

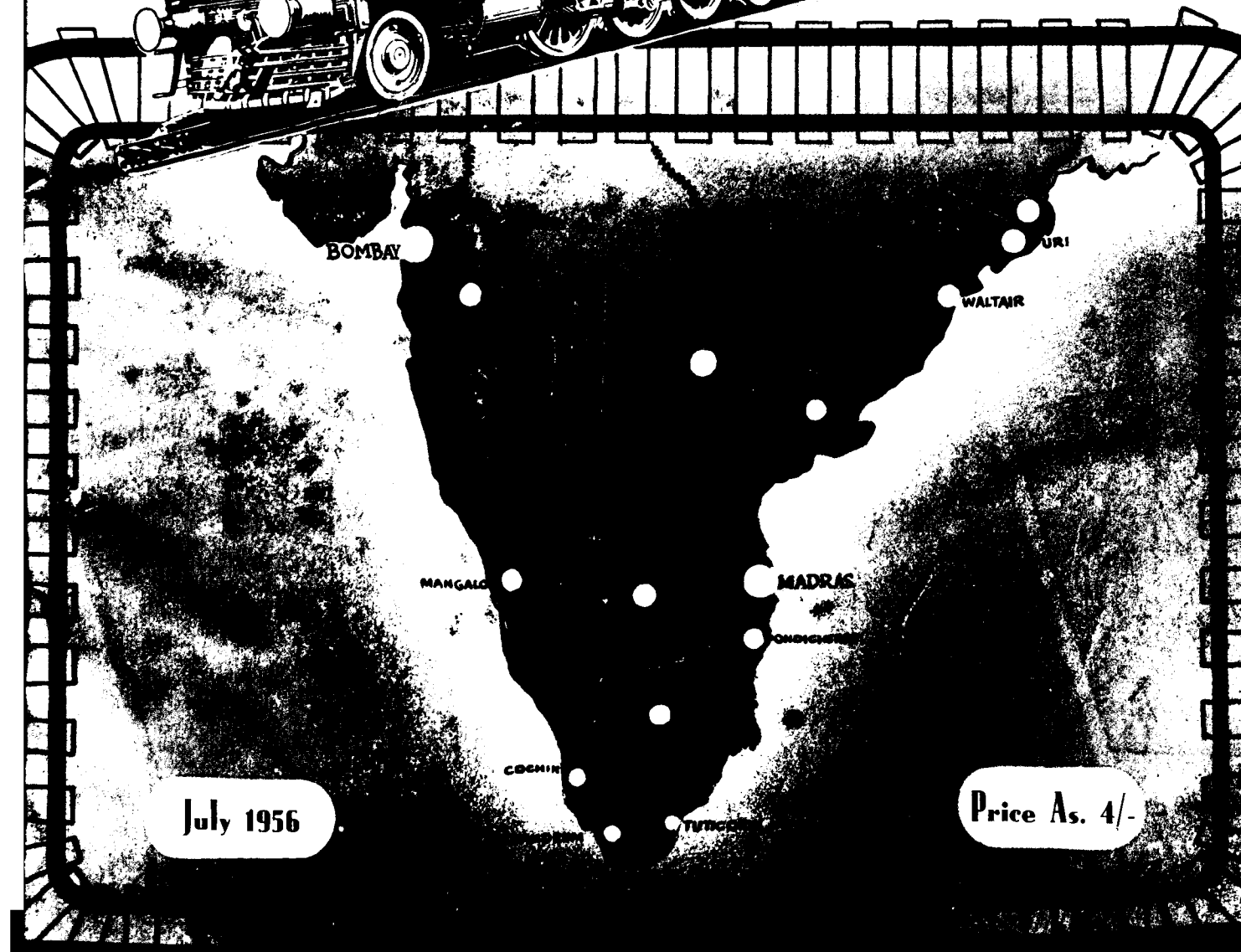
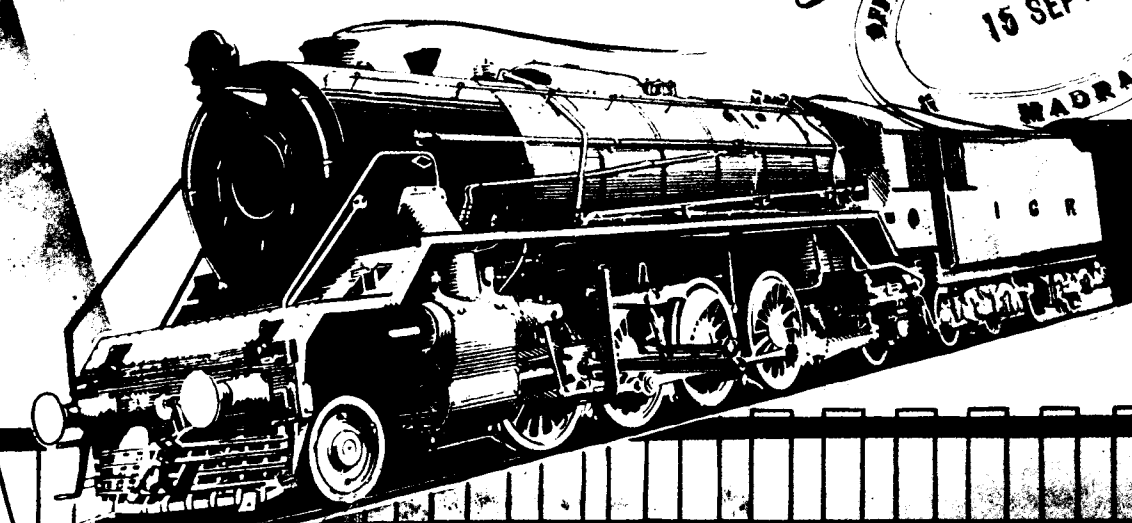
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Magazine

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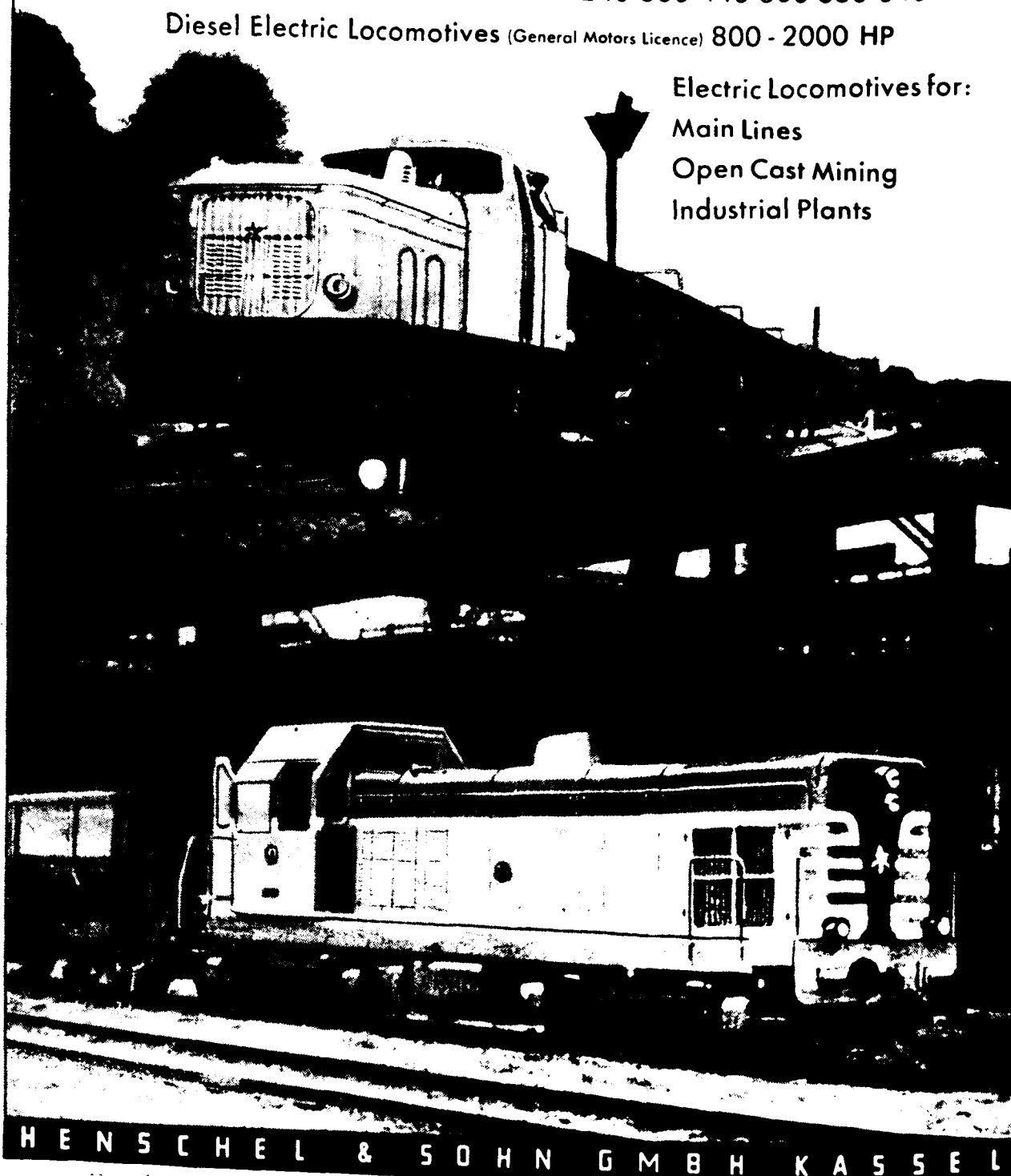
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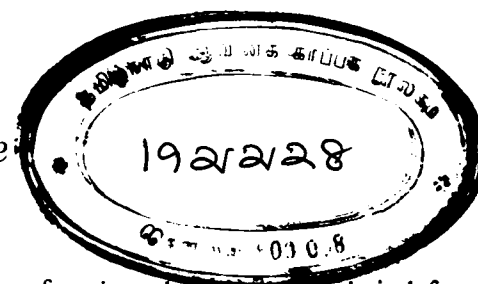
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Editorial Notice



The Editor invites contributions to the Magazine on a variety of topics—short stories, technical features written in simple English understandable to the laymen, Aspects of Railway Working, places of tourist interest, News from home line, activities on Railway Institutes etc. All copy should be brief and typed as far as possible.

Photographs illustrating social functions, sports events, scenic spots etc. are also invited. All contributions should reach the Editor not later than 5th of each month. Rejected Mss. will be returned provided sufficient stamps for postage are enclosed. No responsibility will be borne for copy lost in transit.

Views expressed in this Magazine should not be taken as having official authority.

All correspondence should be addressed to the Editor, "Southern Railways Magazine," Post Box No. 17, Tanjore, (South India).

THE HEY-BACK RAIL FASTENING

BY

THE WORKINGTON IRON AND STEEL COMPANY

(BRANCH OF THE UNITED STEEL COMPANIES LIMITED, SHEFFIELD, ENGLAND)

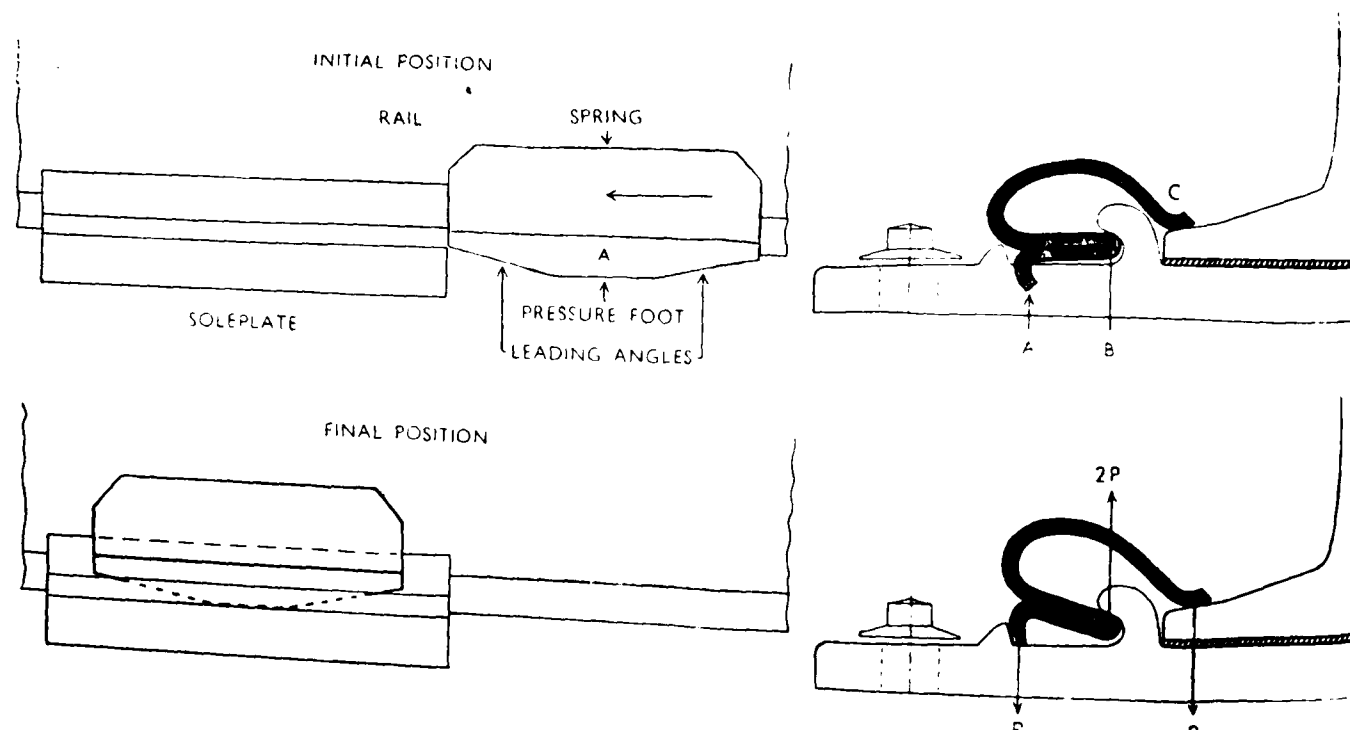
This recently developed system of elastic yet rigid rail fastening may be of interest to all those concerned with track-work problems.

THE development of the system took place in Norway where railway engineers first took out patents in 1942. Subsequently the war years put a brake on progress and it was not until 1949 that production commenced on a commercial scale. Now the System is standard on the Norwegian State Railways and is giving every satisfaction. It behaves admirably on tracks subject to a wide temperature variation from season to season and has allowed the reduction of time spent on maintenance and inspection. Not possessing the necessary manufacturing facilities Norway turned to Great Britain for the production of the rolled steel soleplate which is the heart of the system. In this way it was brought to the attention of British Railway engineers. The first experimental length of track in Britain was laid in 1950 in a heavily worked main line near New Cross Gate on the Southern Region of British Railways. Preliminary results being encouraging, a further trial stretch was laid at Neasden by the London Transport Executive, who have now placed a second order. The Southern Region are likewise extending their use of the system and have ordered a further 20

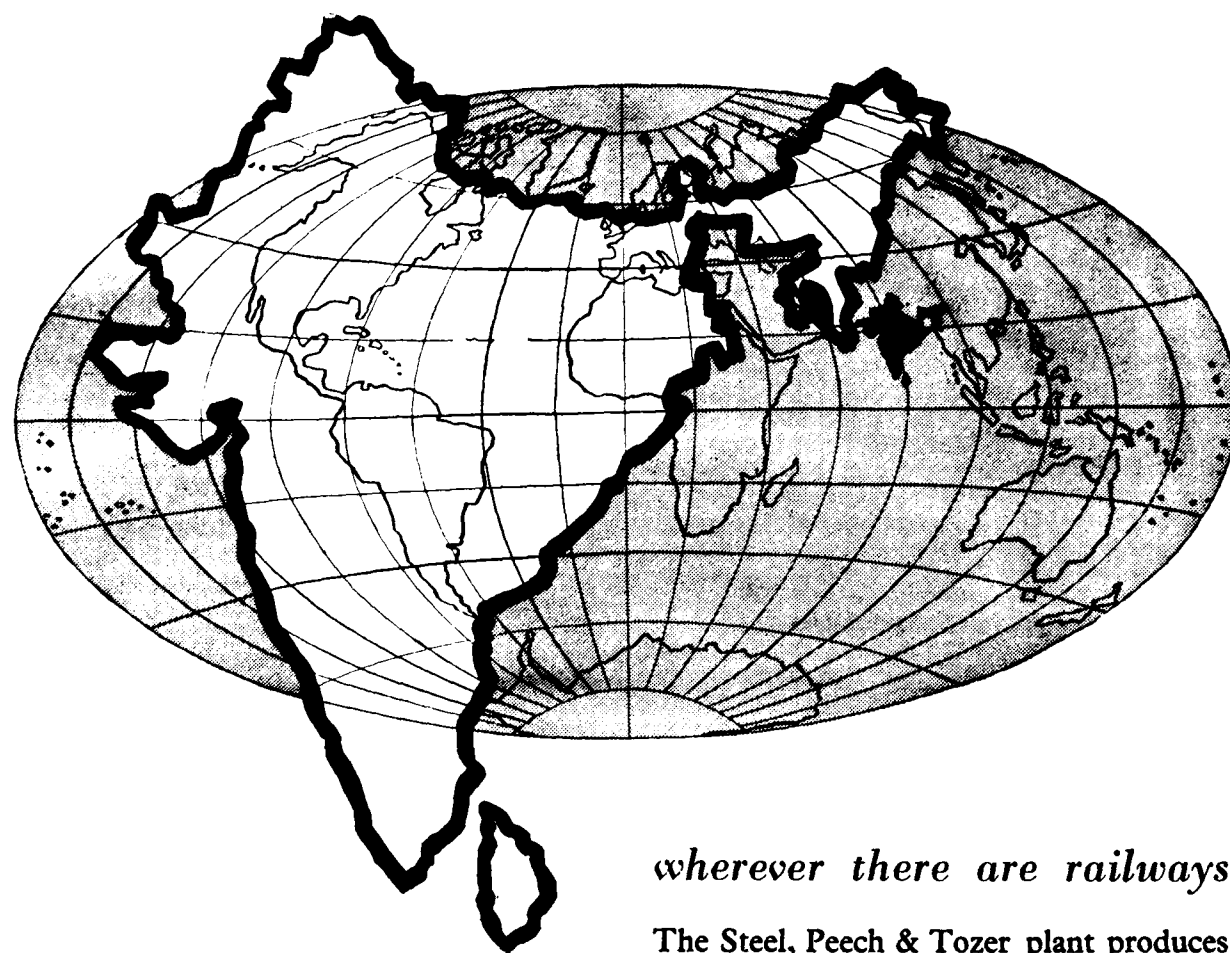
miles of track. Further afield, the South African Railways have planned an experiment which will utilize the Hey-Back system. The system's fitness for use under arduous industrial conditions will be proved shortly by a full scale section of track in the largest steelworks in the British Commonwealth, the Appleby-Frodingham Steel Company, England. Thus under varied traffic and climatic conditions the Hey-Back system is proving itself to the railway world.

A striking feature of the system is that it gives the track engineer so many advantages yet it is simple in the extreme. Two special components are involved, the grooved soleplate and the pressure spring.

The soleplate is produced in rolled steel. The weight compares very favourably with other types of soleplate used with flat bottom rails. For wooden sleepers it is rolled with the required tilt, but for concrete sleepers, where the tilt can be incorporated in the casting of the sleeper, the soleplate can be rolled without tilt, of even thickness, thus considerably reducing the weight per



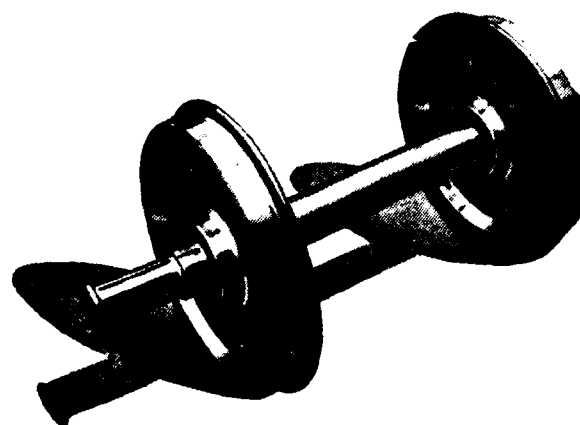
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unit. The soleplate is secured to the sleeper by conventional methods, coach screws or bolts for timber, and bolts or coach screws for concrete, when special resilient sockets can be used. The soleplate is fastened to the sleeper with or without a resilient pad as a seating.

It is equally well adapted to assembly at track preparation depots or for minor renewals on site. Once fixed to the sleeper, the soleplate need never be disturbed during the life of the sleeper.

The spring clips, two per soleplate, are of special design and extremely simple to assemble. They slide into the prepared grooves in the soleplate, being easily entered by hand from either side of the plate and then driven home with the customary keying-hammer. Two leading angles on the clip facilitate entry and as the clip is driven home the spring action comes into operation (see diagram). As the wedge section 'A' is forced into the groove, the projection at 'B' acts as a fulcrum causing the clip arm at 'C' to bear strongly downwards on the flange of the rail. It will be noted from the diagram that the pressure causing friction between the spring clip and the groove is three times greater than that between the clip and the rail.

The function and behaviour of the components in the track under load is such as to eliminate creep.

The spring pressure on the rail flange is independent of the fastening of soleplate to sleeper and it does not depend on correct adjustment of bolt nuts, etc., or of the firmness of the 'grip' in the sleeper. This gives several advantages.

Vertical movement of the rail under a rolling load is permitted without any risk of reduction of spring pressure. The holding-down pressure is constant on every fastening at all times. The sleeper itself will normally attempt to move before relative movement between rail and soleplate occurs. The rail and soleplate are held firmly together irrespective of the condition of the sleeper and whether or not pads are used between rail and soleplate. The positive fastening of rail to soleplate prevents widening of the gauge.

The system thus is vertically flexible and shock-resisting and it keeps transversely stiff irrespective of radius of curve. In other words, it complies with the theoretical conditions laid down for the fastening in connection with heavily loaded, high speed traffic. These conditions are even more important in connection with use of long welded lengths of rail.

The advantages are similarly apparent in connection with concrete sleepers. Cast-in rubber or other sockets

for soleplate coach screws and independent, flexible fastening of rail to soleplate reduce the strain on the 'dead' concrete. The system does not depend on 'anchoring' in the body of the concrete sleeper for maintenance of spring pressure and of gauge.

For those concerned with the metallurgical aspects of railway equipment it may be of interest to note these details about the materials used to manufacture the components. The soleplates are made of 26/32 tons per square inch tensile strength steel to British Standard Specification No. 751 of 1937, or to any other agreed specification. The spring clips are made of silico manganese, carbon chrome manganese or other spring steel suitably hardened and tempered so that the eventual hardness of the springs is Rockwell No. 41 to 45. The springs are made to such a dimension under the pressure point that when they are fitted into the soleplates over the rail foot a calculated pressure is applied to the rail foot. A typical holding-down pressure is 1,200 lbs. per spring.

When deciding the pressure it should be borne in mind that every spring clip maintains a constant pressure all the time. It is, thus, unnecessary to start off with a safety margin to allow for a gradual decline of pressure as is often the case if the fastening depends on the 'grip' in the sleeper being maintained. Further it is obvious that undue stresses in the track may more easily occur if the holding-down pressure is great on some fastenings and small on others.

One feature in the design of the Hey-Back Fastening is that it keeps to a minimum any modification of existing track or methods. It represents a technical advance in design without the serious initial inconveniences usually involved in superceding established standards.

The Hey-Back Fastening also benefits the permanent-way engineer by cutting down to a minimum the time required for rail renewals; at points of high traffic density or where tunnels are numerous the great speed with which rails can be removed and changed makes it a valuable contribution to track maintenance problems.

Finally from the point of view of safety and simplicity the Hey-Back rail fastening represents a solution to the problems of track design which undoubtedly are influenced by the trend towards increasing lengths of rails as well as increasing speed and axle-load. However rapidly modern methods of locomotive propulsion are extended, the main demand of the track designer is 'safety first'.

A Review of the Respective Merits of the Solid and the Built-up Rolled Steel Wheel

By C. F. Ryan, M. B. E., A. M. I. Mech. E., M. I. Loco. E.

Chief of Development, Railway Materials, Steel, Peech & Tozer.

(BRANCH OF THE UNITED STEEL COMPANIES LIMITED, SHEFFIELD, ENGLAND)

THE solid rolled steel wheel has come into increasing use on railways in all parts of the world during the past twenty-five years and it is worth nothing that during the past eight years. British manufacturers have sent a total of 13,750 pairs of solid wheels to India. At the present time solid wheels are used almost exclusively on new wagons for British Railways and have proved satisfactory on London Transport Executive trailer cars. In South Africa and Australia both carriages and wagons are being equipped with this type of wheel. The Swiss railways have standardised on the solid wheel for their international coaching stock and for electric motor coaches and trailers; in Spain it is being fitted to carriages and to electric motor coaches and rail cars. In the United States and Canada, the solid wheel has been adopted for all new rolling stock, including diesel locomotives. These are only some of many examples demonstrating the fact that the solid wheel has become a standard item of equipment on many systems and it is interesting to make an impartial study of the causes which have led to the adoption of the solid wheel under such a wide variety of service conditions.

Before deciding on the most suitable type of wheel for a particular class of rolling stock the designer will naturally consider the conditions under which the stock will have to work. In making the decision the following factors will be borne in mind:

- (a) Reliability
- (b) Effect of wear
- (c) Availability of repair facilities
- (d) Saving of weight
- (e) Cost and estimated life.

(a) Reliability

Reliability, or freedom from defects, is a most important consideration. It is difficult to assess the value of this quality in terms of money since the consequences of any one failure may be serious or trivial—a major derailment or a few minutes' delay. With the built-up wheel there is always the possibility of a loose tyre and danger, admittedly slight, of a broken one. Cases of fractured solid wheels have been known but they are extremely rare.

At least one important railway has found that there is less tendency to flaking or shelling of the surface of the tread in the case of solid than in that of built-up wheels; this they attribute to the fact that with solid wheels the rolling surface is not subject to shrinkage stresses.

With the built-up wheel some trouble may be experienced due to corrosion between the wheel rim and the inner surface of the tyre although there is less likelihood of this when these two surfaces have been given a good finish during machine.

(Continued on page 6)



(Photographs by courtesy Norwegian State Railways)

In general, so far as reliability is concerned, the advantage lies with the solid wheels.

(b) *Effect of Wear*

Where service conditions are such that heavy wear takes place the built-up wheel may prove the better choice from an economic point of view. If, however, there are a number of long and severe gradients on the system and the wheels are braked, the danger of loose tyres may alter the balance in favour of the solid wheel. Similarly, for suburban service applications, where traffic requirements demand frequent starting and stopping with rapid acceleration and deceleration, the tyre wear will be heavy but the same danger of loose tyres will exist.

Under such conditions it may be worthwhile considering the possibility of using a solid wheel in the first place and subsequently turning it down and fitting a tyre as is done on several railways, but it is suggested that this procedure should not be adopted unless a very careful analysis of the economic and other factors involved shows it to be justified. Labour costs will vary widely between different countries and accountancy methods between different railways. It will generally be found that the saving, compared to the purchase of a new solid wheel, is small and at best this practice is only a compromise. If the solid wheel were chosen in the first place because of its inherent advantages these advantages will now be lost and the resulting tyre and disc may not even be as satisfactory as an ordinary built-up wheel.

(c) *Availability of Repair Facilities*

The general availability of repair facilities has some influence on the choice of wheel. Built-up wheels require equipment for removing worn tyres, machining wheel rims, and the fitting and turning of new tyres. Solid wheels only require re-turning; when they come to the end of their useful life, which, except in the case of the A.A.R. one-wear wheel, is very considerably longer than that of a tyre, they have to be pressed off the axle. The wheel seat will probably require skimming up after the wheel has been pressed off, although even this may be avoided in some cases if the oil-injection method, whereby a thin film of oil is created between the wheel seat and the bore of the wheel, is used.

The fact that the wheel never has to be removed from the axle is a definite advantage in favour of the built-up wheel. This particular advantage may be nullified by having a solid wheel which, on reaching the limit of wear,

can be turned down to take a tyre but, as has already been suggested, the economics of the various alternatives should be carefully studied before this design is adopted.

(d) *Saving of weight*

The modern tendency in rolling stock design is to reduce the tare weight as much as possible. This is particularly important in the case of wheels since, in addition to the contribution that they make to the tare weight of the vehicle, account must also be taken of the kinetic energy due to rotation which is built up during the acceleration of the vehicle and dissipated during braking. Furthermore, any reduction of the unsprung weight, of which the wheel constitutes a considerable proportion, has the further advantages of reducing the wear on the track and improving the riding of the vehicle.

In general a solid wheel tends to be lighter than the corresponding built-up wheel and this is, of course, a marked advantage of the one-wear type.

(e) *Cost and Estimated Life*

The two remaining factors, cost and estimated life, may logically be considered jointly. The first cost of a broad-gauge solid wheel is less than that of the corresponding built-up type by about Rs. 135 - per wheel; for metre-gauge wheels the difference is about Rs. 100/-. Under identical conditions of service the solid wheel will have a considerably longer life than a tyre. For two wheels of equal rim thickness, one solid and the other built-up, the difference in total wear is represented by the scrapping thickness of the tyre, which is seldom less than one inch. In the paper which Mr. C. A. Gammon read to the Institution of Locomotive Engineers, in April 1950, on the standardisation and design of goods and mineral wagons as applied to British Railways, he stated that the life of a solid wheel would be about thirty years and, in the course of the subsequent discussion, he indicated that with built-up wheels the tyres would require renewal after approximately fifteen years. These figures are quoted to give an indication of the relative length of life of the two types.

Where tyre wear is heavy and repair costs are low it may prove more economical to re-tyre the wheel so as to get a good life from the centre; but under average service conditions the lower first cost of the solid wheel, combined with normal life and higher scrap value, will give it the advantage.

For overseas railways in particular the question of the total cost of wheels held in stock is an important one; the exact quantities held will, of course, depend on circumstances but the considerably shorter life of the tyre will necessitate holding of larger stocks. These may well exceed in value the smaller stocks of solid wheels that would be held for the same purpose.

CONCLUSION

The trend of modern design definitely favours the solid wheel and the production figures for solid and built-up wheels at the mills of Messrs. Steel, Peech & Tozer provide a convenient yardstick. The figures for the past twenty-five years are tabulated below and clearly demonstrate what a big change-over has occurred. It should be stressed that these figures cover production for all parts of the world.

Year ending June	Percentage Solid Wheels	Percentage Disc Centres
1931	20.0	80.0
1932	16.0	84.0
1933	34.0	66.0

Year ending June	Percentage Solid Wheels	Percentage Disc Centres
1934	61.0	39.0
1935	61.0	39.0
1936	76.0	24.0
1937	77.0	23.0
1938	75.0	25.0
1939	80.0	20.0
1940	79.0	21.0
1941	94.6	5.4
1942	98.0	2.0
1943	96.3	3.7
1944	95.6	4.4
1945	97.2	2.8
1946	94.0	6.0
1947	92.8	7.2
1948	94.2	5.8
1949	92.3	7.7
1950	90.3	9.7
1951	92.6	7.4
1952	95.5	4.5
1953	96.5	3.5
1954	97.3	2.7
1955	97.6	2.4

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The 910 crores of rupees earmarked for the Railways in the Second Five-Year Plan provides for, among other things, a 51 percent increase in goods traffic, a 15 percent increase in passenger traffic and an increase in the production of locomotives at Chittaranjan from 170 at the end of the First Five-Year Plan to 300 in 1960-61.

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MODERN DEVELOPMENT IN RAILWAY ELECTRIFICATION

RECENT years have seen remarkable progress in the field of Railway Electrification and particularly is this so in the application of the high voltage A.C. system at the industrial frequency. Successful pilot schemes in France and England have clearly demonstrated how the earlier limitations of the 50 cycles per second frequency current may be overcome by the use of new materials and ingenuity of electrical design not only be overcome at the locomotive but may yield substantial advantages in the simplification of substation layout and feeder system. The measure of success achieved can be seen in the successful introduction in post-war years of high voltage 50 cycles schemes in Turkey, the Belgian Congo and France and the decisions to proceed with such schemes in France, Great Britain and Portugal.

Parallel with these striking developments, the B.I.C.C. Organisation has undertaken a large scale experimental programme with the object of applying the results of modern research to the improvement of the overhead contact system. In this way it has been possible to study the behaviour of the types of light conductor construction required for high voltage systems so that the equipment, when installed, will give good current collection upto very high speeds while at the same time yielding a saving of nearly two thirds of the copper section normally necessary for a 1500 volt D.C. scheme. The design of the associated fittings has been equally advanced with the object of reducing weight to a minimum, ease of erection and maintenance and freedom from corrosion problems when in service. Not least has been the degree of mechanisation applied to the excavation and concreting for the supporting structures which has revolutionised the technique of structure erection and now permits one mile of single track to be equipped with masts in a line block of four hours. Some of the features of this work are later described in greater detail.

RYE HEY RESEARCH STATION

At an early stage it became apparent that in addition to running trials of the overhead equipment it would be necessary to carry out much experimental work that would require access to the overhead equipment for long periods at any hour of the day. This facility is rarely, if ever, available with equipment erected over railway

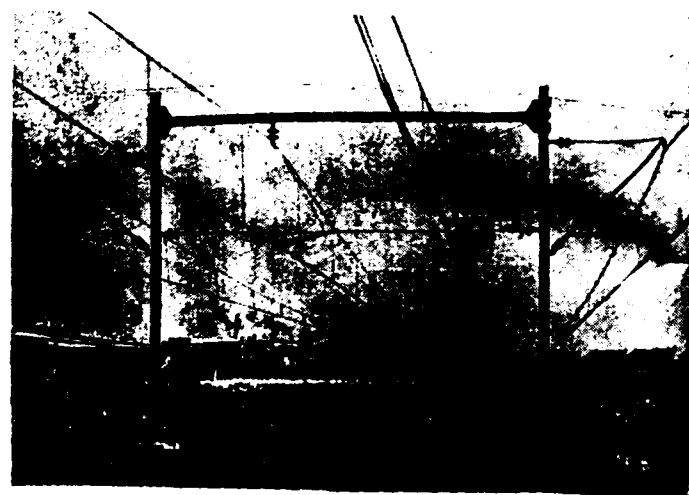


Fig. 1. A general view of the experimental station at Rye Hey.

tracks in normal operation and for this reason it was decided to establish a Research Station on open land at which many different types of contact systems could be installed and studied with complete freedom from restrictions. The general view of the station (Fig. 1) illustrates this point and shows four of the first types of equipment selected for investigation.

One of the main objects has been to study the variations within the overhead equipments caused by changes of weather. A contact system in perfect adjustment for current collection under one set of temperature and wind conditions. These changes are brought about by variations in the tensions, heights, lengths and temperatures of the wires and alterations of the load distribution.

The first of these features is clearly seen in Fig. 2. This equipment was composed of a 7.116" copper catenary wire supporting by means of "suspenders" or "dropper wires" a 0.166 sq. in. cadmium copper contact wire. Both contact and catenary wires were anchored at fixed points and it may be observed how the daily temperature cycle produces small tension fluctuations in the catenary but very substantial fluctuations of contact wire tension. This type of equipment erected under Indian climatic conditions would be suitable only for slow speed running. Even variations in the light loads carried by the dropper wires may have a great effect and Fig. 3 illustrates the miniature hydraulic

HERE'S HOW BICC KEEP AHEAD IN RAILWAY ELECTRIFICATION

Experiments in High-Voltage A.C. Traction

Trials carried out on the Lancaster-Morecambe-Heysham line of British Railways may greatly influence future railway electrification. The overhead system has been converted to 50 cycles single-phase working. For the first time in this country regular services are being operated from a power supply at industrial frequency.

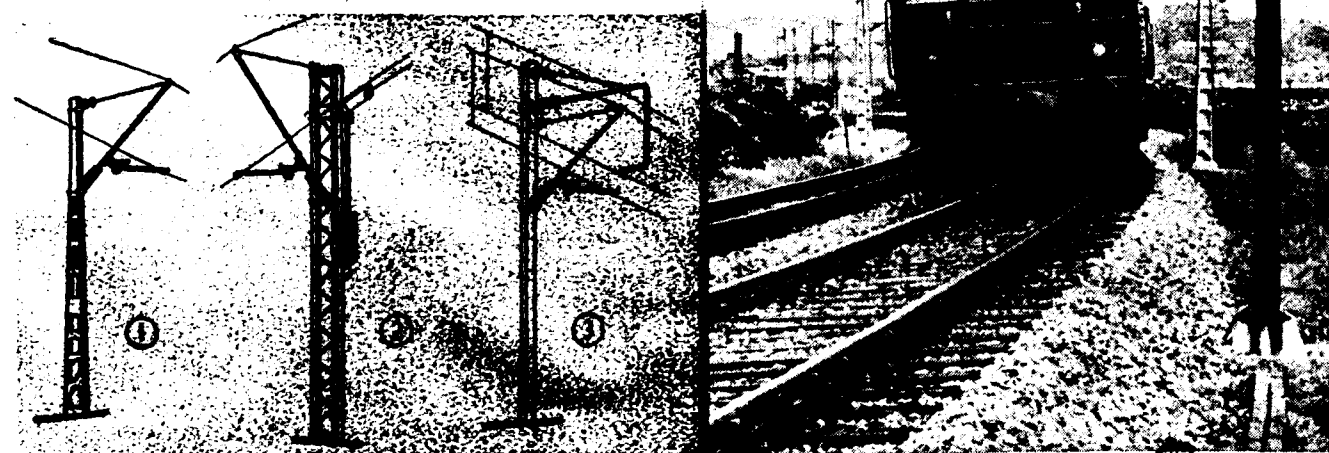
New Overhead Equipment

The early stages of this project included a demonstration of up-to-date overhead equipment. This was designed, supplied and erected by BIC Construction Company, a member of the BICC group. Four thousand feet of the old construction were replaced with light single-track hinged cantilever structures, carried on various types of supports (see below). The equipment is designed for 20,000 volts, although at present operating at 6,600 volts.

By participating in experiments of this nature BICC ensure that their equipment is equal to the changing demands of modern electric traction. The lessons learnt are added to their vast store of experience based on more than 40 years of railway electrification in every continent.

Signalling cables, power feeder cables, cable accessories and rail bonds are also supplied by BICC, who are the World's largest manufacturing, marketing and contracting group concerned with electrical transmission and distribution for power, radio and telecommunications.

For further information, please write for Publication No. 12 "High Voltage A.C. Traction Equipment". Two films on BICC electrification schemes are also available on loan to interested organisations.



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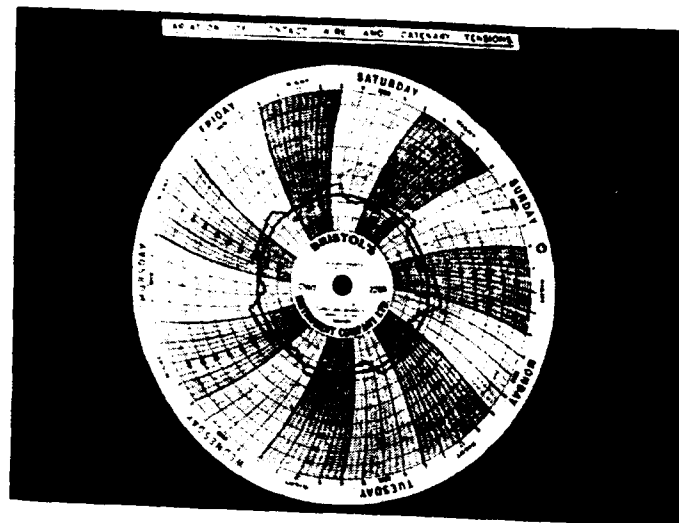


Fig. 2. A chart showing the daily variation of catenary and contact wire tensions.

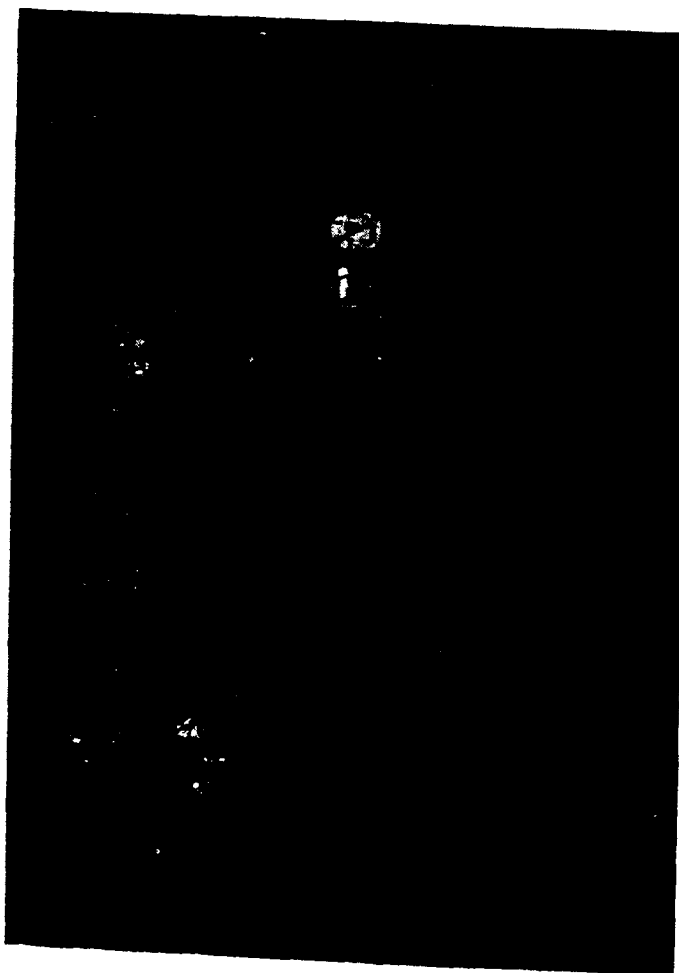


Fig. 3. Miniature dynamometer specially made for measuring the load in the dropper wires which support the contact wire from the catenary.

dynamometer which was specially built to study this problem.

The influence of wind may be judged by a comparison of figures 4 and 5. The former indicates the variations in the height of the contact wire at different positions along its length during a seven day period without wind while in the latter illustration may be seen the severe oscillation caused by gale-force winds on the sixth day of a similar test period.

LANCASTER-MORECAMBE-HEYSHAM ELECTRIFIED LINE

Complementary with the research programme briefly referred to, a section of the Lancaster-Morecambe-Heysham electrified line was with the kind of co-operation of British Railways completely re-equipped with overhead equipment of the most modern design. This electrification is a high voltage A.C. scheme and was converted in 1952 from 25 cycles/sec. to 50 cycles/sec. operation. The opportunity was taken to demonstrate the use of six different type of aluminium, steel concrete and wood supporting structures and many variants of insulators, droppers, clips, switches and other fittings were installed. Electronic records of current collection at high speed were taken to test the methods of suspension adopted and on no occasion was it possible to detect any break in contact between the pantograph and the overhead conductors. This was in marked contrast to the performance on sections of the much older type of equipment previously existing which as the record of three test runs in figure 6 illustrates indicated a serious deterioration in current collection as the speed of the train was increased.

To obtain this high quality of performance the conductors were designed to be automatically tensioned by terminating wires passing over pulleys and supporting balance weights. In this manner any change in length of the conductors is compensated by movement of the balance weights and the tensions remain constant. The arrangement may be seen in figure 7 which shows a self-supporting steel anchor mast alongside one of the old wooden structures which supported the original equipment.

THE WOODHEAD TUNNEL TRIALS

The electrical security of an overhead line is as vitally important to the success of a scheme as its mechanical performance and this is particularly so at high voltages of the order of 25 kV. Many types of insulator varying greatly in cost and electrical strength may be employed

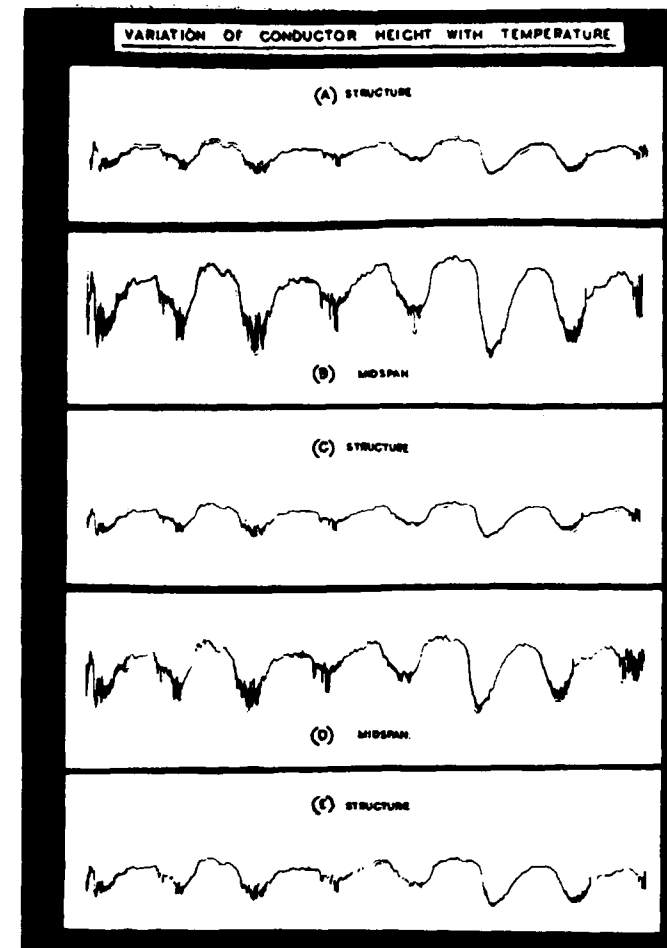


Fig. 4. Records taken from five height recording instruments placed on various points along the line and presenting a complete picture of the movement of the contact wire caused by variation of temperature.

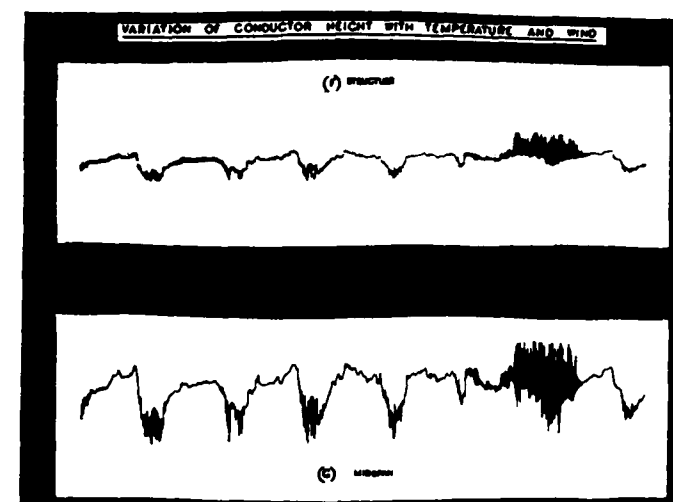


Fig. 5. Two similar records showing the effect of variations in wind pressure as well as variations in temperature.

in both clean and polluted atmospheres. Where steam operation is likely to be encountered after electrification a higher level of insulation must be used than would be required on lines without steam traffic. A commonly accepted direction for the latter is to provide a length of leakage path across the insulator surface of 1 inch per kV. of the voltage which would exist between phases on an equivalent 3-phase system i. e. for a 25 kV. single phase A.C. system the creepage path required would be $25 \times \sqrt{3} = 44$ inches. The insulator must therefore be designed to maintain a high level of insulation even when wet and dirty, to be easy to clean and to require only occasional cleaning, while also possessing the adequate strength to carry the mechanical loads imposed by the part played by the insulator in supporting the conductors.

With these thoughts in mind, 32 insulators of different types were installed above the running track in the Woodhead Tunnel on the Manchester-Sheffield line. This tunnel is some three miles in length on a steep gradient and before electrification carried a heavy mineral traffic. Due to its age and poor ventilation the atmosphere was often very bad and it therefore seemed an ideal location to carry out a study of insulator performance under adverse conditions. The Insulators which were flashover and resistance tested at regular intervals included types protected by cowls and others with oil-bath protection. This series of tests extending over many months yielded much useful information that is now being used when considering designs for future work.

MECHANISATION OF INSTALLATION

The speed with which the overhead equipment contractor is able to install the equipment on any scheme is very largely dependent on the duration of the track occupation which is granted to him. Naturally such blocks cause inconvenience and necessitate modifications to train time-tables. Since lines scheduled for conversion to electric operation are however usually amongst the most heavily loaded it is essential that any line blocks should be kept to a minimum to avoid serious traffic delays. These requirements are unfortunately mutually opposing and the compromise reached may well influence the cost of a new installation.

To meet this situation British Insulated Callender's Construction Company Ltd., in co-operation with Wharton Engineers Ltd., devised and manufactured mechanical equipment which enables the structure foundations to be dug, side masts erected and concrete

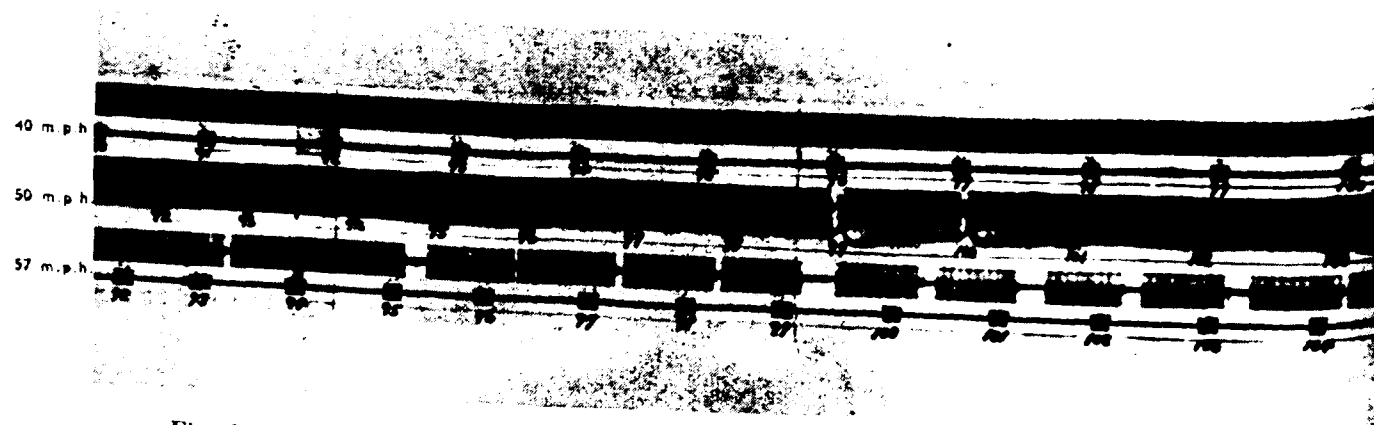


Fig. 6. Part of the electronic records of contact between the collector and the contact wire on the Lancaster-Morecambe-Heysham Railway. Each break in the trace indicates a loss of contact between pantograph & the overhead conductor.

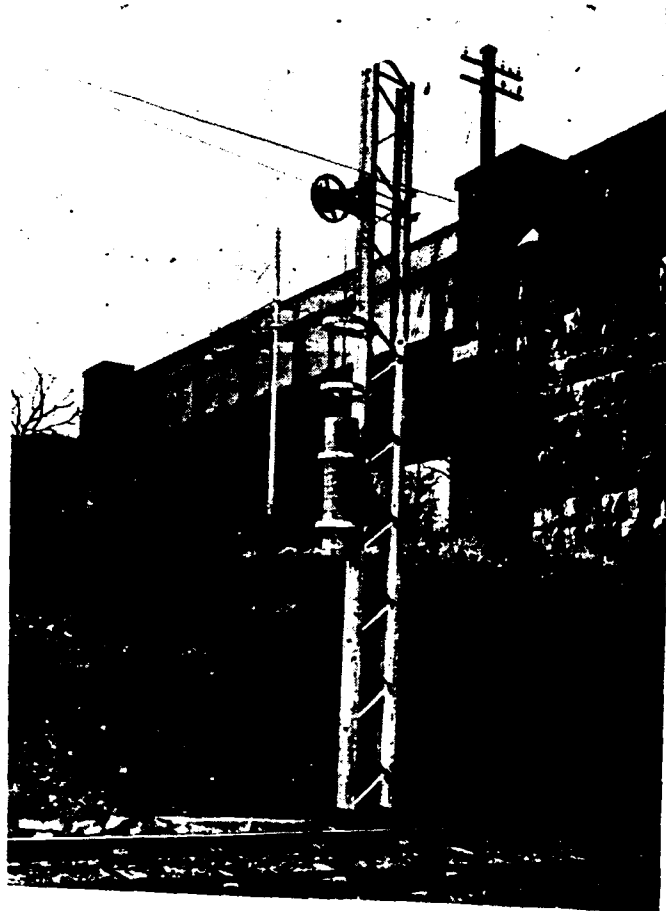


Fig. 7. Self-supporting steel anchor mast carrying balance weight termination of new equipment.

poured at the rate of ten minutes per mast for all these operations. This rate of installation much reduces the total time previously required for this section of the work, utilising hand excavation.

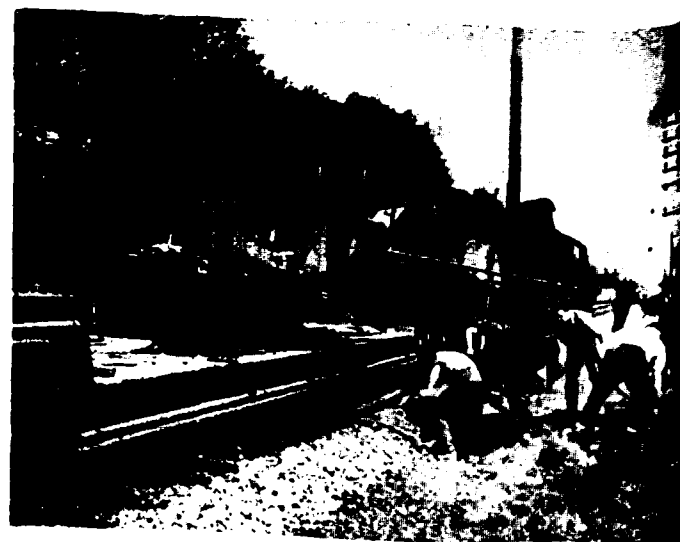


Fig. 8. In this picture the auger is operating at normal boring distance from the rails. The spoil is removed by lifting the auger periodically from the hole and is then flung out by centrifugal force. Distribution of this spoil is carried out by hand.

Each hole is bored by a rail mounted auger. This is followed by a steel erection unit which erects the mast supported by a temporary ground frame in the hole. Following in sequence the concreting unit places the concrete, which has been mixed on the train, into the foundation. As each operation is completed the three units move in turn to the next location. In this way, rapid progress is made and as the operations proceed simultaneously only one track occupation period is required for the three units. There is no waste of concreting materials and foundations need no longer be as large as were previously required to permit manual excavation.

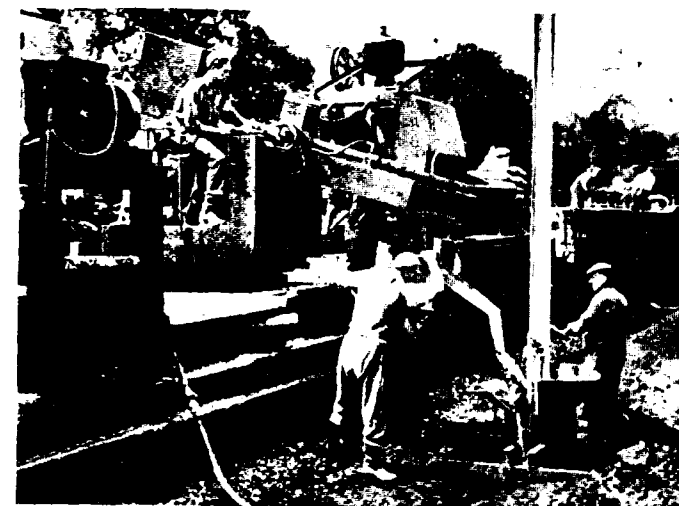


Fig. 9. Concrete placer unit in operation. The bogie wagon also carries the two rotary concrete mixers.

The earth borer (fig. 8) can excavate foundations down to 12 ft. depth with a variation in bore diameter of from 2 ft. to 3 ft. 6 inches. With a maximum reach from the centre line of track of 13 ft. 6 inches lineside obstacles such as drains or cables may be safely cleared. The concreting unit (fig. 9.) incorporates two electrically driven mixers, an electro-hydraulic placer unit with a telescopic jib and a diesel-electric power generating unit. The continuous supply of concrete from the mixers

prevents any hold-up occurring and the placer unit is so designed as to be able to convey the concrete directly to the foundation holes without excessive train shunting.

The application of such a high degree of mechanisation to foundation installation results in big savings of time and materials and has been used with distinct success.

LOOKING TO THE FUTURE

At the present time world-emphasis is naturally centred on the great progress made with high voltage 50 c. p. s. A.C. traction because the savings possible on the fixed installations with this system may reduce the capital costs of an electrification scheme and may also justify the extension of electrification to more lightly loaded lines. The background to this progress lies in the long programmes of trial and development and the resourcefulness of engineers skilled in this field which alone makes such steps possible.

Mention has been made of a number of the more notable advances made by B. I. C. C. in the field of railway electrification. But the work does not end there. Development is a continuous process in which advantage is taken of new scientific processes and improved techniques in the factory and in the field to produce a high performance, trouble free overhead contact-wire network.

CENTRAL RAILWAY LAUNCHES DRIVE AGAINST MEN TRAVELLING IN LADIES' COMPARTMENTS

THERE has been an increasing tendency for men to travel in compartments reserved for ladies in the Bombay suburban area. It is an offence under Section 119 of the Indian Railways Act, for men to travel in compartments reserved exclusively for ladies and under Section 131 of the same Act, a person committing an offence under Section 119 is liable to be arrested even without a warrant. The apprehension of such offenders is being done both by the Police and by the Railway and their prosecution are launched under these provisions of the Law by the Police.

The average of such prosecutions done of persons apprehended by the Central Railway in 1955, in the Bombay suburban area was 13 a month. A drive against men travelling in ladies' compartments has recently been launched and as a result of this drive, 88 persons were prosecuted in April 1956. A further intensification of

this Railway's drive has been made with a view to check this evil. In the last three days of May 1956, no less than 107 persons were apprehended by the ticket-checking and security staff of the Central Railway for travelling in ladies' compartments over the suburban section in the Greater Bombay area. They were handed over to the Railway Police by whom they were prosecuted. Convictions were secured in all cases and the sentences ranged from warnings to fines extending upto Rs. 10/- or simple imprisonment ranging from 1 to 5 days.

These figures do not take into account numerous prosecutions launched by the Police on their own initiative. This being a cognizable offence, no complaint is required by the Police from the Railway for the apprehension and prosecution of offenders under this Section of the Railways Act.

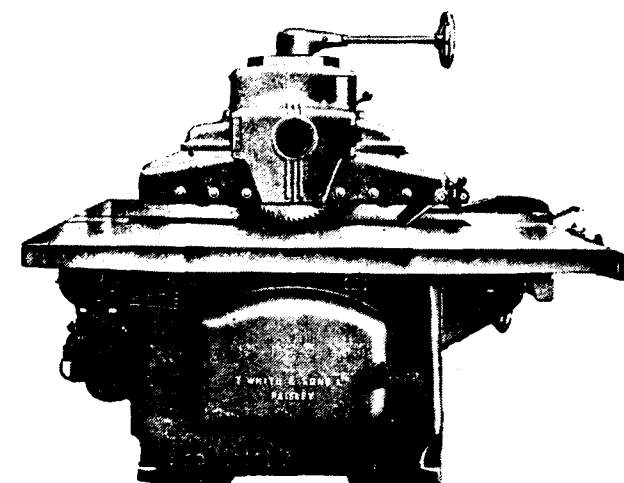
RECENT DEVELOPMENTS IN THE DESIGN OF WOODWORKING MACHINERY

ALTHOUGH it is true to say that within the last ten or fifteen years there has been an increasing tendency to use metals and plastics for articles formerly made from wood, there is no danger of wood either in its natural form or in processed form, being completely replaced by these substitutes. Timber is readily available in most countries, is easily extracted, easily machined, has fairly good mechanical properties and has a natural beauty which defies imitation.

The economic manufacture of wood products calls for a high degree of mechanisation and today all cutting and abrading operations on wood can be carried out entirely by machinery, man only being required to control the machines and to feed them.

The basic cutting principles of Woodworking Machines have been established for many years. These basic cutting operations consist of sawing by means of Circular Saws, Bandsaws or Reciprocating Saws, planing or dressing the faces of the cut timber by means of rotating square or circular Cutterblocks carrying Planing Knives, mortising with chisels or cutter chains and surface finishing by means of abrasive coated paper or cloth applied to the timber either in the form of flat belts or rotating drums.

The main developments in recent years are in the application of these basic cutting principles. The designer's aim has been to combine quality of work produced from the machine with maximum output. To achieve this end he has had to take advantage of the latest developments in pneumatics and hydraulics. Oil hydraulics provide a simple means of obtaining infinitely variable speeds over a wide range applied either to reciprocating or rotary motions. For example, on the latest "White" Vertical and Horizontal Band Mills the forward and return motions of the Log Carriages are controlled by Vickers-Armstrong hydraulic variable speed gear units. This unit enables the sawyer to select quickly any desired feed speed on the forward stroke up to 80 ft. per minute and on the return stroke up to 200 ft. per minute. An example of the application of hydraulics to a rotary motion is to be found on the "White" Trufeed Straight Line Edger, Type SJB, (see illustration). In this case a Carter type Self-Contained Hydraulic Pump and Motor is used for driving the feed chain that carries the work through the machine. When a conventional type of



'Trufeed' Straight Line Edger Type SJB.

gear box is used with a Straight Line Edger the operator can only choose one of four or possibly six feeding speeds over the entire range. It is more than likely that the speed he selects will either be too fast to enable him to feed the wood through the machine end to end, or alternatively, too slow to ensure maximum output. With the Trufeed Edger, however, the operator can select the most suitable feed speed for each particular job and what is more, the actual feeding speed is clearly indicated on a Tachometer located at the operator's working position.

Pneumatics are now being used extensively for quick clamping of components as well as for the reciprocating motions on Crosscut Saws. Hydraulics are, of course, also used for Cramping Machines and for Straight Line Crosscut Saws, but where compressed air is normally available in a factory it will usually be found to be initially less expensive to employ pneumatics for these purposes rather than hydraulics.

The electrical manufacturers are also playing their part in the development of Woodworking Machinery. Many types of Woodworking Machines now have the motors built directly on to the Cutter Spindles. On single and double end Tenoning Machines where the Cutter Spindles have to be tilted to different cutting angles any drive other than direct is most cumbersome. Even where the Cutter Spindle does not have to be tilted, it has been found advantageous to use built in motors. The latest "White" 12" x 5" fully motorised



Photograph by courtesy of the Works Manager, Western Railway, Ajmer.

THE WHITE BDA TRIPLE DRUM SANDER

The Drum Sander is the final sizing or finishing machine in the production line. As any imperfections in the machine will impair the quality of the finished article, more care must be taken in selecting a Drum Sander than almost any other woodworking machine.

Over 1,000 White Drum Sanders have been supplied to customers at home and abroad, and this experience lies behind the design and manufacture of the latest Triple Drum Model B.D.A.

The sturdy construction, the dynamically balanced drums, the synchronised drum oscillations, the floating conveyor unit, the method of mounting the abrasive, the beltless drive are only a few of the features fully described in the illustrated leaflet which will be gladly sent on request.

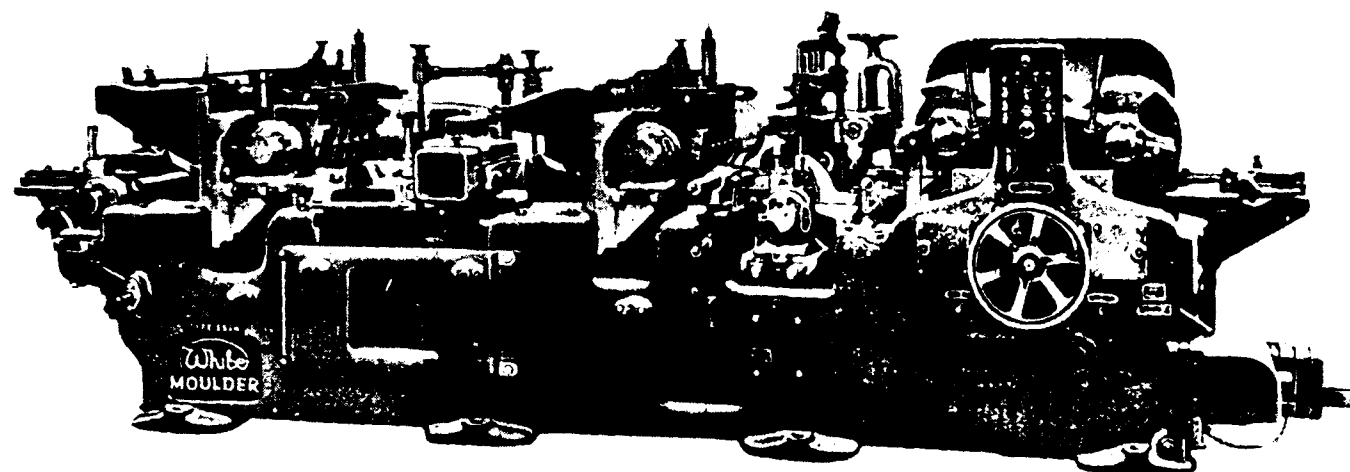
Our range of Drum Sanders includes a 2-drum model 36" wide, 3-drum models 42", 51" and 60" wide and an 8-drum model 51" wide.

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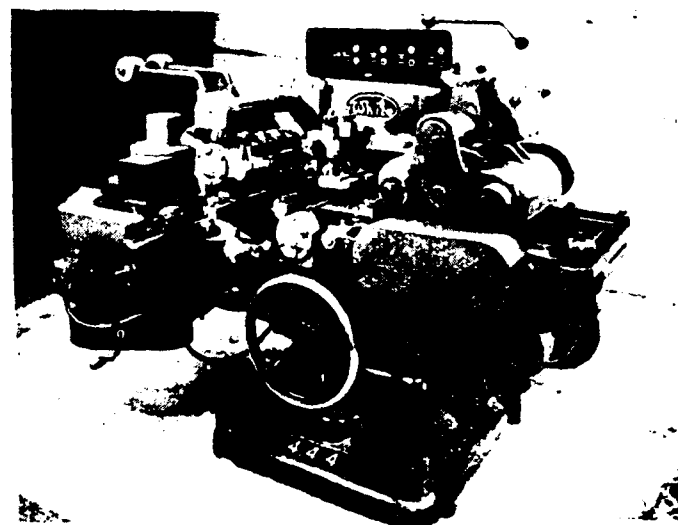
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12"×5" Fully Motorised Planing and Moulding Machine Type 555M.

Planing and Moulding Machine, Type 555M is illustrated. On this machine all the Cutterhead Motors are built-in, a separate Motor being used for driving the feed gear and another Motor for quick raising of the Feed Rolls in case of emergency. Built-in two pole Motors rotate at a synchronous speed of 3,000 r.p.m. on a 50 cycle electrical supply and as this speed of rotation is too slow to guarantee good quality finish on the planed timber at high feed speeds, it is necessary to raise the cutter spindle speeds by using a Frequency Changer. Stepping up the frequency from 50 cycles per second to 75 cycles per second gives a Cutter speed of approximately 4500 r.p.m., which is adequate for most purposes. Although a Frequency Changer is a fairly expensive item of equipment, this cost spread over 20 years is negligible compared with the initial cost of laying down a countershaft or long belt drives and the annual replacement cost of the belts themselves.

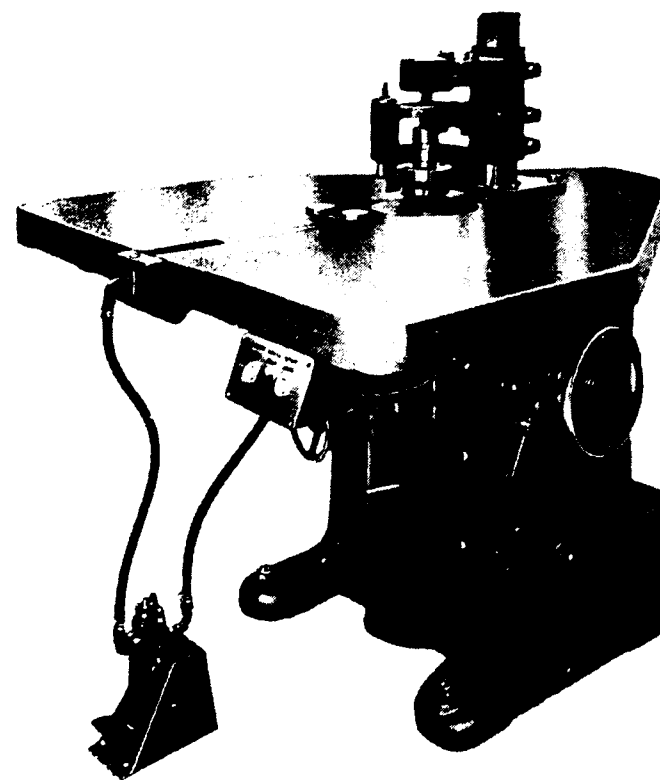


12"×4" Planing and Moulding Machine Type 444.

The other popular method of drive is by means of individual motors mounted on the machine and driving the Cutter Spindles by means of short flat nylon plastic belts. An example of this type of machine is to be found in the 'White' 12"×4" model "444" Planing and Moulding Machine (see illustration). This machine has certain novel features. On the conventional type of Planing and Moulding Machine the Table, over which the work passes, is immovable and the Cutterheads are adjusted relative to this fixed Table. On the model "444", however, the Top Feed Rollers, the Top Cutterhead and Top Pressure are all fixed and the Table which carries with it the Bottom Feed Rolls, the Bottom Cutterhead and the two Vertical Heads is adjustable up and down. All the Cutter Spindles are driven by high speed endless belts from motors forming an integral part of the machine. A Multiple Plate Clutch in the

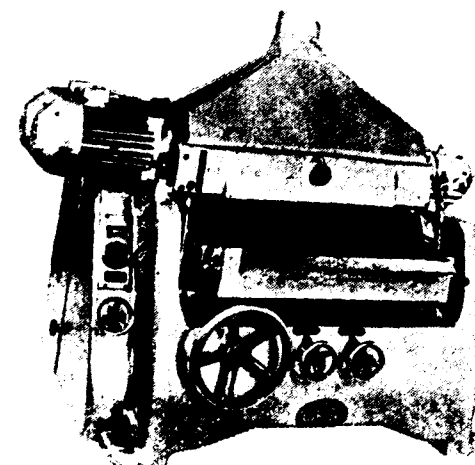
feed drive ensures smooth starting and instant stopping of the feed. The feed speeds are infinitely variable between 30 and 80 feet per minute and the actual feed speed is indicated on a Tachometer. In this case the variable feed speeds are obtained by means of Hainsworth type expanding pulley belt drive. With this type of drive the speed range is normally restricted to a maximum of 3 to 1.

An interesting development in shaping is to be found in the "White" Automatic Spindle Shaper, Type M. P. As will be seen from the illustration this is basically the same as a conventional Spindle Moulder. Mounted concentrically with the Cutter Spindle, but independently driven is a sprocket and Guide Collar. The component, to be machined on the edge, which may be a Table Top, a Chair Seat, a Window Frame, a Kitchen

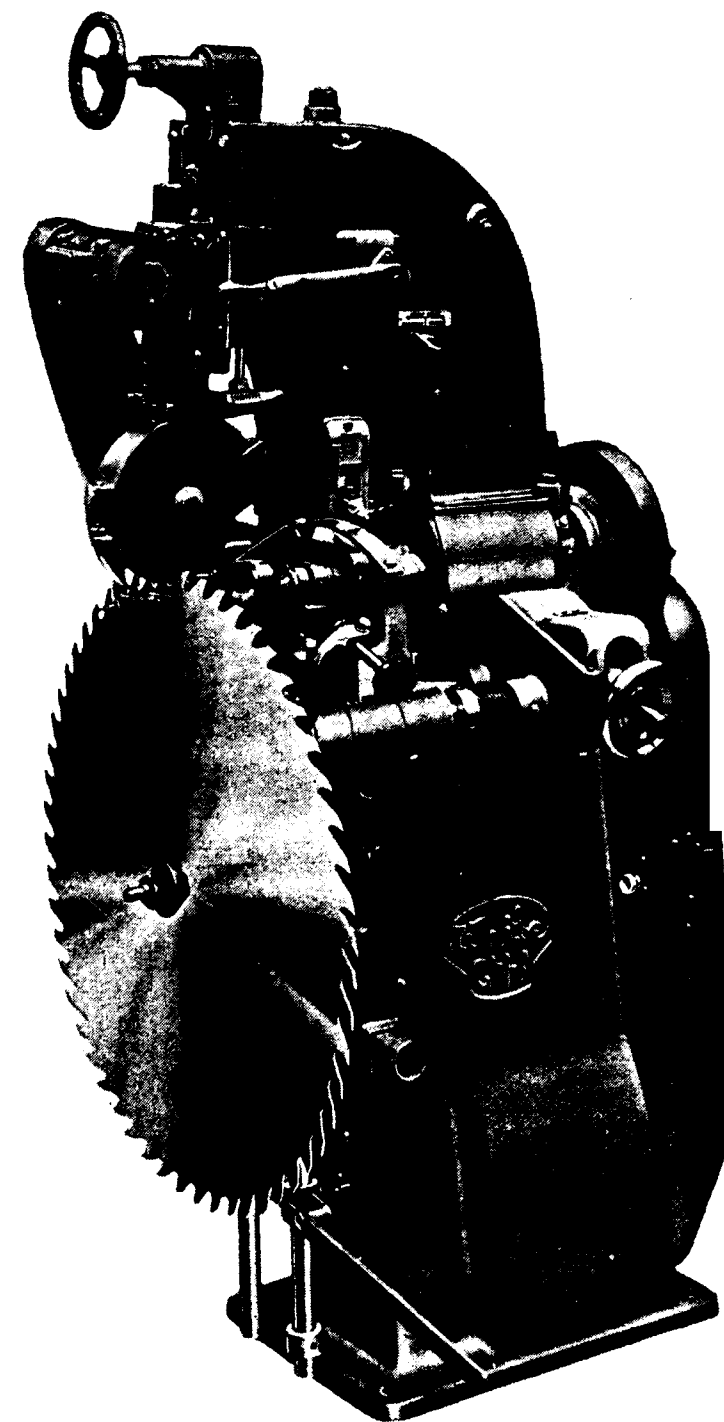


Automatic Spindle Shaper Type MP.

Cabinet Door or similar shaped component, is placed on a Jig around the outside of which is fixed a chain. A pneumatic Ram holds the template of the Jig in contact with the Guide Collar and at the same time brings the chain into mesh with the sprocket. As the sprocket rotates it causes the Jig carrying the component to be moved past the rotating Cutters, thus automatically shaping the edge of the component without any effort on the part of the operator. Maximum output is achieved by using two of these Automatic Spindle Shapers



Double Drum Sander Type BDB.



Automatic Saw Sharpener, Type GWA.

controlled by one operator, the operator loading one machine while the other is cutting.

Drum Sanding is still the fastest and most satisfactory method of finishing wood components. The output from a Drum Sander is very much greater than from a Belt Sander, because of the continuous feeding

arrangement. An illustration of the new "White" Double Drum Sander, Type BDB is shown. The abrasive coated paper is wound onto the drums in the form of a spiral and is kept taught by a special tensioning device. Each drum is driven by its own built-in motor and the drums oscillate axially while rotating.

The conveyor bed is mounted on knife edges and the platens against which the work is held are specially ground to ensure extreme accuracy. The feeding speeds are infinitely variable between 14 and 35 ft. per minute, the actual feed speeds again being clearly indicated on a prominently placed Tachometer. The Exhaust Hood is hinged to enable it to be swung clear when access is required for changing the abrasive paper.

Apart from the Production Shops the designers have also given attention to the Toolroom and Machines are now available for sharpening all types of Saws and Cutters automatically. For example the "White" Automatic Saw Sharpener, Type G. W. A. illustrated will sharpen Circular Saws up to 60" dia., Bandsaws up to

10" width and, of course, will also sharpen Frame Saws. By adjusting cams built into the machine any normal tooth shape can be reproduced. The sharpening is done by means of a Grinding Wheel and the Head carrying the Wheel moves up and down on machined slides and also swivels to the left and to the right to give the correct alternate bevels on the Saw Teeth. This type of machine guarantees the proper spacing and shape of the teeth which is so important for accurate and efficient cutting.

In this article it has only been possible to touch lightly on some of the more important recent developments in the design of Woodworking Machinery. There have, however, been many other developments which, although not spectacular in themselves, have nevertheless represented another step forward on the road to progress. It is difficult to forecast future developments, but as we are on the threshold of the age of Atomic Energy and Automation, it is only to be expected that the next decade will produce some revolutionary changes in the Woodworking Industry.

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RECENT DEVELOPMENT OF GANZ RAILWAY DIESEL ENGINES

BACKWARD GLANCE TO THE LAST DECADES

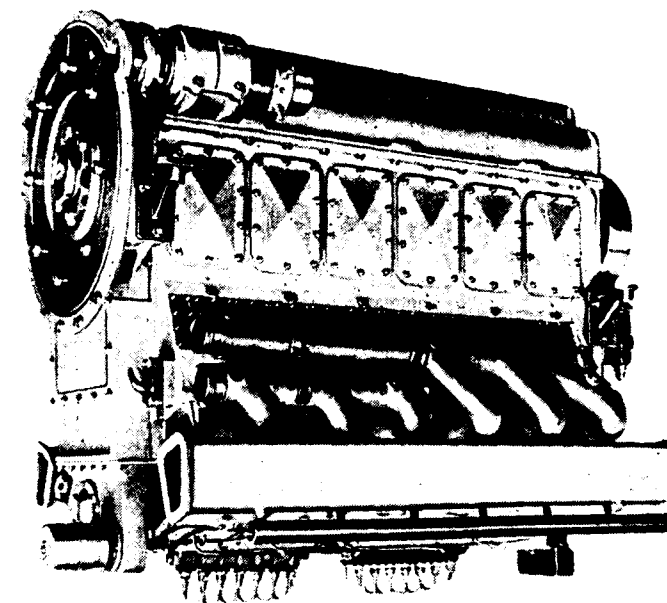
IN the twenties of present century a considerable impetus has been given to the Hungarian diesel engine construction by developing at the Ganz Wagon & Machine Works, Budapest an original type of diesel engines. Around 1925 have been started the first experiments with solid-injection diesels. The trials led by Mr. G. Jendrassik a mechanical engineer of the Ganz Co., have soon led to success. Up to 1929 about 100 diesel engines have been built and many of them have been incorporated into railway vehicles. After 1929 the existing models have been substantially redesigned and a number of new types has been developed. In the following years engines of 135, 240, and 320 b. h. p. respectively have been constructed, chiefly for railcar operation. All the models have been modernised at 1939 and the new types / rated one at 450 b. h. p. and the other at 600 b. h. p. / were added. During the last war, in the years 1944-45, the Ganz factory could not be saved from war devastations, most of the shops and other buildings were left in ruins. After the war first and most important was to rebuild the factory.

From the second world war to the last year generally speaking the prewar types have been built by Ganz, while of course minor improvement have been constantly applied but they were not of a nature touching the general design of the diesel engines. Most important was the introduction of pressure charging. Trials to this effect have been conducted before the world war but without coming to a definite close.

MAIN FEATURES OF GANZ DIESEL ENGINES

The wide popularity of Ganz diesel engines may be attributed to a number of excellent properties. Characteristical features of Ganz engines are:

Fuel injection system, which is perhaps the most important individual feature of these diesels. The working principles underlying to its design are as follows: fuel injection is effected during the whole stroke of the injection pump plunger. The stroke may be regulated from zero to a maximum length and simultaneously the dosing of fuel is undergoing a corresponding. The injection plunger is during the fuel-admission-stroke, pulled back by a cam and



simultaneously a strong helical spring located under the plunger is compressed. At the start of injection retaining effect of the cam is terminated and injection starts in a sudden shocklike manner under action of above mentioned compressed helical spring. After injection is finished, at the end of the stroke of the plunger, motion of the plunger is stopped by the insert between spring and plunger being caught by hitting the fuel pump casing. Thus the stroke is terminated in a very positive and sharply accentuated manner. The method of fuel injection possesses a few very important advantages, namely:

1. Injection is started by the impact of a compressed spring. The pressure above the injection plunger is dependent only and alone on the elastic force of the helical spring. Consequently there is no need for a closed atomizer, for a spring-loaded needle-valve as uniformity of the injection pressure is ascertained by the elastic force of the helical spring, from the beginning of the injection stroke to its end.
2. Perfect atomizing is made sure independently from engine speed. In this way good atomizing is assured even at a very low speed, namely when starting the engine. This fact is leading to very easy starting of the Ganz engine.

3. The Ganz fuel injection pump has the advantage of allowing an extremely simple design of the atomizer. The atomizer is simply a conical blow-pipe. For preventing combustion-gas entering into the atomizer, a check valve provided with a soft spring is applied. Atomizers of this simple design are very long lived.
4. The movement of fluid oil under high-pressure is not controlled by the injection plunger or its admission and delivery valves, with other words: there are no control edges which could be worn out by erosion caused by movement of fuel oil containing impurities. Maximum stroke of the injection plunger is comparatively very small, in smaller engines it is about one mm., in the biggest diesels not more than four mm. Consequently the life of an injection plunger is very long, even after repeated general repairs, there is no need for exchange of the plunger.
5. Maximum stroke of a Ganz-type fuel injection plunger may be adjusted with a micrometer gauge and in this way the quantity of the injected fuel is precisely determined. The spring-force required can be adjusted by using a spring scale or a pressure gauge and no other measuring instruments are for this purpose required.

The stroke of the injection plunger may be varied by shifting the centre of rotation of the lever which serves for compressing the helical spring. When shifting the rotational centre of the lever, the stroke of the injection plunger will change accordingly. The moving wedge is shifted by the elastically coupled draw-bar in unloaded state of the wedges i. e. after the injection has been finished and compressing the helical spring has not yet started. Thus the power required for regulation is small and the wedges may be shifted easily, either manually or from the governor.

COMBUSTION SPACE

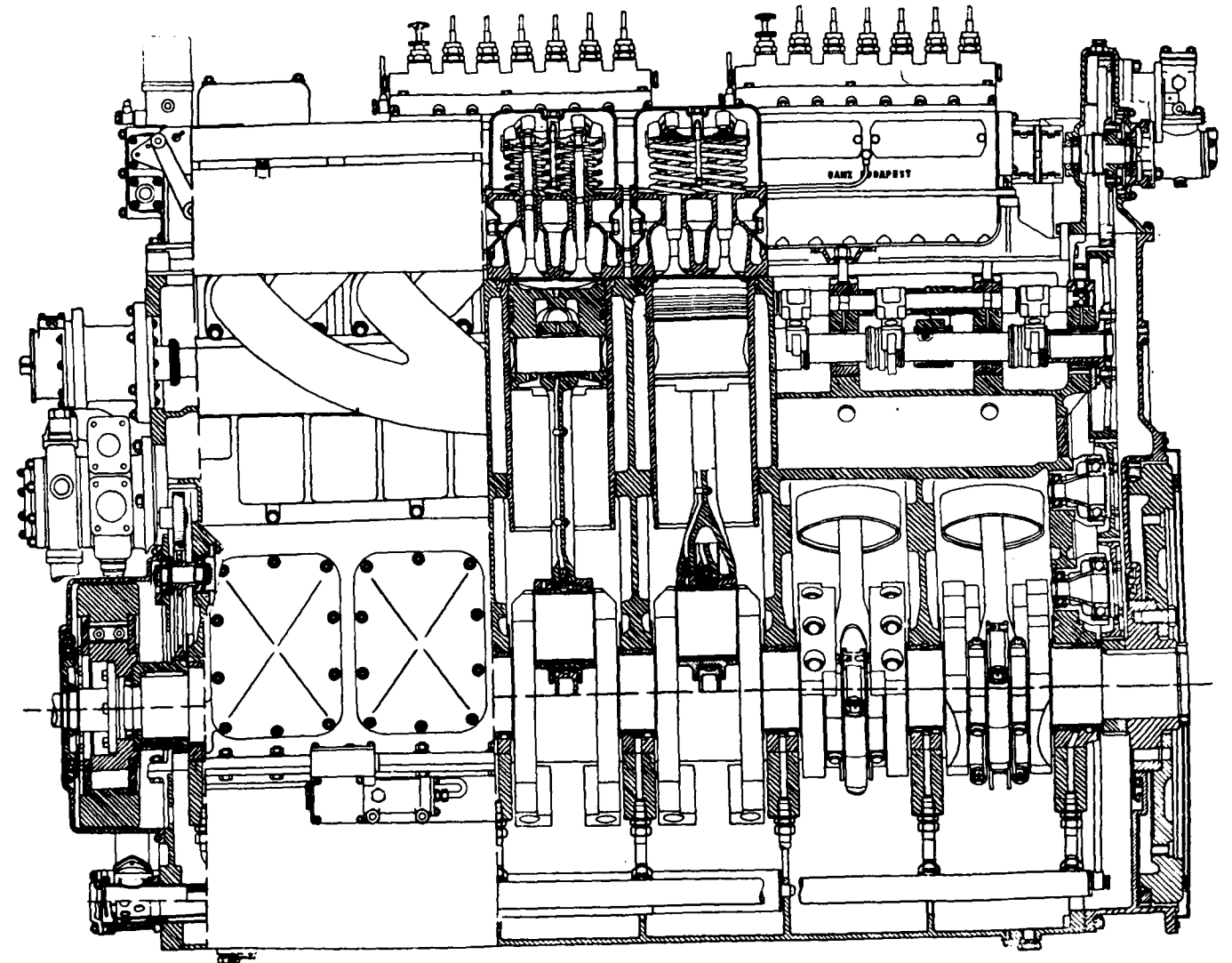
The Ganz engines are fitted with an antischamber of cylindrical shape with comparatively big openings. The fuel oil jet injected through the one-bore atomizer passes along the axis of the cylindrical antischamber and in atomized state rapidly evaporates and ignition is started. The fuel-jet, after such preparation, leaves the antischamber through the large-diameter openings in the bottom of the anti-

chamber and it gets mixed with the compressed air in the cylinder space. It may be seen from above said that the antischamber is a transition between precombustion-chamber and direct injection.

Characteristical for the combustion space of Ganz engines is that, aided by a suitable injection-system, good efficiency and easy starting are attained in spite of the comparatively low compression rate of 1 : 13.

STARTING

An individual feature of Ganz diesel engines is the fact that they can be easily started even in severe cold. Principle of the starting system is as follows: The design of the camshaft controlling the movement of the valves is such that it can be axially shifted until in its starting position the motion of the air inlet valve is controlled by another cam. This starting air inlet cam is designed to open the air inlet valve towards the end of the inlet stroke. Until the inlet opens a certain degree of vacuum is generated in cylinder. After the air inlet valve being opened,



the air streaming with high velocity into the cylinder will raise the temperature of the cylinder as the kinetic energy of the air will be transformed into heat. At the end of the air-inlet stroke the temperature of the air admitted into the cylinder will be consequently considerably higher than it was before entering the inlet pipe. As we mentioned before, the engine is a typically easily starting diesel but, with the starting device described above starts at an ambient temperature of 20°C below freezing point, can be performed with ease.

MODERNIZATION OF GANZ DIESEL ENGINES

What were the reasons for modernization?

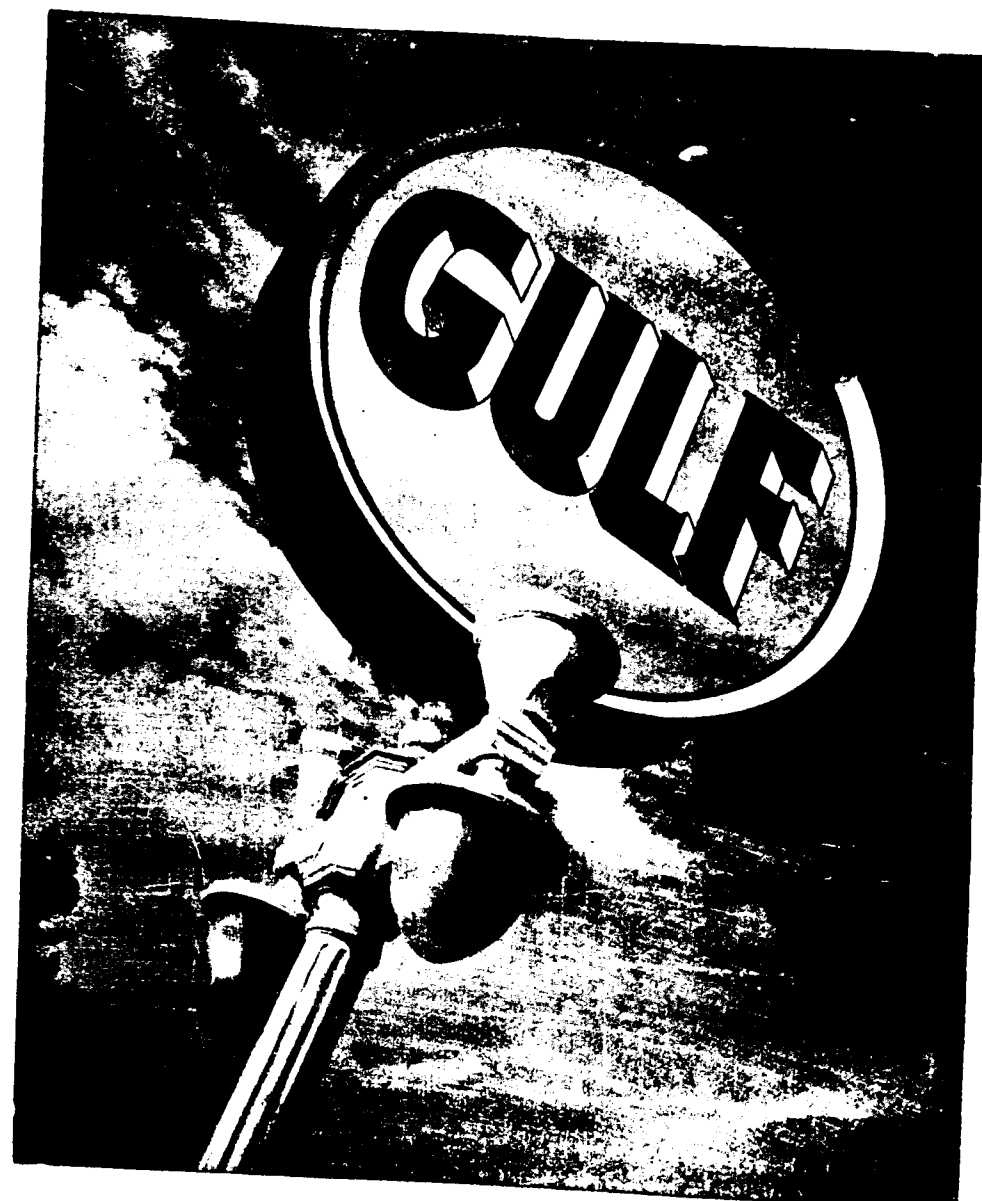
In 1953 management of the Ganz Wagon and Machine Works decided to redesign and standardize the different types of diesel engines. The reasons for this decision have been manifold. Further improvements on the existing types would be difficult. The general layout of the old types does not admit substantial weight

reduction. There are also great difficulties in the way of increasing the output of the old models. In course of long years of operation it turned out that assembly work and maintenance of the engines should be made simpler. The number of common component parts of engines with the same bore and stroke but of different number of cylinders should be as high as possible and in any case higher than up to now.

The engine designing office came to the conclusion that all above requirements can be satisfied if the Ganz engines are going to be entirely newly designed. It is self-evident that the well-proved fuel injection-system, combustion-space layout and starting device will be retained in basically unchanged but in some details modernized form.

THE NEW TYPES

The new types should cover a range of from 7 b. h. p. to 2000 b. h. p. rating including diesel engines, for



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railway traction, stationary and ships, engines. The new types of railway diesels are as follows:

27 cm. cylinder bore engines executed at six or twelve-cylinder units with ratings of 1000 and 2000 b. h. p. respectively at 850 r. p. m. Both engines are pressure charged.

17 cm. cylinder bore—engines. The 6-cylinder model is rated at 250 b. h. p. at 1250 r. p. m., naturally aspirated, while pressure charged the rating increases to 400 b. h. p. The twelve-cylinder model of the same group is rated at 500 b. h. p. when n. a. or at 800 b. h. p. when p. ch.

Of the 13.5 cm. bore engines the six-cylinder type is a one-bank horizontal engine, with a rating of 150 b. h. p. at 1650 r. p. m. When naturally aspirated or 200 b. h. p. if pressure charged. The twelve-cylinder two-bank horizontally arranged engine is rated at 300 b. h. p. at its n. a. version and at 400 b. h. p. at the p. ch. execution. This group is intended for railcars, but a six-cylinder engine with one bank of vertically arranged

cylinders is provided too for smaller locomotives and railcars.

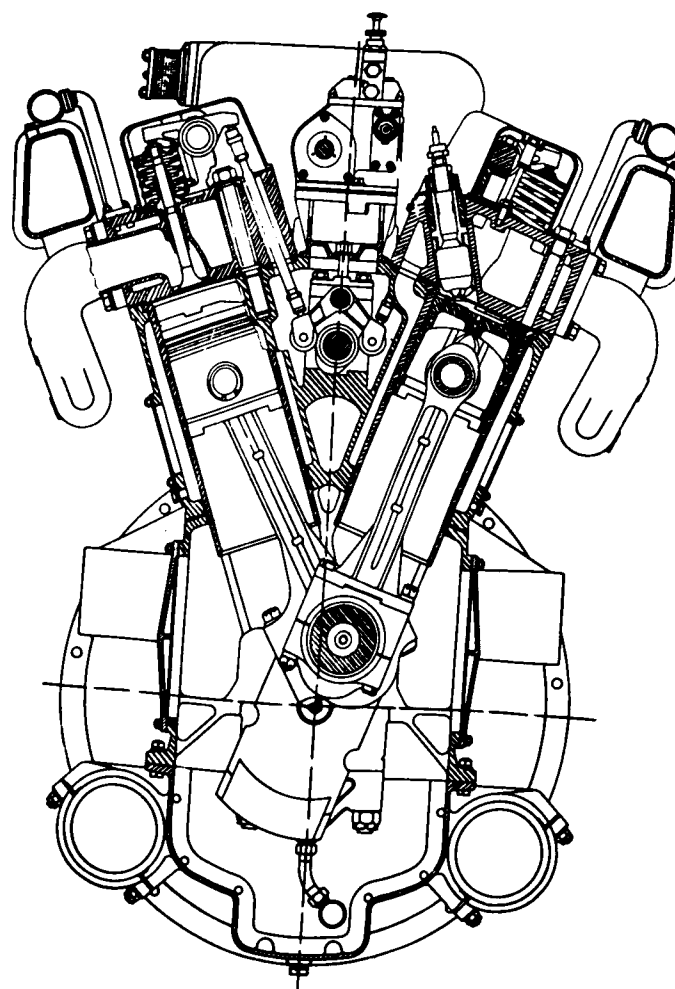
FEATURES OF THE NEW TYPES

Although the outputs of the new type engines as enumerated above vary between wide limits, their design is based on a uniform base.

A common feature of all models is that the cylinder banks are one-piece castings with exchangeable cylinder liners which are of the wet liner type being in contact with the cooling water. Each cylinder is provided with its own individual cylinder head. The antischambers are designed with inclined centre-line and they can be dismantled while the cylinder head is left in its place. Each cylinder head contains one air inlet and one exhaust valve. With the one-bank engines the camshaft is located on the lower part of the cylinder block. The two banks of the V-engines are provided with one common shaft mounted between the two-cylinder blocks and actuating the valves of both banks; this common camshaft is in the longitudinal centre-plane of the engine. As we mentioned above, the camshaft can be axially shifted and three positions of same exist: working-starting and decompression-position. The camshaft is longitudinally shifted by a manually actuated device; the handlever can be dismantled if the lever is in a working position. The valve-actuating push rods may be fitted with a valve-clearance equalizing device.

In the 17 cm. and 27 cm.-bore engines the connecting rods with the pistons can be dismantled through windows located in the side walls of the crank-case. The connecting rods of the V-engines are of the fork-and blade-type. In course of dismantling the connecting rods and the pistons through the openings in the crankcase wall no part of the engine needs to be dismantling the lids of the windows. Thus bearing bushes and piston rings may be inspected and exchanged without major mounting work being necessary. Pistons and connecting rods of the 13.5 cm. bore engines can be extracted and removed identically.

The crankshafts of the one-bank vertical engines with 17 cm. cylinder bore and of all types of the 27 cm. bore diesels are supported in bearings located in the crankcase. Division of the crankcase is in the bottom-plane of the cylinder-block; the crank case is of U-section. This layout is resulting in a very rigid and yet light construction. The cylinder block and crankcase are connected with long bolts and this construction allows the force being transmitted on the shortest possible way



from the main bearings of the crankshaft to the cylinder heads. A similar layout was adopted for the vertical-cylinder bank model of the 13.5 cm. bore engines.

An interesting feature of the group with 13.5 cm. cylinder-bore is that the 12-cylinder model with two banks of horizontal cylinders is derived from the 6-cylinder horizontal engine by mounting to its crank-case the cylinder block of the vertical 6-cylinder model.

AUXILIARY EQUIPMENT TO THE NEW TYPES

Cooling water pump, lubricating oil pump and the camshaft shifting device are located on the front end of the engines. Fuel injection pump and governor are mounted on one side of the vertical one-bank engines, while the same machines are put between the shanks of the V-engines, in the symmetry plane. Each of the auxiliary machines can be dismantled without touching other parts of the engine.

FUEL INJECTION PUMP

As we mentioned above, the system Ganz-Jendrassik fuel injection pump has proved to be a very successful construction, its basic idea being fuel injection effected by the elastic force of a compressed helical spring. In the new types of diesel engines two important modifications have been effected.

First of all the pump has been redesigned to be suitable for fuel injection in two stages, after exchange of a few component parts. Aim of the two-stage injection is to stop the characteristically sharp, knocking sound of diesel combustion and pressure, a feature having very favourable effect on the life of piston rings and bearings.

The second alteration was that a safety quick-cut out device is built in into every fuel oil pump. The aim of this device is to automatically prevent increase of engine speed above the admitted speed limit.

GOVERNOR

The engine speed regulating device of governor is with all new types of Ganz engines mounted on the exterior of the diesel engine. According to the operational requirements, the functional performance expected from the governor of a diesel engine may be very different. The governors of railway traction diesel engines are hydraulic servoregulators as this type of control mechanism can be adapted in the most satisfactory manner to the complex requirements arising in railway power vehicles. The governor incorporates the

remote control systems too, which is of the electro-pneumatic type.

An automatic device is incorporated into the governor with the aim of stopping the engine in the case that lubricating oil pressure should drop below a predetermined limit.

LUBRICATION

All engines belonging to the 17 cm. and 27 cm.-bore groups have the "dry crankcase type" lubricating system. A lubricating oil reservoir is located close to the engine and from this tank is sucked the oil by the oil pump and driven through the filter into the lubricating oil ducts of the engine. Another oil pump is permanently removing the oil from the crankcase. This clearing oil presses the oil through a filter into the oil cooler and from there to the oil tank. Thus the lubricating oil system consists of a high-pressure circuit and low-pressure circuit. The oil cooler is put into the low-pressure circuit which arrangement enables the use of air-cooled radiators for oil cooling.

The 13.5 cm.-bore engine possess similarly two oil circuits of higher and lower pressure respectively. But there is no separate oil tank in these engines, the crankcase serving as oil tank.

COOLING WATER CIRCULATION

Water circulation is effected in all new engines by a single centrifugal pump. The water pump is of a special design without buffing boxes which latter circumstance means considerable simplification of maintenance work.

CLOSING REMARKS

Although there are many types of Ganz engines not intended for railway operation yet in the production programme of Ganz Wagon and Machine Works the railway diesel engines are the most important sector. This can be explained by the fact that railcar building is the traditional domain of Ganz's activity and that this factory has been and is presently too in the rows of the pioneers of the constructors of railway rolling stock and machinery. Above described types of railway diesel engines are able to satisfy all requirements of railcar building but in each category can be found engines to be used as locomotive diesels.

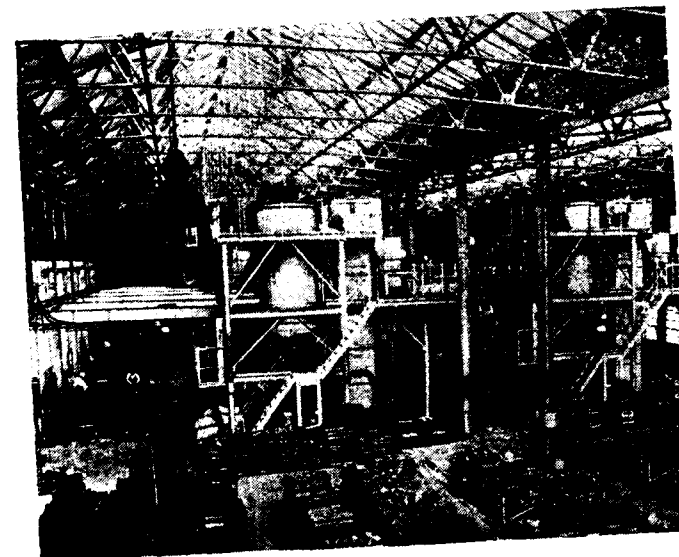
There is also a complete range of stationary diesel engines from 7 to 1600 b.h.p. rating. The same engines are used in river and seagoing motorboats.

Manufacture of Electrical Switchgear and Motor Control Gear

By Our Engineering Correspondent

FOR nearly 50 years, the Midland Electric Manufacturing Co., Ltd., has specialised in the manufacture of electrical switchgear and motor control gear and to-day it is one of the most highly organised and most frequently visited factories in the Midlands. Founded in Conybere Street, Birmingham, in 1908, the steady expansion of M. E. M. has led to various moves, first in 1910 to Rea Street South, then to Barford Street. The present 14 acre site was purchased in 1936 and extensions were completed in 1939 and 1953.

Last year, an additional factory site was acquired at Redditch; building is well in progress and the works will be equipped with the most modern plant. It is planned that this factory will be devoted entirely to the production of domestic heating appliances and thus relieve pressure on working space at the Tyseley Works, where switchgear and motor control gear is scheduled for further development.



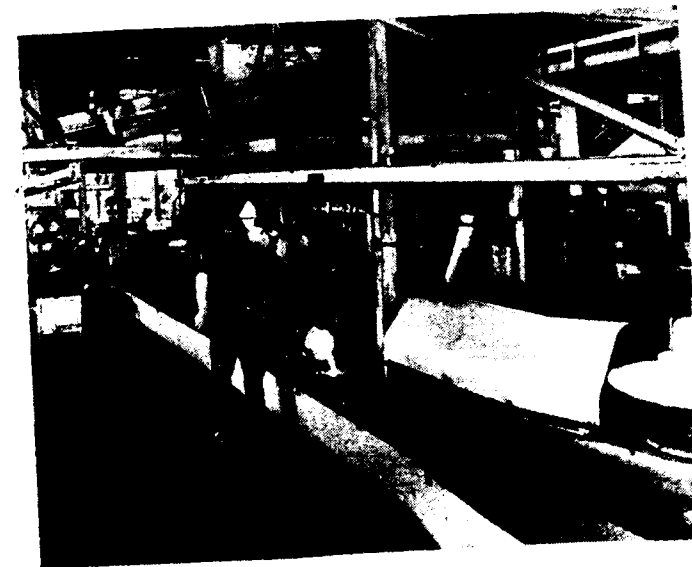
A general view of the M. E. M. Foundry. Two fully mechanised moulding plants are in use—in the foreground of the picture are shown the sand preparation units where the sand is conditioned for moulding and passed out to the batteries of moulding machines by conveyor.



South Works and Administration Block.

The idea of a self-contained organisation has been apparent from the beginning and can be traced back through the years, the introduction of an iron foundry and porcelain works in 1924 and 1925 being major steps in this direction.

The installation of a metal extrusion mill in 1953 brought further economies in the manufacture of non-ferrous components, including contacts and terminal



After the moulds are made, they are brought by conveyor to the pourer. Molten metal is taken from the Cupola by ladles which run on an overhead mono-rail to reduce fatigue and lessen the risk of accidents. The cupolas are designed to give a continuous flow of metal throughout the day.

blocks. New methods of producing basic parts of M. E. M. products are constantly being sought and, to-day, castings, porcelain and plastic mouldings are manufactured in vast quantities by special purpose machines, within the Tyseley Works.

The manufacture of nearly 1,000 catalogue items demands a high degree of internal organisation and closer examination of two of the more interesting works departments gives some idea of the productive capacity which has been built up over the years.

M. E. M. is unique in having its own porcelain works. The clays and basic materials are obtained from Devon and Cornwall, and some are imported from Sweden. All the press tools for the moulds are made in the M. E. M. Toolroom and the clay 'body' is moulded into shape by hydraulic presses. After pressing and preliminary drying the 'flash' is removed and the pressings are glazed and cleaned ready for firing. Girls working on either side of a conveyor carry out the fettling and cleaning and each working place is provided with air extraction to remove dust from the atmosphere. Glaze is sprayed on automatically before the final cleaning and inspection operation. The pressings are finally loaded on to trucks and moved slowly through the 130 ft. kilns, the complete journey taking 40 hours. Town gas is used to obtain the temperature of 1250°C needed for firing and the daily consumption is in the region of 70,000 cubic feet. Well over a million pieces of porcelain are fired in the continuous tunnel kilns which are in operation 24 hours a day, 7 days a week.

The M. E. M. pottery works relies entirely upon local labour and the highly skilled operatives are all trained within the department.

When the present factory site was first occupied in 1937, a new foundry was built and in order to produce 60 to 80 tons of light electrical castings per week, it was necessary for this to be a highly mechanised production unit. The average weight of the castings produced is 2 lbs. and a variety of moulding machines are in use, some working in pairs producing the upper and lower halves of the moulds, and others capable of producing complete moulds.

Sand is brought to the hopper of all machines by overhead conveyor. The rate of production is one mould per minute, per man. After the moulds are made they are brought by plate conveyor to the pourer. Molten metal is taken by the "syphon brick" method



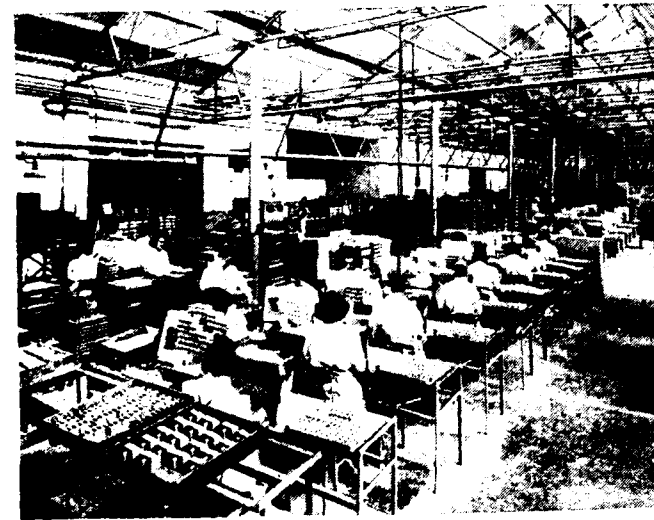
One of the moulding plants in the M. E. M. mechanised Foundry. The machines in the foreground work in pairs, producing the upper and lower half of the moulds respectively. Sand is brought to the hopper above the operator by overhead conveyor and by means of the lever at the side of the hopper he can withdraw just the amount of sand required for a mould.

Further along the line are seen machines each capable of producing a complete mould. The average time taken for production of a complete mould on these machines is under one minute.



The "Knockout Station". The conveyor plate carrying boxless moulds tilts automatically. The mould breaks up and the casting with the sand is carried away by another conveyor. The casting is removed for cleaning and fettling and the sand is then reconditioned and fed to the overhead hoppers for use again.

Altogether, some 80,000 castings are made in the M. E. M. Foundry each week.



After pressing and a preliminary drying, 'flash' must be removed, glaze applied and the pressings cleaned, ready for firing. Girls working on each side of a conveyor carry out the fettling and cleaning work. Each working place is provided with air extraction to remove dust from the atmosphere. Glaze is sprayed on automatically, before the final cleaning and inspection operation. In the background is the bay in which trucks are loaded for the kiln. Over a million pieces are fired each month in the continuous tunnel kilns which are in operation 24 hours a day, 7 days a week.

of tapping from the cupolas, which are of the "balanced blast" type. The ladles run on an overhead mono-rail to reduce fatigue and lesson the risk of accidents.

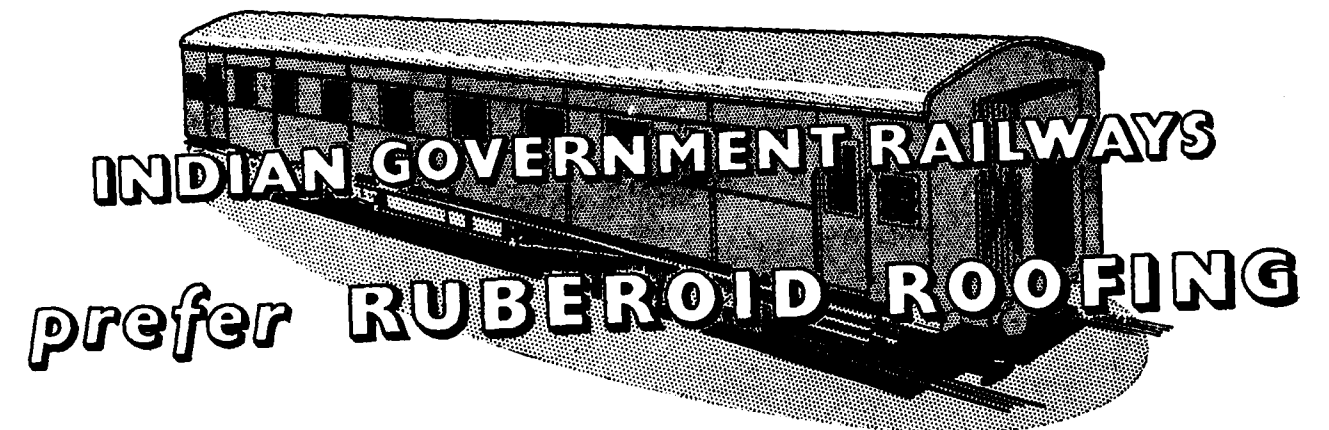
At the "Knockout Station" the conveyor plate carrying the boxless moulds tilts automatically, tipping the mould onto an "apron-plate" conveyor thus enabling the casting to be lifted clear of the sand. The casting is then sent for cleaning and fettling, the sand being re-conditioned and fed to the overhead conveyor for use again.

Cleaning, fettling and grinding is carried out in the main factory building, the layout of which provides an excellent example of flow-line production. Some 80,000 castings are supplied weekly to the factory assembly units and a very high standard of finish is maintained.

Every facility is provided for the maintenance of good working conditions and the M. E. M. Foundry is without doubt, one of the cleanest in the Midlands.

The principles of standardisation of products and simplification of design have been thoroughly applied and this highly specialised unit is typical of the many that make up the self-contained organisation of M. E. M.

For its remarkable **DURABILITY**
under all climatic conditions



In rolls of 72 feet—36 inches
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Narrow-Gauge Locomotives for India

Efficacious twin-engine design for low-speed heavy pulling power conditions up long and steep grades

FOR many years now the 2-ft. 6-in. gauge Kalka-Simla Railway would have been regarded as one of the most difficult in the world to work if its traffic had been at all heavy. Fortunately, it was mostly Government traffic uphill to Simla and returning traffic downwards at the end of the season. Yet Kitson-Meyer articulated steam locomotives were needed for the heaviest freight and other trains, though 25 or more years ago petrol railcars were introduced for the first class traffic. These small cars were supplemented about 1933 by an Armstrong-Saurer railcar, and at a later date some of the petrol cars were converted to diesel propulsion.

Almost the whole of the 60 miles length is severely curved and lies along shelves on the hillside, so that a speed restriction to 20 m.p.h. has always been enforced.

The grades are continuous, for many miles at 1 in 33, with some stretches even steeper, and the line climbs 5,000 ft. from one end to the other to reach an altitude of 6,840 ft. above sea level. These, with a restricted loading gauge, were some of the requirements which had to be met when the Indian Railway Board began to think of diesel locomotives to replace steam motive power.

There was one advantage that diesels did possess over steam, and that was the practicability of choosing as standard a comparatively small unit and coupling two in multiple unit for the heavier trains. The old Kitson-Meyer locomotives, though reasonably successful as steam locomotives, did not have a high ratio of trailing weight they could pull uphill to the locomotive weight. Under physical conditions such as obtain on this line, it



One of the Jung 28-ton 290-b.h.p. (on site) 2-ft. 6-in. gauge B-B diesel-hydraulic locomotives of the Kalka-Simla section of the Indian State Railways.

is necessary to make use of every ton of weight for adhesion, and make use of every lb. of adhesion to provide high effective tractive effort, if high operating efficiency is to be gained. Finally, the possibility of getting with diesel traction a smooth-riding bogie locomotive, of short rigid wheelbase, should add to security in situations where a derailment is likely to mean a considerable fall, and should also conduce to less expensive track maintenance compared with steam locomotives of longer rigid wheelbase and the disturbing forces arising from cylinder pressure and reciprocating weights. Fortunately, judged by 2-ft. 6-in. gauge standards, the Kalka-Simla track is good, and an axle load of 7 to 7½ tons is permitted for diesel locomotives.

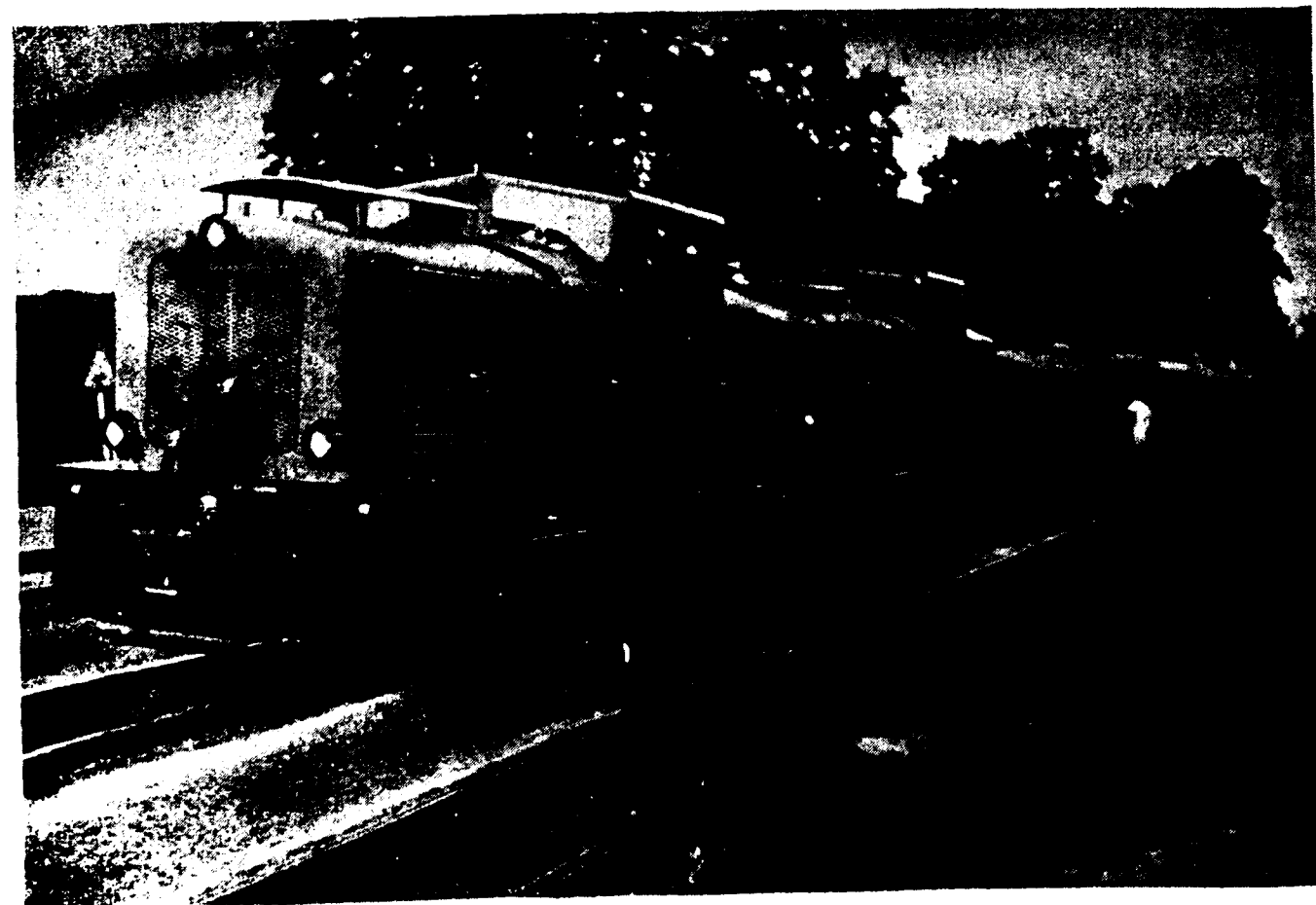
THE LOCOMOTIVES CHOSEN

Some time ago the Railway Board placed an order with the Arn. Jung Lokomotivfabrik G.m.b.H. for diesel-hydraulic locomotives to cope with these conditions. The order actually comprised eight locomotives, but only five of these are for the Kalka-Simla line and the other three are for another I.S.R. narrow-gauge line in Western India. The only difference between the two

is that the K.S.R. locomotives are fitted with multiple-unit control for the handling of two locomotives by one driver.

To meet the developing ideas of the Board, and in accordance with Jung's ideas to have a design suited to other countries also, a locomotive design was evolved which is standard for all gauges between 600 mm. and 785 mm. (1 ft. 11½ in. and 2 ft. 7 in.), the only change for any gauge being the distance one wheel in each wheel-and-axle set is moved along the axle. The engine output, and also the weight, can be varied while maintaining essentially duplicate mechanical portions if the gauges at the bottom end of the scale can take, for such light lines, a heavy axle load.

The specification for the Kalka-Simla locomotives called for the haulage by one locomotive of 30 tons trailing load up a gradient of 1 in 20 at 10 m.p.h., and for the haulage of 100 tons trailing up 1 in 50 at 12 m.p.h. On steep railways such as this braking is a problem commensurate with that of haulage, and on the K.S.R. it is complicated as a locomotive design problem in that vacuum equipment has to be provided for the



Two of the Jung 290-b.h.p. 2-ft. 6-in. gauge diesel-hydraulic locomotives of the Indian State Railways.

train brakes, a provision that in these locomotives caused much effort in getting in the necessary piping and auxiliaries and the multiple-unit connections for the piping. With the straight air brake in operation the braking force on the locomotive is equal to 78 per cent of the braked weight; with combined application of the straight air and automatic vacuum systems the locomotive braking is equal to 69 per cent of the locomotive weight.

EVOLUTION OF THE RUNNING PART

Some of the evolutionary aspects of the B+B locomotive design are interesting. Jung has had some experience in building four-wheel rigid-frame locomotives each with its own cab, and close-coupling two together. The company also built the short metre-gauge B+B locomotives of the German Federal Railway Class V. 29 in which practically all equipment was mounted on the bogies, including the engine casings, which were separate from the single cab. In these Indian locomotives the "bogie" mounting of equipment is retained, but here the vehicles or bogies are close coupled; and the cab structure is carried on three-point mounting with two supports on one bogie and one on the other, and all buffing and drag stresses are taken through the frames without going through the cab.

Running experience with these locomotives shows the simple form of close-coupling to be effective, and round sharp curves the running is smooth up to top speeds of 20—22 m.p.h. and there is not much of the entry-jerk common with many bogie locomotives. The specification called for ability to traverse curves of 48 ft. radius, and this has been achieved in track laid at the works. But on the Rhein-Siegen Eisenbahn, in Germany, where trials were carried out prior to shipment, the curves are more of the order of two or three times that value, though the speed at which they were taken was in excess of 12 m. p. h. and curves of about 200 ft. radius were taken at 20 m.p.h.

Maximum grade on the Hennef-Asbach line of the R.S.E. is 1 in 60, and during the tests two of the locomotives coupled in multiple unit hauled 240 tons trailing uphill at a steady 10½ m.p.h. This means 300 d.b.h.p. and allowing for the two locomotives, and the auxiliary requirements, the efficiency through the transmission must have been of the order of 80 per cent.

The locomotive design, is of twin-engine B+B wheel arrangement, with a wheel dia. of 27½ in., and a bogie wheel-base of 4 ft. 11 in. Owing to the method of

construction it can hardly be said that there is a bogie pivot pitch; indeed, it is debatable whether the design is really a bogie one at all within the usually-understood meaning of the term, being formed of two close coupled power units with a single cab pivoted above them, and whose riding qualities are equal to those of a bogie locomotive of similar dimensions. Length over buffers is 30 ft. 4 in., maximum width 7 ft., and over all height 9 ft. 6 in. With three-quarters of the total fuel supplies of 1,000 kg. on board the weight is 28 tons, which means that at 30 per cent adhesion a starting tractive effort of about 19,000 lb. can be exerted at the rail. No alternative gears are embodied after the hydraulic portion of the transmission. At the top service speed of 20 m.p.h., the rail tractive effort available is 3,800 lb.

The bogie frame structures are welded up throughout. The SKF-type roller-bearing axleboxes have individual laminated springs, and manganese-steel liners are fitted to boxes and guides. The wheels are of disc type with separate tyres and there is one brake block per wheel. ABC centre couplers are carried on the outer headstocks, along with the air and vacuum brake and electrical connections. Between the inner headstocks of the two bogies the close-coupling means consists of a rigid centre drawbar, and a spring-buffer set at each side, there being a diagonally-opposite arrangement of a spring buffer with a convex curved face on one headstock and a concave wearing plate on the other. Movement takes place only when curving. Each bogie carries a complete engine-transmission-auxiliary plant, so that the locomotive can be worked and all services maintained with only one engine working. The casing covering this equipment is carried on the bogie, but is separate from the cab structure, fitting inside the cab at the inner ends and with enough play to prevent contact on the sharpest curve.

CAB SUSPENSION

A strong but light welded plate underframe carries the thin-plate cab structure. This structure is three-point supported on the two bogies, but the actual means of doing it was one of the most difficult problems in the design of the mechanical portion, partly because of the considerable movement which had to be allowed for and partly because of the restricted space available as a result of the amount of general equipment which had to be installed within a narrow loading gauge. On the bogie with the two supports, a tubular trunnion arrangement is used in which a circular guide bar moves in and out of a tube to a maximum extent of about 4 in., the whole being mounted on hemispherical bearers with rubber supports on the bogie frame. The sliding and tilt in

and radial movements are absorbed by the deformation of the rubber. The single centre support on the other bogie also uses rubber, and is carried on a bridge piece across the frame. It is just below the shaft between the engine and transmission.

ENGINE EQUIPMENT

The engines are of the Motorenwerke Mannheim (MWM) four stroke pressure-charged type TRHS. 5185. At 650 ft. altitude, 68 deg. F. ambient temperature, and 1,500 r.p.m. speed, the six-cylinder engine has a continuous output of 240 b.h.p. But to suit site conditions and Indian railway operating conditions, the rating in the locomotives is 145 b.h.p. at 1,100 r.p.m., 5,000 ft. altitude and 90 deg. F. air temperature. The locomotive thus is of 290 b.h.p. on site. Cylinders are 5.15 in. bore by 7.1 in. stroke. Construction is in cast iron with integral crankcase and cylinder block, and wet liners are inserted. Precombustion chambers are carried in the cylinder heads and aluminium-alloy pistons are used. Injection equipment is of Bosch make. Electric starting is used. A Brown Boveri VTR 160 pressure-charger group is mounted at the end of the engine nearest the cab; but as the two Mann & Hummel air filters are carried on the cab structure a flexible bellows connection is needed between them and the pressure-charger air intake.

ACCELERATING USE OF HINDI ON RAILWAYS

RAILWAY Administrations throughout the country are now taking steps to increase the available facilities for teaching Hindi to their staff. Hindi classes are to be started for the benefit of non-Hindi knowing staff, and for this purpose the Railway Board has supplied a model scheme to the Railways.

The Railways will undertake a census of non-Hindi knowing railway employees, covering all categories of staff, including class IV staff who are required to know rules, read names, numerals, etc.

TOWARDS TWO CLASSES ON INDIAN RAILWAYS

THE first token step towards the abolition of second class accommodation on the Indian Railways is to be taken on July 1, 1956, when this class of accommodation will be withdrawn from some of the smaller branch lines. The coaches thus saved will be utilised to increase second class accommodation on some of the remaining lines where there is need and where second class accommodation will, for the time being, continue.

The engine has three-point mounting of the rubber-bushed trunnion type. From the back end of the engine, between the elastic coupling and the Voith transmission, belt drives are taken off to one side for the Westinghouse reciprocating air compressor, and to the other side for the Körting rotary exhaustor. These machines are carried on brackets bolted to the bogie frames, and carry a neat and simple belt-tensioning device formed of a slotted arm.

From the front end of the engine shaft a belt drive is taken for the radiator fan and for a dynamo. The frontal radiator has elements for the engine water, engine oil and transmission oil, and these are protected by a close-mesh grille. The transmission oil is circulated through its cooling system by the delivery pump in the transmission, whose main business is to keep the transmission working circuit filled. Radiator and associated equipment were furnished by the Kuhlerfabrik Langerer und Reich, of Stuttgart.

Three-point suspension is used also for the Voith L. 33 hydraulic transmission, with unsprung ball-and-socket supports. This transmission has one converter and two fluid couplings. From the reversing gears below it, cardan shafts lead forward and backward to simple bevel drives on the axles. Reversing can be effected only with the locomotive at rest.

Communications received at Railway Headquarters or at Divisional, Regional and District levels are proposed, as far as possible, to be answered in Hindi. Hindi signboards, notices, etc. displayed on railway premises and in trains will accord with the standardised terminology.

Among other important steps proposed are the issue of Hindi versions of administrative instructions, booklets, circulars, etc., and the publication of Hindi time-tables simultaneously with the English versions.

On sections where second class accommodation is withdrawn, steps will be taken, wherever necessary, to increase third class accommodation. The token withdrawal of second class accommodation from the smaller branch lines is the beginning of a process towards having only two classes on the Indian Railways in addition to air-conditioned accommodation.

Sulzer 2,300-H.P. Locomotive Engine

The new Sulzer pressure-charged twin-row engine for Diesel-electric locomotives has been very well received by railway companies, and a large number of orders have been placed within a very short time. In the type test carried out under U.I.C. regulations, the engine fulfilled all guarantees.

THE first units of a new type of Sulzer traction Diesel engine have been in service since 1955 in the 060-DA locomotives of the French National Railways illustrated in fig. 1. The order originally placed was for 20 units. Shortly after the first engine had been put in service, five further engines were ordered, to which ten more were added in April 1956. The mechanical part (bogie and superstructure) was manufactured by the *Compagnie des Ateliers et Forges de la Loire*. The *Compagnie de Construction Mecanique Procedes Sulzer* supplied the Diesel engines, and the *Compagnie Electro-Mecanique* the electrical equipment. The first ten engines were manufactured by Sulzer Brothers Ltd. in Winterthur, the others have been or are at present being built by the C. C. M. in their works at St. Denis, France. These 120-ton locomotives of type Co Co are being used on the "Grande Ceinture" in Paris for hauling goods trains of 1,600 to 2,000 tons.

In the meantime British Railways have ordered ten identical engines from Sulzer Bros. (London) Ltd., who are also acting as general contractors for the electrical equipment. The superstructure is being manufactured by British Railways in their own workshops at Derby.

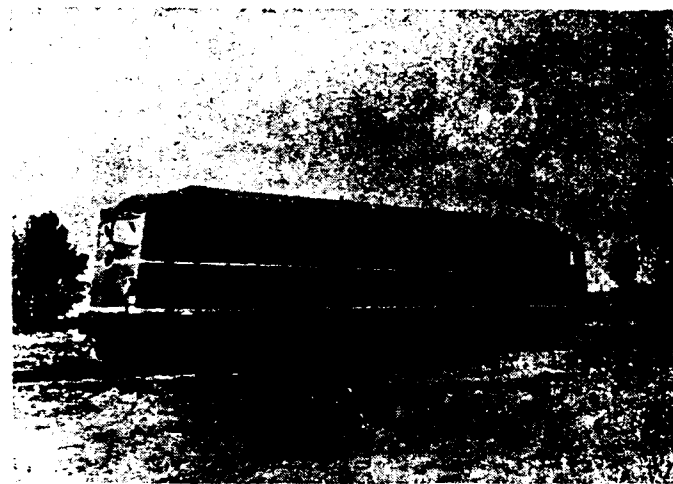


Fig. 1. Diesel-electric locomotive of the French National Railways.

The Sulzer twelve-cylinder four-stroke twin-row engine operates with solid injection and is pressure-charged by an exhaust-gas turbo-blower (see figs. 2 & 4).

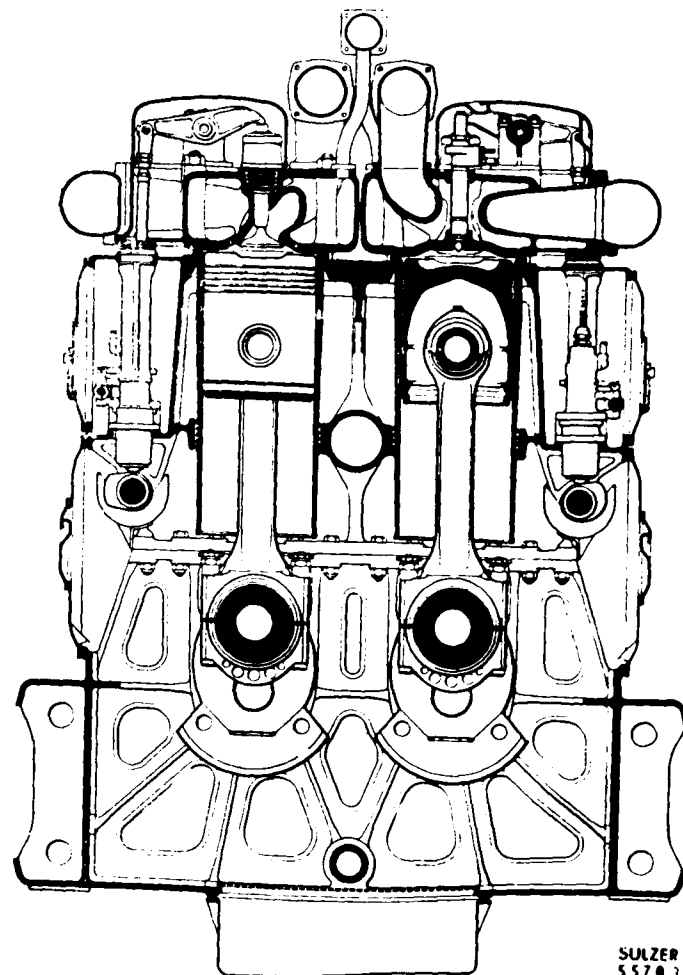


Fig. 2. Section through the Sulzer four-stroke locomotive engine of type 12LDA28.

The Roumanian State Railways have also taken an active interest in these engines and have now placed an order for sixteen of them. The total number so far ordered, including three stand-by sets, has thus reached 64, viz.

French National Railways (including stand-by sets)	38
British Railways	10
Roumanian State Railways	16

One of the first batch of engines for the "Grande Ceinture" was selected at random by the inspection

authority of the French National Railways and submitted to the so-called type test. Under the regulations of the Union Internationale des Chemins de Fer not more than two stoppages of twenty minutes each are allowed in the course of this 100-hour test. In actual fact the engine remained in continuous operation throughout, so that it fully satisfied the requirements.

DESCRIPTION

The twelve-cylinder four-stroke Diesel engine is designed for solid injection and is pressure-charged by a Sulzer exhaust-gas turbo-blower. It has two rows of six cylinders each (fig. 2). Originally intended for 2,000 B.H.P., it has now been brought up to 2,300 B.H.P. by raising the mean effective pressure and the speed.

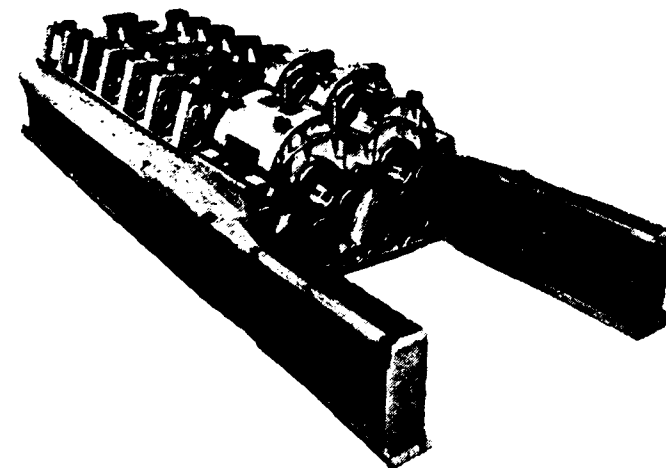


Fig. 3. Welded crankcase.
The longitudinal girders are extended to take the generator. The last two transverse members, with three bearings each, carry the gear.

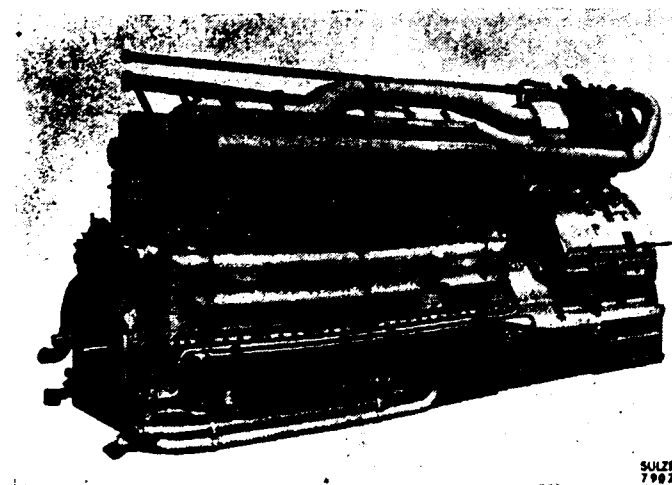


Fig. 4. Engine-generator set.
The compact character of the set is apparent.

The two crankshafts drive the generator through a common gear with a transmission ratio of 1.44 : 1.

The main dimensions of the engine are the following :

Bore	= 280 mm. (11 in.)
Stroke	= 360 mm. (14.17 in.)
Nominal rating	= 2,300 B.H.P. at 750 revs. per min.

The crankcase (fig. 3) is of the welded design which has given such good results in Sulzer Traction engines for the last twenty years. The seven cast-steel transverse members which take the bearings of the two crankshafts are welded to form a rigid whole with the longitudinal girders of steel plate. The latter are extended at one end to carry the generator. The two transverse members nearest the generator support the gear, which synchronises the two crankshafts and steps up the engine speed by 44% for driving the generator.

The Diesel engine thus forms a very compact block with the gear and the generator. U-shaped ribs running

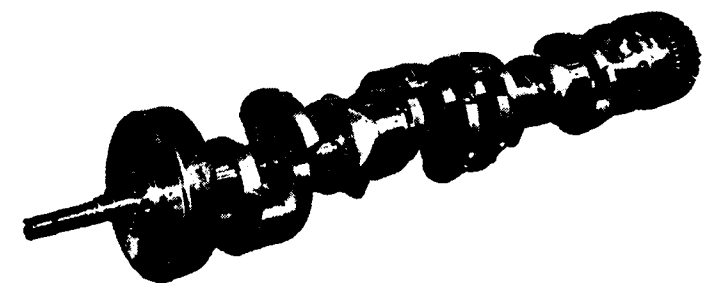


Fig. 5. Crankshaft of the 12LDA28 engine.
On the left, the vibration damper; on the right, the gear-wheel. The counterweights are fitted on the crank webs.

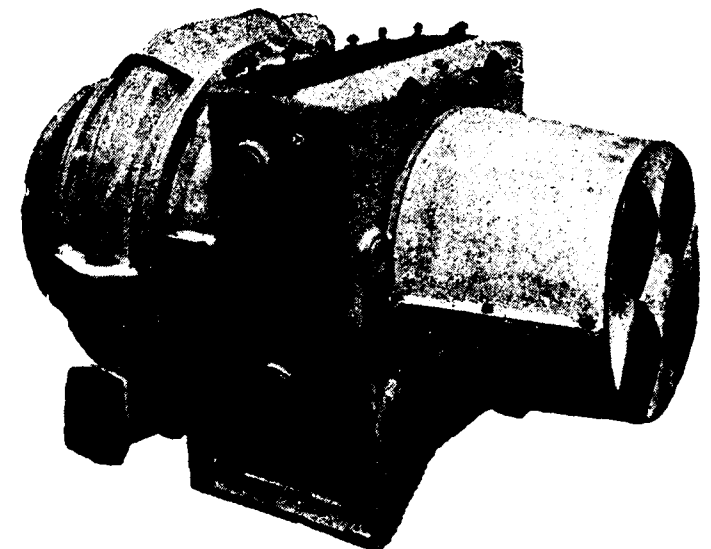


Fig. 6. Sulzer pressure-charging set.

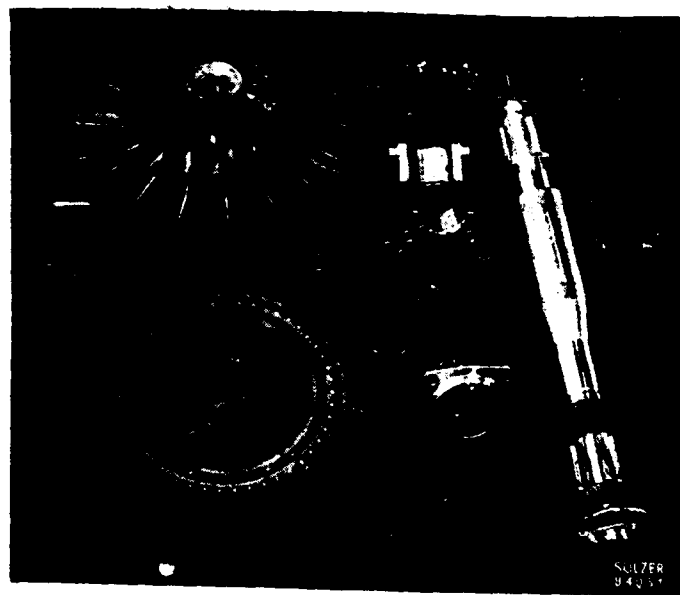


Fig. 7. Components of the exhaust-gas turbo-charger after the test.

Top: Blower impeller.
Bottom: Turbine wheel.
Right: Shaft with bearings.



Fig. 8. Crankshafts after the type test.

round the crankshaft bearings in the transverse members are carried up into the cylinder block which is bolted to the latter, so that the gas forces acting on the cylinder cover are transmitted by the shortest route to the crankshaft bearings, while the other parts of the casing are relieved. This design also permits the crankshafts to be fitted and removed with ease from above.

When the lateral covers visible in fig. 4 are removed, the crankcase is readily accessible, so that the connecting-rod bearings can easily be changed. The main bearings,

pistons, cylinder liners and all other parts subject to wear can be replaced speedily and with a minimum of trouble.

The crankshafts (fig. 5) are provided with counterweights which partially balance the masses. Frequencies which might give rise to torsional vibrations are eliminated by the dynamic damper, so that the engine runs very smoothly over the whole range from no-load to well above the nominal speed.

The cylinder block also consists of cast-steel transverse members welded to longitudinal walls of steel plate. The cross-section (fig. 2) shows how the cylinder block is bolted to the crankcase. Removal of the lateral covers gives access to the injection pumps.

The valve push-rods are enclosed in tubes, so that leaking fuel oil cannot mix with the lubricating oil.

The Sulzer exhaust-gas turbo-charger (fig. 6) is fitted on the generator casing. The bearings are lubricated with oil from the forced-circulation system supplying the engine.

A special pressure-charging safety device ensures that the quantity of fuel injected is never more than would correspond to the momentary volume of charging air. This point is particularly important during rapid load increases, as at such times the air delivery is always somewhat in arrears owing to the inertia of the turbo-blower rotor.

Other safety devices stop the engine or slow it down to no-load speed when the pressure in the cooling-water or forced-circulation oil systems falls below a certain minimum or when the water temperature rises too high.

TEST RESULTS

In the type test already mentioned the air was aspirated from the atmosphere and was not cooled between the blower and the engine. For the first eleven hours, the engine ran at slightly above the nominal output of 2,300 H.P. As the outside temperature was only 6-7°C. the output was then raised to 2,360 H.P. so that the thermal loading was roughly the same as at the nominal output and 20°C (the definition of the nominal output in the regulations of the U. I. C. being based on this temperature). The mechanical stressing during the test was thus somewhat higher than at nominal output.

The fuel used had a specific gravity of 0.843 (measured in gr. per cu. cm.) at 20°C. and a net calorific value of 10,090 cal. per kg. (18,015 B.Th.U. per lb.).



Fig. 9. Parts of the pistons after the test.

The results of the test are given in Table I. The figures are averages of measurements made every hour, or every half-hour in the tests of shorter duration.

Of the total heat supplied during the continuous test at 2,360 H.P., the following percentages were converted into power or led off in gases, coolant and lubricant:

37.2% converted into power
14.9% dissipated by cooling water

Rel. humidity = 75%
Barometric pressure = 727 mm. Hg.

Type of test	Duration	Output	Speed	M.e.p.	Consumption	Charging air			Exhaust gases			Speed of Turbo Charger	
						Temp. at turb. inlet	Pressure at entry to engine	Temp. at entry to engine	Temp. after leaving valve	Pressure at turbine inlet	Temp. at turb. inlet		Temp. at turb. outlet
	hr.	B.H.P. (metric)	r.p.m.	kg./cm. ²	gr./B.H.P.-hr. (metric)	°C	mm./Hg.	°C	°C	mm./Hg.	°C	°C	r.p.m.
Continuous run	11	2314	750	10.65	168.2	6.0	492	67.8	476	250	585	472	10700
at nominal load	69	2360	750	10.88	169.4	7.0	505	70.5	483	263	592	492	10900



Fig. 10. Connecting-rod after the test.

5.9% dissipated by lubricating oil
42.0% led off in exhaust gases lost by radiation, etc.

After the test the engine was completely dismantled for inspection. Figs. 7-10 illustrate the good condition of the various components.

July 1956

Type of test	Duration	Output	Speed	M.e.p.	Consumption	Charging air			Exhaust gases			Speed of Turbo Charger	
	hr.	B.H.P. (metric)	r.p.m.	kg./cm. ²	gr./B.H.P.-hr. (metric)	Temp. at turb. inlet °C	Pressure at entry to engine mm./Hg.	Temp. at entry to engine °C	Temp. after leaving valve °C	Pressure at turbine inlet mm. Hg.	Temp. at turb. inlet °C	Temp. at turb. outlet °C	r.p.m.
10% Overload													
increased m.e.p.	$\frac{3}{4}$	2625	750	12.07	169.2	5.0	604	78.7	498	310	611	504	11700
increased speed	$\frac{1}{4}$	2590	825	10.75	172.7	3.9	636	79.4	485	348	596	492	11800
Partial load													
	2½	2050	700	10.1	162.5	2.4	364	49.7	454	188	547	460	9600
	2½	1460	600	8.4	159.9	—0.3	194	28.4	403	96	491	422	7050
	2½	980	500	6.76	158.0	—0.8	98	14.4	354	51	419	366	5160
	2½	490	400	4.22	165.4	—3.0	36	5.0	268	29	294	263	3250
Alternating Load													
For 9 hours the engine was run intermittently for 6 minutes at nominal load and 4 minutes at no-load, the speed being 750 revs. per min.													
Oil consumption at full-load = 1.8 gr. per B.H.P.-hr.													

RAILWAY ELECTRIFICATION IN INDIA

FRENCH RAILWAY EXPERTS TO ADVISE

A Team of French railway experts is expected to visit Bombay State in the third week of July, in connection with the electrification of the Igatpuri-Bhusawal section of the Central Railway, which is under consideration.

The team came out to India some time ago, following an offer by the French Government. Under the terms of this offer, all expenses on the team, including travel from and to France, are being met by the French Government. The team is expected to advise the Indian railway authorities on certain technical aspects of electrification.

The team is led by Mr. F. Nouvion, renowned railway electric traction expert, who was connected with the running of the world's fastest electric train at 205 miles per hour in France a few months ago. Mr. Nouvion is Chief Engineer, Electric Traction, French National Railways. Other members of the team are Mr. J. Boulongne, Project Engineer, Mr. A. Crepet, Overhead

Lines Engineer, Mr. M. Miot, Tract Engineer, and Mr. A. Lemaire, Communication and Signalling Engineer.

During his recent visit to Europe, Shri P. C. Mukerjee, Member (Engineering), Railway Board, discussed the team's visit to India with Mr. Armond, Chairman of the French National Railways, who is himself an outstanding engineer.

The team has already held discussions with the Railway Board and the General Managers and various experts of the Central, Western, Eastern and South Eastern railways. They have also carried out an inspection of the rail sections in the eastern region which are being considered for electrification. These are Asansol-Sini-Rourkela section on the South Eastern Railway and the Asansol-Gaya-Moghalsarai section on the Eastern Railway.

The leader and another member of the team have gone back to France after the preliminary survey. The former is expected to return to India some time in August.

INTRODUCING THE PAXMAN YL ENGINE

A range of railway diesels up to 2,000 h.p.

AN event of major importance to the British diesel traction industry for home and export markets is the introduction of a series of engines from 710 to 2,000 h.p., of proved design and performance, by Davey, Paxman & Co. Ltd.

This new design is the synthesis of all Paxman rail traction experience from the first 400 h.p. unit in 1931, and has the advantage of much experience gained over a speed range of 750 to 1,750 r.p.m., with welded steel, cast iron, and both cast and welded light alloy framing; high-speed light weight and medium-speed medium-weight construction; Ricardo heads and direct injection; and also the vast and varied experience from 7000 V-type engines of 500 h.p. placed in service. But this new design has two other things. First, the most modern machinery and production technique is available, and backed up by an independent quality-control department reporting to the managing director; secondly, when getting out the prototype design in 1950 the designers took full advantage of the then new silicone viscous vibration damper, which has revolutionised the approach towards problems of torsional vibration.

After many thousands of hours of running with prototype engines at high loads, and the revision of design of certain constituents, the commercial models have been introduced to the world railway market in five different models having all-welded steel framing.

Needs of high power and low fuel consumption resulted in four-valve heads and direct injection. Paxmans have been using the fork-and-blade type of connecting rods since 1937 and from their past experience have evolved the YL engine connecting rods which have proved to be entirely satisfactory. The short stroke-to-bore ratio of 9½ in. by 10½ in. cylinders was adopted to assist robust construction of the main framing in conjunction with a piston speed of 1,750 ft. per min., which is moderate for a large 1,000 r.p.m. model. Nor is the brake mean pressure of 126 lb. per sq. in. of the pressure-charged engine unduly high, and can well be carried continuously by the pistons, rods, bearings and framing. Finally, the weight and dimensions are well in line with



the present-day requirements for large main-line locomotives weighing 115 to 125 lb. per b.h.p., the specific weight of the engines themselves being 19½ to 28 lb. per b.h.p.

The engine gives the speed and pressure figures quoted above, and equal to 125 b.h.p. per cylinder, with an exhaust which is invisible over the whole working range from low fractional loads up to 10 per cent overload, and with an exhaust temperature not exceeding 520 deg. C. Further, the maximum firing pressure is of the order of only 950 lb. per sq. in. Fuel consumption is good and extremely even, varying only between the limits of 0.385 and 0.375 lb. per b.h.p.hr. all the way from 50 to 100 per cent load.

At the moment 8-, 12-, and 16-cylinder YL engines are being offered, either naturally-aspirated or pressure-charged on Buchi principles, and have the characteristics shown in the accompanying table. The b.h.p. and speed figures given are the maxima to which the engines are set, but are, in effect, the continuous ratings.

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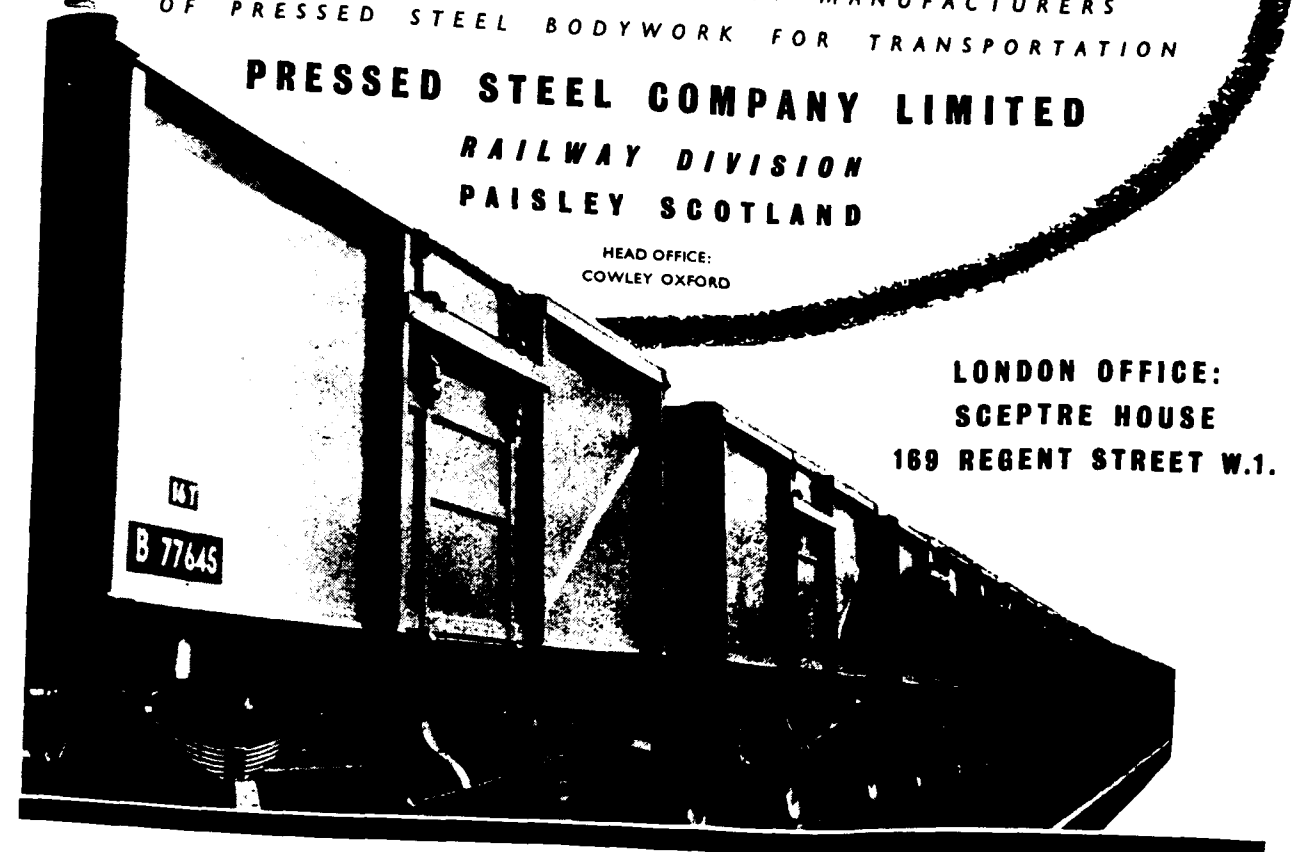
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welded steel frame; four-valve heads with specially-
divided inlet ports to give uni-directorial swirl and good

combustion; and a very high degree of standardisation
of parts, about 75 per cent of all wearing constituents
being both standard and interchangeable between the
five engines in the YL range, so that one stock of spares
will meet all a railway's requirements from a heavy
shunter to the largest main-line classes.

CHARACTERISTICS OF PAXMAN YL AND YLX ENGINES

Model	N. A. or P. C.	B. H. P.	Cyl. bore & stroke in.	R. P. M.	Brake mean pressure lb./sq. in.	Piston speed ft./min.	Dry weight lb.	Dry weight lb./b.h.p.	Gross weight with water & oil—lb.
8YL	N. A.	710	9 $\frac{1}{4}$ × 10 $\frac{1}{2}$	1,000	90	1,750	20,300	28 $\frac{1}{2}$	21,300
12YL	N. A.	1,070	9 $\frac{1}{4}$ × 10 $\frac{1}{2}$	1,000	90	1,750	27,700	26	29,100
8YLX	P. C.	1,000	9 $\frac{1}{4}$ × 10 $\frac{1}{2}$	1,000	126	1,750	22,300	22 $\frac{1}{4}$	23,300
12YLX	P. C.	1,500	9 $\frac{1}{4}$ × 10 $\frac{1}{2}$	1,000	126	1,750	29,200	19 $\frac{1}{2}$	30,600
16YLX	P. C.	2,000	9 $\frac{1}{4}$ × 10 $\frac{1}{2}$	1,000	126	1,750	38,700	19 $\frac{1}{2}$	40,500

N. A. = Naturally aspirated.

P. C. = Pressure charged.

LIFE AND CULTURE OF SOVIET RAILWAYMEN

THE culture of Soviet railway workers is growing
and their technical and general-education level is
rising with each passing year.

The USSR railways now have 14 schools of higher
learning training 40,000 students, 74 specialized
technical schools, hundreds of vocational and thousands
of elementary and secondary schools; their number
will considerably increase during the current five-
year plan. The railways also have 856 clubs, palaces
and houses of culture, 13,000 recreation rooms (red
corner) and 2,500 libraries.

Ever larger funds are appropriated for the social
insurance and health of the railwaymen. More than
5,000 million rubles were spent for these purposes
in 1955 alone. Over 220,000 railway workers spent
their vacations in sanatoria and rest-homes. Twice
as much money has been allotted to the medical service
of the railwaymen during the current five-year plan as
compared with the last; the number of kindergartens
will increase four-fold and that of creches—three-fold.
The social insurance budget will exceed 2,600 million
rubles in 1956.

"CASH YOUR IDEAS" SCHEMES FOR RAILWAYMEN

SENIOR officers of each Railway Administration in the
country are to be associated with the "Cash Your Ideas"
schemes, under which all grades of staff, gazetted or non-
gazetted, are encouraged to come forward with construc-
tive ideas for improving the working of the railways.

The Railways have been requested to publicise the
fact widely that they would be glad to consider any
inventions or constructive suggestions from members of
their staff belonging to all ranks. Monetary rewards are
given to those responsible for useful suggestions which
are found acceptable.

A high-powered five-member Standing Screening
Committee (Inventions and Suggestions) already exists
at each Railway headquarters. In future, the Senior
Deputy General Manager of each zonal Railway will

preside over this committee. Railway Administrations
which do not have a Senior Deputy General Manager
would post other senior officers to guide the deliberations
of this committee.

The Railways have been requested to ensure that the
screening committees normally meet once a month. The
fact that an employee has made an acceptable suggestion
would be recorded in his personal file and would be
a factor in his favour at the time of promotion to
a higher post.

The Railway Board has requested the Railway
Administrations to ask senior officers to personally hand
over awards to employees, to give them the feeling that
the Administrations attach great importance to construc-
tive thinking on the part of their staff.

Internal Lubrication of Steam Locomotives

[Contributed by Caltex (India) Limited]

THE proper choice and use of lubricants forms an indispensable part of the steam locomotive. The lubricant in a bearing serves as important a duty as the metal surface of the bearing itself, which would promptly 'burn out' if no lubricant were present. Not only is excessive wear produced in a steam cylinder by lack of lubrication but also steam leakage results. The long life and service rendered by any machine or moving part is entirely dependent upon the selection of correct lubricants. Correct lubrication is the prime factor of profitable railway operation. Due to the economy of correct lubricants these benefits are secured at little or no increase of cost per mile of operation.

The investment involved in the locomotives of any road is necessarily large. Returns from this investment are largely dependent upon correct lubrication, which lengthens the life of every engine, reducing the rate of depreciation. Maintenance costs are largely due to necessary repairs of the worn parts. Correct lubrication reduces wear to a minimum.

Let us here consider the internal lubrication of locomotives in terms of valves and cylinders.

Internal lubrication of the locomotive has two main purposes:—

1. To reduce friction and wear of valves, valve seats, valve stems, pistons, cylinder walls, and piston rods, to a minimum.
2. To provide an effective oil seal for all these parts to resist steam leakage.

Effective internal lubrication is the result of a series of conditions, each one of which must be favourable if the best results are to be obtained. The oil must be introduced at the proper place and in the correct amount. It must be adequately yet uniformly, distributed or spread over the surfaces to be lubricated. The oil must be adapted to the method of introduction, and distribution, and must possess all of the characteristics required for its functions as a Lubricant and sealing medium, and

must resist whatever film-destroying conditions are encountered.

If water condensation is present, the oil must still adhere to the surfaces and form a satisfactory film in spite of this condition. Steam temperatures, and temperatures of lubricated parts, are influenced by operation while drifting, which may produce conditions extremely adverse to correct lubrication. Soot and cinders may be unavoidably drawn into the cylinder from the smoke box, while the oils must still maintain lubrication.

The factors which influence the selection of locomotive steam valve or cylinder oils are as follows:—

1. Quality of steam in valve chest and cylinder which may be wet, saturated or superheated – in the latter case, the governing figure being the total temperature, i. e. the saturated steam temperature plus the degrees of superheat.
2. Method of application, which may be by hydrostatic or mechanical lubricator to one or more of the following points:—
 - (a) Steam pipe above valve chamber.
 - (b) Valve chamber.
 - (c) Upper part of cylinder wall.
 - (d) Lower part of cylinder wall.
3. Service – long run road service, or suburban service or shifting service.

Diameter of cylinder is also a factor influencing the distribution of oil, and the quantity of oil required.

MAIN STEAM VALVES AND CYLINDERS

Speed and load are extremely variable. While in some classes of service a high speed may be maintained

over a long run, the load may at the same time vary from maximum at starting and on an upward to no load on a downward grade and while slowing for a stop. Speed and load variations have a strong modifying influence on steam quality from time to time.

Steam quality – set, dry or superheated – is a factor which influences the choice of the oil for valve and cylinder lubrication. So long as the degree of superheat is not extreme, there are always times where there is a condensation in the steam cylinders resulting from light loads and the automatic cut-out of the superheater by the action of the damper during certain conditions of operation or stopping. Even when a high degree of superheat is used, the variable operating conditions will at times result in condensation in the cylinders. With high superheat, and long continuous runs, however, there may be justification for the use of an oil of a body heavier than would otherwise be used.

There are two classes of lubricators employed for the introduction of valve or cylinder oil to the internal parts of a steam locomotive, namely, (1) the hydrostatic lubricator, (2) the mechanical force feed

lubricator. Both types of lubricators give excellent service and the choice between them is often difficult.

The hydrostatic lubricator is located in the cab of the locomotive, and is at all times in view and under the control of the engine men. The operation of the lubricator depends upon the oil within the lubricator being displaced by water condensed from steam, which is admitted by a pipe leading from the boiler. The flow of oil is controlled by the adjustment of needle valves.

When a mechanical force feed lubricator is used, it is located near the locomotive cylinders, and consists of an oil reservoir, with several diminutive, positive-acting plunger pumps, which are mechanically operated by a mechanism operated from some moving part of the engine. The plunger pumps are so designed that the quantity of oil discharged can be regulated. After adjustment, this type of lubricator requires no further attention than filling.

It should be observed that the hydrostatic lubricator feeds oil uniformly with respect to time, i. e., a constant number of drops per minute, and that, therefore, an

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engine running at high speed receives less oil per revolution than when running at relatively low speed, unless re-set by engine-man.

The mechanical force feed lubricator, on the other hand, may be made to feed oil at a constant rate with respect to the revolutions of the driving wheels, i. e., to feed one drop of oil for every so many strokes of the piston. Relatively speaking, this type of lubricator then supplies more oil when the engine is running at high speeds than does the hydrostatic lubricator. By driving the lubricator from a part of the valve gear that has a variable motion, the rate of feed may be made to vary accordingly.

Drifting operation that permits access of cinders from the smoke box to the cylinders is a condition that renders satisfactory lubrication exceedingly difficult. Oil is a binder of the impurities which can only be made more serious by the use of an oil of unusually heavy body. It is frequently the practice to keep the throttle slightly opened when the engine is drifting in order to provide steam to atomize the oil, also to avoid drawing in cinders from the smoke box.

The great majority of locomotive operating conditions call for the use of cylinder or valve oil, which has a body sufficiently light to assure atomization. Whenever extreme water conditions prevail, a compounded oil should be used. The compounding of this oil renders it a very adhesive lubricant, capable of maintaining a lubricating and sealing film in spite of moisture resulting from cylinder condensation and has long-lasting qualities.

The locomotives operating on long, continuous runs in which a heavy load predominates, the use of highly superheated steam sometimes calls for the use of an extra heavy bodied oil for which service Caltex 474 Mineral Superheat Valve Oil (G/O-101/33) is recommended, due to its high lubricating value, heavy body and special quality indicated in high temperature conditions.

STEAM REVERSING CYLINDERS

Steam cylinders of power reversing gears require but a small amount of cylinder oil to accomplish lubrication. The same Cylinder Oil as is used for main cylinders

ACCENT ON "SAFETY" IN RAIL TRAVEL

INDIA'S Five Year Plans envisage the gradual expansion of railways. New tracks are being laid, and production of locally manufactured locomotives and coaches is in full swing. Experts are devising more comfort for passengers, and there is an increased accent on the word "safety".

An enemy of safe travel is what engineers term "hot axles" which can cause derailments. The body of a rail coach rests on an axle, and the axle box enclosing it must not only be skillfully serviced but provided with special type lubricants. Otherwise extreme friction will result and the parts will become warped through heat. Derailment can follow.

In their ceaseless development of top quality oils, Caltex engineers have discovered types that will avoid "hot axles". Today, the Southern Railways, one of India's largest networks, largely uses Caltex axle oils.

Experience has tested the superiority of Caltex axle oils over others for the Southern Railways. Their excellence was recently demonstrated again at the Mysore Iron and Steel Works at Bhadravathi. Here iron mines use several locos to carry ore from the distant mining town to Bhadravathi and the effectiveness of Caltex Axle Oil was soon proven.

should be applied by means of the oil cups or other fittings provided for the purpose.

AIR CYLINDERS OF REVERSING GEAR

Where power reversing gear is operated by air cylinders, good lubrication and an effective piston seal can be maintained by the application in the shop of Caltex Petroleum Jelly by means of a compression cup or through the gland.

STEAM CYLINDERS OF STROKE ENGINES AND LOCOMOTIVE AIR PUMPS

These steam cylinders are lubricated by feeds from a hydrostatic or force feed lubricator. The same Cylinder Oil should be used for this purpose as is applied to the steam cylinders of the locomotive.

AIR CYLINDERS OF LOCOMOTIVE AIR PUMPS

The temperature in these air pump cylinders resulting from air compression is high, requiring the use of a heavy bodied oil. It is recommended that the same Cylinder Oil be used here as is applied to main steam

cylinders. Several types of special oil cups and air pump lubricators are employed for this purpose.

AIR BRAKE LUBRICANT

The lubrication of these cylinders requires a special lubricant which will stay in place and maintain lubrication and piston seal from one shop inspection to the next. Caltex 904 Grease Graphite has been developed specially for this purpose and should be applied in the shop to the cylinder walls in a uniform thin coat by swabbing.

TRIPLE VALVES

The correct lubrication of triple valves requires care in application of the lubricant as well as its correct selection. There is a difference of opinion as to the relative desirability of a grease or an oil for this purpose. Where a grease is desired Caltex 904 Grease Graphite is recommended. The correct oil for this purpose is Caltex 754 Oil (G/O-101/44). These lubricants are adapted to resist the effects of low temperatures. In either case, the frictional surfaces should receive an extremely light application of the lubricant at the time of shop inspection. The use of either of these lubricants and the observance of the precaution regarding application will assure the free operation of the triple valve at all times and will guard against clogging any of the parts of openings.

INDIAN CONTRACT AWARDED

To improve communications in the central and suburban areas of Calcutta it has been decided to electrify certain sections of the Eastern Railway. Work on the first stage, covering the main line between Howrah and Burdwan and the branch line to Tarakeswar, has begun. British Insulated Callender's Cables Ltd., in conjunction with their associates the Indian Cable Co. Ltd., have been awarded the contract for the supply and installation of the underground power and control cables.

The total value of this contract is in the region of £250,000 and is for 33kV, 11kV and 3.3kV paper insulated feeder power cables, also 245 miles of control cable.

ELECTRIC FURNACES

THOUGH furnaces, in one form or another, have been known and have been progressively developed ever since man began to use cast and wrought metals, it is little more than thirty years ago since electric heating began to be used for such purposes on an industrial scale. Since that time, electric furnaces have been designed for almost the entire field of heating operations encountered in the engineering and metallurgical industries, from the refining of the crude ore to the heat treatment of the finished product. Within this wide range, the variety of different designs which has been produced is so extensive as to defy analysis in any but the broadest terms.

The Electric Smelting Furnace for the reduction of metallic ore is, perhaps, the biggest member in this variegated class, both in terms of physical dimensions and electric power rating. At the other end of the scale are the small resistance furnaces used for tool hardening or for Laboratory purposes. Between these extremes are included the Arc Furnaces used for metal melting in the production of castings or ingots and the larger resistance furnaces which are employed for the annealing, hardening or other treatment of the wrought metals produced from ingots by rolling, forging and other processes. Not to be forgotten moreover, is the Induction Heating process, though the equipment which it employs may often escape any attempt at defining an electric furnace.

It is possible to classify Electric Furnaces in three broad groups, according to the means by which heat is imparted to the product. In one group, for example, the charge is heated by passing an electric current directly through it, between suitable electrodes and both smelting furnaces and direct-arc may logically be regarded as members of this group, though they do, in fact, involve some degree of radiation heating also. A second class also employs electric currents flowing through the material to be heated but these currents are generated by electro-magnetic induction without any direct connection between the charge and the power source. Induction Heating and Melting Furnaces are typical examples.

The third classification - which probably represents the vast majority of electric furnaces - depends on the transfer of heat from a hot body to the charge by conduction, convection, radiation or a combination of such methods. Loosely described as "Resistance furnaces", these usually employ heating elements of suitable high temperature material which are connected to the electric power supply and which are so disposed

around the charge as to impart to the latter the heat generated in them by the passage of current. The resistance elements themselves are most usually made of a nickel-chromium alloy in the form of ribbon of wire but silicon carbide rods and other refractory materials may be used in appropriate cases or even a crucible of molten salts, into which the work is immersed.

The commonest type of Electric Resistance Furnace has a heating chamber built of refractory bricks, on the walls, roof and floor of which are mounted heating elements of nickel chromium ribbon. The floor or hearth elements are protected by nickel chromium plate on which is placed the work which it is desired to heat. For operation at temperatures above about 700°C, heat radiation from the elements onto the work is usually the main factor in heating the latter but at lower temperatures the furnace atmosphere may be agitated by a motor driven fan to provide, in effect, forced convection heating. Such a furnace may be designed to operate with the chamber filled with artificially-produced gases for the purpose of excluding air and thereby preventing the formation of oxide on the work which is undergoing treatment.

To these basic essentials of a Resistance Furnace may be added many special features, including conveyor mechanism to carry the material into and out of the heating chamber. On discharge from the heating chamber, the material may be allowed to cool down naturally (when some oxidation will be caused) or it may be transferred quickly to a tank of oil or water to give the rapid cooling or "quenching" which is required in certain processes. Again, a cooling chamber may be connected to the furnace and filled with the same protective gas, conveyor mechanism transporting the work from one to the other.

Any attempt to describe the Industries and Industrial Processes in which electric furnaces are used can be undertaken, for practical reasons, only in terms of general categories. Starting again with smelting furnaces, for example, it can be said that these have been successfully applied to the processing of a number of ores, including iron and nickel, copper, tin. When the ore has been reduced to metal, it may be cast into ingots or subjected to further metallurgical processing before taking a form suitable for working into sheet, strip, bar or tube. Electric Arc Furnaces or Induction Melting Furnaces are often used for the production of the billets from which such products are rolled or drawn.



**Melting
CAST IRON
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BIRLEC ELECTROMELT furnaces are regularly used for the reclamation of cast-iron borings. Swarf is loaded into the furnace which produces metal, of controllable composition, ready for casting, and without the necessity of pigging. Further details on this important, and highly economical, electric furnace process are available from Birlec Limited. Photographs by kind permission of Messrs. Howard & Bullough Limited, Accrington.

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In converting a metal billet into the commercial sheet, rod, etc., further heating operations are usually involved. Electric Induction Heating is applicable here and is growing rapidly in importance in this field. The initial product of the mill, however, usually undergoes cold-working operations before attaining its final state and it is usual to anneal or soften the material at various stages during these operations, for which purpose electric resistance furnaces are commonly employed.

Engineering fabricators operate on the material so produced to form finished articles of innumerable different kinds. The fabricating operations often involve further annealing in electric furnaces while, in the case of steel parts destined for use in machinery, hardening to give the parts adequate wear resistance or spring qualities offers further wide scope for electric furnaces.

Both in the primary processes used for producing strip, tube, wire, etc., and in the fabricating processes by which these materials are turned into finished articles, tools of all kinds are employed. The majority of such tools are made of steel which requires to be hardened in

order to give it a long working life under arduous conditions and electric furnaces are widely accepted as the best means for performing such hardening operations.

Primarily, the rapid growth of electric furnaces throughout Industry—where they are daily replacing fuel-fired furnaces to an increasing extent—derives from the superior uniformity of heating and accuracy of control which they provide. Electric power is not subject to the variations which beset many forms of fuel,—variations in analysis, in pressure, etc.—and thus permits the standardization of processing schedules which is an essential feature of modern production planning.

Not all the districts in which Industry is growing, moreover are adequately supplied with reliable, combustible fuels. On the other hand, no Industry can now operate without electric power in some form or other and, apart the technical considerations just mentioned, electric furnaces, therefore have the great value of convenience in installation wherever the supply lines run. With the expected advent of atomic power, it is safe to predict that electricity will be virtually the Universal medium for Industrial energy and furnaces consuming raw fuel may become things of the past.

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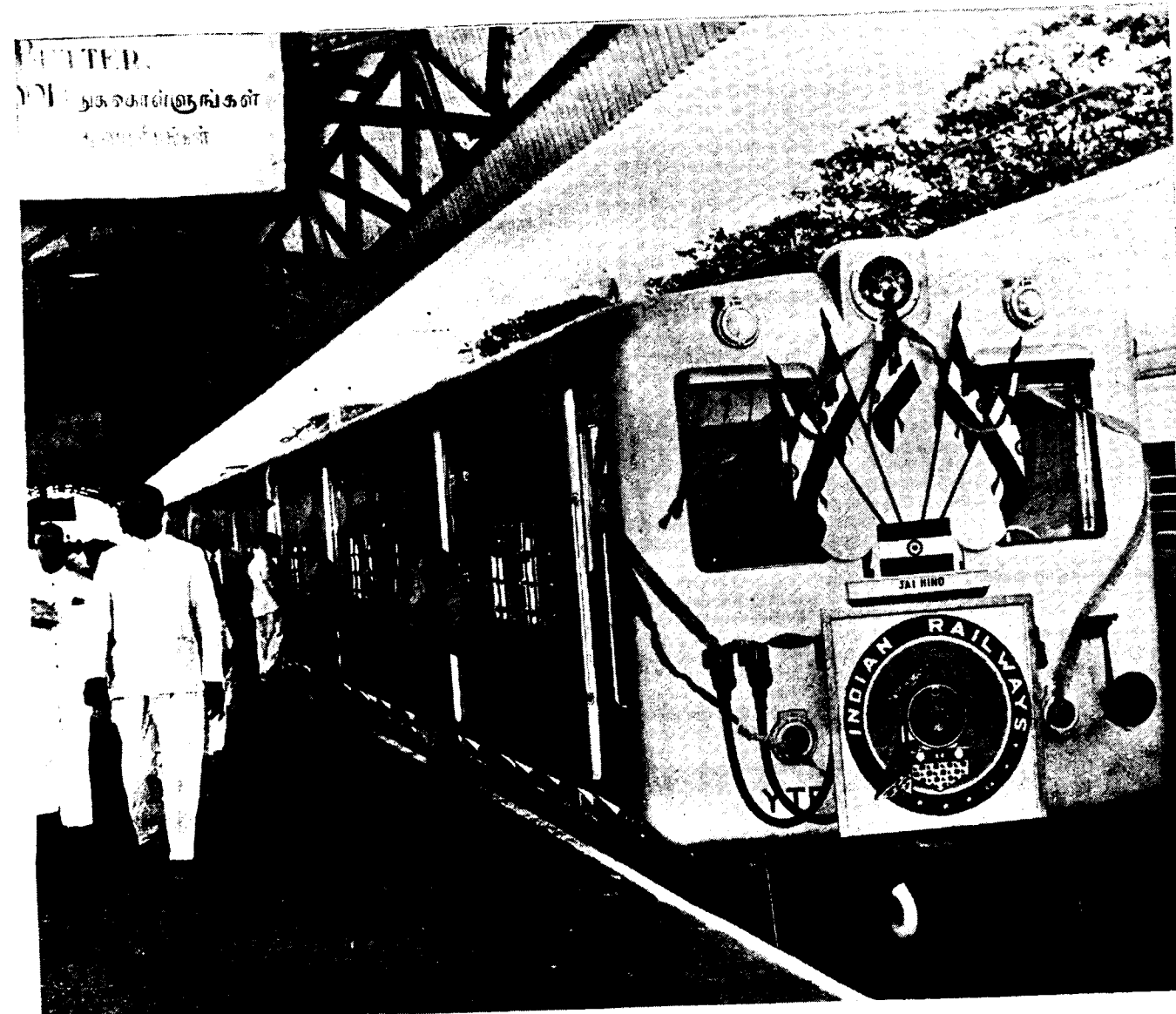


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ARE MANUFACTURERS OF ALL TYPES
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STEAM - DIESEL - ELECTRIC LOCOMOTIVES
ELECTRIC TRAINS - DIESEL RAILCARS
STEAM BREAK DOWN CRANES - WAGONS
CONVENTIONAL AND STAINLESS STEEL COACHES

Recent progress on Japanese Railways

It might be some interest to you to recognize the general idea of the recent progress on the railways in Japan through illustrations of many kinds of vehicles built in the latter years.

STEAM LOCOMOTIVE

With the recent tendency taken by most of the countries throughout the world, production of steam locomotive of the Japanese National Railways (J.N.R.) has never taken place since 1948. Fig. 1 shows class E 10, the last class of newly built on the J. N. R. The locomotives were made for the heavy gradient section of Itaya Pass (later electrified). After the completion of class E 10 locomotives, new classes of steam locomotives, C 61, C 62, D 60, D 61 and D 62, appeared on

the J.N.R., but all of those were of converted ones, but not of newly built. Class C 62 shown in Fig. 2 is the representative among those converted locomotives, that is to say, the locomotives were converted from 2—8—2 type freight ones to 4—6—4 type for express passenger service. The locomotives weigh 143 tons in working order and are fitted with a mechanical stoker, which was specially built in small size to suit to a narrow gauge locomotive. (Fig. 3)

Due to the blank of newly building of steam locomotive on the J.N.R. for nearly ten years, considerable numbers of the medium size locomotives are wanted since two or three years ago. To satisfy the said request, the design for the mixed traffic locomotives of 2—6—2 type was completed last year. (Fig. 4) The

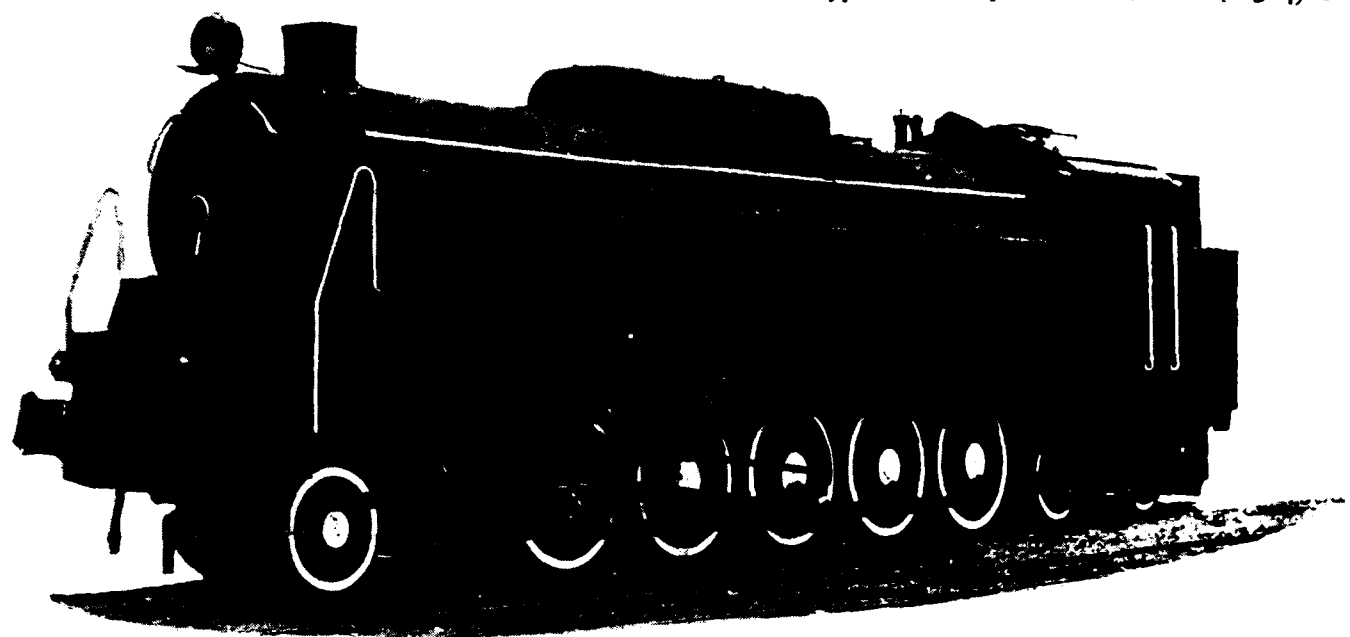


Fig. 1. 2-10-4 type tank locomotive for heavy gradient section of J. N. R.

GENERAL DIMENSIONS

Gauge of Track	1,067 mm	3'-6"	Heating Surface of Tubes & Flues	131.3 m ²	1,414 ft ²
Dia. of Cylinders	550 mm	1'-9 1/8"	Heating Surface of Firebox	14.4 m ²	155 ft ²
Stroke of Pistons	660 mm	2'-2"	Superheating Surface	77.4 m ²	834 ft ²
Dia. of Leading Truck Wheels	860 mm	2'-9 7/8"	Total Heating Surface	223.1 m ²	2,403 ft ²
Dia. of Trailing Truck Wheels	860 mm	2'-9 7/8"	Grate Area	3.3 m ²	35.5 ft ²
Dia. of Driving Wheels	1,250 mm	4'-1 1/4"	Working pressure	16 kg/cm ²	228 lb/in ²
Driving Wheel Base	5,800 mm	19'-3 3/8"	Weight of Engine in Working Order	103,300 kg	221,160 lb
Total Wheel Base of Engine	11,600 mm	38'-5 3/8"	Weight on Driving Wheels	70,000 kg	154,350 lb
Dia. of Boiler (Out. Dia. of 1st. Ring)	1,808 mm	5'-11 1/8"	Tank Capacity	8.3 m ³	282 ft ³
Tubes (Dia.-No.)	57 mm-74	2 1/4"-74	Fuel Capacity	4,000 kg	8,820 lb
Flues (Dia.-No.)	140 mm-75	5 1/2"-35	Tractive Power = $\frac{0.85 \text{ Pd}^2 \text{s}}{D}$	21,700 kg	47,850 lb

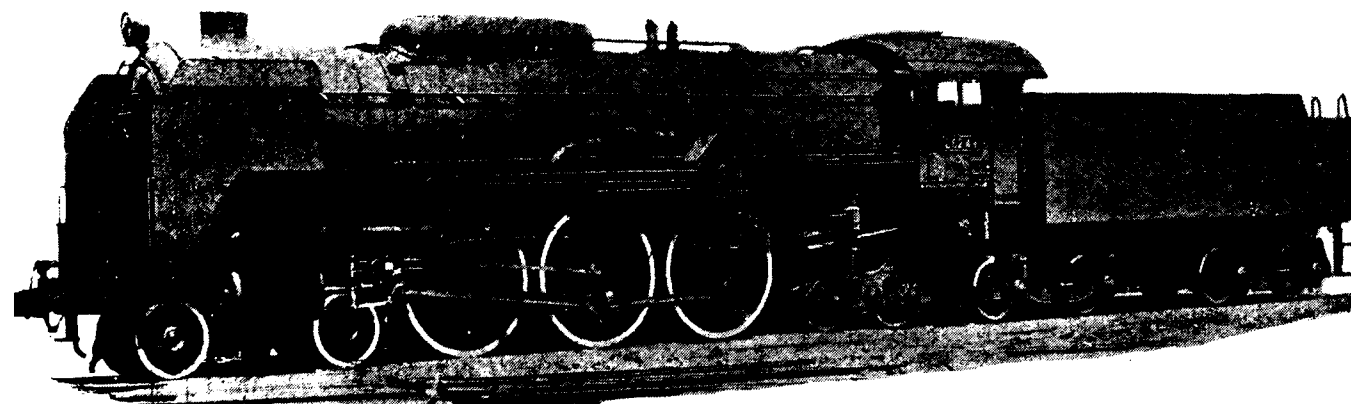


Fig. 2. 4-6-4 type express passenger locomotive for J. N. R.

GENERAL DIMENSIONS

Gauge of Track	1,067 mm	3'-6"	Heating Surface of Firebox	19.7 m ²	212 ft ²
Dia. of Cylinders	520 mm	1'-8 1/8"	Superheating Surface	77.4 m ²	833 ft ²
Stroke of Pistons	660 mm	2'-2"	Total Heating Surface	244.5 m ²	2,632 ft ²
Dia. of Leading Truck Wheels	860 mm	2'-9 7/8"	Grate Area	3.85 m ²	41.5 ft ²
Dia. of Trailing Truck Wheels	860 mm	2'-9 7/8"	Working Pressure	16 kg/cm ²	228 lb/in ²
Dia. of Driving Wheels	1,750 mm	5'-8 3/8"	Weight of Engine in Working Order	87,970 kg	191,990 lb
Driving Wheel Base	3,800 mm	12'-5 3/8"	Weight on Driving Wheels	48,600 kg	107,160 lb
Total Wheel Base of Engine	10,520 mm	34'-6 3/8"	Tank Capacity	22 m ³	777 ft ³
Total Wheel Base (Eng. & Tender)	19,000 mm	62'-4"	Fuel Capacity	10,000 kg	22,050 lb
Dia. of Boiler (Out. Dia. of 1st. Ring)	1,808 mm	5'-11 1/8"	Weight of Tender in Working Order	56,000 kg	123,480 lb
Tubes (Dia.-No.)	57 mm-94	2 1/4"-94	Weight of Eng. & Tender in Working Order	143,070 kg	315,470 lb
Flues (Dia.-No.)	140 mm-35	5 1/2"-35	Tractive Power = $\frac{0.85 \text{ Pd}^2 \text{s}}{D}$	13,900 kg	30,650 lb
Heating Surface of Tubes & Flues	147.4 m ²	1,587 ft ²			

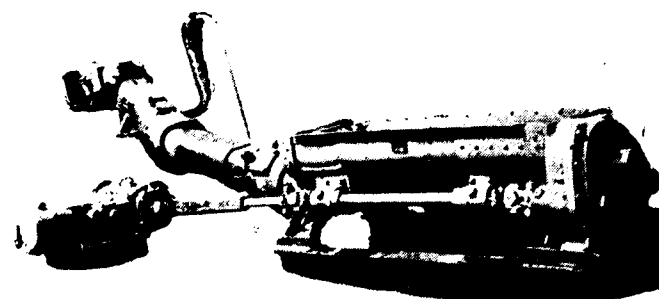


Fig. 3. Mechanical stoker specially designed for narrow gauge locomotives.

boiler of the locomotives is of all welded construction with a U shaped foundation ring and some of the locomotives will be fitted with roller bearings on all of the journal boxes and crankpins. However, any locomotive of this class has never been materialized due to the influences of the electrification and dieselization of the National Railways.

ELECTRIC LOCOMOTIVE & CAR

In Japan, due to lack of oil resources and high price of coal, the electrification takes the priority in the railways. Thus the large amount of electric locomotives were built after the World War II. They occupy bigger portion than any other kinds of locomotives newly built after the War.

There are two classes of the representative electric locomotives on the J. N. R.; classes EF 58 (Fig. 5) and EH 10 (Fig. 6). The former is of 2B-B2 type 113 tons, 2550 h.p. for passenger service and is installed with a set of steam generator for train heating purpose which is illustrated in Fig. 7. The steam generator is of mono-tube type with fully automatic control device and has the evaporative capacity of 1750 lbs. per hour.

The latter locomotive of B-B-B-B type for freight service is composed of two units in permanently-coupled. The locomotive has 3340 h.p. and weighs 116.5 tons.

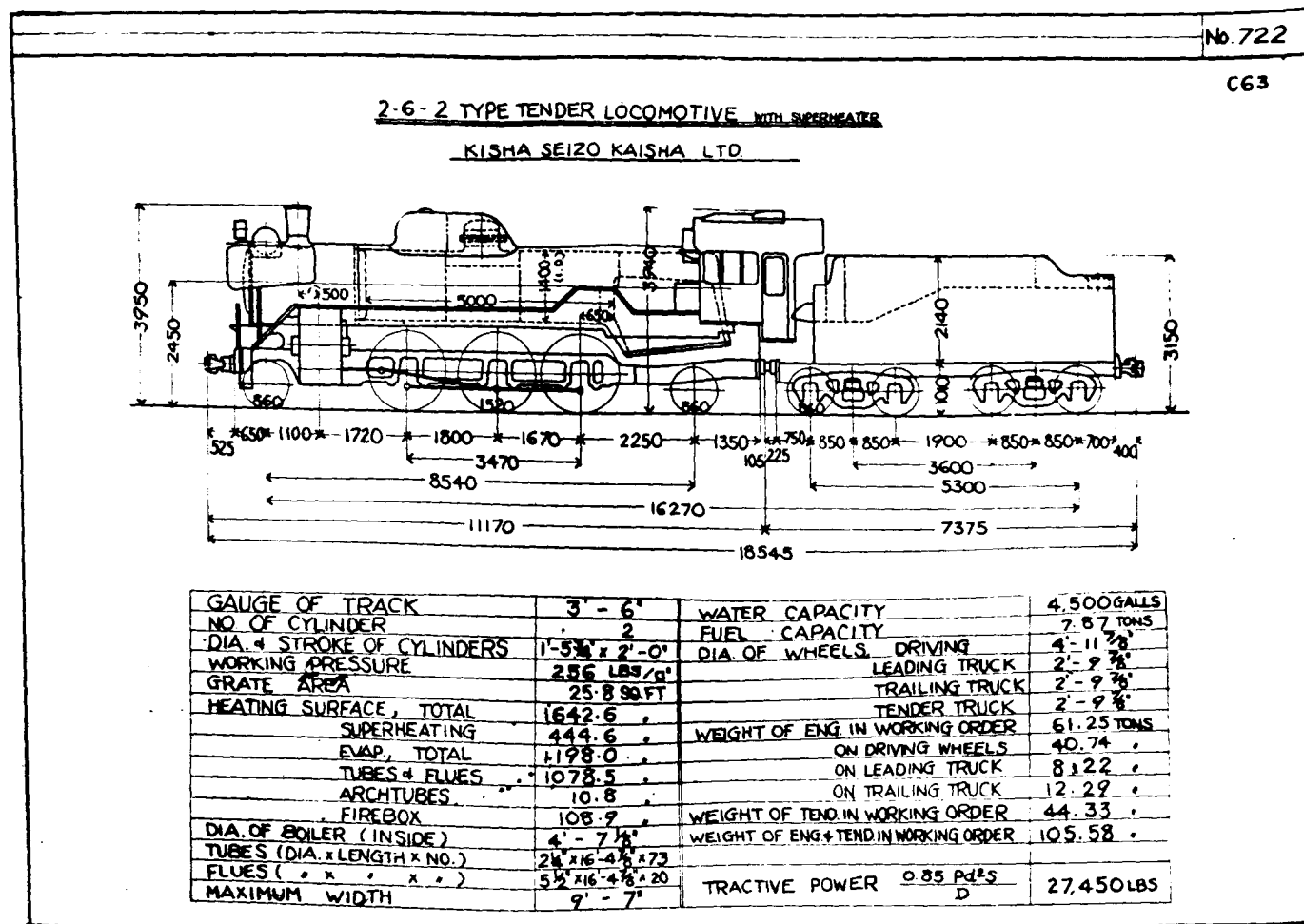


Fig. 4. Diagram of locomotive, class C 63, designed for mixed traffic service of J.N.R.



Fig. 5. Class EF 58, 2 B-B2 type 2550 h.p. electric locomotive for passenger service of J.N.R.

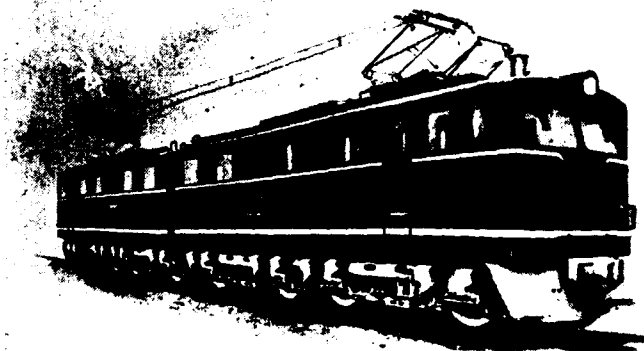


Fig. 6. Class EH 10, B-B-B-B type 3340 h.p. electric locomotive for freight service of J.N.R.

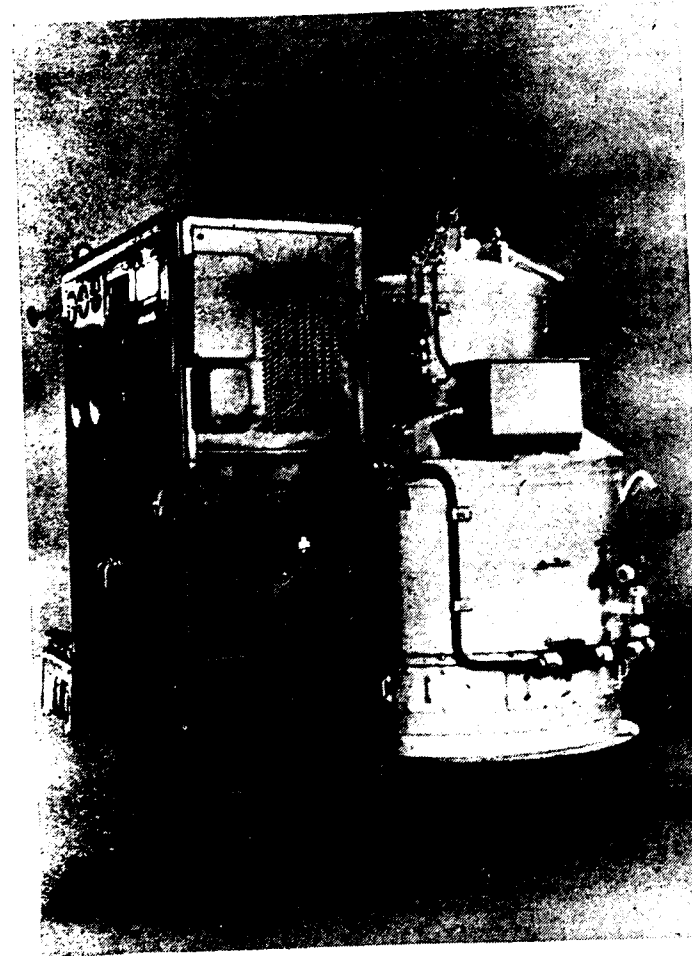


Fig. 7. Steam generator for train heating, installed on class EF 58 electric locomotive.

The generator is of fully automatic control.

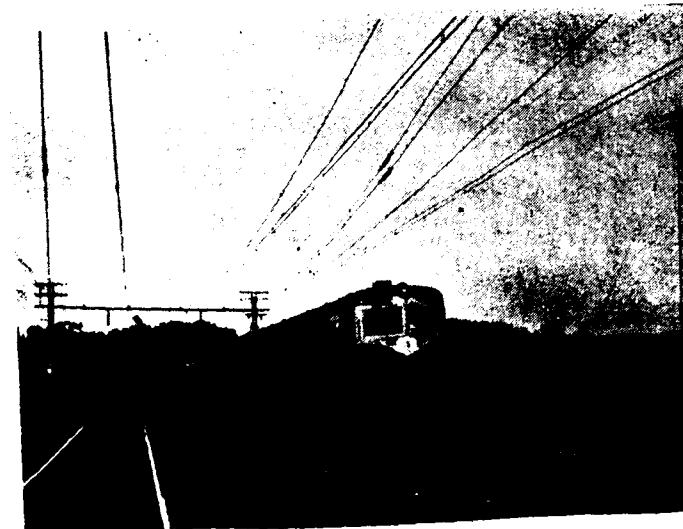


Fig. 8. Multiple-unit train used in Tokyo area of J.N.R. The train is composed of 15 cars.

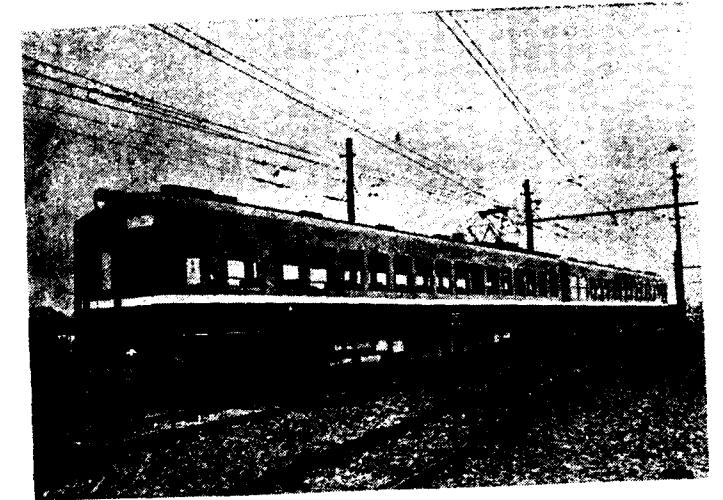


Fig. 9. One of multiple unit trains built for express service between Tokyo and Nikko, Tobu Railway.

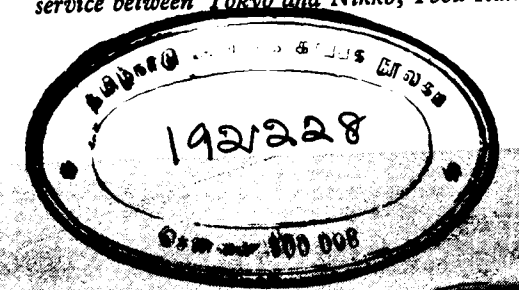


Fig. 10. Electric car built for operation of Tokyo Underground Railway.

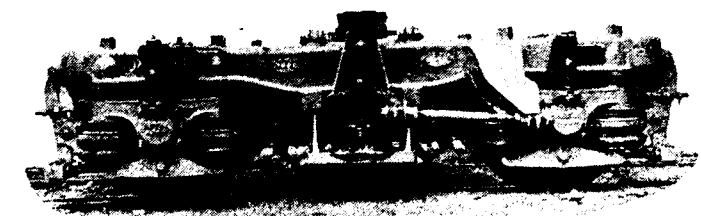
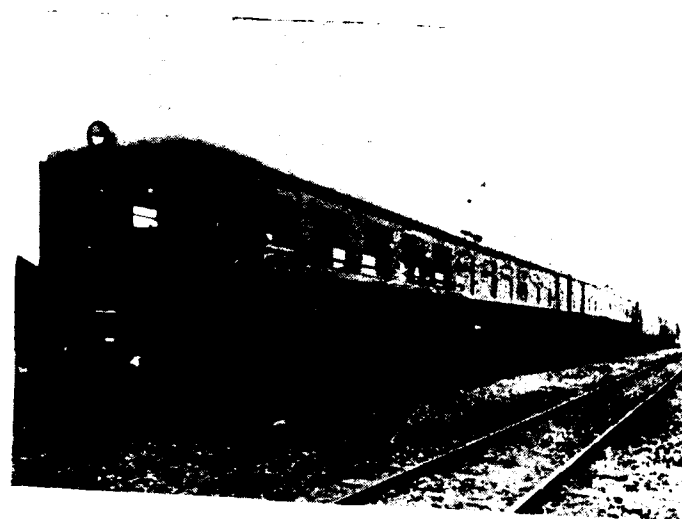


Fig. 11. Bogie with air spring used on electric car for KEI-HAN Electric Railway.



LEFT :

Fig. 12. Four-car diesel unit built for operation on secondary line of J.N.R.

BOTTOM :

Fig. 13. 320 h.p. R-B type diesel-hydraulic locomotive for switching service of J.N.R. (class DD 11).

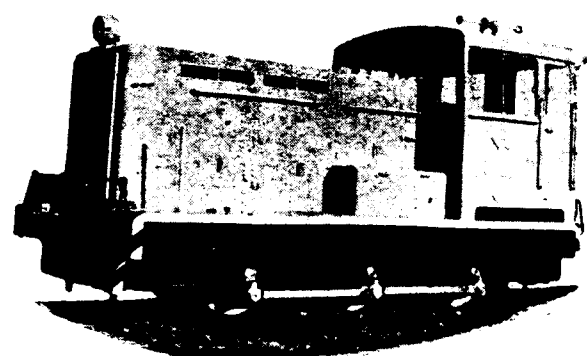
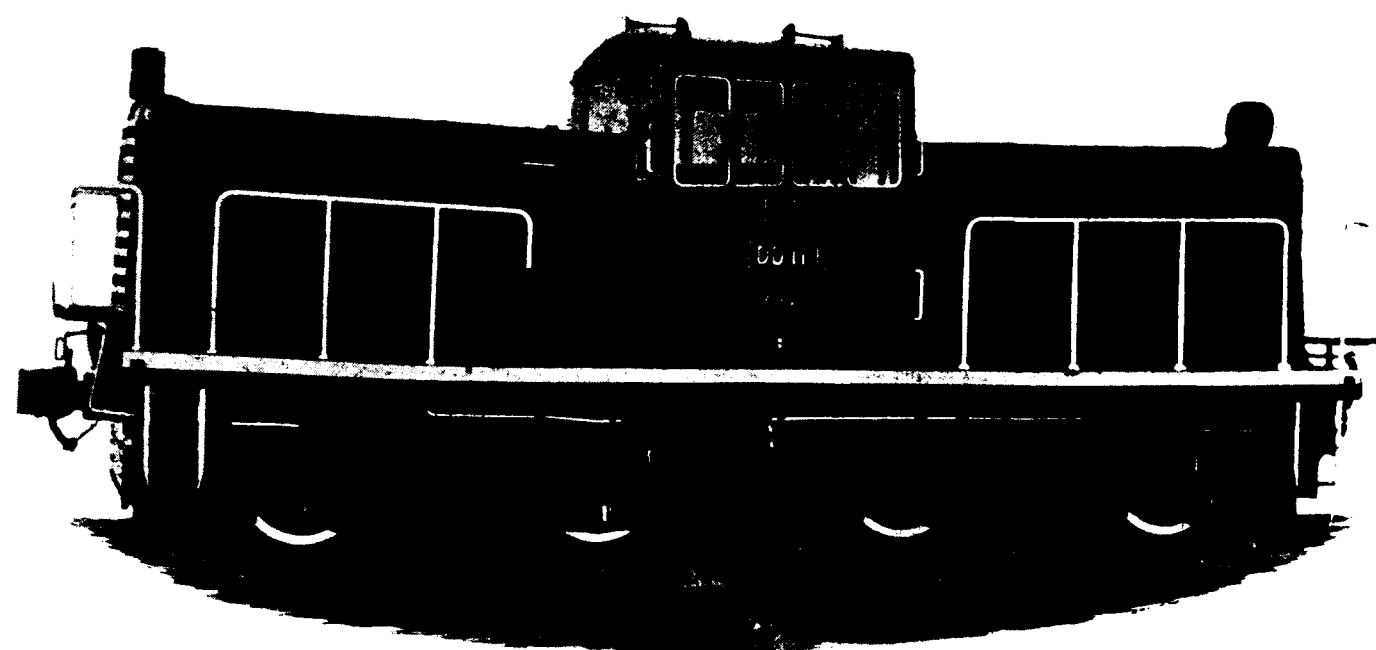


Fig. 14. One of the builder's standard design 25 ton, 160 h.p. diesel-hydraulic locomotives for industrial purpose.

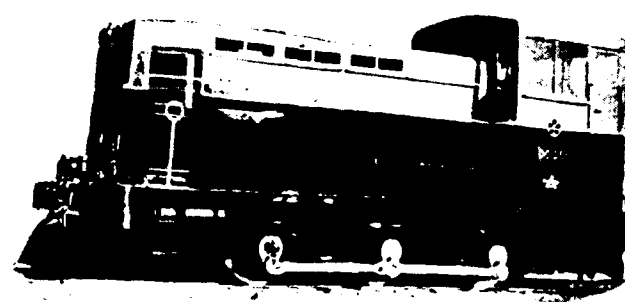


Fig. 15. 35 ton, 300 h.p. diesel-hydraulic locomotive built for mixed traffic on Nambu Railway of Japan.

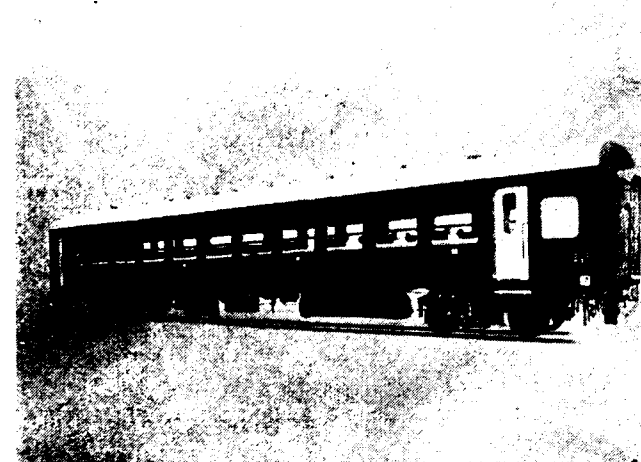


Fig. 16. Light weight, third class passenger car designed for operation on J.N.R.



Fig. 17. Interior of the passenger car, shown in Fig. 16.

Electric cars are also popularized throughout Japan, especially around big cities, such as Tokyo, Osaka & Nagoya areas. Not only the National Railways, but most of the big privately-owned railways apply electric cars, and those cars are proud of their up-to-date design both on the accommodations and on the mechanisms.

Most of the suburban and interurban electric cars are operated in multiple unit which are composed of from two cars upto as many as fifteen cars.

Fig. 8 shows one of the multiple unit trains composed of 15 cars. Those trains are operated on J. N. R. lines of Tokyo area.

Fig. 9 shows the newly built multiple unit train for Tobu Railway Co. The train is used for the express service between Tokyo and Nikko; the latter is one of

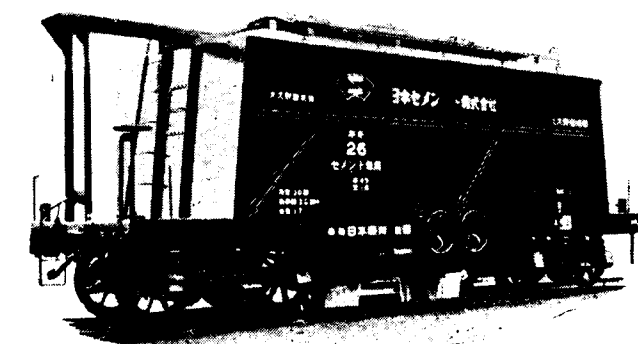


Fig. 18. Cement hopper car specially designed to transport cement.

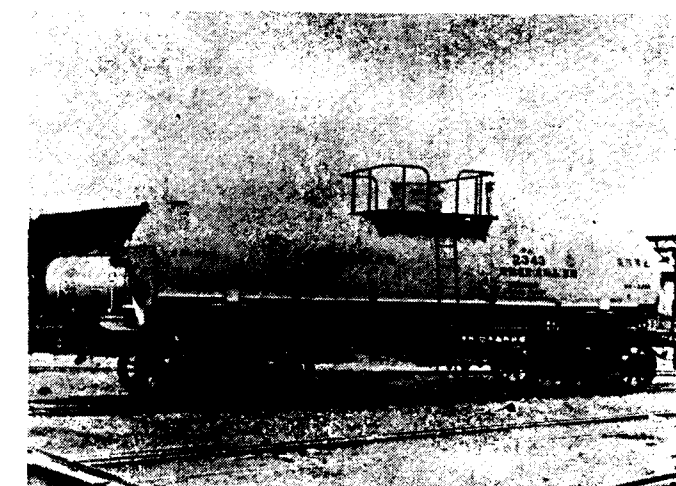


Fig. 19. One of special tank cars carrying liquid chlorine built for Nippon Soda Co.

the most scenic places in Japan. The cars are accommodated with reclining seats and a coffee stand.

The city transportation is also very busy both in Tokyo and Osaka. Those two cities have underground railways. One of the newly built electric cars of the Tokyo Underground Railway is shown in Fig. 10.

The notable characteristics on those modern electric cars in Japan are as follows :—

- (a) Trains are composed of all motor cars for obtaining high acceleration and retardation, the latter can be secured by means of dynamic brake.
- (b) Light weight in construction; about 30 tons per car of 60 feet length with four traction motors of 100 or 125 h.p.

(c) Fully sprung motors are applied instead of nose-suspension type. Power transmission is obtained by means of cardan shaft or flexible coupling between motor shaft and driving axle. The motors are of light weight and high speed.

(d) Truck or bogie is of all coil spring with shock absorber, and some of which will be applied air spring in the near future.

Fig. 11 shows an example of the truck with air spring, which was delivered to KEI-HAN (Kyoto-Osaka) Electric Railway.

DIESEL CAR & LOCOMOTIVE

As have mentioned in above article, the electrification holds the most important position on the Japanese railways, but the diesels are in more or less universal use throughout the country for railcars of new construction, particularly after the War. For local line operation these cars gain popularity by improved passenger service, while on one hand, operational expenses are saved. At the end of 1955, J. N. R. had 801 diesel coaches, some 550 units out of which were built within last four years. Furthermore, besides of J. N. R., some 300 units can be seen on the private railways.

Fig. 12 shows one of the representative diesel trains of J. N. R. All these cars of single-end type and are fitted with the Railways' standard engine of 160 h.p. and hydraulic transmission of the Lisholm Smith or Twin Disc types.

In regard to diesel locomotive, two classes were applied by J. N. R. Those are DD 50 DD 11; the former is of diesel-electric for passenger service on secondary lines and the latter is of diesel-hydraulic for switching purpose.

Diesel-hydraulic locomotives will be used more extensively in Japan due to cheapness in price and simplicity in construction. Fig. 13 shows class DD 11 diesel-hydraulic locomotive, the particulars of which are shown in Table I.

TABLE I

General Dimensions

Gauge of Track	1,067 mm	3'-6"
Wheel Arrangement		B-B

Diameter of Driving Wheels	860 mm	2'-10"
Rigid Wheel Base	2,000 mm	6'-6½"
Total Wheel Base	6,200 mm	20'-4½"
Total Length (Between Bumper Plates)	8,500 mm	27'-10½"
Maximum Width	2,510 mm	8'-2½"
Maximum Height	3,550 mm	11'-8"
Total Weight in Working Order	35,000 kg	77,200 lb
Type of Transmission	Hydraulic Torque Converter	
Diesel Engine	4 Cycle, 8 Cylinders, Straight Vertical	
Normal Output of Engine	2 × 160 HP (= 320 HP)	
Normal Revolutions of Engine	1,500 rpm	

Apart from J. N. R., uses of diesel locomotives on the private railways and industrial firms are rapidly increasing. Old steam locomotives are being replaced with diesel locomotives, which are generally of small size. Figs. 14 and 15 show those units. Fig. 14 is 160 h.p., 25 tons diesel-hydraulic locomotive for Nippon Semento Kaisha (Japan Cement Co.). Fig. 15 is 300 h.p., 35 tons unit for Nambu Railway of North Japan.

PASSENGER CAR

Much progresses have taken place on the design and construction of the passenger cars in the recent years. The progresses mean reducing the weight and increasing the comfort.

The former third class passenger cars of J. N. R., the width and length of which were 9 feet 2½ inches and 65 feet 7 inches respectively, weigh 33.5 tons. In 1955, J. N. R. completed a few of the specially light weight coaches shown in Fig. 16. The weight of these coaches is only 23 tons and yet the coaches have same width and length as of the former ones. Not only the weight of the coaches was reduced by means of all welded construction both on the superstructure and the bogies, but the accommodation was also much refined and improved. The inside panel was applied with hard-board covered by vinyl cloth in place of the former bare wood. Besides the inside panel, many wooden

(Continued on page 58)

The Reinforced Concrete Sleepers of the Vagneux System

By Paul Maille

Graduated from the Polytechnical School, President and Head Manager of the SATEBA.

THE use of reinforced concrete sleepers increasingly goes on finding new adepts among the authorities in the field of railway technics. The SOCIETE ANONYME DE TRAVERSES EN BETON ARME SYSTEM VAGNEUX cannot help feeling a certain pride when seeing that the ideas that its founder, Mr. Edmond VAGNEUX, untirely has put forward and defended since 1914, have made their way and are now adopted in France as well as in other countries.

In fact, no experiment with reinforced concrete sleepers had ever been really successful, no one had led to a real utilization on a large scale, before the task was taken up by Mr. Edmond VAGNEUX, chief engineer of the department of "Highways and Bridges", later chief engineer of the French Railroads, creator of

the system of reinforced concrete sleepers bearing his name.

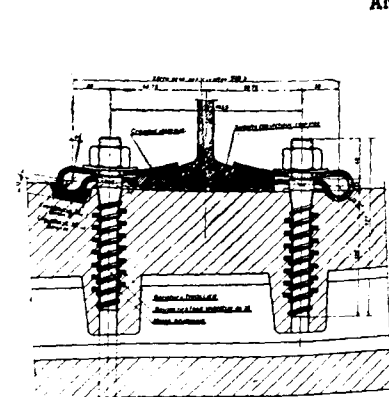
The penury of wooden sleepers after the world war 1914/1918 had shown with acuteness that it was to the interest of the Railway Companies to multiply their sources of supply of sleepers and to guard against the uncertainties of the wood market by appealing to the reinforced concrete. Among the many sleepers that appeared at that time, only the reinforced concrete sleeper of the Vagneux system is still in use, and with success, now for more than 30 years without interruption.

The reinforced concrete sleeper of the VAGNEUX system is well known. It is a composite sleeper, made

S. A. T. E. B. A.

SOCIETE ANONYME DE TRAVERSES EN BETON ARME VAGNEUX System

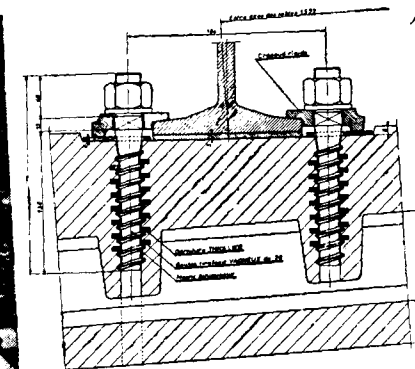
REINFORCED CONCRETE SLEEPERS FOR USE ON MAIN LINES
SLEEPERS AND SUPPORTS FOR TRACKS IN PORTS — CANALS — MINES
ELECTRIC POWER STATIONS — MILITARY DUMPS
FIXED OR MOVABLE BEDDING USING THIOLLIER METALLIC FITTINGS
AND COACH-SCREWS OR BOLTS VAGNEUX COACH-SCREWS



FASTENING USING VAGNEUX COACH-SCREW AND ELASTIC R. N. CLIP



EQUIPMENT USED BY THE S.N.C.F. IN FRANCE, IN 1955 OF THE DIJON-DOLE LINE



FASTENING USING VAGNEUX COACH-SCREW AND RIGID CLIP

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Works: CHALON-SUR-SAONE - LA FLECHE - SAINT-GERMAIN-DES-FOSSES
BENI-MERED - ORAN (Algeria) CASABLANCA (Morocco)

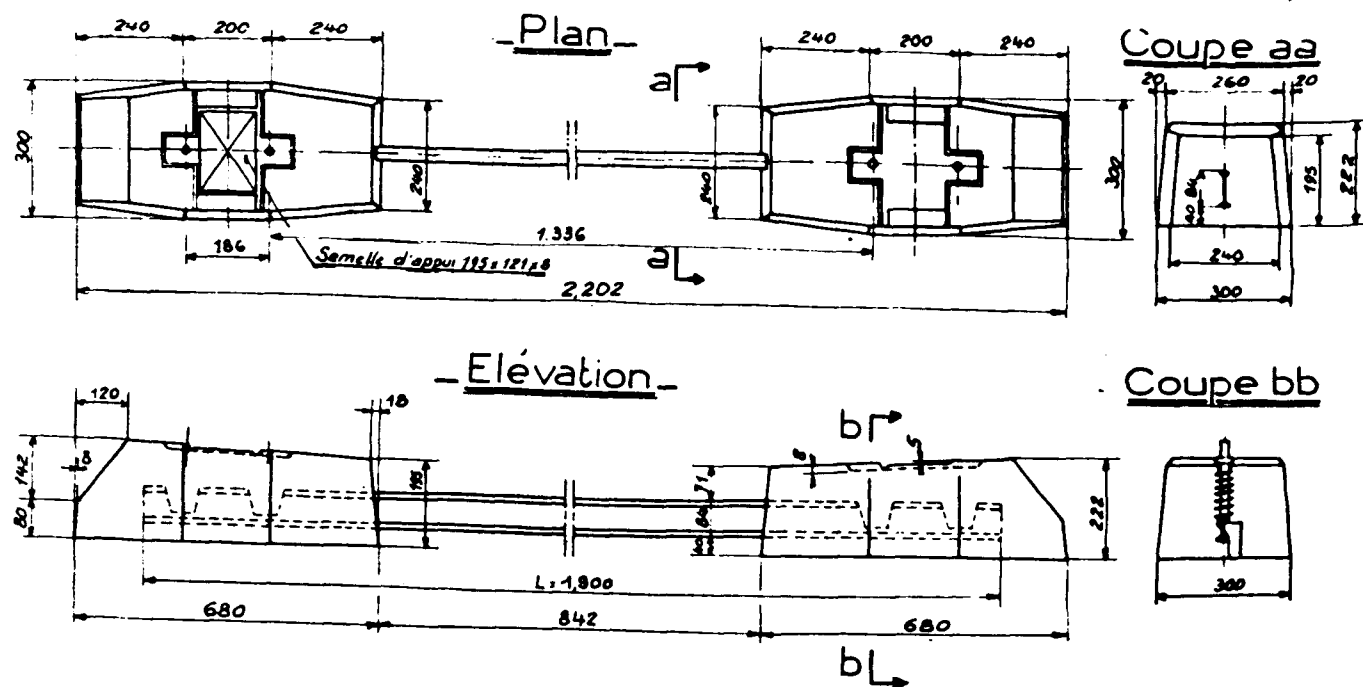


Fig. 1.

up of two blocks of reinforced concrete united by a metal cross-beam, either steel beam I section, or a piece of an old rail, or even an old rail relaminated.

Moreover, in 1954 the SOCIETE DE TRAVERSES EN BETON ARME SYSTEM VAGNEUX has taken out a patent for a sleeper of the same type, but with axial fastening device.

This sleeper (Fig. I.), like the reinforced concrete sleeper of the VAGNEUX system manufactured since the beginning, is built up by means of a metallic cross-beam uniting two blocks or sleeper heads, of reinforced concrete. However, in this sleeper with axial fastenings the cross-beam is a laminated iron with a special bulbous cross-section instead of the beam I PN 80/42.

Besides, the fastenings are situated in the longitudinal axis of the sleeper, two fastenings on each head, placed on each side of the rail.

Like all the VAGNEUX sleepers, these sleepers with axial fastenings can receive any one of the three types of fastening most commonly used at present by the French National Railroads for the equipment of the reinforced concrete sleepers of the Vagneux system, the prestressed concrete sleepers and the longitudinal stringers which they utilize :

- (a) Fastening consisting of a coach-screw SC, coated with the special Maille putty and screwed into the Thiollier fitting forming nut (Fig. II).

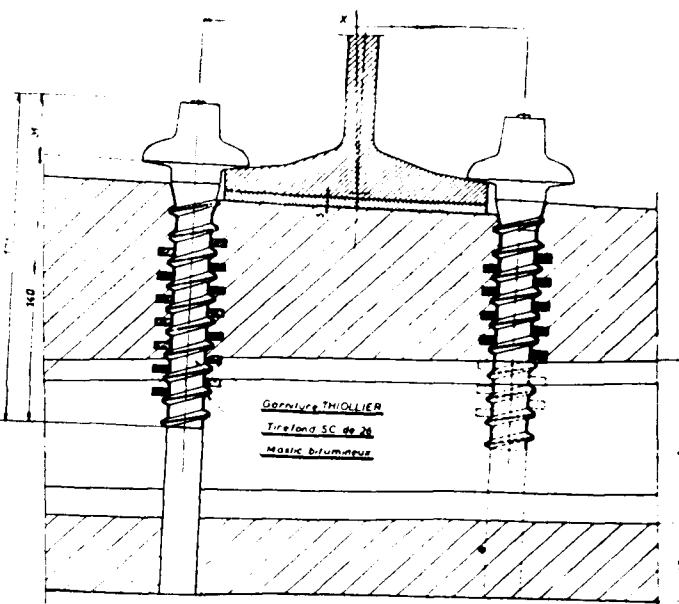


Fig. 2.

This is the most simple and the most economical fastening device.

The fastening is perfectly adapted to tracks with heavy traffic but with moderate speed.

- (b) Fastening by means of Vagneux bolt coach-screw and rigid clip, with sole-plate of bakelized wood or metal sole-plate (Fig. III). The Vagneux bolt coach-screw is coated with special putty and screwed into the Thiollier fittings forming nut.

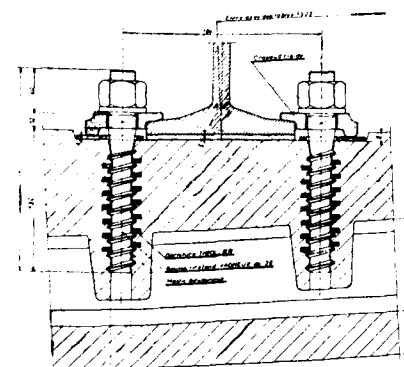


Fig. 3.

The combination of different types of clips permits the realization of various gauges with sleepers of the same drilling (between axes of the fastening holes).

- (c) Fastening by means of Vagneux bolt coach-screw and elastic clip, with sole-plate of grooved rubber. (Fig. IV).

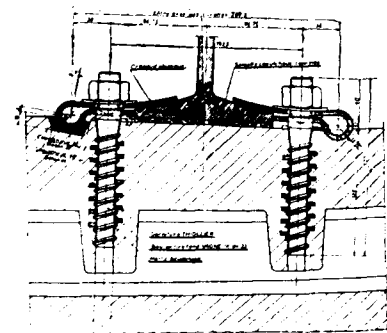


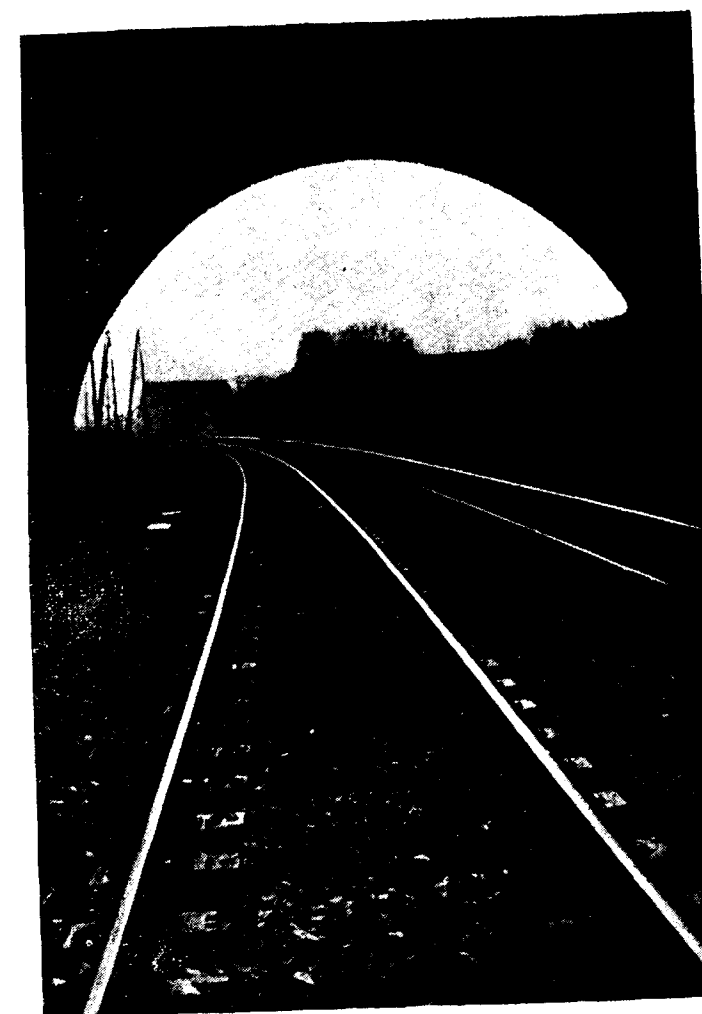
Fig. 4.

The Vagneux bolt coach-screw is coated with a special putty and screwed into the Thiollier fitting forming nut.

These two types of fastening, (b) and (c), are used on modern tracks with heavy and rapid traffic.

The type (c) is particularly suitable to the realisation of tracks with rails welded together forming lengths of more than 900 meters, which is the latest development in the railway technique.

As have been seen above, thanks to the various combinations which are possible with regard to the fastening of the rail, the VAGNEUX reinforced concrete sleeper can be adapted to the track to which it is destined according to the traffic conditions on the line in question.



Thus the Vagneux sleepers are to be found on lines with heavy and rapid traffic (passengers and goods) as well as on lines with slow traffic, as industrial junctions, or on tracks with very heavy traffic as harbour lines, coal mines, etc.

The two latter types of track supporting a relatively slow traffic can also be equipped with pairs of blocks not united with a metal cross-beam, alternating with ordinary sleepers. This reduces considerably the cost price of the track in question.

The Vagneux sleeper is thus characterized by this suppleness in adaption to the traffic conditions that the track has to ensure.

To sum up, in addition to the qualities of resistance proved by the wide use of the Vagneux reinforced concrete sleeper made by the French National Railway Society (more than 2,500,000 sleepers in service, some of them since 1930 and still satisfactory), the following particularly interesting advantages are to be mentioned :

- Suppleness in adaption to the traffic conditions.
- Possibility of equipping without difference with any one of the three principal types of fastening used at present :
 - (1) ordinary coach-screw,
 - (2) Vagneux bolt coach-screw with rigid clip,
 - (3) Vagneux bolt coach-screw with elastic clip.
- A very reduced maintenance requiring only a minimum of labour.
- Absolute resistance against atmospheric agents, and against parasites, termites, etc.
- Possibility of manufacturing on the spot, either in an important centre or on a movable working place near the place of utilisation. The simple conception of the Vagneux sleeper permits a fabrication that needs only a small proportion of highly skilled

labour thanks to the use of a material containing all the latest improvements, manufactured by the SOCIETE DE TRAVERSES EN BETON ARME SYSTEM VAGNEUX in their own factory at Persan (Seine & Oise), France.

At the present time, when great efforts are made, or are going to be made, in the railway service in all countries, either in renovating or in completing the public or private lines it is of importance to lay a great stress upon the advantages offered by the VAGNEUX sleeper, by far the most economical sleeper, because the best adaptable to the various subjections of the traffic and because it has the most important references.

These considerations have not escaped from the attention of the technicians and railway owners who are studying the development and the modernisation of the substructure of their railway system basing their calculations on the use of reinforced concrete sleepers of the VAGNEUX system.

(Continued from page 54)

parts, such as vestibule doors, window sashes, many kinds of trims etc., were replaced by light alloy. Consequently the inside view of the coaches were much modernized and, at the same time, many accommodations were modified to increase the passenger's comfort. Fig. 17 shows the interior of the coaches.

FREIGHT CAR

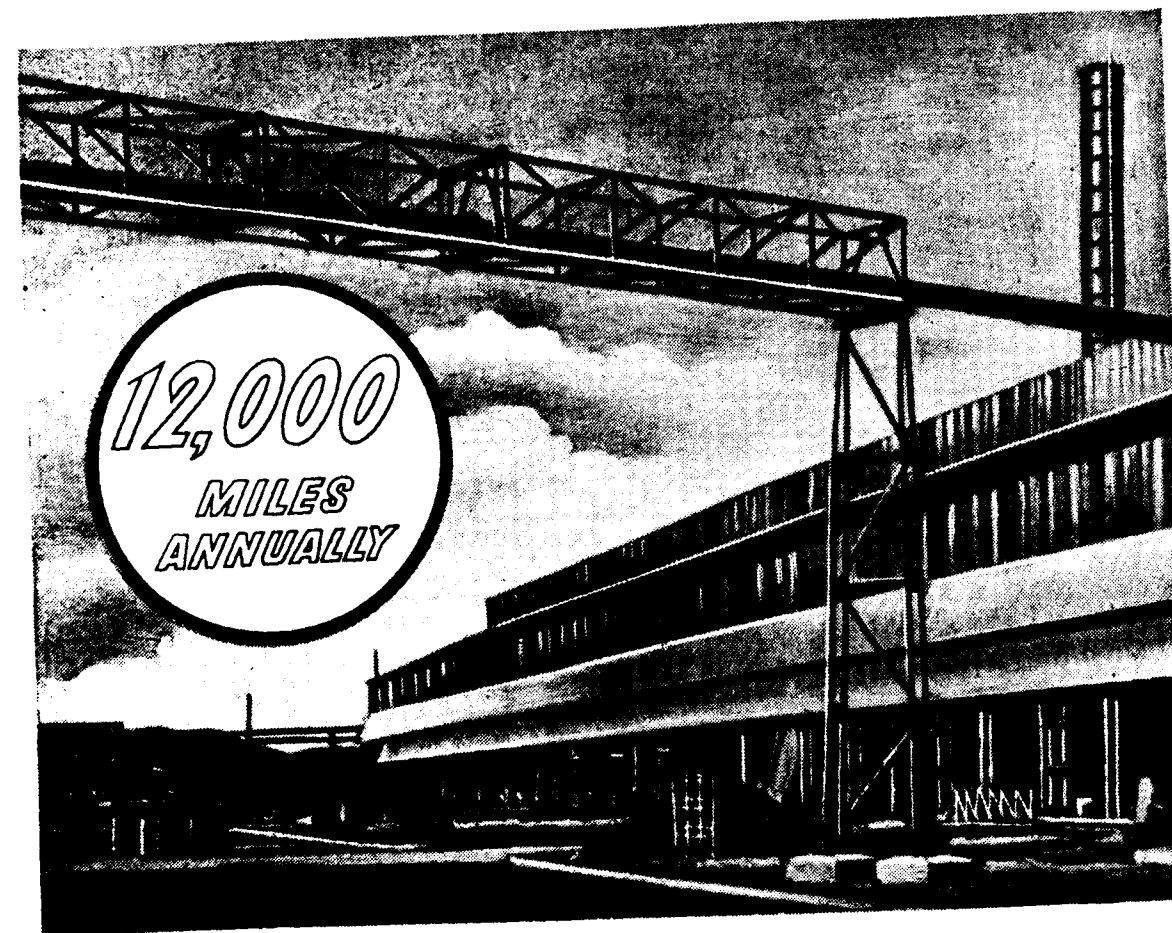
Apart from the conventional wagons, a few examples of the wagons for special purposes are shown in the illustrations. Those special wagons have rapidly increased in Japan in the recent years.

Fig. 18 shows a cement hopper car supplied to Nippon Semento Kaisha (Japan Cement Co.). Cement is discharged from the bottom by means of compressed air, which can be operated from the locomotive cab in the train. Fig. 19 shows a tank car for liquid chlorine. The tank and its mountings, such as inlet and discharge valves, safety valves etc., are carefully designed and manufactured for handling dangerous content of high pressure. Besides above tank car, there can be seen many kinds of special tank cars for carrying liquid ammonium, liquid propane, caustic soda, sulphuric acid, etc. in Japan.

RAIL CONCESSIONS FOR TWO MONTHS—TERMS OF CONCESSION ANNOUNCED

As announced by the Railway Minister while presenting the Railway Budget for 1956-57, it has been decided that concessional return ticket at one and a half single journey fares should be issued on all the Railways from July 15 to September 15, 1956 for Classes I, II and III. Return tickets will be issued only between stations which are situated at a minimum distance of over 300 miles from each other. Break of journey on the return journey will not be permitted, but it will be allowed on the outward journey according to the normal rules applying in the case of single journey tickets.

Passengers must present the return halves of their tickets at the booking office of the station from which the return journey is commenced, and have these dated, indicating the date of commencement of the return journey. This is important, as passengers holding return halves which are not so dated will be treated as ticketless travellers. For journeys between 301 and 500 miles the period of availability of the return tickets will be 20 days; between 501 and 750 miles it will be 25 days; and for journeys of 751 miles and over the period of availability will be 30 days. However, the return tickets will not be valid for the completion of the return journey after the midnight of September 30, 1956. For example, a return ticket issued for a distance over 750 miles on September 14, will be available for completion of the return journey only up to September 30, 1956.



Our Fretz Moon Mill at Jamshedpur has an annual capacity of 90,000 tons of tubes to BS 1387, equivalent to some 12,000 miles—the distance from Calcutta to New York.

A further Mill to produce Electric Resistance Weld Tubes will go into production early next year and the Government have issued a licence for a third Mill which will start producing Seamless Tubes in 1959. India will then be practically self-sufficient in Steel Tubes.

**THE INDIAN TUBE COMPANY
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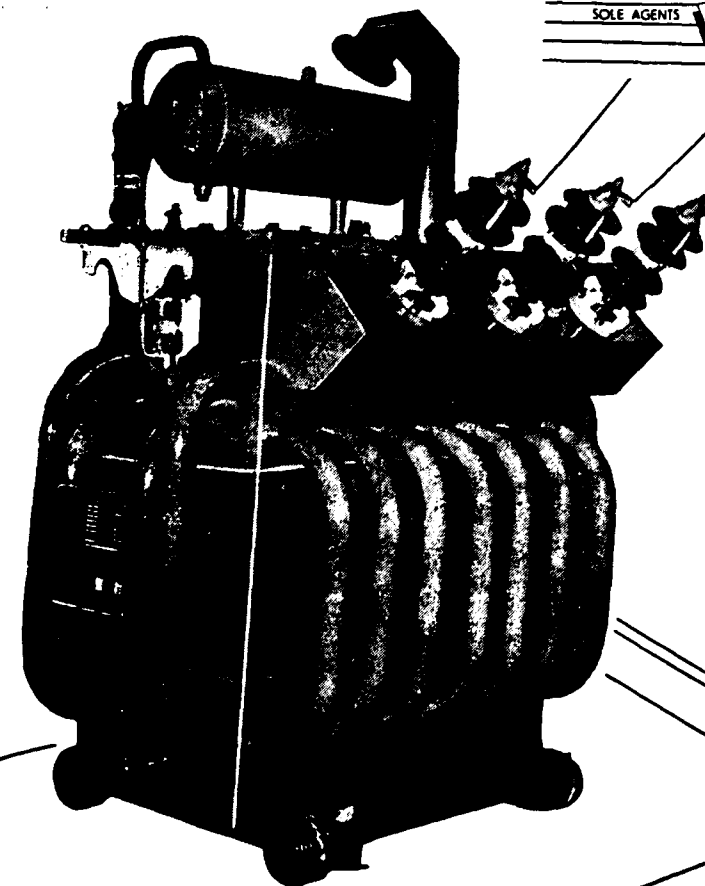
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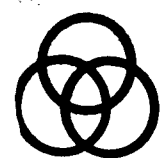
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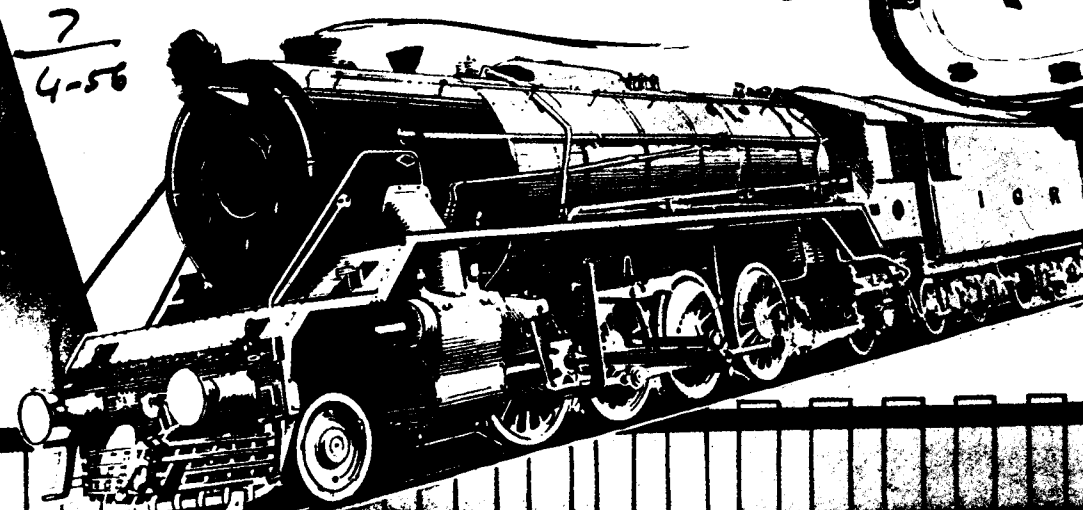
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SOUTHERN RAILWAYS

Magazine



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SOUTHERN RAILWAYS MAGAZINE

1

Front and Trailing Trucks—their Influence on the behaviour of a Locomotive

By M. S. Surma

IN response to the demand of increasing traffic, the power and consequently the size of locomotives is being increased considerably, and the limitations imposed by the moving dimensions, force this increase in the longitudinal direction only. If the locomotives were to move only on the straight tracks, the increase in their length would be beneficial as,

- (i) A longer wheel base results in a reduction of angularity in track.
- (ii) Full weight of loco can be utilised as adhesive weight and thus slipping of wheels while pulling heavier loads can be avoided.
- (iii) The problem of axle load limitations is solved.

But their running on curves and turn-outs brings in the problem of wheel rail infringement which can only

be solved, either by the provision of enormous lateral clearances at the intermediate wheels or by dividing the whole locomotive in a number of trucks.

When both of these alternatives are studied, it would be found that it is advisable to divide a locomotive in a number of trucks than to provide sufficient lateral clearances at the inter wheels. In this way not only the required flexibility on curves and turn-outs is provided, a control mechanism can also be located suitably for efficient guidance. Apart from the consideration of running in curves and turn-outs, the use of low grade coals is another factor which necessitates a trailing truck and more preferably a single axle truck.

While dividing a locomotive into different trucks, the following vital points are to be kept in view:—

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- (i) All the axles grouped together under a common chassis should be parallel to each other.
- (ii) All the wheels forming a truck should preferably have equal diameters.
- (iii) The trucks should be able to swivel and if one of them is unable to swivel, the other should not only be able to swivel but should be capable of lateral movement as well.

In a locomotive the main truck consists of the one formed by the coupled wheels, and the others trucks, if any, are called the auxiliary trucks. The main truck is unable to swivel but is provided with little transverse play, but the auxiliary trucks have provision for lateral movement and swivelling. On Indian Railways they are found in the following combinations:—

- (a) Pony at front end.
- (b) Pony at front and at rear.
- (c) Bogie at front only.
- (d) Bogie at front and at rear.
- (e) Pony at front and bogie at rear.
- (f) Bogie at front and pony at rear.

From the above combinations it will be seen that though the system of providing auxiliary trucks is found in so many combinations, the kinds of trucks are only two namely four wheeled bogies (The bogies, in use in India have four wheels only, though six wheeled bogies are in use abroad) and two wheeled ponies.

The three important points, by which the influence of a bogie or a pony truck on the behaviour of a locomotive can be determined are:—

- (i) The location of contact between flange and rail. This contact have three locations. (a) Ahead of the vertical through axle centre. (b) At a point on the vertical through axle centre. (c) And behind the vertical through axle centre. It can be proved by the resolution of forces acting at the point of flange rail contact, that the magnitude of the lateral force which an axle can withstand before it derails is pretty high in the case of trailing contact (when the wheel is said to have an inward running tendency) than in the case of a leading contact (when wheel is said to have outward running tendency).
- (ii) The guiding force which a truck can supply through its control mechanism, the optimum

value of which should be sufficient to guide a locomotive around a curve or a turn-out with the least possible flange impacts. For the considerations of safety the value of the optimum guiding force has to be kept under a specified value.

- (iii) The amount of lateral swing provided for the truck for smooth running around curves and turn-outs. The maximum desirable value of this swing can be determined by plotting the locomotive on the sharpest curve or turn-out it has to negotiate. The swing should be sufficient to avoid any flange rail infringement. Mathematically the swing for a single axle truck, as given in "Steam Locomotive" by R. P. Johnson can be determined by the following formula.

$$S_p = \frac{d.y^2 + y.c.R}{y^2 + R^2} \dots\dots\dots(1)$$

For a double axle truck,

$$S_b = \sqrt{R^2 + B^2 + AB} - R \dots\dots\dots(2)$$

Where,

- S_p is swing of pony.
 S_b is swing of bogie.
 A is length of rigid wheel base.
 B is distance between the leading coupled wheel and truck pivot pin.
 C is distance between the rigid wheel base centre to pony pin.
 d is Radius of curve minus lateral clearance at inter wheel.
 R is radius of curve.
 Y is length or radius bar.

In the light of the above considerations, an attempt has been made in this note, to discuss in a brief and a simple way, the behaviour of different combinations of the auxiliary trucks i. e. bogies and ponies.

PONY TRUCKS

A pony is a single axle truck used in front as well as rear of certain locomotives. While traversing curves it always adopts constrained curving, because of one of its flange being guided by outer rail and of its attachment to the engine through radius bar, which allows it to run radial to the curve, giving it a natural inward running

tendency. The optimum length of the radius bar can be calculated by the well known Baldry formula,

$$Y = \frac{1}{2} (T - F^2/T) \dots\dots\dots(3)$$

or from the formula given in "Steam Locomotive" by Mr. Ralph. P. Johnson,

$$Y = \frac{(A + B) B}{A + 2B} \dots\dots\dots(4)$$

Where,

F is $\frac{1}{2}$ the rigid wheel base.

T is distance between the centres of rigid wheel base and pony truck

PONY AS A GUIDING TRUCK

For a given speed, there is a minimum guiding force which must be supplied by the control mechanism located on a pony, to guide a locomotive around a curve. At the same time the value of this guiding force, for consideration of safety, should not exceed certain percentage of the axle load of pony truck. As stated before that the remarkable characteristic of a pony truck is its tendency to run inwardly, thus the flange rail contact being behind the vertical through axle centre and the centre of friction ahead of the axle. If this behaviour of the pony trucks can be guaranteed, they will really be very efficient guiding agents for locomotives but unfortunately a higher value of control force—sufficient to guide a modern high speed locomotive round a curve—forces it to adopt an 'outward' running thereby placing a definite limit on control force which can be tolerated in the case of a pony truck.

It may be mentioned that hardly, in India we come across a pony truck having more than 12 tons axle load, and if control force is limited to 40% of its axle load—and a fair figure for the safety consideration—then it may be concluded that the figure will be ridiculously small to guide a heavy and high speed locomotive. It proves that a pony truck in the case of a high speed locomotive cannot be considered as an efficient guiding agent.

PONY AS A TRAILING TRUCK

A locomotive while running in a curve requires a minimum possible control force at its rear end as it opposes the locomotive to adopt itself in curve. Though this anticurving force at the rear of a locomotive is undesirable yet a minimum value of it, just capable of making the rear truck self-centring while running out of curves, has to be provided. The value of this force is pretty small as compared with the guiding force at front. Therefore a pony truck which 'misbehaves' under the influence of a heavy control is most suited as rear truck. As it runs radial to the curve it negotiates it does not produce rearing action on the rear of locomotive.

BOGIE AS GUIDING TRUCK

A bogie with two axles is more suitable as a guiding truck as it can supply double the amount of control force than a pony truck. While running on the curves it may run either with its leading outer wheel or with both leading and trailing wheels against outer rail. The latter is advantageous as the reaction of the control is shared by both the flanges and thus the leading wheel of the bogie is relieved of some of the flange force. If the contact with the rail is made by the outer leading wheel only it is sure to have an outward running tendency so that the wheel cannot take up sufficiently heavy lateral loads and its tendency always will be to mount the rail. If both the leading and the trailing flanges make contact with the outer rail the bogie becomes inward running and the wheel in this case will be able to withstand heavier lateral loads without any danger of derailment. The inward running tendency for the bogies can be gained by providing the swivelling arrangements about the pivot and the control mechanism within the wheel base of the bogie.

BOGIE AS TRAILING TRUCK

When the bogie is trailing it helps the engine to turn itself and adjust in the track while running on the curves, but is unable of turning itself. This induces a rearing action. It is bound to run 'outward' and its leading wheel will always be binding on the outer rail making contact with the rail ahead of the vertical drawn through the axle centre. It also produces some anti-curving effect on the engine as it is well known that any

appreciable control force in the rear will resist the efforts of a locomotive to screw round the curves.

BOGIE AT THE FRONT AND AT REAR

In this case if the locomotive is to run only in one direction, the action of the leading bogie is to guide the loco round the curve smoothly, if provided with adequate control, but as stated above the presence of the trailing bogie will produce rearing action. If the locomotive is to run in both the directions, the problem becomes of a different nature.

As is well known that leading bogie with adequate control helps in guiding the locomotive on curves and a trailing bogie gives an anti-curving force, therefore the amount of control at the rear should be as little as possible, say, only to overcome the friction between the slides of the trailing truck, so that the engine is forced back to its central position after curving out. Even if this control is slightly less than the friction between the slides, it will bring the engine back to the central position, as the frictional resistance between the slides is always changing on account of the vertical oscillations at the cab end.

If the locomotive is to run in the backward direction, this bogie which has a very little amount of control will be leading, and it will be impossible for it to guide the locomotive round the curve without the danger of derailment and excessive lateral forces on coupled wheels. In this case the maximum guiding will be done by the leading coupled wheels. But at this wheel has a smaller lever arm about the centre of friction, it will be subjected to comparatively greater lateral forces. At the same time the trailing bogie with a heavier control will hardly allow the locomotive to screw itself round the curves. The danger of derailment, therefore, in this case is far greater.

If the locomotives fitted with trailing bogies are to run in one direction only, the control provided should, be as stated before, very little. The locomotive while running on a curve does not run as a chord to the curve but facing outward so that the centre of friction always is somewhere between the trailing coupled of wheel and the trailing truck, and the value of the control will not go so high as to be very detrimental.

To provide adequate guiding for the high speed locomotives, the best combinations, therefore, seem to be a bogie at the front and a pony at the rear.

END CONTROL

Controls, if adequate at the front at the rear of a locomotive, will not only keep the whole locomotive in a

single rigid wheel base on a straight track, thus making it run 'hunting free', but will make it run smoothly round curves without giving rise to excessive flange forces. If the curve around which a locomotive has to pass is without any irregularity, then with adequate control force, the whole guiding will be performed by the front truck, without the locomotive encroaching upon its lateral clearances on coupled wheels. But as the irregularities in the track cannot be avoided the function of the controls remains to reduce the value of flange impacts to minimum possible.

Controls may be divided into two classes, viz.

- (i) Gravity control and
- (ii) Spring control

GRAVITY CONTROL

Gravity controls are provided by the introduction of either slanting slides, for example Cartaxi slides, or swing links. In the case of slanting slides, the locomotive after getting shifted from the central position, will try to come back to the original position under the action of gravity. The presence of the slanting slides affects the weight distribution, which is undesirable and therefore they have almost been eliminated as control agents. In the case of swing links if the locomotive drifts from the central position, the vertical component of the link tension and the compression on the spring, force it to come back to the central position. The wear on the pins in the case of a swing link cannot be avoided and consequently the value of the control is affected. On our new locomotives the swing link control has been replaced by more efficient one i. e. spring control in conjunction with slides.

SPRING CONTROL

Two types of springs—laminated or helical—are used in this system. The laminated springs when used afford damping on account of the friction between the plates. This friction has a detrimental effect of reducing the force by which the locomotive has to be forced back to the central position after moving out of a curve, because some work has to be done to overcome the friction between the slides. Sometimes on account of this friction the instantaneous force of the laminated spring becomes less than the frictional resistance between the slides and the truck, even after leaving the curve, goes on running towards one side till such time due to vibrations the frictional resistance between slides reduces to an extent that the spring force is able to move the slide laterally to the central position. Therefore, if the laminated springs are used as control springs, there initial crack off will have to be kept sufficiently high to cope up

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with the above mentioned phenomenon. As the total initial crack off has to set at a specified limit, laminated springs can only be used where metal slides with efficient lubrication are used.

A difficulty, in the case where metal slides with lubrication are used, is generally experienced to attain efficient lubrication. Experience has shown that it is impossible to avoid dirt finding its way thus causing the friction to attain a very abnormal value which may sometime cause a derailment.

In view of the above argument, it may be concluded that laminated springs and lubricated metal slides cannot efficiently perform the function of control device and therefore, they are not very suitable.

It may be mentioned that the two XP locomotives, when first came to India, were fitted with the laminated spring controls. The location of the control at the front end was as usual, but for the rear end it was at the front tender bogie instead of at hind truck. The location of the rear control was however, again brought to the hind truck and the laminated springs control were replaced by helical spring controls, and lubricated metal slides were replaced by fabric friction material slides.

HELICAL SPRING CONTROL

The helical springs do not offer any damping effect and unlike laminated springs do not lose any force while attaining their original position. When these springs are used in conjunction with the friction material slides with a low coefficient of friction say 0.15 or even lower just to offer sufficient damping, give really very good results. The friction slides are meant to run dry, therefore there is no trouble of maintaining the lubrication. They are supposed to have a constant coefficient of friction throughout the service, if given a good smooth surface before fitting in position. Care should be taken that these slides are not lubricated and that the engines fitted with these slides are not allowed to stay idle for a considerable period otherwise there is a danger of these slides getting jammed.

Research on the Indian Railways is in progress to find out a suitable material to match with these slides which will give the lowest and a constant coefficient of friction. Trials by the Research directorate have also been conducted, to determine the behaviour of guiding tracks, when these slides have a reduced bearing area. Some interesting results will come out when the reports of these trials which are under preparation are published.

ANTI-SWIVEL CONTROL AT THE BOGIE TABLE

Moderate friction at the bogie table is desirable to oppose any independent nosing of bogie trucks under a locomotive. At the same time friction should not attain a value so as to augment flange loads at the leading bogie wheel. Mr. da Costa in his paper "Riding of Pacific Locos" has worked out an example which gives the limit for the moment of this frictional couple for a bogie with a particular wheel base and vertical loads on its axles.

EFFECT OF THE AMOUNT OF CONTROL

If the control on the front end of an engine is increased it relieves the leading coupled wheel of the flange force but brings an increase on the truck wheel flange force. This has an advantage, because if the wear on leading coupled wheels on account of excessive flange force is greater, and if the leading coupled wheels are to be turned down to the correct profile, all the coupled wheels, irrespective of the amount of wear on them, will have to be turned so as to have equal diameters. A comparatively greater amount of work, time and money will be involved. But if by the provision of a heavier control, the wear on the leading truck wheels, is greater, necessitating the turning of these wheels, it will be comparatively an easier process.

A very heavy control at the front end makes the leading truck to bear the brunt of the guiding force. On its being at the extreme end, if on account of excessive lateral force it derails, the total guiding will then have to be performed by the leading coupled wheel—only a relatively small share being taken by the other wheels—which are nearer to the centre of gravity of the locomotive. Leading coupled having relatively smaller leverage than that of the front truck may not be able to guide the locomotive effectively and under the influence of heavy lateral forces may follow the leading truck with disastrous consequences. If perchance the wheel, in the case of weaker front control, derails, the leading truck because of its greater leverage can still guide the locomotive and there is a possibility of the leading coupled again getting on to the rails as in fact has been once noticed at Weaver Junction in England.

THE AMOUNT OF CONTROL FOR EFFICIENT GUIDING

The amount of controls at the ends of a locomotive is so determined that the locomotive may remain in a single rigid wheel base while running on straights and may pass the curves with the slightest possible

flange loads. At the front end its value is fixed by taking moments about the imaginary centre of friction at the wheel treads of all the coupled wheels and then by balancing the sum of these moments by another

moment about the same centre of friction at the front truck. For example consider a locomotive as in fig. No. 2. The centre of friction is assumed to be at the hind truck. Then the moments will be,

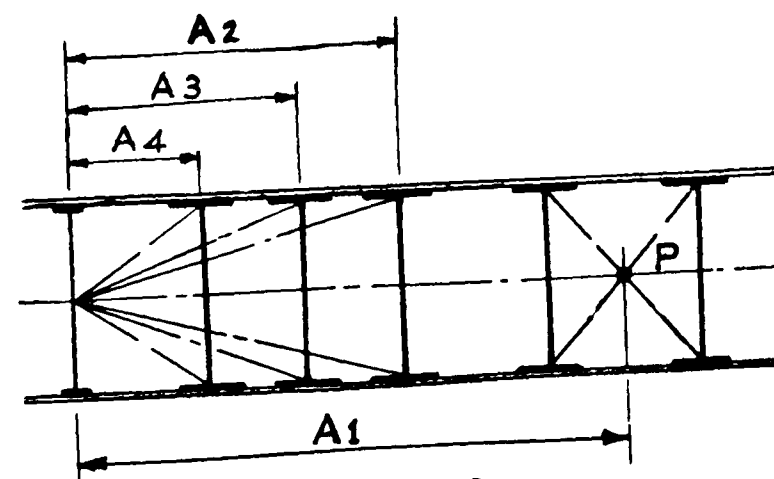


FIG. No. 2

$$2UW\sqrt{A_2^2 + G^2} + 2UW\sqrt{A_3^2 + G^2} + 2UW\sqrt{A_4^2 + G^2} \dots (5)$$

Consider this equal to K

This moment should be balanced by the moment of the coupled A, P

From which,

$$P = K/A_1 \dots (7)$$

where,

W = Wheel load,

= Coefficient of friction between wheel and rail,

G = $\frac{1}{2}$ the track gauge at the tread contact points and

A₁, A₂, A₃, A₄ as given in Fig. No. 2.

$$P = \frac{\text{SPRING CRACK OFF} + \text{FRICTION}}{\text{BETWEEN BOGIE SLIDES.}}$$

The value of P thus arrived at is equal to initial spring crack off plus frictional resistance between the truck slides. The distribution of the load P between the spring crack off and the slide friction is proportioned in such a way as to keep the initial spring crack off a little higher than the frictional resistance between the slides. The maximum value of P may be limited to 40% of the load under the truck.

After a considerable research, the Indian Railway authorities have set out the optimum values of controls at both ends of locomotives. The initial control at the front end may be 16% of the truck weight on the rails with the control spring deflection of approximately one inch for every 20% of the truck weight on rails. To this will be added the frictional resistance of the slides. The amount of control at the rear end may be set at 20% of the truck weight on rails but with a sufficiently greater deflection of the spring per ton load.

RAILWAY DELEGATION TO CHINA AND JAPAN

A three-member Railway delegation left New Delhi on Saturday 9th June, 1956 for a month's study tour of the Railway Systems of China and Japan. The members of the delegation are Shri J. Dayal, Financial Commissioner for Railways, Shri K.B. Mathur, Member (Transportation) Railway Board and Shri H. D. Awasthy, Joint Director (Planning), Railway Board. The delegation is expected to tour important Railway sections in these two countries

and, in particular, make a detailed study of the working of important marshalling yards and control offices; of important movement of traffic; the working of the regulated traffic control system; the capacity of single line sections by diesel and by electric traction; operation of heavy mineral traffic like coal, iron ore etc., and compilation of statistics. The delegation will stay in each country for about a fortnight.

Atoms May Revolutionize Food Industry

(By A Special Technical Correspondent)

THE future of atomic food preservation looks so promising that a new plant to process 1000 tons of food per month will be built in the United States. In this plant, which will start operations in 1958, scientists expect to perfect this extraordinary development, considered the most beneficial use of atomic energy ever discovered. If successful, the results will be preservation of food without refrigeration, an advance that will revolutionize food storage and distribution throughout the world.

Progress toward a practical, effective method of "cold sterilizing" food through exposure to atomic radiation has been rapid during the last five years. At the beginning, scientific knowledge was limited almost entirely to two facts: spoilage bacteria in food is killed by atomic radiation, and food so treated does not retain any of the atomic radiation. They did not know how much radiation was needed, how long the preserved food could be stored without refrigeration, what changes would occur in taste, odor and nutrient value of the food. Most important of all, no one knew whether the atomic-processed food would be harmful to human beings.

Through painstaking costly research, most of these uncertainties have been eliminated. The effort has been nationwide in scope, with research conducted by more than 60 universities, industries, foundations and government agencies. Because of the excessively high cost of such research, the United States Army, which also is interested in the benefits of atomic food preservation, assumed responsibility for the financing and co-ordination of this program. Today, thousands of scientists across the nation are co-operating in this tremendous research effort.

The results to date are remarkable. Atomic energy has been found extremely useful in many different ways. Radiation can be used to completely sterilize food so that it can be stored for weeks, months and even years without refrigeration. It can be used to pasteurize, or partially sterilize food, which increases storage life, so necessary in marketing perishables. The sterilizing power of atomic radiation also can be used to permanently destroy food parasites; insects in dry foods, such as wheat, peas and beans, or to prevent sprouting of tubers, such as potatoes and onions.

Several different types of atomic equipment using the waste products from atomic reactors, atomic rays produced by high-voltage machines, and radioisotopes have proved highly effective.

Through eating tests, atomic-processed foods have been found as nutritious as untreated foods and completely safe for consumption by animals or humans.

Though five years of research have brought rapid progress, there still are problems to be solved before atomic food preservation becomes commercially practical. One problem is the bad odor and poor flavor of some atomic-processed foods, which makes them unacceptable. Many "cold sterilized" foods, both cooked and uncooked, taste exactly the same as unprocessed food, such as chicken, pork, beef, fish, bread, asparagus, carrots, sweet potatoes and a great variety of fruits. Poorest results are achieved with dairy products—milk, butter and eggs. Processing must be improved to make these foods palatable.

When this processing problem is solved, other obstacles in the path of large-scale atomic food preservation must be overcome. Effective, convenient methods must be devised for packaging, handling, storage and shipment of atomic-preserved foods. Also the cost of atomic sterilization must be reduced before it can compete with other food processes, such as canning, freezing and chemical treatment. Operation of the new processing plant is expected to solve these problems.

Although the successful development of atomic food preservation will cost many millions of dollars, the expenditure is warranted by the benefits that will be shared by everyone in the world. Important will be reduction of diseases caused by parasites, by bacteria-contaminated food and by the lack of fresh vegetables, fruits and other nourishing foods in many areas. The greatest benefits, of course, will be increased quantities of food and reduction in the need for refrigeration to preserve supplies during shipment and storage.

The vital need for atomic food preservation is pointed up by the results of United Nations surveys, which show that many areas of the world cannot meet the minimum nutritional requirements of their people and that the world population is increasing by 100,000 persons per day.

Locopulsor Shunting Machine

By A Special Correspondent

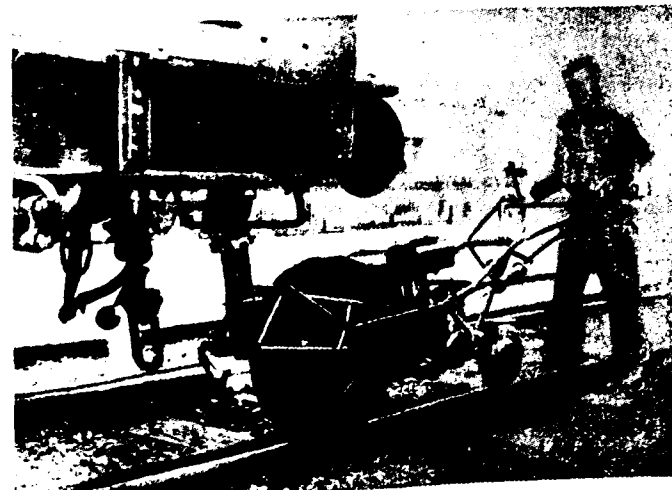
ALL Industrial firms possessing their own Sidings have at one time or another been faced with the problem of how to move and shunt the wagons on these Sidings into position for loading and unloading.

If the Sidings are very extensive or very small the problem generally solves itself, for if the length of the Sidings is great it will probably be necessary to employ a Locomotive, either steam or diesel, whereas if the Sidings are very small, probably the Railway Company will be able to place the wagons in position once per day.

With the intermediate size of Siding installation, however, the problem is by no means simple, and many Engineers will feel that whereas the extent of their Railway sidings does not justify the heavy costs, both in maintenance and capital expenditure, of a full sized Locomotive; neither is it satisfactory to work the Sidings without some suitable mechanical means of shunting the wagons from one siding to another.

Accordingly, over the years a number of methods of shunting wagons without using Locomotives have been adapted, and these vary from the simple device of using a horse full scale installation of electric capstans, etc.

One of the most recent developments in connection with shunting problems has been the design of the Locopulsor Shunting Machine, which has been specially constructed to meet the needs of Industrial Engineers who wish a compact and simple, yet powerful method of shunting Railway Wagons in their own Sidings.



The photographs give a good general idea of the layout of the machine and the method of use. Briefly the details of the machine are as follows.

The Locopulsor has a driving wheel fitted with pneumatic tyres. This tyre is grooved and corrugated to afford the maximum adhesion to the rail, and this wheel is driven through a gear box and a special speed reducing device. There are auxiliary wheels for transporting the machine from one place to another, but in actual shunting operations these are not used and the machine is operated by running the driving wheel on the rail.

The power units is a 600 c.c. J. A. P. petrol engine.

The general principle of the machine is rather ingenious as it utilises the forward torque of the driving



wheel to give a forward and upward thrust through a pushing jack which sits below the headstock of the wagon, thereby employing the weight of the wagon to give adhesion to the rail and not depending on the weight of the machine itself to give the necessary frictional adhesion. This frictional force would be small as the machine weighs only 3.1/2 cwts. for easy handling.

The chassis of the machine is welded throughout from high tensile tubular steel, and specially annealed steel castings are employed in the pushing jack. The whole design of the machine incorporates lightness and strength and wherever possible high tensile aluminium alloy is used in any part where the necessary strength can be obtained in this metal.

The operation of the machine is very simple as the Operator sits the machine on the rail a yard or so from the wagon and raises the pushing jack to the requisite height by means of a hand lever. He then places the jack under the headstock of the wagon and after that it is merely necessary to engage first gear, let in the clutch and simply guide the machine gently on the rail. There is no difficulty in negotiating points or crossings.

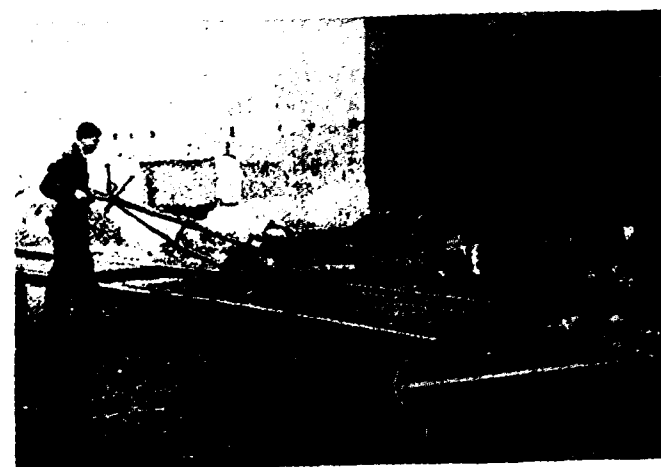
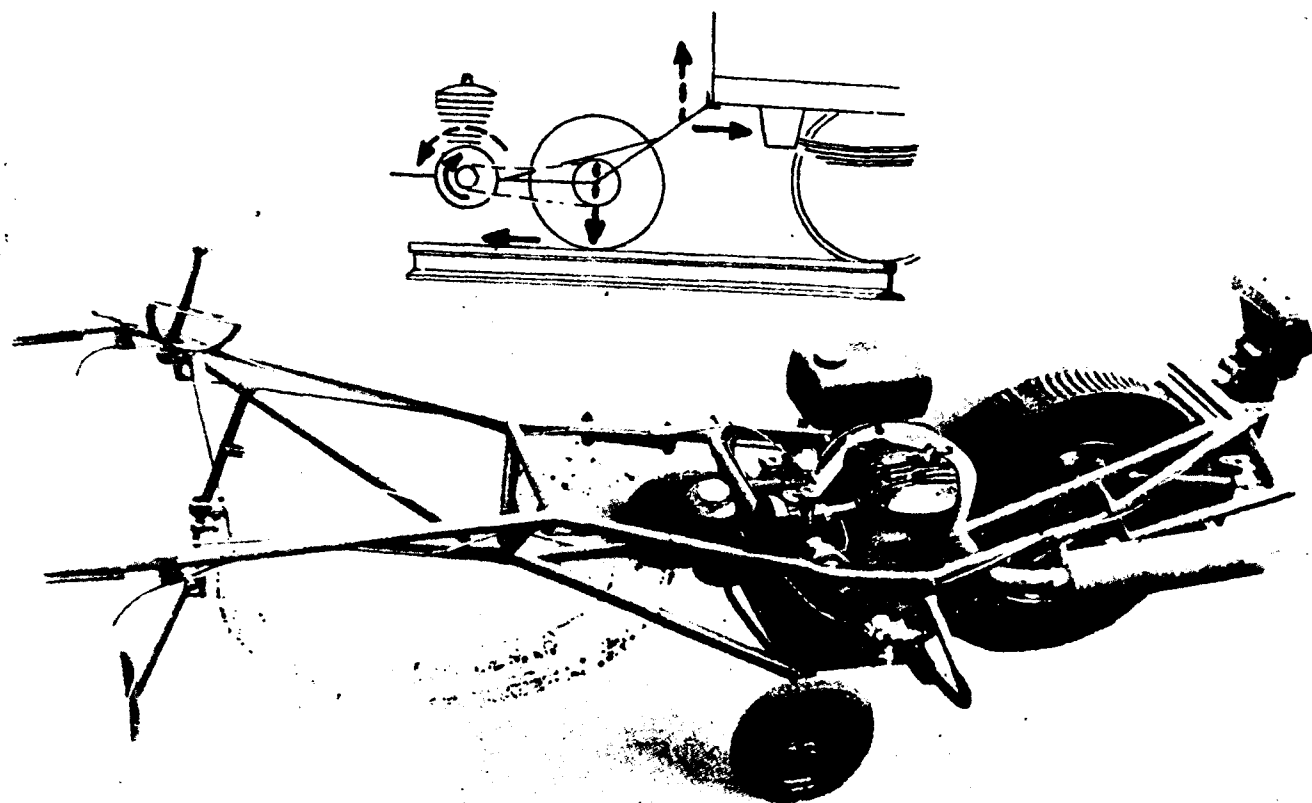
Several features of the design are ingenious. There is for example, a pre-selective gear box. This enable the Operator to have at all times the free use of at least one hand on the handlebars. Once a particular gear has been engaged the gear selector quadrant can be moved to any other position. No change will result until the clutch is let out and in when the desired gear position will then be automatically selected.

In the speed reducing unit there is an ingenious yet simply maintained arrangement of epicyclic gearing; also the clutch is heavily reinforced for heavy starting duties and the gear box has a wide range of ratios which allow for heavy starting and also for high speeds when the shunting is well under way, or when taking the machine from one part of the works to another.

It might be thought that with such an apparently lightly built machine that it would not stand up to heavy duty over a period of years, but the opposite is found, in fact, to be the case. There have been some machines operating in the south of England for almost ten years and the maintenance of them has been exceedingly low. In fact, the bulk of the attention which they require is the renewal of worn control cables from time to time. The specially designed pneumatic tyre is also very resistant to wear and with normal attention the tyre should last for two or three years without renewal.

It is, of course, important in designing a machine of this nature to consider the number of wagons which will be shunted, and it has been found in practice that loads of up to 150 tons or more can be shunted with ease on a well laid level track, with, of course correspondingly smaller loads on inclines. The writer has seen the Locopulsor Shunting Machine shunt over 200 tons, although this probably would not be recommended for every day use, but does demonstrate the fact that 150 tons is well within the working capacity of the machine.

Accessories which can be supplied are a standing gear which can supply a trickle of sand to the rail if the rails are likely to be wet or greasy. Also a special low head



can be supplied for use with very low wagons, for example, those of the type used in quarries, etc. If inflammable material is used in the works the machine can be completely flameproofed.

The safety aspect of the design of the machine has been well considered, in particular the question of a runaway down an incline which might carry the machine away out of control, has been successfully dealt with. First of all there is an immediate release apparatus to the pushing jack which allows it to drop from contact with the wagon headstock immediately on the full of a hand lever. There is, in addition, a free wheel device on the machine which would operate in the unlikely event of the release mechanism failing.

Over a thousand of these machines are now in use throughout the world and it has been found that the machine stands up to heavy use with very little wear and maintenance being required.

One of the facts which might not be considered at first, is that even large works which use Locomotives, often have parts of the works where it is not economical to employ an additional locomotive. Or again, it might be that on week end working it is not an economical method of working to keep a Locomotive under steam, apart altogether from the question of a day requiring to be set aside for boiler cleaning etc. For these reasons a number of very large firms, employing several locomotives, have found that the Locopulsor is extremely useful as an auxiliary, or as a standby in the event of a break down, especially in view of the fact that the capital cost of the Locopulsor is only a very small fraction of that of a Locomotive, and the maintenance and running costs are correspondingly very small.

The following table may be of interest in considering the question of operating costs. The figures are based

on the assumption of an eight hour shift with a running time of five hours per shift for the machine.

	Fuel	Lubricating Oil	Wages	Total
Locopulsor	8/-d.	1/-d.	24/-d.	33/-d.
Steam Locomotive	49/-d.	1/-d.	61/-d.	111/-d.

The marked difference of the operating costs is obvious and the fuel costs of the Locopulsor is based on its petrol consumption of 3/8 gallon of petrol per hour. The comparison between the Locopulsor and the steam Locomotive becomes even more pronounced when annual standing charges are compared. On the following table the following assumptions have been made.



"Depreciation" has been calculated on the life of the machine over the period shown with the machine or Locomotive thereafter assuming a nil scrap value.

"Interest" on the purchase cost has been taken at 4%.

"Maintenance" accounts for the general care of the machine together with recommended oil changes and servicing.

"Replacements" allow for tyres and engine wear.

	Locopulsor	Steam Locomotive
Life	10 years	50 years
Capital cost	£475	£10,500
Depreciation - 600 008	£35	£69
Interest at 4%	18	420
Maintenance	78	715
Replacements	20	-
Total Annual charges	£151	£1204

The above figures are from a calculation given by J. G. Lee, Esq., in "The Engineer", April 30th, 1954, in the comparison of various methods of wagon shunting.

It will be seen, therefore, that the Locopulsor has an annual running cost of less than 1/8 that of a Locomotive and yet for many purposes the services of a Locopulsor are sufficient to replace those of a Locomotive.

The conclusion is obvious that many Industrial Firms which are at present shunting by steam Locomotives

could effect a very large saving by employing one or more of the Locopulsor Shunting Machines.

The Locopulsor is manufactured in Great Britain by E. G. Steel & Co. Ltd., 93 West George Street, Glasgow and already a few of these machines are in operation in India, but there is undoubtedly scope for the increased use of this machine in many works where the shunting of Railway Wagons is a heavy cost in the Annual Budget, and one, of course, which is tending to become heavier each year with the increased cost of coal and labour.

"RAILWAYS MUST PLAN 20 YEARS AHEAD"

IMPROVED METHODS OF WORK UNDER CONSIDERATION

Shri G. Pande, Chairman, Railway Board, declared in New Delhi last month that it was not enough for the Indian Railways to plan only for the next five-year period. "We must look ahead and plan from now on for heavier responsibilities during the next 15 or 20 years", he said.

Shri Pande, who was speaking at a three-day conference of the General Managers of the various Railways broadly indicated the lines on which the Railways had to work in order to achieve even higher efficiency standards than in the past.

The Railway Board was in this connection, he said, examining certain technical points which had a bearing on improved methods of work in the future. The Board was also thinking in terms of heavier trains, better track standards, more intensive operation through dieselisation and electrification on selected sections etc. The question of reorganising on modern lines the Central Standards Office for the Railways and the Railway Research Directorate was also receiving attention.

The Financial Commissioner for the Railways, Shri J. Dayal, said that while the Railways had made considerable progress during recent years, the search for securing further improvement in the efficiency of performance should be continued. Experience of certain foreign

countries which he had recently visited showed that with greater attention to certain matters of technical detail, organisation and planning, it might be possible to achieve a better utilisation of the existing stock of locomotives, wagons, etc., and thereby to improve the railways' carrying capacity, so vital to the successful implementation of the second Five Year Plan.

The conference also heard from Shri P. C. Mukerjee, Member (Engineering), Railway Board, an account of his experience during his recent tour of Western and Eastern Europe, where he inspected a number of factories manufacturing railway equipment, and met various railway authorities.

SEPARATE TARGETS FOR EACH RAILWAY

Sri K.B. Mathur, Member (Transportation) also suggested certain practical means of improved utilisation of rolling stock. The General Managers gave the conference details with regard to performance and maintenance of rolling stock. The view was accepted that, in future, separate efficiency targets should be laid down for each Railway, and for sections within each Railway.

The conference expressed itself strongly in favour of strengthening the personnel organisations of the Railways and felt that greater initiative should be placed in the hands of personnel officers so that the legitimate demands and grievances of the staff could be dealt with more satisfactorily and with greater expedition.

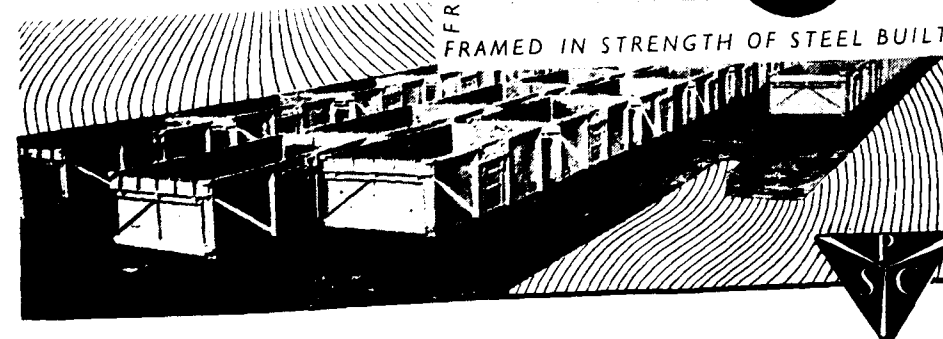
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Bearing Metals and Alloys for Railways

WITH a progressive workshop in Calcutta The Eyre Smelting Ltd., have been associated for a long period with the Indian Railways and can claim an unbroken connexion going back over 45 years. It is interesting to note that the first consignment of bearing metals destined for the Indian Railways was shipped from the parent company in 1910 since when the organisation has been supplying material to the railways either from England or from its Calcutta foundry.

Let us now make a rapid review of the world's largest bearing metal organisation.

The first Indian Railway to be supplied with bearing metals was the Bengal Nagpur Railway, now known as South-Eastern Railway and this business was soon followed by orders from the M. & S. M. and South Indian Railways (now Southern Railway).

Such excellent results were obtained with the bearing metals supplied by this firm that its products quickly gained favour and its reputation was further enhanced by outstanding performances on the Bikaner State Railway.

The engineers of this great organisation paid regular visits to the various workshops of the Indian Railways and gained first-hand knowledge of running conditions in India.

BIRTH OF KIDDERPORE WORKS

By 1930 the business had developed to such an extent that it was decided to set up an Indian Company with a well equipped Works at Kidderpore, Calcutta. Technical personnel from the main foundry in London were sent to India to supervise production and to train Indians in this work. Within a short space of time the Indian counterpart was capable of meeting the entire demands of the Indian market and as a result import of bearing metal from abroad virtually ceased.

RESEARCH & LABORATORY

The Kidderpore foundry has a large well equipped laboratory staffed by qualified chemists and metallurgists and with full support of the parent company in London

it engages in research and investigates any special problems that may arise in connexion with bearings and bearing metals.

The establishment of the foundry in India has enabled the Company to develop the business on broader lines than was previously possible and in addition to railway bearing metals, it has been producing bearing alloys for every type of bearing application and has a wide connexion with general engineering industry. The brand names "Tandem" and "Eyre" are so well known that needs no introduction.

The Company also manufactures solders and tinning and soldering fluxes and having exceptionally wide experience in the application of bearing metals it has been able to give valuable advice on a number of occasions in connexion with the whitemetalling of bearings and the lay-out and equipment of whitemetalling shops. An illustration occurred as early as 1938 when the Company gave advice and technical assistance to the East Indian Railway in connexion with the lay-out and re-equipment of their Carriage and Wagon Whitemetalling shop at Lilooah.

Another aspect of the Company's activity is the manufacture of printing metals for supply to the Printing Trade throughout India. Messrs. Fry's Metal Foundries Ltd., London (an associated firm) have for many years been the main contractors for printing metals to the industry in England, in fact "Fry's" has become a household name in the trade and each and every printer recognises it as the hallmark of quality. The Kidderpore foundry was therefore in a position to take on the manufacture of Fry's Printing Metals and in due course import became unnecessary. Throughout the years thousands of tons have been supplied to Printing Presses throughout India and the demand is expanding considerably with the growth of literacy throughout the country.

Throughout the 45 years that the Company has been supplying its alloys to the Indian market Heatly & Gresham Ltd, have acted as selling agents for all Railway and Printing metal business. With offices in Calcutta, Bombay, Madras and New Delhi they are well placed to cater for demands from all parts of the country. At all times close co-operation has been maintained between the two Companies.

Role of Limpet in Locomotive Building

"LIMPET" is the registered Trade Mark in India of the products of Messrs. J. W. Roberts Limited, Armley, Leeds, England, who specialise in the insulation of Railway rolling stock and they are also the sole lessors of the process known as Sprayed "Limpet" Asbestos.

SPRAYED "LIMPET" ASBESTOS is fully patented throughout the world and is a unique form of insulation. Asbestos fibre is passed through a machine controlling the output of fibre which is blown by a fan through a large bore hose and nozzle on to the surface to be insulated. Atomised jets of water mingle with the fibre steam at the point of discharge and form a covering of asbestos of any desired thickness and density under the control of the Operator.

Special grades of pure asbestos fibre are used for thermal insulation, anti-condensation work in Mills, etc., and the acoustic improvement of halls, theatres and offices. Railway Engineers are mainly interested in thermal insulation and the "K" value of Sprayed "Limpet" Asbestos may be taken as being from 0.30 to 0.35 according to density and quality of the fibre used. It should be remembered that as an unbroken coating of insulation is built up this "K" value is obtained in practice, whereas in the case of most alternative forms of insulation their nominal "K" value is not achieved in practice because of gaps and joints between adjacent sheets. A notable instance of the use of Sprayed Asbestos is on the air-conditioned broad gauge coaches built in India, which, up to the present, have been insulated by means of Sprayed "Limpet" Asbestos, the first of these having been constructed in 1937.

A further use for Sprayed "Limpet" Asbestos by Railway Engineers, is the application of asbestos fibre, usually one inch thick, to the underside of locomotive clothing sheets, so that when the sheets are removed for repair or inspection, the insulation is removed at the same time. One great advantage of this system, on the back ends in particular, is that no provision has to be made for hand holes or boiler stays and the maximum insulation efficiency is obtained. In case of damage to the insulation, it can very easily be made good by spraying on additional fibre.

The insulation of steam cylinders and piping is another outlet for "Spray" and in fact it will serve many other useful purposes in a railway workshop. The use of pure "Limpet" Asbestos ensures that no chemical reaction will take place.

"LIMPET" SHEET is one of the products of J. W. Roberts Limited, widely appreciated by Railway Engineers in India. This sheet or board was designed many years ago to meet the peculiar conditions of heat and humidity prevailing in India and it has proved to be very successful. "Limpet" Sheet, being flexible, is particularly suitable for the interior lining of the ceilings of passenger coaches; it is non-inflammable and is unaffected by climatic conditions. Being composed mainly of asbestos, it is immune to attack by any sort of vermin and is non-hygroscopic. The minimum quantity of paint is required for decoration. A convenient feature is that it is supplied in sheets ten or twenty feet long by four or five feet wide, so that the ceiling of a broad gauge coach can be spanned with the minimum of wastage in cutting. The standard thickness is two millimeters but it can be supplied three millimeters

A CORRECTION

The article entitled "NARROW-GAUGE LOCOMOTIVES FOR INDIA" published in our July Annual Number cum Engineering Supplement is a reprint from the "DIESEL RAILWAY TRACTION". We regret for the above omission.

EDITOR

thick where exceptional strength is required. "Limpet" Sheet is now being made in India by Asbestos, Magnesia & Friction Materials Ltd. by arrangement with J. W. Roberts Limited, Leeds.

"LIMPET" ASBESTOS MATTRESSES for locomotive boiler lagging are another popular of Messrs. J. W. Roberts Limited. These are made of chemically pure woven asbestos cloth free from vegetable or organic matter and with a filling of pure asbestos and, if handled with reasonable care, they will last the life of a boiler. The ease with which they can be removed and refitted is an advantage not possessed by any other form of boiler lagging. "Limpet" Mattresses have a world wide reputation for efficiency and durability and though the tendency in India in past years has been to neglect the complete insulation of locomotive boilers, possibly due to the low cost of fuel in former years, it has been proved that a very appreciable saving in fuel costs can be obtained by efficient lagging and this is not confined to cold weather conditions. Tests carried out with a model boiler in a wind tunnel prove that the

total heat loss with clothing sheets only, is about four times as great as when the boiler is lagged with "Limpet" Asbestos Mattresses one inch in thickness, in addition to clothing sheets.

"DECOLITE" COMPOSITION FLOORING

The name "Decolite" is now generally accepted in India for composition flooring for Railway rolling stock but "Decolite" is a Trade Mark of Messrs. J. W. Roberts Limited, and it should not really be applied to composition flooring of indigenous manufacture. This product is too well known to carriage and wagon builders to require a detailed description, but it is as well to remember that genuine "Decolite" flooring is supplied only by Messrs. J. W. Roberts Limited or their accredited Vendors. The Sole Vendors in India for the products of Messrs. J. W. Roberts Limited, and the Sole Licensees for the "Sprayed LIMPET Asbestos" process, are Messrs. Asbestos, Magnesia & Friction Materials Ltd., Bombay, Calcutta and Madras.

ELECTRIFICATION OF RAILWAYS

FRENCH REPORT PRESENTED

A report on certain aspects of railway electrification in India prepared by a team of French Experts was presented to the Railway Board.

The report was presented by M. F. Nouvion, Chief Engineer, French National Railways, and leader of the team of experts, to Mr. G. Pande, Chairman of the Railway Board.

Among those present at the ceremony were M. Christian Belle, Minister-Councillor and M. Guy Chaumet, Councillor for Economic Affairs at the French Embassy, M. J. Boulgne, Project Engineer, French Railways and Members of the Railway Board.

Mr. Pande said that the report prepared after very hard work would be most valuable in helping the Government of India in taking final decisions in regard to electrification of railways.

In the report the team is reported to have expressed the opinion that A.C.-50 cycles traction system would be more appropriate for Indian conditions and substantially cheaper than the D.C. system.

The services of the team were placed at the disposal of the Government of India by the Government of France, which offered to meet all the expenses connected with their travel and stay in India. The experts visited sec-

tions of the Indian Railways where electrification is planned and prepared the report on return to France.

* * * * *

MACHINERY FOR PERAMBUR COACH FACTORY—ORDERS PLACED FOR 40 LAKHS

Railway Machine Tool manufacturers in eight European countries have secured orders aggregating about Rs. 40 lakhs for the second instalment of machinery and plant for the Perambur Integral Coach Factory.

The factory, when equipped with this machinery is expected to complete its annual target production of 350 coaches one year ahead of the original schedule in four years instead of five.

Firms in West Germany and the U. K. together have secured more than 50 per cent of the total value of the orders, which cover 189 machines of various types. Smaller but sizable orders have gone to manufacturers in Switzerland, Italy, Czechoslovakia, Poland, Austria and Sweden.

Two senior Railway Officers were recently deputed to Europe to negotiate and finalise the contracts on the spot after inspecting the machines where necessary. Global tenders were invited and nearly 170 firms in 15 different countries submitted tenders which formed the basis of the negotiations.

Modern Static Load Testing of Railway Coach Body Frames

WHEN new coaches are built according to a long standing design, it is not customary to carry out any special testing on them before their leaving the factory. Their faults have already been remedied from the experience gained in years of running of similar type coaches.

This is no longer true when a coach is constructed to a completely new design. A case in point is that of the two prototype light-weight steel coaches recently arrived in this country from Switzerland. Previously no all-welded coaches was running on the Indian railway system and these coaches had to be designed to meet Indian conditions and requirements.

The design of the body shell is the first step towards production. A completely welded body frame may be

considered as a large steel tube the wall thickness of which varies and is punctured by door openings, windows etc. On account of these facts the exact calculation of stresses in the steel is impossible and approximations have to be made to simplify the work. The stresses in any part of the shell may be fairly accurately foretold, but it is necessary to check the calculation by measuring the actual stresses occurring in the body shell after its assembly by means of a load test.

Such a test was carried out on the Schlieren prototype coaches for the Indian Railways.

The coach body frame is mounted over two special bogies, being supported at the centre pivots of the body bolsters only. Two tests are then carried out: vertical loading test on coach floor and horizontal compression

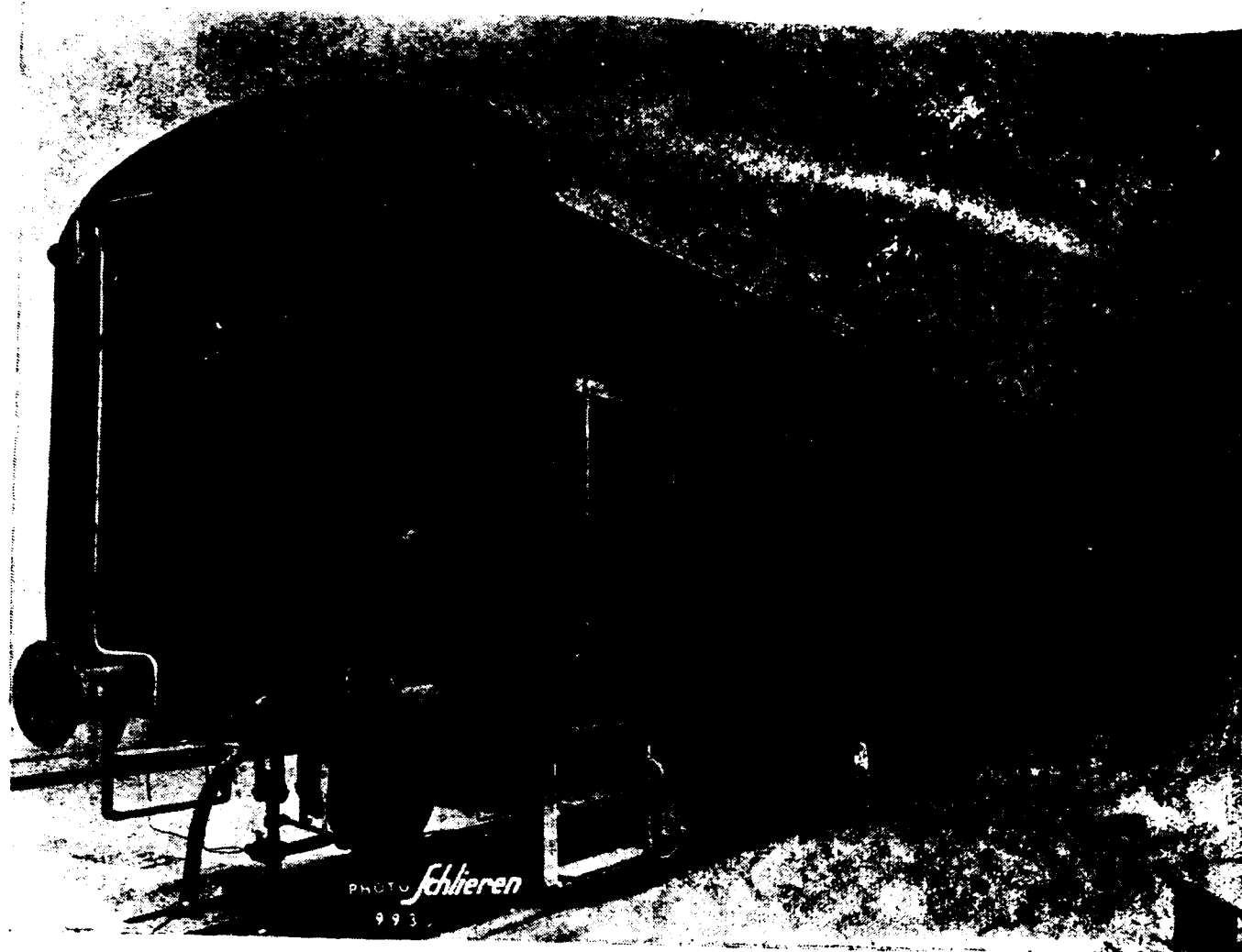
Editorial Notice

The Editor invites contributions to the Magazine on a variety of topics—short stories, technical features written in simple English understandable to the laymen, Aspects of Railway Working, places of tourist interest, News from home line, activities on Railway Institutes etc. All copy should be brief and typed as far as possible.

Photographs illustrating social functions, sports events, scenic sports etc. are also invited. All contributions should reach the Editor not later than 5th of each month. Rejected Mss. will be returned provided sufficient stamps for postage are enclosed. No responsibility will be borne for copy lost in transit.

Views expressed in this Magazine should not be taken as having official authority.

All correspondence should be addressed to the Editor, "Southern Railways Magazine," Post Box No. 17, Tanjore (South India).



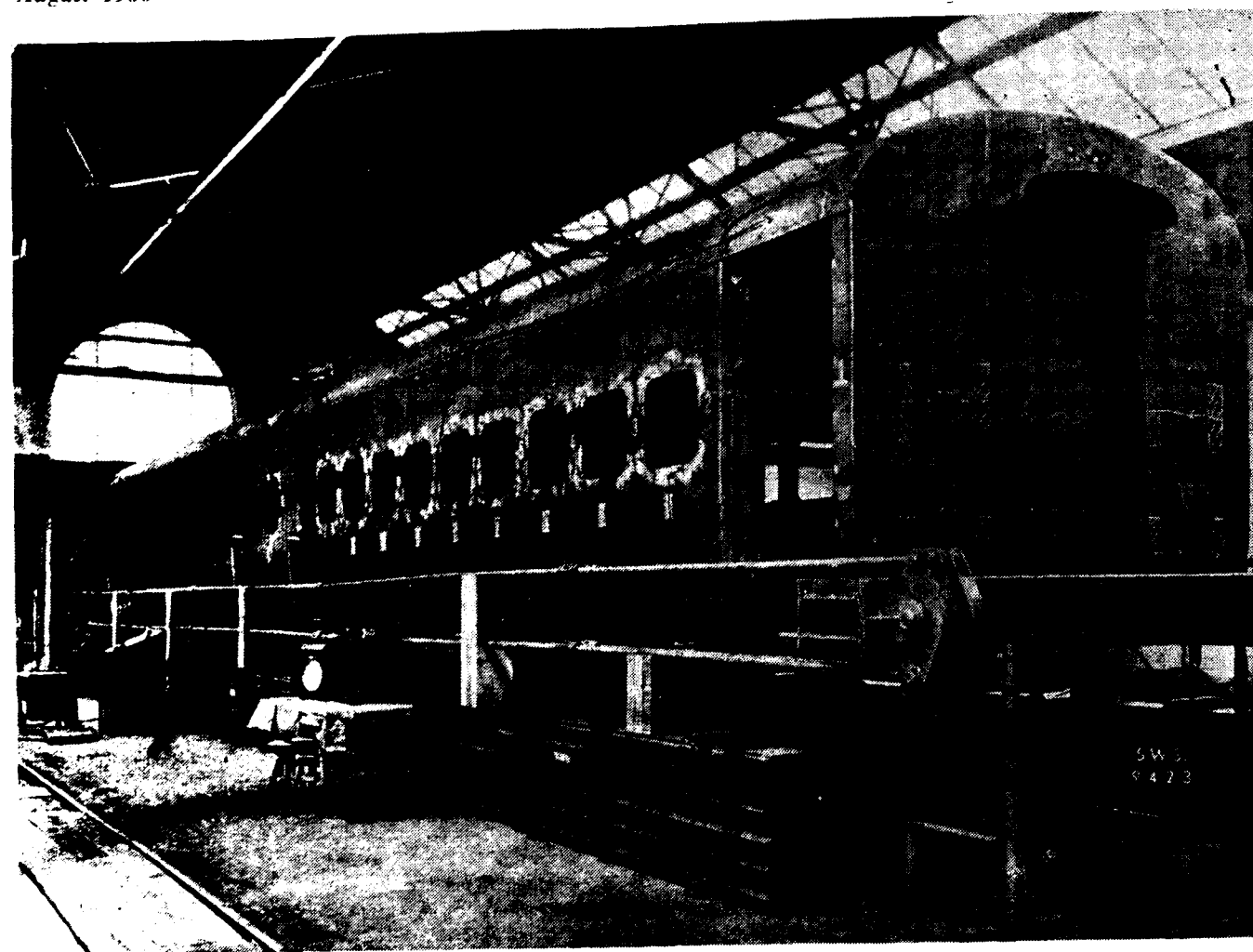
test in the longitudinal direction. About 26 cylinders and pistons actuated by compressed air rest on timber planks laid on the floor. The pistons are anchored rigidly by being connected to beams crossing the coach and anchored outside the coach to heavy *steel masses* resting on the floor of the building. The vertical pressure on the floor can be varied as required by adjusting the pressure of the compressed air supply to the pressure cylinders

The horizontal load is applied by two hydraulic presses acting at each end of the body shell. The compressive load is varied by means of a hand pump.

"Extensometers" or electrical "Strain gauges" are used to measure the stresses occurring in the steel. Essentially an extensometer is a length of very fine wire mounted in cellophane or paper about the size of a postage stamp. This is stuck on to the place to be

tested and electric wires run from it to a recorder. In the case of the new light-weight coaches, 178 of these extensometers were fixed on the roof, side-walls and underframe, i. e. on all points of the coach which wanted testing. When the coach is loaded up, the coach steel work is deformed, thereby causing the wires in the extensometers to contract or extend and thus to change their electrical resistance. By passing small electric currents through these extensometers, the stresses in the coach body-work are recorded on a specially calibrated scale. This method of stress measurement is a comparatively new one and is extensively used in the testing of aircraft.

Another measurement which is carried out is the deflection of the coach under load. This is carried out with an exact clock gauge. The deflection must be less than 1/500th of the distance between centre pivots.



These Coaches are built by Messrs. Swiss Car & Elevator Manufacturing Corporation Ltd., Schlieren for the Indian Government Railways. Now these coaches are being built at Integral Coach Factory, Perambur in collaboration with this firm.

The results of the tests are then carefully examined and in case any parts of the shell should not show a sufficient margin of safety, these would have to be stiffened up. Conversely the results also indicate where members were oversized and where the weight of the bodywork might be reduced in later coaches.

Thus accurate load testing of the coaches points the way towards the most economical use of materials and leads to greater safety for the passenger. Furthermore experience is gained for the design of later coaches since each test is a further step, towards the "Ideal Coaches".

£ 300,000 INDIAN CONTRACT FOR BRITISH CRANES

AFTER a 16-day trip to India, Mr. W. H. Sharp, director of a British firm manufacturing cranes and excavators, is back in Yorkshire with a £ 300,000 contract.

The contract, gained in the face of keen competition from Japanese, Italian, German, Belgian, and French manufacturers, is for 27 cranes for use on Indian

Railways, where they will assist in maintenance work. To be delivered over the next two years, they comprise 18 ten-ton steam travelling cranes and nine five-tonners.

The British firm recently completed a previous contract worth £ 250,000 for supplying 24 cranes.

HOW TO RESERVE ACCOMMODATION

Unless you reserve your berth (I and II Class) or Seat (3rd Class long distance) in advance, you may not be sure of getting accommodation on the train you wish to travel by.

Application should be made to the Station Master of your starting station at least 3 days in advance specifying the date and train by which you intend travelling and the tickets must be bought in advance. The reservation fee leviable is 8 annas per seat or berth.

Reservation by I and II Class from intermediate stations by Express trains can also be made similarly, but reservation ticket can be issued only after getting an advice from the Reservation Centre that the reservation has been made.

Tickets will be used only if accommodation is available.

If the reserved seats or berths are not occupied at least 5 minutes before the booked departure of the train the reservation will be cancelled and the seat or berth given away to another.

Reservation fee is not refundable.

III Class seats are also reservable on Express and certain other important trains for long distance passengers from the train-starting stations on payment of a reservation fee of four annas per seat.

Do not occupy a berth or seat reserved for another, as you are liable to be displaced at the last moment.

If you find another person occupying the berth or seat reserved for you and if he will not vacate it on demand, report it to the Guard or Station Master. They will help you.

(Inserted in the interests of Travelling Public)

H E N S C H E L



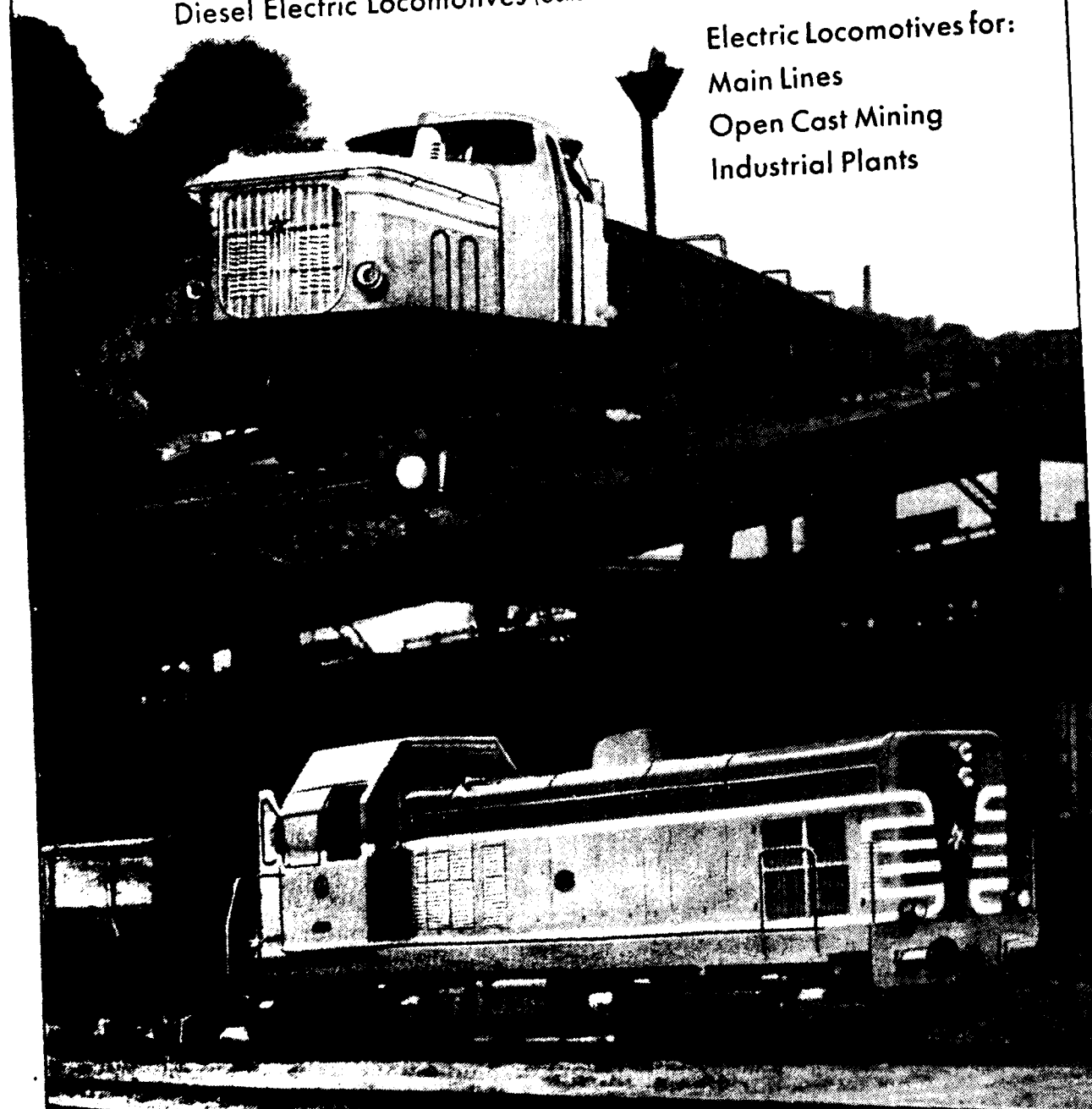
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H E N S C H E L & S O H N G M B H K A S S E L

Henschel & Sohn GmbH, (Kassel) Engineering Office, 21-A, Janpath, New Delhi

BOMBAY DIVISIONAL RAILWAY USERS' CONSULTATIVE COMMITTEE MEETS

THE Bombay Divisional Railway Users' Consultative Committee held its 15th Meeting at Bhusaval on June 30, 1956 presided over by the Divisional Superintendent, Bombay. Representatives of the Hindustani Merchants and Commission Agents Association Ltd., Bombay, the Bombay Chamber of Commerce, Bombay, the Indian Merchants' Chamber of Commerce, Bombay, the Grain and Oilseeds Merchants' Association, Bombay, the Sholapur District Oil Mills' Association, Sholapur, the Passengers and Traffic Relief Association, Bombay and others were present.

With regard to the opening of the new station "Vadshinge" between Kurduwadi and Madha stations, the Chairman informed the Members that there was no justification for opening this station as the traffic expected to be dealt with was very poor. Action was being taken to ensure cleanliness of carriages on Suburban trains, and arrangements were being made to put up notice boards in the office of the Assistant Station Master indicating the availability of staff for cleaning compartments. As regards inconvenience caused to passengers for want of lights, it was pointed out that the absence of lights was due to thefts of electrical parts and fittings. A system of protecting these fittings against pilferage had been devised by which it was hoped that such thefts would be minimised. Steps were also being taken to brighten lights.

It was represented that an Enquiry Office with a public telephone should be opened at Sholapur station. Members were advised that for Sholapur an independent Enquiry Office had been provided in the structural plan that had been prepared and that arrangements would be made to ensure that enquiries were promptly attended to by the staff there. The need for introduction of a Shuttle Service between Kurduwadi and Sholapur, the Members were advised, had been recognised and this item had been included in the Second Five-Year Plan. The introduction of this train would be considered subject to additional stock and power becoming available.

With regard to the suggestion for introduction of a Janata Express train between Bombay and Bezwada, it was stated that this suggestion had already been borne on the programme of additional trains to be introduced during the Second Five-Year Plan period and that much would depend on the availability of stock and power, particularly electric power on the Bombay Division. A suggestion was made for providing Dining Cars on trains on the Miraj-Latur Section as the passengers experienced inconvenience in the absence of proper facilities for food etc. It was explained that the distance between Miraj and Latur was only 203 miles and that adequate facilities exist at present for meeting the needs of the travelling public by way of tea and light refreshments and food. Further, as it was proposed to convert the Miraj-Kurduwadi line to Broad Gauge line in the Second Five-Year Plan, the provision of Dining Cars on this Section was not considered necessary for the present. In regard to the inconvenience caused to passengers due to shortage of water at Bombay V. T. the Members were advised that it had been decided to provide an additional underground reservoir of one lakh gallon capacity. This would meet the requirements of passengers.

Amongst other subjects discussed were effective measures to be taken to deal with the nuisance of un-social elements in railway premises, introduction of II Class accommodation on Deccan Queen, punctual running of 328 Up Raichur-Poona Passenger and 330 Up Bezwada-Poona passenger trains, standardisation of the period of availability of the concession return tickets issued during Diwali Holidays, provision of a direct coach on Calcutta Mail via Allahabad between Bombay and Patna at least twice a week and construction of a foot-overbridge joining the Central Railway Station and the Southern Railway Station at Sholapur. The proposals regarding safety measures to be adopted cautioning the public crossing the Seena Bridge between Pakhni and Mohol stations, withdrawal of II class accommodation from Branch line trains, pilferage of coal from wagons standing in Sholapur Yard and opening of a City Booking Office at Pandharpur were also discussed.

HOFFMANN AXLEBOXES

COMMENCING manufacture in 1898 the Hoffmann Manufacturing Co. Ltd., has expanded until today it is the oldest and largest works manufacturing antifriction bearings in Great Britain and the British Commonwealth. The need for antifriction bearings became acute as transport and engineering science developed in the early 1900's and one by one, commencing with the ball thrust and the compound bearing, the various well known basic types of Hoffmann Bearings were evolved. In the year 1910 the Hoffmann parallel roller bearing, with cylindrical rollers having their length and diameter equal, was introduced. This bearing forms the basis of many modern Hoffmann Axleboxes, although an increase in the ratio of roller length to diameter is sometimes made to obtain greater load carrying capacity. Hoffmann Axleboxes were first supplied for tramcars about 1920. These boxes were fitted with two roller bearings for carrying the journal load and a ball location bearing to deal with end thrust. The bearings were mounted on a sleeve which was machined to suit a taper seating on the end of the axle. Similar boxes were later supplied in large numbers for use in Bombay, Calcutta and Karachi.

This early type of box proved highly successful and after carrying out a number of similar applications to light railcars in Great Britain and Ireland, the first Hoffmann axleboxes fitted to a locomotive and tender were put into service on the Great Southern Railways of Ireland in 1936. About the same time 5 sets of these boxes were fitted to trailing axles of "Princess" Class locomotives of the old L. M. S. R.—now the Midland Region of British Railways. All the sets have run over 1,000,000 miles and are still giving, good service. The first roller bearing application in India was some 54 years' ago when two four wheeled coaches on the old

Eastern Bengal Line were fitted with cylindrical rollers 9" long and 1½" diameter made in their own workshops. These ran 160,000 miles but large scale manufacture was prevented by metallurgical limitations. However the fruits of these early experiments are seen in the recent standardisation in India of roller bearings for all types of tank-vehicles, air-conditioned coaches, explosive vans and well wagons and dining cars, following the earlier standardisation for locomotives, railcars, new main-line passenger stock and electric suburban stock.

Hoffmann Boxes have been supplied to The Bengal Nagpur Railway for locomotive and tender use and in 1950 Indian Government Railways, fitted Hoffmann Boxes to 10 W. G. Class locomotives and these are running very satisfactorily. A further order for boxes was received in 1953 for the same class of locomotive and these are being supplied in collaboration with our associated company in India, The National Bearing Co. Ltd., Jaipur.

Experience in countries all over the world including Great Britain, Ireland, France, Africa, Ceylon and Australia has shown that mileages well in excess of 1,000,000 and 20 years' service are being achieved on Hoffmann Boxes and the ultimate length of life has yet to be proved. Moreover, wear on the rollers, tracks and pad faces even after such prolonged running periods, is hardly measurable.

The famous London Underground has been using Hoffmann Boxes since 1935 and many thousands are in use today on this vast system. All new stock is being fitted with axleboxes of the Hoffmann design. The little known and unique underground Post Office railway, which is driverless and entirely automatic is another system relying on Hoffmann roller bearings. It

ANNOUNCEMENT

We have pleasure in announcing to all Advertisers and Subscribers that we are issuing a special Supplement for Christmas along with our December 1956 issue.

Editor

is noteworthy that these bearings are fitted to the axles of the latest turbo diesel locomotive and to the Metro-Vick Gas Turbine Electric locomotive which is reputed to be the most powerful in its class in the World.

We will now describe two or three types of axlebox which we are putting forward today for railway work. The journal load is carried on two rows of caged rollers each with its own outer race but running on a common inner race. End location of the axle and thrust load, are taken care of independently of the roller journal bearings by a phosphor bronze thrust pad operating against the axle end. The axle end must have a good smooth and unbroken surface. With other types of boxes it is common practice to stamp certain information on the ends of the axles but with the pad box this stamping must be done on the small stepped portion of the outside diameter extending beyond the inner race.

A felt pad is let into the face of the phosphor bronze pad and is kept in contact with the axle end by a spring to promote continuous lubrication between the thrust faces. Axleboxes of this type are in use with both oil and grease lubrication but the box is designed for grease which has of course a number of advantage over oil. Oil tends to drain away from the bearings on standing whereas grease, on account of its coating properties affords protection to the bearing at all times. It also provides some protection against the ingress of foreign matter into the boxes. A further point of considerable importance to Railway Engineers is that grease lubricated boxes require very little attention over extended periods whereas with oil lubrication the oil level must be checked regularly and the boxes topped up periodically.

An outstanding advantage of this type of box is the turning, the bogie frame must be lifted, after which the ease and rapidity with which it can be mounted and removed from the axle. Should it be necessary to remove the boxes for inspection purposes or tyre boxes, complete with outer races, cages and rollers can be slipped off, leaving the inner races and throwers in position on the axle. There is no need to remove the components from the axles for tyre turning.

These axleboxes, complete with their outer races, cages and rollers are interchangeable with one another and any box can be slipped on to any inner race. This is a big advantage from the Maintenance Engineer's point of view as there is no need to mark boxes and inner races so that they are assembled in the same way as they were previously used. It will be noted that no

screw threads are required on the axles and no inner race taper clamping sleeves are employed nor is there any need to provide adjustment for the bearings. The absence of such features does much to ensure the simplicity and ease with which maintenance can be carried out.

It is occasionally necessary to leave the end of the axle clear, and often to fit boxes between the wheels, and in both cases the phosphor bronze pad design cannot be used. In such cases a ball bearing may be used to locate the axle and take the side thrust. Here again the main load is carried on two roller journal bearings and in this particular design each has its own inner and outer races. The ball bearing also has its own races and it should be noted that it is left clear radially in the axlebox so that it cannot carry journal load, leaving its full capacity for dealing with thrust load. A very simple form of mounting is thus obtained and again no adjustment of the bearings is necessary. All the races are clamped firmly endways. The bearings may be inspected after lifting the bogie frame from the axleboxes. In order to carry out inspection it is necessary to remove the thrower which is clamped to the axle and free the detachable end cover after which the axlebox may be drawn to one side leaving the bearings in position. As the distance piece between the outer races is in halves it can be removed, permitting the outer races of the roller bearing to be slipped to one side exposing the outer tracks and the rollers for inspection.

Another type of box known as the cannon box and this type has definite advantages with some frame arrangements and has been found particularly useful for two-wheeled leading and trailing trucks. It is also becoming popular for the axles of the main driving wheels of locomotives. The cannon box is suitable only for cases where the wheels are fitted on the end of the axles, and the bearing arrangement consists of a roller journal bearing at each end of a long cast housing extending between the wheels. A ball location bearing clear on its outside diameter is fitted at one end for locating the axle endways and dealing with thrust. No adjustment of the bearings is required and all the races are held endways. In some cases the cannon box is split along its longitudinal axis or alternatively, loose caps may be provided at the bearing positions only.

Other types of axlebox can of course be supplied and we are always pleased to assist the Railway Engineer and submit recommendations, if full details are put before us.

LITTLE KNOWN FACT

These hearty, Alpine peasants linger to drink from a highly polished steer's horn, as they enjoy a holiday from work. Gasteiner Valley, high in the Austrian Alps, is noted for its health-giving mineral springs, its lakes and magnificent scenery.



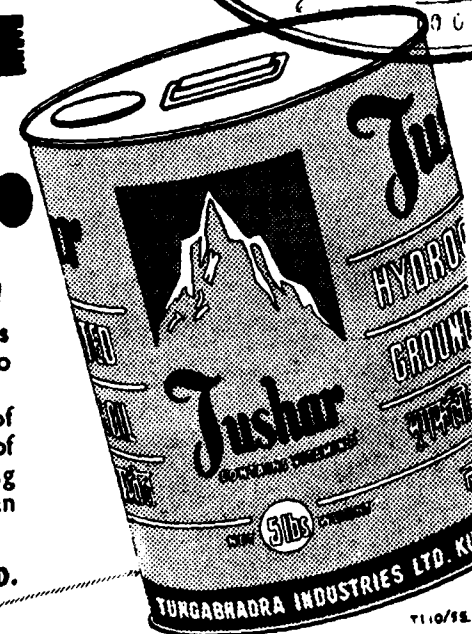
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Cleanliness prevents 'disease; medicine only attempts to cure.

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All Railwaymen should set an example of cleanliness. This will help others and themselves.