra, a graduate of the universities of the Punjab and Kashmir and the University of Washington (Seattle), went to the U. S. about eight years ago and joined Worthington in 1955. Since then, he has been an instructor in the Worthington Air Conditioning & Refrigeration Student Training Program.

After he leaves Puerto Rico, Malani will spend some time in the United States before returning to Bombay.



Hon'ble Shri Jagjivan Ram, Railway Minister, addressing a meeting of the Chief Operating Superintendents of Indian Railways in New Delhi.

Air conditioning, Refrigeration making gains in South East Asia

AIR conditioning and refrigeration are on the upswing in South East Asia, according to Morton R. Berger, resident sales engineer for Worthington Corporation in the South East Asian countries.

Berger, interviewed at Worthington's headquarters during a business trip to the U. S., said, however, that the real future of air conditioning and refrigeration in Asia is contingent on availability of foreign exchange. Current dollar shortages have forced some governments to put restrictive import duties on refrigeration and air conditioning equipment or to block their import altogether, he said.

Any easing of the foreign exchange situation will immediately be reflected in an upturn in sales, Berger feels. His confidence is based on the almost unlimited market potential for air conditioning and refrigeration equipment throughout the area.

For instance, the Worthington engineer noted that according to official policy every government building in India is eventually to be air conditioned. While lack of exchange presently makes it impossible to install equipment in many of the buildings currently under construction, practicaily all are designed with air conditioning in mind.

In Pakistan, Berger said that there is a pressing need for refrigeration equipment to be used in cold storage facilities for food. He noted that Pakistan's Sind Valley is capable of producing almost enough food for the entire country but because there are no cold storage facilities, most of the fruits and vegetables grown in this rich area do not reach the markets of many cities.

In spite of these exchange shortages, a considerable amount of air conditioning and refrigeration has been installed in Pakistan and India. The largest percentage of these installations have been in industrial plants.

For example, 6500 horsepower of Worthington equipment is installed in the Sindri Fertilisers & Chemicals Ltd. ammonium sulphate fertilizer plant in Sindri. Installed by the Chemical Construction Co. and serviced by Blue Star Engineering Co. (Bombay) Pvt., Ltd., the refrigeration system is the largest in India and one of the biggest in the world. The same firm has also installed process air conditioning equipment in several other factories, including a large penicillin plant.

In Pakistan, the Worthington distributor, Jaleel Bros., Karachi, recently installed 400 tons of Worthington equipment in the country's largest drug manufacturing facility—also a penicillin plant.

Berger said the fact that industrial applications get priority when dollars are available is indicative of the understandable desire of the people and governments of Asian countries to take care of first things first. "Comfort air conditioning," he said, "will have to come later in most of these countries except when it is vital to productivity in offices and factories."

Burma, said Berger, is in the same boat as India and Pakistan. Without dollars, this country is right now not considered much of a sales prospect.

Thailand, however, is a different matter. There are no dollar problems, the climate is right and there are no import restrictions The thing that's holding the market there back at the present time is the lack of electric power. However, by 1961 a number of power projects will be completed and the market for air conditioning and refrigeration should expand rapidly.

The market possibilities in both Borneo and Malaya are tied to the future of these countries' exports. In Malaya, tin is the principal export and although it has taken a drubbing in the international market recently, the future looks better. Oil and lumber wealth in Borneo make it a strong possibility for future sales of comfort air conditioning equipment, Berger concluded.

Adcock & Shipley's range of production

By An Engineering Correspondent

ADCOCK & Shipley Ltd. who have been Machine Tool manufacturers since July, 1914, type manufacture a range of Knee and Column Milling Machines from table sizes of 300 × 130 mm. up to 1830 × 430 mm. with horse powers ranging from 1 to 25.

In addition they also manufacture a 1″ capacity Radial Drill and Special Purpose Machine Tools including Cotter Slot and Keyway Cutting Machines for railway locomotive work, Centring and Facing Machines and Deep Hole Drilling Machines.

The smallest machines in their range are the No. 0 size as shown on the illustration '1'. These machines can be provided with speeds as low as 150 r. p. m. or as high as 4,000 r. p. m. They can be provided with lever or screw hand feed, automatic feed, semi-automatic cycle or fully automatic cycle.

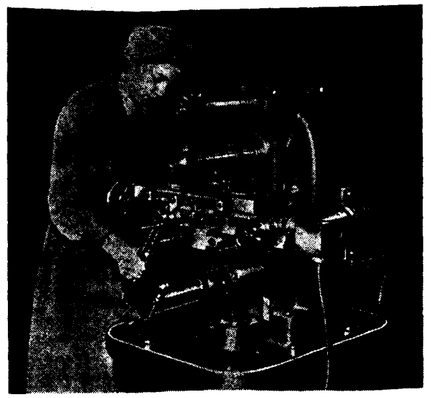


Fig. 1

The fully automatic cycle machine, as shown on illustration '2', can be arranged with an air vice to give automatic clamping and unclamping in the machine cycle. These very small automatic cycle machines have made a tremendous impression at exhibitions all over the world, being demonstrated on machine cycle times as low as 1½ seconds.

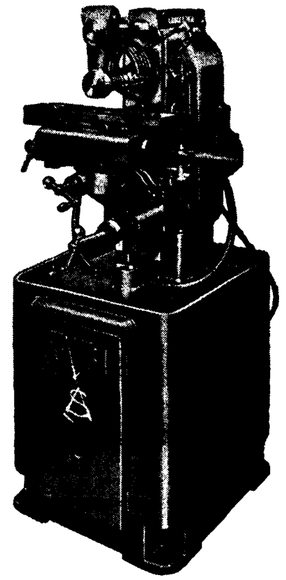


Fig. 2

The No. 1 size machines are extremely sturdy for their size and are available with the same range of feed machanisms as the No. 0.

In the No. 2 size both universal and plain millers are available of simple types or with rapid traverse all ways, backlash eliminators with hardened table screws, push button oiling, etc.

The illustration '3' shows the model 2JUR which is the latest and most sophisticated machine in this size.

In this size there are also available fully automatic cycle machines for batch and series production equipped with a very wide range of speeds and feeds.

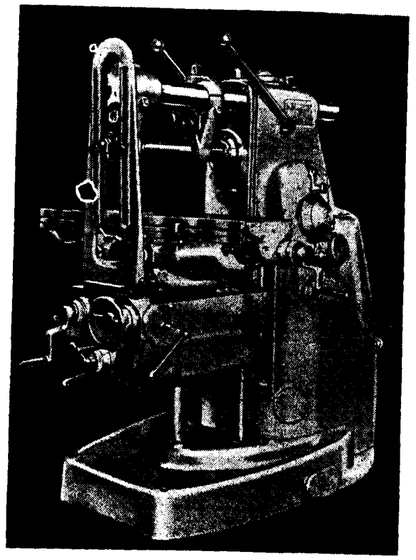


Fig. 3

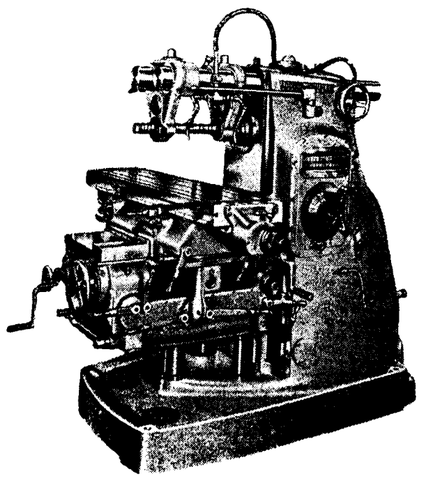


Fig. 4

Illustration No. '4' shows a model 3HG machine which is typical of the No. 3 and 4HG range of Adcock & Shipley. The No. 4 machine weighs 6,650 kilograms and is equipped with a 25 horse power motor, automatic lubrication to all slides and screws, positive backlash eliminator incorporating hardened table screws, five spindle bearings and all hardened and ground speed gears. These machines are suitable for tungsten carbide milling using negative, zero or positive rakes and, in addition, they have been very successfully used on the latest high speed milling techniques using very high positive rake angles.

The No. 3 size machine was demonstrated in 1958 at the American Society of Tool Engineers' Exhibition in Philadelphia at feed rates of 30" per minute climb milling mild steel.

These machines can be fitted with a Heavy Duty Vertical Milling Attachment, as shown on illustration No. '5', this attachment being capable of transmitting the full horse power of the horizontal spindle This attachment readily converts a horizontal machine into a heavy duty vertical capable of extremely high rates of metal removal.

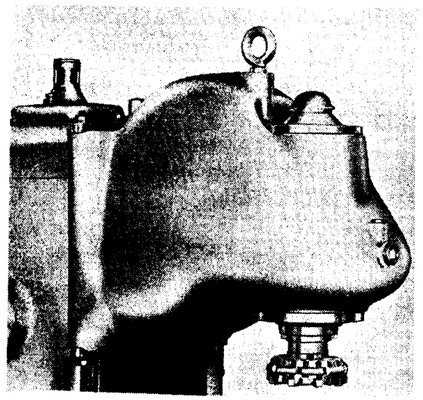


Fig. 5

Adcock & Shipley have recently announced the signing of a licence agreement with Bridgeport Machines Inc. of Bridgeport, Connecticut, U. S. A., whereby they will manufacture the Bridgeport Milling Machine for sale in all parts of the world except the Americas and Japan. The Bridgeport was the original

Turret Milling Machine and its popularity has grown so much that from a small beginning in 1938 production finally reached the rate of 125 machines *PER WEEK* in 1958.

Over 43,000 Bridgeport Milling Machines are in use and they are an ideal machine for any machine shop.

The basic machine is shown on illustration No. '6', but a full range of attachments are available including shaping and slotting attachment, high speed heads, hydraulic duplicating, equipment for co-ordinate drilling and boring using measuring bars or optical methods.

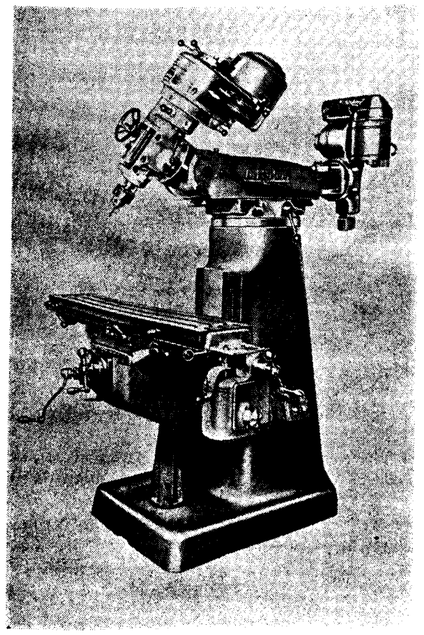


Fig. 6

Adcock & Shipley's Model SV Radial Drilling Machine has been made by them now for many years but has been the subject of continual development. The latest model produces horse powers up to 3 and, as will be seen from illustration No. '7' is equipped with a box table to give maximum rigidity. Although a 36" machine with 1" drilling capacity, it is designed on the lines of a big radial incorporating most of the features desirable on such machines.

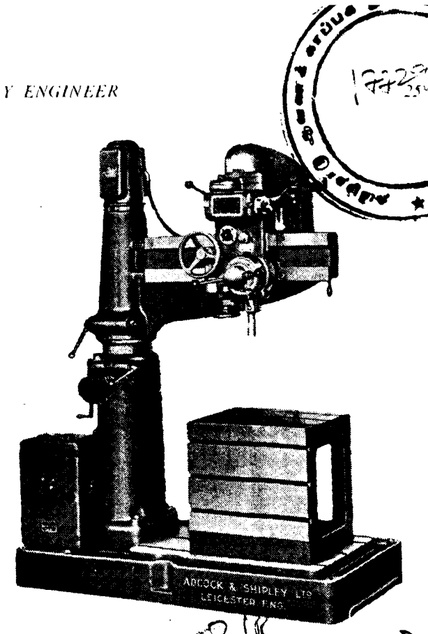


Fig. 7

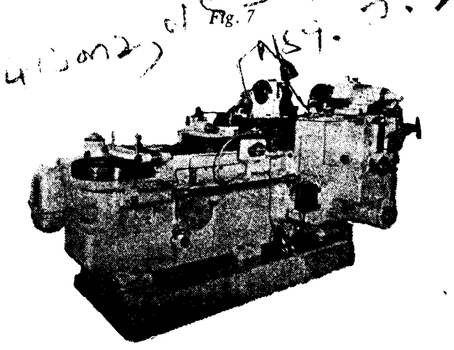


Fig. 8

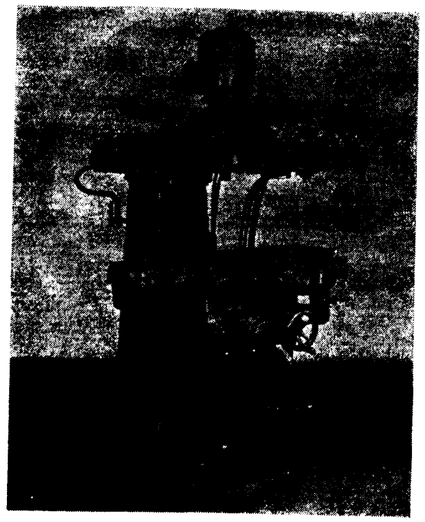
Adcock & Shipley's range of Special Purpose Machine Tools is well exemplified by the illustration No. '8' of the size 1 Cotter Slot and Keyway Cutting Machine. This machine is intended for cutting parallel or taper cotter slots and keyways in heavy components such as are used in the railway industry. A large size No. 2 machine is also available.

Adcock & Shipley's range of manufacture is completed by a range of glass working machines which they make. These machines are used by well-known optical lens manufacturing companies in all parts of the world.

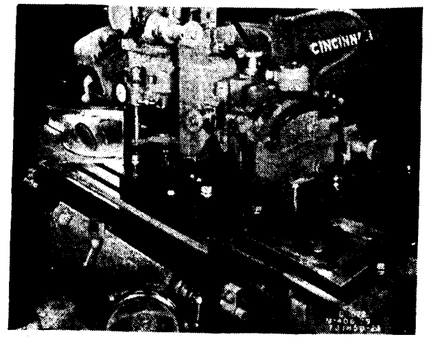
New Cincinnati Contourmaster Milling Machine with 3D Hand Hydraulic Tracing Control

A NEW Contourmaster Milling Machine, equipped for three-dimensional hand guided hydraulic tracer controlled milling, was recently announced by The Cincinnati Milling Machine Co. This new machine, designated 1C, retains the basic advantages and design characteristics of the 1A and 1B styles introduced at the last machine tool show. The principal difference is in the type of tracing equipment: vertical automatic depth control to the spindle for the 1A and 1B styles, and 3-D hand guided hydraulic tracing for the 1C style.

The new 3D unit controls the direction of traverse of the table and saddle for 360 degree horizontal profiling, and the vertical movement of the spindle quill for vertical profiling. Deflection of the stylus results in a corresponding movement of the table, saddle, and spindle quill; separately or in unison. Hydraulic motors perform the actual work of traversing the saddle and table units through feed screws engaging anti-friction nuts. 360° horizontal feed rates, within the limit fixed by a knurled adjusting dial above the tracer finger, are controlled by the amount of tracer finger displacement. A maximum of 25″ per min. may be obtained. When the tracing



New Cincinnati No. 1C Contourmaster Milling Machine.



Setup for milling a saw-handle mold on the new Cincinnati No. 1C Contourmaster. The need for 360° profiling is obvious. The need for depth control, which may not be obvious, is readily apparent after noting the taper formed by the bottom section of the template. Finished mold at the left.

unit and quill are in the fully retracted position, a rapid traverse rate of 50″ per minute is available for positioning the table and saddle. Of course, the conventional handwheel controls can also be used for positioning.

A vertical feed adjusting dial, also above the tracer finger, determines the maximum "down" feed rate of the spindle. This feature is useful when machining hard, tough metals.

In all, four distinct combinations of feed movements are available on the new Cincinnati 1C Contourmaster:

(1) All three movements "active" for complete three-dimensional control.

(2) Vertical movements "blocked out" for 360° profile milling in a horizontal plane.

(3) Cross feed "blocked out" for depth control milling, using vertical feed and table feed.

(4) Table feed "blocked out" for depth control milling, using vertical feed and cross feed.

Power feed in a straight line, using the table or cross traverse, can also be engaged without constant hand deflection of the tracer finger. The device for this feature, mounted on top of the 3-D unit, holds the tracer finger in any desired deflected position. A control knob engages and disengages the mechanism.

In one setting, the full 22″ table travel and 10″ cross travel can be used for 360° hand guided profile milling cuts. Ram mounting of the spindle carrier permits the milling of work wider than 10″ in two settings. Vertical range of the spindle quill is 3-1/2″. A one hp. motor drives the spindle. There are eight speeds, 215 to 5650 rpm.

Additional information may be obtained from The Cincinnati Milling Machine Co., Cincinnati 9, Ohio. Telephone RE 1-2121. Ask for their Publication No. M-2008.

COAL DUST FOR USE IN CAST IRON FOUNDRY

Cast Iron is one of the basic materials to the engineering progress and plays an important role in the country's economy. It constitutes the major foundry metal in the country and requires scientific control for doing its production.

A number of materials are used in the foundry to give protection to mould and core surfaces against the action of liquid metals and help in producing a smooth and clean casting. Coal Dust is one such carbonaceous facing material which is mixed with green sands in cast iron foundry. When molten metal comes in contact with mould surfaces containing coal dust, a gaseous envelope is formed which resists fusion of sand to the metal. A tar produced during the process has a binder effect to the mould. It improves casting finish, increases both dry and green strength, and also reduces expansion.

With a view to prescribing the requirements for coal dust for use in cast iron foundry, the Indian Standards Institution has drafted a specification for Coal Dust for Use in Cast Iron Foundry. [Doc: SMDC 17 (155)].

Importance of Rail Systems to Economy

ADEQUATE rail transportation systems are absolutely essential for productive economies, engineers from two widely separated parts of the world said recently.

The engineers, representing Brazilian and Nationalist Chinese railroads, expressed this opinion during interviews while attending General Electric's (U. S. A.) Locomotive & Car Equipment Department diesel-electric locomotive training school in Erie.

The engineers' views were based on the fact that railroads offer the only effective means of moving large quantities of either raw materials or finished goods over medium to long distances.

International General Electric, in co-operation with ICA, arranged for the Brazilian railroad men to attend the Erie school.

The Far Eastern engineers represented the Taiwan Railway Administration. Attending the school at the same time was a mechanical engineer from the Yugoslav Railroad. While in Erie, the group received training in diesel-electric locomotive maintenance and in operating techniques.

All of the engineers agreed that diesel-electric motive power was much more efficient than steam locomotives. The operating economy of diesel fuel was cited as being the major cause of this higher efficiency.

All of the engineers had warm praise for G-E and congratulated the firm for its technical assistance program which it implements through the training school.

Brazilian, Nationalist Chinese and Yugoslavian railroad representatives at General Electric (U.S.A.) Locomotive & Car Equipment Department diesel-electric maintenance and operation training school, Erie, Pennsylvania. Left to right: F.G.Cruz, General Electric S.A., Rio, interpreting; J. Podskalny, instructor; Tung-Tsing Wu, Taiwan Railway Administration; Chen-yeng Wu, Taiwan Railway Administration; J. Faibicher, Santos a Jundiai Railroad, Brazil; S.A. Sida, Yugoslav Railroad; M. Pessoa, Leopoldina Railroad, Brazil; G.A. Knechtel, Rede Viacao Parana - Santa Catarina Railroad, Brazil.

To date, some 90 engineers from 14 railroads in 11 countries have received training in diesel-electric locomotive maintenance and operation at the G-E school since the beginning of 1958.

Applying latest knowledge to bridge design

KHOSLA COMMITTEE'S REPORT SUBMITTED

The High Level Committee of Engineers on Bridges, appointed by the Ministry of Railways in 1957, has submitted its report to the Railway Minister, Shri Jagjivan Ram.

The committee was headed by Dr. A. N. Khosla, Vice Chancellor of the Roorkee University, and its members included senior engineers from the Ministries, of Railways, Defence, Transport and Communications, Central Water and Power Commission, and the Meteorological Department. A number of other eminent retired engineers were also co-opted on the committee.

The committee was asked to review the methods of design of bridges in the light of the latest knowledge and experience and to indicate the standards which should generally guide the design of new bridges in India in future.

The committee held a number of meetings during the course of nearly two and a half years it has been functioning, and its recommendations have been incorporated in the report submitted to the Railway Minister. These recommendations will now be considered by the Ministry of Railways.

The Modern Rail Track Diagram Switchboard

THE rapid expansion of an intricate network of railway lines has made the development of more efficient control methods necessary for the speedy, safe and dependable operation of trains. The conventional mechanical and powered locking frames are being replaced by modern relay locking equipment to comply with latest requirements.

The centralized rail track diagram switchboard incorporates a system of relays which have converted all mechanical contacts and operations into electric processes. A replica of an entire section of the railway network with all its signals and switches is shown on a diagram, and below this a set of knobs and levers governs the entire system. Appropriate relays thus set each rail switch and signal providing for quick automatic and dependable route-setting. This makes it possible to handle more traffic at greater speed and with full protection against conflicting train movement.

Modern track diagram switchboards must be adapted to such requirements as :

(1) Specific traffic and signal regulations prevailing in the country where they are to be installed ;

(2) That signal relays comply with safety and operational requirements ;

(3) Fast assembly and simple method of changing ;

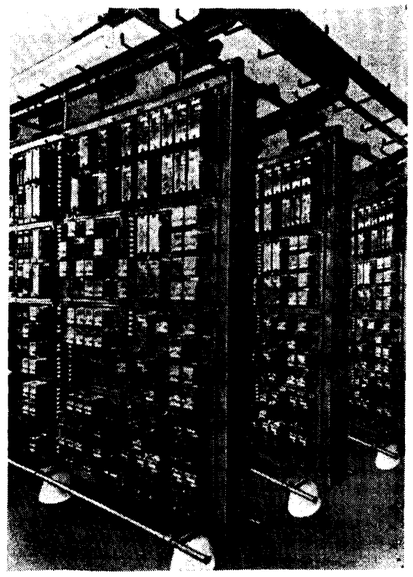
(4) Components subject to great wear should be provided with plug-socket connection (or similar method) for fast exchanging ;

(5) Simple and clear construction and low space requirement ;

(6) Standardized unit construction to raise efficiency.

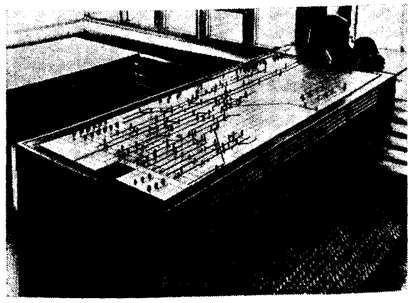
In the German Democratic Republic Rail Track Diagram Switchboards have been built by VEB Werk fur Signal—und Sicherungstechnik Berlin since 1948. Their new development introduced in 1957 complies with the most up-to-date standards.

The newly developed signal relays are produced as small relay with 9 contacts, as normal relay with 21 contacts, as switching relay with 20 contacts and as a relay with 18 contacts. These relays are united in groups according to the circuit. The relays in the groups are all of the plug-in type, while a special arrangement prevents errors. The groups incorporate all components as resistances, condensers, pilot lamps and soldering terminal distributors for switching from one group to another. The groups are designed according to their purpose of application as track group, switch group, signal group, clearing group, command group, etc. The groups are produced as fully circuited component units.



Relay Stand.

Four relay groups can be built in any sequence according to the project in a rack. Two, four or six racks can in turn be assembled in a rack frame. All relay groups are interchangeable. For this purpose only four screws have to be loosened and the connections detached.



Centralized Rail Track Diagram Switchboard.

The rack frame supports, the cable shelf for laying the indoor cables as well as the illumination and power supply lines. This ensures speedy assembly and simple changing of the equipment.

The track diagram is composed of 40 mm. square diagram elements. The surface consists of Interchangeable crystal-clear Polystyrene caps. The required symbols are printed in a special ink according to the silk screen printing process. The colour is mild blue-green and fully anti-reflex. Glass rods and prisms give a flood-light effect, brightly illuminating the symbols.

The track diagram gives the operator exact visual knowledge of the location of trains and of the position of switches and signals. By pulling the start and end keys of a track a line is cleared. This operation automatically adjusts switches in the correct position, checks the track, and sets the signals after all safety conditions have been fulfilled. Normally the line is cleared automatically by the train itself as it passes various contacts provided for this purpose. Relays undertake the necessary clearing operations.

In cases of emergency and disruptions, special keys which can be sealed or fitted with a numbering device, can interrupt the automatic clearing operation. Resetting can also be manually undertaken.

A 60-volt buffer battery provides the power for the relays of the rail track diagram switchboard.

Power supply is fully automatic and in a failure of the mains, power is provided by an emergency petrol or diesel power pack which can supply all units of the track, including the switch gearing. A high-speed transformer bridges the 15 seconds elapsing between mains failure and full operation of the power pack. This transformer is powered by a buffer battery requiring only 1.5 to 2 seconds for starting. Switch-over from mains to emergency power supply is therefore hardly noticeable.

The power pack is automatically stopped by a five-minute retarding relay excited by the mains. The relay throttles the fuel supply and the entire equipment is switched back to mains operation. A retarding period of five minutes was selected to prevent repeated switch-ons and switch-offs of the set.

With electrified lines battery operation and mains switching equipment is usually not used as the line, and locking installation is operated from the same power mains. For industrial and mine railways, for instance, direct current is generated by a selenium rectifier of corresponding amperage while the power for the rail switches and the remaining alternating power requirements is met by the existing three-phase mains.

The Rail Track Diagram Switchboard of VEB Werk fur Signal-und Sicherungstechnik can be adapted in all its components to the requirements existing in the country where it is to be installed. The equipment has proved its worth through its efficient and dependable service.

Polythene insulated and PVC sheathed cables for Electrical Power

In the series of Indian Standards for Insulated Wires and Cables, the Indian Standards Institution has just issued on general circulation one more draft Indian Standard Specification for Polythene Insulated and PVC Sheathed Cables for Electrical Power and Lighting for Working Voltages upto and including 250 Volts to Earth [Doc: ETDC 2 (24)]. This draft covers the requirements of both cables as well as flexible cords.

Polythene, by virtue of its better electrical insulating properties than PVC, is being increasingly used as an insulating material. In the case of cables, however, owing to the lower mechanical strength of polythene, the cables insulated with it require a sheathing of PVC.

Government to buy Diesel Locomotives

By H. Venkatasubbiah

ORDER TO BE PLACED WITH TELCO

THE Railway Board is understood to have indicated to the Tata Locomotive and Engineering Company (TELCO) that they would like to buy fifty diesel locomotives in the first instance the manufacture of which the Company has offered to undertake with the technical collaboration of Messrs. Krauss Maffei of West Germany. The price to be paid to the manufacturers, which will depend upon the specifications of the components going into the new diesel locos., is still being worked out, but it may be in the region of Rs. 7 lakhs to Rs. 7.5 lakhs per locomotive. This is roughly double the price of a steam loco at present being produced by the company.

As against the nearly one hundred per cent indigenous content that TELCO has now achieved for its steam loco, the similar content for a diesel loco. would be substantially less than even 50 per cent, and this is a big factor in its relatively high price. The Railway Board is understood to have rejected the proposal made by the Company to manufacture also the diesel engines for the new locos. in collaboration with Mercedez Benz, but might be agreeing to the proposal of one or two other firms to make these engines in India, also with foreign collaboration. Eventually, therefore, the Railways might be buying the diesel locos. at less cost to themselves.

As regards the future of the Company's locomotive division, it will be recalled that at the last annual general meeting of TELCO held in August, the Chairman, Mr. J. R. D. Tata, had said that they were willing to continue manufacturing steam locomotives beyond the period of the present agreement with the government which expires in March, 1961. He had also added that the orders at present on the Company's books would not carry them beyond March 1961 by when all the steam locos. ordered from them would have been delivered. It now seems likely that the Railway Board will continue to buy steam locos. from TELCO beyond 1961, though naturally the number would be less in view of the Railway's decision to replace steam traction by diesel traction as far as practicable in the Third Plan period. TELCO'S present capacity is 120 locos. a year. It is hoped that utilisation of at least half this capacity will be possible by further Railway Board orders in this period. The new diesel loco. manufacturing programme may not make up the other half of the capacity in full, but with other orders for smaller shunting diesel locos. from non-Railway users like engineering establishments, which are also expected, it should be possible to maintain the economic working of the locomotive division of TELCO.

While a speedy end to the uncertainty in respect of the future of this division should be naturally welcome, the diversification of the company's activities has latterly proceeded so much apace that its dependence on the locomotive division for its growth prospects has been substantially reduced. A recent estimate made by the Company indicated that the contribution of this division to the value of TELCO's gross product was less than a quarter of the total.

Manufacturing Modern Locos for South Africa

The first locomotive in a record breaking railroad motive power order rolled from the General Electric's (U. S. A.) Locomotive & Car Equipment Department recently.

The locomotive is one of 115 universal-type diesel-electric units G-E is building for the South African Railway Administration.

This and 18 other locomotives, slated for completion in the next 20 weeks, will be shipped through New York to Durban, South Africa this year. It is expected that the balance of the locomotives will be completed by late 1961 thus allowing time for completion of fueling and maintenance facilities, and the conversion of 24-inch gage line to standard 42-inch gage.

Before being shipped, the diesel-electric units will undergo exhaustive tests at the special locomotive testing facility maintained by G-E in Erie. All 115 of the 1,980 gross horsepower diesel-electrics will be used in South West Africa where the rail system is operated by the South African Railway Administration.

Villupuram Railway Section— Electrification Programme

ANCILLARY WORK BEGUN

THE first phase of the work connected with the electrification of the Madras-Villupuram section of the Southern Railway would be taken up next year, said M. Boulongne, French Engineer and consultant to the Railway Administration for electrification schemes.

M. Boulongne, further stated that a decision had already been taken by the Railway Board to electrify nearly 1,000 miles throughout the country during the Second Plan period and part of the Third Plan period.

It is proposed to tackle urgently the Tambaram-Chingleput section in the first phase of the scheme. He added that before inviting tenders for the electrical locomotives, they would like to know whether there would be demand for electrification beyond Villupuram to guide them in acquiring proper and suitable electric locomotives for this section.

M. Boulongne, who has just finished his first round of a tour of the southern section, said that he had been in the country for the last 3½ years in connection with railway electrification schemes. So far he had been designing the system in the broad gauge section of the coal belt area near Calcutta.

Referring to the electrification of the Madras-Villupuram section, M. Boulongne said that he knew the scheme had been pending for a number of years. The Railway Electrification organisation, a wing of the Railway Board, was appointed recently as consultant for carrying out the scheme. While the design part of the scheme would be done by the Railway Electrification organisation of which he was in charge, the actual work would be done by the Southern Railway.

Replying to questions, M. Boulongne said that ancillary work such as sanctioning the staff for carrying out the Madras-Villupuram electrification scheme had already begun. They would soon be inviting tenders for getting the traction overhead equipment. Further, they were holding consultations with the P. and T. Department, for laying overhead cables, as the execution of the work involved some negotiations with the postal department. There was no question of delaying or postponing the scheme and the Railway Board had already decided to go ahead with it. He was of the view that the work on this section would be started by next year as soon as they received final orders for traction overhead equipment.

Questioned about the cause for the delay in executing the scheme, M. Boulongne said that the real bottleneck was the shortage of suitable electric locomotives. Their manufacture sometimes took nearly two years. Steps were recently taken to get locomotives from the local manufacturers in Chittaranjan to meet the demand in the country. But his view was that all of them covered only broad-gauge lines and he did not know whether they were suitable for the metre-gauge section.

On the question of electrification of the Madras-Arkonam section, the French engineer said he was not aware of the scheme. It had not so far come under the purview of the Railway Electrification organisation.

Asked when the first electric locomotive would be run on the Eastern and South-Eastern Railways, the French consultant said the Railway Administration expected to achieve this by the end of this year. The target date fixed for running regular train services by the authorities was June 1960 and the scheme was being implemented according to schedule. The first electric locomotive would be run between Raj-kharsawan and Dangoaposi on Durgapur-Rourkela section, he added.

Asked about the possibility of getting aid from the French Railway in the shape of locomotives, M. Boulongne said the French Railway was not associated with any of the schemes in India. But as a design engineer from the French Railways, he was offering his technical knowledge to the Indian Railway Administration for carrying out their schemes successfully.

Questioned about the scope of further expansion of electrification, the French engineer said that if they included all the schemes like the Madras-Villupuram section and areas on the Eastern and South-Eastern Railways, they would be electrifying about 1,000 miles during the Second and part of the Third Plan period. "It is not a small scheme, but a huge and fine scheme", he added. He also indicated that there was some proposal to electrify certain sections on the Central Railway. But the matter was entirely left to the Railway Board and to the Planning Commission. Only when a final decision was taken by the Railway Board and the Planning Commission, could they know about the section on which the electrification scheme would be introduced, he said.

Methods of Chemical Analysis of Refractory Materials

An Indian Standard dealing with sampling and chemical analysis of refractory materials and forming a part of IS : 485—1953 Methods for Sampling and Testing of Refractory Materials, was issued in 1953 as a tentative standard. Since then considerable information has been collected based on the experience gained by Laboratories, manufacturers and consumers who have been using the methods of test prescribed in the standard.

The Indian Standards Institution has now drafted Methods of Chemical Analysis of Refractory Materials [Doc : SMDC 2(171)], with a view to issuing it as a separate firm standard. The scope of the standard ; which covers the methods of chemical analysis of fireclay and silica refractories, has been extended to include analysis of phosphorus pentoxide, at times found in fireclay refractories.

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CODE FOR DESIGNATION OF STEEL

The Indian Standards Institution has drafted a Code for Designation of Steel [Doc : SMDC 1(153)], for codifying the symbols which could be used for the designation of steel on the basis of its mechanical property, chemical composition, physical condition etc.

The need for adoption, by the Indian Standards Institution, of a uniform system of classification of steel was felt by the various technical committees of the Indian Standards Institution, in their task of formulating standards relating to steel and its uses. Hitherto, in many of the Indian Standards, the different grades of steel have been designated by alphabets or numerals. This by itself has not led to any inconvenience, but at the time of the revision of standards, whenever it was considered necessary either to increase and rearrange the grades covered by the specification or to delete any of the grades, it was found extremely difficult to redesignate the various grades without giving rise to a certain amount of confusion. The need was, therefore, felt for a system of codification which could be developed and applied to all steels—the grade designations bearing some relationship with some important characteristic, such as tensile strength, chemical composition, physical and surface condition ; thus making a particular grade designation applicable to a certain steel only. This code, it is expected, would make it possible to simplify reference, marking and identification of the various types of steel.

Shri M. V. Arunachalam (Extreme Right), Managing Director, Carborundum Universal Ltd., left Bombay by Air-India International for a study tour of West Germany, U.K. and U.S.A. as a member of the National Productivity Council Team on Top Management and Organisation. He was seen off at the Madras Airport by Shri A. M. M. Murugappa Chettiar and Shri A. M. M. Arunachalam.

Developments in High-speed Blanking-press building

THE aim in press development is to produce presses of increased rigidity and accuracy allowing to blank components of great quality and precision.

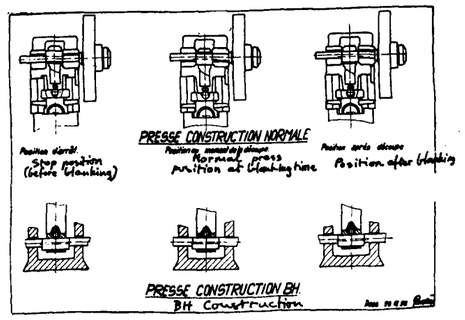
Among the most important facts which are the cause of this evolution, two must be pointed out: the apparition of the tungstene carbide tools for more and more complicated precision blanks, the growing production figures in the press shops. Those two facts are interdependent as the mass production requires tungstene carbide tools for economy reasons.

However the tungstene carbide tool has one disadvantage: it does not support easily a penetration of the punch into the die without damage, even if the penetration is absolutely perpendicular. The Swiss press manufacturers, Messrs. ESSA of Brugg/Bienne, were among the first to have to deal with these factors, for the watchmakers were requiring presses with an increased rigidity and, if possible, the suppression of the clearances causing the penetration of the punch, their tungstene carbide tools being very delicate and small. Besides, tool wear is not only caused by the blanking operation itself, but for a great part by the punch into die penetration. Thus a way was to be found to suppress the backlashes in the clearances, which are one of the main cause of this penetration.

The use of springs to hold the moving parts is one of the solutions to try to avoid backlashes, but it is only a palliatif. If the plays of the main shaft in its bearings can be eliminated with efficacity by using counterbearings and springs, this cannot be the case with the plays in the connecting rod, the pittmann (ball head) and the tool clamping. In those parts, backlashes can be eliminated only partially, for springs are not capable of absorbing the reaction caused by the blanking operation. Springs will never be able to prevent completely the punch from diving into the die, unless they are calculated to be as strong as the working reaction, the latter being equal to the pressure necessitated for blanking. The solution of putting all the driving members in the bottom of the machine (4 tie-rod design) allows to increase the speed, but certainly does not allow to avoid backlashes. Their suppression necessitates notwithstanding the use of springs and supplementary bearings or bridges, so that we have again the same problem as before.

Only a quite new construction principle could allow to suppress backlashes and to increase at the same time the rigidity, the precision and the speed of the press. The ESSA engineers found out that the use of the gravity law was the best way to suppress all the backlashes which are so harmful for the tools.

On this idea they build the first presses, the ram of which was working *upward* and no more downward. All the moving parts of the presses of this model called BH are located in the lower portion of the machine. The ram working upwards, the shaft, ram, connecting rod, etc., rest in their working position in their bearings before, during and after the blanking operation. In this way, the rebounding of the moving parts (cause of the backlashes) from their rest position to their working position and back to their



Sketch 1. BH Principle

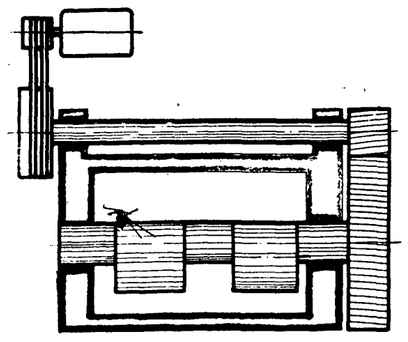
rest position is avoided (sketch). As shown on the above sketch, the use of the BH principle suppress the backlashes in a completely natural way, without any help of springs or supplementary bridges.

Moreover, this principle has many other advantages. It allows the manufacturing of a 2 or 4 column frame of grey cast iron, which is more rigid than steel, and as much better guiding of the ram. Only a two or 4 column frame can ensure a perpendicular diving of the punch. This last point is most important while

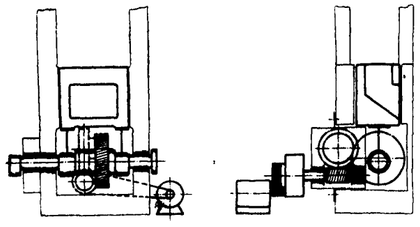
using tungstene carbide follow-on-tools for blanking of very thin sheet, where it is almost impossible to avoid the penetration of the punch into the die, especially as pressures are never centered in this kind of tools. The movable parts and the motor being now in the low portion of the machine, the upper part is freed from vibrations. The low center of gravity allows a considerable increase in speed, permitting speed of 700 r. p. m. for a 6 ton, 500 r. p. m. for a 15 ton and 150 r. p. m. for a 180 ton press. However this is only a consequence of this new construction principle, the essential advantage lying in the suppression of all vertical backlashes and the reduction of the tool costs in connection therewith. The life of standard tools was increased up to four times, even with an increased blanking speed.

In order to obtain a ram drive as direct and as accurate as possible, a new transmission of the power from fly-wheel to eccentershaft was developed for the automatic presses Type BHA 120 and 180 tons.

The customary gear and pinion arrangement was abandoned and replaced by a worm gear drive. The big difference between the new ESSA driving and the old one is shown by sketch 2.

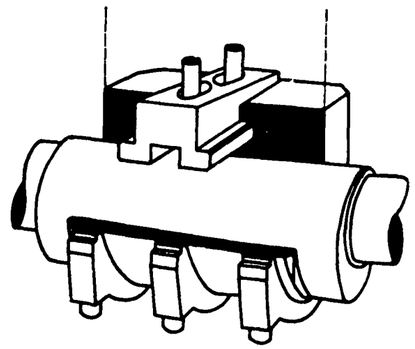


Sketch 2. Old drive



Sketch 2. BHA drive

The shaft located longitudinally and parallel to the strip, the gear wheel driven by the worm gear, the reduction box (see sketch 5, No. 3) and the 2 eccentrics are building a rigid unit, practically insensible to torsion. The connecting rods are of new design too.



Sketch 3. Connecting rod

This design gives an increased contact area between ram and connecting rod, much greater than the one a ball head could give. Moreover, the horizontal bearings give a very accurate control of the ram motion. Owing to the use of these two horizontal bearings and the excellent guiding of the ram on its four faces, any tilting which may be caused by offcentre pressure when using follow-on-tools, is avoided. As the BHA presses are constructed for automatic production, they are equipped with 2 automatic roll-feeds which allow to work either with strips or coil material.

A further step has been done to ensure security of production and avoid any downtime in automatic production. As a matter of fact, the press is equipped with three most useful devices: a scrap shear, a strip end shear, and a strip stopping device.

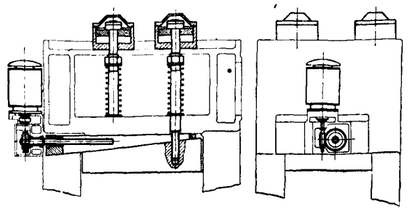
The Scrap shear driven by the main shaft cuts in small pieces the blanked strips, allowing an easy storage of the scraps. The strip stopping device and the strip end shear are the "life guards" of the tool. It is well-known that a half-cut occurring in a blanking tool causes an harmful unbalance. This latter is detrimental to a good function and to the life of the tool, when not resulting in the breakage of the

punches. It goes without saying that the half-cuts might occur only at the beginning and at the end of the strip. It is almost impossible to obtain strips which length is in perfect relation with the pitch required by the tool, especially as the feed length always varies from a serial to another, the size of the blanks being quite different. The purpose of the strip stopping device and of the strip end shear is to give automatically to the strip the necessary length to ensure a serial of complete blanks.

The strip stopping device consists of a lever against which the strip comes when the operator inserts it into the feed apparatus. This stop, actuated electro-magnetically, is synchronised with the upward and downward movements of the upper roller of the feed apparatus. The motion of a handlever let the upper roll fall and remove the stop. In this way, no error can be made at the beginning of the strip, the stop being set to the pitch beforehand.

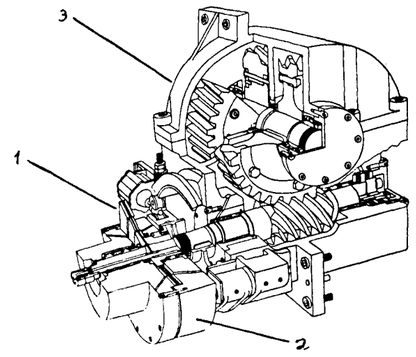
The strip end cuts at the end of the strip the overlength which could have given only a half-cut. This shear is operated electro-magnetically by a feeler set at a multiple of the pitch.

On the BHA presses the depth adjustment is effected very easily by means of an electric motor. Placed in the head of the machine, it enables the operator to adjust the height without losing sight of the tool (see sketch 4).



Sketch 4. Depth adjustment

Another very interesting feature of the BHA presses is their electro-pneumatical drived friction clutch. By choosing a high rotation speed for the flywheel, it was possible to reduce the volume of that cumbersome aggregate. In order to keep the smallest possible size of the unit flywheel/clutch, the engineers of ESSA designed a completely new construction, placing the clutch *inside* of the flywheel (2). Two clutch plates (1) being moved by compressed air are the soul of this new high-powered and small-sized clutch without any axial effects. (see sketch 5)



Sketch 5. Clutch and reduction box

The two plates fitted with clutch lining are pressed onto the free rotating flywheel and transmit the kinetic energy of the flywheel to the machine. Contrarily to certain affirmations that electro-pneumatical operated clutches are slow, the ESSA clutch, without axial displacement of any sorts, is instantaneous and faster than any other one. A powerful jaw-brake is synchronised with the clutch and gives an instantly and reliable stop of the press. The quick clutch reaction allows the use of safety devices for the tools, for inst. for feed checking, even if the press is running at high-speed. This clutch can evidently be engaged and disengaged in any position of the ram and can be driven by micro-switches of photo-electric cells.

It goes without saying that a great importance has been devoted to the safety. The guards do not allow to penetrate in the working area as long as the press is running. As soon as the guards are raised, the clutch is disengaged and the press stopped. It is impossible to put it into motion as long as the guards are opened. Moreover any interruption in electric current or air pressure causes the immediate disengagement of the clutch and an instantaneous stop of the press.

OUT OF THE STEAM AGE

The modernisation of Britain's railways, with steel playing an integral part, is to be speeded up. Here J. H. Davies examines the scope of the original plans on which this vital project is based

ON branch railway lines throughout Britain, green painted two-coach trains have been making their appearance: and, literally heralding their arrival by the now familiar two-tone horns, diesels have come to stay. Railway lines, which up to a short time ago faced closure due to lack of passengers, have been able to attract double or even treble the amount of traffic carried—thanks entirely to the advent of this new form of transport.

Why are these new trains appearing, and what else can the traveller expect to see on Britain's railways of the future? To find the answers we must consult 'The Plan' (officially titled *Modernisation and Re-equipment of British Railways*). This report, published by the British Transport Commission in 1955, outlined one of the most ambitious projects ever to be considered by any railway system in the world. The amount of money involved was then estimated at £ 1,200 million, to be spent over a period of fifteen years. Under the 1955-56 plan improvements to be made in every sphere of the railways embrace passenger amenities in stations and in trains; newer and better equipped marshalling yards to speed freight traffic; replacement of steam locomotives by diesel and electric locomotives; track improvements to allow higher speeds; ever safer forms of signalling to take the place of existing systems.

Altogether, 2,500 main line and 1,200 shunting and

trip diesel locomotives are to be built either by private manufacturers or in British Railways locomotive works. A total of 4,600 diesel multiple-unit trains will be in service at the end of the fifteen-year period. Electrification will play an important part in the plan and will involve the provision of 1,100 electric locomotives together with multiple-unit trains. Initially, the emphasis will be on the introduction of diesel motive power. This is due to the fact that diesel locomotives are independent of any fixed installations and can be introduced as and when they are built, without having to wait for the erection of overhead lines and substations. It is the ultimate intention to electrify a high proportion of the main lines to the north over which traffic density is greatest; until that day, diesel locomotives with their high availability will bear the brunt of the load.

Nearly four years have elapsed since the announcement of modernisation, and nearly three since the first orders for diesel locomotives were placed, and much has happened in that time. The first main line diesel locomotive to be completed under the plan—a 1,000 horse-power unit destined primarily for freight duties—was handed over in June, 1957. The first unit designed for passenger train haulage was put into service a few months later. Up to September, 1958, 75 main line diesel locomotives had been put into service together with 2,115 diesel multiple trains. These figures are being added to at an ever increasing rate. It is anticipated that within the next three years, 400 main line locomotives will be in service on the Eastern Region alone.

The diesel locomotive is of course much more expensive to build than its steam counterpart, and a great many people have doubted the wisdom of abandoning steam traction. However, it should be pointed out that approximate relative thermal efficiencies at the wheel are 25 per cent as opposed to 6 per cent. (The term thermal efficiency is used to denote the useful work obtained from the fuel consumed.) In addition, the diesel locomotive has a much higher availability than steam, the terminal turn-round and servicing time being cut to a minimum.

Recently, the Transport Commission, announcing an order for twenty-two 3,300 horsepower Deltic locomotives, stated that their introduction would displace 55 steam locomotives on Anglo-Scottish passenger trains. There is a Deltic locomotive in service with British Railways operating on the London Midland Region between London—Liverpool and London—Crewe, although it still remains the property of its makers, The English Electric Company. It is the most powerful single-unit diesel locomotive in the world. Running at the rate of 4,000 miles a week, in service for 17 hours out of the 24, six days a week—something no steam locomotive could do—this unit has won admiration from the thousands of passengers who have travelled behind it.

As mentioned previously, it is not possible to introduce electric traction as quickly as its diesel counterpart. A tremendous amount of work has to be done in the planning stage, to ensure that fixed structures such as bridges and tunnels provide sufficient clearance for the overhead conductors. British Railways have, in common with the French National Railways, adopted the 25,000 volt 50 cycle single-phase alternating current system as the standard for all new electrifications. Where it is impracticable to lower the track or remove the overhead obstruction, it is proposed to have sections of overhead line which will feed in the required power at a reduced voltage. This will mean that the distance between roofs of tunnels and the overhead line can be smaller, as the insulation required for the lower voltage is less.

Work is now proceeding rapidly on the Manchester-Wilmslow and Colchester-Clacton lines of the London Midland and Eastern Regions respectively. Special work trains are being used, one to bore holes and pour concrete for the overhead line carrying structure, the other for the erection of the overhead line itself. The former train can erect up to five single track-miles of posts in a working day. Initially, these sections of line, soon to be commissioned, will be used as test areas for the 100 electric locomotives and 300 multiple-unit trains now on order. The first main line to be electrified will be that between Manchester and Crewe. This will be followed by the Enfield-Chingford line of the Eastern Region. Eventually (the target date is currently set as 1967), the main line between London (Euston) to Manchester and Liverpool will be electrified. The rate of electrification builds up to a peak in 1962, when it will be necessary to commission electrified single track at the rate of 1,000 single track-miles a year and to place in service at least 200 electric locomotives and 900 electric multiple-unit train coaches a year.

Apart from the replacement of steam motive power, both new passenger and freight rolling stock is to be introduced. Great emphasis is being given to the replacement of older, wooden-bodied, unbraked freight and mineral wagons by larger steel-bodied wagons, all of which will be fitted with vacuum brakes.

The new wagons will have capacities of 16 and 24 tons: this, coupled with the fitting of brakes, will enable heavier freight trains to be hauled at speed up to 60 mph, thus increasing line capacity considerably. Mechanised handling plants are being installed at suitable terminals to reduce loading and unloading times in order to get greater revenue-earning service from vehicles.

New general merchandise wagons are also to be built to cater for mixed loads and the use of pallets will speed the terminal time occupied. Various forms of containers are being developed to cater for bulk shipment of such materials as cement. Freight reception depots are also being modernised, conveyor belts being used in ever increasing quantity, particularly where transfer to British Railways road delivery vehicles is involved.

New types of passenger coaching stock are being evolved, both by British Railways and private manufacturers. Several prototypes have been in service for some months and embody various features hitherto untried in Britain. Aircraft-type seating, double glazed windows and modern interior decor have been incorporated and the result of their impression on the travelling public will no doubt be taken into account when new orders for passenger vehicles are placed. It has been stated that 31,000 of these all-steel coaches will be brought into commission over a period.

The passenger safety record in Great Britain is one of the best in the world, and British Railways are paying particular attention to bettering it. Automatic train control, a form of which has been in successful operation on the former Great Western Railway for many years, is being applied to more of our main lines as time goes by. One type of automatic train control is at present in use on nearly 1,500 route miles of British Railways although a new system has been developed and is to be installed on five of the main routes out of London. An initial order for 2,000 sets of equipment has been placed.

'Modernisation in progress' read the signs in stations and on linesides all over the country. They are evidence that at last Britain's railways are moving rapidly out of the steam age.—(INGOT)

MANUFACTURING MODERN LOCOS FOR SOUTH AFRICA

The first locomotive in a record breaking railroad motive power order rolled from the General Electric's (U. S. A.) Locomotive & Car Equipment Department plant recently.

The locomotive is one of 115 universal-type diesel-electric units G-E is building for the South African Railway Administration.

This and 18 other locomotives, slated for completion in the next 20 weeks, will be shipped through New York to Durban, South Africa this year. It is expected that the balance of the locomotives will be completed by late 1961 thus allowing time for completion of fueling and maintenance facilities, and the conversion of 24-inch gage lines to standard 42-inch gage. Before being shipped, the diesel-electric units will undergo exhaustive tests at the special locomotive testing facility maintained by G-E in Erie.

All 115 of the 1,980 gross horsepower diesel-electrics will be used in South West Africa where the rail system is operated by the South African Railway Administration.

Value of the entire order is placed at US $ 28,000,000 by officials of International General Electric Company through which the order was placed. Not only in this the largest purchase ever made by the Union of South Africa outside of the Sterling area but it is also the biggest single order for locomotives ever placed by the Railway Administration.

General Electric was awarded the contract for the 115 diesel-electrics last September after the South African railway experts spent nearly a year weighing the bids of almost 30 locomotive manufacturers from the U. S. and Europe.

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SOIL MECHANICS FOR RAILWAY ENGINEERS

(by U.G.K. Rao, 206 pages, illustrated).

The Railway Testing & Research Centre, Lucknow of the Research, Designs and Standards Organization has recently published a book entitled "Soil Mechanics for Railway Engineers" by U. G. K. Rao.

As the name of the book indicates, it is primarily intended for railway engineers and should be valuable to all the civil engineers working on the Indian Railways.

The book is excellently printed and copies can be had from the Manager of Publications, Civil Lines, Delhi-8 and his authorized agents at Rs. 7.50 per copy.

Squiggles and Wiggles for Testing Locomotives

LOCATED just outside of this bustling industrial center is a railroad that would give even the most seasoned locomotive engineer nightmares.

It's the 4.5 mile long test track of General Electric (U. S. A.) Locomotive & Car Equipment Department. Complete with oddly convoluted rails and a maze of multi-gauge trackage, it is possibly the world's most unique railroad.

General Electric uses the track to test riding qualities and engineering refinements of the electric and diesel-electric locomotives it builds for railroads all over the world.

Recently, when G-E was testing an experimental truck design for its new 700 horsepower, universal-type diesel-electric on the track, Globe Press Service reporter was privileged to ride in the cab of the test locomotive as it rocketed down the track at speeds close to sixty miles an hour. Crammed into the small cab with me were four design engineers, all heatedly discussing the riding characteristics of the new running gear, the locomotive operator—test pilot—and a trainman.

An exciting ride? You bet! I'd ridden trains going considerably faster than 60 miles an hour in the past, but there's a lot of difference between riding in a comfortable coach seat on a ten-car express train and bouncing along in a locomotive cab with no cars hitched on behind at all.

"A string of cars would hold her down," an engineer explained. The 50-ton locomotive in which we were roaring down the track needed some holding down, I informed him, as we bounced around the crowded cab like dice in a dice cup at Monte Carlo.

Sometimes, I was told, engineers study the lateral and vertical motion of experimental running gear by attaching movie cameras to the frame of the locomotive. The cameras record the amount and direction of sway and bounce. Studies such as these are often made on a section of the test track where the rails wiggle back and forth a few inches from a true straight line. On another section, the rails squiggle up and down. On still another, the tracks shake back and forth in a lazy "S". Experimental apparatus has got to weather all of these tests before it is approved for manufacture and sale.

Sometimes recording instruments are placed along the track. On some occasions, the locomotives are rigged with instruments to measure everything from lateral sway to current consumption.

The multi-gauge sections aren't there to confuse the locomotive engineers. Since G-E builds locomotives for railroads all over the world, it has to have track of suitable gauge to test them. Parallel rails are laid to six different track gauges (36, 39-3/4, 42, 56-1/2, 63 and 66-inch) for the first mile and a half of the test track. There's even a multi-gauge switch.

It was over this test track that G-E first tested the experimental designs for its now famous line of universal-type diesel-electric locomotives back in 1955. Not content with having exhaustively road tested the original design, G-E still subjects each new model it builds to a trial run as a quality control check.

As a matter of fact, the basic designs of the very first diesel-electric locomotives built for regular railroad service were tested over the G-E track back in 1924.

One of the most unusual tests ever conducted on the track was done in 1924 when G-E staged a gargantuan "tug-of-war" between a steam locomotive, borrowed from the New York Central Railroad, and an electric locomotive built for the Mexicano Railway for use on a rugged stretch of the main line between Vera Cruz and Mexico City—called the Maltrata incline—where grades upto four per cent are common. The point of the tug-of-war was, of course, to test the electric's regenerative braking system.

This type of brake, similar to the "dynamic braking" used in today's diesel-electric locomotive, works by electrically reversing the locomotive's motors. The net result is a little like holding a car going downhill in low gear by the compression of the motor, only the locomotive actually pumps power back into the line.

In the test, the two locomotives were coupled and the steamer towed the electric down the track. At the start, the controller of the electric was off and the steamer pulled it easily enough. But as the electric's regenerative braking was gradually cut in the steamer labored harder and harder. By working his controls, the engineer on the electric finally brought the steamer

This is what the General Electric (U.S.A.) test track looks like to the engineer of a diesel-electric locomotive. Section of track shown here has four different gauges ranging from narrow to broad.

to a dead stop. No matter how hard it puffed it could no longer pull the electric even an inch. Then, as the electric's throttle was opened wider, the struggling steamer was pulled backward down the track.

In another early test, G–E engineers proved to skeptics that it was practical to run electric locomotives with high-voltage direct-current. Opponents of d–c operation, which is widely used today on electrified railroads all over the world, argued that sufficient direct-current to power a heavy train at high speed would burn out the "collecting shoes" or contacts used to pick up power from the overhead wires. G–E successfully ran a series of tests using 3000 volts direct-current, supplied from wires strung over the test track, proved its point and established an important precedent in railroad engineering.

In the early 1930's a long series of tests was run on various designs of 11,000-volt a-c locomotives for the Pennsylvania Railroad. These culminated in the tests of the first of this Railroad's famous GG-1 high-speed electrics, and included measurements of the forces on the rails by means of the "otheograph" —a section of track specially designed to record wheel loads as the locomotive hurtled over it at speeds up to 100 miles an hour. Evidence of their success is found in the fact that after 25 years, No. 4800, the first GG-1 locomotive—is still in active mainline service.

In still another test, General Electric engineers "high-balled" an electric locomotive built for the Paris–Orleans Railway in France over the test track at a speed of 105 miles an hour. And that was in 1923.

Currently under test on the track are huge 8500 horsepower, gas-turbine electric locomotives built by G–E for a Western U. S. railroad. These locomotives are the most powerful internally powered units in the world. Each one weighs 420 tons and is capable of pulling a train more than a mile long at speeds in excess of 60 miles an hour on a flat stretch.

First used by G–E in 1915, the test track was originally intended for running-in locomotives equipped with the friction type journal bearings that were standard equipment in those days. Locomotives were run for up to 100 miles on the track before shipment to customers. The idea was to run in the bearings and correct any troubles before shipment. With today's roller bearings this is no longer necessary.

Oddly enough, the G–E test track is operated not by General Electric but by a regular short line railroad, the East Erie Commercial Railroad—fondly referred to by G–E personnel as the East Erie Comical. The test track is approximately one third of the East Erie's 14–mile right of way which runs right through the G–E Erie plant. Consequently, on almost any day of the week, standard U. S. style freight cars can be seen on its tracks along with locomotives built for far-away lands, such as India, Turkey, Argentina, South Africa or Brazil.