

THE INDIAN RAILWAYS

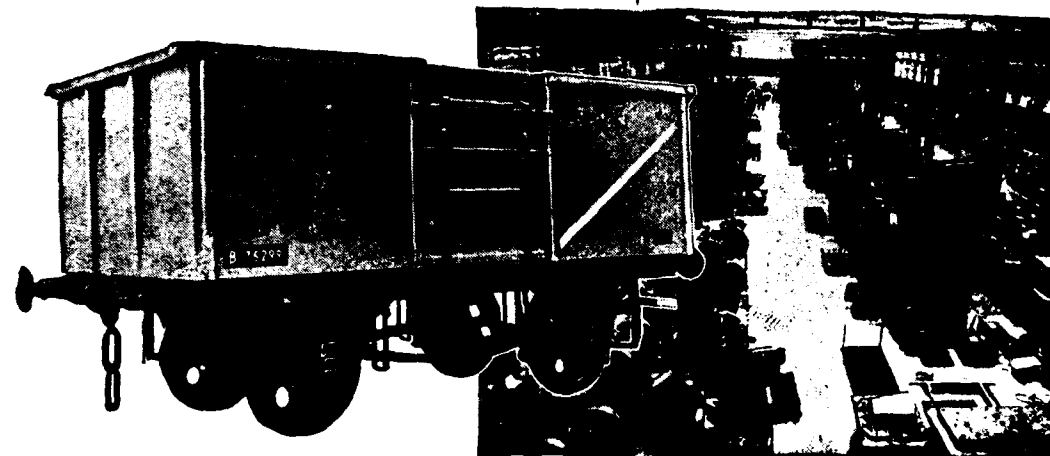
WORKSHOP MAGAZINE

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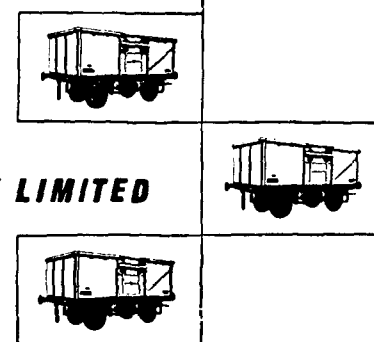
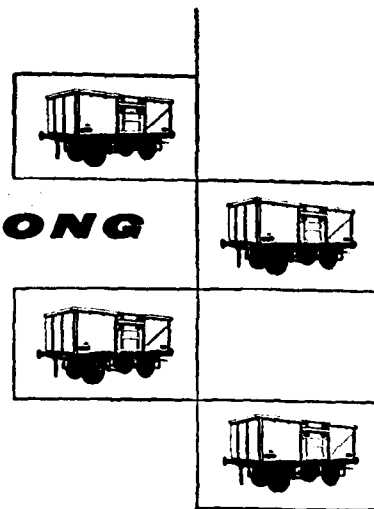
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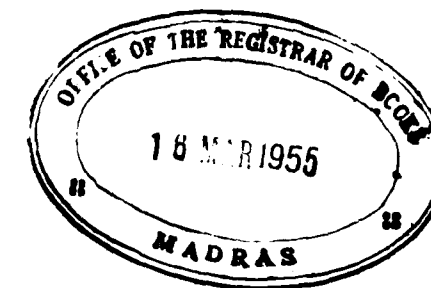
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THE INDIAN RAILWAYS WORKSHOP MAGAZINE

VOL. 1
NO. 2

FEBRUARY

ISSUED
QUARTERLY

WORKSHOP MANAGEMENT

AT the recent Institution of Engineer's Annual Meeting held at Hyderabad recently, the newly elected President, Mr. S. B. Joshi, Consulting Engineer, poured forth sentiments which are commonly held by Engineers of Independent India. He states :

"The weighty arguments in favour of the appointment of scientists and engineers as secretaries of departments had not made any impression on the authorities. In a socialist pattern of society, chief engineers could be made secretaries of technical departments, engineering graduates should be permitted to compete for the I. A. S. Some executive engineers showing special aptitude for administration could be taken into the I. A. S. to make up the deficiency of technical knowledge in the I. A. S. Promotions to higher administrative posts should be by selection. They should be restricted to those who had a reputation for character and integrity and had shown some exceptional merit in extra-service activity. A special cadre should be provided for managerial work".

Management techniques are developed as an art in other advanced industrial countries. Broadly speaking, we can state that the General Manager's responsibility of an industrial concern or workshop is the interpretation of Board's Policy, and as the Chief Administrative official, control of personnel policy. This applies to a private workshop which manufactures products for sale in the market. In the case of Railway Workshops, steel factories, etc., the Chief Technical Manager can perform the above duties in addition to his other responsibilities for all aspects of design, development, quality standards, economic output, maintenance productive resources and

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proper working and up-keep of equipment and plant. A production organisation is essential for proper running of the factories.

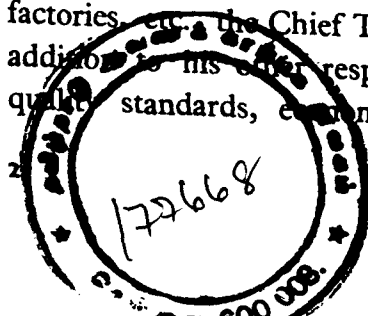
Forecasting of requirements and budgeting are important factors. Unless one is fully informed of the technical aspects of production, this is not an easy matter. Further, the budgeting must take into account, to certain limit, progressive improvement in output or adoption of more economical measures. Ideas for improving productivity do not arise except in the minds of an Engineer. Mechanical Engineers in the past have proved themselves to be successful General Managers in Railways ; they possess fund of technical knowledge and—their power of observation, keen eye for statistics and efficiency and ability to grasp new subjects with amazing quickness and preciseness and their skill in taking quick decisions of a far reaching nature, and by far the confidence in their work gained by years of experience and intimate knowledge of mechanical and human problems—these have stood them in good stead for holding managerial posts which lay stress on production problems.

Why not we, in India, first for Industries, Production and Railway Departments of Government of India, start a cadre for workshop managerial establishments including Production Engineers and Technical Foremen and selecting men of talent, merit and experience, train them in foreign countries according to requirements of the trade and ability of individual and post them in key positions. The grades of technical men, as accepted in Defence Department where they give special allowances, are to be higher, equivalent to Indian Administrative Service men, if not more as in Western Countries, to attract the correct type of men and qualifications.

The present moment is opportune to think on these lines, as we are on the threshold of embarking on an industrial era of Second Five Year Development Plans.

May we expect the Hon'ble Railway Minister, the Industries and Production Ministers and the Planning Commission to think ahead and deeply on these questions ?

FEBRUARY 1955



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Editorial Notice

The Editor invites contributions from the Engineers and Works Managers of Railway Workshops as well as company-managed Engineering Workshops in the form of original articles, research write-up, production techniques etc. relating to Workshop practices in India and abroad. Besides, suggestions for the technical improvement of various aspects of Railway Workshop practice are also invited with suitable write-ups accompanied by photographs wherever possible.

Contributions are accepted on the distinct understanding that they are sent solely to "THE INDIAN RAILWAYS WORKSHOP MAGAZINE". The Editor accepts no responsibility for the views and statements of the contributors.

All contributions intended for publication in any particular issue should reach the Editor atleast 30 days prior to the scheduled date of publication. This Journal is issued quarterly i.e. February, May, August, November.

All published contributions are paid for at our usual rates.

Editor.

THE CONTINUOUS RAIL

How the Difficulties of Providing Continuous Rails
of over 300 feet Have Been Overcome

By F. C. Manno^{*}

MUCH thought has been given to the problem of providing for expansion and contraction in rails on permanent way, but recent developments have shown that the importance of this provision can be over-emphasised.

Theoretically, the expansion on a 60 foot rail for a temperature increase of 50°F. is of the order of $\frac{1}{4}$ in., and that on a 300 foot rail $1\frac{3}{4}$ in., whereas actual practice shows that on a well ballasted system the expansion experienced in the latter case is little, if at all, greater than in the case of the shorter rail.

The temperature stress set up in a rail subjected to a temperature increase of 50°F. and prevented from elongating is of the order of 5 tons per sq. inch—say, 50 tons total stress in a normal main line rail—and the balancing forces are the inertia of the rail itself and the resistance to its movement afforded by the keys and chairs or the sleepers, whichever is the lower.

As these forces are cumulative, actual expansion is only possible in that portion of the rail in which the sum of the balancing forces is less than the temperature stress, so that, with a sufficiently long rail, expansion can only take place in a greater or lesser length at each end, the extent depending upon the tightness of the keys and the efficiency of the ballasting.

Since the temperature stress set up by any normal variation of temperature likely to

be experienced is within the elastic limit of the rail material, there is no possibility of permanent set, nor, as the distance between supports is relatively small, is there likely to be any danger of deformation of any sort in the rail section.

While these considerations strictly apply only to straight rails, the resistance to movement afforded by well ballasted sleepers is sufficiently high to ensure that there is little rail movement as a result of temperature stress in continuous track carried round curves of large radius.

For this reason, railway engineers in many countries are progressing towards the completely continuous rail with its manifold advantages, in respect of track and rolling stock maintenance, and the experimental lengths which have been laid show great promise.

With the aim of reducing the number of rail joints, it is already common practice to weld rails into continuous lengths of up to 300 ft., but the handling of such lengths provides practical difficulties and, where greater lengths are required, welding must be done in situ.

The well known Thermit Welding Process provides a means whereby rails of the greatest length, compatible with reasonable ease of handling, can be joined together, in position, to form a continuous table of any desired length.

^{*} Managing Director, Murex Ltd.

This process, as its name implies, makes use of the affinity of finely powdered aluminium for oxygen, and the Thermit "portion" itself consists of carefully selected and graded particles of aluminium and iron oxide, together with certain alloying ingredients, calculated to produce a cast material having the same physical characteristics as the rolled rails which it is designed to weld together.

While each depends for its efficiency upon the exothermic nature of the reaction between aluminium and iron oxide, and the very high temperature of the steel which results from it, there are two methods of rail jointing to which it has application, these being known as the "Butt" and "Fusion" processes.

In both cases the rail-ends to be joined are first enclosed in a mould of suitable section which is then pre-heated by means of a blowlamp through ports formed in the body of the mould; in the "Fusion" process the rail ends are separated, whereas, in the case of the "Butt" process, a section of mild steel of appropriate section and of a thickness of about $\frac{1}{4}$ inch is inserted between the heads of the two rails.

When pre-heating has been carried out, the Thermit mixture is placed into a conical refractory lined crucible provided with a special tapping device and supported at a suitable height above the pouring gate of the mould; the reaction is then started by means of a heated rod applied to a starter placed on the surfaced of the mixture.

Because of the careful grading of the materials used, the reaction, while rapid, is not of explosive violence, but results, in a few seconds, in the formation of highly super-heated liquid steel and slag. The convection currents which are set up and the widely differing specific gravities of the metal and the slag result in a very quick and clean separation so that, when the crucible is tapped, the liquid steel is first released

into the mould and followed by the super-heated slag cover.

The fundamental difference between the "Butt" and "Fusion" processes is that, in the latter case, the amount of steel produced by the reaction is sufficient completely to fill the gap which has been left between the rail-ends, its super-heat being such as to ensure that the rail ends are fused and a completely homogeneous joint formed.

In the case of the "Butt" process, the amount of steel formed is only sufficient to fill the mould to a level just below the head of the rail, so that the rail head itself is surrounded and heated by the liquid slag. When sufficient time has been permitted to elapse to ensure that the rail heads have been raised to a welding temperature, they are pressed together forcibly by means of clamps and levers attached to the rails, with the result that pressure welding takes place. Thus, the use of the "Butt" process involves a lateral movement of at least one rail during welding and, therefore, is less suitable than the "Fusion" process in cases where very long lengths of rail are being joined together.

In the earlier days of the Thermit process the "Butt" system was preferred, principally because it was believed that the cast metal joining the rail heads would prove a point of weakness, but experience and the advance of metallurgical science have shown that it is possible by the Thermit process to produce weld metal having similar wear resisting characteristics as the rail material itself, combined with even higher fatigue strength.

While, for a variety of reasons, rail-welding has not progressed so rapidly in Great Britain as in many other countries, there can be no doubt that the years of trouble-free maintenance which its use ensures will eventually result in its more general application in this country also.—
Passenger Transport

Simmonds Self-Locking Nuts

THE use of castle nuts and split pins, locking washers and double nuts for secure assembly, has now been widely superseded in all Industries by the application of various types of self-locking nuts, and these give improved performance at considerably reduced production costs.

Three well-known examples are the Fibre Nut, the Pinnacle Metal Diaphragm Nut and the Nyloc Nut. Manufactured by Simmonds Aerocessories Ltd. of Treforest, Pontypridd, Glamorgan, Gt. Britain, these self-locking nuts are absolutely unaffected by vibration and each has a special purpose in its application.

FIBRE NUT

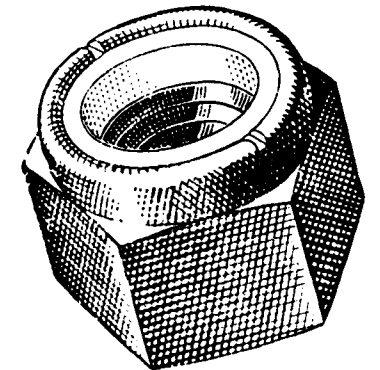
The Fibre Nut, designed for general external use where a positive lock is required, is a standard hexagon nut with overall height slightly increased to incorporate a special fibre insert. This insert or collar has an internal diameter slightly less than the diameter of the engaging bolt and is not initially threaded.

In assembly, when a bolt passes through the threaded portion of a Fibre Nut and reaches the fibre insert, further advance is resisted. In overcoming this resistance, the nut is forced away from the bolt head, until the sides of the thread are in close contact.

nothing rattles the NYLOC

No amount of vibration, however prolonged, can slacken off the Nyloc Nut, and no matter how many times it is used, it still remains locked. Nor is it loosened by oil, moisture and temperature extremes. The special nylon insert moulds itself around the thread of the bolt and refuses to budge unless, and until, you choose to remove the Nut.

Nyloc Self-Locking Nuts are used extensively by railway engineers on locomotives, rolling stock, bridges, permanent ways, etc., throughout the world.



Distributed by:

- JESSOP & Co. Ltd., 63, Netaji Subhas Road, Calcutta 1.
- J. N. MARSHALL & Co., Savoy Chambers, 5, Wallace Street, Fort, Bombay 1.
- PARRY & Co. Ltd., Dare House, Post Box 12, Madras 1.

Manufactured by: Simmonds Aerocessories Ltd., Treforest, Pontypridd, Glamorgan, Gt. Britain.

C.R. 65

This force distributes itself as a pressure on the side of the bolt thread which will normally carry the load when the nut is drawn home and the pressure result in heavy friction between the sides of the thread in contact. Thus a considerable anti-rotational force is exerted to prevent the nut from moving under vibration.

The bolt makes its own thread through the fibre insert and special elastic properties of the material ensure that no chips are removed when in engages the bolt threads. Pressure between the insert and the bolt further increases the anti-rotational characteristic of the nut.

PINNACLE METAL DIAPHRAGM NUT

The Pinnacle Metal Diaphragm Nut has been developed for immersion in oils and other fluids and where high temperatures exist. In design, the Pinnacle Nut is also a standard hexagon nut and it incorporates a unique non-corrodible spring steel diaphragm or cap which has an inside diameter equal to the core diameter of the bolt. This diaphragm is depitched and on engaging the bolt thread it is deflected by an amount equal to at least half the pitch of the thread. The resulting self-locking action is similar to that of the Fibre Nut.

NYLOC NUT

Constructional dimensions of the Nyloc Nut are similar to the Fibre Nut and mechanically the self-locking principles function in the same way. A special form of nylon has been introduced to bring about this latest development in stiff nut technique.

Nyloc Nuts give improved performance under extremely critical conditions. Comparisons with all-metal nut endurance characteristics show that the Nyloc Nut has several considerable advantages, one being its extraordinary ability to adjust itself to bolt thread

irregularities. This significant feature is borne out by results obtained from cold flow tests and these properties of rapid recovery show that the nut is not affected by bolt dimensional limits. The nut possesses good dimensional stability under varying conditions of temperature and humidity extremes and it is also impervious to all oils, boiling water and many chemical solutions.

NYLOC CAP NUTS

Another form of Nyloc Nut is the cap nut. In this instance the self-locking insert and cap are one integral moulding and this affords a completely leak-proof seal which is necessary for special application such as pressurised chambers of various types, fuel tanks, etc.

SELF-LOCKING CHARACTERISTICS

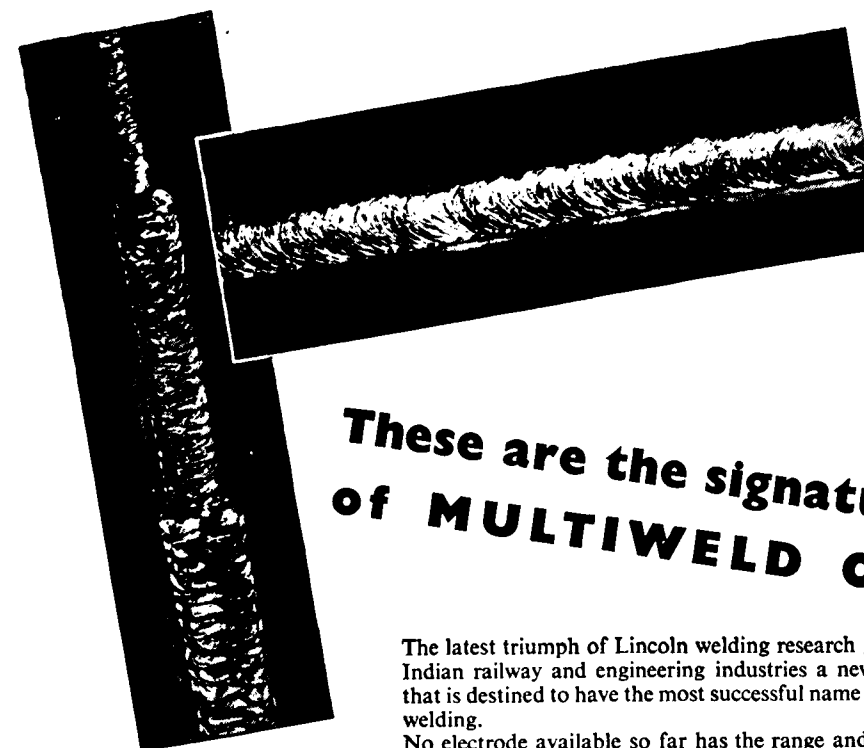
Before a bolt reaches the insert of the Fibre or the Nyloc Nut, or the metal cap of the Pinnacle Nut, each has every advantage as well as every shortcoming of a standard nut, for the play between the threads is to specified tolerances. This clearance, necessary as it may be for ease of production and assembly, is the main cause of an ordinary nut loosening under vibration.

The metal diaphragm of the Pinnacle is designed so that the strain due to deflection is still within the limit of proportionality of the material. The self-locking characteristics of all three Nuts are effective on bolts manufactured to all recognised standards in use throughout industry.

Simmonds self-locking nuts possess normal tensile and shearing strength. Under test it has been found that the Nyloc can be used many times and still retain its locking efficiency.

The Nyloc range which includes ordinary hexagon nuts, cap nuts, clinch nuts, strip nuts, single, double and floating anchor types has been fully approved for use on aircraft

(Continued on page 10)



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Dunlopillo Cushioning in Upper Class Compartments

THE PROBLEMS

RAILWAY seating presents particular problems to the designer which have been the object of special study by Dunlop technicians. It must provide maximum *comfort* for the passenger at the minimum *cost* and with good *appearance*.



1st Class Day/Night seating with upper berth in night position and lower berth in day position.

Maximum comfort means that when the passenger is sitting he is completely relaxed, and is cushioned to the greatest possible extent from vibration and shocks.

Relaxation is a matter of supporting the body properly: the area of support must be as extensive as possible to spread the body's weight, but the degree of support will not be the same in all parts of the seat. In this way the body is "cradled" and does not have to hold itself in position by muscular action.

Cushioning against vibration and shock means that the seat must not be too "bouncy" or even too springy, but should interpose between the body and the moving or vibrating framework a damping construction which will absorb the vibration and shocks.

The seating must do all this within the severe limitations of space in a railway carriage, permitting easy movement past or between occupied seats. The passenger must also be able to take his seat easily and to rise from it without difficulty.

Good appearance means that the seat must have pleasing external contours which must be maintained throughout its life.

All of these things must be achieved in a seat of the lowest possible initial cost, and

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construction and is inter-changeable with, or alternative to, the existing British Aircraft General Standards range of all-metal self-locking nuts.

APPLICATIONS

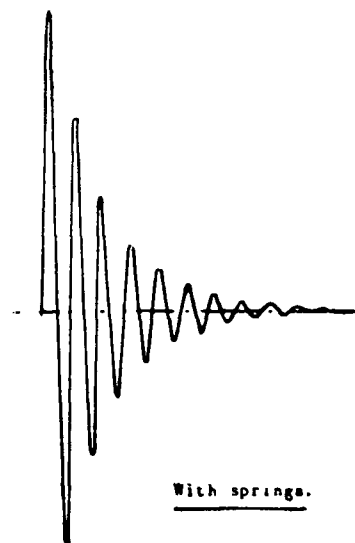
Fibre, Pinnacle and Nyloc Nuts are now widely used throughout the world in the automobile and aircraft industries and by manufacturers of railway, mining, agricultural and industrial equipment. Wherever problems

of vibration and positive fastening are involved, these Nuts may safely be selected for their superior qualities. Their ability to lock in any position on the bolt makes them ideal where positioning is required as on instruments and appliances, etc. "Fibre", "Pinnacle" and "Nyloc" nuts are specified by leading designers who recognise their technical superiority — production and maintenance engineers welcome them because they are simple and reliable to use.

having a long life and small maintenance expense.

THE SOLUTION

Dunlopillo has the qualities necessary to solve all these problems providing that full use is made of them by good designing.



Dunlopillo are subjected to shocks of equal violence, the passenger in the spring seat oscillates further than the one in the Dunlopillo seat, and for a longer time.

This seating is supplied in lengths of 6 ft. (1828 mm.) and over.

Dunlopillo is porous; the constant circulation of air through its structure keeps it cool even in tropical climates.

Dunlopillo is uniform; by using mouldings of the same density, the designer can be certain that the comfort he creates in a prototype seat will be repeated in all production seats.

Dunlopillo outlasts other types of cushioning, has little or no maintenance cost, and

Dunlopillo is so resilient that no springs are required to give a comfortable seat; in fact, as the diagrams show Dunlopillo on its own gives a more comfortable seat than in conjunction with springs, because of its exceptional damping qualities. When seats cushioned respectively with springs and with

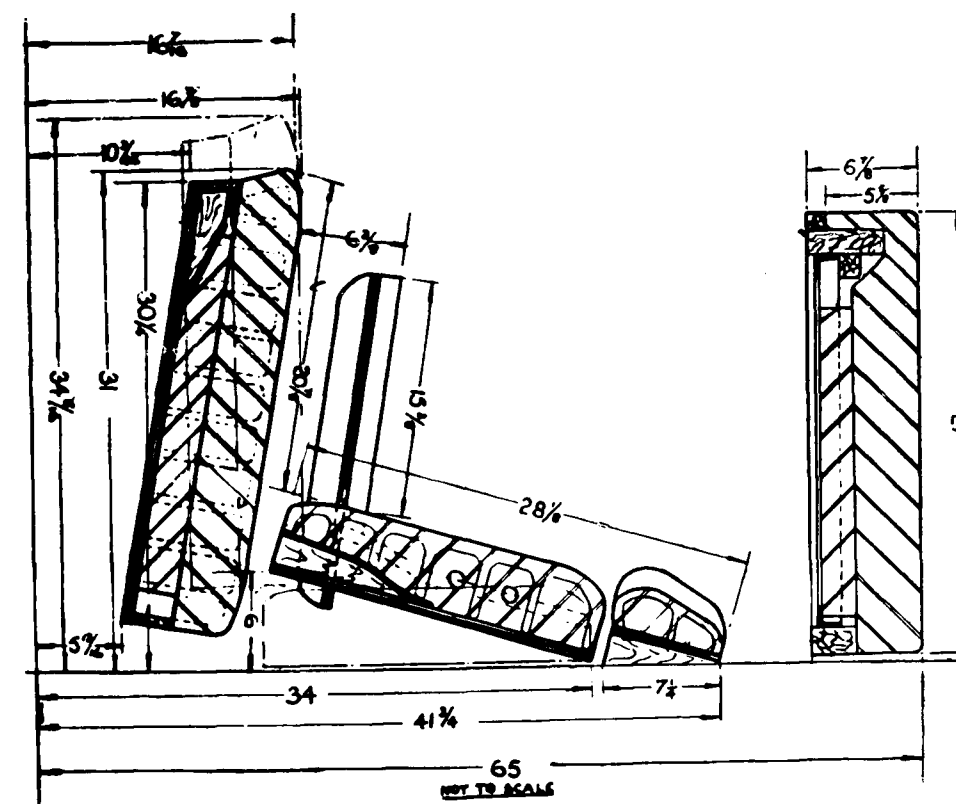


cannot damage passengers clothing even if the seat cover has been torn open.

EFFECTIVE DESIGNING

A Dunlop seat design consists of a shaped Dunlopillo moulding supported by a rigid base designed according to the body's requirements. The whole may be described as a piece of "anatomical engineering". The design of Dunlop 1st Class Day/Night seating is a typical example of anatomical engineering, and makes full use of the qualities which have made Dunlopillo famous.

The scale drawing shows how the Dunlopillo cushion and backsquab are placed on shaped supports which are so arranged that the greatest depth of latex foam falls in the area of the seat where the greatest load will



Each compartment contains 4 berths, 2 upper and 2 lower. All the Dunlopillo units can be trimmed separately before assembly.

Dunlopillo mouldings used in this design

Mattress	BU 4769
Cushion	A 14515
Squab	B 14507
Headroll	D 14513
Armrest Squab piece	C 14543
Flat piece	C 14544

This seating is supplied in lengths of 6 ft. (1828 mm.) and over.

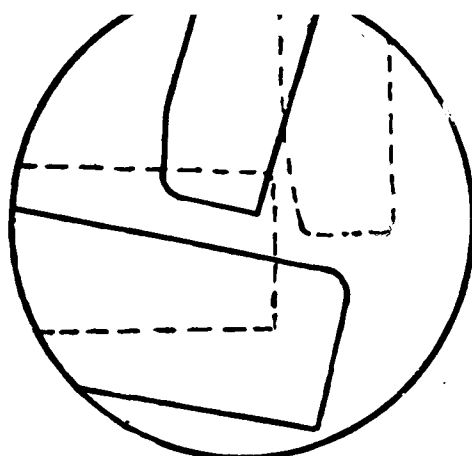
be applied. The passenger is supported in a natural relaxed sitting position.

Some of the features of this design are:

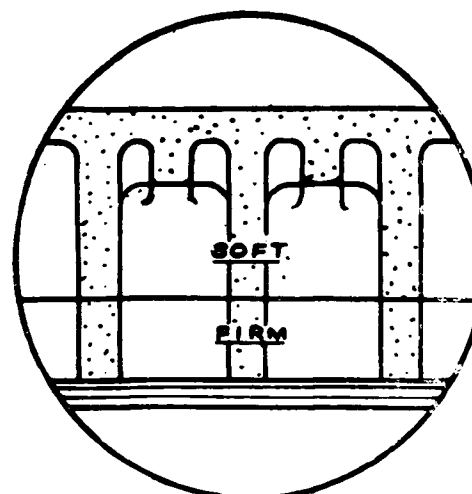
Adjustability: For sitting comfort, the back squab is moved to its forward position to give the most comfortable seat width.

For sleeping comfort, the backsquab lies flush against the coach wall and the seat cushion is moved upwards and forwards, becoming a mattress 29" wide.

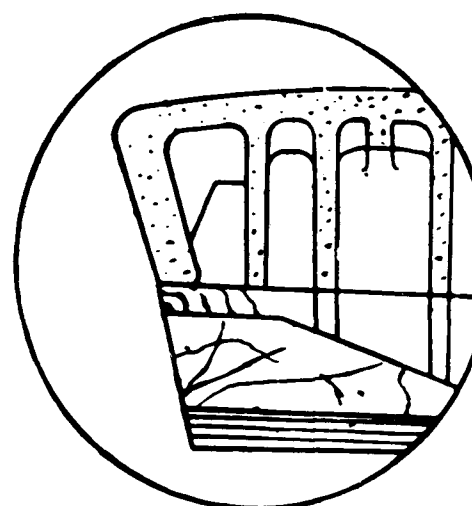
Comfort: The double-density seat cushion is designed to give firm support during the day and soft luxury at night. The firm under-block which absorbs shocks is scarcely to be



Day and Night positions of seat cushion and back squab



Soft cushion with firm underblock.



Interior bargeboard in lower berth.

felt at night because then the reclining body is mainly supported by the soft top layer of foam rubber.

Design : In all Dunlop luxury P. S. V. seat designs, the base upon which the Dunlopillo is placed is designed to support the human body in a comfortable sitting posture.

This entails, amongst other things, the erection of a ramp at the front of the seat base : in the case of the day/night lower berth the ramp has a second purpose—it acts as a bargeboard when the berth is being used as a bed.

The upper berth is an adaptation of the Dunlopillo Deep Six mattress. Since the Dunlop Rubber Co. invented latex foam, the Dunlopillo Division have put many years of research and experiment into the designing of good seating. To them a seat is primarily a functional unit whose parts can be scientifically studied and largely expressed in angles, heights, dimensions, hardnesses, thrusts, etc. and be broken down into the characteristics of component parts and their relation to each other.

The seat designs thus developed using Dunlopillo come up to all the requirements demanded of railway seating. Seating with the largest pitch is naturally more luxurious than that set at a smaller pitch but the maximum comfort is designed into each range.

CHITTARANJAN EXCEEDS TARGET PRODUCTION

Compared with target production of 36 locomotives between April and September 30, 1954, the Chittaranjan Locomotive Works have produced 46 locomotives during this period, as against a total production target of 64 locomotives during the whole of the year 1953-54. This information was given in reply to a question in the Lok Sabha on 10th December, 1954 by the Deputy Minister for Railways and Transport.

Bushing Articulated Joints of Signal Ground Equipment

RAILWAY Signal ground equipment with its multiplied-hole and pin joints, provides an appreciable problem for railway maintenance staff, since the inevitable wear must be kept within limits if signal operation is to be unimpaired. Cranks, compensators, and so on, constitute potential wearing points which by virtue of their multiplicity are an important factor in cost of maintenance and efficient working of the various components.

To provide for such a situation most railways today have adopted the policy of bushing components so that wear is at least confined to a renewable steel bush rather than allowing it to develop on a component part relatively expensive to repair. Such a policy



necessitates the accurate machining of bushes to provide the requisite interference fit, and the provision of oversize bushes and pins to suit holes which for various reasons subsequently need enlarging, and ultimately, the scrapping of components when the maximum hole diameter is exceeded. It also implies the existence of hydraulic or pneumatic presses for fitting and removal, which in turn involves labour in transportation of components to and from such presses, a matter of some importance in dealing with signals equipment

(Continued on page 16)

spread as it is over a wide area at signal boxes, junctions and stations throughout the system.

A simplified and economical method of bushing various components is claimed for the Walter Patent Hardened Steel Split Bush as manufactured by Self-Priming Pump & Engineering Co. Ltd.

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

As such a bush does not have to withstand the pressing-in stresses normal to a plain bush, it is not necessary for it to have a wall thickness of more than $\frac{1}{8}$ in. thus existing components previously unbushed can have the holes opened out this small amount without difficulty and usually without materially weakening the joint.

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

In specifying such bushes for new details the question of standardisation is most adequately dealt with, since future renewals call simply for the replacement of bushes of the original size, and no question of stocks of oversize bushes arises, nor consequent renewal of main components, due to excessive wear of the holes which is completely eliminated.

Rail and Wheel Flange Lubricators

RAIL and wheel flange wear has long been an economic problem which railway engineers have striven to overcome. With the advent of Diesel and electric traction, usually carrying greater loads at increased speeds, rail and flange wear have increased and are increasing to the point where they cannot be overlooked.

The causes of rail and wheel flange wear can be shared between track and rolling stock influences. Track influences include the degree of curvature; length of transition from straight to curve; amount of super-elevation in relation to maximum and minimum speeds of traffic; and amount of gauge widening. Gauge widening increases the angle of attack of the rolling stock wheels, the leading axle of each truck crowding the high rail and the trailing axle assuming a radial position on the curve. The angle of attack of

the wheels is the main rolling stock factor influencing rail and flange wear. Variations in the angle of attack can result from the hunting of bogies; long rigid wheel bases or alternatively insufficiently long wheel bases; the rigid wheel base of driving axles and play in axles, axleboxes and journals. Diesel and electric traction have increased the degree of wear, producing increased and more concentrated lateral thrust by reason of the smaller diameter wheels offering a reduced flange area to the rail head, and often greater unsprung axle loads. Multiple Unit Electric trains show a well known tendency to hunt, while Diesel trains operating under load tend to slew and operate crabwise, in each case the angle of attack of the wheels being increased. The faster speeds and rapid acceleration possible with Diesel and Electric traction are other factors which have increased rail and flange wear, more noticeably in locations

(Continued from page 15)

This split bush by its design lends itself to "on site" replacement requiring the use of nothing more than normal hand tools and thereby offers considerable scope for economies by avoiding the transport of components to a central or branch workshop perhaps hundreds of miles away, at the same time avoiding the need for duplicate sets of components which would be required if sections of the signalling system are to be kept in continual service. To change a Walter bush on site is a job which can be done in a matter of minutes while delays in transport can generally be measured in days and possibly weeks and the economy achieved by reducing stocks of components can reach a truly impressive figure.

As a result of experience gained on British Railways and others overseas over a period of many years the above company have steadily increased their range of bush sizes and are justly proud of having met all requirements

during the difficult years thus enabling re-conditioning of cranks etc. to be carried out at a time when replacements were most difficult to obtain.

To all readers of this magazine it will be evident that the Walter split bush is equally applicable and advantageous when used on brake and spring gear of all types of locomotives as also on brake gear etc. of other rolling stock and it is of particular interest to note that the Beyer Garrett locomotives for New South Wales referred to illustrated on pages 48-56 of our October 1954 issue were so fitted and each of these locomotives carries approximately 600 Walter split bushes of various sizes as specified by the New South Wales railway engineers, while many other interesting contracts are in hand or have been recently completed to meet similar requirements of Diesel Electric Locomotives, coaching stock for steam and electric traction and various types of wagons.

which were previously considered as low speed areas.

The above causes are just a few of many known to be directly related to rail and flange wear, and when combinations of these causes in varying degrees of intensity are considered, one realises how remote is the possibility of altogether eliminating such wear. Railway Engineers have therefore sought, if not to eliminate, to slow down the process of wear by means of lubrication between the wheel flange and the inner side of the rail head.

MECHANICAL LUBRICATORS

Extensive trial and research in lubricant application has led from the manual lubrication of the high rail on curves to the development of the mechanical rail and wheel flange lubricator.

Recent American tests on track experiencing excessive wear, traversed by heavy ore trains drawn by diesel engines, have shown that rail and wheel flange wear can be practically eliminated by lubrication with mechanical lubricators. Comparative tests were carried out using engine-mounted flange oilers and rail-mounted grease lubricators. The results obtained were in favour of the rail-mounted rail and wheel flange lubricator which offered grease to each wheel of the passing trains.

The majority of engine-mounted flange lubricators are automatically controlled by the angular displacement of the bogie in relation to the body. This means that the flange lubricator only commences to function when it has entered the curve, whereas the fixed track lubricator is usually sited at the curve approach, where sidewear of the railhead begins, and can alternatively be installed for example at the shunting necks in marshalling yards, whence the grease can be distributed to numerous turnouts and crossings in the area.

The New South Wales Government Railways, with several thousand "Aladdin" rail

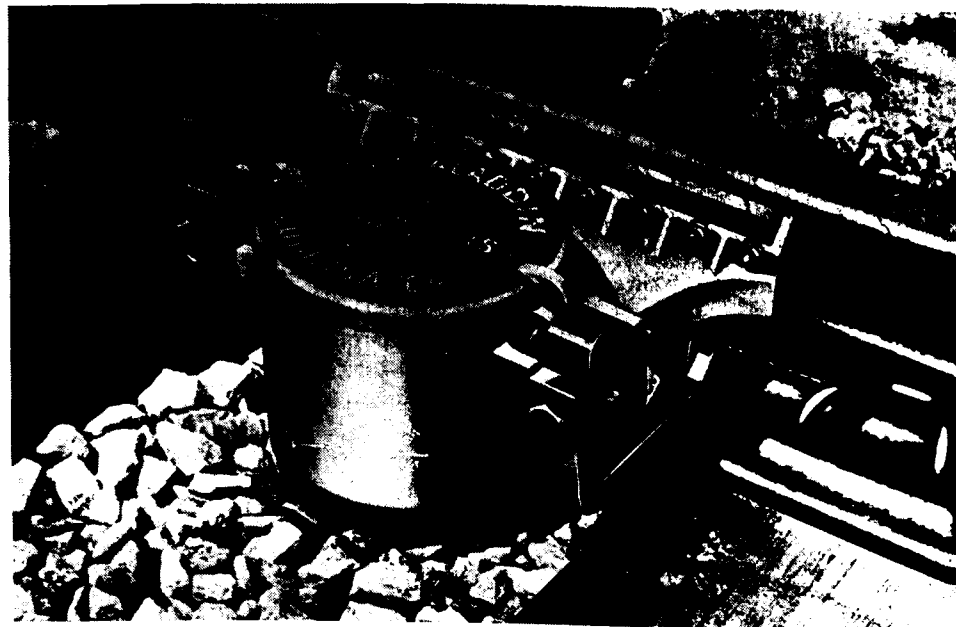
and wheel flange lubricators installed, have maintained careful records of rail and wheel flange wear both before and after the installation of the lubricators. As long ago as October 1939 the Locomotive Superintendent stated that on one particular mountain section, the mileage between turning of locomotive wheel flanges had risen from 12,500 to 50/60,000 as a result of the installation of the lubricators, and in fact the flange wear had become so light that the tyre thread wear just about equalled the flange wear. The economies of lubrication in New South Wales were summarized in November 1947 by Mr. A. C. Fewtrell, Chief Civil Engineer, who wrote: "I originally estimated the saving, as a result of the use of the Lubricators, at approximately £ 70,000 per year for my Branch, and an equivalent amount for the Locomotive Branch for the saving in the wear of the tyres on locomotives and rolling stock. In my own Branch, I would say that we have at least doubled the original estimated saving in regard to the replacement of rails on curves".

Maximum efficiency with minimum maintenance is a maxim suited to rail and wheel flange lubricators, and it is with this object that the modern lubricator is designed. Simplicity is the guiding factor in design; simple installation, simple operation and simple maintenance will ensure satisfactory results in use, even if the lubricator is located at an isolated position.

It is most important for the correct operation of a lubricator that a grease of the correct consistency is used. Here again, much research has resulted in the development of graphited greases, in which the variations in the stiffness due to temperature fluctuations are kept to minimum. This ensures, together with design features incorporated in the lubricator, that no grease is wasted by splashing and none reaches the head of the rail or the treads of the wheels.

Two entirely different lubricators are patented and manufactured by the Executors

of James Mills Limited of Woodley near Stockport, England, the "Aladdin" and the "Mills Hurcol", both being operated by the movement set up in the rail by passing traffic, no part of the lubricators being in direct contact with the wheels.



Standard "Aladdin" Lubricator.

mounted by two "U" springs on brackets clamped to the rail. The vibration and deflection of the rail caused by passing traffic are transmitted to the grease cylinder, and by the inertia of the piston feed the grease to a position where it can be picked up by the passing flanges. The amount of grease is controllable to suit the location and conditions of traffic by adjustment of the gap between the delivery tongue and the rail running face, and vertical adjustment of the tongue. The standard model will fit a very wide range of rail sizes.

THE "MILLS HURCOL"

The Mills Hurcol Rail and Wheel Flange Lubricator is of a higher capacity than the Aladdin, and is operated by the slight vertical movement of the rail under traffic.

THE "ALADDIN"

The Aladdin Rail and Wheel Flange Lubricator is simply and substantially designed. Briefly, it consists of a main body casting comprising grease cylinder and delivery spout,

It consists of a single unit embodying a 20-lb. capacity grease container and pump, which is installed within the ballast either on the inside or outside of the high rail as preferred. Under passing traffic slight vertical movement of the rail occurs, and this is transmitted to the pump through an actuating arm clamped to the rail, the arm's extremity being in positive contact with the taper head of the pump. The pump is a simple section unit of sturdy construction which can be bodily unscrewed from the lubricator without special tools for inspection or cleaning. A special head is provided to avoid interference with track circuiting.

The grease is delivered by the pump through an assembly of flexible hose and steel tubing to one, two or more applicators



"Mills Hurcol" Lubricator Mounted Inside the Track.

each 22" in length. The applicators are attached to the rail by 'C' clamps, and may be fitted to the running rails or check rail or both as desired. Incorporated in each applicator is a grid with graduated perforations. These ensure the even omission, throughout the length of the applicator, of a ribbon of grease to the side of the rail head to be picked up by the wheel flanges. The applicator blades are adjustable both vertically and laterally to allow adjustment for any rail wear which may have occurred prior to the installation of the lubricator.

Multiple applicators grease a larger area of each wheel flange, making for quicker and more even distribution of grease round the curve, and enabling a greater part of the grease output from the pump to be effectively used. This also avoids wastage through splashing resulting from centrifugal action of the wheels.

The actual stroke of the pump corresponds to the amount of vertical movement of the rail, the capacity of the pump being such that only a small vertical movement pumps sufficient grease at any one location. If for

any reason the vertical movement exceeds the maximum pump stroke of $\frac{3}{16}$ " the unwanted movement in the actuating arm is absorbed by an overload spring, so that no damage occurs to the pump casing. In practice, the capacity of the pump exceeds requirements, and output is regulated by a graduated handwheel control, any desired proportion of the grease pumped being returned through a by-pass into the container.

A free piston within the grease container exerts a gravitational force on the grease, so ensuring a constant supply to the pump chamber and eliminating the possibility of air-locks within the pump. When the grease cylinder is almost empty the piston automatically releases an "empty" indicator.

Both the Aladdin and the Mills Hurcol rail and wheel flange lubricators are supplied to suit any type or size of rail, Flat Bottom or Bull Head. Installation in both cases is simple, all components mounted on the rail being secured by clamps, eliminating the need for drilling or other special preparation of the rails. There being no direct contact between the passing traffic and lubricator components, wear is negligible and normal



Alternative Mounting Outside the Track.

maintenance reduced to the occasional refilling of the grease container and an occasional external cleaning.

By the use of mechanical lubricators such as these, rail life on curves has been extended up to four times, with a directly proportional increase in wheel flange life, and a corresponding reduction in maintenance costs. In addition to the direct benefits, the decreased

wheel flange friction makes curves, turn-outs and crossings safer for high speed, increases stability and tractive efficiency and decreases fuel consumption in curved areas. The enormous savings thus made possible more than justify the comparatively low first cost and subsequent maintenance of these types of lubricators, which are now in service on large numbers of light railways, industrial sidings, and over 70 of the world's railway systems.

REQUIREMENTS OF RAILWAY WAGONS

It is estimated that about 250,000 (four-wheelers) wagons would be required by the Indian Railways by the end of the first Five-Year Plan to meet their requirements, said Shri O. V. Alagesan, Deputy Minister for Railways and Transport replying to a question in the Lok Sabha on 2nd December, 1954. He said about 12,000 to 13,000 wagons would be required annually by the end of the second Plan period to meet the needs of the Railways.

Asked when Government hoped to be in a position to meet all demands within the country, Shri Alagesan said: "We are practically self-sufficient for normal replacements and additions and within about two years the necessity for ordering from abroad is likely to

be obviated except in regard to some special type of stock".

NEW GOODS WAGONS FOR INDIAN RAILWAYS

The Indian Railways received 1,182 new goods wagons during September, raising the total number so far received during the present financial year to more than 4,300 wagons. About 76 percent of the wagons delivered during September were manufactured in India and the balance came from Europe.

Orders have been placed by the Railway Board for a total of 28,800 goods wagons to be delivered in the present and the next financial years. Out of this number, Indian Manufacturers will deliver more than 24,000 wagons.

Aluminium Subway Cars for Canada

ONE of the most advanced examples of urban transport practice is provided by four aluminium alloy cars that have just been completed by a British firm for Canada's first underground railway system, opened last Spring in Toronto.

These cars—which incidentally are an instance of Canadian aluminium returning to Canada after dollar-earning work has been done on it in Britain—were designed and built by the Gloucester Railway Carriage and Wagon Company Ltd., who also supplied all the 100 steel cars now in service. It was decided to build the four aluminium cars, with two more to follow, in order to obtain an assessment of the economics of aluminium construction for this type of

vehicle. Since the aluminium cars are identical in general design, capacity and power to the steel ones, a direct comparison of performance and operating costs will be possible. In railway system of this type where stops and starts are frequent and brisk acceleration is called for (the steel cars can accelerate at 2.3 m. p. h. per second and reach 55 m. p. h.), weight-saving is obviously of value. Adoption of aluminium has resulted in a saving of 5½ tons per car, thus reducing the weight of the superstructure, complete with all equipment, from 22½ tons to 16½ tons. To assess comparative power consumption, kWh meters are fitted in the aluminium cars and in four steel cars. Another respect in which the aluminium cars are expected to show an



The clean and spacious interior of a Toronto subway car gives no hint of the mass of complex equipment beneath the floor and seats.



The aluminium subway cars for the Toronto Transit Commission will go into service in the natural colour of the bare metal, with scarlet decorative trim. Obviation of external painting will reduce maintenance costs.



The close-up of a Toronto subway car shows the high standard of finish achieved on the riveted and welded aluminium plating.

economic saving is that of maintenance, since no external paint will be used on the bodywork.

The standard design of the Toronto cars, to which the light-alloy versions conform, has already been described at length in the technical press. In brief, the operating unit consists of two cars, one carrying the air-compressor and the other the auxiliary motor-generator set; a train may comprise up to four two-car units. The cars are large and spacious: 57 ft. long and over 10 ft. wide, with seating for 62 passengers and a total capacity of 230. Four 68 h. p. frame-mounted traction motors power each car, automatic retardation control is provided, and in general the equipment embodies many refinements, including elaborate heating equipment for pressure ventilation; special attention has been given to safety and to the suppression of noise and vibration.

In the case of the aluminium cars, the economics were investigated by the Aluminium Development Association, and

recommendations were later made by the Association and by Northern Aluminium Company Ltd., who supplied the structural material. Aluminium alloys, in the form of fully-heat-treated sections, plate, and sheet, were used for all structural members above the bogies with the exception of the main bolster, which remains in steel.

Extensive use was made of the argon-shielded tungsten arc welding process, while in riveted joints, aluminium-alloy rivets to B. S. 1473: NR5 were employed. The attachment of the external panelling is of special interest; the edges of the panels are butt-welded and attachment to the framing is by rivetting, but in view of the high initial finish necessitated by the fact that no filling or painting was to be done, the rivetting called for more than usual precision. The methods adopted were very successful, the lines of rivet heads being rendered imperceptible on the finished cars.

It will be interesting to see to what extent the experience of the world's latest subway will, in time, confirm the economic case for light alloy rolling stock.

AN IMPORTANT ANNOUNCEMENT

George Richards & Co., Ltd., Boadheath, Near Manchester the well-known manufacturers of Horizontal Boring Machines, Vertical Boring Mills, Planing Machines, Crankpin Turning Machines, Axle-Box Boring Machines and Keyway Cutting Machines, announce that they have appointed Alfred Herbert Ltd., Coventry, Sole Distributors of their products throughout the world.

It may be recalled here that Messrs. Alfred Herbert Ltd. Coventry recently concluded

an important sales agreement with George Richards. Alfred Herbert Company has eight branches in Great Britain besides associated companies and agents in forty-nine countries of the world. The Indian Company is very efficiently managed by its Managing Director Mr. E. D. Mitchell who needs no introduction to the Indian Railway Engineers in general and Mechanical Engineers of Railway Workshops in particular. We are sure that he will maintain the popularity of George Richards whose popular machines are already in use on the Indian Railways.

Manufacture of E. R. W. Steel Boiler Tubes

THE Electric Resistance Weld Process of Steel Tube manufacture was introduced into Great Britain over 25 years ago by Messrs. Tube Products Limited of Popes Lane, Oldbury, Near Birmingham. The manufacture of "Tru-wel" tubes by this process has developed rapidly ever since and the name of "Tru-wel" has become firmly established in a wide variety of industries all over the world.

The Electric Resistance Welded tube has been accepted for pressure applications, including use in Boilers and Super-heaters and has for many years been established as a safe and reliable product. Tubes made by this process are widely used by Government Departments, Shipyards and Railway Companies.

The publication of British Standard Specification 1654-1950 covering the use of Electric Resistance Welded Steel tubes for Boilers and Super-heaters was a landmark in the development of this type of steel tube for pressure purposes. The experience gained over 25 years in the manufacture of Electric Resistance Welded tubes for mechanical and structural purposes has enabled "Tru-wel" E. R. W. Boiler Tubes to be produced in the knowledge that every tube made fully met the requirements of the specification and compared favourably with any type of Boiler Tube made. Extensive trials have been carried out by the various regions of the British Railways Executive and by leading Marine and Stationary Land Boiler manufacturers. In all cases the use of "Tru-wel" E. R. W. Boiler Tubes has produced favourable results.

The following authorities have officially approved the use of "Tru-wel" Boiler Tubes:—

The British Admiralty
British Railways

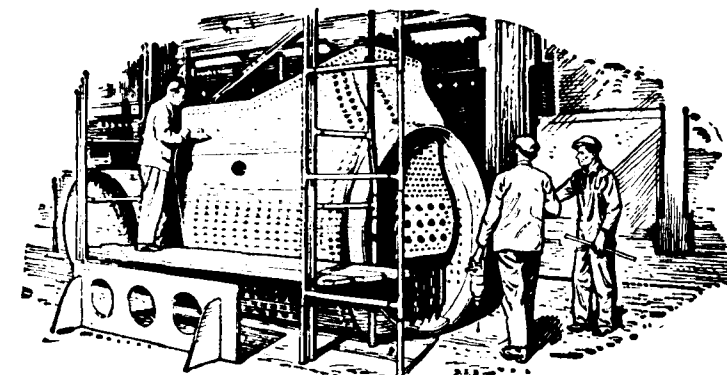
Crown Agents for the Colonies
Lloyds Register of Shipping
The Ministry of Transport
The Insurance Companies Associated Offices Technical Committee

"Tru-wel" E. R. W. Boiler Tubes are manufactured from coiled strip which has been rolled from specially selected casts of steel. The types of steel used are 'Rimming' Steel, which is in general use where the design steam temperature is below 750°F. and 'Killed' Steel which is used when service temperatures of between 750°F. and 850°F. are required. Modern methods of continuous rolling produce strip with an excellent surface, and since the strip form lends itself to examination, complete inspection of what becomes the inside surface of the tube is assured.

The process begins when the flat steel strip is fed from a coil into one end of the machine and ends when it emerges at the other end and as a precision electric resistance welded steel tube. It is a continuous process and involves eight stages: Cleaning the surface of the strip;

cutting the strip to accurate width.
forming the close jointed tube.
electrically welding the joint.
removing the external and internal weld flash.
accurately sizing the welded tube through finishing rolls.
cutting to mill lengths, and testing.

First the steel strip is carefully inspected and cleaned on both sides and then fed through rotating cutting tools to ensure that its width is accurate and edges are square—essential for obtaining the correct diameter. The strip then runs through a series of shaping rolls of varying contour which shape the



For over 25 years we have been manufacturing Electric Resistance Welded steel tubes. During this period we have accumulated a wealth of experience which enables us to offer you Tru-Wel E.R.W. steel tubes for boilers*—made to the rigid standards of British Standard 1654/1950.

* Tru-Wel E.R.W. steel tubes for air heaters have been supplied for many years to leading boiler manufacturers.



TUBE PRODUCTS LIMITED, OLDBURY, BIRMINGHAM, ENGLAND A  COMPANY

steel strip into a close jointed tube of the required size. The butted edges then pass under a pair of copper electrodes, where the resistance of the joint to a heavy current produces the welding heat. No metal is added at the weld and the steel is not altered chemically in any way. The process results in a weld of the same composition as the parent metal, free from inclusions or similar defects. Immediately after passing under the electrodes the external fin is removed completely by a special cutting tool so that there is no surplus metal on the outside wall of the tube. Internal fin cutting is also carried out throughout the length of the tube to conform with the requirements of British Standard 1654-1950. The tube then passes through finishing rolls which straighten and size it accurately to the specified dimensions.

"Tru-wel" E. R. W. Boiler Tubes are subjected to critical inspection at each stage of their production. Samples are of course taken from every production batch and submitted to the specification tests for tensile strength, elongation, flattening and expansion. In addition special tests of an exploratory nature, such as hydraulic test to destruction, transverse tensile tests and micro examinations are carried out at frequent intervals.

Facilities are afforded for the inspection of "Tru-wel" E. R. W. Boiler Tubes by inspecting authorities nominated by customers.

All Boiler tubes are subjected to testing by Hydraulic Pressure. The following table shows how B. S. 1654 requires that the test pressure shall be governed in relation to the design pressure.

Design Pressure. <i>Lb. Sq. inch.</i>	Hydraulic Test Pressure. <i>Lb./Sq. inch minimum.</i>
Up to and including 500	1000
Above 500 up to and including 1000	Twice the design pressure

Above 1000 1000 above the design
pressure

Finally after completion of manufacture all tubes are normalised in modern furnaces under carefully controlled conditions of temperature and atmosphere.

In conclusion it may be helpful to summarise the advantages of "Tru-wel" Electric Resistance Welded Steel Boiler Tubes.

1. The strip from which "Tru-wel" E. R. W. Boiler Tubes are made is thoroughly inspected on both sides. This ensures that there is no flaw either on the inside or outside of the tube.
2. The cold forming of the flat strip to a tubular section further improves the surface.
3. As the Electric Resistance Welding is fully automatic, variations due to the human element are eliminated.
4. It is possible to work to very close limits of wall thickness and concentricity. This means a low thermal stress, uniform heat transfer and uniform weight. Concentricity is also a great advantage when expanding or reducing the ends of the tubes.
5. "Tru-wel" E. R. W. Boiler Tubes can be satisfactorily expanded, reduced, beaded, flanged, flared or bent.
6. "Tru-wel" E. R. W. Boiler Tubes meet the requirements of BS.1654 of 1950.
7. They are available in a wide range of sizes up to 4.3' 8" o. d.

Diesel Railcars — A Brief Survey

By A. H. Sommer, M. I. Loco. E.

IN spite of the enormous strides made in road transport and the claims made by road enthusiasts, railways are and will remain the most important and economical means of transporting goods and passengers; provided the railways take advantage of suitable technical developments.

Foremost among these is the high speed compression ignition engine, more commonly known as a diesel engine and this has been the most important factor in the successful competition of road transport with the railways. This factor was not overlooked by many railway engineers and early attempts made to apply the new power unit to railway working. These efforts although promising, were not entirely satisfactory, one of the factors being the absence of the rubber tyre between wheel and running surface. One attempt to overcome this was the adaption of pneumatic tyres to rail vehicles but the load carrying capacity of the tyre is severely limited by the narrow width of the rail head. The adaption of a new type of rail with head six or more inches wide would solve this trouble but at prohibitive expense, with the further disadvantage of the loss of the very low tractive resistance enjoyed by the steel wheel running on the steel rail.

However, due to improvements in engine design and the development of technique in methods of engine and transmission mounting by means of bonded rubber fittings the early troubles have been overcome and the modern high speed diesel engine is as equally reliable as the steam engine and boiler. Moreover the availability is higher, no time being lost in raising steam or for the need of frequent withdrawal from service for boiler attention.

Broadly speaking the adaption of diesel power units to railway working has been tackled in two ways, the United States of America developing the high power diesel electric locomotive hauling more or less orthodox rolling stock, and the European solution of self-propelled coaches capable of running as single units or coupled together and controlled by one driver. Both solutions have been remarkably successful and in the U. S. A. the building of steam locomotives has practically ceased.

It must be remembered that in the U. S. A. initially the locomotives were not purchased outright by the railways but hired from Finance Corporations, the hire fees being made possible by the savings in operational costs. This had a very encouraging effect in speeding up the adaption of diesel units and spread widely knowledge of the possible savings.

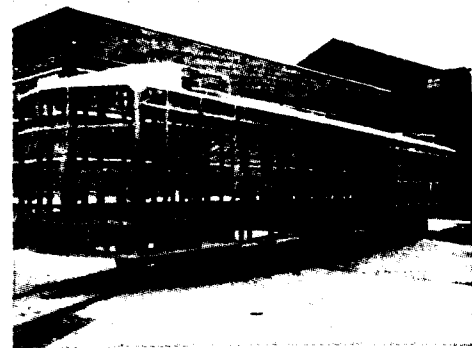
Both schools of thought have proved their ideas to be right and are now trying out the alternatives, the European school developing the high power locomotive and the U. S. A. multiple unit rail cars. Possibly the final result will be railcars for passengers and diesel locomotive hauled freight trains.

As regards railcars, they are developing into two types, those with vertical engines, usually mounted on the bogies and the underfloor type.

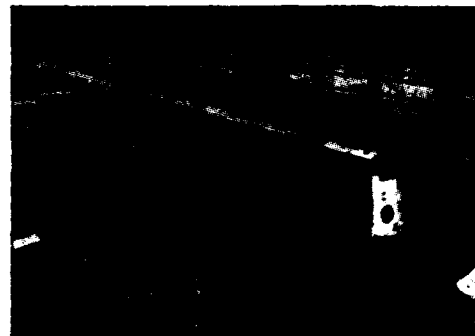
Of necessity the earlier cars were fitted with vertical engines, a wide variety of types and power being available. This type is very popular in the form of permanently coupled three car sets comprising power car, trailer, power car, with controls at the end of each

power car. These units have proved very successful in providing high speed non-stop services between large towns. A typical power bogie is shown on page 32.

The production of the horizontal engine for underfloor fitting in road transport led to their adaption for railcars giving the advantage of easy car-to-car communication and the use of



Typical of Wickham's unique tubular construction. The all-steel body is fabricated with solid drawn tube of square section and is designed as a box girder, thereby eliminating the conventional underframe.



The main assembly shop of D. Wickham & Co., showing passenger railcars and inspection cars under construction.

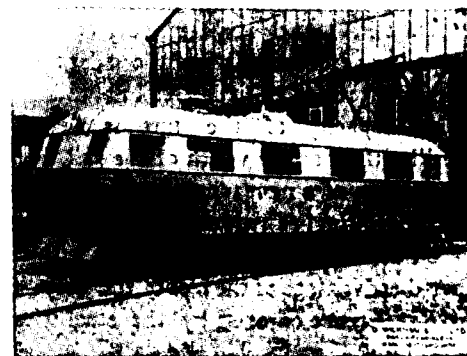
all the floor space for pay load. Train make up is also more flexible as the cars can be used as single units or coupled into trains of practically any capacity. The drawback up to quite recently was the limited engine power available from the road engine, in practice it being advisable to limit the 125 HP road rated engine to 100 to 105 HP for rail service.

There are now available however horizontal engines designed for railcar work with a working rating of 200 HP and more.

Generally speaking it can be safely asserted that the European school has most experience in the manufacture and running of diesel rail cars both in single unit and multiple operation and over the years have tried all known types



An early railbus with 3 axles supplied to the Peruvian Corporation Railways in 1935.



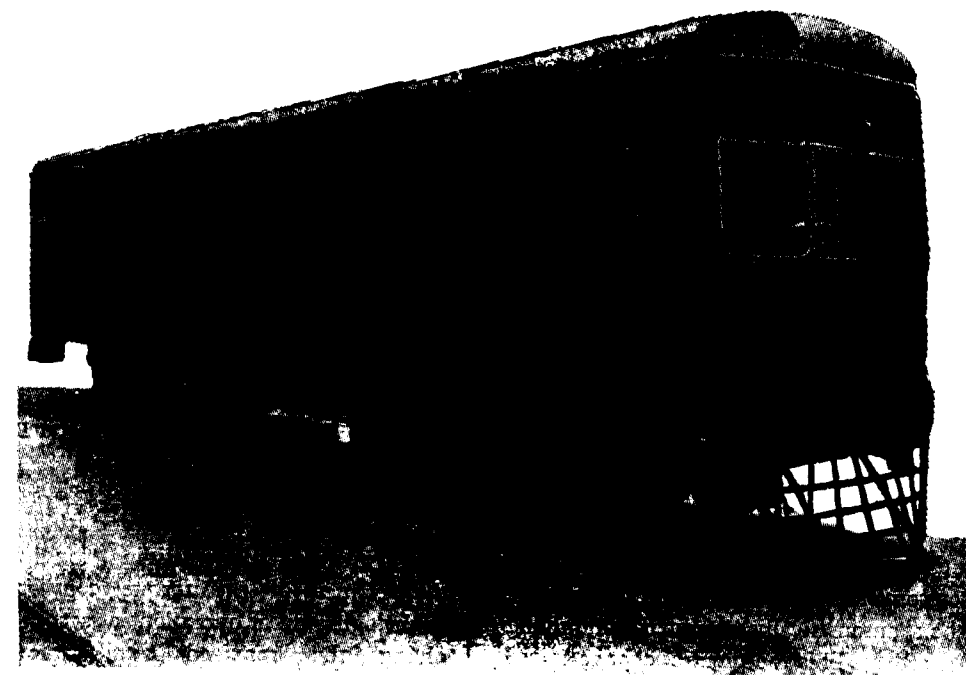
A two-axle railbus supplied to Buenos Aires Great Southern in 1936.

of transmission — mechanical, electric and hydraulic. It is significant that the French who have great experience over many years, have standardised on mechanical transmission. The Italians also have exhaustive experience and here again mechanical transmission is extensively used.

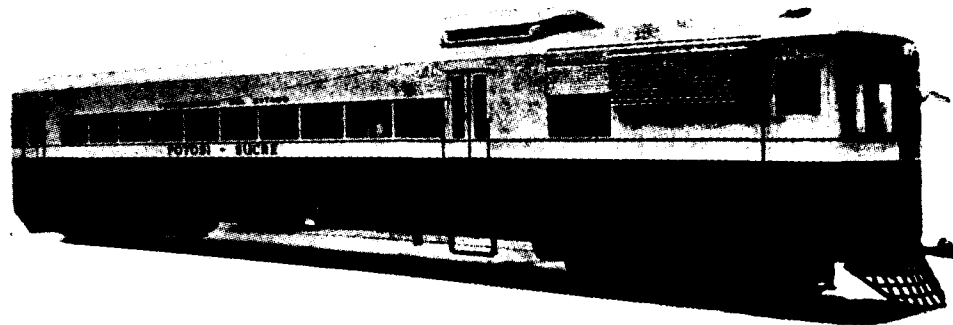
Germany on the other hand, after trying electric, hydraulic and mechanical shows signs



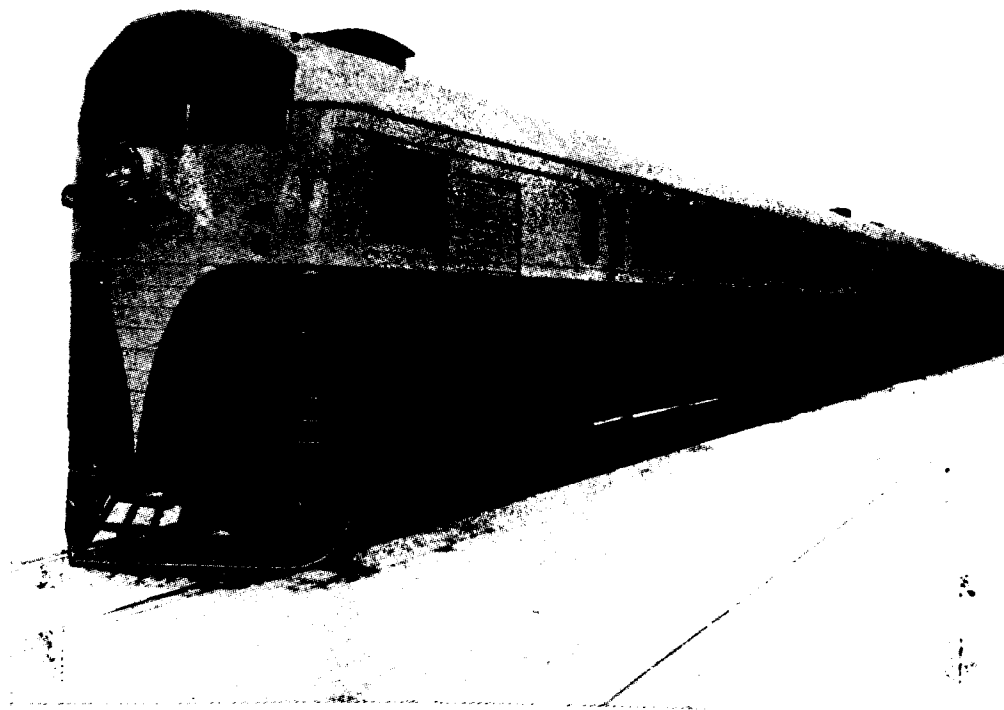
Modern Wickham railbus as supplied to the Burmese and Egyptian Railways. Powered by an underfloor diesel engine rated at 100 B. H. P. this is an extremely economical unit, able to haul a lightweight trailer and having a fuel consumption of 10-12 miles per gallon.



Modern Railcar designed for mountain railways with single end control and mechanical transmission.



Modern diesel electric railcar made in conjunction with Messrs. British Thompson Houston Ltd., for the Bolivian Railways.



Two-car diesel railcar unit supplied to the Colombian National Railways. Powered by Saurer 220 B.H.P. pressure-charged diesel engines and fitted with a Cotal electro-magnetic gearboxes.

of settling on a special type of hydraulic transmission comprising a simple type of torque converter combined with a change gear box automatically operated and giving four speeds. This automatic change speed mechanism, in order to operate, requires a slight reversal of input torque at the

moment of changing gear and this is very cleverly arranged by sliding longitudinally the runner of the torque converter and so bringing into operation a set of blades giving the required small amount of reversal. It is conceivable that if the necessity of momentary reverse torque could

be eliminated, the substitution of a simple fluid coupling in place of the torque converter would result in slightly increased efficiency and lower cost; also the transmission would then without hesitation be labelled mechanical.

British Railways, although late in the field, started off with hydraulic transmission; no official results have been published but the latest information available indicates that mechanical transmission will be used in future cars.

Until quite recently, owing to the lack of a home market, British railcar manufacturers have of necessity shipped their products to countries all over the world and the extremely diverse conditions experienced have enabled them to gather invaluable information and experience. With few exceptions rail cars built by British manufacturers have been fitted with mechanical transmission.

In the United States comparatively few rail cars are in service and these mainly are fitted with torque converters, maybe because this type of transmission was highly developed for use in heavy earth moving equipment where it has special virtues not applicable to railway use. Also no development had taken place in high power remote controlled multi speed gear boxes capable of being coupled together for multi unit operation.

Having very broadly and briefly surveyed the rail car picture the following details of a few cars designed and built by an English manufacturer of 30 years experience may be of interest.

In the early years their experience was confined to various types of small vehicles, from very small track inspection cars to four-wheeled rail buses carrying about forty passengers. The first double bogie coach was built for a British owned railway in South America, where starting at sea level the terminus was at an altitude of 12,000 feet,

the highest point reached being over 15,000 ft. above sea level. The first 80 miles of the trip is a continuous climb including gradients of over 4% and a number of zig-zags. The conditions were of the hardest and the problem presented many difficulties, one of them being an air temperature of 75°F at an altitude of 10-11,000 feet climbing 3-4% grades in a ravine with a following wind equal to the car speed.

Obviously the elimination of all unnecessary weight was the most vital problem and it was soon seen that the skimping down of any orthodox type of railway construction offered little return in the way of weight saving. It was found that a departure from the then orthodox was essential and a solution of the problem was found in the elimination of the standard underframe, the combination of a tubular structure fabricated by electric welding in the form of a body shaped tubular girder enabling this to be done.

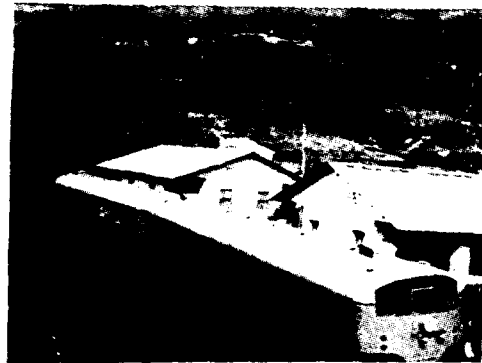
The tubular members are of solid drawn mild steel of square section $2\frac{3}{8}" \times 2\frac{3}{8}" \times 10$ g. the square section being chosen as offering easier welding technique and final panelling, with of course the additional advantage of being stronger and stiffer as against round tubes of equal diameter. Panelling is 16 g. aluminium.

Bogies were also electrically fabricated from steel plate and the complete car with accommodation for 40 first class passengers and luggage, with a light-weight petrol engine, gear box and transmission in each bogie had a tare weight of 12 tons.

In service the engines proved to be the weak factor and eventually these and the transmission were removed and the car is in use as a trailer behind a later type diesel car. At no time however did the novel type of body construction give any signs of trouble and after eighteen years of service the latest report is that the car appears to be good for at least a similar period.

Since this early car was built many others, larger and of course fitted with diesel engines have been supplied both to this railway and others, though all built on identical principles.

On a more normal railway with easier or no grades the elimination of weight might be thought to be of less importance but a



Typical track and altitude conditions for which Wickham railcars have been designed. This shows a Wickham multi-car unit at a 6,000 ft. mountain halt in Colombia.

moment's reflection will reveal that with a self-propelled (or any other vehicle for that matter) accelerating and stopping unnecessary weight calls for extra horse-power and wear and tear, both costing money.

As regards strength it has been proved in practice that although much lighter no sacrifice has been made in strength; in collisions with vehicles of orthodox construction the tubular body has suffered only minor damage, repaired in a matter of hours whereas the other vehicle has been in the shops for weeks.

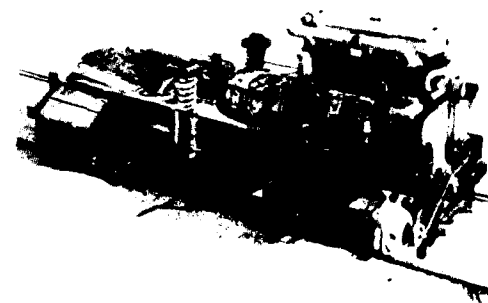
Open road crossings are another source of test when the unlucky driver of the road lorry has just failed to beat the rail car to it. In each case reported no person, (including the driver) in the rail car, has suffered hurt nor has the rail car received other than superficial damage. Such however cannot be said for the road lorry. Fortunately it has been found that road drivers rapidly learn

that the acceleration and speed of the rail car is much higher than the steam stock they were accustomed to and behave accordingly.

A few words on the question of mechanical transmission.

The number of gear ratios and final ratios chosen are important and depend upon the duties required and the conditions in which they are to be performed; the variation required for different duty is usually small and easily arranged.

The number of gear ratios is mostly dependent on the ratio of horse-power available and the gross weight—here is another advantage of light weight. In the early days a ratio of $3\frac{1}{2}$ to 4 horse-power per ton was usual but it will be found that investigation of successful running in service has necessitated this to be increased to between 6 and 7 HP per ton. Here again the service required



A Wickham power bogie fitted with a Saurer pressured charged engine and Cotal electro-magnetic gearbox.

dictates the ratio, on suburban stopping service to run without trouble may call for up to eight or nine H.P. where as a fast long distance non-stop run can be managed with four to five. It must be borne in mind that the introduction of a rail car service should give improved benefits to the customers, the travelling public, in the way of more frequent,

more comfortable and faster services, this calling for power.

A number of types of gear boxes are available, the most popular being of the four speed epicyclic type arranged for either air or electric operation both types being remotely controlled and arranged for use in multiple operation. Regarding power units, generally speaking a power of about 200 HP per car



A multi-car unit showing the power car and two trailers. Typical of the practical application of railcars in modern railway operations.

has been found the most practical and useful and here a single rail engine of the under-floor type or two road type underfloor engines offer a solution. The available road type engines have the advantage of lower price due to the method of mass production and these engines are usually rated at 125 HP for road service. It is however unwise to utilise this rating for most railway conditions and a maximum rating and setting of 100 to 105 HP will result in better service.

Railway requirements differ greatly from the road but as more and more railcars are used engine developments will no doubt keep pace and the special features required incorporated, these mainly being ample air supply for brakes and control equipment and larger electrical equipment. Several prominent English engine builders have now available horizontal engines developed for railcar service.

The above remarks apply in the main to the double bogie type car. An extremely useful and paying acquisition for the railway's outlying branch lines is the small-wheeled railbus usually of the 2 axle type. These are extremely economical to run and can compete with road bus services. Typical of this type are those shown in illustrations published elsewhere in this article. Some of these have been in service over 18 years, running in Bolivia at an altitude of 14,000 ft. above sea level and coping with increasing traffic requirements.

With this type of car the road transport underfloor engine (suitably derated) provides an ideal power unit with sufficient power to haul the light weight trailer when required. This type of car can be arranged for multiple control but this adds to the cost and it is possible to couple cars together each with its own driver.

Finally a word regarding servicing and maintenance. Putting in service the odd rail

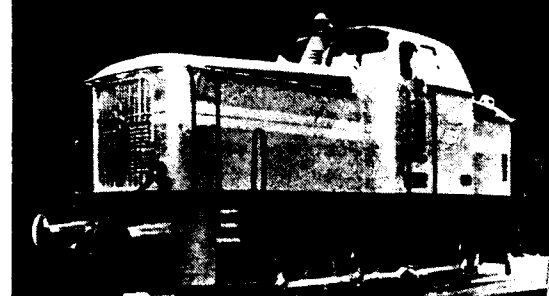


Interior view of a modern luxury railcar. The car is fitted with adjustable fully rotating seats. A buffet and bar with refrigerator and cooking facilities.

car and leaving it to the local loco. running shed and shops to service and maintain is asking for trouble. This is not to disparage the steam loco. man in any way as probably the quickest way to stop a locomotive working

(Continued on page 35)

HENSCHEL



Henschel is building Steam Locomotives since 1848
Henschel is building Electric Locomotives since 1906
Henschel is building Diesel Locomotives since 1924

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Electric Line Service Locomotives

Electric Locomotives for Industrial Purposes

In 1954 Henschel delivered 60 Class WG Steam Locomotives with tender for the Central Railways of India.



Messrs. Henschel & Sohn GmbH.
Kassel

Engineering Office :

21, Queensway

NEW DELHI



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

"WG" Class Steam Locomotives

By K. Das-Gupta ★

MESSRS. Henschel & Sohn are the largest manufacturers of locomotives on the European Continent. Besides steam locomotives, this firm produces Diesel trucks, Diesel roadrollers and heavy machines on a large scale. Their workshops are also equipped to produce Diesel and Electric locomotives, rotary and normal snow ploughs and, of course, spare parts for locomotives, etc.

The Ministry of Railways (Railway Board), India, placed an order for 60 locomotives of the "WG" class, destined for service on the Central Railway, with Messrs. Henschel & Sohn at the end of 1953. The following is a brief description of the manufacturing process of locomotives in general and particularly of the WG class locomotives at the works of Messrs. Henschel & Sohn.

On receipt of drawings and specifications for the WG class engines prescribed by the Central Standards Office for Railways in India, these were thoroughly studied and scrutinized. Any points for clarification or suggestions for alterations of material specifications or design were referred to the Railway Advisor to the High Commissioner of India, London. Orders were then placed on "Sub-Contractors" for supply of raw material and

certain finished or semi-finished products, namely, proprietary articles like roller bearings, injectors, ejectors, and steel castings etc.

All materials supplied by sub-contractors were inspected by Inspecting Officers of the India Store Department at the suppliers works prior to despatch to Messrs. Henschel's works. On receipt at their own works, Messrs. Henschel & Sohn again inspected and tested the materials in their own laboratory.

They have a laboratory equipped with the most modern testing and control apparatus, such as mechanical, electrical, supersonic, spectral and x-ray instruments. By a system of stamping and exact control methods interchange of materials by mistake and utilization

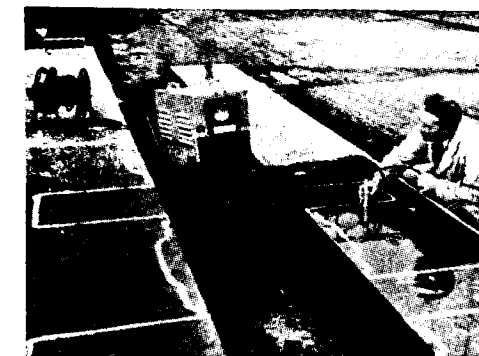


Illustration No. 1.

(Continued from page 33)

would be to put it in the hand of the diesel trained mechanic.

Special running sheds and maintenance shops should be provided or adapted from existing buildings together with specially trained staff, and these can usually be found by taking the younger and brighter members of the upcoming generation and giving them

special training. In addition the manufacturers of the vehicles are usually only too glad to receive at their works for special training members of the railway staff.

If this factor is given the attention that is necessary there is no doubt whatever that the introduction of diesel cars will result in better service and economy in running.

★ Senior Railway Inspecting Officer, India Stores Department.

FEBRUARY 1955

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of unsuitable material is obviated. Illustration No. 1 shows a modern supersonic apparatus in the laboratory of Messrs. Henschel & Sohn.

The work of production may be broadly divided into the following stages :—

- Processing in Smithy, Flanging Shop and Foundry,
- Testing of Material,
- Finishing Operations, such as machining and assembling of parts,
- Erection of Engine and Tender,
- Trial Run and Final Inspection.

Unlike most of the other locomotive manufacturers in Europe, Messrs. Henschel & Sohn have their own Flanging Shop, Smithy and Foundry, fully equipped to undertake mass production of locomotive parts. The independence from sub-contractor firms for this type of work enables shorter period of delivery and better control of quality.

Illustrations Nos. 2 and 3 show the forging of an axle and a connecting rod, respectively,



Illustration No. 2.

from ingots under heavy hammers. In order to ensure economy in production many parts are die-forged. A great deal of machining is thereby reduced on such parts. Illustration No. 4 shows an example of die-forging.

Illustration No. 5 shows a part of the Flanging Shop. Plates are heated in gas



Illustration No. 3.



Illustration No. 4.



Illustration No. 5.

furnaces and then taken to the flanging presses by means of charging cranes. The illustration shows Henschel's 1,000 tons hydraulic press, just before inserting the heated outer firebox back plate. The process of flanging is based on long experience, the press block and the method being designed to avoid folds and excessive reduction of thickness of the plates. In addition to their high capacity hydraulic presses Messrs. Henschel & Sohn boast of a team of highly skilled artisans in the Flanging Shop. It may be mentioned that thermic syphons for boilers are flanged by Messrs. Henschel & Sohn themselves.

Illustration No. 6, showing the pouring of metal in a large mould, gives a glimpse of the



Illustration No. 6.

work in the Foundry. The Foundry is equipped for both iron and non-ferrous castings.

The Boiler Shop has a very large production capacity and follows the most modern and economical production methods. After the plates are straightened by passing through rollers, the edges of the plates are machined on a planing machine which has a length of about 46 feet (14 meters). The process of rolling the individual boiler courses in the

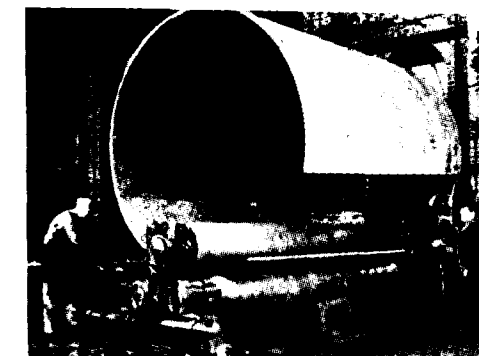


Illustration No. 7.



Illustration No. 8.

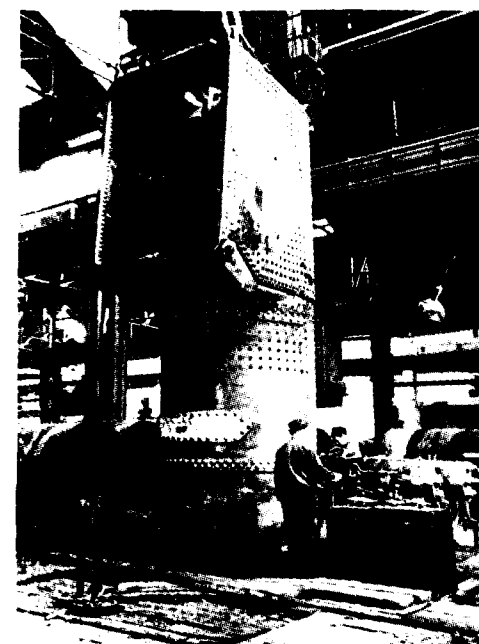


Illustration No. 9.

sturdy circular plate bending machines is shown in illustration No. 7. Illustration No. 8 shows the drilling of rivet holes in a boiler barrel. Illustration No. 9 shows the rivetting of a circular seam of a "WG" class boiler hanging vertically from a crane above a rivetting stand. The rivetting machine stands vertically in the rivetting pit and the boiler hanging from a crane, is put over the rivetting arm, which has a length of about 20 feet (6 meters). Three workers are engaged in the rivetting operation. The first one directs the position of the boiler and of the hydraulic rivetting arm. The second one heats the rivets and hands them over to the third one. The latter inserts the rivet in the hole and places the rivet head against the support of the rivetting arm. The rivetting process itself is automatically controlled in respect of time and pressure required. It is worth mentioning that in the shops of Messrs. Henschel & Sohn, x-ray photographs are taken of all welded seams of boilers. With "WG" class locomotives this applies to the welded seams of inner firebox and thermic syphons. The films are examined by the Inspecting Engineers for any faults that may have to be rectified. Messrs. Henschel's works are equipped with special machines for manufacture of boiler stays by the latest scientific and economical technique. The design of the new type of stays is based on long experience and research. The newly designed type of stays has been incorporated in some of the boilers for the "WG" class locomotives and shall thus be tested also on Indian Railways.

In the Frame Shop the frame slabs are planed to the required thickness on a planing machine with a length of about 62 feet (19 meters), as shown in illustration No. 10. Subsequently the contour of the frames is machined on slotting and milling machines with beds of about 82 feet (25 meters) length.

While the manufacturing operations, described above, go on in the various shops, machining of connecting and coupling rods,

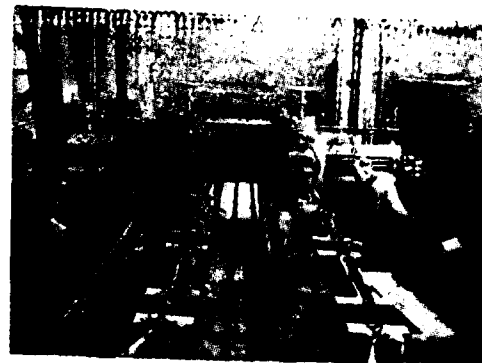


Illustration No. 10.

cylinders, wheels and all other locomotive and boiler components is carried out in the Machine Shops. Machining operations are based on the most economical methods, jigs, fixtures, special tools and gauges being extensively used. Messrs. Henschel & Sohn themselves are well equipped to manufacture tools, gauges, etc. They have an air-conditioned measuring room equipped with modern measuring instruments made by Zeiss, Leitz, Strassmann, etc., capable of measuring up to 1/1,000 of a millimeter. All gauges and measuring tools used in the workshops are checked here periodically. It may be mentioned here that Messrs. Henschel & Sohn are used to working to dimensions in inches, i. e. not to dimensions in inches converted to metric dimensions as is usually done on the Continent. Gauges and measuring instruments are also manufactured to dimensions in inches.

According to a previously fixed production schedule, deliveries of parts and groups of part assemblies to the Erection Shop are carried out at fixed intervals to avoid any interruption of erection work and to ensure completion of the individual locomotives in the rhythm laid down for delivery. During the manufacture of the component parts and the assembly of the parts, constant control as regards quality, accuracy of dimensions and efficiency of function is exercised by the Control and Inspection staff of the workshops as well as by the Inspecting Officers of the

India Store Department. These measures of control extend to all working operations including the final erection and trial run of the locomotive.

As mentioned above, according to a precise production schedule the finished component parts and assemblies arrive in the Erecting Shop, of which illustration Nos. 11 and 12 show partial views. The work in the Erecting Shop proceeds as follows. The boiler and the cab are put on the frame. The boiler is lagged and clothed at this stage. The boiler mountings and other fittings are mounted. The locomotive is wheeled, the motion gear fitted and valve setting is regulated. The cab is fitted with all instruments, as shown in illustration No. 13. The weighing of the locomotive together with the ascertaining of the individual wheel load on



Illustration No. 11.

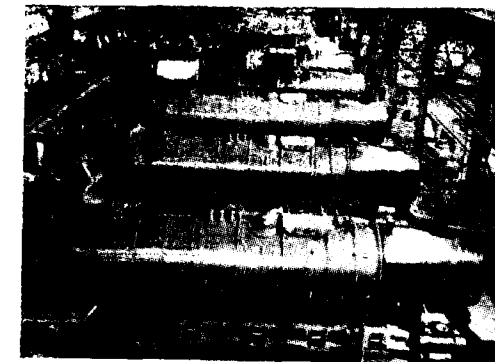


Illustration No. 12.

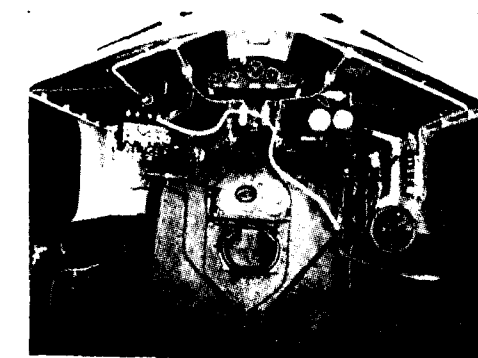


Illustration No. 13.

rails, forms also a part of the inspection at this stage. After the locomotive has passed these stages, it is lighted up for trial run. For the purpose of trial run of "WG" class locomotives a 5'-6" gauge trial track has been

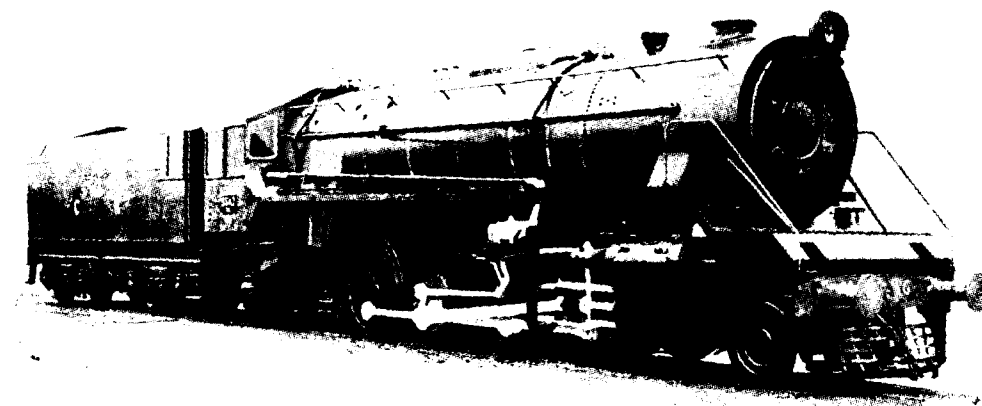


Illustration No. 14.

(Continued on page 40)

Electric Hoists in Railway Workshops

SOME thirty or more years ago it became obvious that the hand operated pulley block was both slow in operation and tiring to the operator. Some means of raising loads by electric power was sought and resulted in a very simple form of Electric Hoist Block which, although it raised loads without manual effort, was not very efficient or, for that, silent in operation.

Evolution was, however, rapid and many variations of the principle of electric hoisting were developed until present day Hoists are extremely efficient machines as well as examples of good engineering.

It is probably true to say that there are few, if any, industries today in which the Electric Hoist Block is not used. In heavy industry, however, the call for electric hoisting is most marked and many special types of power block have been designed to suit the particular needs of the engineering shops.

In heavy industries, such as Railway Workshops, where often heavy and awkward shapes have to be handled, the need for some mechanical means of lifting is more than ever necessary. Hand operated blocks with their chains often making operation difficult are at best only 70% efficient and their continued use for even the simplest of raising and lowering problems cannot be justified. The energy of the operator to move the load could and should be used to perform a constructive piece of work and not wasted in pulling on a chain.

If one accepts that, on the grounds of energy saving, time saving, more silent operation and greater efficiency, an Electric Hoist is necessary in any heavy engineering workshop it still remains to decide the type of Hoist to be installed.

In such matters the very nature of the works lays down certain requirements but

(Continued from page 39)

laid with a test curve of a radius of 573 feet. This is the final inspection at the works.

Special low loading trucks are used for the transport of the locomotives to Hamburg,

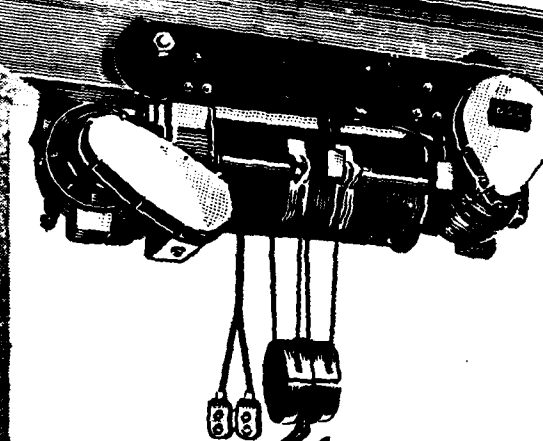


Illustration No. 15.

the port of shipment, from where they are shipped, fully erected, to Bombay. A number

of these locomotives have already arrived in Bombay, (cf. illustration No. 14 and 15).

Every two days one "WG" class locomotive leaves the Works of Messrs. Henschel & Sohn. The delivery of these locomotives began in August, 1954, and is scheduled to be completed in December, 1954, which is 3 months in advance of the contract date of completion. A general idea of the production capacity of Messrs. Henschel & Sohn's locomotive works will be gathered from the fact that simultaneously with the "WG" class locomotive, they are building steam locomotives (with all-welded boilers and frames) for the German Federal Railway, diesel-hydraulic locomotives for various other customers and a series of heavy electric locomotives for the German Federal Railway and a mining concern in Western Germany.



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analysis of many hundreds of lifting problems indicates that basically an Electric Hoist should :—

- (1) Be compact, absorbing as little headroom as possible.
- (2) Have as few moving parts as possible, and those that do must run on ball or roller bearings.
- (3) Be easy to maintain.
- (4) Be safe, even in the event of a current failure.
- (5) Have controls which are simple to operate. And finally running adjustments be kept to a minimum.

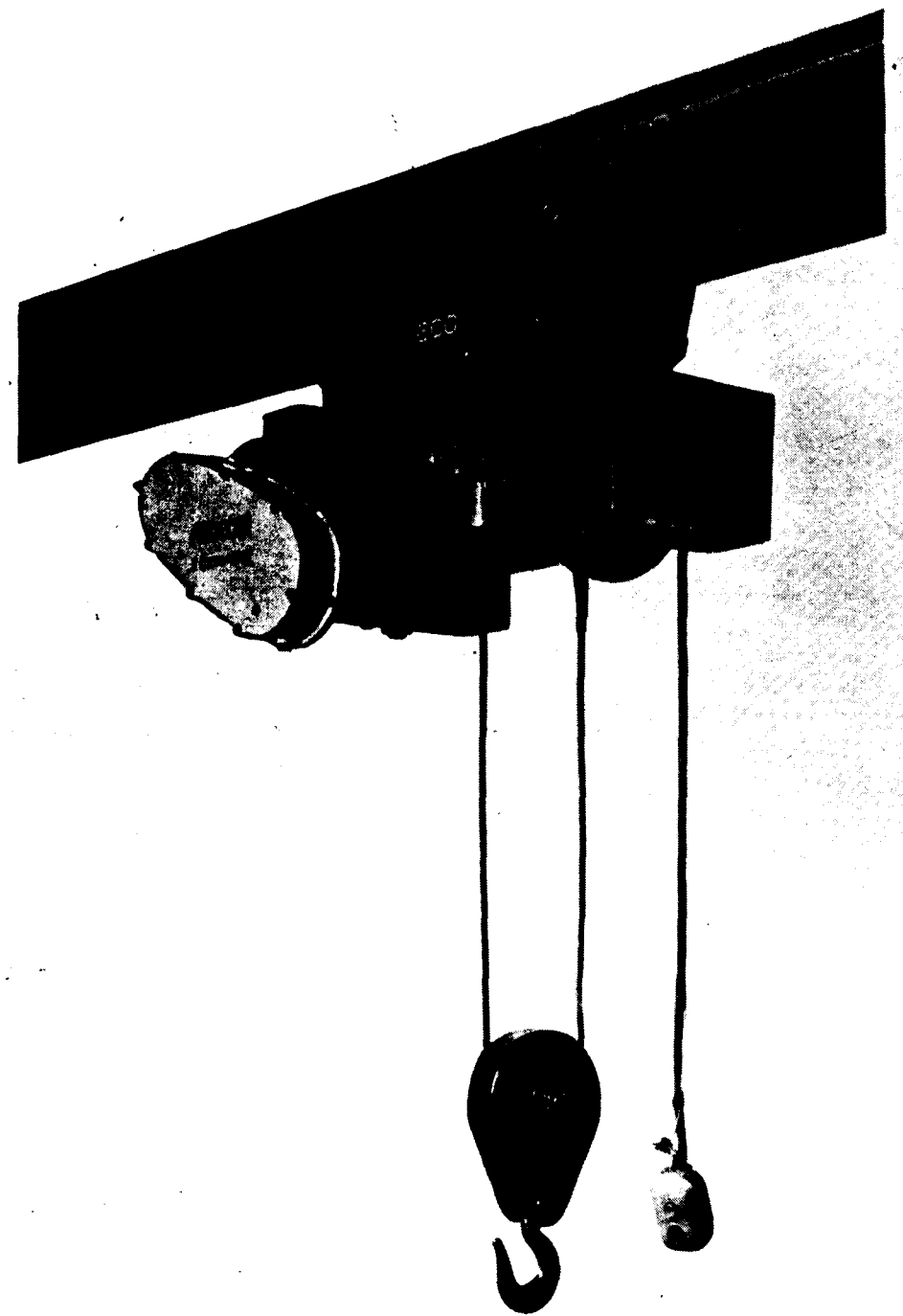
A Hoist which answers all these requirements is the 'Hoistmaster' manufactured by Ardecar Limited and distributed throughout

the world by George Cohen Sons & Co., Limited.

Study of the photograph shows that requirements 1 and 5 of the above list have been met. Equally the remaining points are proved from a perusal of the specification :

The Hoisting Motor is of the totally enclosed, high torque, ball bearing type and drives a totally enclosed oil immersed worm reduction gear enclosed in a steel gear case.

The Worm is of 3° nickel steel hardened and ground running on angular contact ball bearings, drives a special phosphor bronze worm wheel carried on a 3° nickel steel shaft ground on the bearing surfaces and carried on ball and roller bearings.



The Cast Iron Winding Drum, heavily ribbed internally, is accurately machine grooved right and left handed. The outer end of the winding drum is also carried on 3° nickel

steel shaft carried on heavy duty ball bearings.

The Wire Rope has a factor of safety of 6 to 1. The Bottom Block is fully

shrouded by a split malleable iron cover.

The Load Hook to B. S. S. 488 is tested to a 100% overload and is carried on a steel trunnion machined from the solid. The hook which is freely rotating, is carried on a ball bearing thrust race.

The Gearbox and End Bearing Plate, which form the two main supports for the hoist unit, are heavy steel castings.

The Chassis, also of steel, has the main travel wheels housed so that the axles can be withdrawn from the outside of the chassis to facilitate erecting the hoist on a closed runway.

The Travel Wheels run on wide roller bearings on steel wheel pins, hardened and ground on the bearing surfaces. The axles are adjustable for width by means of the keeper plates and slots in the main axles.

Control is by pendant push buttons. The hoisting and lowering limit switches are positively driven off the winding drum and they are adjustable, automatic, self-resetting, shunt type.

Automatic, electro-mechanical brake, with continuously rated coils is a standard fitting.

A TUBULAR QUIZ

Is it possible for a tube to be weldless but not seamless?

Yes, a close joint tube is weldless—i.e., it has no weld but it has a seam and cannot be called seamless.

A rivetted pipe has no weld, but it certainly is not seamless.

What are the advantages of using chrome molybdenum steel tubing?

Chrome molybdenum steel tubes have a U.T.S. of 45 tons P.S.I., are extremely tough and are suitable for brazing. When used for cycle frames we recommend tubes 2 gauges thinner than in mild steel (i.e. 22 swg. instead of 20 swg.) and the frames are then, both lighter in weight and stronger. A cycle frame in this steel is 9.25 lbs. lighter than one of mild steel. This tubing is also ideal for bus seat frame side bends etc.

The speed with which the load is raised and lowered is very much a question of requirement to suit the application. Over the years that the 'Hoistmaster' has been produced, experience has again indicated the most general need as being up to 40 feet per minute for 1/4 ton and 1/2 ton loads—20 feet per minute for 1 ton to 2 tons and 15 or 12 1/2 feet per minute for hoists larger than this. In the same way a standard hoist is one having a capacity of up to 5 tons and a lifting height of 20 feet.

Some workshop lifting problems do, however, call for variations to these standards—faster, or even two, lifting and lowering speeds, longer lifts and larger capacities. These special needs can be met, very often inexpensively, providing the basic design is sound.

It can be seen, therefore, that another great advantage held by the electric hoist block over its hand operated relative is one of flexibility.

The 'Hoistmaster' is a machine soundly constructed which does permit variations both electrical and mechanical.

The Distributors will be pleased to study and advise upon hoisting problems involving electric hoist upon receipt of details at their Wood Lane, Shepherds Bush, London W. 12. Office.

THE PANNEL RAIL BARROW

THE Rail Barrow is an appliance which enables rails to be lifted into and out of the track with less manpower and with greater facility than with rail tongs or by hand, and reduces the risk of injury to workers. It comprises a tubular steel frame with a standard sponge rubber tyred wheel at one end and a

pair of handles at the other (hence the term Barrow). At a point near the wheel a crossbar carries a device for gripping the head of a rail, which is known as the grip. This grip is simple to operate, being provided with a "T" shaped handle at the top which is raised to open the jaws and lowered to close



Rail on ground at sleeper ends.

and lock them. The locking takes place at the end of the closing movement and is necessary to prevent the rail from dropping out of the grip during operation.

The whole appliance is robustly constructed in first quality steel to ensure a long life under rough conditions and experience has shown that the sponge rubber tyre will last years used on stone ballasted track.

The Rail Barrows are used in sets which vary in number in accordance with the weight and length of the rails to be handled. Standard practice being six Rail Barrows to a 60 ft. long 109 B. S. rail. A handy formula being weight of rail in pounds divided by 350.

These figures are for normal relaying and re-railing operations. If the rails are to be carried more than say three feet



Rail into chairs, or on to base-plates.

the number should be increased. The accompanying illustrations show the procedure in lifting a rail into the track.

No. 1. Shows the operators ready to lift a 60 ft. 109 lb. rail, and awaiting the order from the ganger to ensure a co-ordinated lift. Note the position of the men's feet. One foot forward ready to move with the rail.

The ganger is placing in position an expansion gap gauge on the end of the previously laid rail.

No. 2. Shows the rail being lifted and moved in one motion from the ground alongside the sleeper ends on to the baseplates already partly spiked to the sleepers. It will be noted that there is no sign of strain on the men's faces.

No. 3. Shows the rail in position on the base plates and the Rail Barrows slewed round ready to swing the rail longitudinally up to the expansion gap gauge.

A lateral movement of the Rail Barrow handles will give a movement of the rail of about six inches which is usually sufficient to close one rail up to another.

The whole operation of placing one rail and moving on to the next takes less than a minute and long lengths can be done without undue fatigue.

For men who have not seen or used the Rail Barrows it is best to give a demonstration or at least some instruction in their use and operation. Thereafter a little practice to get the feel of the movement is all that they will require.

The points to remember are :—

1. Lift and travel in one movement.
2. All move together.
3. Space evenly along the rail.
4. Make sure the grip is engaged.
5. Clean and oil regularly.

A TUBULAR QUIZ

What is the difference between a tube, a pipe and a hollow?

There is no difference between a tube and a pipe: the terms are interchangeable—*e.g.*, "Exhaust pipe, gas pipe", etc.

A Hollow is unfinished material for re-drawing.

Define the following terms :—

D. A.	E. R. W.
D. P.	C. D.
E. & O. E.	H. F.

D.A.—Documents against acceptance of draft maturing at a specific date.

D.P.—Documents against payment.

E. & O. E.—Errors & Omission Excepted.

E. R. W.—Electric Resistance welded.

C. D.—Cold Drawn.

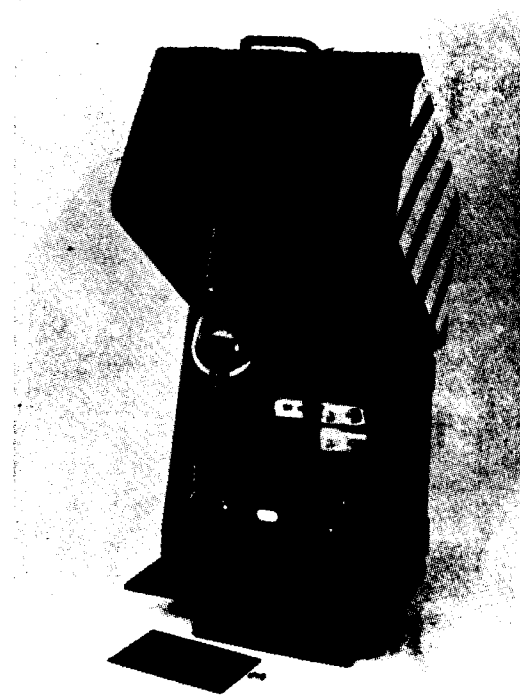
H. F.—Hot Finished.

Railway Communication Systems by "Standard"

ONE of the largest telecommunication manufacturing organisations in the Commonwealth, Standard Telephones and Cables Limited, is well established as a principal supplier of railway communication systems and equipment to leading railway administrations throughout the world, and this article describes and illustrates three important systems in the "Standard" range.

TRAIN DESCRIBERS

Until fairly recently the only method of conveying information from Signal Box to



Signal Post telephone way station.

Signal Box regarding the type of trains approaching, and their destinations, was provided by the block bell in which the various types of trains were indicated by the particular code ringing of the bells. Where only one train can be between two successive boxes on a track, the block bell method does not prove too difficult to work, in fact

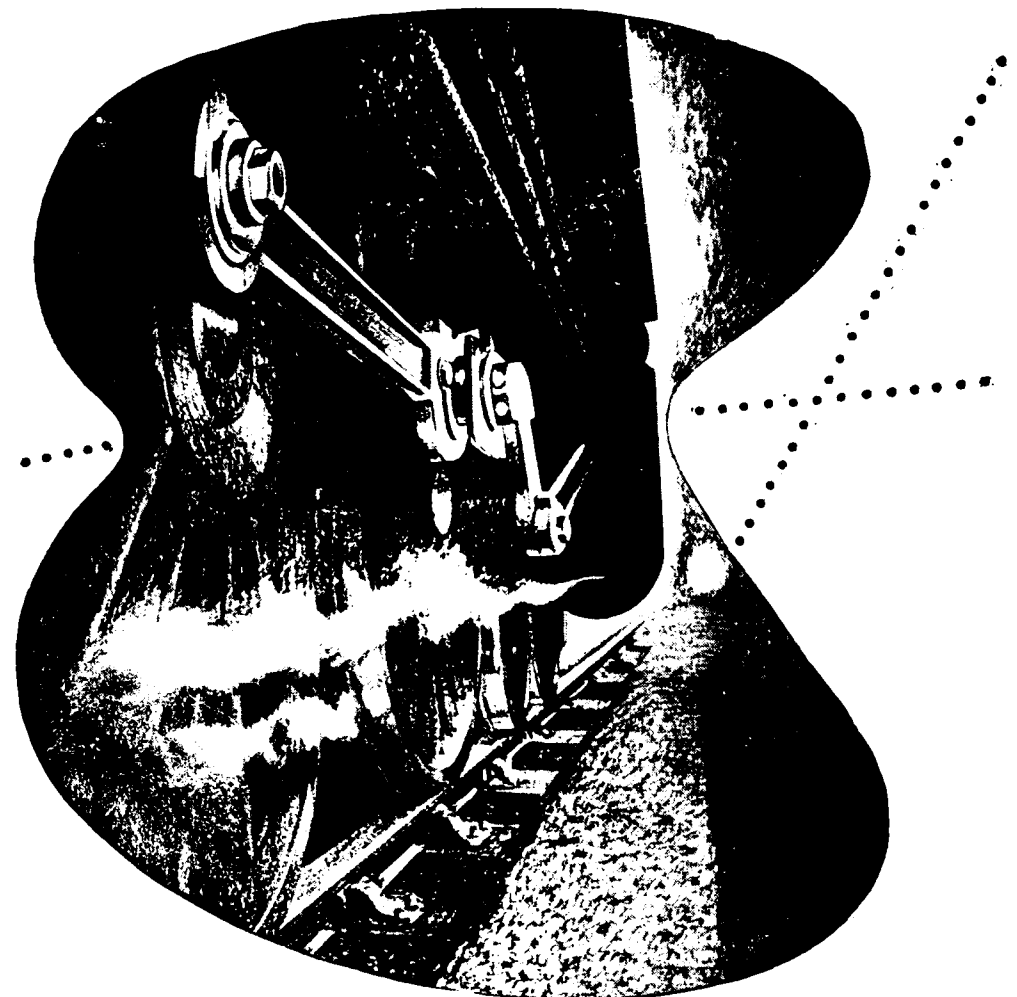
it is the system employed in the vast majority of locations.

Where, however, due to the introduction of automatic signals, it is possible to get more than one train on the same track between boxes, then obviously some method whereby trains can be indicated to the signalman at the receiving end in their order of arrival becomes necessary. The storage train describer has been developed to fulfill these requirements.



Signal Post Telephone Way Station in use.

Many types of train describers have been developed using various types of coding over common line channels between boxes, but the more usually accepted systems are those employing automatic telephone apparatus, and using impulse codes not unlike those employed in modern automatic Telephone Exchanges. Descriptions are stored as required by means of telephone apparatus at the receiving end, and progressively stepped forward position by position as each train



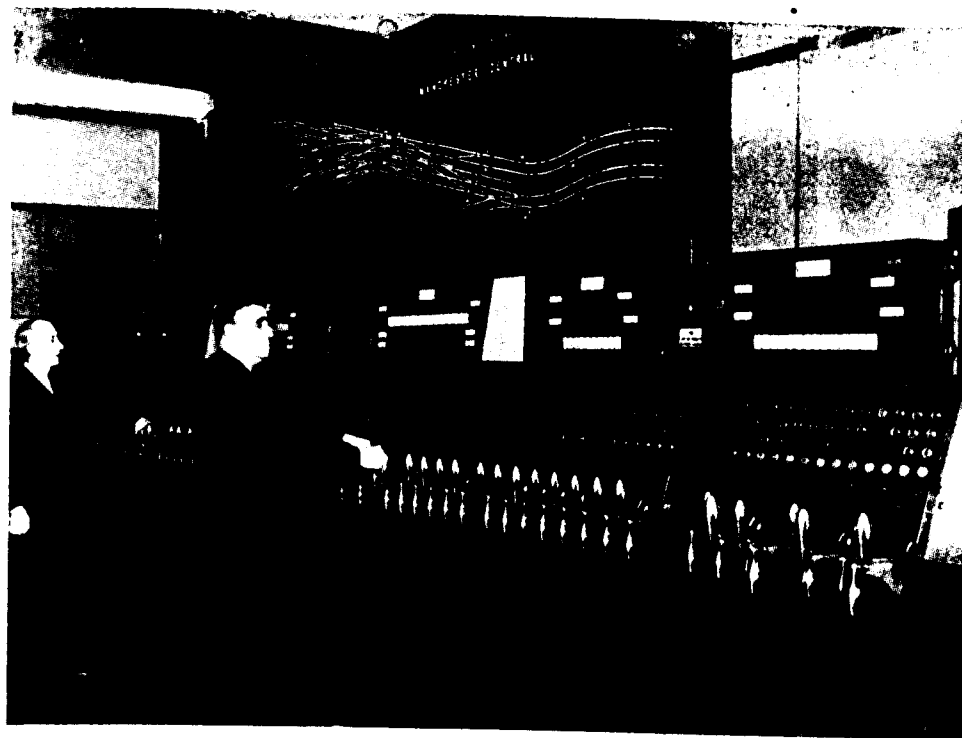
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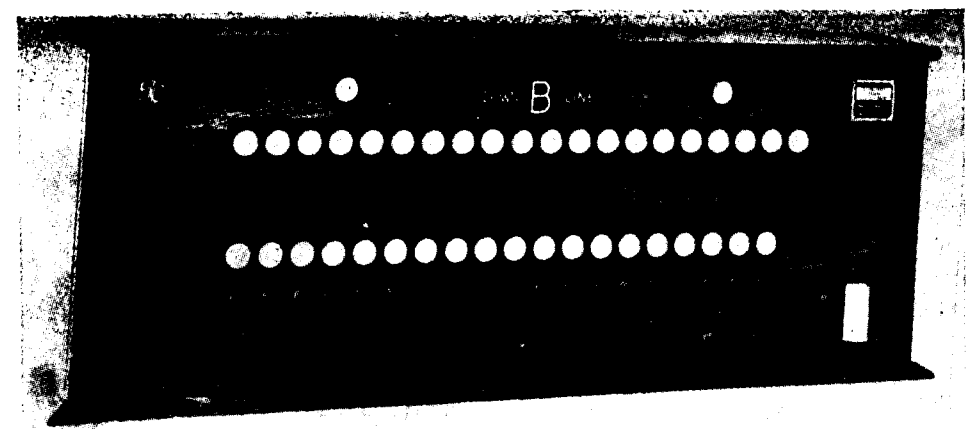
NEW DELHI OFFICE: P.O. BOX 348, NEW DELHI



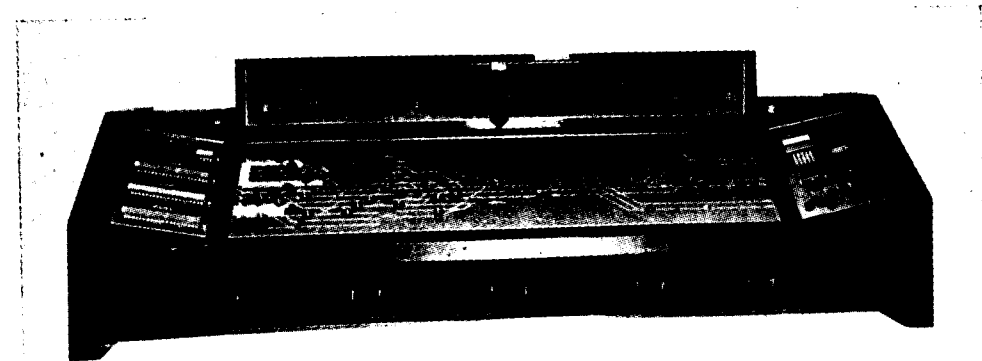
Train Describer transmitter & receiver. —Manchester Central Station.



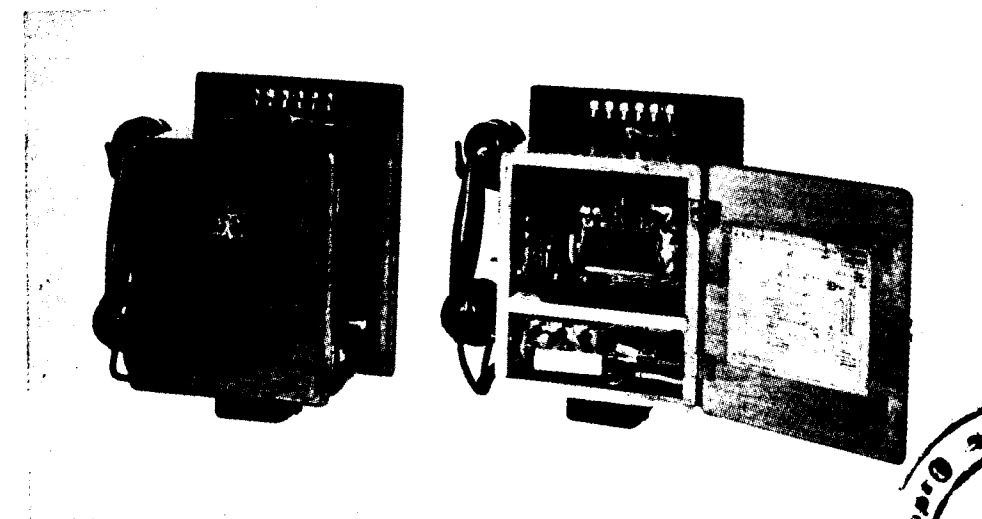
Control Room at Liverpool Central showing Traffic Control keyboards.



Typical train describer transmitter.

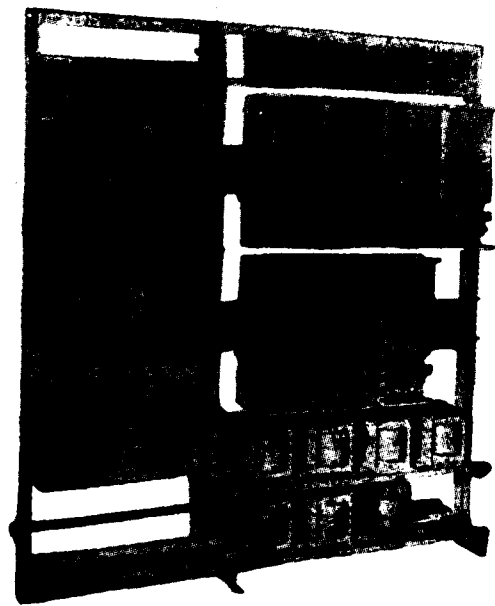


Train describer transmitter & receiver built into control desk.



Traffic Control Way station set showing selector.



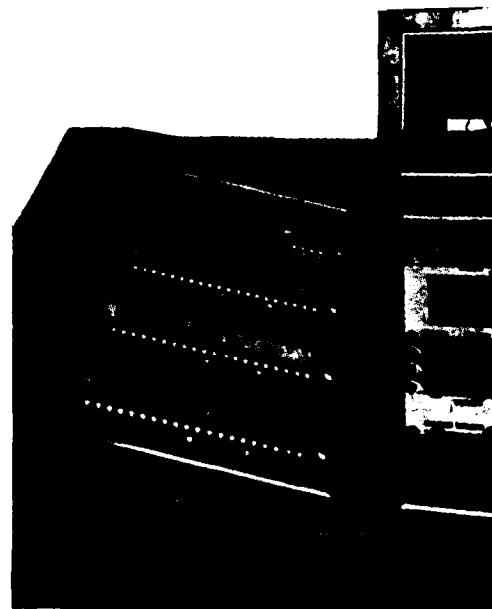


Traffic Control Apparatus Rack.

arrives, so that the signalman need not remember or write down the order in which they are coming.

At busy interlocked areas or main stations where a multiplicity of parallel tracks exist, and where trains can be routed from one track to another before arrival, complex systems have been developed. These systems provide for transferring descriptions from one track indicator to another to follow a train's movements, such transfers being initiated by the positions of signals and points, and the occupancy of certain track circuits.

In all these cases the signalman is given advice concerning the type and order of arrival of trains on each of his incoming tracks, and by reference to his track diagram he can associate a particular train description with a particular train indicated on the diagram. In order to simplify his task developments are in progress whereby the receiving indicators of a Train Descriptor System show, not only the order in which trains are arriving, but also the location of those trains physically on the track with relation to known signal positions.

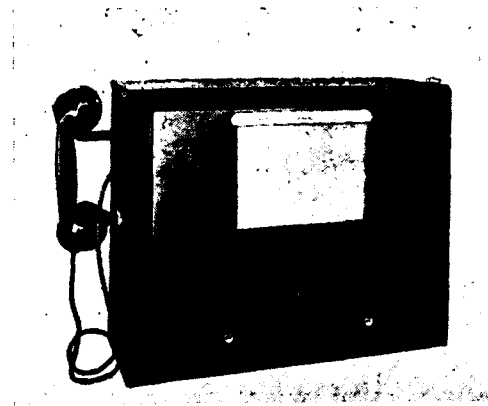


Train describer transmitter built into control desk providing "block code" indication.

When such a display has been provided a signalman has been supplied with the maximum amount of information he can possibly need to permit him to perform his switching operations intelligently, and with the shortest possible delay.

SIGNAL POST TELEPHONES

The introduction of automatic signals on open sections of track between interlocked areas brought with it the problem of how to keep trains moving should a signalling failure occur. It is obvious that, with signals normally showing green and displaying the red aspect while the section ahead of the signal is occupied excellent control is provided as long as the system is working satisfactorily, but the failure of one signal will delay all trains behind that signal. This problem was answered initially by the introduction of the "stop" and "proceed" rule. By this rule it was necessary for the driver of a train if held at an automatic signal to wait for one minute and then proceed at caution, being prepared to stop short for any obstruction. Responsibility was therefore



Signal Post telephone cabin equipment.

put on to the driver's shoulders, and the safety of the system depended very largely on the interpretation he put on caution. In fog and bad weather generally his task was no light one, and several unpleasant following collisions did occur.

In recent years the Signal Post Telephone has been introduced, which provides for a telephone at every automatic signal. With this installed the Driver or Fireman could, when held up at an automatic signal, telephone to the signalman in the Box in advance and be given instructions regarding the condition of the track, and whether it was safe for him to proceed.

A later development removed the possibility of confusion by permitting a "P" sign or "Proceed" sign to be displayed at the Signal Post under the control of the signalman ahead. Thus verbal instructions are not used to call a Driver past a danger signal, and therefore the possibility of confusion of terms no longer exists.

TRAIN DESPATCHING OR TRAIN CONTROL SYSTEMS

On most railway networks, in addition to the normal telephone facilities provided for commercial reasons, it has been found necessary to provide what is known as Train/

Traffic Control, or Train Despatching Systems. These are primarily telephone systems of special nature, provided solely for the purpose of controlling the operation of trains, the routing of engine power, the marshalling of stock, and the arrangement of goods working etc. Such a system basically comprises a Controller's equipment in some central Control Office, and a number of "way stations" arranged in parallel on a two-wire line channel. These way stations are fitted in Signal boxes, Goods Sheds, Loco Depots, etc. The Controller is provided with a means for selectively calling any one of these way stations, and conversely, any way station may call the Controller.

Thus, with the minimum of delay a Controller can get in touch with any part of the area he controls, and arrange for change of routing or provision of engine power, or any other matter relating to the actual running of the traffic. He is also advised by reports sent in by the signalman as to the running of trains, and he is able to graph or record the position and timing of every train in his area. Any delays and possible reasons are brought to his attention immediately and he is often able to obviate the effect of these delays by re-arrangement of schedules.

It is becoming the custom in England to group controllers in one office in the centre of a particular area of the railway network, and it therefore happens that some controllers require access to more than one line. To meet this need Keyboards are now provided with line keys and ordinary telephone dials. The operation of a line key connects the controller to the required line, and dialling the appropriate code connects him to the required way station on that line. Inter-communication circuits between keyboards in the same office permit a Controller to transfer a call to the Chief Controller or to some Specialist, such as Loco Controller, if such transfer is necessary.

New 2-8-2 two-cylinder locomotives with a 4-axle tender for the Indonesian State Railways

IN October 1950, the Indonesian State Railways concluded with the Krupp Lokomotivfabrik Essen a contract for supply of 100 2-8-2 steam locomotives with 8-wheel tender for passenger and goods train service on their cape gauge lines. 50 locomotives are fired with coal, and 50 locomotives are fitted with an oil burning device. These locomotives are very robust, and from manufacturing point of view, they are of more

fashionable type than the approved 4-6-4 tank locomotives, series C 28, in service for long years :

The photograph shows new series, the first locomotives of which were put in service in September 1951. Please find hereafter their chief characteristics as compared with the 4-6-4 tank locomotives of series C 28 :

	2-8-2	4-6-4
Gauge	1067 mm	1067 mm
Cylinder diameter piston stroke	500×600 mm	485×600 mm
Driving wheel diameter	1503 mm	1503 mm
Leading wheel diameter	777 mm	775 mm
Trailing wheel diameter	904 mm	775 mm
Rigid wheelbase	4800 mm	3500 mm
Total wheelbase of the locomotive	10050 mm	11100 mm
Steam pressure	16 kg/cm ²	12 kg/cm ²
Grate area	3,5 m ²	3 m ²
firebox heating surface in contact with fire	15,3 m ²	13,14 m ²
tube heating surface in contact with fire	155,7 m ²	118,40 m ²
surface of evaporation in contact with fire	171,0 m ²	131,54 m ²
Superheater heating surface in contact with fire	60,0 m ²	48,50 m ²
Distance between tube plates	5350 mm	4900 mm
Water	—	10 m ³
Coal	—	3 t
Weight empty of the locomotive		
(a) with firebox of copper and coal firing	64,2 t	59,4 t
(b) with firebox of steel and oil firing	63,22 t	—
Service weight of the locomotive		
(a)	73,61 t	79,0 t
(b)	72,28 t	—
Maximum adhesive weight	51,2 t (54,0 t)	36,0 t
Maximum axle load	12,8 t (13,5 t)	12,0 t
Tractive effort 0,75 p	12000 kg	8500 kg
Maximum speed	90 km/h	90 km/h
Minimum curve	140 m	140 m

backwards (170 m)

TENDER

Wheel diameter	777 mm	—
Bogie wheelbase	1650 mm	—
Total wheelbase	4950 mm	—
Total wheelbase of both tender and locomotive	17500 mm	—
Total length of both tender and locomotive	19650 mm	12915 mm
Water	25 m ³	—
Coal (oil)	5 t	—
Weight empty		
coal tender (oil tender)	19,75 t (20,4 t)	—
Service weight		
coal tender (oil tender)	50,42 t (50,8 t)	—

The above specification shows that the locomotives with coal firing have copper fireboxes whilst the locomotives fitted with an oil burning device have steel fireboxes. In both cases, we fitted the locomotive with a combustion chamber and three water circulation pipes for enlargement of the steel heating surface.

The following details are worth mentioning for the construction of the locomotives :

In general, materials according to German conditions and tolerance specifications for interchangeable pieces and the German boiler law are admitted. As to the boiler, welding has been used more than riveting. The longitudinal and circumferential seams of the boiler barrel courses are butt-welded; the firebox shell, too, is welded, but it is connected with the boiler barrel by a lap joint double-row riveting seam. Even the smokebox tube plate is riveted for easy replacement. The plate stays for the smokebox tube plate and firebox backplate are welded to the firebox shell. Welded joints are used even for supports etc.

The fireboxes of copper as well as the fireboxes, made of age-resisting steel brand "Izett II" with a tensile strength of 40—50 kg/mm², are completely welded, excepted the riveted tube plates. The smoke tubes and

	2-8-2	4-6-4
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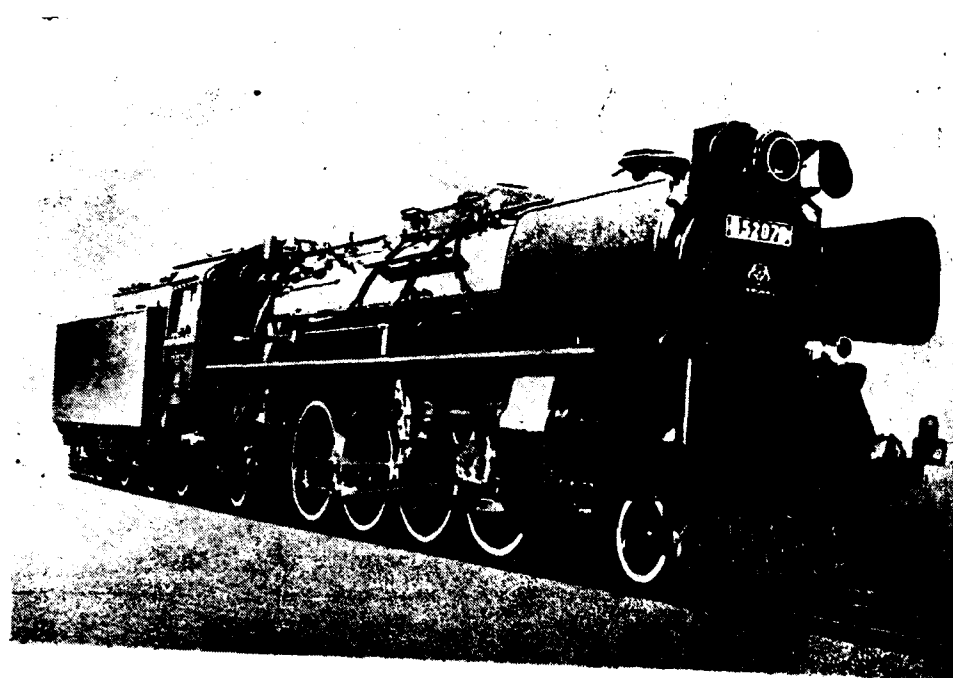
flue tubes are rolled-in and flanged, and, in case of using a firebox of steel, they are welded to the firebox tube plate.

The copper firebox is fitted with drifted threaded staybolts, and in the stressed zones with manganese staybolts having oversize thread, whilst the steel firebox has rigid and flexible staybolts of steel: "Izett" brand without thread, welded-in with play. Even the crown stays and cross stays are welded-in without play.

We used 31 smoke tubes 125/133 mm and 117 flue tube 46/51 mm as well as 31 superheater elements with a diameter of 30/38 mm. The superheater made by "Schmidt'sche" Heisdampfgesellschaft is connected with the superheater header by means of a metallic cone packing.

The coal grate is designed as a rigid bar grate with a spindle rocking grate (with a 43% free grate surface for ombiline coal of 7000 Kcal/kg calorific value). The completely welded ashpan in pocket form facilitates a quick emptying.

With regard to the boiler equipment we would mention: the saturated steam valve regulator in the dome, 2 non-lifting "Friedmann" type injectors ASZ-class, 2 "Klinger" type water gauges extended owing to the



maximum gradient of 40%, "Gestra" type blow-off valve, "Marcotty" type firedoor, 2 "Coale" type safety valves, boiler insulation by means of spun glass mattresses under all-sheet clothing.

The sandboxes in front and in rear of the steam dome are sanding by means of hand-operated sanding devices, the first coupled axle in front, and the driving axle in front and in rear. Small wind guiding screens are fitted to the smokebox side plates.

The boiler is connected with the frame by means of smokebox supports, 3 breathing plates at the boiler barrel and by slipper bearings of the firebox shell.

The rolled bar frame plates of 80 mm thickness are lengthened in rear of the 4th coupled axle by plates of 45 mm thickness and laid only to the centre of the carrying axle.

The front frame portion is formed by a large steel casting containing the truck guide and drawbox inclusive of the buffer plate. The cylinder connection arranged in rear is designed as a welded construction of

drop forged, butt-welded, angular pieces. All other frame braces are made of cast steel.

The axlebox guides for the driving and coupled wheelsets are kept broad for obtaining a low surface pressure for axleboxes without adjusting wedges. They are made of steel brand "St C 15 M". The axleboxes have gunmetal slippers and the play between axlebox and axlebox guide is totalling 0.2—0.3 mm. For oil lubrication (from the lower box), the driving and coupled axleboxes have gunmetal bearings lined with white metal. The axlebox guide surfaces are lubricated from special oil cups.

In the driving and coupled wheelsets, the circulating masses are balanced by 100% and the masses moving to and fro by about 28%. The free centrifugal forces are amounting to about 11—18,5% of the reposing axle load.

The front "Bissel" truck (with centre load distribution, swing link suspension and re-adjustment, as well as spiral spring suspension of the truck frame with swing bolster suspension) and the trailing "Hodge" truck (with non-suspended rear frame portion and laminated spring suspension of the main

frame and of the longitudinal equalizers to the coupled axle in swing link hangers) are fitted with "SKF" type roller bearings (arranged inside to the front and outside to the rear). Even the tender bogies with a welded lattice-work frame are equipped with "SKF"-type roller bearings arranged outside.

The locomotive is suspended by means of 2 spring groups which are separated between the 2nd coupled axle and the driving axle. The bolts at the bearings of both rear and of the front longitudinal equalizer can be changed in order to adjust the maximum axle load on the coupled axles between 12.8 and 13.5 t.

According to European practice, both cast iron cylinders are fitted to the frame plates from outside and they are rigidly bolted against the frame plates and against the cast steel smokebox support. The "Z"-shaped piston with narrow rings have piston rods with 5 front guides (stuffing box packings "Sack & Kieselbach").

Safety valves are inserted into the cast steel cylinder covers, and an automatically functioning bye-pass valve of the "Winterthur" type connects both piston sides by a poppet valve opening at no-load.

The double bar crosshead of the "Alligator" type are guided in case-hardened slide bars. The driving and coupling rods have gunmetal bushes lined with white metal and are running on case-hardened driving and coupling pins. They are oil-lubricated, the oil cups being fitted with screw plugs.

The piston valves with a diameter of 250 mm and of normal type are adjusted to the points of out-off by a Walschaert's link motion with screw reversal. The piston valve crossheads are running in lateral parallel guides at the rear steam chest cover. This type admits single type combination levers and a very robust execution of the crosshead guide.

(Continued on page 58)

A lubricator of the "Friedmann" type driven mechanically by the right expansion link, feeds over 14 outlets and oil atomizers the pistons, piston valves, piston rod and valve rod guides with oil.

The locomotive is equipped with a steam brake for driving and coupled wheels. The tender and the train are fitted with a vacuum brake, the tender being equipped additionally with a handbrake. The brake is operated by a brake ejector of the SJP-type with steam brake valve for the locomotive.

A "Henricot" type centre coupler with "Uerdinger" annular springs and "Perdyk" coupling have been mounted to the front of the locomotive and to the rear of the tender. Locomotive and tender are coupled by a main and two emergency coupled irons as well as by two suspended buffers.

Furthermore, there are inserted: a recording speed indicator of the "Hasler" type, electrical lighting of the "Stone" type with a 0.5 KW-generator 24 V, 250 W head lamp.

With a view to obtaining a low weight empty for the tender, we completely welded the water tank and the coal bunker, frame and bogie frame as well as the oil tank for the locomotives for which oil firing had been provided. Weight empty obtained: for the coal tender 790 kg/m³ capacity of water, for the oil tender 820 kg/m³, resp. 660 kg and 680 kg/per ton of provisions.

For the locomotive with oil firing, we used slit burners with steam-operated oil atomizers projecting from the front into the burning box being completely welded and lined with bricks in the usual manner. The oil is pre-heated in the oil tank and in front of the burner.

Due to the wheel flange weakening in the 2nd coupled wheelset and in the driving wheelset as well as due to a maximum side play

Swedish Electric trains for Warsaw's Suburban Traffic

IN pre-war years, Warsaw had approximately 1.3 million inhabitants. One year after the termination of hostilities approximately $\frac{1}{2}$ million people were resident there, and it is claimed that the number has now risen to 0.7 million. The city is built up in a compact manner, and is situated in the centre of the partly-forested Polish plains, through which flows the Weichsel which at this point is exceptionally wide. Despite the characteristic flatness of the country, the river valley is quite deep, making it possible for railway bridges to span the river without necessitating any appreciable elevation, the railway track leading directly into tunnels built under the streets. The principle part of the city, with the business centre, public buildings and the old Princes' Palace, is known as the "Old Town" and is situated west of the river, whilst on the outskirts one finds a great number of industrial buildings. East of the Weichsel lies Praga, at one time a suburb but now a major part of the city. Praga is mainly a residential centre with a limited number of industries.

Because the city has so few suburbs, the suburban traffic does not run in co-ordination with the internal traffic, the two systems being wholly separated from each other. The internal traffic consists of tram-cars of the older two axled type, Diesel buses and

trolley buses. The suburban traffic between the capital and neighbouring suburbs and towns, spans a distance of about 10-35 miles and is served by electric trains running on normal-gauge mainline tracks. These run through tunnels to the citie's centre, but because of the nature of the trains they are not suitable to supplement the internal city traffic. This problem, however, has met with a proposal in the form of a separate underground railway, essentially of the loop-line type.

During the war a great deal of Warsaw was destroyed, including also railway lines, generating plants and rolling stock, but a few pre-war suburban trains were restored to an operational condition. This gave rise to even greater difficulties especially when more people were forced to reside in the less damaged suburbs at the same time as workers were required in the city for rebuilding. The quickest possible delivery of new suburban trains was therefore urgent, and in 1947 Asia obtained a contract to build, in co-operation with AB Svenska Jarnvagsverkstaden and Kockums Mekaniska Verkstada AB, 44 3-coach unit trains for the Warsaw Suburban lines. Included in this order were also 6 rectifier substations and 8 electric locomotives intended to have the steam trains,

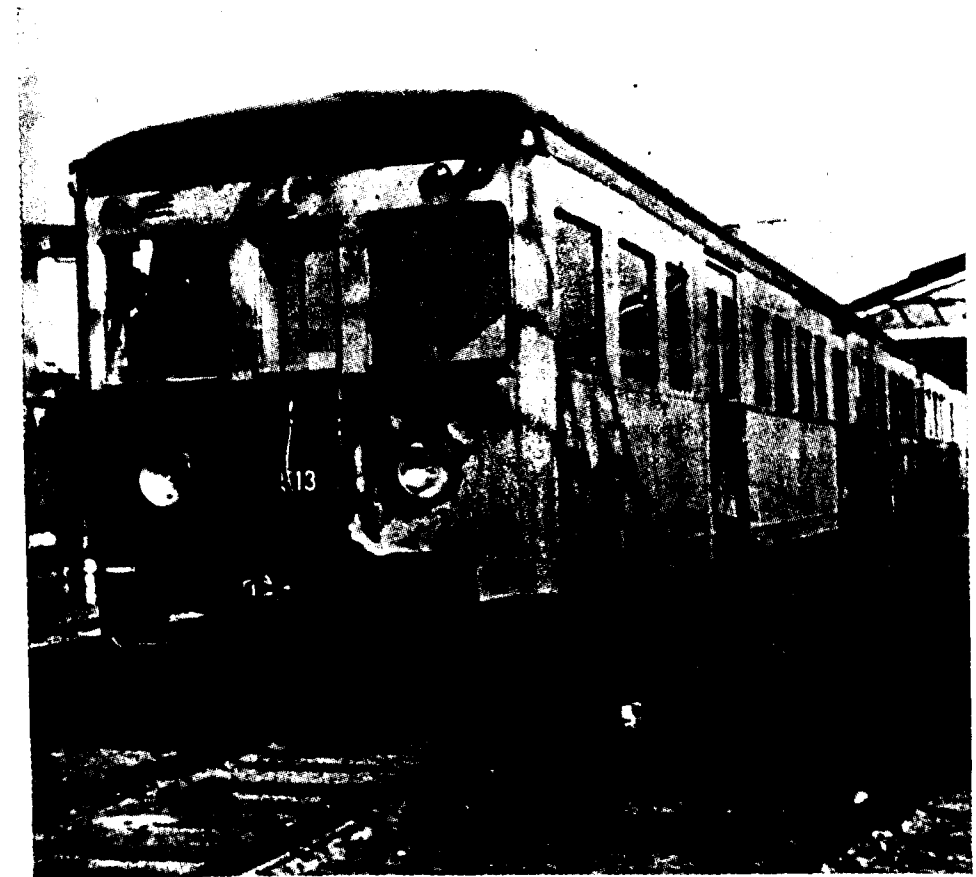
(Continued from page 57)

of 90 mm at the front "Bissel" truck and of 100 mm at the trailing truck, the locomotives can freely negotiate curves, even the smallest curve of 140 metres.

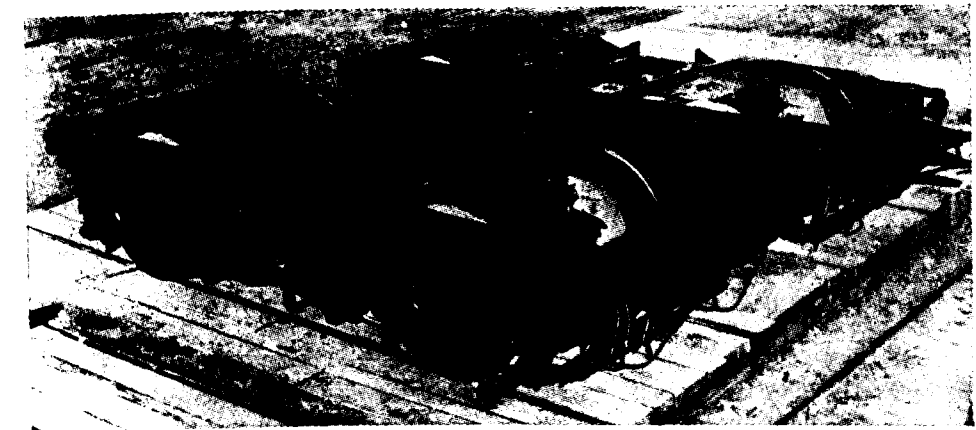
The purchaser had not requested a special train load program for the various gradients and speeds. However, the figures of efficiency and speeds of train-loads on gradients could be safely attained as stated during trial

runs. The lines to be run have numerous gradients and lines rich of curves up to 40% and curves down to 150 and 140 metres.

At the end of October 1951, a successful exhibition run took place in the presence of President Soe Karno and other members of the Government of the Republic Indonesia, thus showing the interest in this new supply of such a big order of locomotives.



Pre-war type.



Motor bogies.

which had to enter the citie's boundary, over the electrified stretches where steam haulage

would not be suitable. These locomotives were built in Falun by ASJ.



Swedish 3-car unit ready for delivery.

The extension work on a number of the lines is somewhat delayed, but the map gives, however, an idea as to the time taken for this work.

The size of these suburbs would seem to vary between 5,000 and 20,000 inhabitants. Before the war many of the suburbs consisted of summer residences but are now, throughout, permanent quarters for people who work in the city.

It was agreed that the Swedish-built suburban trains should be of the 3-coach-passenger unit type, but it was found that this arrangement with trailing coaches on Jacob type bogies was unmanageable and heavy. Instead, the trains were built as 3-coach units, the centre one of which is the motor-coach and the two outer coaches functioning as driving trailer coaches. The motor coach is furnished with all the necessary electric traction equipment, pantograph, starting resistances, rectifier, battery, compressor and the two motor bogies. Driver's cabs are not included in the motor coach as these are

situated in the two end coaches. The two end coaches are identical internally and carry only brake equipment in the underframe. On each side of the motor coach are two openings for twin-leaf sliding doors, these being placed near the coach ends, whilst in the centre there is an opening for a double type folding door, on the inside of which a luggage compartment is arranged adjacent to the framework of the electrical apparatus. This framework, which carries both high and low tension equipment, is placed in a special cabinet attached to the floor and can be removed or replaced as one unit, through openings in the side of the coach. On each side of the end coaches are three openings for double sliding doors. A toilet with W. C. is situated in each of these end coaches.

The 3-coach unit trains, in similarity to those which were built before the war, so constructed as to be coupled together giving three units of 9 coaches with an overall length of 624 ft. The unit's important main data is as follows:



Interior of a new car.



Driver's cab.

COACHES

Track gauge	4' 8½"
Length of coach	67' 3"
Length of 3-coach unit over the faces of the couples	208' 0"
Distance between bogie centres	48' 0"
" axles	9' 0"
External breadth	9' 8"
Internal "	8' 10"
Height over rails	12' 0"
Floor height over rails	3' 9"
Height of roof internal	8' 2"
Number of seats	200
Maximum number of passengers	500
Weight of motor coach	53 tons 11½ cwts
" end coach	30 tons 8 cwts

Total weight of 3-coach unit	114 tons 7½ cwts
Maximum speed	62 m. p. h.

ELECTRICAL EQUIPMENT

Overhead line voltage	3000 V D. C.
Voltage of control system, lighting, door control, brake system, compressor motor	110 V D. C.
Number of traction motors	4
Nominal time-rating per motor	225 HP
Nominal tractive effort with time-rating per motor	1.370 kp at 27 m. p. h.
Motor suspension	centrally slung—direct drive

FEBRUARY 1955

Control system	totally electric, motor controlled drum-switch starting-rheostat for 3 kv.
Number of rheostat stages	Series 6 Parallel 5 Field decrease 2
Number of pantographs	2
Output of motor generator	10 kW
Number of cells in battery	72
Capacity of compressor at $^{\circ}/\text{kp}/\text{cm}^2$ pressure	32 cu. ft./min.
Average acceleration to 25 m.p.h.	2 ft./sec ²

The brake system is a combined electro-pneumatic and pneumatic of the Westinghouse type (London). With the electro-pneumatic brake, the cylinders are fed direct from the high-pressure pipes, application and release being effected through an unlimited number of stages. The pneumatic brake is an auxiliary, and being of the standard single-cylinder type.

The lighting system is an arrangement of standard type bulbs attached in roof fittings of the Polish State Railways standard equipment.

The 3-coach unit is heated by means of electric radiators, placed under the seats and in the vestibules. Ventilation is obtained by suction type ventilators situated in the roof.

All doors are electro-pneumatically controlled from the control panels, which are situated in the nine vestibules of the 3-coach unit. The door operating cylinders are of

the differential type by which the doors automatically close, if, for example, the current to the control system should unintentionally be cut off.

The driver's cabs are equipped with traction and brake controllers, speed indicator, brake pressure manometer, volt and ammeter for the low tension circuits, switches for the control, lighting and heating circuits, main switches etc.

The outer ends of the train unit have no connecting doors to the next coupled unit. In the ends of the train units are attached the Scharfenberg automatic couplers, which also transfer to the next unit, high pressure air and brake air, also the 110 V control current with a total of 34 multiple leads, the contacts of which are automatically closed when coupling takes place.

The interiors of these 3-coach units are, as well as the construction in general, executed under intimate co-operation with architects and engineers of the Polish State Railways. The seats are all of the double type and the lay out is symmetrical, there being two rows of seats, one row on each side of the centre gangway. The semi-bulkheads positioned at the entrance doors, divide the coaches into departments having 24 places, access to the various departments being made through sliding doors in the partition walls. The seats are not upholstered but are of the wooden bench type manufactured in ash with frames of pressed steel plate. Above the windows are luggage racks of chromium plated metal netting on frames of chromium plated steel tubes, the whole rack being supported on brackets of polished aluminium. The plating of such details has been avoided as they call for more maintenance such as re-chroming. The windows are of 5 mm single pane glass in aluminium frames, all of them being of the half-drop type. On the inside of each window is a horizontally placed safety

rod. Blinds, sliding in built-in cornices are provided for all windows.

The exterior colour scheme is royal blue up to the lower edge of the windows and beige-yellow from this level up the light gray roof. Internally, and up to the level of the lower edge of the windows the walls are covered with brown linoleum. Above this level the walls are painted a light green. The inner roof is painted a dull white. By this choice of colours, which harmonize with the wooden surfaces, the interior is given a peaceful and pleasant impression.

"FIELDING" EXTRUSION PRESSES

The name of "Fielding" has been associated with Hydraulic Presses for the Extrusion of Metals for many years, and we have built up a reputation for quality and service in this branch of the Engineering Industry.

Since the early days of Extrusion process, Fielding & Platt Ltd. have specialised in the design and manufacture of Hydraulic Extrusion Presses, and continuous research and development have resulted in great advancement in this particular branch of Engineering.

"Fielding" Extrusion Presses designed and built in our Works at Gloucester, cover a wide range and are of the horizontal or vertical types suitable for the direct or indirect process of extrusion. Presses have also been designed to combine both direct and indirect extrusion. A high rate of production combined with ease of operation and low maintenance costs are distinctive features of these presses.

Extruded products may be tubes, rods, bars, wire, strip, and irregular sections in copper, brass, light alloys, aluminium and other non-ferrous alloys, also lead and carbon. Special designs can be supplied for lead piping and lead covering of cables, also the coating of electrodes.

As was previously mentioned, the order included 44 3-coach units, ASEA being the main contractor and responsible for the electrical traction equipment, whilst ASJ and Kockums in Malmo, were responsible for 28 and 16 units respectively.

The first delivery was made in October 1950, with 2 units from ASJ and one from Kockums. The delivery continued with 3 units every 2 months and the order was completed towards the end of 1952. Since then the operation of the various units has proved entirely satisfactory.

To the accumulated wealth of experience of our Engineers and Technicians on all types of Extrusion Presses, must be coupled the workshop capacities and machine tool facilities which enable us to produce equipment of the finest quality to meet the exacting requirements of our customers.

The wide and specialised experience we possess enables us to give expert advice and guidance in the selection of the most suitable types of equipment to meet customer's requirements. Designs and layouts for complete plant can be prepared to suit local conditions.

The fullest information regarding other features, devices and materials used in the manufacture of "Fielding" Extrusion Presses will be gladly provided with all the essential information regarding pressures, speeds and output, pressure water plant and pumping units, also ancillary equipment which may be required for the complete installation.

In addition to the extensive range of "Fielding" modern Extrusion Presses we have produced, we also design and supply the necessary equipment such as containers, solid and hollow thrust rods, mandrel holders, die

assembly carriers, mandrels, dies, die holders, thrust pads etc. All tools are designed to withstand the stresses and temperatures involved and to ensure long life. Special oil or air cooling devices can be provided for cooling mandrels and dies which are exposed to excessive heat conditions.

Containers are made of two or three parts, the liner which is subject to wear being of special grade material, thus minimizing operational expenses. Containers can be equipped with gas heaters, or where accurate temperature control is essential, electric heaters of the resistance or induction type. Portable electric heaters to fit various container bores can be supplied for pre-heating containers.

For facilitating the replacement of containers on horizontal type Extrusion Presses specially designed container housings are provided. Special handling gear can be supplied to suit customers particular requirements.

The application of our handling devices will greatly assist in cutting down time losses to a minimum. Handling gear can be either

hand or mechanically operated billet conveyors, and roller tables for feeding billets from the furnace to the press. Hydraulic billet lifters, wedge operating devices, container sealing cylinders, die shifting arrangement etc. are embodied in the press designs, depending upon the size and type of press.

Hydraulic control valves are of the fully balanced type permitting easy operation and sensitive adjustment. All parts are made of suitable wear resisting material to keep maintenance costs as low as possible.

Recording devices of approved designs that register speed and measurement can be fitted to presses in order to assist the operator in keeping extrusion speeds under close control during operation of the press. For powering Extrusion Presses we can offer "Fielding" Variable Delivery or Horizontal Type Pumps, also "Fielding" Air Hydraulic Accumulators of modern design fitted with dual electro-hydraulic control tube system, working in conjunction with "Fielding" Three Throw Pressure Pumps that are of special robust construction to ensure long service and continuous operation.

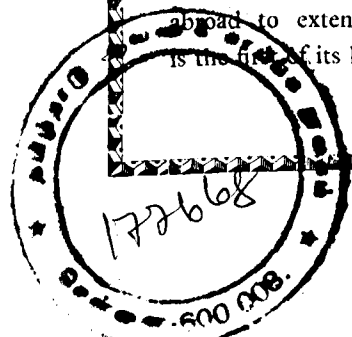
AN IMPORTANT ANNOUNCEMENT

We have pleasure to inform all our readers and advertisers that we are issuing a special Supplement sometime in September 1955 for the INDIAN RAILWAYS INTEGRAL COACH FACTORY at Perambur on the occasion of turning out the first Coach from this factory. It is expected that the Prime Minister of India will participate in the opening ceremony.

This Supplement will contain a comprehensive review of the Integral Coach Factory and its origin, besides a number of technical articles on the various stages of Coach construction written by eminent engineers of the Indian Railways.

We take this opportunity of requesting all Engineering firms in India and abroad to extend their full co-operation for the success of this Supplement which is the first of its kind ever to be published in India.

Editor.



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