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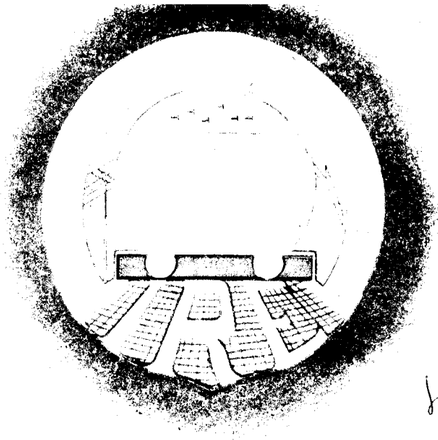
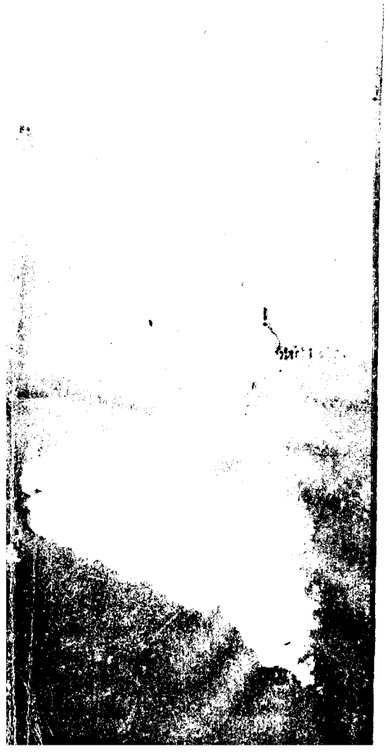
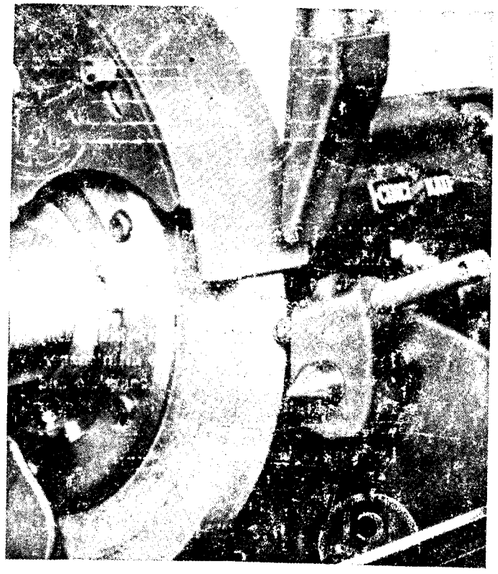


THE INDIAN RAILWAY ENGINEER





Standard wheel truing device on a Centre-type grinding Machine

(See page 42 – 46)

THE INDIAN RAILWAY ENGINEER

(A Quarterly Journal devoted to Railway Matters of technical interest)

79, Jayprakashnagar, Goregaon,

BOMBAY

Grams: INDRAIL, Goregaon *Phone:* 84311

VOL. 3 NO. 4 APRIL 1956

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Managing Editor
T. S. N. Rao

Advertisement Manager
B. Amruta

Pointers Towards Greater Efficiency in the Railways' Second Five Year Plan

"THE proof of the pudding is in the eating of it" says an old English adage. Similarly, the Efficiency of the Railways' Second Five Year Plan will have to be judged by its achievements.

The main function of Railways is transport; transport of human beings, and transport of materials from one place to another quickly, punctually and economically. It is on these achievements and these alone that the Efficiency of the Railways will be judged during and at the end of the Second Five Year Plan.

It will matter little in the final verdict of the Nation if the Railway Ministry can show that it has built Class III Air Conditioned Coaches, large and well appointed waiting rooms and halls, covered extensive portions of existing railway platforms, provided cool drinking water etc., at stations, looked after the housing of a large portion of its staff but failed to resolve the bottle necks which have impeded transport in many direction.

While "playing to the gallery" by spending a lot of money on amenities, may be alright from the view point of gaining the goodwill of the public and ensuring their votes for the present Government at the next election, it will be on the verdict of Efficiency that the Railways will have to be eventually judged.

One of the most important factors of efficient Railway working is the anticipation of requirements and the taking early steps to meet them when the need arises.

The ability to spend money allotted for the Second Five Year Plan of Railways will not necessarily be the criterion for judging efficiency, but rather what that money has been able to produce and how economically it has been spent. The allocation of funds for the Second Five Year Plan is fairly large, nearly four times that of the First Five Year Plan, but can we say that the Railways have anticipated requirements and taken steps in advance to meet them?

Take the case of staff, superior staff, supervisory staff and workmen. Can the Railways say that they have taken steps to recruit the number of staff of all categories and of the right calibre, to man the Second Five Year Plan? What steps have been taken to train this staff in their future duties which they will have to perform.

Now that the plan period has already started, if adequate steps have not been taken in anticipation but are to be taken now, there is bound to be a time lag which might make the plan just go all hay wire.

With regard to the Superior Staff, Administrative Officers and Executive Officers with a high degree of intelligence, foresight, courage and perseverence, it is patent that they cannot be recruited overnight particularly in the technical cadres. Bodies we may have, but experience involves a factor of time and no amount of even intensive training can be an adequate substitute for experience.

Supervisory staff, which will be the backbone of the plan must have come up the rungs of the ladder by way of promotion more for their knowledge, initiative and control of labour. Can it be said that our Supervisors of today can hold a candle to those of the good old days.

What about the workmen of today? Have they learnt their trade by serving a full five years apprenticeship at it or have they been promoted from coolies as a result of the pressure exerted on the Administration by the Unions. It is well known that men recruited during the War to nail ammunition boxes are today designated Carpenters in the Railway Cadre, those who drilled holes in hand grenades are machinists and others who filed off burrs from metal details are fitters. How can efficiency be extracted from this type of labour who have not received the correct basic knowledge of their trade?

Further, does the youth of today show the same keen interest of learning their trades as their forefathers did in the days of long ago or have they too many other attractions to occupy their working day and leisure hours? Do they just work because they have to, keeping one eye always on the clock to start work as late as possible and to leave off much earlier from workshop premises even before the sounding of the buzz or gong.

These are stubborn facts and will have to be faced and grappled with before Efficiency can be achieved. The longer action is postponed regarding them, the poorer will be the Efficiency of our Railways.

If efficiency is to be improved much greater attention will have to be paid to punctuality. In these days the travelling public have come to look upon arriving at their destination on time as an exception rather than the rule. This slur on the efficiency of our train services must be removed at the earliest moment, and it will never be done unless staff are indoctrinated in the principles of efficiency, where the late running of trains is viewed with grave concern and where railway staff feel it as a failure in their personal responsibility.

The overcrowding of trains whether it be in Suburban or long distance ones is considered one of the normal hazards of travel these days. With regard to Suburban traffic, it frequently happens that one or two trains get cancelled at a peak period and all the patient humanity waiting to get to work or return home are crowded into the third train and, therefore, jammed like sardines in a tin, with the result that there is a continuous struggle to get in or get out. For long distance third class travel, it is not unusual for passengers to shove and push through doors and even windows and then in addition to sitting on hard benches to sit on their luggage in the passages, again blocking entry and exit. In no other country except ours would such conditions of travel be tolerated. Railways being a monopolistic organisation just do not care. The Indian travelling public is by nature patient and docile, but as the say goes "even a worm will turn".

In this connection the report on the Second Five Year Plan glibly remark "with regard to passenger traffic the anticipation is a 15% increase, and while every effort will be made to handle it, there will be no relief from the present overcrowding". This is like throwing in one's hand before starting a game of cards. Is this a fair attitude on the part of the Railways towards the travelling public?

With regard to Goods Traffic, the need of the day is a faster service with locomotives pulling heavier loads up the steepest gradients without banking or parting the load and so losing time. There must be a quicker turn round of wagons handling coal and minerals by the introduction of wagon tipplers at power houses, docks, storage yards which would dispose of the contents of wagons in as many minutes as it now takes hours.

Marshalling of wagons must be done at a very much faster pace at hump yards by sorting them more rapidly by the new automatic system of wagon control and insisting that the optimum number of trains leave on time every day without fail. If higher speeds with heavier vehicles care to be attained then our track must be brought in line with the best abroad and their maintenance must be planned on a basis which will impose the minimum restrictions on the speed of trains.

Signalling systems introduced 50 years ago are now obsolete and efficiency demands that automatic signalling which will saturate line capacity must be introduced to a much wider extent. Trains must proceed strictly according to schedule, without missing their position in the chain of transport. In this way, foreign nations have increased their line capacity to such an extent that they have been able to save the heavy expenditure on additional track and its additional maintenance. It is even recorded that certain American Railway lines which were quadrupled and others which were doubled have now introduced double and single line working simply by paying special attention to the signalling and allowing more train to pass over the same lines as used to on the additional lines. This method, therefore, is a pointer to an increased efficiency, and should be adopted early.

Dieselisation of Locomotive tractive power has definitely come to stay. America has completely discarded the outmodeled steam locomotive. England is spending millions of pounds in converting her tractive power from steam to Diesel Electric. India, therefore, cannot afford to remain static in her form of Railway traction because stagnation means deterioration. Therefore, the sooner our Locomotive Plants at Chittaranjan and Jamshedpur are geared to produce Diesel Locomotives the better it will be for the country for an efficient form of tractive power.

Finally we come to our Workshops and Running Sheds, on whose efficiency depends the overhaul and maintenance of our rolling stock. There is no doubt that our Workshops require modernisation in many directions if efficiency is to be achieved.

On the manufacturing side of spare parts for stock, the per capita output of our labour must be increased much beyond the present figure. Starting with Railway Drawing Offices where owing to a shortage of experienced draughtsmen drawings for Workshops cannot be produced fast enough. Early steps must be taken to recruit and train draughtsmen in apparently such men are not available. Our Engineering Colleges and Technical Institutions produce every year many graduates and diploma holders, who while they have the brains have not the physical stamina or inclination to work on the shop floor. These could be recruited in larger numbers and given intensive training for short periods in workshops to acquire knowledge of methods and practices and then seconded to the Drawing Office as Draughtsmen, to prepare these various drawings. It is felt that if this method is adopted we will not be crying in the wilderness for Draughtsmen who just don't exist in sufficient numbers in this country.

Our production methods of workshop manufacture were introduced 30 years ago and there has been continuous progress during these years and particularly during the Second World War in the techniques of production, such as Time and Motion Study, intensive utilisation of machinery, plant and equipment and the training of Supervisors to get the best out of the staff under their charge.

Under the ægis of International Labour Office, we have had teams of experts both on production and training within industry, who by their talks and demonstrations have been able to indicate the most modern methods and techniques in their respective fields. It is, therefore, necessary to take advantage of these courses and train our Planning & Production Engineers, Supervisors and Workmen in order that a higher standard of efficiency may be attained.

It is further necessary that a continuous series of refresher courses should be made compulsory for all grades of staff in order that they may be able to keep pace with the more recent advances in Engineering Science, and its application to raise the efficiency of the Workshops of which they hold charge or in which they supervise and work.

If all these pointers towards Efficiency could be effectively pursued during the next FIVE YEAR PLAN, it must result in a higher standard of Efficiency which in turn will improve the whole Railway transport system in the country and enable India to hold her own on with other more advanced countries of the world.

Bedfordshire's New All Welded Gas Main

By a Technical Correspondent

Complete co-operation between Gas Board and contractor, speeded the construction of 15 miles of gas main

A new gas main has just been completed well ahead of schedule, to carry gas from the main Bedford Gas Works to the Sandy and Potton areas, and will eventually form part of a much larger integrated distribution scheme.

The gas main which consists of 8″ diameter mild steel and runs for 15 miles, was entirely welded by Messrs. Biggs, Wall & Co. Ltd., the contractors to the Eastern Gas Board.

CHOICE OF ELECTRODES

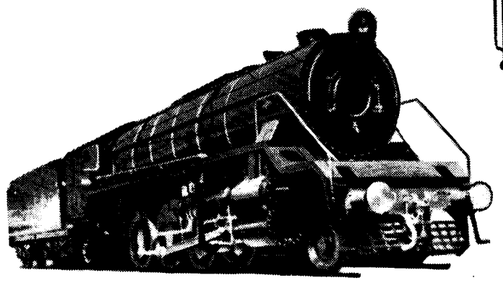
Rigid specifications were laid down by the chief engineer of the Eastern Gas Board, which insisted that only the best and most suitable electrodes must be used on such an exacting job, and that all welds must be tested by Gamma Ray for perfection. To satisfy this, Lincoln Multiweld O. V. electrodes were used exclusively, and all the welds were examined to the entire satisfaction of the Eastern Gas Board, by Messrs. Welding Supervision Ltd.

DELICATE OPERATION

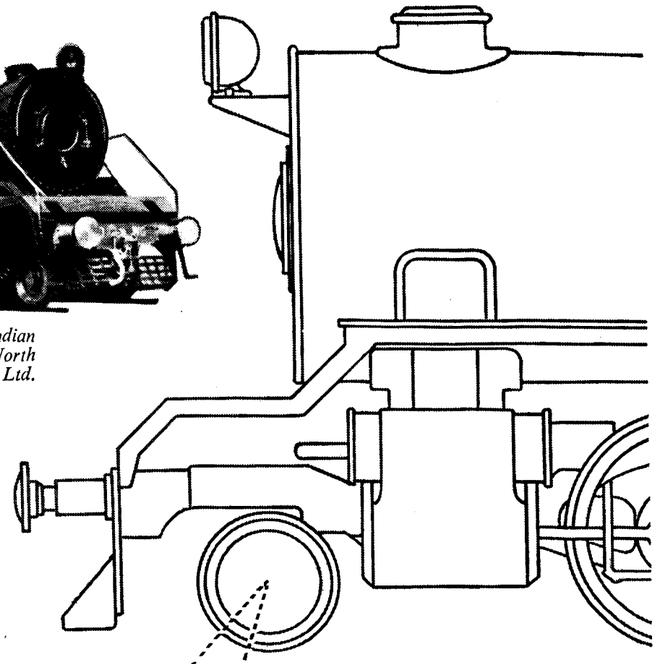
The most delicate operation during the laying of the main, happened at the end of the pipe journey where the River Ouse had to be crossed. This operation was started at 6.30 a.m. on Sunday morning at the end of

1000 000 SKF AXLEBOXES

With **SKF** axleboxes nothing is left to chance—and it is not by chance that **SKF** is the first to have supplied 1,000,000 roller bearing axleboxes to the railways of the world. Designers and railway engineers have long known that there is always an **SKF** axlebox that is exactly right for their particular requirement. Standard axleboxes, special axleboxes, single and double bearing axleboxes for mounting inside or outside the wheels—all are included in **SKF**'s first million. All these types—and more special types too if the need arises —will make their contribution towards **SKF**'s second million.

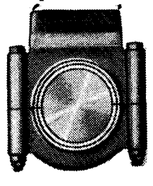


Steam locomotive for Indian Railways built by the North British Locomotive Co. Ltd.



SKF MEANS THE RIGHT BEARING IN THE RIGHT PLACE

THE SKF BALL BEARING CO. (PRIVATE) LTD.



BOMBAY, P. O. BOX 71,
CALCUTTA, P. O. BOX 588,
MADRAS, P. O. BOX 66.

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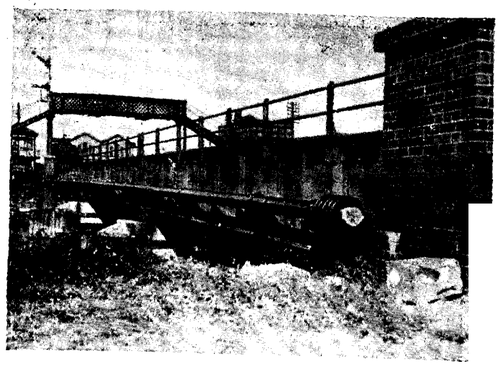
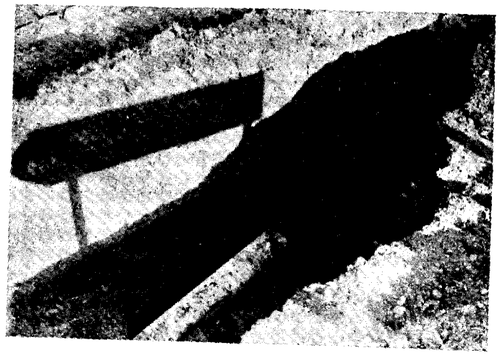
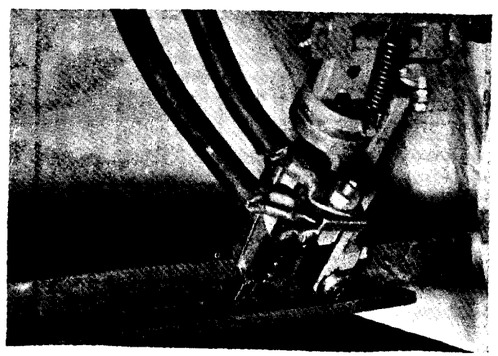
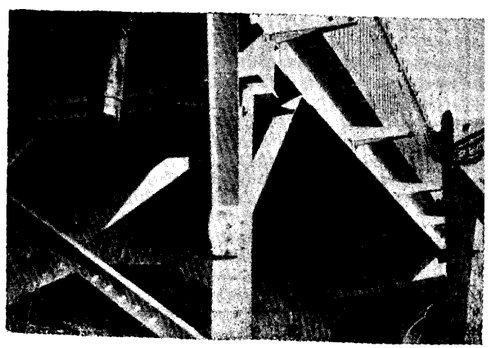
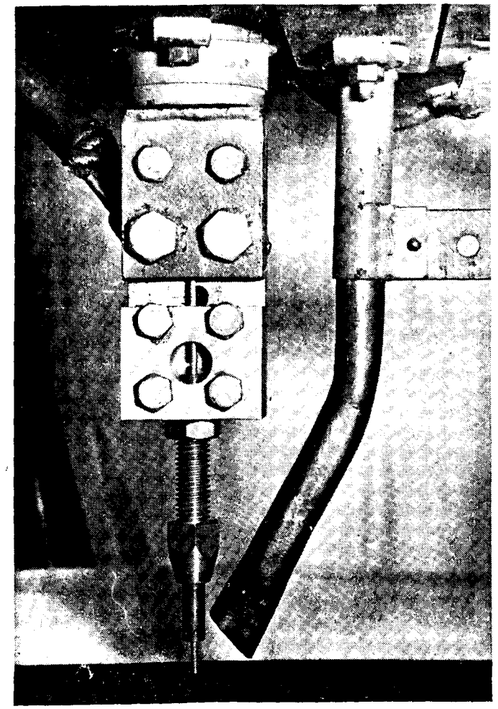










September, and involved the lifting of a 157 ft. length of gas main on to the railway bridge which spans the Ouse at Bedford.

Because of the unusual length of the pipe, a high degree of skill was necessary to ensure the plans success. In addition, the Biggs Wall and the Gas Boards' engineers were allowed only 12 hours on the bridge, and nearby track.

This allowance was to eliminate any delay in the goods or passenger goods service normally running during weekends by British Railways.

Faced with the time limit imposed by the Railway Authorities the contractors pre-fabricated the pipe at a site close to the bridge which entailed the welding together of shorter sections of pipe.

THE BIG LIFT

Two heavy mobile cranes negotiated, not without difficulty, the cumbersome railway tracks and slowly began lifting the pipe.

A worrying moment came when one of the cranes started to slip on the tracks, but this was quickly righted and the pipe was lifted gently into position on brackets already fixed on the south-west side of the bridge by 8.30 p.m. with many hours to spare.

MEASURES TO IMPROVE BOMBAY SUBURBAN TRAIN SERVICES

174 New Electric Multiple Unit Coaches for the Bombay Suburban Service of the Central and Western Railways are now on order, the first of which are expected to be in service by the middle of this year.

Shipment of the first four new Electrical Multiple Unit coaches out of an order for 50 such coaches placed on Messrs. Breda, an Italian firm, has already commenced. These coaches will be serviced and put into commission by the middle of this year. Deliveries of the remaining coaches on this order will continue into the second quarter of this year and as and when the coaches arrive, they will be got ready for service.

Out of the balance of 124 coaches, an order for 50 electrical Multiple Unit coaches has been placed with the same Italian firm and deliveries of these coaches will start in the latter part of year. Orders have also been placed with two Japanese firms, one for 50 coaches and the other for 24 coaches for the Bombay Suburban Railways. Delivery of these coaches will be effected in the latter half of this year.

Of the 174 coaches ordered, 149 have been allotted to the Central Railway and the balance to the Western Railway. 64 of the new coaches will be utilised exclusively for running additional trains in the Railway's endeavour to ease the overcrowding, in the peak periods, in particular. The remaining coaches are intended to serve as replacements for some of the units now running and which have been in service for 30 years.

* * * *

Spherical Roller Bearings in Railway Axleboxes

(From a special Technical Correspondent)

RAILWAY axlebox bearings have always been of vital importance to the reliability of railway vehicles and have for long been a factor having a considerable influence on the running economy of railways. Ever since railways first came into being, constant efforts have been made to improve the design of the bearings - not only to make them more reliable and economical, but also to make possible larger payloads, higher train speeds and to reduce starting resistance.

It is now generally recognised that rolling bearings offer the solution to the railway bearing problem, particularly for the heavy, high-speed and intensive railway traffic conditions which prevail to-day. The success of rolling bearings has been achieved by the joint efforts of the rolling bearing industry and the railways over a long period of years.

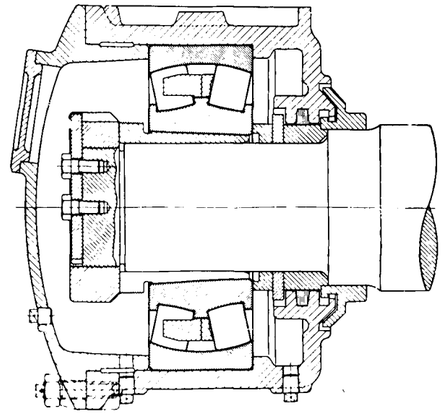


Fig. 1. Axlebox for heavy American passenger bogies installed in 1921.

Special interest is centred on this matter at the present time because SKF has just announced the supply of the millionth SKF axlebox. For many years a pioneer and leader in the field of railway bearings the SKF organisation is believed to be the first Company to have reached this total. The vast majority of the million axleboxes so far supplied have been equipped with double row spherical roller bearings, a type which was specially designed and introduced to solve railway bearing problems.

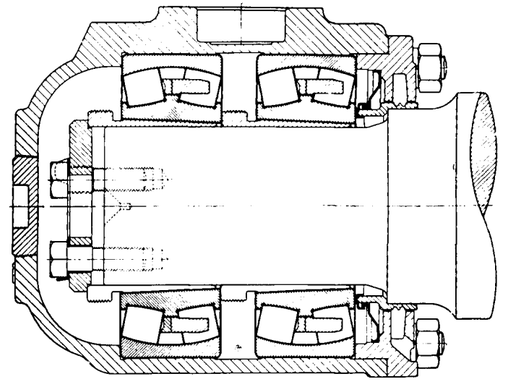


Fig. 2. Roller bearing axlebox fitted with two spherical roller bearings for four-wheel goods wagons.

A study of the development and of the part played by this type of bearing may therefore be of historical and current interest.

As far back as 1911 axleboxes incorporating self-aligning ball bearings, were fitted experimentally by SKF to a number of heavy passenger coaches on the Swedish State Railways, and shortly afterwards a number of steam locomotives were similarly equipped. For reasons which are obvious in the light of later experience, the restricted space available for the axleboxes did not permit the fitting of ball bearings with sufficient carrying capacity. Better results were achieved, however, with 6-wheel ore trucks on the North Swedish ore railways, to which a large number of ball bearing equipped axleboxes were fitted from 1915 onwards. Extensive examinations were made, however, of the train resistance compared with plain bearings equipped trains, which proved that the saving in power and the permissible increase in train lengths would offset the additional cost of the bearings. The reduction in the starting resistance was found to be very considerable, particularly in very cold weather. At this stage, however, one of the Major advantages of rolling bearing axleboxes increased reliability and reduced maintenance costs—did not immediately become apparent. That was to follow later with the large scale use of roller bearings in railway vehicles.

The ball bearing installations mentioned above were very largely of an experimental nature, but meanwhile SKF seriously took up the question of railway vehicle

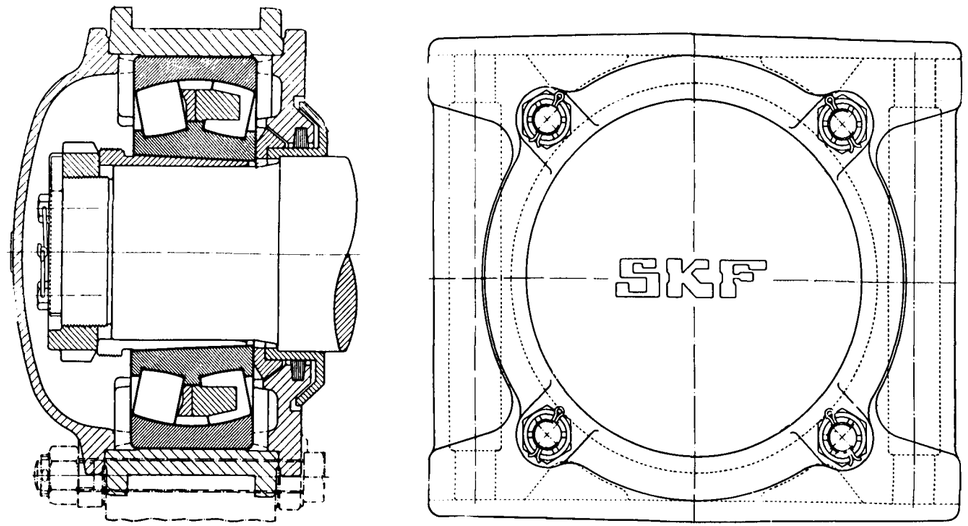


Fig. 3. Completely self-aligning axlebox for diamond bogie of locomotive tender.

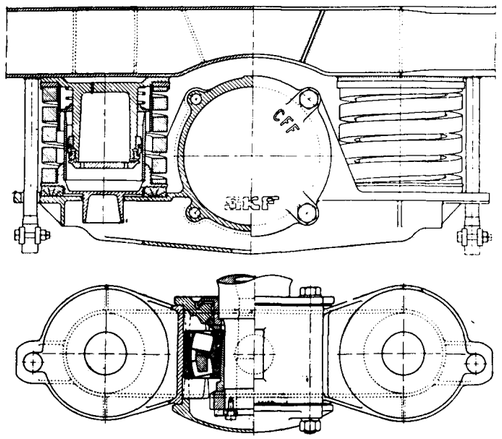


Fig. 4. Bearing scheme of Swiss Schlieren bogie. The axlebox is fitted with one spherical roller bearing.

working conditions and the problems encountered with the design of bearing schemes, with the object of producing a suitable type of bearing for railway service. It was quickly realized that the problem could only be solved by using roller bearings of very high carrying capacity, and efforts were centred on designing a self-contained, non-adjustable unit capable of carrying thrust loads in both directions.

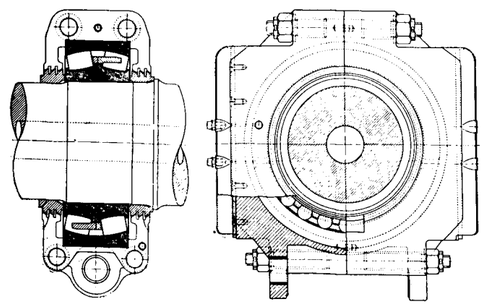


Fig. 5. Single bearing axlebox for the driving and coupled axles of steam locomotives.

In 1919–1920, the first SKF double row spherical roller bearing was put to its first practical tests on the Swedish State Railways. This marked an important turning point in the development of railway bearings because for the first time a roller bearing became available which had been designed specifically for railway service.

In 1921 an installation of considerable significance was carried out on the Pennsylvania Railroad, when 48 axleboxes of the type shown in Fig. 1 were fitted. These

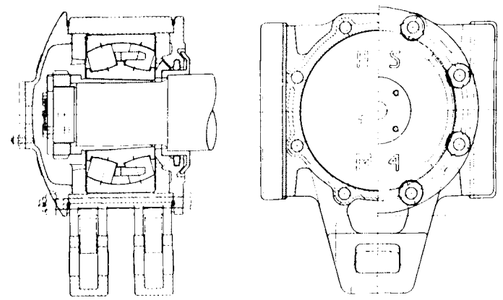


Fig. 6. Axlebox with load carried by an underslung equalizing beam for motor bogie of Dutch multiple unit stock.

axleboxes remained in service until 1946, when the coaches were scrapped. The design of this axlebox is of special interest because it was the first time that a single, completely self-aligning bearing had been used successfully in a railway axlebox. It was also the first time that axlebox bearings had been mounted on withdrawal sleeves – a feature which ensured a tight fit between the bearing inner ring and the axle journal, even though the journal might be machined to a relatively coarse tolerance. Dismounting of the bearing for inspection of the journal was also greatly facilitated.

Nowadays, the use of modern workshop equipment ensures accurate machining of axle journals to close tolerances. This has led to a saving in cost and space, because it enables the bearing to be mounted direct on the axle journal.

On four-wheel wagons, which are the most common type of goods vehicle in Europe, two bearings are used per axlebox, as shown in Fig. 2. This bearing scheme has

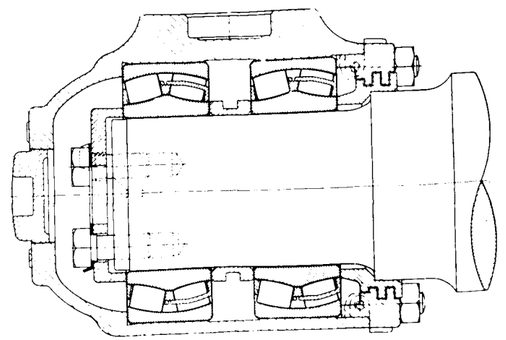


Fig. 7. Axlebox for European goods wagons with axle load of 20 tons, manufactured to U.I.C. standards.

become the most widely used for many different types of railway vehicle—both for rolling stock and locomotives—even though the self-aligning properties of the spherical roller bearing are not completely utilized.

In many cases, however, the unique self-aligning properties of spherical roller bearings have given considerable freedom to the vehicle designer in drawing up bogie, rolling stock and locomotive designs. A single

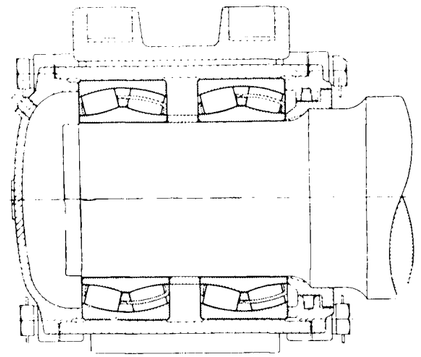


Fig. 8. Axlebox for American passenger coaches, electric locomotives and diesel locomotives with axle loads up to 24 tons, and manufactured to A.A.R. standards.

bearing axlebox with one spherical roller bearing (Fig. 3) is virtually essential in diamond-type bogies. In other cases the self-aligning properties of the axlebox have led to simplicity of design, flexibility and other advantages. An outstanding example is the Swiss bogie bearing scheme shown in Fig 4, which has become world famous because of its excellent riding qualities. Single bearing axleboxes also offer advantages on locomotives because their narrow width allows them to be fitted inside the wheels on driving and coupled axles. A single bearing design often offers the most efficient and economical solution for axleboxes which are bottom-loaded either by underslung carrying springs or equalizing beams as shown in Fig. 6.

Over the years the demands made on the performance of roller bearing axleboxes have become more and more severe. Axle loads, train speeds and annual mileages have increased, and at the same time the tendency in modern bogie and vehicle design has been to restrict still further the available space for the roller bearings. This has confronted roller bearing manufacturers with the problem of developing bearings with even greater carrying capacity in relation to their size. SKF successfully solved

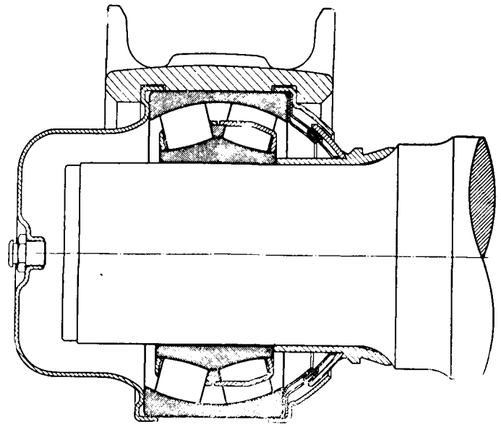


Fig. 9. Rocker-type axlebox for American goods wagon bogies.

this problem by a radical redesign of the spherical roller bearing to give no less than a 40% increase in its carrying capacity. This development marked a major advance in the field of railway bearings and made possible the successful application of axleboxes with smaller external dimensions than hitherto for given loads.

Examples of axleboxes incorporating the redesigned spherical roller bearing are illustrated in Figs. 7 and 8, Fig. 7 shows an SKF goods wagon axlebox for four-wheel wagons with an axle load of 20 tons, conforming to U. I. C. standard dimensions. Fig. 8 shows an SKF axlebox for passenger coaches, electric locomotives and diesel locomotives with axle loads up to 24 tons, conforming to A. A. R. standards.

An axlebox for American goods wagon bogies, Fig. 9, is undergoing extensive tests in the U. S. A. Free axial oscillation of the axle in relation to the bogie frame, made possible by the self-aligning feature of the bearing, makes this axlebox particularly suitable for high train speeds. Moreover, this bearing scheme is probably the most economical ever produced for goods wagons.

The development during recent decades has also resulted in the manufacture of satisfactory axleboxes fitted with cylindrical or taper roller bearings of suitable design, each possessing characteristic features. Spherical roller bearings, however, occupy a central position in modern railway bearing engineering as general-purpose bearings. The millionth SKF axlebox was fitted with spherical roller bearings.

Diesel-electric Shunting Locomotives

(By a Special Correspondent)

350-B.H.P. UNITS FOR BRITISH RAILWAYS

TEN of the batch of 85 Diesel-electric shunting locomotives that has been ordered by British Railways are being fitted with traction equipment made by Crompton Parkinson, Limited, Chelmsford, and engines made by Crossley Brothers, Limited, Manchester, 11. These locomotives are all of the 0-6-0 350-h. p. standard design of which many are already in use in various parts of the country. The Crompton Parkinson/Crossley batch are at present being tested and commissioned. Their maximum tractive effort is 35,000 lb. with a continuous value of 15,400 at 5½ m. p. h. With a weight of 46 tons, the maximum speed is 20 m.p.h.

The Diesel engine used is the EST6, of which many are already in service in Diesel-mechanical shunters. It is a robust unit of 7-in. bore and 9-in. stroke, using the two-stroke cycle and employing the port-controlled loop-scavenge principle in conjunction with exhaust-pulse pressure charging. All parts are readily accessible for maintenance, including the exhaust ports which can be reached through doors in the exhaust manifold. An engine undergoing trials is shown in Fig. 1. The illustration also shows clearly the standard three-point mounting system for the complete engine and generator unit. The one-hour traction rating for this engine is 400 brake horse-power at 900 r. p. m. For this application the maximum speed is 825 r. p. m. and the service idling speed 350 r. p. m.

MAIN GENERATOR

The main generator has a 1-hour rating of 220 kW. 570 amps., 385 volts, 825 r. p. m. and a continuous rating of 214 kW, 492 amps., 435 volts, 825 r. p. m. It is a single-bearing self-ventilated machine, solidly coupled to the engine. The armature is built on a shaft which is a special forging, the shaft and coupling being in one piece. Another feature of the construction is the special hand barring gear that has been

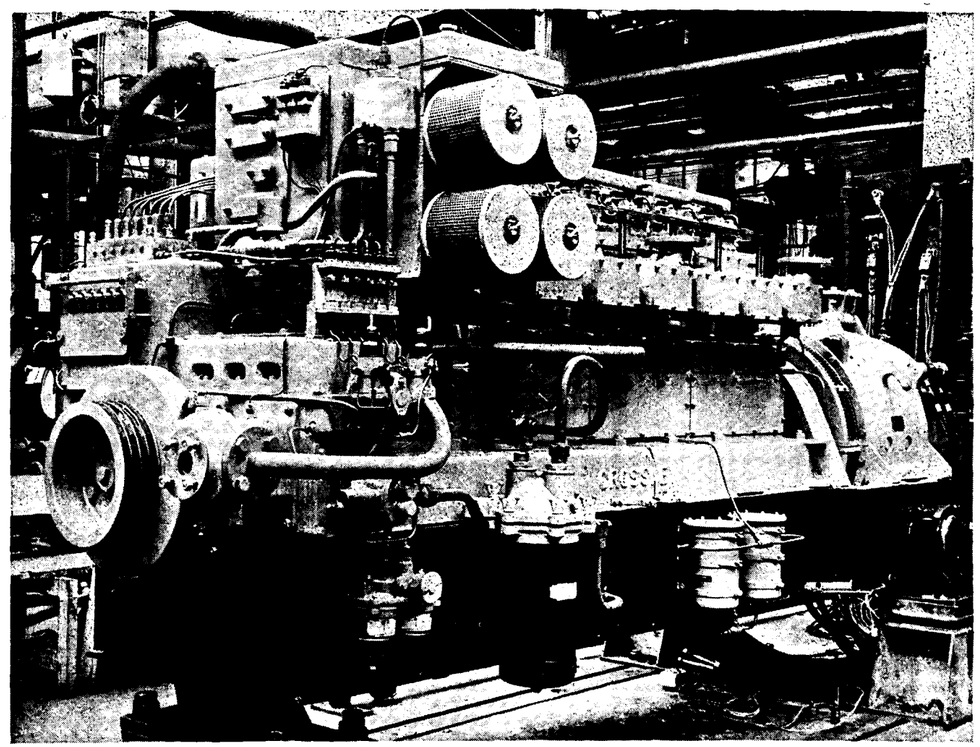


Fig. 1. The Crossley EST-6 two-stroke loop scavenge engine is close-coupled to a Crompton Parkinson generator to form the power unit of a shunting locomotive having a maximum traction effort of 35,000 lb.

embodied in the coupling end of the rotor, so providing a simple means of turning over the whole engine generator shaft assembly. This consists of a lever which fits on a pivot pin mounted on the generator, and which carries at its end a swinging link. The free end of the link engages with projections on the fan disc of the rotor, forming a pawl-and-ratchet mechanism which can operate in either direction. Very accurate positioning of the crankshaft is therefore possible.

The magnet frame is of cost steel, the proportions ensuring moderate weight in conjunction with maximum strength. Mounting arrangements for the magnet frame include vertical and horizontal bases whereby the main generator frame is attached to the fabricated engine underbed, which in turn is bolted to the Diesel engine crankcase.

The generator has three field windings, namely, self and separately excited shunt windings, and a series winding which is used only for starting purposes. Its characteristics have been so designed that no complications such as separate exciters or regulating devices are necessary. Both the field and the armature coils have been fully pressed and bakelised, thereby eliminating shrinkage during service and ensuring rigidity, freedom from breakdown and close dimensional tolerances. Double-annealed soft copper is used throughout All field coils are in separate sections and each section embodies terminals to receive the external connections. The main insulation is carried throughout the complete length of the armature coils, thus eliminating the source of weakness that would be present if the main insulation were supplied only to the slot portions of the coils.

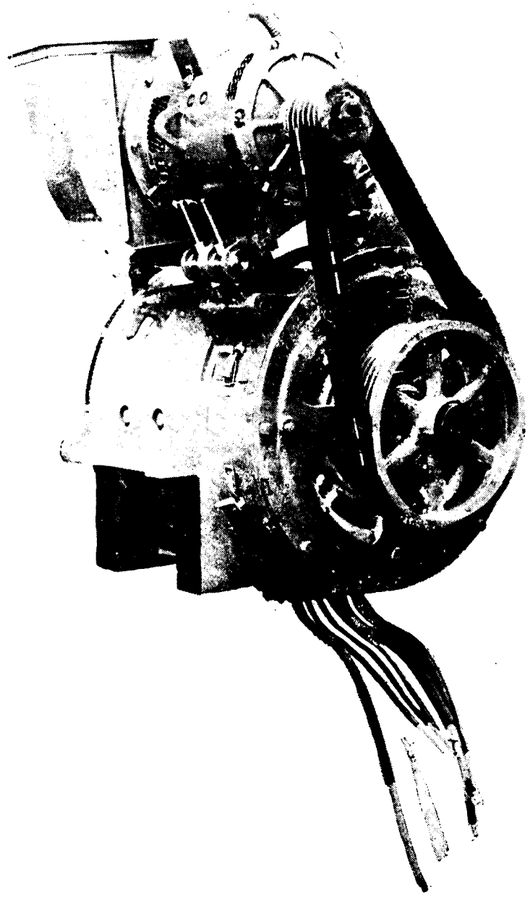


Fig. 2. As shown here, the auxiliary generator is mounted on top of the main generator and is bel driven. The forced-cooling fan for the traction motors is bolted to the auxiliary generator.

Mounted on the main generator in the manner shown in Fig. 2, is the auxiliary generator, which, in turn, has a centrifugal blower mounted on it for the forced ventilation of the traction motors. This arrangement obviates the need for more than one belt drive from the main generator. The 1-hour rating of the auxiliary generator is 90 volts, 13.5 kW at 1,165/2,750 r. p. m. and the continuous rating is 12 kW under the same conditions; corresponding engine speeds are 350-825 r. p. m. The auxiliary generator voltage is maintained at 90 volts by means of a carbon-pile automatic voltage regulator installed in the driver's cab.

TRACTION MOTORS

The two axle-hung nose-suspended traction motors have double-reduction gearing, one gear-wheel and pinion being accommodated at each side of each motor. The layshaft joining the first and second train is carried on roller bearings, and is mounted in an eccentric shaft whereby the drive is easily de-meshed if the locomotive has to be moved at speeds in excess of 20 m. p. h. from one shunting yard to another. In Fig. 3, which shows

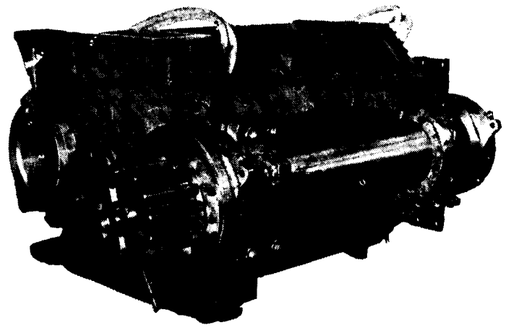
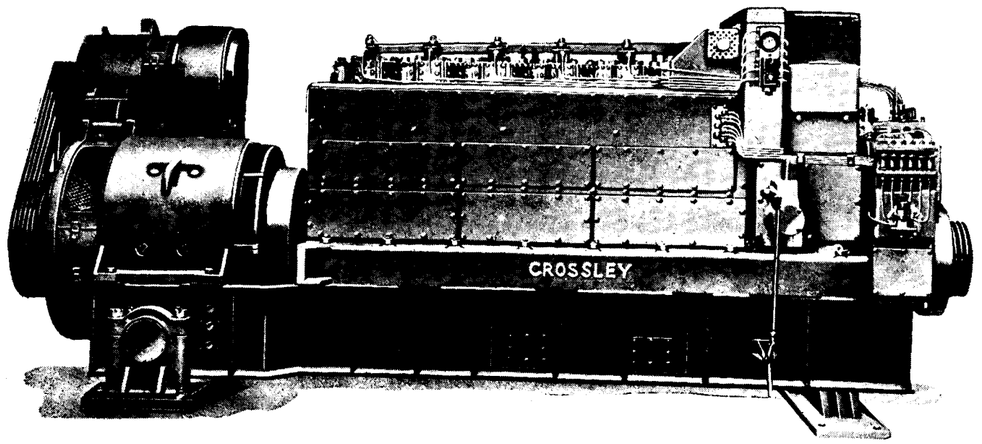


Fig. 3. The traction motors are nose-suspended and drive through double-reduction gear. The lay-shaft is eccentrically mounted in the sleeve so that the pinions can be taken out of mesh.

the traction motor viewed from the layshaft end, the pinion is shown partly out of mesh. To move it in or out of mesh the nuts holding the two sleeve clamps are slackened and the clamps freed with a jack screw. The sleeve which carries the layshaft can then be rotated until the lugs at the ends correspond to the holes in the frame. A bolt then holds them in place.

A particular feature of the drive is the lining-up of the layshaft, the armature shaft and the axle all in the same plane. This has resulted in a motor of relatively small overall dimensions and, in that the armature shaft and axle are at the same height, it has provided ample clearance between the motor frame and the locomotive footplate to simplify erection and servicing. A further feature of the drive is that the armature pinion, as well as the pinion and gearwheel on the layshaft, is arranged for removal when necessary by high-pressure oil injection. As mentioned above, the motors are nose suspended and the necessary resilience is introduced by rubber springs located between the nose support and



the fixing on the locomotive frame. Suspension bearings are of the conventional type, but to simplify maintenance, Armstrong lubricators have been fitted.

The Control gear was designed and made by Allen West and Company, Limited, Brighton, 7. It is contained in a single desk-type cubicle located in the driver's cab, and has controls which are to the standard British Railways pattern. The power circuits are also standard to British Railways in that the two traction motors are connected in parallel across the main generator. No series-paralleling arrangements are provided, however, since it was considered that the capacities of the generator and the motors would be ample for all the varying duties that the locomotives would be called upon to perform, including hump shunting, without resorting to this expediency. However, a switch has been included which weakens the field of the main generator, thereby enabling the speed of the Diesel engine to be raised and so increasing the quantity of air supplied to the traction motors while maintaining the same power output. This switch can be used when particularly heavy loads are being hump shunted.

The notching sequence of the controller is as follows. Moving from 0 to 1 the main contactors are closed and excitation is applied to the generator. In between notches 1 and 2 there are seven steps of excitation (affecting the separately-excited winding) any one of which is a "running" position. The engine speed throughout remains constant at 400 r.p.m., having been increased from 350 r.p.m. (the idling speed) when the controller was moved into the first notch. When in notch 2, the maximum tractive effort at low speed is obtained. Between notches 2 and 3 the controller acts on the engine governor and raises the speed to its maximum of 850 r.p.m. Notch 4 is only for use at high running speeds; in this position the generator field is again increased. An example of the use of this position would be when the locomotive was returning light to pick up another train; wrong use in prevented by an automatic relay. The switch mentioned above for speeding-up the Diesel engine by weakening the field is quite separate from the main controller. Each motor is controlled by its own contactor and protected by its own overload relay. The general system is earthed through an earth-fault relay which provides protection both to the generator and the motors. Each motor can be isolated, if ever necessary, by means of the isolated links provided for this purpose in the control cubicle. The starting battery is divided, half being arranged each side of the main engine. This allows the relay contactor to be close to the generator and avoids taking heavy-current cables into the cab.

TALBOT—Oldest German Rolling Stock Builders

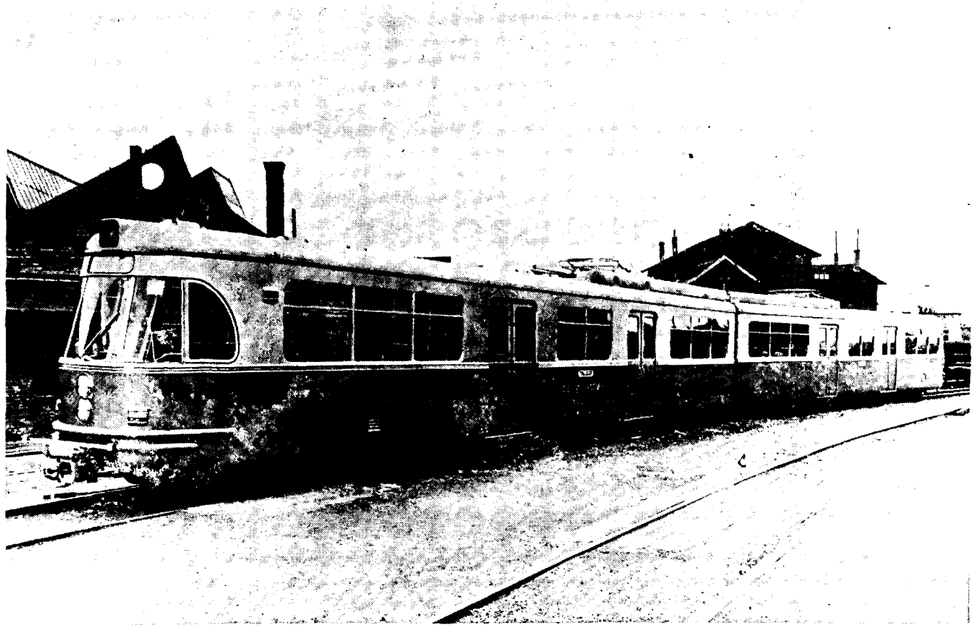
(By our Engineering Correspondent)

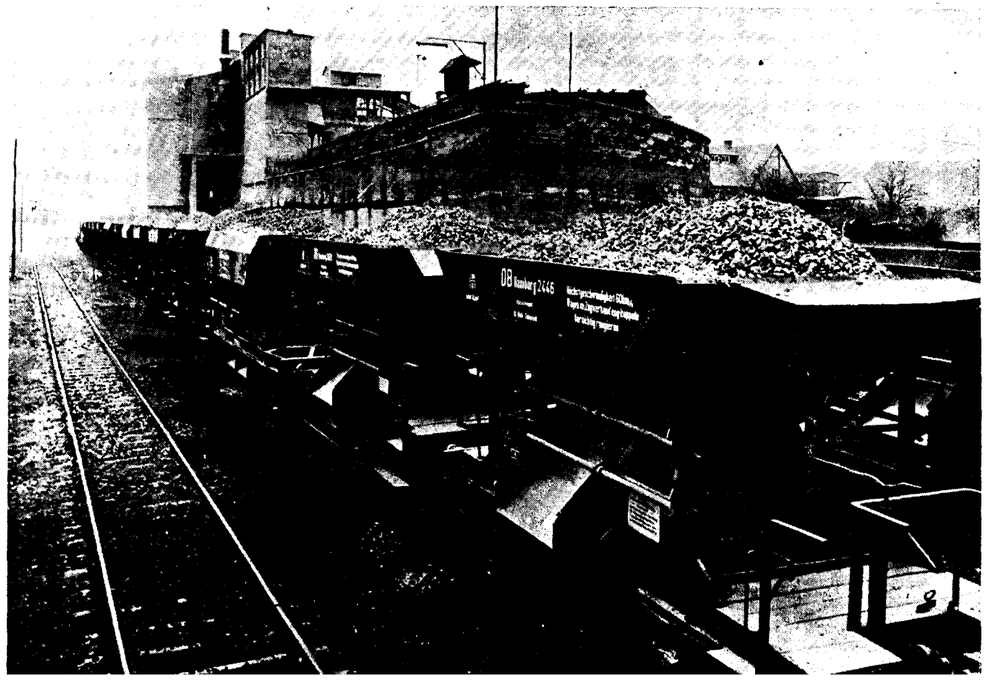
FROM its very beginning on, the Talbot Wagon Factory in Aachen has taken a great part in the development of German Railway matters. The Company was establish in 1838, three years after the inauguration of the first German railway line between Nuremberg and Furth. The Talbot factory became the oldest place of German Rolling stock building, and the ancient town of Aachen, the traditional place of coronation of many German Emperors, added another interesting industry to its manifold existing ones.

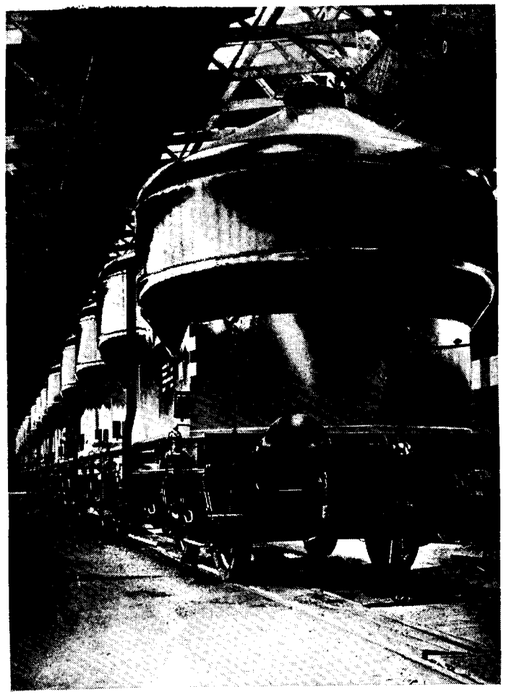
The establishment of the Talbot Works was followed, through many years, by a constant up and down of varying success. Branch works, which meanwhile had been established, had to be temporarily dissolved, the main works, however, always maintained their sound economical nucleus.

Intensified research of best working methods, adapted to up-to-date requirements, ensured new and better rolling stock production.

Presently, the Talbot manufacturing programme comprises the building of: Passenger coaches of 26.4 m of length, express coaches for the German Federal Railway, mail coaches and comfortably equipped "Touropa" traveller's coaches. In passenger coaches built for the Indian and Burmese Government Railways, latest technical improvements and climatic conditions were put into practice. Especially, air-cooled light Diesel Rail Cars, developed by Talbot in various sizes and types, answer, in all respects, the present state of requirements of near distance traffic. The constructive development of Rail Cars, according to the latest state of light metal construction technique marking a new epoch, representing beauty of exterior form combined with most solid and comfortable interior equipment, has met with approval and grateful appreciation throughout. The reduction of total weight brings about relief for the engine capacity. Moreover, this design, in conjunction with the unified construction system and the unified building elements, enables less important Railways to provide for a simple



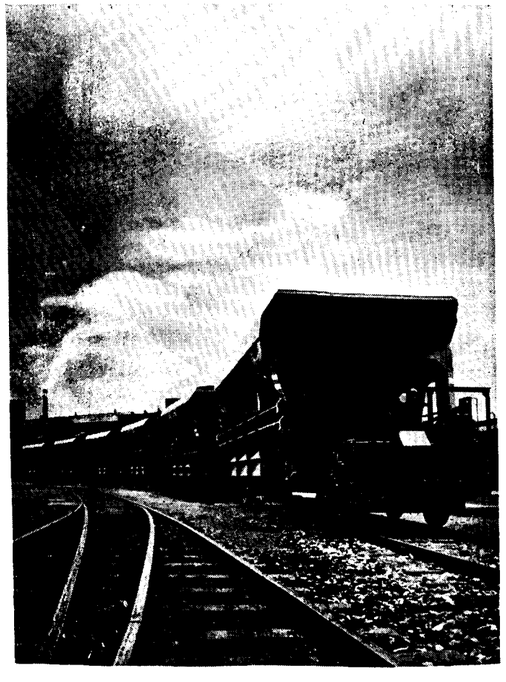




condition which led to favourable contracts for all kind of rolling stock with the following countries : Australia, India, Turkey, Sweden, Holland, Luxemburg, South Africa, Nigeria, Burma and others.

It has always been the aim of the Talbot Wagon Factory to maintain their reputation of having a more than 100 years experience in wagon building by constantly intensifying research and progress along their lines.

In 1891, for example, Talbot was able to create something altogether new on the goods wagon sector : Privy Councillor Georg Talbot took out a patent for a self-discharging goods wagon which, of all things, proved to be very suitable for industrial works transportation. This type of wagon then started its victorious campaign all over the industrial world. Since a long time the German Federal Railway has made the self-discharging wagon an indispensable part of its carriage rolling stock, especially after the wagon was developed to hold a voluminous loading capacity. Further more, this self-discharger gained another outstanding significance as a two or four axle ballasting wagon after the introduction



and easy maintenance and repair of vehicles saving considerable expenditure of means of operation. Rail car trailers can alternatively be put into operation in Rail Car service and steam operated train service. The Power Rail Cars will eliminate the use of the locomotive and the luggage van.

For working methods the Talbot Wagon Factory has adopted the policy of intensified rationalization as from planning of work until the execution of a contract. As a consequence, of this method, railway wagons are now built after the so-called "building-box" system in accordance with the latest technical experiences in series production. Thus, any type of wagon : self-dischargers, goods wagons or passenger coaches, are assembled from sub-assemblies, which beforehand, were made in series production. In case of rolling stock being delivers oversea, wagons are shipped in dis-assembled condition. This method of shipping proved to be the best up-to-date. Talbot was the first wagon factory to secure—against overwhelming foreign competition—an important export contract covering large-sized goods wagons of a special design—a combination of self-discharging and open goods wagon. Costs of transport were considerably reduced on account of the wagon being shipped in disassembled

of the so-called adjustable discharging doors rendered possible a discharge of ballast in varying quantities and any desired individual operation of the doors. This way it become possible to distribute the ballast between the rails and to both sides of the tract, and even underneath the wagon. Because of these manifold qualifications the mentioned type of self-discharging wagon has been sold in great number not only to the German Federal Railway but also to many reputed European and overseas Railways. It is a fact that the invention of the full-automatic adjustable discharge greatly consolidated the world-wide reputation of the Talbot Self-discharges.

Presently, the German Federal Railways is aiming at having replaced the open goods wagons conveying coal and bulk goods, by two axle self-dischargers. This third development of selling facilities of the Talbot self-discharger is to be attributed to the constant progress in construction in which are incorporated all experiences made hitherto. The Talbot workshops are presently manufacturing 500 self-dischargers for the Federal German Railways.

The disposition of the Talbot workshops is such that it will always be possible to comply with all requirements in regard to building various wagon types.

The imposing Administration building situated at a distance from the workshops and office buildings screening the whole works area from the main street where many houses were built by the firm granting, together with vast settlement outside of the town, accommodation to the Talbot Factory workers.

Work never rests in this enterprise belonging to a family who, since 4 generations, have closely liked up their name and fate with the building of rolling stock.

Constant day and night work in the Talbot workshops is serving the purposes and requirements of clients throughout the world.

DEPARTMENTAL CATERING ON WESTERN AND CENTRAL RAILWAYS

In pursuance of Government's decision to make a beginning with department catering on the Railways on which at present catering is handled exclusively by contractors, it is proposed to introduce departmental catering on certain stations on the Western and Central Railways with effect from April 1, 1956. On the Northern Railway departmental catering was introduced at Delhi and Pathankot from October 1, 1955, while on the North Eastern Railway it was introduced at Gorakhpur from February 1, 1956. On the Eastern and South Eastern Railways, where departmental catering has been in vogue for several years, it is proposed to extend it to more stations.

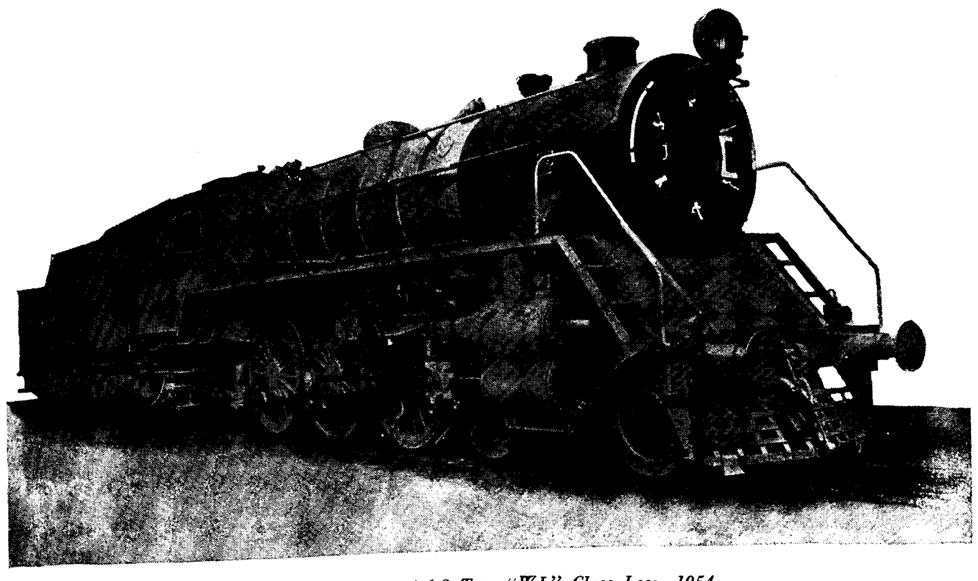
The Government of India have decided that small contractors who may be displaced as a result of introduction of departmental catering should be rehabilitated at other stations. It has also been decided that as many of the staff as possible employed by the contractors who are likely to be displaced are to be absorbed, either as vendors on a commission basis or as regular Railway employees. Efforts are being made to rehabilitate the affected small contractors and their staff by April, 1956. The decision to introduce departmental catering on the Railways over which catering establishments are worked exclusively by contractors was taken on a recommendation made by the High-Power Committee under the chairmanship of Shri O. V. Alagesan, Deputy Minister for Railways and Transport. The Committee felt that departmental catering should set the standard for private contractors and should function side by side with them, each profiting from the experience of the other and fulfilling a complimentary role.

Vulcan Locomotives for Indian Railways

By The Works Manager, "The Vulcan Foundry Ltd." Newton-Le-willows, U. K.

THIRTY 2-6-4 TYPE "WM" CLASS SIDE TANK LOCOMOTIVES (5′—6″ GAUGE) SUPPLIED IN 1951

IN the late 1930's the Indian Government Railways placed orders with The Vulcan Foundry Limited, for a number of new type locomotives designated the "W" series, ten of these being the "WM" Class built in our Works and delivered in 1942. The thirty locomotives recently constructed incorporate all the major features of the original design, with the exception of the inner firebox which has been changed from copper to steel, the consequent saving in weight permitting the thickening up of tank and bunker plates.



Indian Railways 4-6-2 Type "WL" Class Loco. 1954.

The two course boiler barrel has a Belpaire type firebox the all welded inner firebox being fitted with two arch tubes supporting the firebrick arch. "Flannery" flexible water space stays are provided in the breaking zones at the firebox sides, back and throatplates and the first four rows of the roof stays are also of this type.

The grate comprises a dump bar at the front with hand operated rocking bars, in two sections controlled from the Cab and provision is made for fitting a rocking grate cylinder if required at a later date. A single hopper all welded ashpan, in two parts is provided, the shallow top portion being attached to the foundation ring and the lower portion carried on horizontal frame stretchers. The juxtaposition of the top and bottom portions provides air openings on all four sides of the ashpan, air control doors not being fitted. The usual Indian type cast iron self-closing hopper discharge door is operated from track level.

A "Joco" regulator is fitted in the dome and the Superheater Header is the "AX" type with 21 "A" type elements. Two Gresham & Craven No. 8 Live Steam Injectors supply water to the boiler through a standard type clackbox fitted on the top of the boiler barrel adjacent to the Smokebox Tubeplate. Other mountings include two 3″ "Ross Pop" Safety Valves, two "Everlasting" Blow Off Cocks, and a continuous Blow Down Valve.

Plate type frames 1″ thick are firmly stayed by means of horizontal and vertical plate stretchers. The coupled horngaps are strengthened by one piece cast steel

axlebox guides, fitted with manganese steel liners, separate horn and frame fork clips being provided. The overhead spring gear for the coupled and front truck wheels is compensated throughout and the journals of the bronze coupled axleboxes are hard grease lubricated.

The cylinders are fitted with cast iron barrel liners and covers to suit dished type piston heads and the 8″ dia. plug type piston valves are actuated by Walschært Valve Gear, the valve travel being 6¼″. Lubrication is provided by a Wakefield "A. C." pattern sight feed hydrostatic lubricator in the cab. The connecting rod big end and coupling rod bearings are fitted with fixed casehardened steel bushes and bronze floating bushes and are hard grease lubricated, the gudgeon pin and coupling rod knuckle pins being arranged for soft grease lubrication.

The coupled wheels are of SCOA-P type and 71.8% of the adhesive weight is braked by two 21″ dia. vacuum cylinders positioned between the frames behind the trailing coupled wheels. The brake rigging is compensated and a hand brake is provided in the left hand side of the cab. The front radial arm type truck is lateral spring controlled and fitted with a Timken Cannon Type tapered Roller Bearing Axlebox. The outside journals of the hind bogie are also provided with Timken Roller Bearing Axleboxes. Two side Tanks, bunker tank and a middle tank located beneath the boiler between the frames at the driving wheel, are connected by 6.7/8″ bore equalising pipes. The tanks are of welded construction with stay and surge plates bolted in position. Filling boxes are fitted on each of the side tanks and on the right and left hand side of the bunker tank. Stone's electric lighting equipment is provided and includes two 14″ Tonum "E" headlights and a 500 watt 32 volt. T.G.I. Turbo generator, Gravity sanding is arranged to deliver sand to the front of the leading and the rear of the trailing coupled wheels.

The principal dimensions are:—

Cylinders (2)	..	16″ dia. x 28″ stroke
Coupled Wheels, diameter	..	5′-7″
Boiler Pressure	..	210 lbs. per sq. in.
HEATING SURFACE		
85 Small Tubes 2 in. out. dia.	..	506 sq. ft.
21 Large Tubes 5¼″ out. dia.	..	328 sq. ft.
Firebox incl. 2 arch tubes 3 in. out. dia.	..	131 sq. ft.
Total Evap.	..	965 sq. ft.

Superheater (21 elements 1.⅜" out. dia)	..	230 sq. ft.
Grate Area	..	24.6 sq. ft.
Adhesive Weight	..	48.4875 tons
Tractive effort at 85% Boiler Pressure	..	19084 lbs.
Adhesive Factor	..	5.68
Total Weight in Working Order	..	96.5625 tons
Total Weight light	..	73.05 tons
Water Capacity	..	3000 gallons
Coal Capacity	..	6.5 tons

The inspection of the locomotives was carried out by Messrs. Rendel, Palmer & Tritton and the locomotives were transported fully erected by road to Liverpool for shipping to India.

TEN 4-6-2 "WL" CLASS LOCOMOTIVES (5'-6" GAUGE) SUPPLIED IN 1955

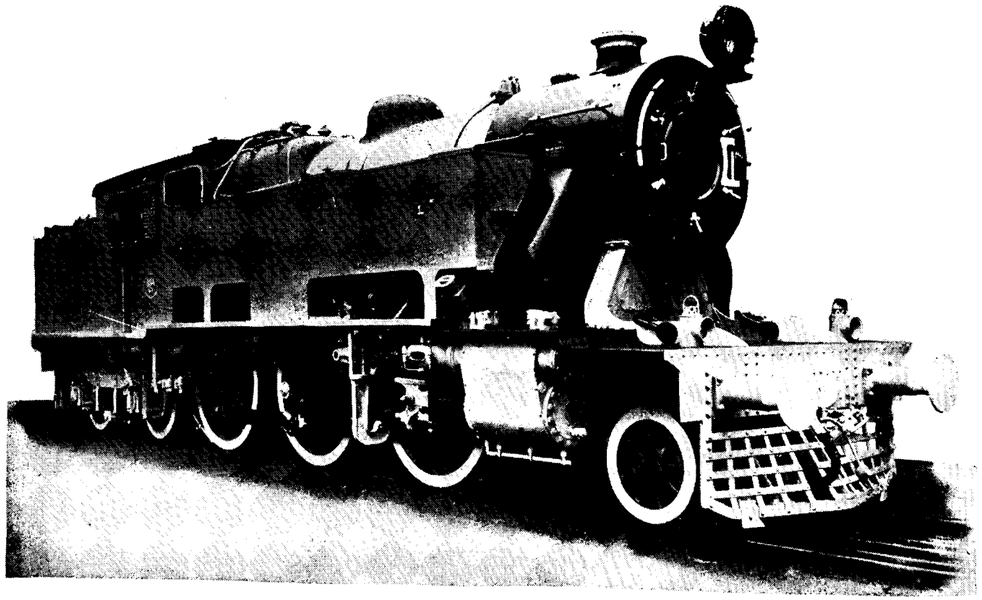
These locomotives are an entirely new design, and except for the wheel arrangement, bear no resemblance to the "WL" class supplied in 1942 to the North Western Railway, which is now in Pakistan.

The ten locomotives recently built in our Works, constitute the prototype of one of a new series of standard classes and are designated as a "light passenger" class, the heavy passenger type being the 4-6-2 "WP". The "WG" Class some of which have already been built in our Works, are designated as heavy goods.

The boiler barrel consists of three courses with the firebox of the round top type. The inner firebox and combustion chamber are all welded and fitted with a thermic syphon and two arch tubes. The roof stays are arranged radially and the front four rows are of the flexible type. Flexible water space stays are also provided in the combustion chamber, throat plate and in the breaking zones, side and backplates. All the water space stays are of "Longstrand" steel.

A "Joco" balanced regulator to suit a 7" int. dia. steam pipe, is mounted in the dome and is operated by a "rams horn" handle on the firebox back.

The all welded ashpan is of the single hopper type with side air openings and a discharge door operated from the right hand side of the engine. The grate is of the Hulson pattern.



Indian Railways "WM" Class 2-6-4 Type Tank Loco. 1951.

The smokebox is of particularly ample proportions and is equipped with self-cleaning plates and a spark arrester. On nine engines asbestos mattresses are fitted only in the portion of the firebox inside the cab, but on one engine only, the whole of the boiler and firebox is completely covered with a special asbestos covering.

Mountings include two Gresham & Craven No. 10 Live Steam Injectors, located under the driver's platform, one on each side, supplying water to the boiler through a top feed clackbox mounted on the first barrel; three 3" dia. Ross Pop Safety Valves; two 1½" dia. "Everlasting" type blow-off cocks, located respectively below the top feed on the first barrel and on the throatplate; two water gauges and a drifting valve on the firebox back. A steam stand located on the firebox top outside the cab, carries the valves supplying steam to the auxiliaries. The firedoor is of the Indian standard inward opening type.

The frames are of rolled steel bars, 4¼" thick for the main portion and are jointed below the firebox front, the rear frame being 2" thick. The axlebox and guide liners are of manganese steel, the cannon type axleboxes being of Timken manufacture in five engines and of SKEFKO manufacture on the other five. Spring compensation is provided between all the coupled and the trailing truck axles. The whole of the revolving and 33% of the reciprocating masses are balanced in the coupled wheels.

The leading bogie is of the standard Indian pattern with two sets of side control springs. On five engines the cannon type roller bearing axleboxes are of Timken manufacture and on the other five engines they are of SKEFKO manufacture.

The Trailing Truck is of the "Cole" pattern, with outside roller bearing axleboxes of Timken manufacture for five engines and of SKEFKO manufacture for the remaining five.

The bogie and truck wheel centres are of rolled steel and in all cases the alternative makes of axleboxes are arranged to be interchangeable in the respective guides.

The cylinders are of cast steel, each cylinder being cast with half the smokebox saddle. The barrels are fitted with cast iron liners, the piston valves being 11" diam. and each valve head is provided with four rings. Five engines have "United States" and five "Britallic" piston rod Metallic packings. N. C. type bye pass valves are fitted on the steam chests.

(Continued on page 33)

The cast steel crossheads are of the "Alligator" the gudgeon pin being soft grease lubricated. The connecting and coupling rods are all fitted with roller bearings at the crankpins in the case of five engines, where the bearings are of Timken manufacture. For another four engines SKEFCO roller bearings are fitted at the driving crankpin only, the leading and trailing crankpins having floating bushes lubricated by hard grease. On the remaining engine, SKEFKO roller bearings are fitted at all crankpins.

The Walschært Valve gear is lubricated throughout by soft grease and the reversing screw is located above the motion bracketoperated from a handwheel in the R.H. side of the cab.

The engine brake is steam operated and the gearing is compensated throughout. Equipment includes a graduable Mk. IV steam brake valve and a SJ-right hand Type P. Ejector for operation of the tender and train brakes.

The cab is of roomy design with walls and roof of steel plate and an inner roof of wood. The platform extends over the tender front and is made from aluminium plate and covered with wood.

Sanding is by gravity feed to the front of the leading coupled wheels only.

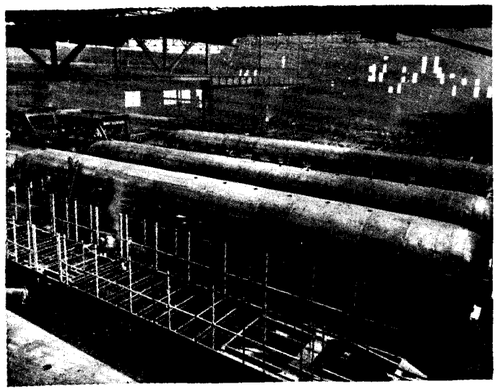
Stones electric lighting equipment consists of a 14" diam. headlight, gauge, SF. lubricator and bunker lamps with current supplied from a 32 v. turbo generator. Oil burning guage, hind and buffer lamps are also supplied.

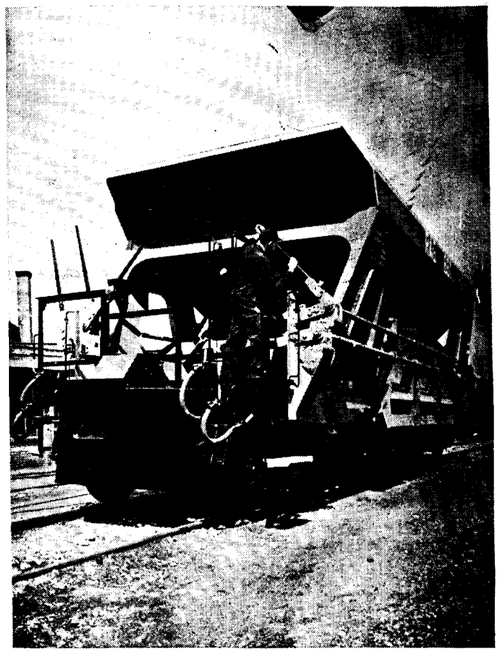
A "Wakefield" AC type, 4 feed hydrostatic lubricator supplies oil to the steam pipe and cylinder barrels.

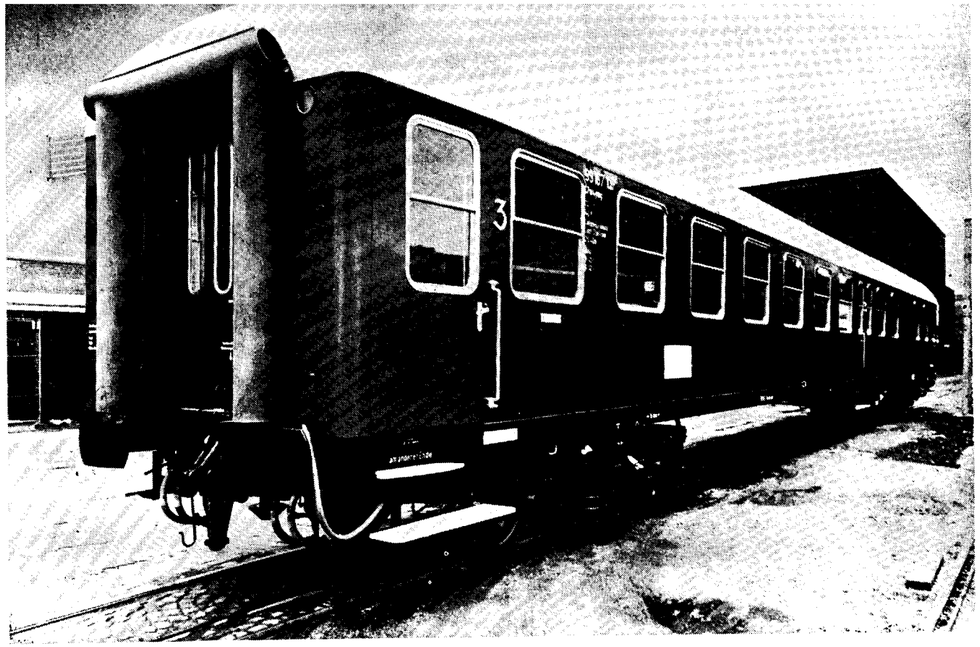
The tender tank is of riveted construction and is carried on a frame made from rolled steel channels and sections. The tender bogies have cast steel one piece frames and wheels with pressed steel centres. Five sets of roller bearing axleboxes are supplied by Messrs. Timken and five by Messrs. Skefko. Braking is through Cast Iron blocks operating on the inner sides of the wheel rims and is vacuum operated. A screw operated hand brake is also provided.

All the buffers and drawgear are of standard I. R. S. design and intermediate spring loaded buffers are also provided.

The locomotives are being dispatched to India in the fully erected condition.



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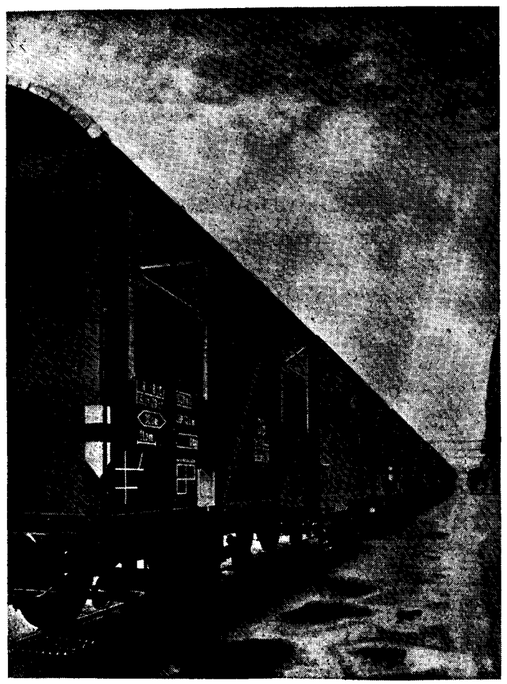

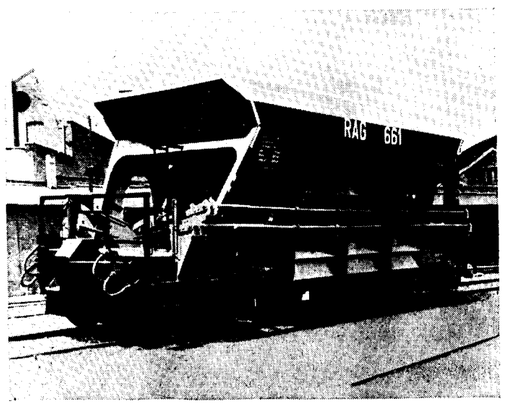
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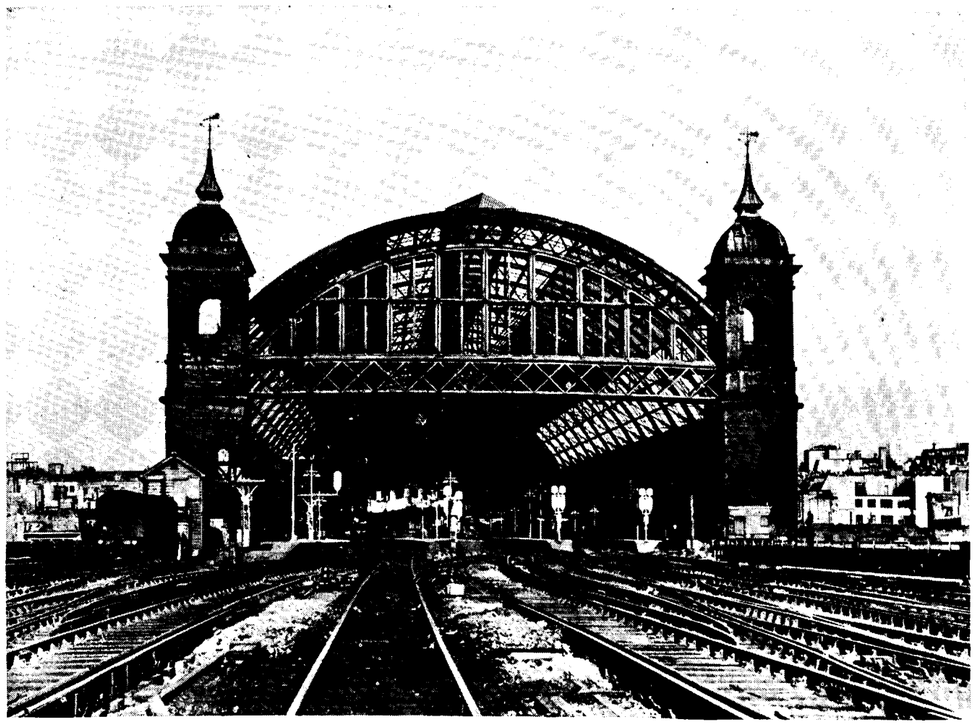


Remodelling of Cannon Street Station.

Photograph: By courtesy of British Railways.

walls. The main block of buildings was designed and built as an hotel for an independant company by Edward M. Barry and was knows as City Terminus hotel. The famous arched roof, which contained two acres of glass until entirely broken during an air raid in the last war, was designed by John Hawkshaw, consulting engineer to the South Eastern Railway Company.

The number of trains in and out of Cannon Street in 1925 immediately before electrification and remodelling of the track approaches was 325. These conveyed 56,000 passengers a day compared with 417 trains which carry an average of 68,000 passengers daily at the present time. The majority travel during the rush hour periods.

*** *** ***

£10 MILLION CONTRACTS PLACED FOR DIESEL LOCOMOTIVES

The British Transport Commission announce the placing of contracts with British manufacturers, of a total value of nearly £10,000,000 for 141 main line diesel locomotives (130 diesel-electric. 11 diesel-hydraulic) and 30 power units required as part of the £1200 millions Plan now in progress for the modernisation and re-equipment of British Railways. The 30 power units will be used for locomotives to be built in British Railway workshops.

Over the whole period of the Modernisation Plan, some 2,500 main line diesel locomotives are proposed to be built, but this number is subject to variation as the Plan develops. The contracts now placed are for the 171 locomotives forming the pilot scheme under which trials will be made before placing any further orders. These contracts comprise three main designs: Type A (800–1,000 H. P., for freight); Type B (1000–1,250 H. P., for mixed traffic); and Type C (2,000 H. P. or over, for heavy duties).

The main contracts for complete locomotives have been placed as follows :—

BRITISH RAILWAYS MODERNISATION

By H. C. Towers

REMODELLING OF CANNON STREET RAILWAY STATION

WORK is to start immediately on the rebuilding of Cannon Street Station at a cost of approximately $1\frac{1}{4}$ million pounds sterling. This station carries heavy morning and evening traffic to and from the City of London to the suburban areas of North Kent. Already 10 car electric trains are running from the Charing Cross terminal chiefly to Dartford via Bexley Heath and Sidcup as against the 8 cars usual on other routes but the full development of the scheme is entirely dependant on the lengthening of the platforms at Cannon Street to take trains of this length.

The work will be divided into stages and because of its magnitude a certain amount of inconvenience is bound to be caused to the 68,000 passengers who use this station daily. The ground floor of the main building called Southern House will be cleared to provide accommodation for a modern ticket hall and concourse. This work will unavoidly restrict passengers access to and from the station.

During the first stage, temporary ticket and luggage offices will be opened in the station forecourt to be followed by the transfer of the ladies cloakroom and bookstall and the removal of the general waiting room. Temporary office buildings erected over the tracks extending from platforms 1 to 6 will accommodate the occupants from Southern House and for railway staff. In the second stage platform lines 1 to 4 will be extended to take 10 car trains and a portion of Southern House will be demolished. The third and most difficult stage will be the actual underpinning of Southern House and the bringing into use of the new booking hall with platforms 1 to 6 lengthened to take the longer trains. At the same time work will commence on a new block of buildings at the east side of the station to provide accommodation for general waiting room, ladies room, refreshment room and staff offices.

The final phase will include the lengthening of platforms 7 and 8 and a start will be made on the removal of the famous arched roof and towers. A new roof will be provided at a lower level. It is expected that the work will take $2\frac{1}{2}$ years to complete but it is anticipated that it will be possible to run 10 car trains into the station by the summer of 1957.

Cannon Street Station, situated on the north bank of the River Thames, in the heart of the City of London, was opened by the South Eastern Railway in 1866. It covers an area of over 152,000 sq. ft. and is 855 feet long from the northern end of the railway bridge, over the River Thames, to Cannon Street public highway. At platform level the station is 187 feet wide inside the

(Continued from page 31)

The leading dimensions are :—

Maximum axleload	..	16.9 tons
Minimum curve	..	574 ft. (10°)
Cylinders	..	$19\frac{1}{4}$" dia. × 28" stroke
Coupled Wheels	..	5'-7" diam.
Leading Bogie Wheels	..	3'-7" diam.
Trailing Truck Wheels	..	3'-7" diam.
Boiler Pressure	..	210 lbs./sq. in.
Heating surface :		
Small tubes (92) 2" o/d × 11 wg.	..	733 sq. ft.
Large tubes (30) $5\frac{1}{2}$" × 8 wg.	..	629 sq. ft.
Firebox (incl. 2 Arch Tubes & Thermic syphon)	..	251.1 sq. ft.
Total Evaporative	..	1613.1 sq. ft.
Superheater elements $1\frac{3}{8}$" × 11 wg.	..	450 sq. ft.
Grate Area	..	38 sq. ft.
Adhesive Weight	..	49.6 tons
Tractive effort @ 85% Boiler Pressure	..	27640 lbs.
Factor of Adhesion	..	4.02
Weight of engine-working order	..	88.1 tons
Tender-Water Capacity	...	4500 gallons
Fuel "	..	12 tons
Wheel diam.	..	3'-7"
Weight fully loaded	..	62.59 tons
Engine & Tender in Working Order	..	150.69 tons.

Birmingham Railway Carriage & Wagon Co. Ltd.,
Smethwick —20 locomotives of Type B.

British Thomson Houston Co. Ltd.,
Rugby —10 locomotives of Type A.

Brush Bagnall Traction, Ltd.,
Loughborough —20 locomotives of Type B.

English Electric Co. Ltd.,
Bradford —10 locomotives of Type C; 10 of Type B; and 20 of Type A.

Metropolitan-Vickers Electrical Co. Ltd.,
Manchester —20 locomotives of Type B.

North British Locomotive Co. Ltd.,
Glasgow —10 locomotives of Type B; and 10 of Type A; also 11 diesel-hydraulic locomotives, 6 of Type B and 5 of Type C.

Contracts for power equipment sets for locomotives to be built in British Railways workshops have been placed with:—

Sulzer Bros. (London) Ltd.
—10 for locomotives of Type C.

British Thomson Houston Co. Ltd.,
Rugby —20 for locomotives of Type B.

These main contracts will also involve substantial orders for engines, electrical equipment, and mechanical parts. The firms concerned include—Messrs. Mirlees, Bickerton & Day, Ltd. (Stockport); Crossley Brothers, Ltd., (Manchester); Dovey, Paxman & Co. Ltd., (Colchester), Crompton, Parkinson Ltd., (Chelmsford); General Electric Co. Ltd., (Birmingham); and Clayton Equipment Co. Ltd., (Tutbury).

Delivery time of the first locomotives under the main contracts will vary from 18 months to two years. In announcing these contracts the British Transport Commission state that over 200 tenders or variations of tenders were received from manufacturers following the issue by the Commission of the specification and invitations to tender. The contracts as now announced spread the work as widely as practicable over the locomotive-manufacturing and associated industries and, subject to the general limits of the Commission's specification, will enable manufacturers to introduce their own ideas and special features in a manner which should prove beneficial, from the standpoint of long-range testing, to both British Railways and to the manufacturers. The latter will also be helped to a considerable extent indirectly in their efforts in the export field.

The types of diesel engines to be used in the locomotives include products of British manufacturers with actual experience in this country or in the overseas market. In addition, the Commission are to carry out extensive trials of the Sulzer (Swiss) and M. A. N. (German) engines, both of which are now made in this country under manufacturers' licences.

The 11 locomotives to be built by the North British Locomotive Company will embody Voith (German) hydraulic transmissions, which are now manufactured in this country under licence. The use of the diesel-hydraulic principle under British railway conditions will be studied with particular interest in view of its successful application in Germany and elsewhere abroad.

The Commission have actively under review their future policy for the manufacture and repair of diesel and electric locomotives. The orders to which this announcement refers, being pilot models for trial purposes, should not be taken as an indication of permanent policy.

Although detailed specifications of all the new diesel locomotives under the pilot scheme have been prepared, their external form and liveries have yet to be settled. The Commission in conjunction with the manufacturers are paying special attention to æsthetic external design, on which they are obtaining expert advice, and pending decisions on this aspect—which will not delay construction—outline drawing of the new designs are not yet available.

AJMER RAILWAY WORKSHOP TO BE REMODELLED—ONE CRORE SCHEME SANCTIONED

The 69-year old Railway carriage and wagon workshop at Ajmer, on the Western Railway, is to be remodelled as part of the Railway development programme during the Second Five Year Plan period. The remodelling scheme, estimated to cost Rs. 1,08,00,000 will more than double the repair capacity of the workshop, and enable it to undertake the periodical overhaul of about 2,000 passenger coaches and 3,600 goods wagons per annum.

Originally built in 1887 by the ex-Rajputana-Malwa Railway, the Ajmer workshop has undergone very little major change since then. Its Capacity at present is considerably short of the Western Railway's requirements, which are likely to increase substantially during the Second Five Year Plan period.

ACCOUNTAL OF RAILWAY STORES

By A. Deb, B. E.
Chittaranjan Locomotive Works, Indian Railways.

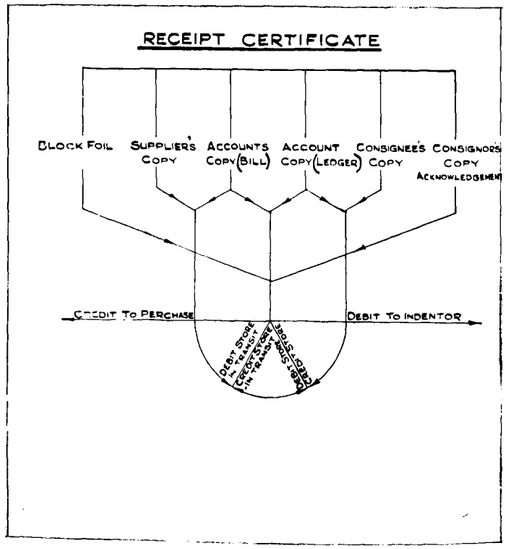
STORES and equipments required for construction, operation and maintenance of railway service during peace and war as well as in emergencies, are procured by the stores department of respective railways. The responsibilities of the stores department does not cease with the procurement of material alone. Concomitant functions are

(i) Receipt of stores
(ii) Inspection of stores
(iii) Accountal of stores
(iv) Proper storage
(v) Issue of stores
(vi) Recoupment of stores

In this chapter, we will deal with the accountal of stores after it has been received, inspected and accepted by the department.

In any stores depot, inward consignments arrive in railway wagons, or by parcel or goods train or in store-van from sister or central depot or in lorries or in carts accompanied by supplier's representative or in trucks from adjacent railway workshops. Whatever method of transit might be adopted by the source of supply, all stores are accompanied by a forwarding document issued by source of supply. This forwarding document is known by various nomenclatures such as invoice, challan, despatch memo, delivery note, packing account, workshop issue note etc., etc. Irrespective of the nomenclature, the contents of the forwarding documents include the reference to the purchase order or acceptance of tender, the description and quantity. These forwarding documents are checked with the materials supplied, regarding quality and quantity, by the receiving sections of stores department. While discrepancies are referred back to the supplier, the accepted supplies are taken into books and accounted for.

Receipt certificates are granted by the receiving sections for accepted supplies and payments are made against these receipt certificates. To facilitate submission of bill by the vendor, payments by accounts branch, accountal of stores by the ledger section, acknowledgement of receipts of stores by storage section to the receiving section, the receipt certificates are prepared in six foils. The distribution of these foils are :—



The supplier, bills for the contracted value, supported by the receipt certificate or inspection certificate issued by the Directorate of the supply. The accounts checks the bills, with their own copy of the receipt certificate and the original purchase order or acceptance of tender. They have also to exercise check regarding recovery of any sales tax, octroi duty, freight charges, price variation, liquidated damage charges. After the bill is passed, the purchase account is credited and stores department is debited. Herein lies the difference between commercial accounting and railway accounting.

In the case of commercial accounting, the accounts are maintained on an accrued basis, i. e. taking into account not only the earnings realised but also the earnings accrued and the expenditure actually incurred as well as the anticipated liabilities which have fallen due, while Govt. accounting require only systematic records of actual receipts and expenditure exclusive of accrued earnings and anticipated liabilities. In order to maintain a link between the two methods, i. e. to indicate the

accrued earnings and anticipated liabilities, suspense head under revenue are employed.

The stores department accept the debit against the suspense head, which is released as and when indentor draws material from stores, under definite heads of expenditure. Till the accounts department receive acknowledged copy of receipt certificate (usually called 4th foil or ledger foil) the amount at credit in the purchase account (after receipt of bill from firm) will not be released by contra debit to stores department. Such amounts are borne against a suspense head under Stores-In-Transit. When the accounts office receives the ledger foil (4th foil) duly acknowledged and allocated by the stores department or the indentor, credit to purchase accounts is released by contra debit to the stores or indentor.

Two copies of the receipt certificates are given to receiving section of the stores or indentor. One copy they retain as their record for acceptance of debit and the other copy after due acknowledgement being endorsed, is sent in acknowledgement to the section/ office, wherefrom the receipt certificate emanates.

It is thus seen that the accounts office gets three copies of receipt certificate, one from the supplier, in support of his bill, one from the issuing office, direct and the third through the receiving section. It is thus possible to ensure proper financial control as well as accounting for the bills and materials.

In cases of purchases, outside India, the supplier does not submit the bill supported by the receipt certificate. Payment is made in advance on the strength of shipping documents. The High Commission raises debit which is wiped off, on receipt of the material in India and proper distribution and allocation against respective heads. The receipt certificate in these cases is made in five copies, omitting the supplier's copy.

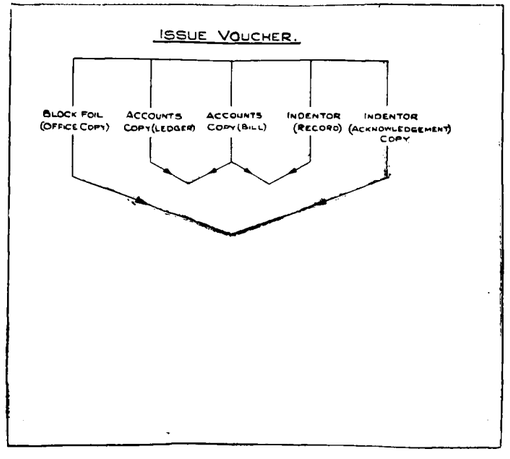
In cases of purchases, through the medium of Directorate of Supply, it is not necessary to prepare supplier's copy of the receipt certificate, as payment is made on the strength of the inspection certificate issued by the Directorate of Supply. The Inspection certificates submitted by the supplier is certified by the receiving section for the quantity accepted and returned back to the supplier, to prefer bill to the accounts department.

There are instances, where materials are received without any voucher from supplier, e.g. in case of wrong booking of wagons or empty containers, the contents of which, have been accounted and paid for, excess quantity due to mistake of consignor. Stock adjustment account is operated to account for such excess or shortages. The excess is credited and shortages debited to the account. When vouchers are received from supplier to connect the supply, receipt certificates are prepared as usual, and the credit to stock adjustment account wiped off by preparing a 'Minus return'.

Receipt and issue of stores, complete one cycle of transaction. For receiving stores, debit is accepted and by issue of stores, that debit is released as the constituent to whom the stores are issued, then accepts the debit.

It has been stated that the Accounts Office receives three copies of Receipt Vouchers. One copy (Supplier's copy) is used by them to deal with Purchase Account. One copy (Bill copy) is sent by the Accounts Office, along with summary of debits. One copy (Ledger copy) is used by the Accounts Officer (Stores) as record that the Stores Depot/Indentor has received the stores.

When stores are issued from Stores Depot, the Accounts Office receives two copies of Issue Vouchers. One copy (Bill copy) is sent by the Accounts Office, along with summary of debits; one copy (ledger copy) is used by the Accounts Officer (Stores) as records that the stores have been issued to the Indentor. The distribution of Issue Vouchers is shown below :—



There are forms, in use, wherein requisition and issue notes are combined in one form. The principle is however same, only snag in using a combined form is that, when a part complaince is made, either the issue note is kept pending for effecting balance supply (which is irregular) or a fresh issue note is to be made while effecting the balance supply.

When stores are received on loan or issued on loan no debit is raised by either party, though the rate either actual or provisional is mentioned in the voucher. When the loan is released or realised, the same rate is mentioned in the voucher thus wiping out the original amount. While issuing stores on loan 'suspense' issue note is made which is written-off, when the stores are received back. When the stores are received on loan, 'suspense' receipt note is prepared which is released by issue note, while returning back the stores. Every effort is made, to return the loan as early as possible, as the amount involved in the loan hands on 'suspense'.

SPECIAL TRAINS FOR U. S. TOURISTS

The Cunard's famous luxury liner, the 34,000-ton CARONIA, arrived in Bombay on Friday, 2nd March, 1956, in the course of a round-the-world cruise from New York, bringing more than 500 tourists, mostly rich American businessmen.

During a week's stay of the liner in Bombay, parties of the tourists were taken by special planes and air-conditioned trains to places of historical and cultural interest.

For the convenience of the tourists, Western Railway provided two special trains—one made up of air-conditioned coaches and the other of first class tourist cars. The Central Railway also ran a special train consisting of air-conditioned coaches. About 420 tourists travelled by these special trains.

The special trains started from Ballard Pier and ran over the Western, Central and Northern Railways, visiting Fatehpur Sikri, Agra Fort, Delhi, Jaipur, Allahabad, Banaras etc.

The trains returned to Bombay on 8th March, 1956.

TRUING AND DRESSING GRINDING WHEELS

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

TO ensure lower costs, longer life, consistent accuracy and better performance, it is always necessary to keep a constant check on the care and correct use of tools and equipment. Many points in good machine shop practice, even though elementary, must be emphasized again and again in achieving that end. This is also true with regard to the correct use of diamonds for truing and dressing grinding wheels, particularly in this day and age of surface finishes expressed in micro-inches and dimensional tolerances in five or more decimal places.

TRUING AND DRESSING

Before proceeding further, it would be proper to know clearly what the terms truing and dressing actually mean. They are often used incorrectly. *Truing* is the shaping of the wheel so as to make its face concentric, its sides parallel, or to shape it to a given contour. On the other hand, *dressing* refers to cleaning the cutting face of the wheel and restoring its cutting action. The object of truing and dressing the grinding wheel is for a number of reasons and they are briefly stated as follows :—

(a) Wheel balancing

(b) Rough and finish grinding

(c) Removing the "Loaded" surface of the wheel as well as the dull grains to improve the finish on soft work

(d) To eliminate glazing and burning the work

The diamond most generally used for this purpose is the bort or ballas stone, a semi-transparent one, mounted in a metal post or "nib", as it is known in shop terms. About 80 to 85% of these stones are mined in Africa. Although diamonds are primarily mined for use as gems, many of them are not suitable for this purpose due to colour, imperfections, spots, etc., and they find the market as commercially used diamonds.

QUESTION OF SIZES

The size of the Diamond used is governed by the size of the Grinding Wheel and the following table may be worked to as closely as possible for satisfactory results.

Size of grinding wheel	*Weight of diamond*
Up to 6″ diameter	0.50 Carat
Larger than 6″ up to 8″ diameter	0.75 ,,
,, ,, 8″ ,, 12″ ,,	1.00 ,,
,, ,, 12″ ,, 15″ ,,	1.25 ,,
,, ,, 15″ ,, 18″ ,,	1.50—2.00 Carats.
,, ,, 18″ ,, 24″ ,,	2.50—3.00 ,,
,, ,, 24″ ,, 30″ ,,	3.00 ,,
,, ,, 30″ ,, 36″ ,,	4.00—5.00 ,,
,, ,, 36″ ,, 40″ ,,	5.00—7.00 ,,
,, ,, 40″ ,, 48″ ,,	7.00—10.00 ,,

For wheels of intermediate sizes, one will have to use his discretion in selecting the sizes of diamonds to be used, referring to the above table. There are also

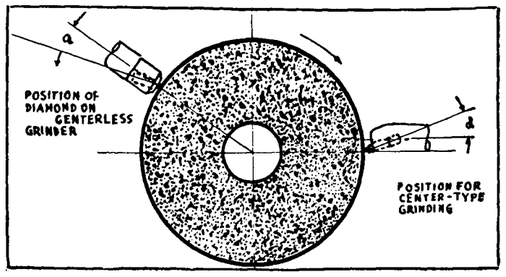


FIG 1.

Diamond should point in the direction of wheel rotation and be set at an angle to a line drawn through the point of contact and the centre of the wheel.

exceptional cases where the wheels have a large surface, i. e. over 4″ in width, and a larger diamond must be used accordingly.

MANNER OF USE

This is a very important factor, for it must be remembered that every type of Diamond, although hard, s extremely brittle and easily shattered when subjected to a sudden shock or sharp blow. Even steady pressure is therefore essential and the application to the wheel should not be too heavy, in other words, the dressing cut should be fairly a light one. It is false economy to attempt speed up a dressing or truing operation by taking deep cuts or by using heavy traverse rates. It is far better

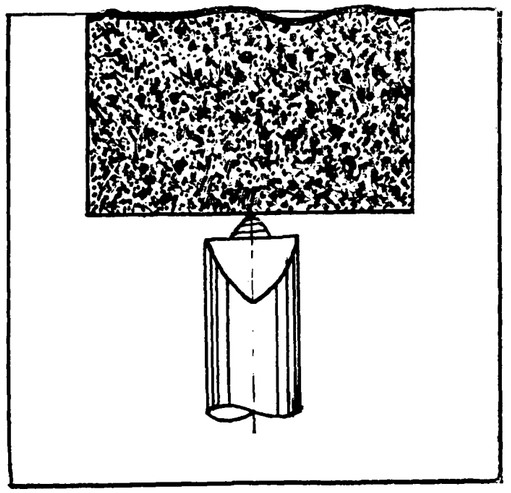


FIG. 2.

Diamond should contact the wheel at the highest point which is about the centre of the wheel face in Centre-type grinding.

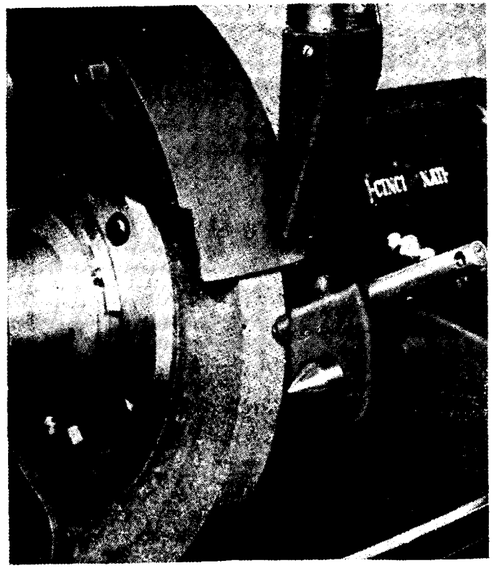


Fig. 3. Standard wheel truing device on a Centre-type grinding Machine.

to take several light cuts across the surface of the wheel rather than a deep one. Overheating is also detrimental and it is therefore advisable to make use of a lubricant, water or compound, during the dressing operation. Care should be taken to see that the stream is directed at the point of contact so that the tool is flooded at all times. Failure to do this will result in the diamond sparking excessively over a certain portion and then plunging into a deluge of cold water in its overheated condition after completing that portion in its traverse and ultimately cracking due to this shock. The lubricant however is not necessary where the wheels are of a smaller size such as for internal or tool grinding and in that case the diamond should never be quenched but allowed to cool normally.

While the basic rules which operators should follow consistently will be discussed later, it might be a good idea to point out how a diamond should be set in relation to the horizontal axis of the grinding wheel. From experience it has been seen that the diamond should always point in the direction of wheel rotation in order to prevent gouging or chatter. Furthermore, the diamond should also be set at an angle to a line drawn through the point of contact and the centre of the wheel. This angle may differ on various sizes and types of machines but in usually about 10 to 15 degrees. Figure 1 illustrates these points. Too flat an angle will reduce the resharpening effect on the diamond and tend to wear it flat and blunt.

The sketch also depicts that for centreless grinding the diamond is usually mounted above the horizontal axis of the wheel, whereas, for the centre type machine, it contacts the wheel on the horizontal axis, never above it and never more than $\frac{1}{4}$″ below.

PROLONGED DIAMOND LIFE

The following practices should help in prolonging diamond life, obtaining accuracy and surface finish, reducing wheel wear and increasing production.

(i) To prevent excessive penetration with possible damage to stone, the diamond should be adjusted so as to contact the wheel at the highest point (point of least wear) which is about the centre of the wheel face in centre-type grinding, as depicted in Fig. 2, where the grinding wheel face usually wears on the edges. In case of centreless through-feed grinding this point will be very close to the rear side of the wheel and for infeed grinding, the point of least wear will have to be determined by "cut and try" using experience and judgment.

(ii) The diamond tool should be returned frequently in order to wear in such a manner as to maintain the

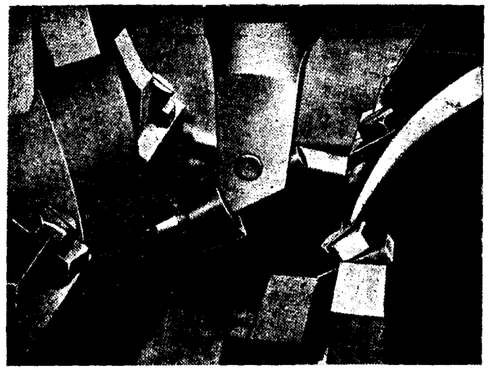


Fig. 4. A close up view of dressing a Centreless grinding Machine.

sharp cutting angles and prolong the life and efficiency of the diamond.

(iii) Frequent re-setting will ensure a long life to the diamond and when worn down close to the metal, it is time for re-mounting. The amount of diamond to be exposed out of the holder depends upon the shape and size, but as a general rule about one third of the diamond is exposed. Care should be exercised so as not to grind away the setting, for interference with this will result in the diamond becoming loose and eventually breaking.

(iv) The diamond should be securely mounted in its nib and rigidly held on the machine with a truing post, during truing and dressing operation. In the mounting of a dressing tool, rigidity and angle are the two considerations of paramount importance, to produce satisfactory results.

(v) For roughing cuts, the diamond should be fed in about .001″ to .002″ per pass: for finish dressing, the diamond should be advanced in increments of .0005″ or less per pass followed by one or two dead passes, i. e. without advancing the diamond in case an extra fine finish is required.

Speed of traverse will depend largely upon the grain and grade of the wheel and finish desired. It is recommended however that a speed of 7 to 10 inches per minute be used for roughing: for finishing operations, 2 to 3 inches per minute may be used. A slow traverse produces a fine finish but if too slow, it will result in glazed wheel. Similarly a fast traverse results in a free cutting wheel, but if too fast it may leave diamond marks on the wheel.

Fig. 6. Photomicrograph of typical Faxfilm replica of a grinding wheel surface when crush dressed.

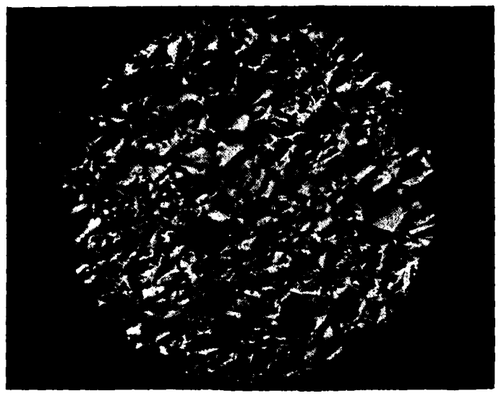


Fig. 5. Photomicrograph of typical Faxfilm replica of a grinding wheel surface when diamond trued.

Care should be taken not to contact the wheel without traverse which would put diamond marks on the wheel and be transferred to the work.

(vi) Finally it should be remembered that a steady and uniform rate of traverse should be maintained throughout each complete pass and the dressing should be done at uniform operating speeds.

This tool is also a cutting tool and like others its usefulness depends on how sharp it is kept. The

(Continued on page 46)

SIGNALLING AND INTERLOCKING

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

Chapter 21. Power Supply.

IN 1837 an electrical device was invented as an aid to train movement. This was the Cooke and Wheatstone Telegraph, which, having been thrown out by other railway companies, was accepted by the Great Western Railway, installed between Paddington and West Drayton and subsequently extended to other parts of the line. The first signal cabin was opened in 1839 at Corbett's Lane Junction on the London & Greenwich Railway. Thus, the electrical side of signalling really started first but, although very extensive electrical signalling installations can be found all over the world, mechanical signalling is still predominant ; the electrical adjuncts developed along the lines of indication for signal arms and points and telegraph instruments for passing trains from one block post to another. These instruments operated on intermittent currents of a few milliamperes and the question of housing the few Daniel or Leclanche cells for their operation was hardly given a thought. With the large mechanical signalling schemes still in operation today, there are many electrical devices attached requiring a large number of primary or secondary cells or direct supply.

Point layout showing Point Machine and Asbestos Hut Housing the Battery Point Motor rates 30 volts 5·5 amperes maximum operating time 6·0 seconds.

In the British Isles it would be difficult to find a railway station, where, if not electrically illuminated, a power supply is not available close at hand. This is not so in other countries, particularly away from the continent of Europe. In these cases, although electricity is available in towns and suburbs, there are many important railway stations up country where illumination is by oil or petromax lamps or by electricity from a local railway plant already too overloaded to take additional loads for signalling purposes.

The signalling and interlocking in such cases is usually mechanical with electrical apparatus superimposed in the form of track circuits, electrical slots on signals, electrical point detection, electrical route indicators, etc. Since no dependable electrical supply is available for charging purposes, secondary batteries have to be ruled out. The A.D. type Le Carbone cells, the

(Continued from page 44)

information given and the procedure indicated regarding its correct use, if rigidly followed, will yield results which will be most economical and efficient under general working conditions.

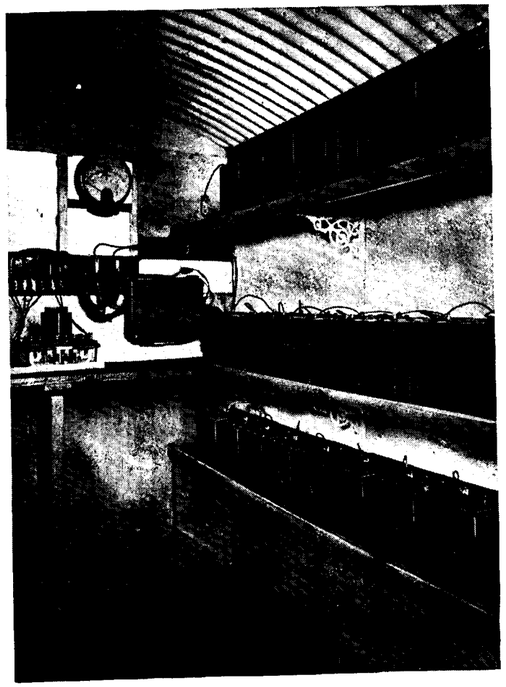
CRUSH DRESSING

Within the past decade the art of crush dressing has made rapid strides and is now finding its place as a valuable tool in industry. In crush dressing the dressers are of wheel type which rotate with the rotation of the grinding wheels.

Although crush dressing is now being applied to a variety of precision grinding operations, it should be remembered however that diamond truing has not been replaced by any means. It is only the diamond dressing which produces a more accurate surface of revolution and also a better finish on the work.

In addition to its having often proved to be the most economical method, crush dressing has the advantages of providing cooler grinding and less normal force. It has also the adaptability to the process of dressing intricate forms in the wheel surface.

Whatever may be the process, satisfactory results can only be obtained when the process is applied intelligently with clearer understanding with regard to the correct way of use and proper care of the tool.



Inside of Housing for Point Motor Battery showing battery of 33 cells A. D. 513 installed May 1949 Reading taken Feb. 16th 1950 — O. C. 44 volts. Points operating 39 volts 4 amperes.

Edison and the Columbia cell have been found to be very efficient for such purposes and many hundreds of thousands are in use all over the world.

As over a hundred cells may be in use at large cabins, special attention to their accommodation must be given. The old idea of cramming all these cells into a cupboard is no longer acceptable. This method necessitates three or four lines on a shelf which means those in the second and third rows, etc., cannot be inspected. A good way is to arrange the cells on shelves or racks similar to signalling relays in a signal cabin relay room. An angle iron construction is used with wooden shelves for the cells to stand on. Only a single line of cells is permitted on each shelf and each cell is serially numbered having a red numeral painted on the jar. One shelf is connected to another by standard terminal blocks fixed at the end of each shelf.

The cells are pooled for the complete installation; in other words, there is not a group of cells for each function. Generally the apparatus operates on about the same voltage and where there are slight variations adjustments are made by suitable tappings. On the distribution panel are several sets of bus bars and fuses, according to voltage required, and groups of cells connected across. This means that the maintainer can disconnect and remove one group of cells for cleaning etc. without interfering with the operation of the signalling installation, a highly desirable feature.

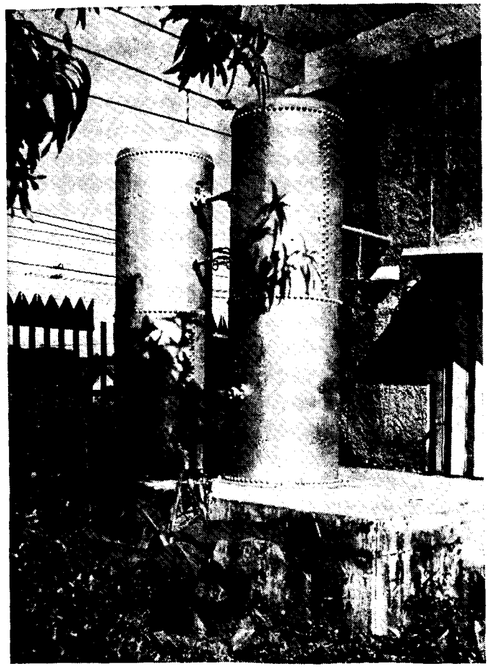
Where installations of this type are unavoidable, they are very efficient though the maintenance charges in battery renewals are heavy. Where an electrical supply is available, a secondary battery installation is preferable on trickle charge. Usually the supply is alternating current which means a metal rectifier. In the event of the supply failing for a short time, the installation can continue to function from the secondary batteries. In addition to pure signalling layouts, these battery arrangements can be used in the battery rooms attached to large telegraph offices, traffic control telephone systems, etc.

Power installations are understood to be those where all points and signals are operated by either the all electric method or electro-pneumatically. In the early pneumatic installations, the magnets on the point valves were DC working on 12 Volts. This power was supplied from secondary batteries in the signal cabin on trickle charge through resistance from DC mains. In course of time alternating current supply displaced DC on account of the ease with which voltage can be stepped up and down by means of transformers. The conversion of

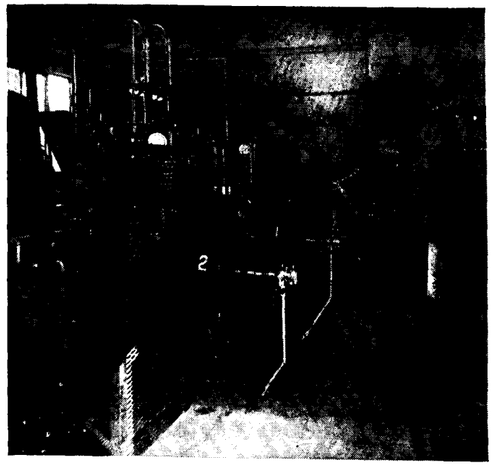
Standby diesel generator set, air compressors, and switchboards for power supplies to the signalling.

electro-pneumatic point operation from DC to AC necessitated the point valves being fitted with coils operating on 110V AC. The alternating current coil and iron system has never been entirely satisfactory and in the case of the point magnets they were noisy, there was chattering of the operating parts which meant frequent changing for shop overhaul. The increasing use of metal rectifiers in all industries led to the inclusion of a small rectifier with each point valve permitting DC operation of the valve magnet from a line operating voltage of 110V AC.

In earlier power installations, where all electric point machines were in use, they were operated from secondary batteries on trickle charge at the signal cabin. The idea was that if the power supply failed, at least the points could continue to be worked for some time from the batteries, the trains being moved on hand signalling. In latter schemes it is more usual to have several independent sources of electrical supply and to supplement these by a standby generator which would be automatically started up by a diesel engine in the event of all other sources of power failing. Some railways stil continue to use DC all electric point machines worked from secondary batteries on trickle charge.



Air storage tanks.



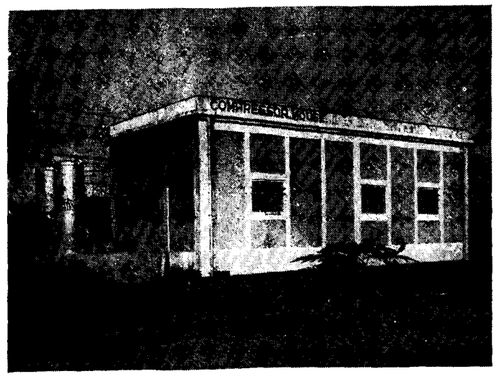
Interior of Air Compressor House.

A brief survey of the types of power supply used by British Railways, most of them put down before re-gripping, will give a general idea how various railways deal with the problem of alternative supply. At Paddington, Western Region, there are 3 power signal cabins with a total of 368 levers which were brought into use over twenty years ago. The main power supply 460-VOLT, single phase, 50 cycles, is obtained from the railway's substation at Royal Oak an alternative supply being provided by the British Electricity Authority. The DC supply for point operation is obtained from either of two trickles charged 120-VOLT batteries, one being in Royal Oak sub-station, and the other near the Paddington arrival signal box.

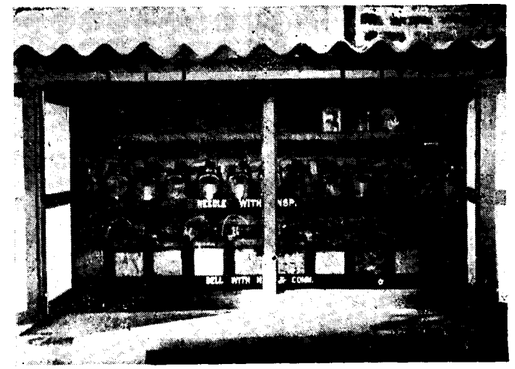
At Bristol, also on the Western Region, there are 3 power signal cabins with a total of 728 levers which Bristol East, Bristol West and Bristol South. The point operation is 120 Volt DC similar to Paddington. The power supply for the signalling installation is taken from the British Electricity Authority at Temple Meads (Bristol) Railway's sub-station; an alternative supply from the City is taken at the East cabin. A ring main is provided between the railway station substation and the east and west signal cabins and works at 400-VOLTS 50 cycles AC, this being transformed at the East and West cabins to the standard 110 VOLTS AC which is used for all signal circuits. The point operating current is

taken from 120 VOLT 200 Ampere hour batteries trickle charged from the AC supply, a DC ring main being provided between the East and West cabins. In the event of a complete failure of the main supply, a 110 horse power Diesel engine set with push button start, can be brought into use and by means of interlocked switch gear can supply the 400 VOLT AC ring main.

In connection with the electrification of the heavy suburban section between Liverpool Street and Shenfield (Eastern Region) the latest type of route relay interlocking was installed controlling multi-aspect signals and all electric points. At Stratford there is a very large signal cabin with a panel controlling 178 routes on the NX system. Since this cabin was only opened a few years ago, the power supply for it may be considered to be the latest practice. The power supply for the electric traction and signalling is received from the British Electricity Authority at 33,000 Volts 50 cycles and is distributed at this voltage to each of the traction substations. At Stratford substation duplicate transformers deliver two supplies at 415 volts 3 phase to what is called the Stratford Standby building. Here the supplies are selected by means of an automatic interlocked contactor unit and fed through hand operated changeover switches to one of two Scott connected transformer groups. Each group delivers two single phase supplies at 660 Volts, one phase feeding the other signal areas and the other phase the Stratford area which is on a closed ring main. In the event of a complete failure of the supply, a 10% reduction in voltage or a 2% variation in frequency, a 60 h. p. diesel-engined alternator, is automatically brought into use, and this takes the load in five to eight seconds. When the supply is restored, provision is made for synchronising the two supplies and the changeover is accomplished manually by the operation of a push button. The set is shut down manually. The points are worked on 120 Volt DC from 32 nickel iron batteries on trickle charge.



Exterior of air compressor house showing storage tanks outside.



View of primary batteries in cupboard outside signal cabin.

MEETING OF THE REGIONAL RAILWAY USERS' CONSULTATIVE COMMITTEE, GONDAL REGION

The first meeting of the newly appointed members of the Regional Railway Users' Consultative Committee of the Gondal Region was held at Gondal under the Chairmanship of Shri D. D. Sethna, Regional Traffic Superintendent, on 29th February, 1956 at 3 P. M.

The discussions embraced important items, such as, closure of grain market siding at Jamnagar, speeding up of passenger trains, condition of upper class coaches, provision of slip coaches between certain points, provision of sweet oil tank wagons for Gondal Region, lighting arrangements at Talaja and Mahuva, conversion of R. M. C. service into mixed train on Bhavnagar-Mahuva section, punctuality of trains etc., etc.

Shri Ramniklal Bhogilal Shah and Shri Shiv Prasad Chunilal were elected by the members to represent Gondal Region on the Zonal Railway Users' Consultative Committee at Bombay.

An informative show serving the cause of Economy and Efficiency in production

THE *special show* arranged by the associated sales organization operating on behalf of the "Mannesmannröhren-und Hüttenwerke" under the heading MANNESMANN PRODUCTS FOR THE MECHANICAL ENGINEERING INDUSTRY will be in the form of an effective display of typical applications for :

Mechanical Tubing Pipe Cylinders (Tubes with superfinished bore) Pipes and Tubes Plates and Sheets Sections.

Designs which have become well established in their respective fields will be on view. Because of their performance record they should appeal to every designer, as they emphasize the point that in a great variety of cases the adoption of Mannesmann products results in improved and more economical production than could previously have been achieved with the convential raw materials and manufacturing techniques. It may be observed here that this show had a successful predecessor in the *informative show* organized by Mannesmann last year under the heading INCREASED PRODUCTIVITY THROUGH MANNESMANN on the occasion of the machine Tool Exhibition at Hanover in 1955. That show, which was intended to demonstrate the new and useful possibilities offered by Mannesmann products as a positive aid in achieving notable improvements in methods of manufacture, attracted the particular interest of the specialized engineers. The suggestions offered there were found to be worthy of careful study. Indeed, many of the interested inquirers visiting the show, lost no time in taking advantage of the suggestions by putting them into immediate effect.

The informative show of 1955 has been extended to include further examples of typical applications and designs of outstanding interest, which has resulted in a highly valuable survey of the important developments and progress achieved in recent years. It is hoped that this comprehensive exhibition will encourage visitors to re-examine, from the point of view of improved productivity, the methods of manufacture used in their own plant.

In order to enable interested designers to evaluate more fully the wealth of useful suggestions provided by the show, with special reference to the information they need for their particular design requirements, a new and augmented edition of the leaflet entitled RATIONELL FERTIGEN MIT MANNESMANN (Increased productivity through Mannesmann), the first edition of which met with a wide response among the experts, has been prepared by Mannesmann. The leaflet contains everything worth knowing regarding the contribution Mannesmann products can make towards increased productivity in the field of mechanical engineering.

MANNESMANN MECHANICAL TUBING

A great variety of machinery parts with circular cross section will be shown to demonstrate the benefits that can be gained by substituting Mannesmann Mechanical Tubing for conventional rounds and sections as the base material. This special product of the Mannesmann works is characterized by the outstanding purity of the steel grades employed, resulting in advantages which make the use of mechanical tubing an obvious choice for progressive manufacturers of high-grade machinery parts that are required to stand up to severe stresses. A selection of designs in a wide variety of sizes will be displayed to provide practical proof of the fact that any metal cutting operation may be applied without difficulty also on circular cross-sectional area. The advantages over the use of the conventional round steel include lower charge weights, savings in transportation costs and reduction in machinery cycles, so that less time is required per finished part.

A new important development :

MANNESMANN PIPE CYLINDERS

A new product developed by Mannesmann "the Mannesmann Pipe Cylinder with superfinished bore" will be of particular interest to manufacturers of hydraulic and pneumatic equipment. The interior surface of these pipes is perfectly smooth and polished by a non-cutting process. Due to the excellent sliding properties of this class of pipe, the additional cost normally incurred in machining operations applied on the inside, such as drilling, grinding, and honing, can be saved.

NON-CUTTING SHAPING THROUGH FORGING

Also on view will be tubes subjected to a non-cutting shaping process through *fine forging*, with forged-on collars, shoulders, reducers, inside sectioning, etc. These products are displayed by mannesmann as blanks suitable for the manufacture of cylindrical and conical hollow parts, such as cylinders and pistons for lifting, hoisting, and pressing equipment, as well as for the manufacture of hollow shafts, rings, and bushes.

A selection of hot-worked tubes comprising axle journals, shafts, and axle bridges is likewise intended to give some idea of the *many new and useful possibilities* which the use of tubular products can offer from the point of view of the economical manufacture of products of consistent high quality.

STEEL TUBES AS STRUCTURAL MEMBERS

The Mannesmann Tower, which rises to a height of 120 metres and yet has the amazingly low weight of 35 tons, demonstrate the advantages inherent in the use of Mannesmann seamless tubes as structural members. Also in general applications of the mechanical engineering industry, in vehicle construction and in the agricultural machinery industries, the use of *steel tubes*, either with *circular cross section* or *shaped*, has become an established practice. Many examples of pipe connections, which can be achieved by simple means, will be displayed by Mannesmann as practical proof that efficient joints have been evolved with design features which make it possible for tubes to be joined together just as easily as the connections in conventional sectional designs of bar steel. Other exhibits will demonstrate the advantages inherent in the low weight and favourable static properties of steel tubes. Interested inquirers will be provided with carefully prepared tables giving the static values and weights of seamless steel tubes.

WELDING AND PRESSING OF SHEET METAL

Machinery parts welded in sheet metal will be on view to demonstrate the benefits to be gained from this building method. Advance in modern welding techniques has been such that the *manufacturing process* can be made *more economical and efficient*, compared with older methods.

SUGGESTIONS FOR PRACTICAL USE

The items displayed at the special show represent examples of potential applications based upon experience gained by the users of Mannesmann products. Interested design and production engineers may obtain useful machining data on request. Visitors to the Mannesmann stand will be received by engineers with expert knowledge, who will be only too glad to give the benefit of their advice in problems concerning increased productivity to inquirers desirous of obtaining the best results in any given circumstances.

A CORRECTION

We regret for the following errors which had inadvertently crept in the article entitled "The Influence of the Driving and Carrying Wheel Diameter on the Design, Performance and Behaviour of a Locomotive" by Shri M. S. Surma published in our January 1956 issue. Ed. IRE.

Page 43 column 1st line 30 :—
'bach pressure' should read 'back pressure'

Page 43 column 2nd line 32,
Should read any axle which does not satisfy.....

Page 46 column 2nd line 10,
'page 7' should read 'page 47'

Page 46 equation 7,
should read $2\,\Pi \sqrt{\frac{D}{2} \times \frac{b}{t}} \times \sqrt{\frac{b^2+c^2}{b^2}}$

Page 47 equation 8,
should read $\sqrt{Dh-h^2}$

Page 47 equation 9,
should read $t = \frac{\sqrt{Dh-h^2}}{v}$

Page 47 column 2 under "conclusions" line 15
RPM of 5 should read RPS of 5

Tyre Profile—its influence on the behaviour of a Locomotive

By M. S. Surma, Indian Railways Testing & Research Centre, Alambagh, Lucknow.

THE tyre profile has some influence on the stability of a locomotive. A good contour of the tyre raises the critical speed, at which instability in riding tends to appear.

Lot of literature, mathematical as well as descriptive is available on the subject, and the contributions of M/S. Davies, Carter and Cain are commendable. Mr. Nadal has dealt with the subject relating to the slope of the flange at the gauge face. The formula, developed from the line of analysis followed by him, has been found to suffer from a discrepancy, which has been removed by Mr. R. G. da Costa in his papers entitled "Riding of pacific locos" and "Notes on wheel flange profile".

The tyre profile may be divided into two sections.

(i) Tread profile and
(ii) Flange profile

TREAD PROFILE

In the earlier days of locomotive practice, the tyres of the railway vehicles were provided with parallel treads, but later on coning was introduced. An inclination of 1 in 20, for the tread, was adopted by all the railways, with one exception i. e. The New York Central* Lines which preferred 1 in 38 to the standard coning.

The counter of the tyre is a disputed item and the railway engineers have divergent views on its optimum taper. Though 1 in 20 taper has been adopted, with the rails canted to suit, cylindrical tyres have also been tried by investigators in different countries. It is claimed in certain quarters, that cylindrical tyres afford better riding qualities—a fact which has yet to be established.

The riding of a vehicle depends upon so many factors and the influence of the tyre profile is one of them. Tyre profile affects the riding characteristics in so far as the sinous motion in the track is concerned. If by the adoption of a particular tyre profile, the wave length of the sinous motion can be increased and its amplitude decreased, there will be found a considerable improvement in the riding. Both the objects stated above can be achieved by reducing the inclination of the coning and by having a suitable slope and thickness of the flange.

Wear on the tread is another important factor affecting the riding qualities. In normal practice as the rails are canted to suit the standard taper of the tread, a tyre with an angle of inclination other than the standard, will start developing wear and before long will get the taper to match the rail cant. Experiments on L. M. S. Rly. have shown that in the duration of this period the riding is seriously affected and as the wear approaches the rail cant there is a gradual improvement. A second flange, on account of this wear is, therefore, formed towards the outer edge of the tyre. This second flange may, to some extent, reduce the amplitude of the sine waves (this cannot be said definitely) but is sure to set up a vertical periodic vibration, and if, at any time, the frequency of this vibration coincides with that of the natural frequency of the "rolling" the vehicle will be subjected to a violent oscillation.

The tendency of the formation of this second flange is found on cylindrical as well as on coned tyres, but to a greater degree on the former. Its depth on the wheels, having no brakes, is still greater. The French Railways have got over this trouble by having a taper of 1 in 10 for a distance of $1\frac{3}{8}$" from the outer edge of the tyre. Figure No. 1 shows the profiles of the treads adopted by the Indian and French Railways.

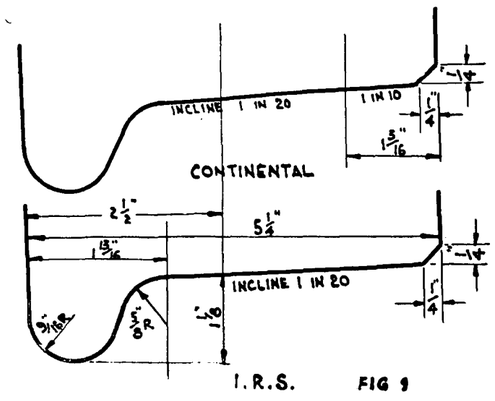


FIG 1

Another draw back in the cylindrical tyres is the unavoidable difference in the diameters, ever so slight, of the pair of wheels fitted on to a single axle. The normal

* Report of Japanese National Railway Int. Rly. Cong. Buln. 1933.

difference allowed in the shop practice is of the order of 1/32". If, therefore, the tyres are coned, the wheels will adjust themselves in the track, but if cylindrical some degree of relative slipping must occur. On the curves, the wheel running on the outer rail has to travel a greater distance, than that running on inner rail. Here again excessive slipping of the wheel in the case of cylindrical treads, cannot be avoided. It was probably due to this reason that the cylindrical wheels made way for the coned wheels.

CONING OF THE TREADS

Effect of coning on a straight track :—Two wheels of equal diameter having coned tread, when rigidly fixed onto a single axle, if undisturbed by an external lateral force, will run central in the track, the diameter at the points of contact being the same. When disturbed, they will run on different diameters. The wheel running on bigger diameter will try to go ahead of the one running on smaller diameter. The axle will then no longer be running normal to the track but will make an angle with it. A stage will then be reached, when the axle is forced to rotate and get a skew, until the opposite wheel starts running on a bigger diameter. The result is an oscillatary movement and nosing of the vehicle on the track. The wave length of this nosing oscillation, as given by Klingel is,

$$D = 2\Pi \sqrt{\frac{r.a}{i}} \qquad \ldots\ldots\ldots\ldots(1)$$

Notations are given in appendix I.

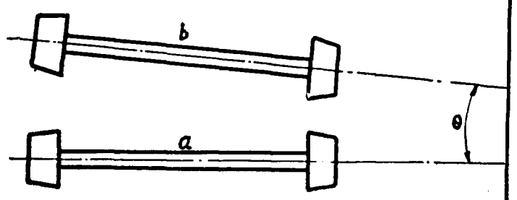


FIG 2

Fig. 2 shows the behaviour of an axle as stated above.

If a number of pairs of wheels, fitted on axles, and grouped together under a common chasis, are moving on a track they will also behave in a similar way, if the conditions given below are fulfilled.

(i) Weight on all the wheels must be equal

(ii) Diameters of all the wheels must be the same

(iii) All axles must be parallel to each other

(iv) No longitudinal play exists between the axle box and the guides

(v) Taper of all the tyres must be identical

(vi) No lateral control exists except the unavoidable tread friction

(vii) No irregularity exists in the track

Any departure from the above conditions will affect the wave length of the motion. No data is available, as to the extent of the influence of the above said items, individually or collectively. Some amount of modification of this wave length will positively occur as none of the above considerations can be rigidly fulfilled.

Uptill now the investigators have conducted experiments on single and double axle trucks. Klingel was probably the first to publish data (Year 1833) for a single axle truck. Since his time the subject has been under the investigation of some of the eminent engineers of the world and the behaviour of these trucks has been reduced to mathematical equations.

The equation for a single axle which Klingel evolved in 1883 has been accepted as 'perfect' by all the investigators but there is no consensus of opinion in formulating the equation for a double axle truck. All the investigators differ with each other. In the case of a double axle truck the form of equation for the wave length, given by various investigators is :

$$D' = D.K \qquad \ldots\ldots\ldots\ldots(2)$$

Where K is a multiplying factor.

For a bogie having 8' wheel base the value of K according to different investigators is :

(i)	According to Bedecker K	= 1.75
(ii)	„ „ Davies and Cain K	= 1.8
(iii)	„ „ Heumann K	= 2.1
(iv)	„ „ Recard and Carter K	= 2.5

The problem of trucks having axles more than two in one chasis, for example, the coupled wheel truck of a locomotive, have not been taken up by any of the investigators, and nothing can be said about the influence of the coning on the stability of these trucks.

The effect of coning on the heavy vehicles is small on account of heavy moment of inertia about a vertical axis, and higher damping effect due to greater friction between rail and tyre. But its effect on the light weight stock is pronounced.

Dr. Davies in his paper "Some experiments on the lateral oscillations of rail vehicles" has dealt with this subject and states, that nosing oscillation once started, goes on building up on account of the action of coning, unless there is sufficient damping action. Mr. B. S. Cain in his paper "Notes on the dynamics of the electric locos." has investigated the influence of coning on the critical speed of a locomotive. The method adopted by him is based on the calculation of energy input on account of disturbing forces and energy dissipated by the damping forces. He states that the coning reduces the critical speed by about 8% on straight or nearly straight track, in the case of larger wheels. His formula is given below :

$$*V = 2\,w \sqrt{\frac{\Sigma f\,(l^2+a^2)}{\Sigma f}} \times \frac{1}{1+a.i\,\frac{(\Sigma f/r)}{\Sigma f}} \qquad \ldots.(3)$$

For the meaning of symbols please see Appendix I.

Effect of the coning on curves :—On curves two wheels of one axle, will run on different diameters, the outer running on bigger. This is an advantage as the outer has to travel a longer distance than the inner wheel. This is what is generally said. But there is another thing to mention, that the inter wheels which generally guide against the inner rail also run on bigger diameter. The above stated advantage is lost in the case of these wheels.

At the speeds, say, about 40 M. P. H., taking the case of a Pacific locomotive, the bogie wheels and the leading coupled wheel bind against the outer rail, and driving and trailing against the inner. In the case of turnouts, the bogie wheels bind against the outer rail and the coupled wheels against the inner. The coning, therefore, in the case of these wheels which bind against the inner rail, defeats its purpose.

In my opinion the coning in these cases (where wheels bind against the inner rail) helps the locomotive to screw itself round the curve, thus giving relief to the leading wheel which is subjected to the maximum amount of guiding force. At speeds well over 45 M.P.H. the locomotive under the influence of centrifugal force and heavy control at the front is screwed round the curve, even without the help of coning.

It will be clear from the foregoing that the profile of the tread, whether cylindrical or conical, has merits and demerits, and there is little to choose between the two. Certain railways have tried different tread profiles, but none has given definite decision in the favour of any inclination. However, some investigators have recommended 1 in 100 taper. But unless the cant of the rail is changed to match this taper, little advantage will be gained, as the tread will soon wear to the rail cant. In the case of this taper, or any other reduced inclination of the coning, the flange rail contact will be below the root of the flange. This is undesirable from the riding point of view and will be discussed later. Figure No. 3 shows the flange rail contact in the case of standard and cylindrical tyres with the rails canted to suit the former.

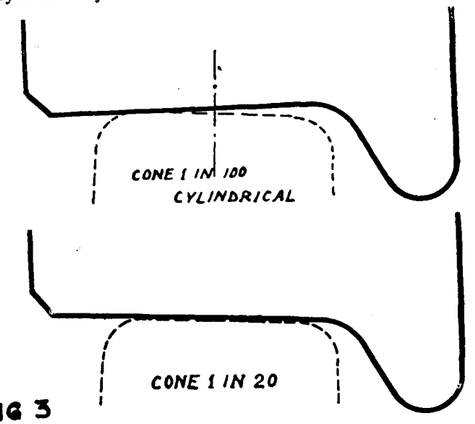


FIG 3

FLANGE PROFILE

The profile of the flange may be devided into two parts.

(i) Thickness of the flange and

(ii) Slope of the flange at the gauge face.

Indian investigators have recommended that for better behaviour of the locomotives the thickness of the flanges should be,

(i) Greater at the extreme wheels.

(ii) Standard at the leading and trailing wheels.

(iii) Smaller at the inter wheels.

There are two effects of this set of flanges. The first is that the angularity of the wheel base in the track is reduced due to the reduction in the lateral clearance at the extreme wheels. This results in lower flange impacts on the rail. Secondly when we consider a locomotive entering in a curve, it is found, that the first wheel to come in contact with the rail is the outer leading wheel of the front truck. In the case of a bogie, when the forces acting on it attain a certain

* Dynamics of electric locos. by B. S. Cain.

magnitude the trailing wheel also comes in contacts with the outer rail. If the centrifugal force is sufficient, the outer leading coupled wheel will also shift towards the outer rail; but before it could make a contact with the outer rail, the control mechanism comes into action and the intensity of the wheel impact is reduced.

The reason for the thin flanges on the inter wheels is that as they are quite near the centre of gravity of the locomotive, they do not perform any guiding work. Therefore it is better that they do not come in contact with the rail at all. Taking off these flanges has been advocated by almost all the eminent engineers of the world. Mr. da Costa has dealt with the subject in his paper "Riding of pacific locos." He states that on sharper curves of less than 2000 ft. radius, at cruising speeds, the engine is subjected to a screwing action. The driving wheel at this instant is touching the inner rail. The leading coupled wheel under the influence of a very heavy control drifts towards the inner rail and the trailing coupled towards the outer rail. The driving wheel acts as a fulcrum. A condition is then reached when the bogie control becomes too less and the leading coupled wheel again moves back to the outer rail. This oscillation goes on repeating till the engine is able to attain stability again.

From the foregoing it can be safely concluded, that even with the thin flanges at the inner wheels, the question of their infringement with the inner rail on curves and turn-outs cannot be solved. At this infringement contributes to instability and produces heavy stresses on the vehicle and the track, a better practice may be to remove them. On locomotives which fit in the turn-outs and sharp curves without any infringement, the need of removing these flanges may not arise.

Recent analysis done by Mr. da Costa confirms that it is advisable to remove the flanges of the intermediate wheels. In the case of locomotives fitted with bar frames, as they afford comparatively little flexibility on the curves and turn-outs, the possibility of the flange infringement is still greater. Therefore, to avoid heavy stresses in the track and the locomotive parts, it would be a better practice to remove these flanges.

To avoid any infringements at the nose of the turn-outs, by the wheels fitted with thin and thick flanges, the amount of the thickness increased or decreased on the gauge face should be increased or decreased on the opposite side of the gauge face of the flange.

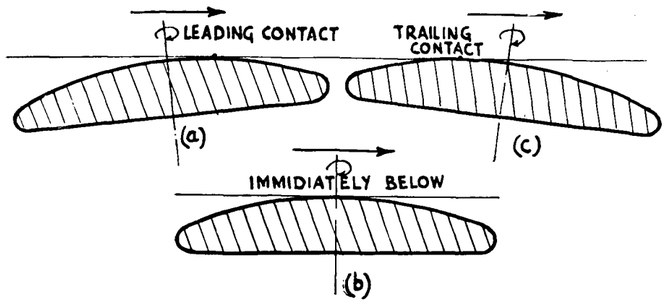
SLOPE OF FLANGE

Another very important factor in the profile of a flange is its slope at the gauge face, which determines the point of flange rail contact. It is this slope of flange on which depends the safety of millions of passengers travelling daily by the trains. This will be briefly discussed in this note, and those, sufficiently interested in the subject, are requested to refer, for a detailed analysis, to,

(i) Notes on wheel flange profile by Mr. da Costa.

(ii) Development of electric locos. in Switzerland by Dr. Boygeaurd.

It will be seen from the following analysis that there is a limit for the slope of the flange with respect to horizontal, for safety. Any increase in the wear on the flange gauge face, results in a corresponding increase in the angularity of the wheel base in the track, and brings the flange rail contact below the root of flange which is a source of danger. In the extreme angularity cases the flange may contact the rail just at its tip. As will be shown by the application of Nadal's formula for safe lateral loads, the tendency for the flange to mount the rail table even under the influence of relatively smaller lateral load, will be greater.



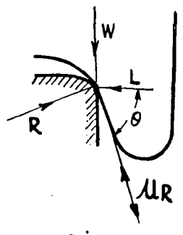


Fig_4

While running on a curved track there are three possible points of flange rail contact.

(i) The flange may contact the rail, at the point, ahead of the vertical through the axle centre. This will be called a leading contact. Fig. 4(a)

(ii) The flange may contact the rail, at a point, on the vertical through the axle centre. This will be called centre contact. Fig. 4(b)

(iii) The flange may contact the Rail behind the vertical through the axle centre. This will be called trailing contact. Fig. 4(c)

Let us now consider the wheel moving along the rail, making a contact ahead of the vertical through the axle centre. As the flange moves along the inner side of the rail, its tendency to mount the rail table is greater as the friction is also opposing. The forces acting at the flange are,

(i) Lateral force

(ii) Vertical wheel load

(iii) Friction between the rail, and flange

(iv) Reaction of the rail

By resolving these forces in the line of action of u_R the components of the forces acting downwards should be greater in magnitude than the components acting upwards. Therefore if the wheel is not to derail,

$$W \cos(90-\theta) > L \cos\theta + u_R$$

$$\text{or } L \cos\theta + u_R < W \sin\theta \quad \ldots(4)$$

$$R = W \cos\theta + L \sin\theta \quad \ldots(5)$$

Substituting (5) for R in (4) we get,

$$L(\cos\theta + u \sin\theta) < W(\sin\theta - u\cos\theta)$$

$$L < W \frac{\sin\theta - u\cos\theta}{\cos\theta + u\sin\theta} \quad \ldots(6)$$

If the flange is making a trailing contact, the friction helps and the wheel requires a lateral load of sufficient magnitude to mount the rail table. In this case, if the wheel is not to derail, then,

$$L\cos\theta < W\sin\theta + u_R \quad \ldots(7)$$

$$R = W\cos\theta + L\sin\theta \quad \ldots(8)$$

$$L(\cos\theta - u\sin\theta) < W(\sin\theta + u\cos\theta)$$

$$L < W \frac{\sin\theta + u\cos\theta}{\cos\theta - u\sin\theta} \quad \ldots(9)$$

Taking the value of u as .25 and that of θ as 45° and 75° the safe lateral load will be .63 W and 1.6 W for the leading contact respectively and 1.7 W and very large respectively in the case of a trailing contact.

The foregoing analysis shows that an increase in wear on the flange gauge face helps the wheel to withstand heavier lateral load before it could derail. But in actual practice, we see that the wear on the flange helps derailment. Nadal's formula has some flaw as it does not take into account,

(i) The frictional resistance between the rail and the other wheel of the same axle.

(ii) The point of contact between the flange and the rail (see App. II)

Taking into account the frictional resistance of the opposite wheel, (fig. No. 5) we get,

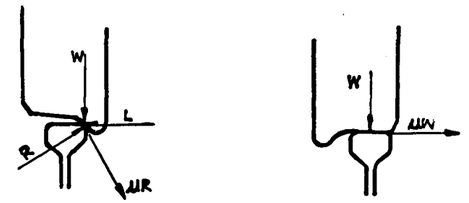


Fig. 5.

$$L(\cos\theta + u\sin\theta) < W\sin\theta(1+u^2)$$

$$L < W \frac{\sin\theta(1+u^2)}{\cos\theta + u\sin\theta} \quad \ldots(10)$$

for the values of θ as 45° and 75° the safe lateral load will be .85 W and 2 W respectively. Similarly the values for a trailing contact can be calculated.

Mr. Yukta Sato of Japanese Railways has introduced creep theory developed by Dr. Carter and has changed the original formula. The application of Mr. Sato's formula is restricted up to a stage before the actual slip occurs and after which Mr. da Costa's formula equation (10) applies.

It will be seen from the foregoing analysis, that Mr. Nadal's formula errs on the safe side in so far as the safe lateral load is concerned and ensures more safety. Even in the case of a leading contact, as the safe lateral load increases with an increase in the value of θ, the wheel can sustain heavier lateral load before it can mount the rail table. The investigators in India who have imposed a limit on the safe lateral force upto 55% of the axle load, possibly want to guard against any lateral bodily movement of the track.

The formula developed for leading contact has also a discrepancy which has been discussed by Mr. da Costa in "Riding of pacific locos". After the flange actually slips, the friction is reversed and instead of helping a derailment opposes it and, if L is not of sufficient magnitude the wheel will slip down again. This is the reason that even under the influence of relatively higher values of L than those given by the leading contact formula derailment does not normally occur.

It may be safely deduced from the above analysis that apart from Θ there is another factor L, the value of which depends upon Θ, which controls derailment. As an increase in the value of Θ raises the safe lateral force and also the value of L (a source of danger) a compromise in fixing its value is necessary.

OPTIMUM VALUE OF ANGLE Θ

As stated before, that the investigators in India and abroad have recommended a lateral force of 55 % of the axle load as 'SAFE', the limits for the value of Θ may be so fixed as to enable the wheel to withstand a lateral force of at least equal to its instantaneous vertical load. In this respect the recommendations by Mr. da Costa in his paper are reproduced below.

(i) The flange gauge face should not make an angle exceeding 30° with the vertical ($\Theta = 60°$). This is based on Nadals analysis which indicates that the flange with this angle can sustain lateral force almost equal to the instantaneous vertical load.....

(ii) The flange gauge face should make an angle of at least 15° with the vertical.....

(iii) It may be from the above that the value of Θ should lie between 60° and 75°.

For the geomatrical lay out, drawing Nos. CSL 120 and 121 may be referred to.

APPENDIX - I

2a = Width of the track gauge at tread contacts.

2b = Wheel base of the vehicle

C = Total lateral clearance between frame and rail

D = Wave length of the sinous motion of an axle truck

D' = Wave length of the sinous motion of double axle truck

f = Creepage cœfficient

i = Coning of the tyre

K = Multiplying factor to determine the wave length of a four wheeled truck

L = Lateral force

ℓ = Distance of an axle from the centre of friction

r = Radius of the wheel

R = Reaction at the rail

R_2 = Radius of the curve

u = Coefficient of friction

V = Critical speed (A speed when the energy input by the disturbing forces is equal to the energy dissipated by damping forces)

W = Vertical wheel load

w = Angular velocity of nozing oscillation

n = Angularity of the wheel at a time when the leading and trailing wheels are contacting outer rail

y = Angle of swivel of wheel base, when the leading wheel maintains contact with the outer and trailing wheel shifts to inner rail.

α = Total angularity of the wheel base when the leading and trailing wheels are against the outer and inner rails respectively.

Θ = Angle which slope of the flange makes with horizontal.

APPENDIX-II

Location of the point of contact between the flange and rail

The point of the flange rail contact can be located by plotting the wheel base on the track and finding the total angularity which the wheel makes with rail. The Total

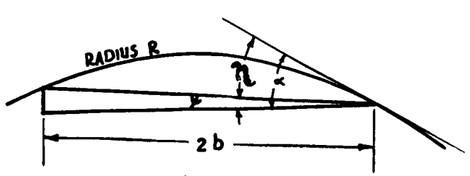


Fig-6

angularity can be determined by first finding out the total lateral clearance which comprises of,

(i) Clearance between the hub and horn including wear.

(ii) Clearance between the flange and rail including wear.

(iii) Gauge widening.

In fig. No. 6 the wheel base of a locomotive is plotted on a curve, with the leading and trailing wheels against the outer rail.

$$n = \frac{b}{R_2} \qquad \ldots.(11)$$

If locomotive takes a position with the leading and trailing wheels against the outer and inner rails respectively, then the angle of swivel.

$$y = \frac{C}{2b} \qquad \ldots.(12)$$

Then

$$\alpha = n + y = \frac{b}{R_2} + \frac{C}{2b} \qquad \ldots.(13)$$

In the figure below, for a given slope of flange: lateral clearance and wheel base, the flange rail contact is located. It will be seen that with any increase in the angularity resulting from the wear on the flange gauge

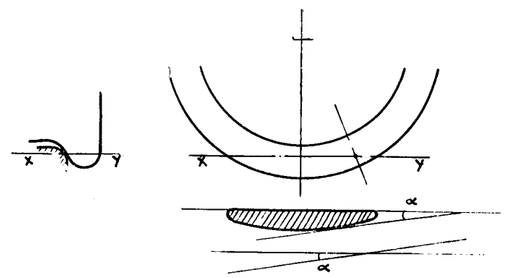
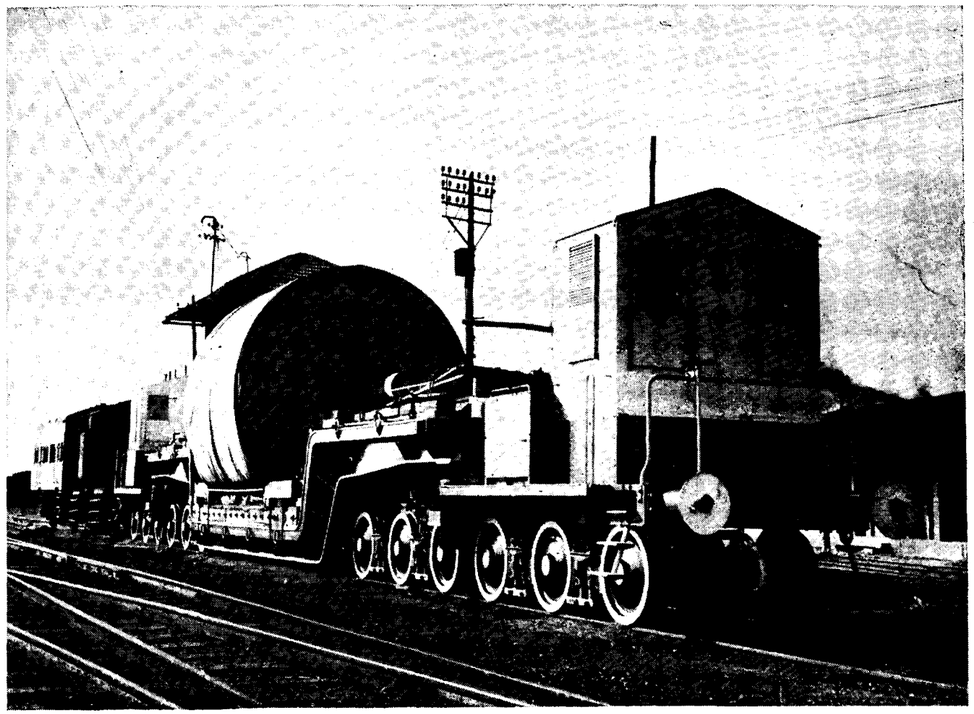


Fig-7

face, this contact will move ahead of the axle centre. This analysis helps in determining the maximum wear that can be tolerated on the flange gauge face.

A MASSIVE YANKEE CYLINDER MOVES

YET another massive steel 'monster' has been carried by the Eastern Railway from the Calcutta Docks to Dehri-on-Sone for the expansion of the paper industry there. This is the second movement of a heavy extra ordinary size consignment to the same destination within a month, the previous one being that of the 31-ton 'Kiln Shell' of similar dimensions carried on eleventh of last month.



A massive yankee cylinder moves.

The 'monster' is an Yankee Cylinder 21'–9" long with a 13'–9" dia. The machine weighs 50 tons.

Loaded on the Railway's 130-ton well-wagon the only one in India—the out-size consignment left the East Docks Junction by a special train on its nine-day 450-mile detour run to Dehri-on-Sone.

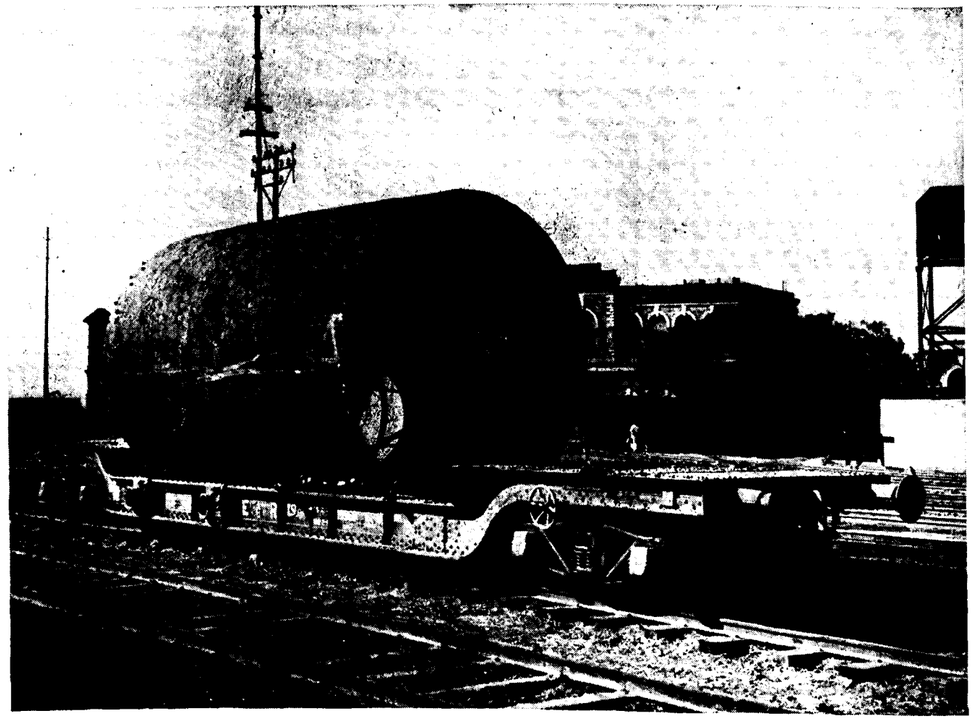
The load which allows at places minimum clearances of $1\frac{1}{2}$" in height and $1\frac{1}{4}$" on either side is being transported under the supervision of a party of railway transportation and engineering staff.

Elaborate prior planning has been made for the load to move during daylight only and for the safety of all passenger and goods trains which may cross the special on the run.

The first Yankee Cylinder was moved by the Eastern Railway to Dehri-on-Sone in July, 1953.

A MONSTER MACHINE MOVES

LAST month a special train with a 50-ton wagon left the Calcutta Docks under the supervision of a party of railway transportation and engineering staff on its nine-day journey to a cement factory at Dehri-on-Sone. The special carried an imported 'Kiln Shell'—that measured 15′–7″ in its overall height from the rail-level after loading, and was about 22′ long with 13′–9″ dia. Its weight was 31 tons.



The bulk of the consignment posed difficult transportation problems for the Eastern Railway as the load allowed at places hairbreadth clearance from overhead and side structures.

Elaborate prior planning was done for the load to move during daylight only. Precautionary measures have been taken all along the route for the safety of the goods and passenger trains.

All goods trains have been ordered away from the tracks adjacent to that occupied by the special and suitable alterations made in the running schedule of a number of goods, passenger and suburban trains to avoid their crossing the load on its run. Warning has been issued to all stations on the way to keep the edges of the passenger platforms clear of waiting passengers and their luggage at the time when the special is expected to pass by them.

INDIAN STANDARDS INSTITUTION NOTES

UNREINFORCED CORRUGATED ASBESTOS CEMENT SHEETS

AN Indian Standard Specification for Unreinforced Corrugated Asbestos Cement Sheets has been published by the Indian Standards Institution.

The Specification covers unreinforced asbestos cement sheets manufactured by the lamination process and lays down requirements regarding composition, colouring matter, classification, manufacture, dimensions and tolerances and tests. Both corrugated asbestos cement sheets and the semi-corrugated abestos cement sheets are included in the specification. Recommendations for use of unreinforced corrugated sheets for roofing have been included as an Appendix to the specification.

* * *

METAL AIR DUCTS

The Indian Standards Institution has issued an Indian Standard Specification for Metal Air Ducts (IS : 655—1955).

Metal ducts used for conveying conditioned air are being manufactured locally, mostly for a specific job. The materials used depend often on what is available in the market. While there exists some guidance regarding the material and constructional requirements of ducts, a uniform practice has not come into existence as yet. It is hoped that this standard which lays down minimum requirements for ducts would help to bring about uniformity in the manufacture of these ducts and would at the same time serve as a basis of agreement between the purchaser and the vendor for supply and installation of metal air ducts.

* * *

REFRIGERATION AND AIR-CONDITIONING

The Indian Standards Institution has just published the following three Indian Standards relating to refrigeration and air-conditioning :

(1) IS : 659–1955 Safety Code for Air-Conditioning

(2) IS : 660–1955 Safety Code for Mechanical Refrigeration

(3) IS : 661–1955 Code of Practice for Insulation and Safe Operation of Cold Storages.

The manufacture of refrigeration and air-conditioning equipment in this country consists mainly in assembling the different types of units for which a large part of the major components is imported. The assembling operation involves putting together imported components and indigenously manufactured parts to produce units having the same performance as that of a fully imported unit. These codes have been prepared as a guide to the manufacturer regarding the performance requirements expected of the units and further to assist the consumer in satisfying himself that requirements of safety and efficiency of operation have been met.

The Code for Air-Conditioning covers the safe design, construction, installation, operation and inspection of air-conditioning equipments and systems. The Safety Code for Mechanical Refrigeration covers features in the design, construction, installation, operation and inspection of mechanical refrigeration systems including working conditions in the plant room considered necessary to safeguard life, health and property. The Code for Insulation and Safe Operation of Cold Storages covers construction and safe operation of cold storages with special reference to insulating and finishing the structures of permanent construction such as brick, steel, concrete, etc.

* * *

PURPOSE LOW FREQUENCY CHOKES

A draft Indian standard specification covering requirements of General Purpose Low Frequency chokes with one or more windings suitable for use in radio receivers, amplifiers, small transmitters and other similar electronic devices, has been prepared by the Indian Standards Institution and circulated for comments. This is the fifth Indian Standard in the series of standards on radio components, four of which have already been published.

Radio chokes of the types covered by this standard are being manufactured in India in appreciable quantities now and it may be said that practically the entire needs of the radio receiver and amplifier assembling industry in the country are being met by local production. The scope of the draft standard is at present restricted to cover smoothing chokes or filter chokes up to 50 cycles per second. The scope will be extended to cover other types of low frequency chokes when sufficient test data have become available. The draft standard relates to chokes up to 250 mA direct current with voltages not exceeding 1500 V (RMS) or DC to ground including what are known as "swinging chokes".

Two grades of chokes are recognized in the draft standard based on the permissible temperature rise above specific limits of surrounding temperature. Besides laying down details of materials and construction, a number of tests under different categories, namely mechanical, climatic and electrical, have been included in the draft. The sequence of type approval tests and a sampling procedure for the batch sampling tests are also given in the draft.

* * *

ELECTRICITY METERS

The Indian Standards Institution has published an Indian Standard Specification for AC Whole-Current Electricity Meters—Part I and Part II. Part I of the standard covers general requirements for AC electricity meters of all types of the induction variety. Part II deals with special requirements of single phase 2-wire whole-current credit type meters. Subsequent parts of the specification, which are complementary to these two parts, are under preparation and would be issued in due course. Part I of the standard stipulates, among other things, terminology, reference standards, constructional details, registering mechanism, provision for sealing, marking and tests. Part II covers the details of single-phase 2-wire whole-current credit type meters and stipulates, among others, the standard ratings, diagram of connections, terminal holes, speed of rotation, power losses, limits of error and tests. Among the tests is also included test for corrosion resistance, which is very important for meters used in a country where high humidity and high temperature are experienced.

This standard has been prepared by the Electrical Instruments Sectional Committee of the ISI on which are represented important meter manufacturers, experienced technologists and electricity and other Government departments concerned.

* * *

ELECTRICAL STEEL SHEETS

The ISI has published Indian Standard Specification for Electrical Steel Sheets. This Standard covers the requirements for electrical steel sheets of four grades intended for use in the manufacture of fans, motors, dynamos, transformers and similar other electrical equipment. The Standard specifies maximum specific core losses of electrical steel sheets and prescribes standard sizes for different grades of such sheets. It also includes the inspection and testing facilities required to be afforded by the manufacturer to the purchaser with a view to satisfying that the manufacture of the product has been in accordance with the Indian Standard.

Methods of tests for determining the requirements of steel sheets used for electrical purposes in respect of specific core loss, permeability, space factor, surface quality or lamination, brittleness, and ageing have been laid down in a separate Indian Standard entitled Indian Standard Methods of Testing Electrical Steel Sheets.

Manufacture of electrical steel sheets in India is a post-war development and the foregoing standards have been formulated for the purpose of regulating their mauufacture and supply, for the benefit of both the producers and the purchasers.

* * *

ALUMINIUM PLANT AT HIRAKUD

INDO-CANADIAN VENTURE

The terms of agreement for setting up an aluminium factory at Hirakud with an annual production capacity of 10,000 tons have now been finalised and work is expected to commence shortly for its erection at Hirakud. The Indian Aluminium Company is a joint Indian and Canadian enterprise. Its representatives, Mr. A. E. S. Greenwood and Mr. Maheshchandra, met the Orissa Government at a conference presided over by the Chief Minister, Mr. Nabakrushna Chaudhuri and attended by the Orissa Industries Minister, Mr. K. G. Deobhanj and Government officials.

Under the proposed agreement which is expected to be signed shortly, Orissa is to supply 20,000 kilowatts from Hirakud to the 10,000-ton smelter. The ultimate production capacity of the factory will be 20,000 tons. It is understood that the company asked for 5,000 kilowatts more for having aluminium sheet rolling machine also. It asked for lands required for the factory (about 200 acres) to be made over to them immediately, so that construction of works might start by the middle of this month. It will have a capital investment of about seven and half crores rupees.

HIGH-DENSITY 'ALKATHENE'

(From a Special Correspondent)

A New Development of the I. C. I. High-Pressure Process

I. C. I. will soon have available in development quantities a high-density, stiff 'Alkathene' which can be sterilised. It is made by a modification of the high-pressure process. To be known as 'Alkathene' HD, the new polythene can be processed in the same way as normal low-density or flexible 'Alkathene'.

The terms "high-density" or "stiff", as opposed to "low-density" or "flexible", describe the two products qualitatively in terms of select properties, but there are many other differences between them, one of the most important being their softening points. Articles injection-moulded or extruded from 'Alkathene' HD can be heated without distortion for 15 minutes at 110°C, whereas similar articles of flexible 'Alkathene' collapse after the same treatment.

During 1956 one to two hundred tons of 'Alkathene' HD will be available, mainly for trial purposes at home and overseas. It is intended to establish commercial manufacture on a progressively increasing scale, although it may not be possible to meet all demands for some time, particularly in face of the constantly increasing demands for the conventional product.

The availability of this new 'Alkathene' and the possibility of blending with the current material will open new fields of application.

The properties of 'Alkathene' HD suggest that it will be particularly suitable for mouldings. Advantages for this and other applications are:

Mouldings—Can be sterilised at temperatures of 110°C without distortion. Possible raw material saving through reduction in wall thickness. Improved stiffness and finish.

Pipe —Higher working pressures and greater heat resistance.

Cable —Thinner insulation and tougher sheath—higher service temperatures.

Film —Less permeable to water vapour and gases; more resistant to oils and fats.

At present, however, 'Alkathene' HD Films have a tendency to be shock-brittle.

Typical properties of 'Alkathene' HD are compared with those of standard 'Alkathene' 20 in the following table:

Property	'ALKATHENE' HD	'ALKATHENE' 20
Melt flow Index (Grade Number)	0.7	20
Density	0.940 grams/cc.	0.92 grams/cc.
Ultimate Tensile Strength		
Straining Rate 6"/min.	2580 p.s.i.	1600 p.s.i.
" " 12"/min.	2750 p.s.i.	1580 p.s.i.
" " 18"/min.	2900 p.s.i.	1500 p.s.i.
" " 30"/min.	3200 p.s.i.	1400 p.s.i.
Elongation at Break		
6"/min.	380%	450%
12"/min.	300%	490%
18"/min.	200%	490%
30"/min.	180%	500%

(Continued on page 69)

RAILWAY OFFICIALS' GAZETTE

CHIEF MECHANICAL ENGINEER
SHRI B. VENKATARAMAN

SOUTHERN Railway's Chief Mechanical Engineer, Shri B. Venkataraman, subject of this profile, has interested me a good deal. From the first time I came to know of him curiosity has grown in me whether the mechanical aspect of the Engineering Division is not just a mechanism but he disillusioned me and satisfied my curiosity. Mechanical Engineering is a subject which opens out large vistas and is apt to be more rough than the Civil Engineering which apparently puts on a garb of civility. But without the mechanical aspect the civil part pales into insignificance, and in the ultimate analysis one is the complement of another for the successful completion of any engineering project.

Shri Venkataraman joined the Railway Engineering Service in October 1924 while just 23 years on the then G. I. P. as a Probationer. Within a month or so he was deputed to the United Kingdom to undergo a specialised course of training with particular reference to Mechanical & Locomotive Engineering and returned to India after two years when he was posted to the N. W. Railway as Assistant Works Manager. The practical training and the knowledge he acquired while in the U. K. stood him in good stead in his new assignment and he applied his talents unremittingly. In 1930 he became Production Engineer on the G. I. P. Railway and thereafter was transferred to the East Indian Railway where he remained for a number of years and played an important role in the prosecution of numerous war time programmes in the Workshops. His services were requisitioned by the Railway Board in 1945 and was

(Continued from page 68)

Property	'ALKATHENE' HD	'ALKATHENE' 20
Vicat Softening Point	116°C	83°C
Stiffness Modulus at 20°C	5×10^4 p.s.i.	2.6×10^4 p.s.i.
Environment Stress Cracking Test (I.C.I. test using "Lissapol" N)	1.75 hours	0.25 hours
Low Temperature Brittle Point	below—70°C	−30°C
Colour Possibilities	Excellent natural colour. Readily pigmented to any shade.	Excellent natural colour. Readily pigmented to any shade
Electrical Properties	Excellent Equivalent to standard 'Alkathene'.	
Moulding & Extrusion	Can be handled on most standard equipment, to give products with good surface finish.	
Permeability	Less permeable than "Alkathene" 20 to most vapours and gases—e.g., for hydrogen the figures are: Alk. HD.—0.2×10^{-9} Alk. 20. —0.9×10^{-9} ccs/cm/cm²/cmHg./sec.	

Shri B. Venkataraman.

posted as Director and subsequently as Joint Director of Mechanical Engineering. With the partition of the country he was assigned to the East Indian Railway as its Deputy Chief Mechanical Engineer.

In the year 1947 he was selected as a Delegate of the Special Team of Officers to represent Indian Railways at the International Railways' Conference held at Lucerine and while in the continent he seized the opportunity of visiting switzerland and studied the various aspects of design and construction of Light Weight Coaching Stock. On his return to India he again joined the Railway Board as Officer on Special Duty for some time and then was posted to the Chittaranjan Project to help the construction of the Workshop as a colleague to Shri Ganapathy, the Civil Engineer of the Railways. In the middle of this assignment he was transferred to the B. B. & C. I. (now Western Railway) Railway as its Chief Mechanical Engineer and with the regrouping of the Indian Railways on a new zonal basis he became the Chief Mechanical Engineer of the Western Railway. In 1953 he was again transferred to the Southern Railway as Chief Mechanical Engineer which position he continues to hold to this day.

Looking at the unique career Shri Venkataraman has had on the Indian Railways in various assignments in different parts of the country, I can well recollect several anecdotes which mark him out as a great Engineer endowed with agility of mind, drive, energy and initiative. He was indeed happy to return to his home state where he may perhaps settle down to a quite life in a couple of years free from the burdens of Office. But rest is not a craze with him and he never contents himself remaining idle. His mind never knew respite although the physique might yield to exhaustion.

Gifted with a personality all his own, he stands out in a crowd and his voice commands attention. Scion of a respectable family of orthodox brahmins of the South with a long tradition of loyal and efficient service to the country—his father Shri Balarama Iyer was for a while the Auditor-General of India, Shri Venkataraman is one of the most talented and highly experienced Engineers of our Railways of which any country could well be proud of.

We wish Shri B. Venkataraman good luck.

AMENITIES TO THIRD CLASS PASSENGERS

The Union Railway Minister, Mr. Lal Bahadur Shastri, said that during the next seven years, third class passengers would be provided with electricity, water and waiting hall at every railway station in the country.

Mr. Shastri, who was addressing a public meeting at Rajpura, seventeen miles from Patiala, also asserted that the Government was progressively reducing the difference in amenities between first class and third class passengers.

The Government had already launched a number of schemes to attain self-sufficiency in coal, electricity, petrol and iron. This, he said, would greatly improve the railway system in the country.

He said that special train facilities would be provided for peasants if there were five hundred persons on a trip to visit the Chittaranjan Locomotive Works and Sindhri Fertilizer Factory.

RAILWAY WEEK SUPPLEMENT

THE ROLE OF ENGINEERS ON RAILWAYS

By Shri M. Ganapati, General Manager, Western Railway

ON the occasion of the celebration of the Railway Week, I have chosen to address the listeners on the role of engineers on railways. Indeed, the part played by the engineer, both in the construction of railways and in their maintenance, is a very fascinating one.

On railways the term "engineer" applies to the civil engineer as apart from the mechanical engineer, the electrical engineer and the signals and telecommunication engineer. This may perhaps be due to the fact that the civil engineer who is responsible for the very construction of the railways from the time it is conceived till the time the railway line is established for the purpose of running trains, is first in the field in connection with any railway project. It is over a century now since railways were first constructed in our country, and the civil engineer has held the field throughout as an indispensable component of any railway organisation. On him devolves the responsibility of undertaking the survey, both preliminary and final, of any railway project, the eventual construction of the railway line in question and its ultimate maintenance for the running of trains, both passenger and goods. On him also devolves the responsibility of designing, constructing and maintaining other civil engineering works connected with the railway undertaking, namely, station buildings, goods sheds, staff quarters, bridges, both minor and major, roads, buildings and offices, water supply and sanitary arrangements, including social amenity centres, such as institutes, clubs, schools for children, dispensaries, hospitals and the like at stations and colonies, whether they be in the sub-district, district, divisional or regional or general headquarters. He is also responsible for the construction and maintenance of running sheds, workshops both small and big for the maintenance of rolling stock, such as locomotives, carriages and wagons and workshops for the ordinary maintenance of civil engineering works at various stations. The construction and maintenance of store depots at suitable sites as well as in the headquarters of railways is also his charge. Structures for power houses or substations and connected civil engineering works are also his charge. In short, he provides and maintains the wherewithal for the Operating, commercial, Mechanical, Electrical Stores and Medical departments, etc., of railways. No one can, therefore, deny him the pride of place in the railway organisation. He is verily the creator of assets as far as the railways are concerned.

Shri M. Ganapati.

His task in these diverse fields is by no means an easy one. Beginning with the survey of a projected railway line he is faced with the problem of selecting the most

suitable alignment for the projected railway line between the two stations selected by the authorities and for this purpose he has first to study the contour plans of the Survey Department of the area in question, decide upon the approximate alignment depending upon the important places which have to be touched along the proposed route, make first a reconnaissance survey to determine the most suitable alignment and then proceed with the actual survey of the country to be traversed. What might appear on the contour plan to be an easy connection between two points touching important places may not actually prove to be quite so feasible on the ground on account of geographical conditions and only a careful survey of such geographical conditions such as the existence of rivers, canals, mountains, hillocks, valleys and other such barriers, will reveal the feasibility or otherwise of an easy connection consistent with practicable gradients which can be economically negotiated by the types of locomotives proposed to be used on the section. There are thus a large number of limiting factors which have all to be taken into consideration before the most suitable alignment can be selected and surveyed in detail at the time of the final location survey before the actual construction is sanctioned and commenced.

Coming next to the actual construction of the railway line, while the economics of such construction would have been studied by the appropriate authority and ultimately sanctioned as necessary, the detailed final location survey enables the engineer to assess precisely the alignment to be followed, the extent of sub-grade work consisting of earth work in embankment and in cutting and tunnelling and the bridging, both minor and major, to be done in connection with the project. The location of stations to serve the needs of the country being traversed, depending upon the importance of the major villages and towns touched by the proposed alignment, is also determined as a result of the final location survey which enables the engineer to prepare a reasonably accurate estimate of the cost of the project with all the data made available by such survey. The actual construction of the earth work in embankment and in cutting and tunnels, of the culverts and bridges designed most carefully to carry the full discharge of maximum flood waters known, and of station buildings and staff quarters, followed by the linking of the railway track and the various yards at stations, both small and big, and the construction of necessary running sheds, turn tables, etc., for use by rolling stock and the provision of station equipment at various stations all follow one after another until the projected line can be said to be completed in all respects and handed over for running of trains on the section. With the collection of necessary rolling stock, namely, locomotives, carriages and wagons for running trains on the new section and the posting of necessary operating staff at stations and for manning the locomotives, etc., the line is now ready for being declared open for traffic. Before opening the line to traffic, the very necessary precaution of making a thorough check through the agency of the Government Inspector of Railways of the new construction comprising sub-grade work, bridges, track, stations and other appurtenances to ensure that they all comply with the standards laid down for such purposes, is doubtless taken. With this formality complied with, trains are now free to run on this section as necessitated by the dictates of traffic, both passenger and goods. This then is the story behind the opening of a new railway line in which, it will be obvious, the railway engineer plays a very important role.

Once the railway is opened to traffic, the engineer's responsibility is not finished. Actually, his responsibility increases after the opening of the line to traffic. He has to constantly attend to the maintenance of the railway line so as to keep it in good condition for the running of trains. Such maintenance become more intensive on sections where the traffic is heavy and where trains are required to run frequently and at fast speeds. In such cases the condition of the track which consists of rails laid on sleepers, either of wood, cast iron or steel, which in turn rest on a bed of stone or other ballasting material laid over earth work in embankment or cutting, suffers deterioration rapidly and need correction with regard to alignment, cross levels, longitudinal levels and wear and tear of permanent way materials. Such attention to track is given by gangs of men appointed over sections of 3 or 4 miles in length at the rate of between 2 to 4 men per mile depending upon the intensity of traffic on the section. It will thus be seen that every mile of track on a railway has 2 or 3 or 4 men attending to it every day in the year. The gangs of men thus appointed for sections of about 4 miles, work as one unit, overhauling the track in their charge little by little every day and thus ensure that the track in their charge is overhauled at least 3 to 4 times a year, besides giving emergent attention to any particular spot whenever required. Such intensive maintenance has to be closely watched by the engineer through his organisation so as to ensure that the railway line is at all times safe for the trains which run on it. Track maintenance is a very important charge of the engineer. During the monsoons, especially in places where rainfall is heavy, track maintenance becomes even more difficult and the utmost care and attention is required on the part of the engineer and his staff to maintain a good running track at all times of the year. Station yards with their numerous sidings and

points and crossings giving connections to the sidings also require considerable attention. As regards bridges, small and big, these also require constant watch and periodical repairs to keep them in good condition so that they do not fall into disrepairs and eventually fail or collapse, thus endangering the track which they support. Some of the major bridges across the rivers need meticulous attention to keep them in good condition. Rivers which carry large volumes of water during rainy season sometimes endanger the foundation of the piers or supports constructed in their bed and these require to be watched during the rains and immediately after the rains. Cases have been known where phenomenally abnormal conditions in this respect have endangered the safety of trains running over these bridges during the rainy months. On sections where the intensity of traffic is very heavy, as in the suburban areas attached to cities like Bombay, Calcutta, and Madras, the maintenance of track needs the utmost attention on the part of the engineer.

Quite apart from the construction and maintenance of the running line together with its sub-grade work, stations and yards, the engineers also have to construct and maintain various workshops and running sheds for the repairs and maintenance of rolling stock. Every railway has a large number of such major workshops and running sheds for repairs to locomotives, carriages and wagons. They have also large numbers of power houses, store sheds and other structures for use by the Electrical and Stores departments which require to be constructed and maintained in good condition. These workshops, power houses and store sheds have their yards attached to them to enable the free movement of rolling stock, machinery or stores to and from these sheds. All these require to be laid out properly and maintained so that these repair facilities and ancillary services are put to the maximum use. Fabricated steel work or concrete work, both reinforced and plain, are used in abundance in connection with these structures, and the engineer has to be an adept in the design, erection and maintenance of such structures.

In regard to staff quarters, roads and horticulture in railway colonies, not only has the engineer to design and construct these buildings to suit modern requirements, but he has to plan carefully the layout of these colonies with adequate number of social amenity centres such as institutes, clubs, children's parks, playfields, dispensaries and major hospitals whenever necessary. In deciding the construction of these social amenity centres, he has to keep abreast of times and plan them in such a manner that the staff colonies, small and big, at various stations are most suited to the requirements of staff living in them. The engineer has to realise that staff have to be kept happy and contented in decent homes and in hygienic surroundings and proper environment with adequate facilities for recreation, etc , if such staff are to give of their best in running the railways. Here again, the engineer is faced with the problem of planning, designing and constructing structures not only from the point of view of maximum utility and minimum cost, but from the point of view of an æsthetic sense to satisfy discerning eyes.

Office accommodation at various centres, including district, regional and general headquarters, is also the engineer's charge, and in modern times this is assuming more and more importance on account of the large increase in staff and the need to provide them with well ventilated and adequate accommodation for doing their work. Offices built in the early days are now totally inadequate with large increase in the volume of work and the consequent increase in staff with the result that additional accommodation is required at many places, as at the general headquarters of the railways in Bombay. The Churchgate offices are totally inadequate now and additional office accommodation has to be built for housing a large part of the staff who are now scattered in various hired buildings in the town. It becomes imperative for the engineer to plan such additional office accommodation on modern lines even if he chooses to be austere.

Engineers have not only to initiate construction of new projects but have often times to remodel yards to meet ever increasing requirements of facilities and to renew existing structures, especially of major bridges on running lines under traffic conditions without dislocating existing services. Here the ingenuity of the engineer is taxed to the utmost. One example which I can quote here, is that of the regirdering of the single line Ganga Bridge at Kashi consisting of 7 spans of 350 feet and 9 spans of 110 feet into a new double line bridge including the provision of an overhead roadway and footpaths, all under traffic conditions without stopping even a single train of the total of 52 trains which were running on this single line section. This is at once one of the most intricate and complicated pieces of engineering work a railway engineer was called upon to execute. This work was actually done in a period of just 24 months. There are several instances like this where the Railway engineer is called upon to rehabilitate existing assets on the railways under traffic conditions and I can assure you that he rises to the occasion every time. The role of the railway engineer will, I am sure,

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Western Railway's Rs. 100 Crore Plan
Larger Traffic, More Amenities and Staff Welfare

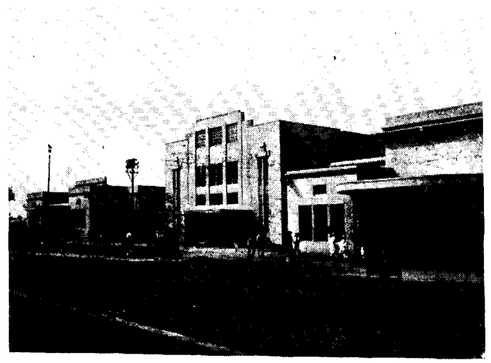
By Shri M. Ganapati, General Manager, Western Railway

The Western Railway has a second Five Year Plan costing Rs. 100 crores. It will, in addition, receive fresh rolling stock costing about Rs. 69 crores. The Railway's Plan provides for relief in over-crowding in its suburban services, transport of larger passenger and goods traffic, increase in line capacity and survey of new lines, introduction of new Janatas and more amenities for rail-users. The Railway will spend Rs. 6,00,00,000 on quarters for staff including a new township at Kotah, and Rs. 2,53,00,000 on staff welfare works, including Rs. 2,28,00,000 on medical amenities.

OVER a century back, India saw the beginning of the railway system in 1853 with the construction of a small line from Bombay to Thana on what is now the Central Railway. The other rail system, the Western Railway, with its headquarters at Bombay, the commercial capital of India, saw its beginning at Surat, which was the first foot-hold of the British in this country.

The Western Railway feeds the fertile fields of Gujerat with an intensive service. The distance between Bombay and Ahmedabad is served by a double line track except for a small portion between Baroda and Anand, which is also soon to be provided with a double line.

From Ahmedabad, the metre gauge track leads one into the equally rich state of Saurashtra, and skirting along the desert of Rajasthan provides an alternative route to Delhi and East Punjab. The metre gauge system of this railway will shortly provide a link between the north and south with the construction of the metre gauge line from Khandwa to Hingoli.



The new Mehsana Station, which was opened in July 1954.

Formed in 1951 by the amalgamation of the B. B. & C. I. Railway, Jaipur, Rajasthan and the Saurashtra Railways—the latter was itself the result of amalgamation of various small railways owned by the Princes of Kathiawar—the Western Railway consisting of a route

(Continued from page 74)

be conceded as a very varied one demanding the utmost ingenuity, resourcefulness, care and devotion to duty.

In talking about new construction, both of new railway lines and projects connected with works calculated to bring self-sufficiency to railways in the matter of rolling stock, mention may be made of a few important projects like the Assam Rail Link project, Kandla-Deesa, Chunar-Robertsonganj, Pathankot-Mukerian railway constructions, conversion of Gandhi-dham-Bhuj narrow-gauge line into metre-gauge, restoration of Shoranur-Nilambur and Madura-Bodinaickanur lines, the Chittaranjan Locomotive Works and the Integral Coach Factory project, which were all completed in recent times in record time, to meet the urgent requirements of the Indian Railways. The skill, energy, enthusiasm, devotion to duty and the team spirit displayed by the engineers engaged in these construction works have alone been responsible for the outstanding results achieved. There are many more projects on the anvil during the second five year plan and there is title doubt that the engineers will play their part in ensuring satisfactory completion of these projects, not only in time but within the estimated costs.

Third class waiting hall at the newly built Mehsana Station.

mileage of 5,614 miles was at once faced with the task of providing additional facilities necessary to cope with the large-scale development in the field of agriculture and industrialisation which followed independence.

The problem of bringing the amalgamated metre gauge lines to the standard of maintenance and operation of Government railways also meant a considerable amount of planning and execution of various works. With the coming of independence, this Railway was also faced with the task of finding transport capacity to replace the loss of Karachi port. It was, therefore, natural that during the first Five Year Plan stress should have been laid on the clearance of a heavy backlog of renewals and replacements which could not be carried out during the war and immediately thereafter.

"SPECTACULAR" PROGRESS

The progress of Western Railway's schemes for rehabilitation of rolling stock and for the removal of bottlenecks that hampered the progress of industrialisation and all-round development, has been almost spectacular.

Without much increase in its holdings of rolling stock and locomotives, the Western Railway carried last year 305 million passengers against 258 million passengers in the first year of its formation; similarly, the tonnage of goods carried increased from a little over 13 million tons to well over 16½ million tons.

Over 400 miles of metre gauge lines were completely renewed and nearly 900 miles were partially renewed.

Known as "the Line of bridges", this Railway had to face the task of strengthening bridges and culverts to enable heavier engines and heavier loads to be carried at faster speeds. As many as 120 bridges between Bombay and Baroda alone, a distance of 240 miles, were strengthened during the first Plan. A new high-level bridge of about 1,500 feet in length was completed over the Mahi river at Sevalia on the Anand-Godhra section.

This period saw the construction of the Kandla-Deesa Railway, a length of about 170 miles, designed to provide an alternative cheaper and quicker route between the west and the north of India and to serve the developing port of Kandla as a relief to Bombay port. The construction of the Indore-Dewas-Ujjain line, the Raniwara-Bhildi line north of Kutch for establishing an alternative outlet from Kandla to its hinterland, and the Fatehpur-Shekhawati-Churu line has also been taken in hand and works are in progress.

The line from Ahmedabad to Kalol was doubled and the section from Kandla to Bhuj, a distance of 30 miles of narrow gauge line, was converted to metre gauge during the first Plan period. A large number of line capacity works for increasing the sectional capacity at various places have also been carried out. These include the construction and opening of 35 new crossing stations, the provision of new reception and despatch lines at various stations with a view to increasing terminal facilities, additional loop lines at various stations including extension of existing loops and signalling arrangements etc.

SECOND PLAN

The Western Railway has extensive plans for development in the future. The Western Railway drew up a Second Five Year Plan costing Rs. 149 crores excluding rolling stock. Due to shortage of funds this has been reduced to Rs. 100 crores, and within this amount it is proposed to cater for a 15 per cent increase in passenger traffic and 25 per cent increase in general goods traffic, in addition to meeting the additional requirements of industries and agricultural projects for which a definite demand for transport can be anticipated on the basis of information available at present.

To cater to this traffic, the Ratlam-Godhra-Nagda section and intermediate section between Baroda and Anand will be doubled, and double line working would be established from Bombay to Ahmedabad and from Bombay to Nagda. In regard to new construction, the survey for the Loharu-Pilani link, a distance of 13.75 miles, has been completed. The survey of the Kotah-Chitorgarh line (104 miles) is in hand, and it is also proposed to carry out surveys for the following line

End view of the new bridge at Sevalia which was opened for traffic from 28th September 1954. This bridge was built at a cost of half a crore of rupees.

projects: Dungarpur to Ratlam *Via* Banswara, Bhavnagar to Tarapore, and a broad gauge line into Saurashtra.

Additional line capacity works, bridge rehabilitation, track renewal, workshop expansion, signalling and safety arrangements, are all included in the Second Plan. Additional locomotives, coaches and wagons costing about 69 crores of rupees would be obtained to enable this railway to cater for the additional traffic.

RAIL-USERS' AMENITIES

During the first Five Year Plan, the Western Railway spent Rs. 200 lakhs in looking after the welfare of the passengers. Of particular significance is the rebuilding of stations like Baroda, Surat, Rajkot, Indore, Ujjain and Mehsana with modern facilities. The waiting halls, concourses, refreshment rooms, lavatories and booking windows at these and other stations have been designed to give the maximum comfort to the public. The remodelling of the Churchgate, Godhra and Jaipur and other large stations is contemplated.

Janata Express trains have been introduced between Bombay and Ahmedabad and it is proposed to introduce similar trains between Bombay and Delhi and between Ahmedabad and Delhi.

During the second Five Year Plan, an allocation of Rs. 230 lakhs has been made for the remodelling of stations to increase their usefulness for goods and passenger traffic.

Owing to the paucity of coaches, over-crowding is endemic on the Indian Railways, and some sections of the Western Railway are particularly bad, such as between Ahmedabad and Mehsana. Passengers on the Bombay suburban section where there is heavy over-crowding, particularly during the peak hours, will be interested in the relief that is being planned for them.

SUBURBAN TRAFFIC

The three lines between Bandra and Borivli have already been electrified to cope with the additional traffic in the suburban section. It is further proposed to spend Rs. 32 lakhs on the provision of additional facilities and for bringing these three lines into use for suburban traffic also. Additional electrical multiple unit stock has been ordered and is expected to be delivered during 1956–57 and 1957–58. One of the big schemes in the second Plan is the remodelling of the Churchgate station.

With the provision of these facilities it should be possible to run additional trains which can be introduced on receipt of the 25 multiple electrical coaches which are on order. The new Churchgate station, which will also provide additional accommodation for the overflow of the Western Railway headquarters office, will be a modern, multi-storeyed structure.

The suburban traveller whose number has increased from 145 million to 173 million during the last two or three years may take consolation in the fact that he is no worse off than his "comuter" on the English or American railways.

On the claims side, apart from expediting the settlement of claims, a claims prevention organisation has recently been set up with a view to improving the security afforded to packages in Railway custody during transit or otherwise. It is the common experience of the public that settlement of claims either for compensation or refund is normally very expeditious on the Western Railway.

STAFF TRAINING AND WELFARE

While great stress is being laid on efficiency and improvement in working, equal attention is also being devoted to the betterment of staff and their welfare. Training of staff has been given a very important place in the second Plan of the Western Railway. At present, two training schools are functioning, one at Ajmer and the other at Udaipur. In the second Five Year Plan, provision has been made for the development of the school at Udaipur at an estimated cost of Rs. 62 lakhs, and for the establishment of a school at Dohad for

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Survey of 868 Central Railway Stations
More Passenger Amenities, Faster Trains

By M. N. Chakravarti, General Manager, Central Railway

The Central Railway has carried out an exhaustive survey covering all its 868 stations to find out what basic rail-users' amenities are lacking, and as a result, plans are being made to provide more amenities in stages. This article relates how as a result of a vigorous drive the Railway is now able to carry more traffic. Plans are also under way to run faster trains on certain sections.....

THE first Five-Year Plan commenced with the Central Railway's assets badly in need of rehabilitation. Traffic increased during the war period and has continued to increase thereafter, and this has had to be carried with attenuated and overage assets, by making more intensive use of them.

Considerable arrears had to be made up in track renewals, replacement of locomotives and rolling stock and other assets and this claimed the major portion of the funds available. Although rehabilitation was the keynote, the needs of increasing traffic were not overlooked. During the first three and a half years of the Plan period, additional traffic facilities were provided on a somewhat limited scale to cater for the increasing needs of traffic, then estimated to be of the order of 2 per cent per annum.

It was towards the end of 1956 that the Railway Board directed the individual Railways to prepare themselves to carry 20 per cent more traffic during the busy season of 1955-56 than what they did during the busy period of 1954–55. This entailed considerable expansion in the Railways handling capacity.

INCREASING TRAFFIC CAPACITY

Additional crossing and block stations had to be provided to increase line capacity. Loop lines had to be lengthened and additional loops provided at a number of stations. It was estimated that on the Central Railway 19 new crossing stations would be required and additional lines would be necessary at 20 other stations. The handling capacity of 16 yards through which the stream of traffic passes had to be improved, including some major yards. Improvement of terminal facilities in large goods-sheds, facilities for transhipment at break-of-gauge, junctions, facilities at repacking points were required to be undertaken. It was also considered necessary that efforts should be made to improve locomotive usage and wagon usage by cutting down drastically all avoidable delays. Detailed plans had to be chalked out to achieve all these objectives.

By the end of November 1955, most of the works planned were completed. For example, work went on unceasingly during the monsoon in Bombay last year to improve goods-shed facilities at Wadi Bandar, to enable it to handle an additional 100 wagons. Extensive work

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imparting training to technical apprentices at a cost of about Rs. 20 lakhs.

An interesting feature of the plan of this Railway is the provision of Rs. 20 lakhs to be spent on various training centres where class IV staff would be given instruction in accordance with the recommendations of the Accident Enquiry Committee. Similarly, staff in the Mechanical Department will be provided with training facilities at an estimated cost of Rs. 25 lakhs.

For efficiency, it is essential that the staff should be in good health, both physical and mental. Towards this objective, over 253 lakhs of rupees would be spent, of which Rs. 228 lakhs would provide medical assistance to the staff and their families During this period, Rs. 600 lakhs would be spent on the provision of staff quarters, and on the creation of a township at Kotah where a wagon repair shop is to be established.

All this expenditure on behalf of the staff is being incurred on the well-established economic theory that man does not live by bread alone, and that for a worker to give his best, he should be guaranteed entire satisfaction of certain minimum needs.

The Western Railway embarks on the second Five Year Plan with courage and confidence. If past achievements are any indication the future of this Railway is bright in its sustained efforts in the service of the public and the nation.

Shri M. N. Chakravarti.

was undertaken at the Ghorpuri transhipment shed which was generally considered a traffic bottleneck. Traffic moving across this junction was previously subjected to quota restrictions, but from the middle of December, it was possible to do away completely with the quota regulation and to allow booking freely.

A number of improvements of a minor nature were effected in loco workshops and running sheds to improve the out-turn of locomotives. Special efforts were also made to improve the availability of wagons. As many as 8 to 10 per cent of the total number of wagons on the Railway used to be out of commission due to damages. Through a vigorous drive, it was possible to bring down the number of damaged wagons to 3.5 per cent. Besides, a number of wagons which had outlived their existence were "rehabilitated" temporarily. To reduce the incidence of hot axles on goods trains, a number of "first aid" posts were set up near marshalling yards.

Thanks to the co-operation of the mercantile community, it was possible to improve further the availability of wagons for loading by keeping goods sheds open for longer hours than before and by sometimes loading in open wagons commodities which used to be moved only in covered wagons.

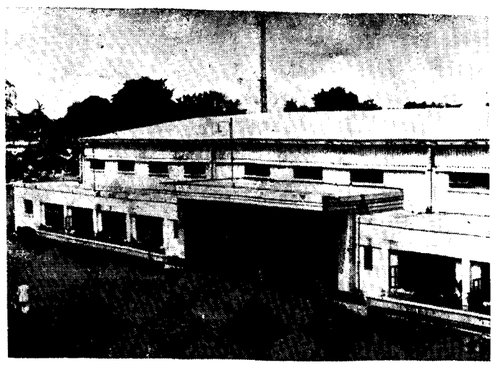
BETTER OPERATIONAL EFFICIENCY

As a result of these steps it is heartening to note that the number of wagons loaded on the Central Railway (B.G.) during the six months from September 1955 to February 1956 was ten per cent more than what it was during the corresponding period last year.

The efficiency of operation on the Railway improved enormously during the six months. For example, the figure of "wagon miles per wagon day", which is a measure of the number of miles a wagon moves in one day on an average (inclusive of delays at terminals, transhipment and other points), improved steadily from 53.5 in February 1955 to 59.6 in February 1956. Likewise, the "net ten miles per wagon day", which is a measure of the quantum of traffic moved by a wagon each day, improved from 714 in February 1955 to 808 in February 1956.

During the second Five-Year Plan we will be called upon to carry more and more traffic. We are gearing our administrative machinery in order that we may fulfil our future obligations.

While we have been able to achieve substantial results in the field of goods movement, we have not been able to achieve much in regard to passenger train services.



The exterior view of the new III Class Waiting Hall and Booking Office at Nagpur station. Almost 3 crores of rupees have been expended on providing passenger amenities over the Central Railway since 1949 when the scheme was introduced.

The work of construction of the 187 mile long Khandwa-Hingoli Metre Gauge rail link was commenced in March 1954. This project will link the 10,100 mile long Northern and 4,900 mile long Southern Metre Gauge systems of the country. This work is by far the largest Engineering work undertaken by the Central Railway during the first Five Year Plan. Considerable headway has already been made in the construction. 53 miles of earth work in formation has been completed and work is in progress on earth work in formation over 70 miles whilst masonry in bridges is in varying stages of progress for over 100 miles. More than 20,000 workmen are busy on this project which is expected to be completed in 1959 at an estimated cost of some 9 crores of Rupees. The project is a symbol of the progress made on the Central Railway, the Pioneer Line of India.

Photo shows the launching of a 60 foot skew girder across the Rameshwar Nalla at the north entry into Khandwa.

The punctuality of passenger carrying trains has unfortunately been low and we are making considerable efforts to improve it. Owing to limitations of rolling stock and locomotives, it has not been possible to effect substantial improvements in the quality of the existing train services or to improve their frequency, except on a few branch lines.

Efforts to procure additional stock to augment the Bombay electric suburban services have, however, just borne fruit and the first consignment of coaches from Italy has just arrived. In the coming months, we hope to receive many more coaches. While every effort will be made to run additional trains, the need for replacing old and worn out stock will have to be constantly borne in mind.

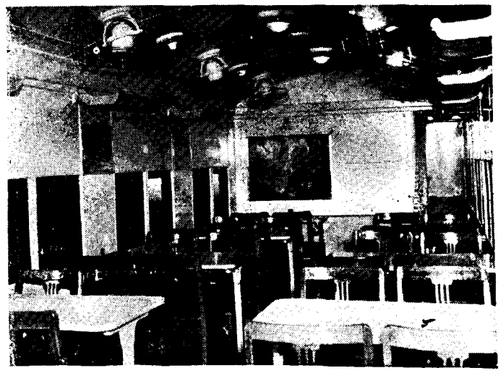
FASTER TRAINS

As a result of signalling improvements, it would be possible in the near future to run faster trains on certain sections. The Itarsi-Nagpur line which lies along the Grand Trunk Express route is being provided with a new type of signalling called "Multiple Aspect, Upper Quadrant Signalling". When this is completed and the section between Wardha and Balharshah is relayed with 90 lb. rails, it will be possible to speed up the Grand Trunk Express train further.

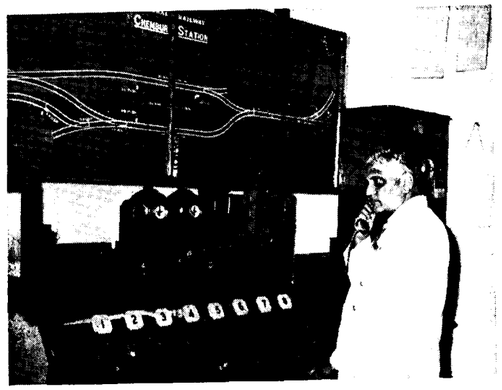
It is interesting to know that the twelve-coach corridor Janata train between Delhi and Calcutta, which was inaugurated on October 2 last year, was built in the Matunga Workshops on the Central Railway. The experimental First class chair car, now running on the Northern Railway, was also built in the same Workshop recently.

PASSENGER AMENITIES

Last year an exhaustive survey was undertaken by the Central Railway on the nature and extent of deficiencies in basic amenities provided at all its 868 stations and also of the additional amenities needed at the bigger stations. The deficiencies at some of the stations are being made up in the current year's amenities programme but there will still remain a number of amenities to be provided at different stations.



Interior of the Dining Car of the fully corridored Janata Express which now runs between Howrah and Delhi exclusively for the 3rd class passengers. The Dining Car is well lighted and is provided with many fans to keep it cool. Dust-proofing minimises this nuisance to diners. The panel have been decorated with photos and paintings. In the background may be seen a painting of a famous scene on the outside of cave No. 17 at Ajanta. The furnishing of Dining Car, like the rest of the train, was executed at the Central Railway's Carriage & Wagon Workshops at Matunga last year. The train performed its inaugural run on Gandhi Jayanti, 1956.



For the first time in India, the Automatic Block System on a single line section was introduced between Kurla and Chembur in the latter half of 1954—One of the more important signalling projects undertaken by the Central Railway in the first Five Year Plan. With this modern signalling system more than 90 trains a day are now being run between Kurla and Chembur, a symbol of the progress made by Central Railway, the Pioneer Line of India, under the first Five Year Plan.

Photo shows the miniature lever frame installed in the Station Master's Office, Chembur, for operation of colour light signals and power operated points.

Amenity works costing over a lakh of rupees have been carried out at Ahmednagar, Chalisgaon, Kings Circle, Burhanpur, Banda, Belapur, Gadarwada, Itarsi, Manikpur, Jalgaon, Masjid, and Satna — to name a few stations. At a number of other medium and small stations, a number of works have been carried out including improved water supply, waiting arrangements, food stalls, surfacing and cover over platforms. Some of the major works are now in progress at Jabalpur, Sholapur, Raja-ki-Mandi, Agra Cantt., Nasik Road, Katni and Kurnool Town stations.

In connection with the 2,500th anniversary of Lord Buddha, extensive amenities have been provided at Sanchi station, including extension, raising and paving of platforms, construction of two retiring rooms, etc. at a cost of about Rs. 2,00,000.

DIVISIONAL SYSTEM

A chronicle of achievements in other spheres of activity of the Central Railway would be too long to mention within the compass of a short article. We would, however, draw attention to a very significant change in the system of administration. It is now widely realised that decentralisation and devolution of authority are essential for the successful administration of a big unit like the Railway. The introduction of the full divisional system of working where it does not exist, with a wide measure of decentralisation of authority, has been decided upon by the Railway Board as a matter of policy. The Central Railways which has an organisation very close to the full divisional system has introduced it on two of its existing divisions, viz., Secunderabad and Bombay. Very active steps are being taken to extend it to the remaining divisions, and before the next year we hope that it would have been introduced in practically all the divisions.

WORLD STEEL OUTPUT WILL BE DOUBLED

Mr. Alfred Krupp, proprietor of the well-known German steel firm of Krupps, in an informal talk with the Pressmen in New Delhi said he estimated that in the next 30 to 40 years, steel production in the world would have to be doubled to meet demands. India would require large quantities of steel for her second Five Year Plan.

Referring to the steel plant at Rourkela in Orissa for which Krupps along with another West German firm, Messrs. Demag, are technical consultations, Mr. Krupp said that by October 1, 1958, the first blast furnace of the plant would be ready.

The Rourkela plant, he said, would be one of the most modern steel plants in the world.

Asked whether the German firm would provide credit for the steel project, Mr. Krupp said that his firm was not in a position to do it and it was for the West German Government to consider the matter.

Apart from the State-sponsored steel project, he said, his firm was building three cement factories for private firms in India.

Mr. Krupp disclosed that his firm had also offered to provide machinery for the lignite project in South India. The firm had also supplied locomotive boilers and other locomotive parts to the Indian Railways, he said.

INDEX TO ADVERTISERS

Printed and published by S. Sundaram at S. R. Press, Tanjore, for
"The Indian Railway Engineer", 79, Jayprakashnagar, Goregaon, BOMBAY.
Managing Editor : **T. S. N. Rao.**