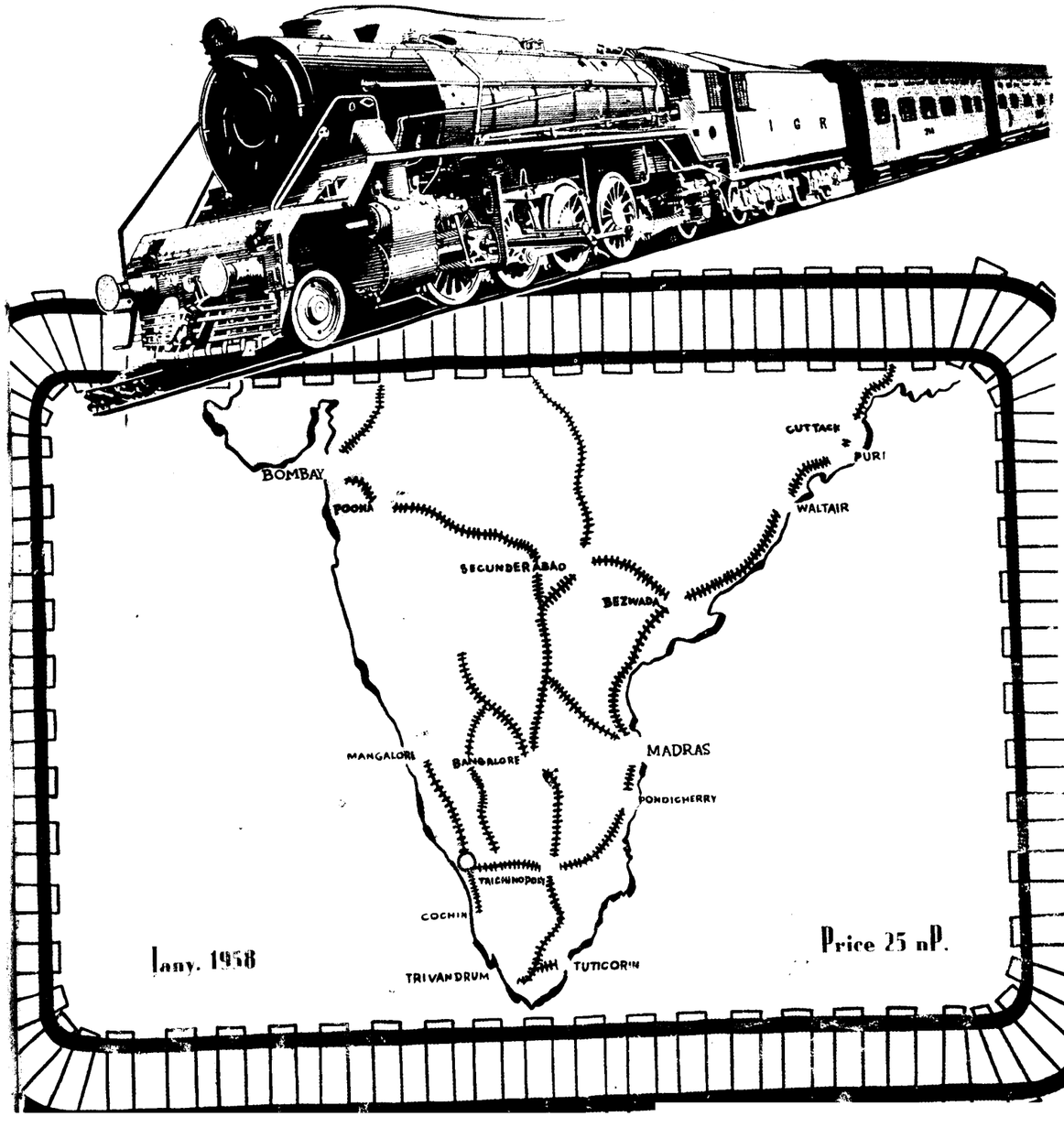
SOUTHERN RAILWAYS Magazine



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CONTENTS

SEA TRANSPORT SECTION

EDITORIAL NOTICE

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

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

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

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

Automatic Train Control on the German Federal Railways

*By D. W. Chilian**

SOON after the 1st World War, the German Railway recognized the necessity of introducing a system of Automatic Train Control by which it should be possible to enforce a train moving on any line section to adhere strictly to the signals indicated to it for its safe passage along this section. This system should prevent the engine driver to pass any signal at 'danger' and enforce an automatic braking of the train in case he should not respond immediately to the signal.

The development of such a system which is commonly known as Automatic Train Control, was substantially pioneered in Germany by the firm of Siemens & Halske, and this system is also known on the Continent under the abbreviation INDUSI. The vital problem for such a system was a reliable transmission of controls from an apparatus on the track to the running train at speeds ranging from nearly zero up to the highest ones, being at this time 100 m.p.h. The system adopted was capable of a reliable transmission of multi-aspect signal controls by non-mechanical means.

The German State Railway at this time selected a 3-frequency system, thus allowing 3 different controls to be transmitted simultaneously.

From 1935 up to 1940 a total number of 1000 engines, mostly steam ones, have been equipped with this apparatus and on approximately 2200 miles of double line sections a total number of 10,000 track equipments have been installed. This apparatus is still in service with the present Federal Railway of Western Germany. It has proved its reliable operation during the strenuous years of World War II and after when only a very limited supply of spare parts was available and little maintenance could be spared on this equipment. It is further proved that in many cases severe train disasters could be avoided and heavy damages thereby prevented.

It was possible for Messrs. Siemens & Halske to improve the pre-war system still further in close co-operation with the Federal Railway. Thus according to the concepts of modern manufacture and technique, the vital parts of the equipment could be made much smaller in size, the apparatus could be made suitable for all existing traffic conditions and the power consumption of the engine equipment could be reduced considerably.

What is now the reason for such Automatic Train Control equipment being employed in many technically advanced countries?

The safety in railway traffic and the improvement of the operating conditions has drawn much benefit from the introduction of modern power signalling, by track circuiting of big yards and by Automatic signalling on open line sections. It is, however, known that all such arrangements cannot provide an ultimate protection of the train traffic, since its safety also depends on the watchful eyes of the engine driver. Thereby the human element cannot fully be eliminated, as has been proved by many fateful train disasters.

The driver is compelled to make his driving fully dependent upon the indications of signals. For properly recognizing their position good knowledge of the section is required. Short sections of slow driving which may be provided permanently or occasionally within the section demand special attention of the driver. On some other sections colour-light signals may

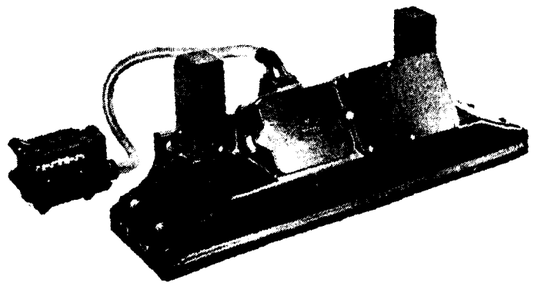

Fig. 1. 3-Frequency Vehicle's Magnet with Plug-in Connection Cable.

* Signal Engineer of Messrs. Siemens & Halske in India.

.ge intermittently with semaphores. From all this ..ay be seen that the driver is fully occupied, since ... much pay his utmost attention to the signals and at a .he same time handle his engine. An error in the former, therefore, is not impossible and has been experienced due to the following reasons, mostly leading to major disasters :—

(a) Poor signal view due to foggy or misty weather.

(b) Poor signal view due to smoke from other trains.

(c) Sighting of wrong signals at major yards.

(d) Divertion of driver's attention due to technical faults on his vehicle.

(e) Momentary absent-mindedness or fainting of the driver.

(f) In rare cases even complete neglect of his duties by the driver.

With automatic train control, however, an apparatus is provided which does not require any operation when a signal is passed in 'off'-position, since there is no danger in passing such signal, although for restrictive signal aspects there will be an automatic interference in order to enforce a reduction of the train speed or to come to a stop.

The principle of operation is as follows :—

An electric motor-generator on the engine generates A. C. of 500, 1000, and 2000 cycles p. s. simultaneously. These frequencies are resonated in series with special impulse relay each over impedance coils and condensers, thereby making the current through the relay a maximum. The impedance coils, which are housed together, are mounted at the lower part of the

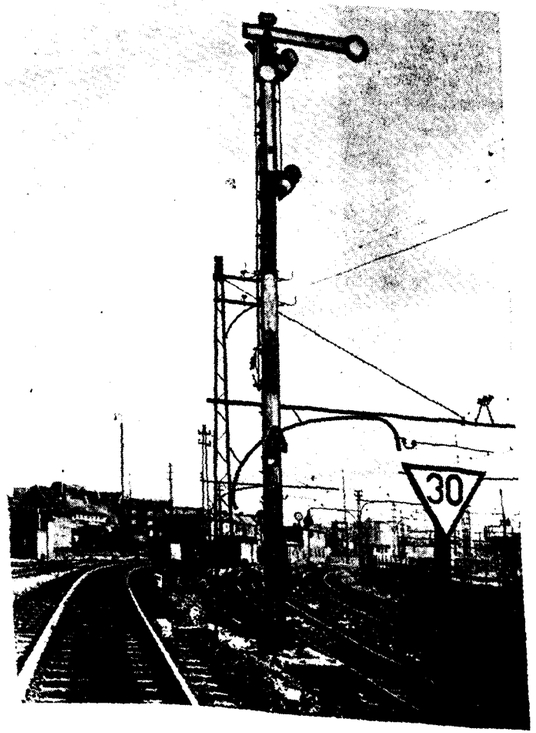

Fig. 2. Track Magnet on Main Signal (Semaphore Type) for 2000 c. p. s.

Fig. 3. Track Magnet for 1000 c. p. s. at mechanical Distant Signal.

engine on one iron core, thus forming the engine's magnet. (Fig. 1)

On the track at the signal location another magnet, the track magnet is provided the coil of which is also resonated with a built-in condenser for any one of the frequencies 500, 1000, or 2000 c.p.s. (see Fig. 2 and 3). The condenser at the track coil becomes, however, short circuited by an ordinary circuit controller in case of semaphores or a contact of the signal control relay with colour light signals, when the signal is in 'off' position. The track magnet does not require any power supply.

By the track magnet being in resonance with the particular frequency of the engine's magnet, enough power is absorbed at the moment when the engine passes to ensure a safe drop-away of the respective impulse relay. Although the time for this seems to be rather short (it may be only 0.0012 second at a train speed of 60 m. p. h.), it will be sufficient for the very sensitive impulse relay, since its current drops to only 20% of its normal hold-up value.

The drop-away of the respective impulse relay at the engine is the first step to release some other relays, which in turn either force the driver to reduce his speed considerably or in case of an absolute stop signal being passed at 'danger' to effect an enforced braking of the train. The relay apparatus will operate a certain air valve. This valve will open the pipes of the air braking system of the train, similarly as the pulling of the chain for the emergency brake.

The operating sequence of Automatic Train control has been laid down for the German Federal Railways in accordance with the operating conditions and train speeds prevailing on this railway. Since the first sections to be equipped with this new apparatus in 1934 were trunk lines with high speed traffic, the 3-frequency system was adopted.

By this system three different phases are observed for influencing a train on the run :—

1. At a Distant Signal showing either caution or attention aspect by the frequency of 1000 c/s.

2. At a distance of approximately 160 yards in the rear of any main signal showing danger or caution position by the frequency of 500 c/s.

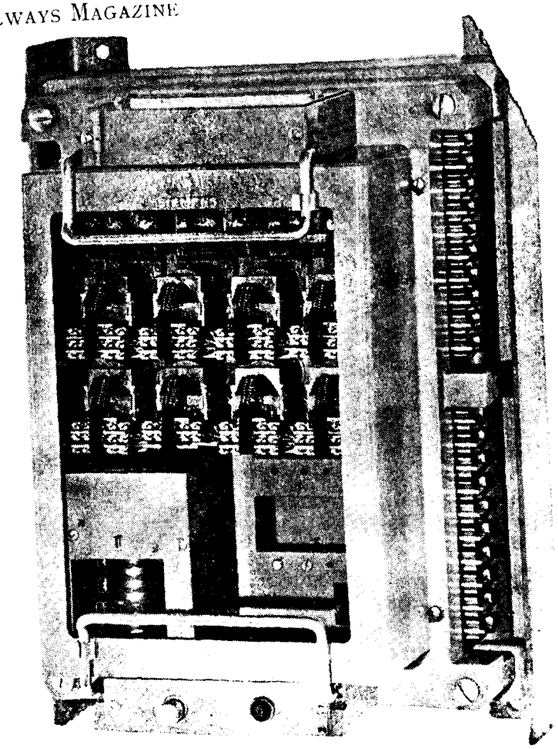

Fig. 4. Plug-in type Relay Unit on Mounting Frame.

3. At an absolute stop signal displaying 'danger' position by frequency of 2000 c. p. s.

In order to enforce a halt of the train at least 220 yards behind an absolute stop signal, which is the maximum overrun distance normally provided on main lines of the Federal Railways, the reduction of speed for trains at highest admissible speeds i. e. 100 miles per hour has to be started at the distant signal. When the train is, therefore, passing a distant signal at either caution or attention position, an automatic transmission must take place at this location. By intercepting the 1000 c. p. s. resonance, the impulse relay will initiate another time relay, a contact of which will delay the enforced breaking for about 5 seconds. This is provided to give the driver ample time to respond by pressing a certain push-button, indicating that he is aware of having passed the distant signal in restrictive position. This button may be called the vigilance button or also acknowledgement key. If the driver, however, neglects to do

First Aid Fire Extinguishers for Railway Workshops

THIS article is written as a guide to all who may be called upon at a moments notice to use extinguishers against an actual outbreak of fire. It is not intended to expound the great value of first aid fire extinguishing appliances to industry.

Tens of thousands of extinguishers are installed in commercial buildings throughout the country—from the numerous and large workshops of the State Railways to the small individually owned premises. As these extinguishers are of extreme value in the event of fire, it is therefore, important that the handling of the different types should be understood if the full benefit is to be obtained, as there is no single type of extinguisher which is effective against every kind of fire.

The information given here will assist those responsible for property and also life, who are considering the necessity of equipping premises with fire extinguishers to select the appropriate types to cover their particular risks.

First aid fire extinguishers are divided into four main classes, and brief details of each, and how they should be used are as follows :—

CLASS—I WATER TYPE (SODA-ACID)

This is a general-purpose extinguisher and will effectively cope with all fires involving timber, fabrics, paper, straw and all other freely burning materials. The normal capacity of this appliance is two gallons and the filling is composed of 2 gallons of water, into which is dissolved a quantity of pure bicarb. soda and also a glass tube containing a solution of acid. Instructions for setting the extinguisher in action are affixed to the outer casing of the extinguishers and should be carefully followed. The usual procedure is to drive in the plunger, situated at the base; this action shatters the glass tube, thus liberating the acid, which mixes with the soda solution (alkali) and results in the generation of carbon dioxide gas in sufficient quantity to reach the necessary pressure to eject the solution from the nozzle to a distance of 30 to 35 feet. The duration of discharge is approximately 1½ minutes.

When the extinguisher is required for use, the operator should take it reasonably close to the fire before setting it in action. The liquid discharged must firstly be, directed to the base of fire, then worked upwards as control is obtained. The Soda-acid Extinguisher is not effective against burning liquids.

CLASS-II FOAM TYPE

The foam producing extinguisher is used against fires involving inflammable liquids, i. e. petrol, benzine, paraffin, oils, paint, tar. The standard capacity of the hand appliance is two gallons and the filling consists of two solutions, a foam salt and an acid salt. The foam salt is 1½ gallons and the acid salt, ½ gallon, this is housed in a small container which fits inside the main body of the extinguisher. In some models the inner container is sealed to prevent accidental discharge. Instructions for setting in action are affixed to the face of the extinguisher. Generally the extinguisher is turned upside down, and where the inner container is sealed the extinguisher will be fitted with a plunger for the purpose of breaking the sealing disc, thus allowing the two solutions to mix. There is an instant generation of carbon dioxide gas, the pressure of which causes agitation in the extinguisher and discharges a thick foam to a distance of 20 to 25 feet. Duration of discharge, approximately one minute. The quantity of foam ejected is equal to six to eight times the liquid capacity of the extinguisher and is sufficient to cover a surface of 12 sq. ft. with a blanket of foam and so cut off the flames. When dealing with burning liquid in an open container, the operator should stand away from the fire to avoid splashing the surface as this not only retards extinction but may increase the area of the fire. The reason for standing away is to reduce the force of the jet of foam before it comes into contact with the burning surface.

CLASS III-CARBON DI-OXIDE (CO_2) TYPE

This class of extinguisher is most suitable for the protection of electrical apparatus; it is effective for generating and power stations, transformer houses and any premises where electrical equipment is used. The capacity of this type of extinguisher is referred to in lbs. i. e. lbs. of liquid gas. A popular size for industrial premises is one of 10 lb. capacity. It is a non-conductor of electricity, therefore, there is no danger to any delicate mechanism other than that caused by the flames, in fact it is non-damaging to any class of material. It is excellent protection for large kitchens, as in restaurants, canteens etc. The gas is in no way injurious to food stuffs.

CO_2 is an inert gas and extinguishes fire by either diluting or displacing the oxygen in the air. It is, of course, appreciated that combustion cannot be sustained without oxygen. The gas in the extinguisher cylinder or bottle is liquified, and on release to atmospheric pressure has an enormous expansion and it is comparatively easy to get a very high concentration of gas to envelop and extinguish the flames. Carbon Dioxide is equally effective protection for all inflammable liquids.

When using a CO_2 Extinguisher, it is necessary for the operator to tackle the fire at fairly close range in order that the highest possible concentration of gas shall cover the fire. Owing to the very high pressure at which the gas is discharged there is considerable noise whilst the extinguisher is being operated. CO_2 should not be used as protection for freely burning materials as whilst it may cut off the flames, there is lack of penetration which is so very necessary when materials have been burning for sometime and this penetration can only be effected by a high pressure jet, as may be discharged from the water type extinguisher.

CLASS IV—CARBON TETRA-CHLORIDE (CTC)

This extinguisher is generally fitted with a double action hand-pump and is intended for motor cars and commercial motor vehicles. As Carbon Tetrachloride is a non-conductor of electricity, it can be used for the protection of a small switch board, a small dynamo, electric or petrol motor. It should not be installed in buildings unless in very small numbers as there is danger to persons from the toxic vapours which are generated when this extinguishing fluid comes into contact with heat. There are two sizes, one a quart capacity, the other a pint. The actual liquid content in the quart size is 1½ pints, and in the pint capacity, 3/4 pint. The action when using this type of extinguisher is similar to that of an ordinary cycle pump. During the outward and inward thrust of the pump rod, liquid is being discharged, and ceases when the operator stops pumping.

It is very important that a fire extinguisher should be thoroughly rinsed and refilled as soon as possible after being used.

It is essential that fire extinguishers should have a periodical inspection to ensure they are full and in proper order for immediate action.

One very important point, which should be remembered is that the quicker a fire is tackled the more easily will it be extinguished.

NORAL SHALLOW-TROUGHED SHEETING

A new aluminium corrugated sheeting has now been added to the extensive range already produced by Northern Aluminium Company Ltd. This new thin-gauge shallow-troughed sheet is suitable for many panelling applications where flat sheet was previously used; it will provide a stiffer sheeting that has considerable decorative appeal.

The sheeting has 1 in. wide troughs, depressed 1/16 in., at pitches of 2 in., 3 in., 4 in., or 6 in. The edges parallel to the corrugations are given borders of sufficient widths to provide a 1 in. overlap, and at the same time to present a continuous, symmetrical pattern across joined sheets. The overlap may be used for a variety of fixing methods and will give standard effective sheet widths of 36 in. and 48 in.

Primarily designed for caravan builders, to provide an attractive panelling with enough 'shape' to minimise the risk of buckling, the sheeting is also suitable for use in vehicle bodywork generally, building and domestic equipment. It will provide a thin-gauge material with the stiffness of flat sheeting of much thicker gauge in the direction of the corrugations.

Flooring Compositions for Railway Coaches

INDIAN Railways have been using for the last 30 years a special flooring Composition on the floors of passenger coaches, replacing Linoleum, Carpet and Rubber Tiles.

The flooring composition (and the patent dove-tailed wooden base on which the flooring composition is laid) is manufactured by the Oxy-Chloride Flooring Products Ltd., of Bombay. In technical language the compositions are known as Oxy-Chlorides of Magnesia. They are laid down in one piece without joints or uneven surfaces where dirt can easily collect. These floorings are available in a variety of colour, Plain, Mosaic or Mother of Pearl with polished or matt finishes.

The Compositions are used for making Monolythic (one piece) non-crackable floors, partitions, dadoes and ceilings and being composed of the most hygienic building materials, are largely used in Railway coaches, Hospitals, Mills, Public Halls and Barracks etc. The material is prepared in the form of fine powder and is despatched in hermetically sealed steel drums.

In Railway coaches the best results are obtained by laying the Composition on a dove-tailed wooden base which has been patented by the Oxy-Chloride Flooring Products Ltd. Wooden strips are cut by a planing machine so that when assembled they form an interlocked dove-tailed surface. The dimensions of the wood strips depend on the requirements of the space to be covered. Railways are equipped with Carpentry shops and can easily cut the wood strips in the size and shape required.

As there are no maintenance charges and as the life of the Composition on wooden base is as long as the base lasts, the economy of using this method of floor covering need hardly be stressed. Moreover, it is possible for Railways to utilise scrap wood which otherwise would have to be sold for a song. It may

(Continued on page 12)

Thirtyfive years of Leadership in Cable Manufacture in India

IT may come as a surprise to some readers to learn that the electrical cables and wires, which make such amenities as lighting and fans available to the travelling public, and which also contribute to making modern railway signalling possible, have been manufactured in India for almost thirty five years. In the Indian Cable Co. Ltd., the country has been in possession of a cable-making factory since 1922, located nowadays at its original site in Jamshedpur, Bihar. The intervening years since its inception have witnessed a gradual expansion of the factory, which is now actively engaged in helping to meet the growing needs of the new Indian industrial era for electrical goods of all kinds.

Covering an area of over 150 acres, this important industrial unit, with the new factory buildings now taking shape around it, is rapidly developing to form a sizeable community on its own, situated in pleasant healthy surroundings such as are seldom obtainable in the overcrowded smoky cities. In keeping with an enlightened outlook on modern industrial relations, the Company is providing, as quickly as the present availability of building materials will permit, a steadily growing number of substantial, well-designed houses for its employees, equipped with tapwater, electric lighting and fans, to supplement the many existing quarters. Other amenities such as free medical attention, canteen facilities, and subsidised rations are enjoyed by more than thirteen hundred workers.

The normal basic raw materials for electrical cable manufacture is high-conductivity electrolytic copper. Imported usually in the form of electrolytic copper bars, this useful metal is reduced in Indian non-ferrous rolling mills to the form of thick rods of circular section, and it is from these rods that the factory commences manufacture of its variegated cable and wire products.

The first stage involves the drawing-down of the coils of copper rod into wires of a wide range of sizes by passing them through a series of dies. This process is carried on by the intricate machinery of the factory's Wire Mill. Bare copper wires thus produced, in their hard-drawn state, normally form a substantial part of the factory's output for the market, in both solid and stranded form, hard-drawn copper conductors are in general service as transmission lines, conveying the electricity generated at the many power stations all over India to countless distribution points, whence it is led by networks of electrical cable to bring power, light and comfort into a multitude of factories, offices and homes. With the realisation of the great new schemes for the utilisation of India's river water in hydro-electric generating stations, now in progress, such conductors will be required from the cable manufacturers in thousands of miles a year.

The main direction of the Indian Cable Company's activities, however, lies at present in the production of low-tension electrical conductors, insulated with special vulcanised rubber compounds. These rubber insulated cables and wires are the arteries and veins

(Continued from page 11)

safely be stated that nearly 30% saving can be effected on the cost price of the former types of wearing surface materials utilised.

As regards wearing properties, it is the hardest known material yet used for flooring. There is no expansion or contraction with the variations of climate. If a portion of the floor is broken or damaged, the affected portion can be renovated without the necessity of reconditioning the entire floor. Owing to its germicidal properties the flooring is insect proof and actually serves as a preservative of the wooden base. A composition floor is fire proof that is, it will not burn but may crack under extreme heat.

The tensile strength of the Compositions compares advantageously with that of cement. After 24 hours the Composition shows a tensile power of 650 as compared with 600 of cement. The tensile strength continues to grow until it reaches the figure of 1200. It takes one ton of pressure per square inch to crush one inch composition which has set.

To meet the requirements of the Railway authorities, the flooring products are subjected to the most stringent tests with regard to durability.

which carry current to lights, fans, refrigerators, tools and machinery wherever electrical energy is used, and are turned out in a wide variety of sizes and finishes in quantities reaching thirty lakhs of yards of finished cables and Wires per month.

In order to prevent the deleterious chemical interaction which would occur if the vulcanised rubber insulation were in direct contact with the copper conductors, the bare wires intended for rubber insulated cable manufacture are given a coating of tin. Hard Drawn Bare wires for insulated cable manufacture, with a few exceptions, also require to be annealed, which process restores their ductility and conductivity.

The varied sizes of conductor in demand are produced by stranding single wires together. The finer gauges of wire, for use in specially flexible types of finished cables and cards are " bunched " to form the flexible conductors required.

Into the production of the special rubber compounds, used for insulating purposes, go raw rubber of the highest grade from Indian plantations and various chemical agents which, blended together, and carefully processed, are designed to yield a durable and efficient insulation, and protective covering for the cables. By the process of vulcanisation the characteristic resilence and wearing properties of the rubber are imparted to the rubber insulation, and also the rubber covering of certain types of finished cable.

Vulcanised rubber insulated cables and flexible cords are produced in a number of main finishes. For the protection of the inner insulated conductors, either a sheathing of special rubber compound may be extruded over them to produce a tough rubber sheathed cable, or the conductors may be lapped with a proofed calico tape and then passed through a braiding machine, which applies a tightly-woven braided outer covering of fine cotton yarn to the insulated cores. Taped-and-braided cables of the latter kind are usually finally passed through a bath of insulating compound, which also helps to prevent the ingress of moisture when the cable is in service.

For train-lighting use, cables of this construction are impregnated with a special flame-resisting compound as protection against short circuits and possible fire risk in consequence. An even greater measure of protection is afforded by using an asbestos braid in place of cotton.

Mechanical strength and security against damage are characteristics of another common type of finished cable, in the construction of which a lead alloy sheath is applied over the insulated cores. For this purpose special equipment in the form of a Lead Press is employed. This is a massive piece of plant in which the molten alloy, reduced to a plastic state, is extruded under pressure around the insulated cores to form a seamless, continuous, closely-applied sheathing.

Cables of the type used in railway signalling systems frequently contain as many as a dozen or more insulated cores, each of which is marked in a specified way to facilitate identification by the railway electrical engineer. For this particular construction the cores are ' laid-up,' that is, twisted and then filled solid by an extrusion process with a special rubber compound, which fills the interstices between the twisted cores. In order to secure the cable against the deleterious effects of exposure to the elements, and possible mechanical damage, further protective covering is necessary. Layers of hessian tape are then applied, and upon this bed of hessian galvanised iron wires are tranded and finally served with further layers of hessian. The finished cable is then finally passed through a weatherproof compound.

Most of us have watched with a certain amount of fascination, the gleaming " eye " of a locomotive headlight shining into the darkness. In order to supply this important piece of equipment with current, a cable of special flame-resisting finish is employed, which is also among the many requirements of Indian railways supplied by The Indian Cable Co. Ltd. Universally in service with the railways, too, is the tough-rubber coupling cable, which ensures the continuity of a train's electrical system by linking the wires from coach to coach throughout the length of the train.

This brief account can give but a limited impression of the widely diversified nature of the Indian Cable Company's production. A more detailed description would have to take cognisance of the services rendered to Industry and to Government departments in the supply of a vast assortment of cables for lighting and power, copper winding wires and strips for electrical motors and transformes, trolley wire for tramway systems etc. As a guarantee of their quality the Company's products are made and tested to the exacting specifications of the British Standards Institution, and will also conform to the new Indian Standards now being evolved.

The Reinforced Concrete Sleepers of the Vagneux System

By Paul Maille,

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

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

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

The penury of wooden sleepers after the world war 1914/1918 had shown with acuteness that it was to the interest of the Railway Companies to multiply their sources of supply of sleepers and to guard against the uncertainties of the wood market by appealing to the

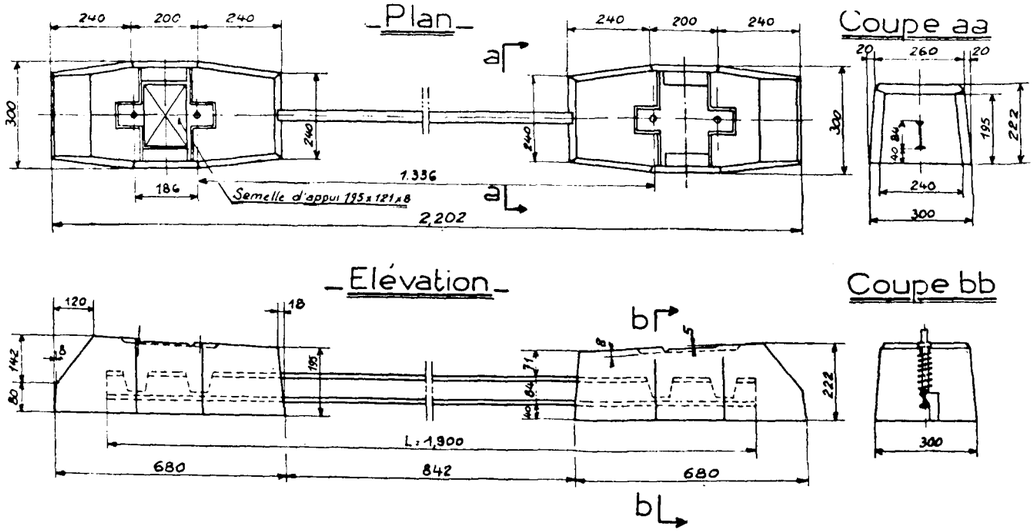

Fig. 1

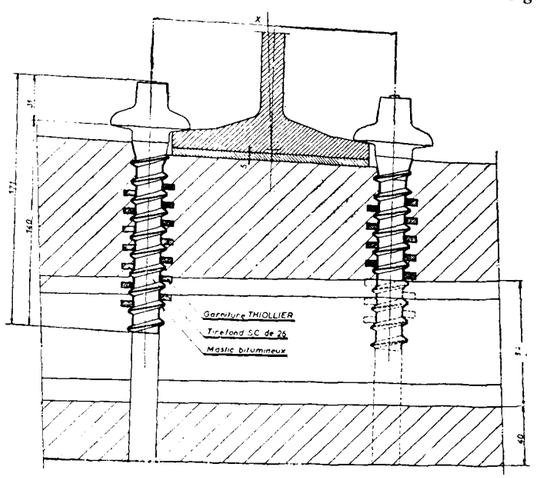

Fig. 2

reinforced concrete. Among the many sleepers that appeared at that time, only the reinforced concrete sleeper of the Vagneux system is still in use, and with success, now for more than 30 years without interruption.

The reinforced concrete sleeper of the VAGNEUX system is well known. It is a composite sleeper, made up of two blocks of reinforced concrete united by a metal cross-beam, either steel beam I section, or a piece of an old rail, or even an old rail relaminated.

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

This sleeper (Fig. 1.), like the reinforced concrete sleeper of the VAGNEUX system manufactured since the beginning, is built up by means of a metallic cross-beam uniting two blocks or sleeper heads, of reinforced concrete. However, in this sleeper with axial fastenings the cross-beam is a laminated iron with a special bulbous cross-section instead of the beam I PN 80/42.

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

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

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

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

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

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

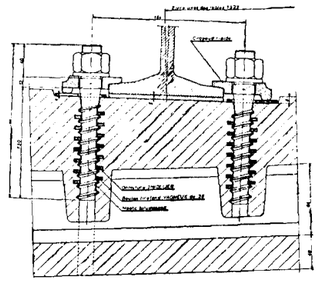

Fig. 3

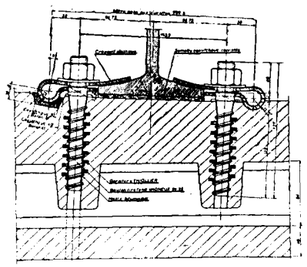

Fig. 4

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

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

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

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

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

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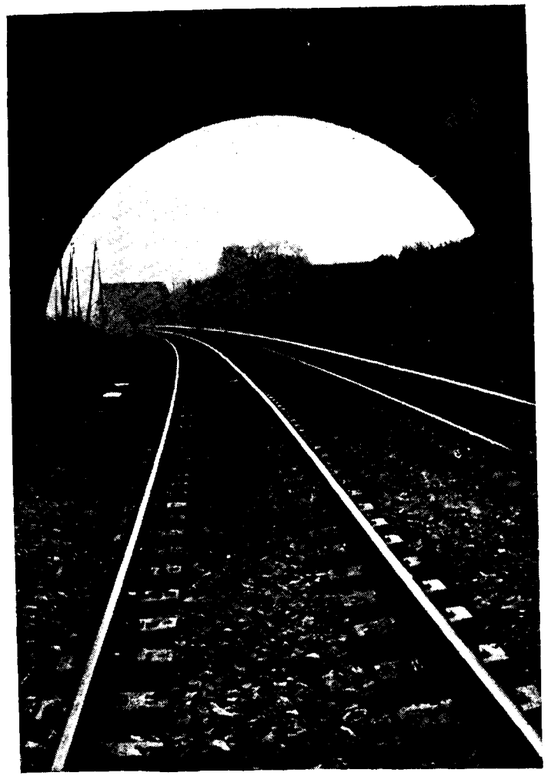


As have been seen above, thanks to the various combinations which are possible with regard to the fastening of the rail, the VAGNEUX reinforced concrete sleeper can be adapted to the track to which it is destined according to the traffic conditions on the line in question.

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

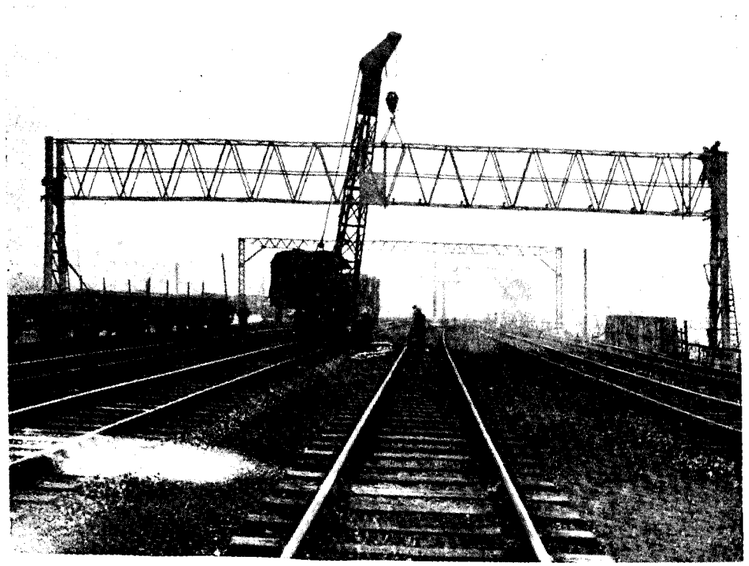
The two latter types of track supporting a relatively slow traffic can also be equipped with pairs of blocks not united with a metal cross-beam, alternating with ordinary sleepers. This reduces considerably the cost price of the track in question.

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

huge latent reserves of water power and it is therefore proper that these peoples should seek to derive the maximum benefit from the natural resources within their boundaries. For such reasons hydro-electric power stations have been planned and built to generate electricity to supply the industrial areas while at the same time the adoption of electric traction is projected in many cases to make use this readily available power.

It is also without dispute that the energy to be derived from coal or other indigenous fuels can be extracted through the medium of thermal power stations and converted to electrical energy with far greater efficiency than can be obtained by burning these fuels in steam locomotives. In addition, lower grades of fuel are normally consumed at power stations in contrast to the high quality coal required for steam traction.

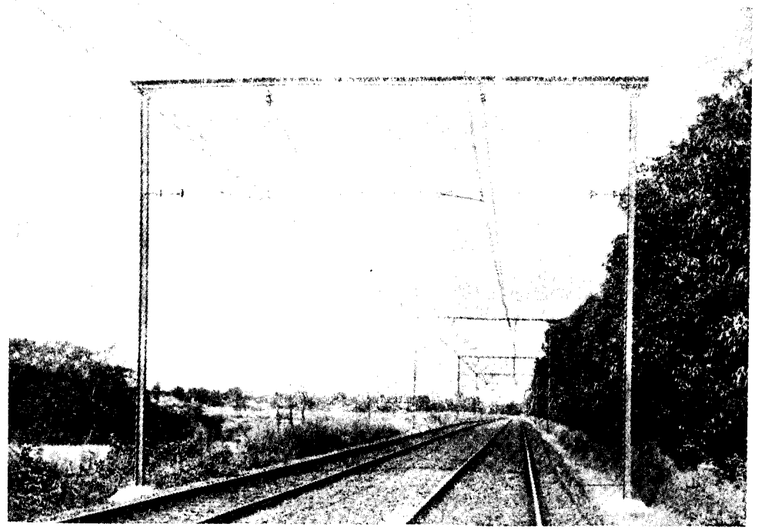
Thus it may be said that conversion to electric traffic effects a considerable saving in the annual amount of fuel consumed. The efficiency of transmission and utilisation at the traction motors is extremely high, and the nature of the power demand at industrial off-peak hours enables the available generating plant to operate at a more uniform and therefore more economical loading.



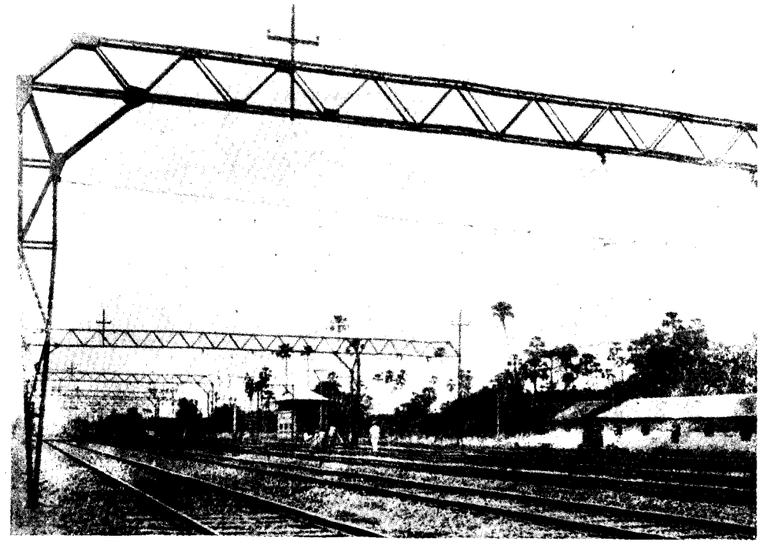
Erecting the bridge of a multi-track anchor structure—London to Shenfield Electrification.

Four-track, broad flange beam portal structure. Showing a method of "registering" (i. e. locating) the contact wire and auxiliary catenary wire over each track. The wires are arranged in compound catenary form.—London to Shenfield Electrification.

From the operating viewpoint railway electrification provides advantages of similar magnitude. The availability of electric locomotives is very high because power is immediately on hand without the delays [illegible]d by refuelling or refiring. Existing services may thus be operated with fewer locomotives, requiring a smaller maintenance staff together with the complete abolition of fuel storage facilities and turntables, leading to the simplification of sidings. Electrically propelled rolling stock has high rates of acceleration and deceleration permitting more punctual running and closer timings which enable (heavier and) more frequent trains to be handled over the existing tracks on faster schedules. Costly track duplication is thereby eliminated.



Two-track construction on the Central Railway (ex G. I. P. Railway, India).

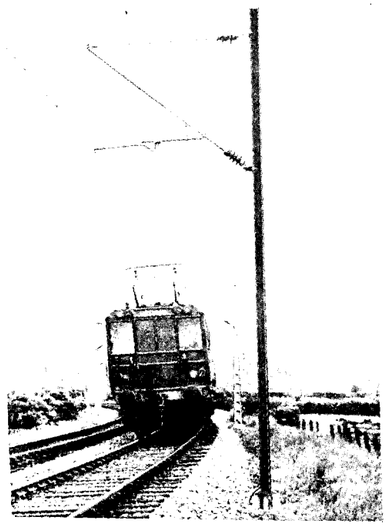


Long span lattice structures on the Western Railway (ex B. B. & C. I. Railway), India showing the structure extensions to carry transmission lines. The wires are arranged in simple catenary form.

In the absence of smoke and soot associated with steam locomotives, the travelling public is presented with clean, fast and attractive rail transport which is unfailingly reflected in increased passenger traffic typified by two recent suburban schemes carried out by BICC in Britain. Today after 5 years of electric operation, the traffic on the London to Shenfield line is more than 100% higher than prior to electrification. On the Manchester-Glossop service after only 8 months, passenger traffic has increased by 142%.

Railway Electrification schemes are of necessity complex operations involving close co-operation between the several railway departments and contracting engineers to ensure the smooth flow of materials and an uninterrupted erection programme. It is at this stage that the wide manufacturing interests of the BICC Organisation and unrivalled skill of the construction staff offer to the railway the maximum advantage.

A detailed track survey must first be made to determine the types of foundation to be employed and siting of structures, places of electrical feeding and sectioning to mention but a little of information that must be carefully compiled. It is sometimes necessary to supplement existing track plans by aerial photography of sections of the route. With this knowledge to hand the structures which are to support



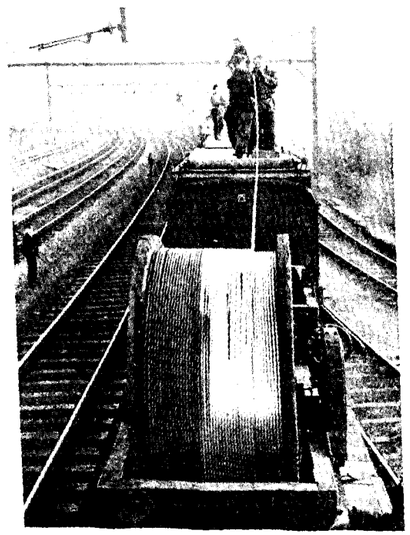
Single track cantilever construction with steel and pre-stressed concrete structures. 6600 Volt alternating current electrification.—Lancaster to Morecambe & Heysham Railway.

or anchor the overhead contact systems are carefully designed while a parallel examination is made of the relevant electrical data including the power to be supplied over each section of the route, permissible voltage drop and the provision of protective devices. Particular attention is required at tunnels, stations and at road crossings where adequate electrical clearances are generally more difficult to obtain.

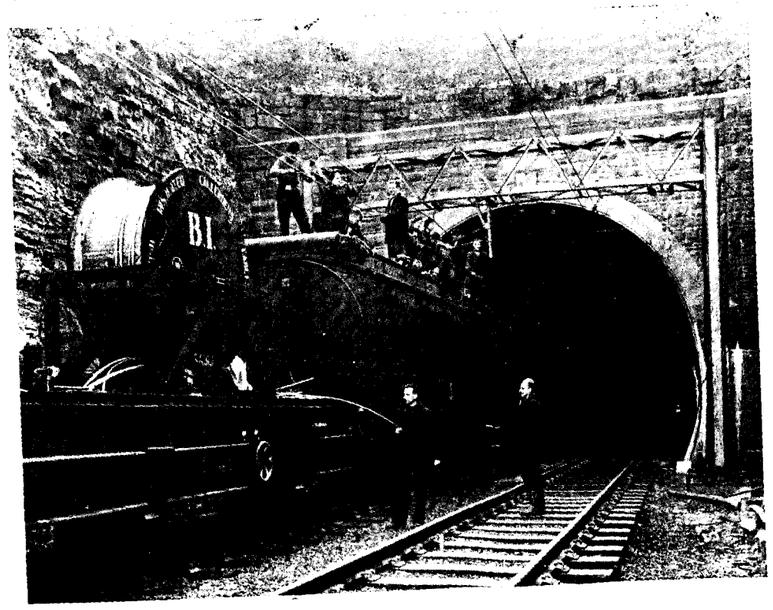
Operations on site begin with the selection of a suitable centre from which the field operations can be supervised and the necessary office and stores accommodation set up. From this depot foundation and steelwork trains convey the material to each track location at which experienced engineers control the excation and placing of the foundations and the subsequent erection of the structures which are usually of steel in one of the many sections-channels, rods, broad flanged beams, rolled steel joists etc. When it is recalled that structures are sometimes required to span eight or more tracks it will be readily appreciated that any small errors in the placing of foundations may prove extremely costly during the steelwork erection. Here, too, close liaison with the railway operating department is vitally important to prevent delay to normal traffic; reference to some of the accompanying photographs will illustrate these remarks.

In due course, other construction trains, from which the overhead conductors are erected, begin operations under the surveillance of the wiring engineers. The conductors will usually be composed of one or two stranded wires per track which are suspended by insulators from the track structures in what is generally known as compound or simple catenary construction (See photographs). These wires form a flexible suspension system to carry the solid copper contact wire. Flexibility is essential to ensure sparkless current collection by the locomotive pantograph which must remain in sliding contact with the contact wire. For the same reason it is essential to avoid sharp changes of gradient of the contact wire during the planning stage and as these changes may also be self-introduced by seasonal changes in the conductor tensions it is sometimes desirable to arrange automatic tensioning devices (see photograph) whereby a constant mechanical tension may be maintained in the conductors throughout the complete temperature range.

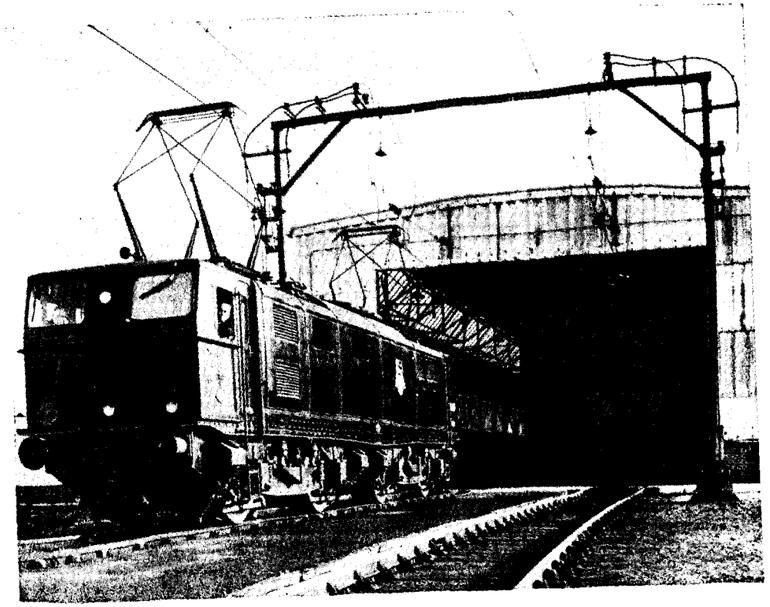
Other site work includes the provision of feeder cables and switches by which the catenary system is energised from adjacent traction substations. These substations are frequently interconnected by overhead transmission lines are power cables and may be remotely controlled from a central supervisory centre



Erecting the contact wire using specially modified flat roofed coaches.—Manchester to Sheffield & Wath Electrification.



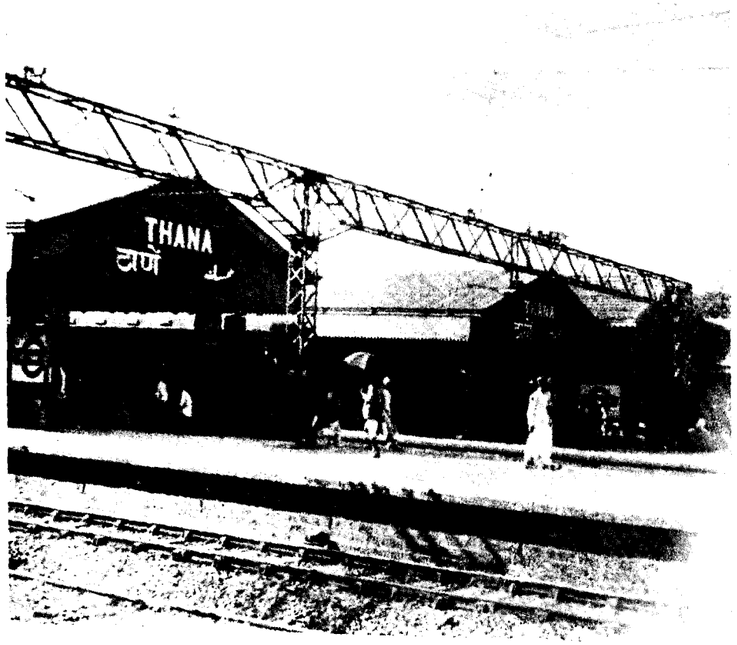
Adjusting the overhead equipment at the entrance to the New Woodhead Tunnel. Manchester to Sheffield & Wath Electrification.



Electrical sectioning point outside locomotive shed showing switches and feeder cables mounted on the structure.—Manchester to Sheffield & Wath Electrification.

for which purpose telecommunication cables are required. Special auxiliary power cables are also provided for the remote operation of signal and point motors. The joints between the ends of rails are usually electrically bonded to provide a conducting path for the return current and for safety reasons structure to rail bonds are fitted or else a continuous earthwire is used to connect all structures. These and numerous other essential features of a completed electrification scheme cannot be more than briefly described in an article of this length but it is hoped that the details mentioned will serve to enable the reader to appreciate more fully the overwhelming advantages of careful planning in design, manufacture, supply and erection which are made possible by many years of experience in this specialised field.

As recorded earlier the first complete railway electrification scheme pioneered by the BICC Group was in Australia where in addition to the conversion of 341 track miles to electric operation BICC also supplied 20,000 volts transmission mains linking the various traction substations to the Central Power House and telephone cables laid along the same route. In 1922 on behalf of South African Railways electrification of 300 track miles on the Natal Main Line between Pietermaritzburg and Glencoe was undertaken. This section was the most difficult to negotiate by



Lattice-type supporting structure at Thana, Central Railway, India. Note the bird guards over the insulators to prevent accidental earthing of the overhead equipment.

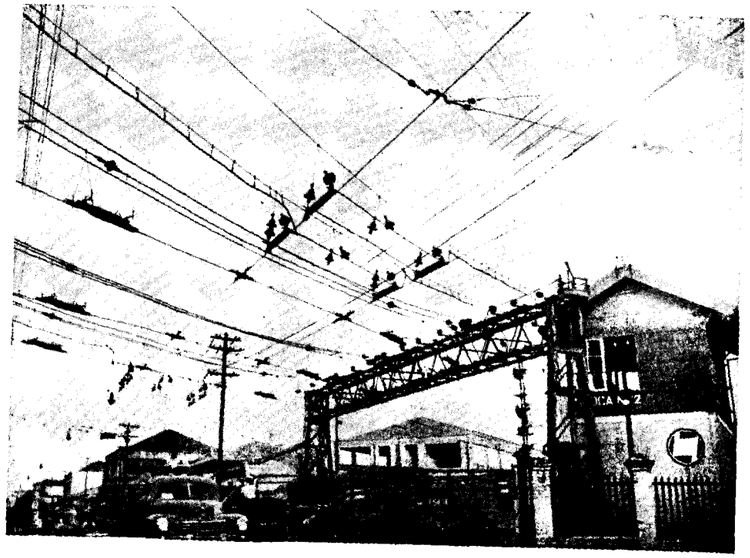
steam traffic, as the route passes through the mountainous parts of the South African Tableland. It is also the main artery between the Natal Coalfields and the coast at Durban where there is a constantly increasing demand for bunker coal. Since electrification the daily gross tonnage hauled in the Glencoe-Durban direction has increased from 13,000 tons to 34,000 tons and the average travelling time in the reverse direction for passenger traffic has improved from 14½ hours to 8 hours. On this scheme which was completed in thirtynine months some 1,000 miles of copper conductors and 7,000 tons of steel structures were used.

Electrification schemes in India commenced in 1923 with the Bombay Harbour Branch and local lines from Bombay to Thana comprising 160 track miles of equipment. This was followed by an extension from Thana to Kalyan and later extensions from Kalyan north eastwards to Igatpuri, and south eastwards to Poona with storage yards and goods sidings. Both these routes include a mountainous section and the equipments for the heavy gradients, tunnels and other special features demanded particular attention. In all 591 track miles of overhead equipment were erected together with 2.2 kV signal supply and 22 kV power supply lines. On the Kalyan to Poona section it was possible as a result of electrification to increase the gradient and remove the reversing station on the Bhore Ghat and so obtain through running. Smoke and fumes in tunnels which had been a source of great nuisance to the passengers were eliminated and considerable increases in train mileages and passenger traffic were obtained (e. g. the annual passenger traffic increased from 33 to 130 millions between 1929 and 1949).

Simultaneously the 52 track miles of the main line between Bombay and Borivli were electrified. The reasons for this electrification, which has since been extended to Vihar, was the necessity for providing a quick means of transport for the growing population ; recent figures indicate that the number of suburban passengers rose from 42 million in 1938 to nearly 135 million in 1948.

In 1934, 163 track miles of the Warsaw suburban system, Polish State Railways, were electrified. This scheme was notable in view of the wide temperature range and ice loading conditions under which the overhead equipment had to operate. For this reason the catenary and contact wires were automatically tensioned using balance weights and supported on swinging canti-lever structures.

BICC has undertaken two major schemes in Brazil where a total of 380 track miles of the Estrada de Ferro Central and the Estrada de Ferro Santos a Jundiai were electrified. The former, officially opened in 1938, served the densely populated area of Rio de Janeiro where electrification was adopted to increase the carrying capacity of the line to deal with the rapidly increasing passenger traffic. The development of hydro-electric power in Brazil combined



The overhead equipment at Mooca levelcrossing showing the arrangement designed to permit tramcars to operate across the electrified tracks. The central section containing the actual points of crossing of the overhead wires is electrically separated from both tramway and railway equipments but may be energised at 600 volts or 3000 volts according to whether the crossing is open to tramcars or trains.– E.F.S.J. Railway, Brazil.

with the scarcity of local fuel supplies and the high cost of imported fuel naturally led to the conversion from steam to electricity as the motive power in the latter case. This scheme from Jundiai to Maua runs through the richest coffee growing area in the world and serves the heavy suburban traffic around Sao Paulo. A rather unusual problem was presented by a tramway crossing at Mooca. Here a system was devised to enable inter-running of both railway and tramway services on the overhead equipment at the crossing, whereby the contact wires were energised at 3,000 volts or 600 volts according to whether the crossing was open to trains or tram cars. A photograph of this equipment is included with the illustrations. As part of both railway projects high voltage power lines and low voltage signal feeder lines were also supplied and erected on extensions to the track structures.

In Britain there are many miles of electrified railway using the third rail conductor principle. This has many disadvantages including limitation of conductor voltage, faults in bad weather and obstruction to track maintenance. Three exhaustive reports in the past twenty years have concluded that the most suitable and economical method of electrification for this country is the overhead catenary system and this form of construction is to be adopted for all major schemes in the future.

Between 1929 and 1931 BICC converted the Manchester-Altrincham suburban line to electric operation. This line, which was the first in the country to be electrified using the 1500 volt overhead system, included a 1¾ mile section carried on a viaduct with curves and a gradient of 1 in 100.

In 1938 work commenced on the electrification of the London to Shenfield and the Manchester to Sheffield and Wath Lines. Work was stopped during the war years but both routes are now operating electrically and the former scheme is being extended to Southend and Chelmsford. Reference to the great increases in passenger traffic resulting from these schemes has already been made but perhaps even more remarkable are the freight results achieved on the Manchester-Sheffield-Wath project where the haulage of heavy mineral traffic over the Pennine Mountains has been so speeded up that the running time in some cases has been more than halved. On the formidable 1 in 40 gradients of the Wath bank to electric locomotive now haul heavier loads at double the speed of the four steam locomotives previously used while locomotives on the downhill journey with empty stock return power to the line by regenerative braking. Work is now proceeding on the electrification of the main lines between Sydney and Lithgow in New South Wales, Australia. This project across the Blue Mountains, reaching a height of 3700 ft., comprises 240 track miles and the first section has recently been put into service.

We have seen how the cleanliness and speed of electric travel is appreciated by the general public and railway staff alike, while the overall saving and economy in fuel made possible are points of national importance. The Weir Report of 1931 gave the conclusion that in Britain alone the electrification of all main lines would result in a reduction in coal consumption by 72% and in the cost of locomotive maintenance by 57%. Such trends are not unique but have been the experience wherever existing lines have been electrified.

BICC, the largest single organisation in the world with facilities for the design, manufacture, supply and installation of material for the complete overhead system, is proud to have been associated with the many schemes outlined herein. Its resources include well equipped factories backed by first class research facilities and a field force of widely experienced engineers. The Group is foremost in the field of new developments including the provision for British Railways of overhead equipment for an experimental high voltage section using alternating current at the industrial frequency. In addition experimental sites have been built where the characteristics of various forms of overhead construction are continuously recorded by instruments and conductor endurance and foundation tests are carried out.

The results of these and many other similar investigations will be taken into account in BICC's designs for the future and will enable the Group to maintain and improve its reputation for high quality equipment which meets the requirements of Railway Engineers in every land.

BRITISH RAILWAYS ELECTRIFICATION

The British Transport Commission have awarded to British Insulated Callender's Cables Ltd. and British Insulated Callender's Construction Company Ltd. three contracts valued at approximately £5,000,000 for the supply and installation of overhead equipment for about 415 miles of track. The routes are:

Fenchurch Street (London) to Tilbury, Southend and

Shoeburyness — about 170 track miles;

Liverpool Street (London) to Enfield, Chingford, Hertford and Bishop's Stortford — about 105 track miles;

Crewe to Liverpool — about 140 track miles.

The equipment, suitable for operation with 25kV single-phase 50 cycles A. C., includes the foundations, steel structures, and overhead wiring. Survey work on all these schemes has already been started.

The BICC Group has been working for some time on the British Railways pilot schemes between Colchester, Clacton and Walton and on the Manchester — Crewe Line. Installation of foundations and structures started in March 1957, running-out of conductors commenced in October 1957, and the first trial trains should be using sections of equipment during 1958. Staff and plant engaged on the pilot schemes will be employed on the new work, all of which is being controlled from site offices at Crewe and Shenfield (Essex) respectively.

Current will be collected from 0.166 square inch cadmium-copper contact wire suspended from 0.101 square inch catenaries made up of 19 strands of .083 inch diameter cadmium copper.

An extensive research and testing programme has been undertaken to determine the most suitable types of insulators for supporting the catenary wire on the steel structures. On double tracks the conductors will be supported by copper-clad steel cantilevers attached to, and insulated from, galvanized steel masts at the sides of the track.

For more than two tracks a new type of portal structure has been designed to avoid obstruction to the sighting of signals, to reduce weight and to give a good appearance. It is constructed with angles as the main members and with rod bracing welded to the toes of the angles. The structures are completely galvanized after fabrication.

The three new contracts will require about 11,000 tons of steel.

New types of plant for rapid excavation of foundations, erection of masts and concreting have been developed by engineers of the BICC Group, who have over 40 years of experience of railway electrification in all parts of the World.

STANVAC TANKER BRINGS FOODGRAINS TO INDIA

Instead of carrying the usual cargo of crude oil or finished petroleum products, a Stanvac tanker berthed at the docks in Bombay loaded with urgently needed foodgrains for India.

The tanker, "STANVAC MELBOURNE", wrote a new chapter in the history of the Stanvac fleet by taking 560,000 bushels of wheat 8,000 nautical miles from Quebec to Bombay.

The cargo of wheat weighing 15,000 tons which was purchased under the Colombo Plan, constituted one of the most unusual cargoes ever carried under the Stanvac house flag.

The "STANVAC MELBOURNE" under the command of Capt. Norman Halliday picked up the cargo at the St. Lawrence river port of Three Rivers in Quebec Province, Canada.

Enroute from Houston, Texas (U.S.A.), to Three Rivers, the crew prepared her 26 tanks to receive the grain. This involved a thorough cleaning with a special detergent and hot salt water, under the direction of the charterer's expert taken aboard at Houston. The tanks were carefully swept, cleaned and dried to meet the standards of the Port Warden of Three Rivers.

Loading proceeded from grain elevators at a rate of 350 tons per hour (compared to 450/500 tons for regular grain carriers) and the tanker departed for Bombay on December 8.

Incidentally, the grain cargo carried by the "STANVAC MELBOURNE" is the largest ever shipped from Three Rivers, in any type of vessel.

The unloading of wheat in Bombay will be done with vacuator machines, including two loaded at Three Rivers. They suck the wheat from the holds on the same principle as a vacuum cleaner.

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GEN. KIRPAL VISITS ARMY OFFICERS AT PETROLEUM TRAINING COURSE

Major-General P. N. Kirpal, General Officer Commanding, Bombay Area, paid a visit to Indian Army Officers undergoing the Long Petroleum Installation Course in Bombay.

Organized by Standard-Vacuum Oil Company, the Course is being attended by six Officers from all over India.

General Kirpal visited the Stanvac Marketing Headquarters building here, the venue of the training sessions.

This is the third training Course conducted by Standard-Vacuum for Army Officers. During the present 16-week training programme, which will be completed at the end of February, Officers will be orientated to all aspects of the petroleum industry.

The extensive ground covered by the Course can be gauged by the fact that the instruction includes all phases of terminal operation, tank construction, laying of pipelines, pumping equipment, quality control, field storage, product receiving, tanker discharge, waterway distribution, and rail and road distribution.

In addition, specialists are giving lectures on basic refining, geology and drilling, petroleum engineering, blending of oils, construction of ocean-going tankers, fire fighting and even labour welfare.

The training programme set up by Stanvac includes lectures and demonstrations at the Stanvac Marketing Headquarters, the Stanvac Bombay Refinery and Oil Terminals. Arrangements have also been made for the Officers to visit many other important factories. They will see the Atomic Energy Establishment at Trombay and the new Marine Terminal at Butcher Island.

The six Officers from all over India who are attending the Course include five from the Army Service Corps and one from the Engineers. They are: Maj. D. K. N. Soni, ASC; Major K. A. Callender, ASC; Capt. V. P. Singhal, ASC; Capt. S. John, ASC; Capt. John Koshy, ASC; and Capt. R. S. Chaudhri, Engineers.

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A. E. I. in India's Development Projects

By H. C. Hardy, M.I.A.E.E., A.M.I.E.E.

AMONG the basic requirements of economic development, the generation and distribution of electrical power has benefited from the contribution made by the A. E. I. organisation, backed by the considerable technical resources of the constituent companies.

From the beginning of development in India of high voltage technique, A. E. I. have studied the suitability of the plant supplied by them for the onerous climatic conditions to be met in India and in many instances, details of design incorporated in the electrical apparatus have been influenced by the Indian operating requirements.

In addition to supplying equipment, consulting services have been rendered in the case of many projects, particularly in the early stages of development. Such services comprise electrical system studies, load surveys and design of complete electrical projects. The aggregate capacities of the more important types of equipment so far supplied to, or on order from the different electricity undertakings illustrate the part played by this Company in furthering electrical development in India.

Waterwheel generators of an aggregate capacity exceeding .8 million KW.

Thermal power plants of about .68 million KW (both State and private owned).

Transformers of over 1 million kVA.

About 500 outdoor oil circuit breakers for voltages 33-kV and above.

The contribution of Messrs. Associated Electrical Industries Manufacturing Co. Private Ltd., is also significant. Many transformers and about 2500 outdoor type gang operated isolating switches for voltages in the range 3.3 kV to 132 kV have been supplied by Associated Electrical Industries Manufacturing Co. for various electrification projects, also large quantities of motors and transformers for industrial use.

In point of fact, whether the gigantic Damodar Valley Project, Bhakra-Nangal in the East Punjab, Hirakud in Orissa, Khaperkheda Thermal Scheme in Madhya Pradesh, Machkund in Andhra, or the modest Duduma Transmission Scheme in Orissa, North Calcutta Rural Electrification Scheme in West Bengal, to mention only a few, there is hardly any electrical scheme included in the first Plan in which this Company did not participate, in one way or other. The following is a very brief account of the association of this Company with some of the many power projects which were included in the first plan.

Of the several hydro-electric projects in which this Company participated, the Hirakud Project in Orissa may be particularly mentioned. Apart from the supply of complete indoor and outdoor switchgear for the power station, comprising British Thomson-Houston power transformers, ranging from 2 to 42 MVA, voltage ratios 132/11-kV, 132/66-kV, 66/11-kV, with an aggregate capacity of 167,000 kVA, large numbers of Metropolitan-Vickers 132 kV and 66 kV oil circuit breakers and A. E. I. M. gang operated, outdoor type, isolating switches, the outdoor switching station as well as the supporting structures were designed by this Company. Erection, testing and commissioning of the plant supplied, under expert supervision, were also undertaken by the Company.

In the field of thermal power, of the many schemes which this Company executed, the first stage of the Khaperkheda Thermal Scheme and the Grid Substations in the state of Madhya Pradesh, deserve mentioning. For the Khaperkheda Power Station, three 10,000 KW steam turbo-alternator sets of M/s. Metropolitan-Vickers manufacture, complete with all auxiliaries and power station switchgear, were supplied by this Company. For the Grid Substations, which were completely engineered by this Company, the equipments supplied include Metropolitan-Vickers power transformers ranging from 500 to 12,500 kVA, voltage ratios 66-kV/11-kV, total kVA 85,000, outdoor and indoor switchgear manufactured by M/s. Ferguson Pailin Ltd.; complete erection, testing and commissioning also being carried out.

There is yet another field, namely, electric traction, with which this Company has been actively engaged since its inception in India. In recognition of the Company's specialised experience in this regard, an order was received for equipments pertaining to the Railway Electrification Project of the Howrah-Burdwan main line and Tarakeshwar branch line. The order comprises of thirty-six complete sets of 3000 volt D. C. traction equipment for 3-car trains, each having one 840 h. p. motor coach and two trailer coaches, six 3000 volt rectifier substations (total capacity 32,000 KW) comprising twelve pumpless, air cooled, steel tank rectifiers, fiftyone D. C. high speed circuit breakers and auxiliary plant, four 3000 volt track sectioning cabins, having a total of twenty-two D. C. high speed circuit breakers and associated equipment.

The equipments are designed to permit a maximum speed of 65 m.p.h. on level track with a fully loaded train and a starting acceleration of 1.2 m. p. h. per second up to 25 m. p. h. Worthy of particular note is the fact that approximately 15 percent of the traction equipment is being manufactured in India. This manufacture is being carried out by Associated Electrical Industries Manufacturing Co. to the designs of Metropolitan-Vickers. This is the first occasion on which electrical traction equipment has been manufactured in India, and represents a substantial and welcome saving in foreign exchange.

The fixed equipment, i. e. rectifiers, transformers, etc. have been manufactured by the British Thomson-Houston Co. and here again the local manufacture of some of the high speed D. C. circuit breaker equipments has been carried out in India.

Among the several electrical projects under the Second Plan, with which the Company is associated, one example is the Bhakra Power Station in East Punjab, for which the Company will shortly be delivering five 100,000 kVA (maximum rating 115,000) water wheel generators, the biggest capacity so far installed in India.

Calcutta Electrification Project

(By Our Engineering Correspondent)

ON 14th December 1957, the Eastern Railway commenced their operation on the 3000 Volt D. C. Traction with the running of the first electric train between Howrah and Sherophuli. It could be expected that this service will be extended by about the middle of the coming year till Burdwan through the main line and till Tarakeshwar from Sherophuli. Undoubtedly it is a very promising start with the inauguration of the first electric train in this part of our country, for the scheme for electrifying the lines till Moghalsarai in the north, Kharagpur in the south and also the suburban lines of the Sealdah division has already been finalised. It may well be taken that this scheme will take shape very shortly and the routes electrified in the near future.

Messrs. S. A. E. (India)'s contribution to the first stage electrification scheme has been quite substantial. For this scheme about 180 different types of galvanized track structures had to be designed involving as many as 3038 Nos. of structures, of a total weight of about 7000 tons. They have supplied all these structures in addition to about 800 tons of copper catenary wire, 700 tons of copper contact wire and various fittings and attachments all to electrify about 300 track miles of lines.

The technical aspect of this scheme of track electrification is a matter that has taken quite some time for designing the most advantageous and economical solution. The design and fabrication of materials have been done jointly by S. A. E. (India) and their Italian suppliers who have a contingent of highly qualified and experienced experts and Engineers backed with an experience of over 30 years in this line. The structures are all galvanized, of partly high tensile and partly of normal tested steel. The fabrication has been done in the works of Messrs. Societa Anonima Elettrificazione, S. p. A., Milan, where every month about 10,000 tons of fabricated steel is being produced and much of it exported to many countries of the World including Australia, Canada, the U. S. A., South America, etc. The Overhead Equipment fittings have been supplied partly by M/s. Societa Anonima Elettrificazione, S.p.A., Milan and partly by M/s. Rebosio of Milan. The copper contact wire has been supplied by M/s. Metallurgica Italiana, Firenze, Italy. The Insulators have been supplied by M/s. Industria Ceramica Italiana of Laveno, Italy. The copper catenary has been supplied locally by Messrs. NICCO of Calcutta.

The complete erection of these structures and overhead equipment is being done by specialised staff equipped, organized and trained both in India and Italy whose work has the appreciation and the kindest co-operation of the Departmental Engineers. It would be interesting here to note that they have been able to achieve within the last 2 months a record progress setting up nearly 70 miles of lines inspite of the difficulties faced on account of the monsoon and the heavy traffic running on one of the most congested Railway in the World, where work can be carried out only at night for a very limited number of hours.

NEW DIESEL-ELECTRIC LOCO FOR BRITISH RAILWAYS

The first mixed-traffic Diesel-electric locomotive for British Railways' £1,200 million development scheme — a scheme which is designed to make the system the most up-to-date in the world — was handed over on October 31, five weeks ahead of schedule. This 1,250 hp. locomotive is designed for speeds up to 75 mph. though it is capable of 90 mph.

The remaining 19 locomotives in this batch, now on the assembly line, will roll off at the rate of one every three weeks. They will go into service next year in the Eastern Region of British Railways, hauling both passenger and freight trains.

Under British Railways' development scheme there will be a huge increase in the number of services operated by Diesels; by the end of 1957 alone it is expected that over 1,450 vehicles for use in multiple-unit Diesel trains will be in service. At least 1,000 more will be added by the end of 1958.

HISTORY OF MYSORE LAMPS

By A Correspondent

THE History of ELECTRIC LAMPS dates back to the time of Alwa Edwin Edison (1879). As a result of his repeated Researches he was able to produce the Incandescent Lamps making use of Carbon Filaments achieving a life of about 500 hours. Ever since that time, the Industry has developed with new improvised Techniques making larger production with increased light out-put, all such lamps giving 1000 hours of burning life.

By 1911 Lamps were produced with Tantalum Filament and later by 1912 drawn Tungsten Wire came into use as a filamentary body. It was the endeavour of the Lamp Engineers to search for a material of a very high melting point so that they could raise the operating temperatures to the filaments. The success was achieved by 1914 and the modern gas-filled lamps came into vogue. The straight wire that was originally used was coiled into a helix and subsequently to a double helix which is commonly called as Coiled Coil. Further Researches are taking place in the advanced countries to make Coiled Coiled Coil. This is yet to come to production in our country. Thus, we see the History of the Electric Lamps is the History of the evolution of the technique of vacuum and starting from Carbon Filaments they have reached Tungsten Wire Filaments passing through the stages of Osnium and Tantalum.

The principle of Electric Lamp is fairly simple. With the electric current passing through a metallic wire it results in heating and the matter is raised to incandescence. It is this light out-put which a Lamp Engineer attempts to conserve to simply increasing the efficiency of the lamps, other qualities being equal. It is therefore apparent that the high melting point of Tungsten (3400 Deg. C) has a very important advantage in the economic production of light. Though Tungsten is ideally suited as a filamentary body, the technique of drawing the material into a thin wire involves the entire

engineering skill at command. The Wolfram Ore is crushed and brought to a powder form. This powder is pressed into a small bricket and these brickets are pressed into bars (10×10 mm. Square) and from 8×24" in length. The strength of the bar is increased by heating it in hydrogen. These bars are further subjected to a treatment known as "Sintering". The sintered bars are further subjected to a process "Swaging" where very rapidly rotating hammers around the axis of the tungsten rod convert tungsten into thick wires. These thick wires are passed through Diamond Dies through special lubrications to various required sizes and these are called drawn tungsten wire. Tungsten while it is yet in powder form it is customary to add certain Oxides so that the growth of the crystals can be controlled to maintain the luminosity. It is at this stage various grades of wire are developed meant for various types of lamps depending upon the efficiency of the lamp required.

Simultaneously the tungsten filaments a special wire was devised so that it could be pinched into a glass making it vacuum tight. Such an economical alloy is "Dument". This revolutionise in working out the cost of the Lamp production.

It was found that if the filament inside the lamp was subjected to an increased pressure it could be operated to a higher temperature for the same wattage and in consequence the Gas-filled lamps were developed. The straight wire that was used in the vacuum lamp had to be re-designed into a single coil or coiled coil as the case may be to minimise the loss of heat by way of convection when it was surrounded by gas pressure inside the lamp. Needless to mention that the gas must be inert in view of the high temperature of the filament inside the lamp. Hence, normally Argon and Nitrogen are the chief Gases required in this Industry. Sometimes, "Helium" and "Xenon" Gases are also used to get higher efficiency lamps in special cases. Each of these inert gases in various proportions at various pressures inside the lamp exhibit special characteristics in luminosity and every Factory has its own special proportions. Inspite of such improvised techniques in Lamp Engineering, it may appear strange that in a 100 W. Incandescent Lamp, the Lamp Engineer has utilised about 12% of the input energy while 88% is converted into heat and removed from the lamp by radiation, by evacuation and by conduction.

In view of the Tungsten being at a high temperature within the lamp and also its sensitiveness for reaction of the moisture it is absolutely necessary that the inside of the lamp must be moisture dry. The reaction is very sensitive and the presence of moisture will result in rapid evaporation of the lamp and consequently very early blackening. It is for this reason in the Lamp World, moisture is said to be the enemy of the Electric Lamp during production. It is said that one drop of moisture may spoil 50,000 lamps if the system is not free from it.

PRODUCTION: The first stage during manufacture is Stem Making. The two Electrodes, the evacuating glass tube, the flare and the cane are alligned properly and they pass through a process wherein a vacuum is made at the Dument. At this stage a small bore is made at the pinch to facilitate evacuation at the Exhaust. These stems are passed on to the Anchoring Machines where a small button is made at the tip of the cane and the Molybdenum Wire is inserted. It is very interesting that small lengths are cut and at the end of each the pit-tail hooks are made at a fairly fast rate at the automatic machines. These Machines are designed to accommodate from 1 to 24 supports, depending upon the type of the lamp. These anchored stems pass on to the Mounting Mill where the filaments are automatically picked up, clamped and mounted. Generally such mounting mill is very costly and hence it is the normal practice to use leg-operated mechanical Clampers engaging more Operators. This is typically suited for our Indian conditions, where unemployment is a problem in our country. Moreover, even for lesser labour we are fortunate to get more intelligent and skilled labour in our Country. For this delicate process Girls are specially suited.

The mounted stem passes on to the Sealing Machine wherein in Bulbs are sealed to the Flare and the extra cullet is automatically removed and the sealed bulb passes on to the Vacuum Pumps. At this stage of Exhausting, the Lamp passes through a heating temperature and simultaneously suction is going on. In this process all the gases from the glass walls are released and pumped out. After a sufficient high degree of vacuum is attained, the inert gases are filled in and finally the exhaust tube is sealed off automatically. Now the lamp is ready to receive the Brass Cap. This is the finishing stage where the Brass Cap with a thin ribbon of the bakelite cement at the neck will be fitted and subjected to baking.

This will result in glass to melt still and finally they are soldered at the eye-let and outside. It is the commercial practice to give a coating of Red Phosphorous on the filament itself before it is sealed.

After finishing of the lamp, the lamp is lighted up in very low voltages, so that the phosphorous may get pulcerated into small highly reactive particles and as a result electrically charged. In such a condition, the highly reactive phosphorous will absorb the extraneous matter within the lamp. This process being a surface absorption is called as "Absorption". This pressure comes from high vacuum and the process is called "Flash Ageing".

The Day's production undergo systematic check-up at regular intervals at the Photometry. These lamps at present are being designed for the British Standard Specification, the normal average life being 1000 hours. It is important that every process during manufacture must be rigorously controlled and inspected. Periodically sub-standards are got from the authorised Testing Laboratories so that the production is standardised for its uniformity and high quality.

Though there are more than 10 Major Factories in India and a few small Factories manufacturing the Electric Lamps, in South India the Mysore Lamp Works is the only one of its kind. It has a modern Automatic Plant for the production of General Service Lamps and also they have added a few more Machines to manufacture Miniature Lamps like Bicycle, Torch and Automobile Lamps. At present they are manufacturing Lamps from 15 Watts to 1500 Watts which is the maximum in the B. S. S. as far as General Service Lamps are concerned. A Personnel in the Works has undergone special training under American Experts in production technique.

The Factory was started in 1937 with a production capacity of 2000 lamps per day and now it has an installed capacity of 4.8 million per annum (16,000 lamps per day). It is successfully catering to the needs of the Electrical Departments of Mysore, Hyderabad, Bombay and Madras and also some of the Electrical Corporations in the South. The Lamps are very popular for its quality.

The Sales Organisation has its Distributors throughout India including Kashmir and Nepal. The Mysore Lamps are on the approved rate contract for the Railways and General Service. The Country for the first time is meeting its demand of High Wattage Lamps like 750 W., 1000 W. and 1500 W. Due to their quality, these high wattage lamps enjoy full confidence of the D. G. S. & D. in matters of Rate Contract. It has also met the full demand of lamps like Headlights, Train Lighting Lamps, Coloured Lamps, Cab lights, etc. In addition to these types, Series Type of Street Lighting is a speciality for Mysore Government and Hyderabad Electricity Departments. For a visitor who has seen this Factory in 1937 and who visits in 1957 he will be impressed with the rapid progress made at the Works in increasing the production and also the methods of production control. Simultaneously with the progress of lamp making it is a happy sign there is perfect co-operation between the Management and the Labour in the Day to Day administration. Certain amenities like Canteen, Club Room with facilities for Outdoor and Indoor Games are worth noticing and the activities after the day's labour are thrilling, at the Club. The Sports Club has won many Trophies and Medals in Basket Ball and Ping-Pong.

The relations between labour and the Works are highly democratic and as a result the Management is enjoying full confidence of the labour. In short it is a model Factory in the South with regard to production maintenance and labours relations with all æsthetic environment at the surrounds. In India, the Annual requirement was 18 million and in 1952 it was 20 million and just now it is 30 millions. By 1961 our Country may have an annual demand of 35 millions and with a little exaggeration it may even be 40 million per annum. Much depends on the development of Hydro-Electric Schemes for generation of electricity and its transmission to the consuming Centres which ultimately results in rural Electrification and also providing adequate number of houses for raising the standard of living in general. With such a programme ahead, there is a bright future for Electric Lamp Industry. Though at present it is unfortunate we have to import most of the raw materials from abroad, serious effort is being made on a planned basis to start making most of the raw materials in our Country. Till then it is difficult to say that this Lamp Industry is self-sufficient in India.

Manufacture of Steel Castings for Locomotives, Carriages and Wagons

*By * N. C. Chakrabarti, A.M.I.P.E., M.I.B.F., M.M.G.I., M.A.E.*

INDIA with all her past glory and tradition was not lacking in the technique of casting metal to shape. At one time she had the privilege of making the finest steels which were widely exported to other parts of the world. The remnants of iron and Steel castings discovered by archæological exploration, such as cannons provide vivid examples of founding technique of the highest calibre. The metallurgical composition of such castings was of uniform consistency and showed excellent workmanship in moulding technique. The famous "Iron Pillar" at Delhi is an outstanding example of the existence of such technique in India. Writing in the Preface of his Book "Stainless and heat resisting Steel", Dr. Edwin Gragory Prof. of Metallurgy, Sheffield University, made the following remarks "Only at one known point of the world's surface was a notable victory obtained over the inevitable red destroyer at Delhi, where for centuries an iron pillar, 'one of the wonders of the world' stood and still stands, unassailed by time."

With the revival of India's iron and steel industry, at the beginning of 20th century, the steel foundry industry, also expanded rapidly, mainly on account of the expansion of Indian Railways and their demands for castings required for the maintenance of Locomotives, carriages, wagons etc. Since World War I, about 6 or 7 Commercial steel foundries have been established in the country with potential capacity of about 1,000 tons per month or 12,000 tons per annum. This is very insignificant compared to what is produced in the U. S. A. and the U. K.

From the various technical journals it is gathered that Britain produces nearly 2,38,000 Tons of Steel Castings per year from about 102 steel foundries and U. S. A. 8,00,000 Tons from 300 foundries. Even South Africa's production of Steel Castings has been 45,500 Tons per annum from 17 steel foundries.

India with her extensive Railway communication system covering nearly 44,602 miles of track including sidings and with 2,00,645 wagons, 12,813 carriages and 7,732 Locomotives on the track, has in actual service about 3,30,000 Tons of steel castings. If the renewal of these castings, be assessed at 2% per year the total requirements of steel castings, for the purpose of maintenance alone comes to about 6,600 Tons. On the top of this, there are fresh building programmes which comes to about 6000 wagons 400 carriages, and 220 Locomotives. The demand on this side alone can be assumed to be between 10/11 Thousand Tons per annum. Steel foundry Industry therefore, constitutes a key Industry and is vitally essential if India is to become self-supporting in the manufacture of Railway Rolling Stock etc.

Steel Foundry technique is extremely intricate and requires many years of practical experience, although a good deal of information is available in the metallurgical and Engineering Text Books about melting technique, Foundry Pattern making, moulding, foundry sand and so on. The subject is so vast that it is impossible to do full justice on all the aspects in full detail in a short paper like this. I will therefore touch very briefly on the fundamental principles of Foundry Technique required for the manufacture of railway castings. In India, the manufacture of steel castings for Railways is generally governed by I. R. S. Specification M 2 which states. "The Castings shall be manufactured from steel made by the open hearth, Electric or Acid Bessemer process, and shall not show on analysis more than 0.06 per cent of sulphur or of phosphorous. Castings manufactured from steel made by the Basic Bessemer process will not be accepted. The castings shall be required to pass the tests, specified according to classification and grade. The class of castings and grade required shall be specified on the drawing or in the order." It would be foolish to assume that this is the be all and end all of all the technique required either for the manufacture or Inspection of steel castings. The mysterious trade secrets and craftmenship of a few artisans on different foundry techniques are now generally breaking down and the subject is rapidly becoming an exact science.

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MELTING PRACTICE

Liquid steel is made either by oxidising and refining of pig iron or by remelting and refining of scrap steel. The furnaces used in India for this purpose are Acid or Basic open hearth furnaces, basic electric furnaces and tropenas furnace. For acid open hearth practice, selected raw materials (particularly selected pig iron) i. e. Hematite Iron is used as Dephosphorisation and desulphurisation cannot be effected by this process. For basic open hearth practice 50% basic pig iron with 50% scrap steel are used as raw materials. In the case of the basic electric furnace process which is very widely used in India scrap iron, the cheapest raw material is used for the purpose. Phos. and sulphur content of the steel must be low as red shortness or cold shortness may develop during subsequent heat treatment. The molten metal should be properly killed by addition of ferro-alloys, such as ferro-Manganese, Ferro-Sillicon and Al, etc., as otherwise the castings will be unsound due to formation of blow holes. By whatever method the liquid steel may be produced it is poured into some form of moulds for solidification. If these cast objects are used without any further mechanical working except cleaning and machining such parts are called "Steel Castings".

PATTERN MAKING

The ultimate form of the steel casting depends entirely on the particular size and shape required by the designer. To produce sound casting, the necessity for good and accurate pattern making cannot be over emphasized. The job of making of proper patterns, core-boxes for core making, methods of gating and feeding are very complicated. Standardization of these processes requires long experience with high standard of workmanship. Patterns may be made of metals such as brass, cast iron, Aluminium etc., Timber, Plaster and Plastic-Timber being most commonly used.

While selecting the material for pattern making one must consider the design of casting, number of castings to be made, method of moulding to be employed and the question of overall economy. Shrinkage allowances, finishing allowances and gating and feeding arrangements as provided by the processing drawing, are the vital points to be considered by the pattern makers. Each and every casting has its own peculiar running and feeding problems which are thoroughly studied and standardised. During recent years, this has developed into a highly technical subject and after many years of research and practical tests the following different types of feeding and gating systems developed. The attached table shows the different methods of gating and feeding.

TABLE I (B)

Gating & feeding method	Yield%	Type of castings
1. Gravity	40 to 60	Any casting
2. Whirl gate	55 to 65	Casting up to 1 Ton.
3. Atmospheric	60 to 75	Properly designed castings up to 10 Ton can be made by this method.
4. Centrifugal	65 to 85	Circular or symmetrically designed castings may be made by this Process.

FOUNDRY SAND

Foundry sand mixing is another very important factor. Green and dry strength green and dry permeability, refractoriness, grain size and shape, angularity, plasticity and the chemical composition are the properties of foundry sand which should be given utmost consideration. For use in the foundry different sands along with binding materials such as bentonite powder, fulbond or other proprietory bond, molasses, cement, Linseed oil, destrin, resin etc., along with some water or moisture are properly milled to develop the necessary properties and are used for moulding, core making etc.

ANALYSIS OF SAND

	SiO_2	Fe_2O_3, Al_2O_3
Taljuri	90%	8%
Jubbulpore	92%	5%
Yellow Sand	70%	30%

SIEVE SIZE

	8	10	16	22	30	44	60	100
Taljuri			0.6%	10%	28%	37%	13%	6%
Jubbulpore	7%	2.6%	17%	17%	19%	13%	14%	8%

MOULDING TECHNIQUE

Having thus obtained the proper pattern for the desired casting preparations of moulds in sand according to practice are to be considered. The methods of moulding to be employed in case of steel castings are (1) The old orthodox method of dry sand moulding (2) Green sand moulding and (3) Cement moulding. (not practiced yet in India).

In case of Dry sand practice, the mould are baked in drying ovens before core setting and closing.

In case of green sand practice the composition of the moulding sand is such that drying of the moulds is not required. Generally medium railway castings and other medium jobs can be made by green sand method. It is to be noted that for the first time in India, M/S. Bhartia Electric Steel Co., Ltd. have introduced green sand practice with very satisfactory results since 1948. Considerable economics have been effected by the introduction of this method.

The moulds may be made on various types of pneumatic moulding machines such as Jolt squeeze and Turnover type machines, sand slingers, Pneumatic rammers etc. Along with these moulding machines, hand moulding still survives. The standard railway castings are generally carried out in standard Jolt-squeeze turnover type pneumatic machines.

After these moulds are made they are rectified, cores are properly set, closed, runners and riser heads are set in position and then cast into form by liquid steel of desired specification and composition.

FETTLING, ANNEALING, MACHINING ETC.

After these castings are made, the risers and runners etc. are cut off by Oxy-Acetylene gas flame and the castings are properly cleaned from adhering sand by shot blashing, sand blasting, grinding, filing, chisseling etc., rectified by welding if required and sent for proper annealing in annealing furnaces for removing stresses and strains set up during solidification and also for the development of required 'structure' and physical properties. Then these castings are sent to machine shop for proper machining.

INSPECTION

Inspection actually starts from the blue print stage followed by careful checking of patterns, core-boxes, moulds, core setting, checking before and after fettling and before and after machining. While simultaneously carrying out Inspection of important basic raw materials such as scrap steel, Ferro alloys, Chemicals, various types of moulding sand, coal, Lime stone Dolomite etc. along with various machine tools, such as grinding wheels, cutting tools etc. In all Foundries Inspection is such an important factor that it must be carried out vigorously so that castings manufactured from such raw materials satisfy the chemical and physical tests as provided in the specification.

If all the factors such as proper layout of equipments proper methoding, standardisation of patterns and core boxes, coupled with mechanised supply of required sand, supply of molten metal of required specification and temp., skillful work by the workmen at every stage, can be synchronised, founding becomes a good sport and art when success can be very easily obtained and India can be self-sufficient so far as the supply of steel castings required for our entire Railway system is concerned.

INDO-NORWEGIAN TRADE

The validity of the trade agreement between India and Norway, has been extended up to the end of December next. Under the agreement India will continue to export to Norway, inter alia, mica, iron and manganese ores, and light engineering goods. Among the commodities available for export from Norway to India are aluminium manufactures including aluminium boats, galvanised and black steel pipes, testing machines, welding equipment, machine tools and miscellaneous machinery.

A.E.I. Equipment for first 3000 Volt D.C. Railway Electrification in India

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THE electrification of the Howrah-Burdwan Main Line of the Eastern Railway has the distinction of being the first 3000 volt D.C. Electrification on the Indian Railways. Associated Electrical Industries (India) Private Ltd. are proud of their contribution to this important suburban electrification, which is calculated to bring much-needed facilities to Calcutta's travelling public after a century of steam locomotion. Their role in this scheme includes the supply and erection of substation and track cabin equipment, electric traction equipment for the multiple unit stock and electric signalling equipment. All the equipments incorporate the accumulated experience, aggregating over a century, of the A. E. I. Group of Companies in the design and manufacture of all classes of electrical plant for use all over the world.

The 66-mile Howrah-Burdwan Main Line is equipped with 6 rectifier substations and 3 track cabins, the entire equipment for which, with the exception of the outdoor 33000 volt A.C. Switchgear, has been supplied by A. E. I. This large installation uses pumpless steel tank aircooled rectifiers which have now become well-established for traction service.

The installed capacities and other basic details of these stations are as follows :—

Station	*Installed Capacity*	*No. of Outgoing Feeders*
Belur Substation	3–2500 KW units	10
Sheoraphuli ,,	3–2500 KW units	7
Bandel ,,	2–3000 KW units	6
Pundooah ,,	1–3000 KW unit	4
Memari ,,	1–3000 KW unit	4
Gangpur ,,	2–2500 KW units	8
Howrah Track Cabin	—	11
Konnagar ,, ,,	—	6
Burdwan ,, ,,	—	4

The Substations receive power from the Damodar Valley Corporation system, over the Eastern Railway's transmission lines, at 33000 volts, 3 phase, 50 cycles A. C. It is then transformed and rectified to 3000 volt D. C. by the transformers and rectifiers in the substations. The outgoing D.C. supply to the overhead equipment on the tracks is controlled by 3000 volt D.C. high speed circuit breakers. At the track cabins, similar high speed circuit breakers are provided to sectionalise and parallel the overhead equipments of the various tracks.

The rectifier transformer is of the outdoor, oil-immersed naturally-cooled type and weighs approximately 34 tons. The 33000 volt primary is connected in star, while the 3000 volt secondary is a 12-phase quadruple zig-zag winding. The transformer tank also houses a tertiary winding to provide a 400-volt 3-phase A.C. supply for the rectifier auxiliaries, a no-load voltage rise suppression unit and special current transformers for protection of the rectifier against back-fire.

Each rectifier unit consists of two pumpless, steel tank, air-cooled, six-anode mercury arc rectifiers. The tanks are mounted on withdrawable trucks on wheels, and are housed in steel cubicles. Underneath each tank, and forming part of the truck, is mounted a motor-driven fan to cool the tank. The rectifier cubicle also houses the ignition and excitation unit, grid control apparatus and other auxiliaries for the rectifier. The complete rectifier unit occupies a floor space of only 8 ft. × 5 ft. 6 ins., which has been possible due to the use of a most compact design of rectifier tank so far developed for Railway service.

The rectifier tanks are provided with grids, which are used for arc suppression in the event of a back-fire. Voltage control on the rectifiers is by means of off-load tap-changing switches on the rectifier transformers.

Adjacent to the rectifier cubicles, and forming a continuous panel with them, are the two cubicles which house the control and protective gear for the rectifier and its associated oil circuit breaker. In these cubicles are contained various instruments to measure the voltage, current and power being supplied by the rectifier, switches to start and stop the rectifier, indicating lamps and protective relays.

All the 3000 volt D.C. circuit breakers are of the high speed type, working on the "rate of rise of current" principle, which enables discrimination between overloads and short-circuits. The breakers are mounted on trucks on wheels, which are housed in concrete cells. Shutter mechanisms, with padlocking arrangements, are provided which ensure perfect safety for personnel working inside the cells with the breakers racked out. The rectifier breakers are rated at 1600 amps. and are set to trip on a reverse current of 500 amps. The feeder breakers are rated at 1000 amps. and can be set to trip on forward currents in the range of 1500 to 2500 amps.

The operation of the entire equipment is automatic, and can be controlled either from the control board in the substation or from the supervisory remote control board in Howrah. Operation of one switch will in succession, close the 33000 volt A.C. oil circuit breaker, start the rectifier fans, put on the ignition and excitation circuits in the rectifiers and close the 3000 volt D.C. rectifier high speed circuit breaker. Protective devices ensure that the set is shut down and re-started (for a pre-determined number of time) in the event of any type of fault or incomplete sequence.

A noteworthy feature in the equipment is the comprehensive scheme of interlocking provided. Before access to the rectifier equipment could be obtained, a series of operations in a definite sequence have to be done; this is aimed at isolating the A.C. and D.C. sides of the equipment and earthing all live parts; conversely, these operations in the reverse sequence must be performed before the equipment could be energised.

Other items of equipment inside the substation are an L.T. A.C. / D.C. board, which provides power at 400 volt 3-phase A.C., 110 volt single phase A.C. and 110 volt D.C. for the control circuits and auxiliary services, a negative recording cubicle to record the current drawn from the substation and to provide protection against an excessive rise in voltage of the rails above earth, a lead-acid station battery and a charging equipment.

The entire equipment, with the exception of the batteries and charging equipments which have been supplied by two well-known battery makers, has been designed and manufactured by the British Thomson-Houston Co. Ltd. of England, a member of the A.E.I. Group of companies. A portion of the 3000 volt D.C. switchgear has also been manufactured in India by Associated Electrical Industries Manufacturing Co. Ltd., to BTH designs.

Associated Electrical Industries (India) Private Ltd. have also on order the complete traction equipments for 36 motor coaches and 68 trailer coaches to operate on the Howrah-Burdwan Main Line. These equipments, which will be installed on coaches built by Jessop & Co. Ltd., are being designed and manufactured by Metropolitan-Vickers Electrical Co. Ltd. of England, another member of the A.E.I. Group of Companies. The design of the equipment will be generally similar to the 450 sets of 3000 volt D.C. motor coach equipments successfully manufactured by Metropolitan-Vickers for railways in South Africa, Brazil and Poland.

Each 3-car train will comprise one motor coach and two driving trailer coaches, the motor coach being in the middle. The train will be powered by 4-210 H.P. traction motors, mounted in the motor coach. The motors will be of self-ventilated, axle-hung, nose-suspended type, driving the wheels through solid gear-wheels. Current at 3000 volts D.C. will be collected from the overhead line by either of two light-weight pantographs and fed to the motors through the standard form of resistance control. The motors will be connected permanently in series—pairs, and the control gear will be of the modern electro-pneumatic unit contactor type. A motor-generator set, mounted on the underframe and driven off the 3000 volt D.C. supply, will provide low tension power at 110 volt D.C. for train lighting and ventilation, operation of the control circuits and of the brakes.

The equipments are designed to permit a maximum speed of 65 m.p.h. on level track with a fully loaded train, and a starting acceleration of 1.2 m.p.h. per second up to 25 m.p.h. Upto three 3-car trains can be coupled together and operated by one driver in the leading cab, which facility will be required during peak hours. Provision is also made to cut out half the motor power and run the train at reduced speed, in the event of a fault in any one motor.

Worthy of particular note is the fact that approximately 15% of the traction equipment is being manufactured in India. The manufacture is being carried out by Associated Electrical Industries Manufacturing Co. Ltd., to the designs of Metropolitan-Vickers. This is the first time when manufacture of traction equipment is being carried out in India, and represents a substantial and welcome saving in foreign exchange.

The electrification of the Howrah-Burdwan Main Line also involves provision of automatic signalling between Howrah and Serampur, and manually controlled colour-light signalling beyond. Well over 350 colour-light signals of the multiunit type, 50 electric point machines, and considerable numbers of junction direction indicators, A. C. and D. C. relays, and other signalling equipment have been supplied by Associated Electrical Industries (India) Private Ltd. These equipments have been designed and manufactured by Metropolitan-Vickers-GRS. Ltd. of England, also a member of the A. E. I. Group of Companies.

PRESSURE ON THE RAILWAYS

Shri M. N. Chakravarti, General Manager of Central Railway, speaking on the subject of "Pressure on the Indian Railways", described the difficult position in which they were placed with an almost crippling shortage of rolling stock, machinery and plan on the one hand and a sharply rising volume of traffic to be carried on the other. Besides, heavy arrears of renewals and replacements of overaged assets awaited clearance.

Discussing the problem of overcrowding in trains he stated that the travelling habits of our people had changed and they had become more travel minded. Against $1\frac{3}{4}$ journeys per year performed, on the average, per citizen in India in 1940, the figure was now 4. To this must be added the traffic arising from the growth of population over the period of almost two decades. The cumulative result was that against 499 million passengers carried in 1938-39 in the whole of undivided India, we carried 1360 million in our country in 1956-57. To carry this traffic which had increased almost three-fold, the railways of undivided India had 15,500 passenger coaches which fell to 11,000 just after partition and was now just back to what it was for the whole of India in 1938-39. The usage of coaches was 25 per cent better now as coaches were doing longer runs (170 miles per day against 137 pre-war, on the average) with quicker turn rounds. The overcrowding that we would otherwise have had, has been relieved to this extent.

Referring to goods traffic, Shri Chakravarti stated that it grew from 69.8 million tons in 1947-48 to some 126 million tons in 1956-57 i.e., by 81 per cent. Half of this increase had occurred in the last three years of this decade, he said, showing how the rise was not just proportional—the increase was becoming steeper and steeper and by 1960-61 it was expected to rise to 180 million tons, i.e., by 54 million tons in four years against 57 millions in the previous decade. Against this increase of 81 per cent in goods traffic carried, Shri Chakravarti stated, wagons had increased by 20.6% and locomotives by 21.4%.

The higher increase in traffic carried had been the result of more efficient use of rolling stock. Universally adopted indices of efficiency such as the net ton miles of traffic moved per wagon day had shown increases of 60% in the past decade. Locomotives which were averaging 72 miles per day per engine on line in 1947-48 were now averaging 85 miles. After their assessment of the performance of the Indian Railways, the World Bank remarked on the fine job done with the assets at the disposal of the Administration.

Putting right certain misconceptions that existed in some quarters, Shri Chakravarti stated that only Rs. 525 crores out of the total outlay of Rs. 1125 crores on the railways under the Second Plan was for development and expansion. The balance of Rs. 600 crores was being spent on rehabilitation including renewals and replacements of overaged assets, inescapable safety works, Passenger amenities, staff quarters and training programmes which had no bearing on development and would have to go through, plan or no plan. Of this expenditure of only Rs. 525 crores for development, Rs. 183 crores or more than a third would go for rolling stock on additional account.

The current Plan, admittedly, could no more than overtake arrears of replacement and add a little on the development side, he stated. Effective modernisation could not yet be undertaken. The addition to capacity would not be anywhere near the 50% extra goods traffic and 30% extra passenger traffic to be carried for which an allocation of Rs. 1480 crores would have been necessary against the actual allotment of only Rs. 1125 crores. Shri Chakravarti nevertheless expressed his optimism about the future outlook for the railways. The accent would have to be on further improving efficiency and he had every confidence that with the co-operation of the public, railwaymen throughout the country would ring true to the clarion call to fill this big gap by putting in the extra effort that would be necessary so that the Nation's goods would be delivered.

Electric and Diesel-Electric Motive Power by G.E.C.

IN its works at Witton, Birmingham, and Dudley Port, near Wolverhampton, The General Electric Co. Ltd. of England manufactures traction equipment for all types of electric and diesel-electric railway motive power. Complete locomotives and rolling stock for all electrification systems and voltages and for diesel-electric services are supplied in conjunction with leading British manufacturers of mechanical parts.

The Blue Train of the South African Railways leaving Cape Town Hauled by N. B. L. —G.E.C. 3,000V. D.C. electric locomotive.

Orders in hand and work recently completed are representative of the many different railway operating requirements of which the Company has experience. Following the decision of British Railways to adopt the 50-cycle, single-phase system of a.c. traction, equipments are in production for multiple-unit, suburban trains and for main-line locomotives to operate on a normal line voltage of 25 kV, with automatic changeover for running on a 6.6 kV supply on sections where clearances are restricted. The seventy suburban train a. c. equipments now in course of manufacture for British Railways are for installation in three-coach units each comprising a driving trailer, motor coach, and second driving trailer. The power equipment will be mounted on the motor coach underframe, and the battery, battery charging equipment and compressor, will be carried on the underframe of the second driving trailer.

The motor coach transformer, the switchgear for series or parallel connection of the primary winding to permit operation on 25 or 6.6 kV, and the cam group tap changer in the secondary circuit for control of the traction motor voltage, will form a single assembly, all parts being oil-immersed and cooled by forced oil circulation.

The alternating current will be rectified by a group of single-anode rectifiers with liquid cooling by forced circulation. Smoothing of the d. c. input to the traction motors will be provided by air-cooled chokes.

The four axle-hung, nose-suspended, self-ventilated traction motors will be rated at 200 h.p. (one-hour) and will be designed specially for operation on d. c. with a ripple component. Silicone insulation (Class H) will be used for the traction motors and smoothing chokes. The motor contactors, weak-field contactors and reverser will be electro-pneumatic. All auxiliary machines will be driven by rectifier-fed d. c. motors supplied from a low-tension tertiary winding on the transformer. Overall protection of the equipment will be given by an air circuit-breaker, which, with pantograph, will be supplied by British Railways.

Acceleration will be automatically controlled and the control scheme will provide a shunting notch followed by three running notches, in the last of which the motors will operate in weak field.

Ten complete main-line locomotives are also being supplied for the British Railways 50-cycle electrification. This design has been developed in close collaboration with the North British Locomotive Co. Ltd., who will build the mechanical parts. Five of the locomotives will be geared for a top speed of 100 m. p. h. and five for 80 m. p. h., but both versions will be mixed traffic units in the fullest sense for those with the 100 m. p. h. gear ratio will be able to haul mineral trains of up to 950 tons at 55 m. p. h. The locomotives geared for 80 m. p. h. maximum will be capable of hauling a 1,250-ton freight train between Manchester and Willesden (London) at an average speed of 42 m. p. h., including four one-minute stops and observance of all speed restrictions, with a top speed of 55 m. p. h.

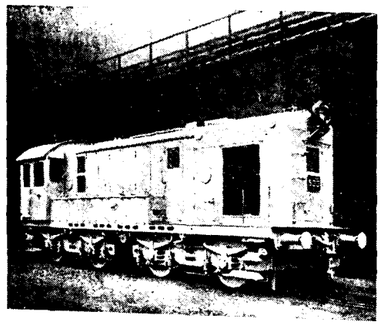
The locomotive body will be of special light-weight construction using light steel sections, the underframe, sides and ends forming an integral load-bearing structure. It will be carried on two two-axle bogies, in which the traction motors will be fully-springborne and will be geared to the axles through spring drives. There will be a driving cab at each end of the body. Weight in working order will be 80 tons and the continuous rating 3,300 h. p. The tractive effort at starting is a maximum of 60,000 lb.

Control of the locomotive will be effected on the high-tension side of the transformer. For 25 kV operation the regulating transformer will act as an auto-transformer, the voltage across the tapped portion of the winding being 6.6 kV. When running on 6.6 kV the tapped portion only will be in circuit, the necessary switching for either line voltage being effected automatically. By means of the tappings a variable voltage will be supplied to the primary of the main step-down transformer feeding the traction circuits, the maximum on either contact line voltage being 6.6 kV.

The main and regulating transformers, high-tension tap-changer and the selective switchgear for alternative line voltages will form a single assembly, all parts being oil-immersed and cooled by forced oil circulation. An air-blast circuit-breaker will protect the electrical equipment.

The alternating current from the main transformer secondary will be rectified by a group of single-anode rectifiers, the d. c. output from which will be smoothed by air-cooled chokes and fed to the forced-ventilated traction motors.

Principal auxiliaries will be powered by d. c. motors fed from a mercury-arc rectifier or from d. c. generators. A special winding on the transformer will provide a supply for electric heating in rolling stock.



A 625 h.p. diesel-electric locomotive for the Ceylon Government Railway built by the North British Locomotive Co., Ltd., with G. E. C. power equipment.

The rectifiers to be used in the foregoing 50-cycle, single-phase equipments have a particularly favourable power/weight ratio and are of small dimensions, the design having been developed specially to meet the requirements of installation in locomotives and motor coaches.

DIRECT CURRENT TRACTION

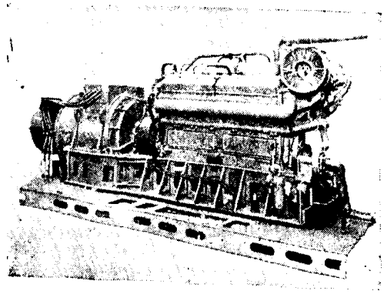
Last year the semi-express type rolling stock, for limited-stop services on the 1500V d.c. electrification between London (Liverpool Street) and Southend-on-Sea—a popular resort and large residential area at the mouth of the River Thames—was introduced. The equipments supplied by the G. E. C. for the 32 four-coach multiple-unit trains built by British Railways for these services are representative of the Company's latest practice for the 1,500V system. Each motor coach is powered by four axle-hung, nose-suspended motors, the two motors in each bogie being permanently in series and controlled by series or parallel connection of the two pairs. Ratings of a four-coach unit are as follows :

	Full-field	Weak-field
1-hr.	800 h. p.	880 h. p.
Continuous	632 h. p.	696 h. p.

Two rates of automatic acceleration, selected by alternative "forward" positions of the reverser handle, are available. The normal rate is 1.1 m. p. h. p.s., while the lower rate, intended for use in greasy rail conditions, is 0.85 m. p. h. p. s. The electro-pneumatic contactor control equipment, with the relays, reverser and motor cut-out switch is accommodated in three cases mounted in the motor coach underframe, and is operated from master controllers in the driving trailers at each end of a unit, the motor coach being the second vehicle from one end. In the main contactors the butt contact interlocks, protected by "Perspex" covers, and the electro-pneumatic valves are mounted at the front so that both are accessible when the front covers of the equipment cases are removed.

In this stock as in other recent G. E. C. equipments the tripping of an overload relay is arranged to illuminate an indicator lamp in the unit affected through a contactor which latches in. Consequently the lamp remains alight after the driver has reset the overload relay from his cab pushbutton, and as long as the control key is in position, identifies the motor coach in which the overload has occurred. The indicator lamp contactor is reset by the maintenance staff at the depot when investigating the cause of the overload or its effects.

In supplying equipment for electric rolling stock the G. E. C. provides from within its own organisation the electrical services which contribute to the comfort and convenience of railway travel. Typical of the facilities available is the toilet water heating installation in the Southend stock. The 1½ kW, 1-gal. water heaters in each toilet compartment are thermostatically controlled via contactors in underframe equipment cases. A special locking device is incorporated to secure the thermostat at any of three temperature settings so that it is unaffected by vibration, and the complete heater is thoroughly shock-tested.



Engine-generator set supplied by the G. E. C. for Ceylon Government Railways 625 h.p. diesel-electric locomotives. The engine is a Davey, Paxman 12 RPHXL 12-cylinder vee type.

The Company is also supplying electrical equipments for 57 three-coach multiple-unit sets which are about to go into service on the London suburban routes of the London Midland Region, British Railways, from the Euston and Broad Street termini. These trains operate on a 630V d.c. third—and fourth-rail supply and incorporate an improved design of shoegear in which rubber is used as a noise-damping and springing medium. The power busline connections between coaches, through which the various sets of shoegear in a train are interconnected, are provided by jumpers and receptacles of a new design in which line contact with the plugs is obtained by the use of spring-loaded fingers. Air-operated cam groups are employed for reversing and field-weakening. In addition to two rates of automatic acceleration selected from the reverser handle, an emergency setting of the accelerating relay can be obtained by operating a normally-sealed push-button if it is necessary to start against a severe gradient with one pair of motors of the four-motor equipment cut out of circuit.

Four-coach multiple-unit set with G.E.C. electrical equipment for the Liverpool Street—Southend Service, British Railways, Eastern Region.

Ratings of a unit of these London Midland Region trains are as follows :—

	Full-field	Weak-field
1-hour	680 h. p.	740 h. p.
Continuous	540 h. p.	600 h. p.

The two motors in each bogie are permanently in parallel and are controlled by series or parallel connection of the two pairs.

Other low-voltage d. c. equipment supplied by the G.E.C. includes large numbers of motors for the underground and tube lines of the London Transport Executive, the latest design being an 80 h. p. (continuous rating) machine for new prototype tube trains in which one axle of every bogie will be motored. An air-operated camshaft controller for tube rolling stock has been developed, and two experimental regenerative equipments are being supplied for the Executive's trials with regenerative braking in tube stock.

D. C. ELECTRIC LOCOMOTIVES

The efficiency of the modern d. c. electric locomotive as an operating unit is based both on the wide range of duties a single design can undertake and on high availability resulting from minimum maintenance requirements. Several years' service of the 3,000V, 3,030 h. p. Class "4E" locomotives on the South African Railways have demonstrated their merits in both respects. The locomotives were built by the North British Locomotive Co. Ltd. and equipped by the G. E. C. for service on the Cape Town-Touws River section of the main line to Johannesburg. Heavy gradients in the Hex River Valley imposed special requirements, such as the ability to start a 1,070-ton goods train on a 1 in 66 grade, or a 610-ton passenger train on a 1 in 50 grade. Regenerative braking alone was required to hold trains of these two types at speeds of 25 to 40 m. p. h. and 40 to 55 m. p. h. respectively down a gradient of 1 in 66. To meet these braking demands the locomotives are equipped for regeneration in all three groupings of the six traction motors, while flexibility of control when motoring is obtained by the provision of three weak-

field notches in each grouping. Two of the locomotives can be operated in multiple when required.

In these locomotives the lateral forces imposed on the track have been considerably reduced by allowing the motors a limited amount of transverse movement relative to the axle under the control of rubber springs between the motors and the bogie frame.

BATTERY LOCOMOTIVES

On electrified systems provision must be made for hauling trains for permanent way and other maintenance duties when power is off. Numbers of equipments for work of this type have been supplied by the G. E. C. to the London Transport Executive for installation in battery locomotives. In this particular instance provision is made for taking a supply from the third rail when power is available. The control system is designed to permit very fine control at crawling speeds when cable-laying as well as for running at speeds which do not interfere with normal traffic. These service conditions have resulted in the development of equipment able to meet economically any requirements likely to be put forward for battery locomotives or passenger vehicles.

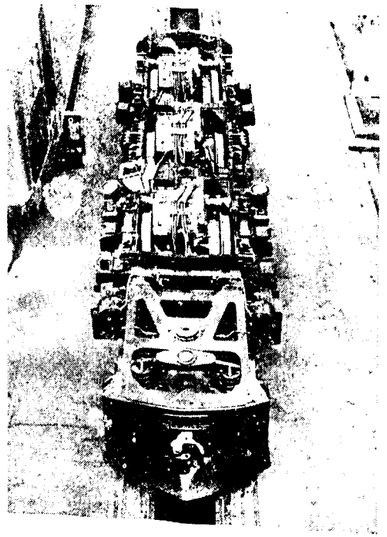
DIESEL-ELECTRIC TRACTION

At the present time the G. E. C. has orders in hand for the diesel-electric traction equipment of high-speed Pullman trains, main-line locomotives and shunting locomotives. The five high-speed trains, which are being built by the Metropolitan-Cammell Carriage and Wagon Co. Ltd., Saltley, Birmingham, will operate on British Railways between London and Bristol, London and Manchester, and London, Birmingham and Wolverhampton. There will be two power cars in a train, each with a machinery compartment containing a N. B. L./M. A. N. 1,000 h. p. pressure-charged vee 12-cylinder engine direct-coupled to a G. E. C. single-bearing main generator with belt-driven auxiliary generator. Eight self-ventilated traction motors will be distributed through the train. The motors will be fully-springborne in the bogies and will be geared to the axles through Brown-Boveri spring drives. Cooling air will be supplied to the motors through ducting from protected intakes.

The control system will comprise a combination of main generator field control and engine speed variation, with automatic torque control through an oil servo-regulator. A range of several engine speeds will be provided by means of three air-operated pistons acting on the engine governor through a system of interconnected levers.

Equipments are being supplied for 20 Bo-Bo locomotives being built by the North British Locomotive Co. Ltd. for British Railways in connection with the British Transport Commission's modernisation programme. One of these is a 1,000 h. p. design powered by a 12-cylinder N. B. L.-M. A. N. engine and the other a 800 h. p. locomotive with a 16-cylinder Paxman YHXL engine. In each case the diesel engine will be direct-coupled to a G. E. C. main generator with overhung auxiliary generator, and the four axle-hung, forced-ventilated traction motors will drive the axles through Wiseman resilient gearwheels. When running on any power notch, transitions between full-field and weak-field in the traction motors, both forward and backward, will be made automatically, thus ensuring maximum utilisation of engine power over a very wide speed range.

In G. E. C. diesel-electric equipments for horsepower ratings of the above order, the control system operates by a combination of main generator field control and variation of engine speed. An automatic load control system, acting on the main generator field, is available on all controller notches, and although it does not normally come into action on the lower engine speeds



Motor bogie of N.B.L.—G.E.C. 3,030 h.p., 3,000V d.c. locomotive for the South African Railways.

it acts immediately to relieve over-loading should the engine power output fall for any reason while running on any notch. Otherwise, the system acts to match the generator output to the power demand over the widest possible range of locomotive speed, ensuring that the output is fully utilised and protection is given against overloading the diesel engine.

The oil servo regulator in the automatic load control system provides very finely-graded adjustment of the field circuit resistance in a compact form by means of numerous tappings connected to the segments of a fixed commutator, around which brushes are moved by the servo mechanism. The vane type servo motor ensures precise adjustment to varying conditions with negligible hunting.

Many of the British Railways 350 h. p. standard 0—6—0 diesel-electric shunting locomotives are now being powered by the G. E. C. The equipment supplied for duties of this type comprises a Lister-Blackstone 6-cylinder vertical 4-stroke engine with a flange-mounted main generator, on top of which are mounted an auxiliary generator and a traction motor blower, both belt-driven. The generators and blower from a combined unit with the engine, thereby dispensing with the need for a separate bedplate, but they can be detached from the engine as a single combined assembly.

With the diesel engine running at idling speed, ten steps of generator field control provide control of the locomotive speed, after which the engine speed can be adjusted continuously between idling and maximum r. p. m. to provide a stepless control which is of particular value on shunting duties. Series or parallel connection of the two traction motors is selected by means of an off-load switch. When running in parallel with the controller moved to its furthest extent, generator excitation is increased automatically subject to the overriding control of a voltage relay which restricts working in these conditions to the upper part of the speed range. The controller and reverser handles are duplicated at each end of the desk to permit driving from either side of the cab.

In these shunting locomotive equipments the drive is through double-reduction gearing. The whole gear train is located on the same side of the traction motor, which facilitates demeshing when a locomotive has to be towed. The hollow intermediate shaft and its roller bearings are mounted in eccentric housings which are joined by a spindle passing through the hollow shaft. A square end on this spindle projects beyond the inner bearing cap so that it can be turned by a spanner. Two bolts lock the bearing housings in the meshed or demeshed positions, and after they have been removed, rotation of the spindle by the spanner moves the gears into or out of mesh as required. The operation can be carried out quickly and easily by one man.

GENERAL DEVELOPMENT

Means of increasing the output from G. E. C. traction machines are being studied continuously and improvements have been effected in the transfer of heat from windings to the cooling air, giving higher output for a given temperature rise. Practical experience has also been gained in the use of Class H insulation, which permits higher operating temperatures. Investigations of bogie construction, and of adhesion with various methods of motor combination and control, have contributed to understanding of the fundamental problems common to all types of locomotives and rolling stock powered by electric motors.

The G. E. C. organisation as a whole enables the Company and its associates to supply complete equipment for railway electrification from its own resources, including substation plant, distribution cables and overhead line equipment, remote supervisory control systems, signalling installations, and all electrical services for rolling stock.

JAPAN PLANS TO SELL STEEL CHEAPER

Japanese steel mills are planning drastic cuts in export prices in view of intensified competition in world markets. The Fuji Iron and Steel Company said Japanese steel exporters had been beaten in recent weeks by European exporters who offered semi-finished steel billets at 88 dollars and round steel bars at 98 dollars, both per ton f.o.b. The low priced semi-finished steel was offered by Swedish exporters at an international tender held in Argentina. To compete with such a price, Japanese semi-finished steel must be exported at about 83 dollars per ton, f.o.b., because of larger freight costs from Japan to Argentina.

A Century of Rollingstock Production in Sweden

By An Engineering Correspondent

MORE than a century has elapsed since 1847 when the present firm was founded under the name of Trollhatte Mekaniska Verkstad (The Trollhattan Engineering works). In 1850 the name was altered to Nydqvist & Holm, and in 1916 the firm was converted into a limited company under the name of NYDQVIST & HOLM AKTIEBOLAG. (NOHAB).

To start with the range of manufacture comprised water turbines, steam engines, and various machine parts. After a few years the manufacture of locomobiles was taken up, and the step was then not for to locomotives, which, as a matter of fact, from the very beginning had been contemplated as a future speciality. The first order for locomotives was from one of the private railways in Sweden and the delivery began in 1865. One of these locomotives is now in the Railway Museum, Stockholm and another of them was in service for 70 years before being sent to scrap yard. Many locomotives of NOHAB's make are after more than seventy years still in daily service. The first three locomotives built for the Swedish State Railways were delivered in 1868.

The Directors of the company have always been anxious to make use of all improvements in the locomotive sphere and in this connexion it may be mentioned that compound gears and superheaters were applied at a comparatively early stage, and further, amongst the first 3-cylinder locomotives in Europe were those supplied by this firm in 1913. In 1925 the firm commenced to build steam turbine locomotives under licence from Aktiebolaget Ljungstroms Angturbin, Stockholm, and amongst engines of this type may be mentioned the non-condensing turbine locomotives for iron ore transport, supplied by Nohab to the Trafikaktiebolaget Grangesberg-Oxelosunds Jarnvagar (The Grangesberg-Oxelosund Traffic Co.'s Railway).

Sweden's richness in water power soon led to the electrification of the Swedish State Railways. Electric locomotives had been built by Nohab before 1900, but it was first in connection with electrification of the State railways that the manufacture of such locomotives became of real significance. The first of these locomotives was of the type 1-C-1, a coupling rod type of locomotive, of which Nohab have since delivered a great number. During recent years several private railways have been electrified and locomotives of various types for these railways have been built by us.

Completion from omnibuses and lorries has, in instances where electrification has not been considered suitable, compelled the railways to motorise the service, and this induced Nohab to take up the manufacture of motor driven locomotives and rail cars. The first rail car built was of the 4-wheel type but nowadays Nohab rail cars are normally of the 8-wheel type with two bogies.

Nohab's manufacturing programme comprises not only locomotives and rail cars but also other kinds of rolling stock, such as special wagons of various types, rotary snow ploughs and impregnating plants.

To meet the ever increasing demands considerable extentions of workshops have been carried out time and again. The works originally covered an area of 8,300 square metres, and now extend over more than 205,000 square metres. The shops with a floorspace of 59,000 square metres are full equipped and up-to-date in every respect.

Location of the works at Trollhattan was to a large extent dependent on access to water power and to a waterway to Gothenburg, Sweden's largest port. In 1922 a special quay was built and equipped with a crane allowing assembled locomotives to be lifted on board ships, specially built for the transport of locomotives. Messrs. Nohab has their own railway, with a length of 3 kilometers, connected to the Swedish State Railways and thereby also to the Continent. Trial runs of locomotives are made on their railway. There is also a

connection to the narrow gauge railway system of Western Sweden.

Prompt deliveries of locomotives have made the firm known far beyond the borders of Sweden. Scandinavia and Finland have early been their customers. Amongst other countries, to which Nohab has supplied rolling stock of various kinds, may be mentioned, the Argentine, Brazil, Iran, Netherlands, Poland, Portugal, Rumania, Turkey, U.S.S.R., and the Union of South Africa. Firm's deliveries have been large, especially to Iran, Turkey and U. S. S. R. In 1920, the Soviet Government ordered 1,000 heavy goods locomotives, one of the largest contracts in the history of the locomotive industry, as a result the firm had to make large extensions of their works, In order to utilise the increased capacity of the works it was necessary to look for new markets.

Early in 1927 the Turkish Government favoured the firm with a rather unique and complicated commission. The contract entered into comprised the building of railways with a total length of 900 kilometers, and the delivery of 100 locomotives and 1,500 coaches and wagons of different types. The railways were built in collaboration with the Danish firms Kampmann, Kierulff & Saxild A/S and J. Saabye & O. Lerche. The rolling stock was supplied by Nohab. The whole contract was completed in nine years. The enterprise was followed by a similar commission given by the Iranian Government to the three collaborating firms, who under the name of "Consortium Kampsax" undertook the building of the Transiranian Railway. Nohab supplied the rolling stock, consisting of locomotives, goods wagons, coaches, diesel-electric rail cars, some special wagons and a saloon-car for H.I.M. the Shah.

Since April 1950 there exists an agreement between Nohab and the General Motors Corporation, Electro Motive Division, La Grange, with a view to build and market diesel-electric locomotives utilising General Motors Corporation's constructions and equipment sets consisting of diesel engine, main generator and other supplementary equipment.

The Swedish locomotive builders formed in 1945, a sales company, Swedish Locomotive Works Association Aktiebolag for the export of steam locomotives. Nydqvist & Holm Aktiebolag is a member of that Association.

NEW TYPE OF CRANE FOR DURGAPUR

Demonstrations illustrating many advances in design have been given at the works of a British engineering company which has recently completed orders for self-propelled and rail-mounted cranes for the new Indian steel works at Durgapur and other Indian iron and steel plants.

A four-minute operation by one crane involved the hoisting of an overhead travelling crane weighing 10 tons to a height of 35 ft. and then, with great precision, placing it delicately upon the tracks. The crane was a 25-ton capacity, self-propelled type fitted with a 60 ft. strut jib.

On all the cranes used in the demonstration, the Diesel-electric transmission system was featured. This consists of a Diesel prime mover driving a shunt-wound generator which, in turn, supplies current to separate motors for each of the crane motions. It is stated that one great advantage of this system is the resulting reduction in fuel consumption, since the engine is not kept running at high speeds, power being developed according to needs.

This variable-voltage system provides an infinite variation of speeds, smooth acceleration, controlled lowering under power, and a high degree of accuracy. As an indication of the degree of precision, a five-ton-capacity crane lifted a steel tube and lowered it into another with such fineness of control that it did not unbalance or move in any way. There was only one-eighth of an inch clearance between the two tubes.

The British company concerned (Steels Engineering Products Ltd., of Sunderland), besides the seven cranes supplied for Durgapur, has delivered one self-propelled crane for the Indian Iron & Steel Co. of Burnpur, two rail cranes for the Tata Iron & Steel Co. of Jamshedpur, and several others for constructional companies carrying out work at Indian iron & steel plants.

SEA TRANSPORT SECTION

The Great Eastern Shipping Co. Ltd.—Spectacular Record of Progress and Expansion

IN less than ten years the Great Eastern Shipping Company has set up a new record in the expansion of Indian Shipping under Indian management. It has shown how, given a combination of business enterprise with judicious State encouragement, the progress that would otherwise take many years, can be compressed within a few.

The Company was established in August, 1948. It commenced its business with one ship s. s. "Jag Vijay", which had been purchased from the United States Maritime Commission. In 1950 orders were placed for the building of two ships with a Japanese Shipyard. These two ships were named as "Jag Ganga" and "Jag Jamna". The Great Eastern was the first Indian Company to build ships to order in Japan.

The Coastal reservation for Indian ships and the encouragement given by the Government in the shape of loans to Indian Shipowners for the purchase of vessels gave a stimulus to further expansion of the Great Eastern. In 1952 s. s. "Jag Rani" built at the Visakhapatnam Shipyard was purchased by the Company. By the end of the First Five Year Plan period, three ships were added to the Company's fleet. This included s. s. "Jag Tara" built at a Norwegian Shipyard.

The Company has also pioneered in the tanker line in India with the purchase of the tanker "Jag Jyoti" in April 1956 at a cost of about Rs. 90,00,000/-. The motor ship "Jag Laxmi" built by a Japanese Shipyard and delivered in February, 1957 is the largest ship on the Indian Registry with a deadweight tonnage of 12,970. In June 1957 s. s. "Chepman" which has been renamed "Jag Janani" was added to the fleet. Two ships of 14,200 deadweight and 6,000 deadweight are being constructed on account of the Company at a West German Shipyard and the Visakhapatnam Shipyard respectively.

The Company has also purchased recently s. s. "Durham Trader" under the "Pay while you earn" scheme initiated by the Government.

The Company maintains regular cargo service on the coast of our vast Peninsula. The Great Eastern is the only shipping company engaged in the international tramp shipping.

The Managing Agents, Messrs. A. H. Bhiwandiwalla & Co. (Bombay) Private Ltd., have far-flung business interests in the country. Mr. Vasant J. Sheth, who as a Director-in-charge manages the affairs of the Company has been associated with the Company since its inception. The Managing Agents realise that the prosperity of the Company can be built up only on the foundation of a highly efficient service to others, on the prosperity and goodwill of both shippers and consignees, and on no other. In short, their guiding motto has been — PROSPER THROUGH BETTER SERVICE.

BRITISH STEEL FOR INDIAN RAILWAYS

Large quantities of steel will be supplied by British Steel Makers to the Indian Railways during 1958. Contracts placed include 30,000 tons of Rails, 15,000 tons of Steel Sleepers and over 10,000 tons of Fishplates, costing some £ 2¼ million. Shipments are expected to start early in the New Year.

OVERSEAS SHIPPING TARGET FOR INDIA

how to achieve it

By C. H. Bhabha

WITH all our grandiose schemes and projects for economic planning and development, since the attainment of our Independence, ten years ago, the slow pace at which Indian shipping has moved forward, is a matter of deep regret and a great blow to our national hopes and aspirations. This vital limb of our economy, which everyone welcomes and wants to acquire unexceptional vigour and rapid expansion, remains unfortunately even today in a state of comparative inertia and undeserved neglect. One feels a sense of frustration and despondency when one examines dispassionately and objectively the achievements of a decade of this important facet of our national growth. Since the dawn of Independence, "brave in words but timid in deeds", seems to be the key-note of our shipping policy. Performances are in conflict with promises. Assurances keep miles away from actions. The early enthusiasm and drive which produced some remarkable results soon after freedom in carrying the Indian Flag forward have given place to inexplicable indifference and unpardonable lethargy.

The old spirit of diffidence, the continuous inertia resulting from red-tapism and the woeful lack of courage and foresight to take timely decisions and vigorous action are mainly responsible for the comparatively minor place and low priority which our benign rulers have assigned to our shipping without which we cannot promote our economy, preserve our security, maintain our strategy and discharge our international obligations. Barring some forms of cheap loans accompanied by rigours of regulations and controls and the slowly hastening patronage of Government cargoes to be carried often at concessional and unprofitable rates, no other measure of actual help and encouragement has so far been taken by our national Government to fulfil the urgent needs of the country for building up a crucial and vital industry like shipping.

COASTAL RESERVATION NEGLECTED

Undoubtedly, as a result of India's destinies shaped by her own countrymen, the coastal trade was reserved for the ships flying the Indian Flag. This long overdue measure created a healthy atmosphere and a buoyant spirit in the Indian shipping world. This, however, did not last long. Our new hopes were soon blasted. Over four million tons of crude oil imported and nearly two million tons of petroleum products carried round the coast by the three Indian Oil Refineries were allowed to be moved by foreign tankers. The opportunity of building up a tanker fleet for the import of four million tons of oil was not utilised. Although the three refineries were Indian companies and although several concessions were given to those refineries, no step was taken for arriving at an arrangement for importing crude oil by Indian tankers. As if this was not enough, even the refined petroleum products were also allowed to be carried in foreign tankers round the coast of this sub-continent, although the coastal-trade was reserved for national ships. This gave a deadly blow to India's national honour and pride. It is, however, some solace that after considerable pressure, one tanker in the private sector has been allowed to move the refined products round the coast and it is hoped that a second tanker in the public sector will be allowed to do so from March 1958. It is, however, a pity that while foreigners are accorded the same treatment as given to Indians, when they start companies in India with Rupee Capital, Government miserably failed to enforce on them the just obligation of giving the first preference to the national ships of the country in bringing the raw materials they need or the finished products which they want to carry.

FACTORS THWARTING PROGRESS

The Planning Commission has estimated that the coastal tonnage will reach the figure of 317,202 G.R.T. at the end of the First Plan. The actual tonnage, however, will only be 264,360 G.R.T. There will thus be a short-fall of over 52,000 tons. It is remarkable that this short-fall has not been made good, although more than twenty months have passed since the First Plan came to an end, and despite the appeal made by the Transport Minister in 1955, that Indian shipowners should acquire immediately twenty-five to thirty additional coastal ships. We are constrained to remark that the Government themselves are responsible for this gap remaining unfilled. Rates of freight on the coast are controlled by the Central Government. While the rates of freight and fares are allowed to be increased by the Railways, not only for economic working, but also for securing additional finance for capital expenditure, and while increases in the fares have been allowed to Air Transport Companies, the same freedom is not given to the shipping companies even to earn a reasonable return on the capital employed by them in their business. The recent acceptance of the recommendations of the Rail-Sea Coordination Committee, to allow the coastal ships to raise their rates of freight by 15%, inclusive of the two previous increases, under a new hush hush policy of the so-called previous consultations with the shipowners, ignores the stern realities of the rise in the cost of tonnage, the growing cost of operations and the increasing needs of funds for building up substantial rehabilitation reserves. It is common knowledge that the figures given in the Report of the Rail-Sea Coordination Committee are highly misleading. The surplus of Rs. 37 lakhs, which they have shown, will turn, if proper calculations are made, into a substantial deficit. We need not examine here the logic and the arithmetic of the Rail-Sea Coordination Committee. Suffice it to say that with the Government not allowing the rise in the rates of Salt recommended by the Committee, and the Committee not providing for the proper amounts of Income and Corporation Taxes, as a result of the new Taxation Policy, etc., all these reserves will vanish into the thin air. Had the Government not ignored their responsibility of appointing a representative of the shipping interests on this important Committee, the recommendations for enabling Indian shipping to work on an economic basis would have been quite different. The Rail-Sea Coordination Committee have urged that the coastal tonnage must reach 4.12 lakhs of tons by 1959 and have held out the threat that if the shipping companies do not do so, the balance of the tonnage should be acquired by the Government themselves. The Government contend that they wish to build up Indian economy under democratic methods. Free Enterprise cannot invest, however, crores and crores of rupees in a hazardous industry like shipping, with the prospects of incurring heavy losses. It is, however, no wonder that Indian shipping should not expect any better treatment from the Free and Independent Government of India, when shipping continues to be treated as the Cindrella of the Industrial World.

INACTION—A GRAVE CRIME

The main problem of Indian shipping, which has been causing serious concern to every patriotic Indian today is the very poor progress which Indian shipping has made in the carriage of India's overseas trades. It is well-known that the national prosperity of many important and progressive countries of the World is largely due to the development of shipping services for the substantial carriage of overseas and cross trades. It is ostrich like for our authorities to bury so prominently seen in the historical firmament of war-shattered economies, like those of West Germany, Japan and Italy. Attempts are unfortunately made in the highest quarters to justify the inaction of the Government on the ground "that it would be unrealistic to expect the pace of development and achievement in India to bear any comparison whatever, with that in the countries of the West who have had a long start and who have taken quite a long time to reach the stage where they are". This lack of faith and determination does not overpower the Government, when they have to make rapid progress for building up the Steel Industry, but it unfortunately makes them faint hearted when the building up of shipping services, vital for defence and a great earner of foreign-exchange, is concerned. Failure to take cognizance of the valuable lessons which war-shattered countries teach us and to adopt energetic measures for expanding the shipping tonnage for carrying our overseas cargoes will not only be a serious blow to our national interests, but it will also be a grave crime against the democratic form of Government, which we are taught to cherish as our greatest treasure in life. Let the Government remember that the posterity will judge them not by their words but by their deeds.

"SMALL OVERSEAS TONNAGE"

Shipping is an international business needing all possible facilities and assistance to establish itself firmly, particularly under difficult competitive conditions in overseas waters. When all the seventeen ships, which were under construction at the end of the First Plan, would be delivered by the middle of 1958, 86 ships of about 264,000 tons will be employed on the coast and 51 ships of about 347,000 tons will be employed in the overseas trades of India. It is true that further commitments have been made for the construction and/or acquisition of overseas tonnage to the extent of about 142,000 G. R. T., but the ships representing this tonnage are not likely to be delivered before the end of the Second Plan. It will be impossible for the Indian ships to carry even 15% of India's overseas trades, as visualised by the Planning Commission and the Transport Ministry, with such small overseas tonnage.

India ranks seventh in the world in the matter of international trades. According to the recent Report of the Export Promotion Committee, India's foreign trades represented 3.56% of the total world trades in 1956. Both the volume and the value of our foreign trades have increased during the last quinquennium—thanks to the energetic revitalisation of India's economy. The following figures (according to the Report of the Reserve Bank on CURRENCY AND FINANCE 1956-57) will give an indication of the extent to which the values of our overseas trades have gone up:—

Year	*Total value of imports and exports*
1952—53	Rs. 1,234.9 crores
1953—54	Rs. 1,131.5 ,,
1954—55	Rs. 1,280.4 ,,
1955—56	Rs. 1,391.7 ,,
1956—57	Rs. 1,713.5 ,,

RAPID RISE IN TRADE

As regards the volume of our international trades, no accurate statistics are unfortunately available. From the reports, however, of the working of the five of our major ports, viz., Calcutta, Vizagapatam, Madras, Cochin and Bombay, we note that the tonnage handled at these ports has gone up from 18.5 million tons in 1948-49 to 23.6 million tons in 1955-56. It is also observed that the total tonnage handled at all the ports in India in 1955-56 exceeded 30 million tons. While separate figures for the movement of cargoes in the coastal and in the overseas trades are not available in each case, from such figures of the tonnage moved in the coastal trade as are given in the Lok Sabha and from other reliable sources, it is estimated that about 18 million tons of cargoes were carried in the international trades of India in 1955-56.

As regards the tonnage, India had the following tonnage at the beginning and at the end of the First Plan.

	Coastal ships		*Overseas vessels*		*Total*	
	No.	*G.R.T.*	*No.*	*G.R.T.*	*No.*	*G.R.T.*
On the 1st April 1951.	73	217,202	24	173,505	97	390,707
31st March, 1956.	81	241,896	39	261,007	120	502,903

The above figures tally more or less with the figures given by the Rail-Sea Coordination Committee of 494,242 G. R. T. in their latest Report.

PLAN TARGET & OVERSEAS TRADE

Let us now examine the tonnage that is likely to be added to the above figures in the international trades of India during the Second Plan period and the extent to which the volume of the cargo to be carried in the international waters is likely to go up during the same time.

There were 12 overseas ships of 86,725 G. R. T. under construction on the 31st March, 1956. Orders have been placed for the purchase or construction of 20 additional ships of 142,100 G. R. T. during the first year of the Second Plan. All the 12 ships under construction on the 31st March, 1956, are likely to be delivered by the middle of 1958. Ships which have been ordered during the Second Plan period will be delivered during the last year of the Second Plan, or the beginning of the Third Plan. Even when all these ships are delivered, India's overseas tonnage will only be 71 vessels of 489,832 G. R. T. It is, therefore, obvious that India cannot carry 15% of her growing overseas trades even with that tonnage.

As stated above, the volume of India's overseas trades was about 18 million tons in 1955-56. According to the Report of the Estimates Committee on Shipping, 11.95 lakhs of tons dead-weight cargoes were carried by Indian ships in the overseas trades in the calendar year 1955. This represents a little over 6% of the total trades. The Estimates Committee, in their Report on Major Ports, have, however, pointed out that according to the information given by the Ministry of Commerce and Industry to the Ministry of Transport, additional six million tons of imports and exports would be brought or carried from India by the end of the year 1958. This would mean that the total of the overseas trades would go upto 24 million tons before the end of the Second Plan. If, in addition to this, the negotiations for the export of Manganese and Iron Ores to Japan materialise, the

volume of overseas trade will go up by another six million tons per year and reach the figure of million tons by March 1961. Both the Planning Commission, as well as the Transport Ministry are anxious that Indian shipping should carry at least 15% of India's overseas trades. The minimum tonnage which Indian ships will have thus to carry in international waters would be 36 lakhs of dead-weight tons and if the negotiations for the sale and carriage of Ores materialise, Indian ships will have to handle 45 lakhs of tons of dead-weight cargoes in India's overseas trades. As stated above, when all the tonnage will be delivered, Indian shipping will reach the figure only of 489,832 G. R. T. The maximum which Indian tonnage would then be able to carry would be about 18 lakhs of deadweight tons. This would be only 6% of the total cargoes of 30 million tons. In other words, not only will Indian shipping make no progress in the carriage of overseas trades by the end of the Second Plan, but it may also be possible that Indian shipping may receive a little set back in the percentage of the total volume of cargoes which it may handle by 1961.

NO PROGRESS IN INTERNATIONAL WATERS

Let us not, therefore, continue any longer merely toying with our plans and programmes for the development of Indian Merchant Navy. Let us not forget that soon after we attained Independence, the Expert Shipping Policy Committee, appointed during the British regime, submitted its report, which was accepted by our new national Indian Government as its Bible for the future policy in respect of India's Mercantile Marine. Thus, even as far back as 1947, the Government of Independent India, announced that India should possess a merchant fleet of at least two million tons within a period of five to seven years, that is at the latest by 1954. This target of two million tons was expected to cater for the carriage of the entire coastal trade, 75% of India's adjacent trades and at least 50% of her overseas trades. It is really unfortunate that while we have not reached even 30% of the target in 1957, which we were expected to reach in 1954, India has made no headway in the carriage of her trades in international water and her tonnage today is even less than $\frac{1}{2}$% of the tonnage of the world, while her international trade is, as stated above, 3.56% of the world trade.

SERIOUS DRAIN ON FOREIGN CURRENCY

The implications of this unfortunate situation on our economic growth are bound to be more serious than they are generally understood in the country. In the first place, with the increase in our foreign trades, a larger freight bill will have to be paid to the foreign flags out of our meagre foreign-exchange resources. It is estimated that our annual freight bill runs today round about Rs. 140 to Rs. 150 crores. With the rise in our foreign trades of a further six million tons per year, the freight bill is bound to go up by about Rs. 60 crores. It is significant to note that while India imported about 24 lakhs of tons of foodgrains during the first ten months of 1957, she had to pay a little over Rs. 31 crores to the foreign flags for bringing the imports of these commodities as against the sum of Rs. 25 lakhs paid to Indian ships. The average freight works out at Rs. 127/- per ton. No one can think with equanimity of the serious consequences of this drastic drain on our poor finance exchange resources, which we are called upon from day to day that we should do everything possible to conserve and augment. In the second place, through inadequate increase of Indian tonnage for our overseas trades, the contribution of Indian shipping to the foreign exchange pool of the country will not be commensurate with the rising tempo of economic activities in the land. If we were to carry only 15% of our total estimated trades of 24 million tons by 1960-61—and not 50% of those trades as announced by the Government in 1947—the contribution of Indian shipping to the foreign exchange pool of the country will go up from the present meagre figure of Rs. 7 to 8 crores to Rs. 25 to 27 crores. No Government can ignore their serious responsibility of augmenting the country's foreign-exchange pool to such a substantial extent by the expansion of its shipping tonnage, particularly when it has been faced with a foreign-exchange crisis of unforgettable dimensions.

URGENT RETHINKING NECESSARY

As regards the long-range policy of carrying 50% of our overseas trades in our own bottoms, it is obvious that we shall have to revive substantially our present target of two million tons. We shall have to fix a new target. A properly phased programme will have to be worked out with a definite "D" Line for the fulfilment of this very vital objective. It is essential that urgent steps should be taken by the Government to entrust this important work of fixing the target and drawing up a suitable programme to non-official experts having knowledge and experience of this vital industry. Any further delay now in this respect, will mean nothing but a severe set back to our economy as a whole and will do immense harm to the laudable objectives of systematical development of our resources for ensuring a balanced economy in the country and thereby raising the standard of life of our teeming millions.

It saddens our hearts to note that a spirit of unwarranted coldness has come over not only on the Government of the country, but it has also unfortunately affected those who are connected and concerned with the shipping industry and are anxious to expand our tonnage commensurate with the growing needs of our overseas trades. Whatever may be the provocative causes which have led to the growth of this harmful spirit, it is necessary for all well-meaning patriots to think afresh and anew about the highly complicated, but essentially vital industry of the country, affecting both its future economy and its future security. In order to create the necessary climate and for searching for a solution for the achievement of the above mentioned modest objective for our overseas trades, a few random suggestions, it is hoped, will prove useful.

ASSURANCE TO CREATE CONFIDENCE NEEDED

As a condition precedent to any regeneration of enthusiasm for achieving the new target for our overseas trades, a comprehensive examination and a radical revision of the Shipping Policy of the Government is urgently called for. Despite all the professions of having a dynamic policy for Indian shipping, the actual measures or steps taken for translating our hopes into concrete achievements or deeds, have unfortunately been feeble and faint-hearted. It can almost be said, without any injustice to anyone, that our Shipping Policy has been halting, hesitating, half-hearted and even heart-breaking. What is now urgently needed is to lay out immediately a bold Policy of Shipping for a long term and to announce specific assurances and concrete measures for that purpose in advance. With a view to develop the Shipping Industry and particularly that branch of the Industry, which will deal with the foreign trades of the country, it is essential to know well in advance the Policy of the State, which will hold the field for a number of years with certain guaranteeing factors in order to create and sustain confidence and also enable all concerned, to take bold action for the acquisition of additional shipping tonnage.

COMPETITION POSSIBLE ON EVEN TERMS ONLY

In the matter of overseas tonnage, we should never forget that it has to face international competition. That aspect of the shipping industry must deserve its fullest weight in the creating of such climate as would help Indian shipowners to go in for those trades. Recognising these particular features of the overseas trades, it is essential that the Government should undertake certain obligations in order to foster a healthy spirit of competition, as well as to remove any hardships or obstacles that may lie in the path of the development of the shipping industry. Even the advanced maritime countries, like the United Kingdom has given a special Investment Allowance of 40% as compared with the meagre Development Rebate of 25% given in this country. If Indian shipowners are to be encouraged to help in this national effort, the least that should be done by the Government is to create terms and conditions for operations for Indian shipping which should not be dis-similar or less advantageous than those enjoyed by foreign shipowners, particularly those who are competing with Indian ships in India's overseas trades.

There is nothing unusual for a Government to extend the patronage of its cargoes to its own ships for building up the Navy of Supply of its own country. It is a matter of satisfaction that the Transport Minister has given the repeated assurance that Indian shipping will be given the first preference for the carriage of Government cargoes. The real trouble is that there is no policy of coordination in the implementation of this Shipping Policy amongst the different Ministries of the Government. When large volumes of cargoes are to be carried on Government account, attempts are always made to drive Indian shipping to the corner and compel it to compete in the matters of rates in the falling chartering market from any tramp ship. When the chartering market is, however, rising the Government do not give the benefit of such a state of the market by giving the Liner ships a higher rate, but quietly ask them to carry the cargo at the usual rates, which are in many cases, far lower than the rates obtaining in the charter market. Such a state of affairs cannot be tolerated if a healthy, strong and vigorous force of Indian ships is to be built up in the larger interests of India. Government must give a definite assurance that at least a certain proportion of cargoes within the control of the Government, will be placed at the disposal of Indian ships at rates not lower than the average rates

(Continued on page 60)

Role of Arc Welding in Steel Economy Project

By S. V. Nadkarni, M. Sc., A. M. Inst. W. (Lond.)

IT is in the fitness of things that arc welding should be called upon to play a major role in big projects everywhere in India to-day. Arc welding has been recognised all over the world as the most versatile and efficient method of joining metals. The Planning Commission has also been quick to realise the need of popularisation of welding in India, of drastic changes in our design and fabrication methods so that riveting is replaced as far as possible by welding. In fact, the Planning Commission has listed "Popularisation of Welding" as a major step in the successful implementation of the Steel Economy Project which is now being looked after by the Indian Standards Institution.

WHAT IS ARC WELDING

Welding may be defined as a method of joining metals by heating the edges or surfaces to a plastic or molten state and allowing them to solidify together with or without the application of pressure. When, in welding, the edges are allowed to melt before solidifying together without the application of pressure, the process is called fusion welding. Fusion welding can be accomplished in two ways : one, in which the heat necessary is obtained from an oxy-acetylene flame, the process being commonly called gas welding and the other in which the heat is obtained from an electric arc, the process being known as arc welding. Arc welding has proved itself to be the most versatile of the various methods and is the most popular.

In arc welding, the arc is struck between an electrode and the base metal to be welded. (See Fig. 1). The electrode is held in a holder with an insulated grip, and this holder is linked by means of welding cable to

(Continued from page 59)

of such cargoes prevailing in that area over the preceding three months or so. With the Government having more and more cargoes within their control, it is essential that some sort of bias and preference is definitely and calculatedly exercised in favour of their carriage by Indian ships. By such action and by such policy, a definite confidence will be created in the hearts of Indian shipowners and will embolden them to acquire larger tonnage for servicing at least the reserved portion of the Government cargoes. A policy achieving that end cannot be considered by any stretch of imagination as an unfair practice. It would on the contrary, strengthen the hands of all concerned to acquire additional tonnage for India's overseas trades and put Indian shipping on a more economic and more durable basis.

NATIONAL SHIPPING MUST BE ENSURED A SHARE

It is well-known that every enlightened maritime country today has been expanding and expanding rapidly its overseas tonnage. India cannot and should not remain impervious to the enormous benefits, which the nation would derive through the expansion of their shipping services for carrying, at any rate, a sizable portion of India's foreign trades. The Government should keep this question in their minds upper-most, while negotiating any bilateral trade agreement or entering into any contract for the sale or purchase of any goods. It was unfortunate that while making a contract for the sale of lakhs of tons of Ores to Japan, on f.o.b. basis, no arrangement was made for the carriage at least of a sizable portion of those Ores by Indian ships. Just imagine what a tremendous loss it would be to the foreign-exchange pool of India, if all the six million tons of Ores per year, were sold f.o.b. and allowed to be carried by the ships fixed for that purpose by the purchaser. That would mean that India will lose all opportunities of earning a large sum of foreign exchange which will be involved in the carriage of Ores to the tune of about Rs. 45 crores. It is necessary, therefore, that the Government should take the country into their confidence and give them a definite indication and a positive assurance as regards what they propose to do in matters of this nature.

With greater attention and deeper thought on the problems of Indian shipping, with the formation of a long-range policy, and the evolution and execution of well balanced and well evolved plans to implement that Policy without any delay, the economy of India can not only be strengthened, but the all round progress and development of the country will also be facilitated and assured. This very crucial and vital pre-requisite for India's economic regeneration needs to be kept uppermost in mind so that India can secure her rightful place a tan early date in the comity of Nations.

(By courtesy : "Transport")

one terminal of an electrical equipment called welding generator or a welding transformer. The base metal is connected to the other terminal.

The electrode is generally a metallic rod covered concentrically along its length with a chemical material called "flux". One end of it is kept bare upto an inch or so, so that it can be held in the jaws of the electrode holder to carry the current to the other tip. When this other tip is touched to the base metal, withdrawn, and held a fraction of an inch away, an arc of intense heat is formed. This arc which has a temperature of about 6900°C, becomes a miniature furnace with two extremely hot spots, one on the electrode and the other on the work just under it. The portion of the work melts under intense heat and forms a small pool or crater and simultaneously the electrode also melts at the tip and deposits itself in the crater. As the arc travels further down the joint, the metal in the crater just behind the arc is solidifying into a dense joint. Obviously, feeding the electrode down all the time as it melts and maintaining the same arc length and its speed of travel call for skill on the part of the welder.

ADVANTAGES

Switching over from riveted designs to welded designs seems a far cry. It is not merely a matter of substitution but of complete reorganisation. Welders have to be trained, right types of electrodes have to be obtained, very often joints have to be bevelled for obtaining complete fusion and steps have to be taken to avoid porosity and cracks in welds and distortion of the assembled parts. Rigid inspection methods have to be laid down, right grades of steel have to be selected as higher carbon contents in the steels may lead to hardness and brittleness in the weld or in the heat-affected zones next to the weld, and high sulphur contents may cause porosity in the weld metal. However, advantages in favour of welding arc so overwhelming that any amount of organisational work is worthwhile.

The advantages of welded steel construction can be summarised as follows:

1. Welding decreases weight and cost of structural members which need not be weakened by rivet holes.

2. Saves material in structural connections by making them more compact, and in some cases, by eliminating connection materials altogether through the direct welding together of members or structural elements.

3. Saves cost in fabricating, fitting and assembly by eliminating operations of punching, drilling, countersinking, etc., and by reducing the amount of handling of heavy pieces in the shop; also provides greater flexibility to keep pace with other fabrication and erection operations.

4. Provides greater freedom in architectural and structural design, and better appearance (when steel work is exposed), because of smoother surfaces and outlines.

5. Facilitates economical and convenient alterations and additions to structures, with a minimum need for removal of existing walls, partitions, floors or other members and with no field drilling of holes for connections to existing members; also results in a minimum of noise and other inconvenience to occupants.

6. Reduces corrosion and cost of cleaning, painting and maintenance of exposed steel work, because of the smooth surfaces provided by welded construction, which prevent the accumulation of corrosive dust and other matter in the framing of powerplants and industrial buildings, and which discourage corrosion in coal bunkers and other coal handling equipment. Corrosion is generally

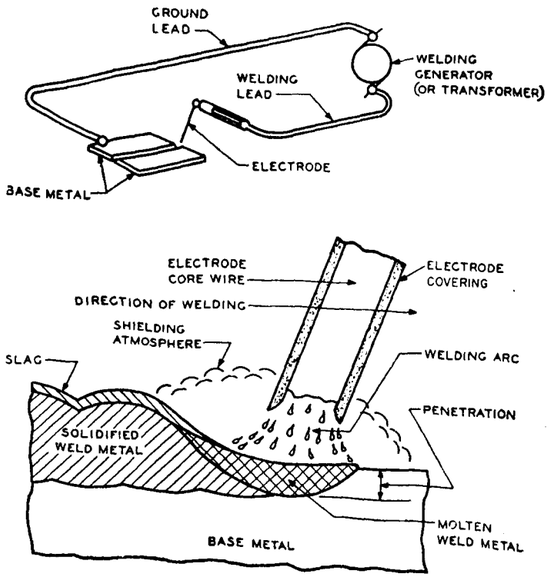


Fig. 1.

greater in rivets than in base metal, but welds are more corrosion resistant than base metal.

7. Eliminates leakage at joints in storage tanks, service piping, etc.

In order to obtain a more convincing picture of the superiority of welding or reveting in steel construction work, the following table is reproduced. It has been prepared by the Air Reduction Company of New York, from data reported for various examples of welded bridge and building construction:

Class of Structure.	Saving in Weight compared to riveted structure.
Rigid-Frame or Arched Roof Buildings, Auditoriums, Hangars, etc.	20—26%
Mill Buildings, etc. with Roof Trusses	10—15%
Industrial Handling Equipment	15—30%
Girder and Arch Bridges	15—30%
Truss Bridges	10—20%
Continuous Rolled Beam Bridges with cover plates, splices, stiffeners, etc.	10—15%
Conventional Tier Buildings	5—10%
CLASS OF MEMBER OR UNIT	
Truss-Type Bents for Mill Buildings	20—30%
Built-up Plate Girders	20—35%
Trusses	15—28%

OVERCOMING WELDING DIFFICULTIES

Changeover from riveting to welding requires some amount of forethought and caution because, to the uninitiated, welding presents a number of unforeseen difficulties.

During welding, steels are subjected to structural, dimentional, and compositional changes which have an important bearing on what is called weldability. First, in a process like arc welding, metal is melted and often must resolidify under conditions that are approximately the same as those encountered in chill casting. Second, the base metal adjacent to the weld is unavoidably heated momentarily to a maximum temperature that varies, with the distance from the weld, from the melting temperature of the steel to room temperature. Third, the temperature and phase changes taking place introduce in the weld volume changes which cause plastic flow and residual stresses and which may lead to cracking.

Again, structural distortion in one form or another is incident to all forms of welding, and if improperly controlled may be sufficiently severe to render the welded assembly nearly useless. It is caused by two factors: The thermal contraction or shrinkage of the weld metal on cooling from molten to atmospheric temperature and the different expansion and contraction of the metal adjacent to and affected by the heat of the weld.

Difficulties such as those described above have been successfully overcome by using weldable steels, applying preheat or postheat treatments wherever necessary, and by a proper sequence and procedure of welding.

POPULARISATION OF WELDING

Earlier, mention has been made of the work started by the Indian Standards Institution to popularise welding in India. For successful execution of this work, the I. S. I. has formed a welding sub-committee representing the electrode manufacturers, steel makers, welding inspectors, and leading designers and fabricators in steel. This Sub-Committee is bringing out a series of codes and specifications on arc welding electrodes and equipment, on arc welded applications such as bridges and pipelines. Courses are being prepared for the systematic training and testing of welders, and steps are being taken for the setting up of welding schools in the country. A series of hand books for the instruction of welders, welding supervisors, welding inspectors and welding engineers is being published.

FAITH IN WELDING

Faith in the efficacy of welding is an important requisite for its popularisation and faith cannot be born merely by the availability of published codes and handbooks. Thanks to the enterprising spirit of those in charge of such projects as the Integral Coach Factory and the Chittaranjan Locomotive Works, welding is being accepted and put to test on important fabrication jobs. Welding is being organized on many other projects. Hindustan Shipyards at Vizagapatnam are also organising a welding school in view of the growing use of this process in shipbuilding. All-welded Vaitarna-cum-Tansa pipeline in Bombay is a triumph of welding. Standard arc welding electrodes, equal to the world's best, are now

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CLEANLINESS LEADS TO HEALTH AND HAPPINESS

Clean orderly habits contribute to general health and welfare and as such to happiness and prosperity; they are more important than medicines.

Cleanliness prevents disease; medicine only attempts to cure.

Cleanliness of the person, of the houses and colonies, reflects discipline in the individual and the community. Discipline is the foundation stone for progress of oneself and the country. Cleanliness is a good habit. It is also cheap.

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

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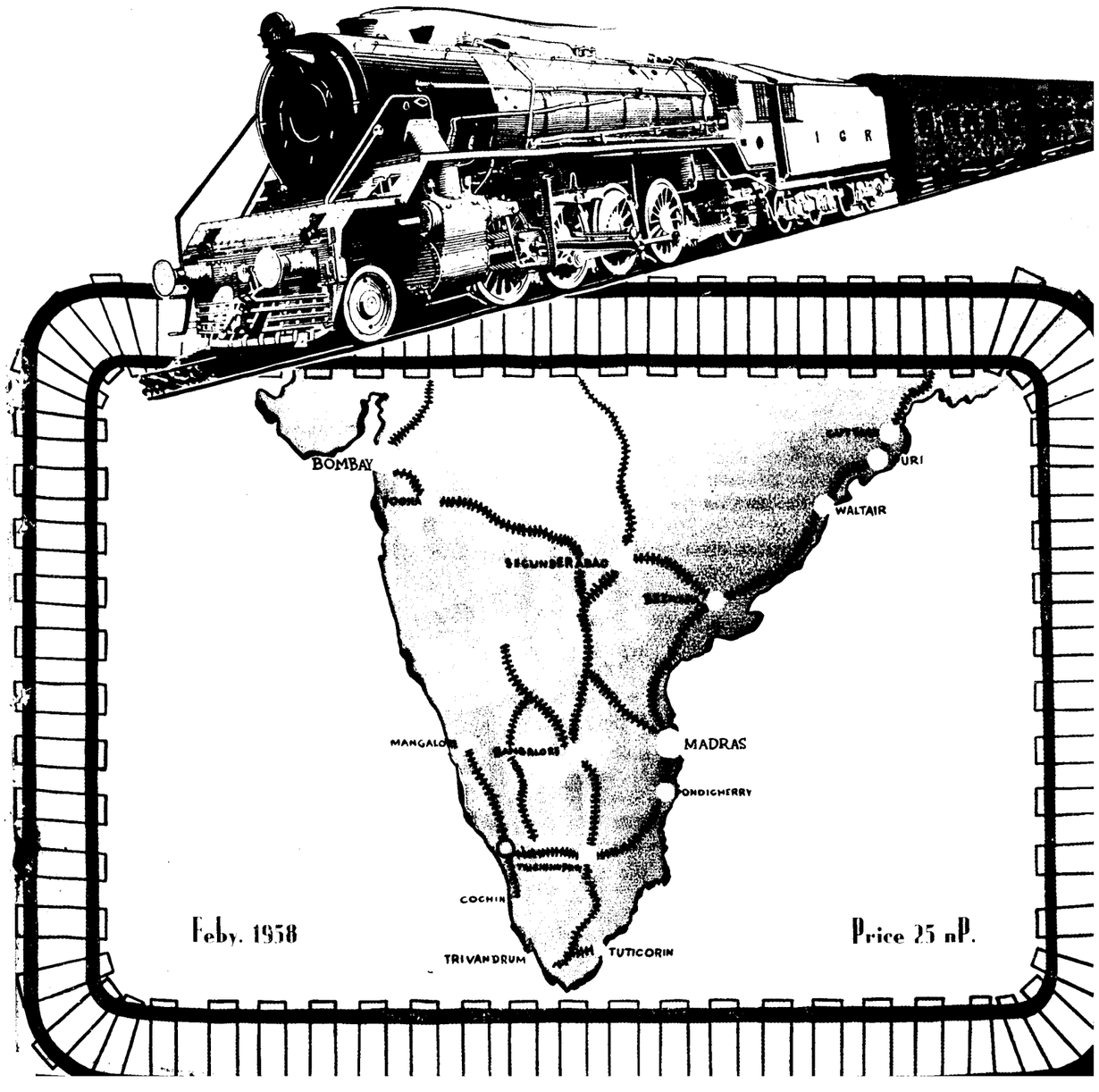


Feby. 1958 Price 25 nP.

manufactured in India, and almost all these projects use exclusively. Indian-made electrodes. One enterprising electrode manufacturer has already introduced what are called " Low-Hydrogen " electrodes in this country which are specially meant for the fabrication of high tensile steels and these are already finding large scale application in the various projects like Perambur Coach Factory, D. V. C. etc. etc.

GOLDEN RULES OF CONDUCT FOR RAILWAYMEN

1. Do you plan your work daily? Get the more essential things done first and do not neglect the important ones sidetracting them to the fag end of the day.

2. Do not express casually careless opinion. Never venture forth an opinion unless asked for it.

3. Remember that most of our mental worries come either from trying to fight life hard or from trying to run away from life. Do neither.

4. Learn to accept people as they are, love them, respect them, praise them, encourage them, differ with them, but above all, learn the priceless art of give and take.

5. Cry neither for the moon, nor over spilt milk.

6. Accept the things that you cannot change; have the courage to change the things that you can, and possess the wisdom to know the difference.

7. Do not drive too hard a bargain with yourself.

8. Accept life as it is—its wonders, changes, disappointments, frustrations etc., etc.

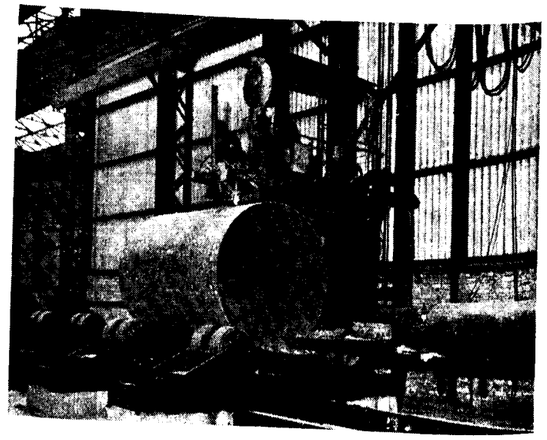
★

Wheels are rotated on a manipulator at 45° for fillet welding the discs to the rim. The FUSARC automatic welding machine is stationary, but for other applications may be traversed along the portal beam.

for welding the longitudinal seams. Some models of the cantilever also permit adjustment of the head outwards along the cantilever arm.

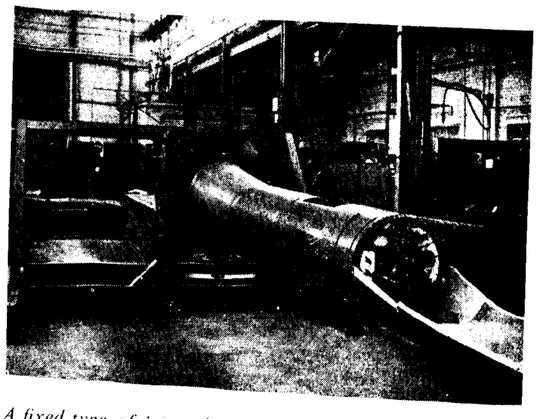
For internal welding, a welding head is fixed on the end of a slender boom. For internal circumferential seams the vessel is rotated on a roller bed at the welding speed, while the boom, within the vessel, is stationary. For welding internal longitudinal seams the roller bed may be traversing the vessel at welding speeds or the internal welder itself may be traversing.

There are several variations of this equipment. One is where the operator lies prone in a lay trough and observes the arc and the progress of welding through a dark-glass screen let into the base. In front of him is the control panel from where he has

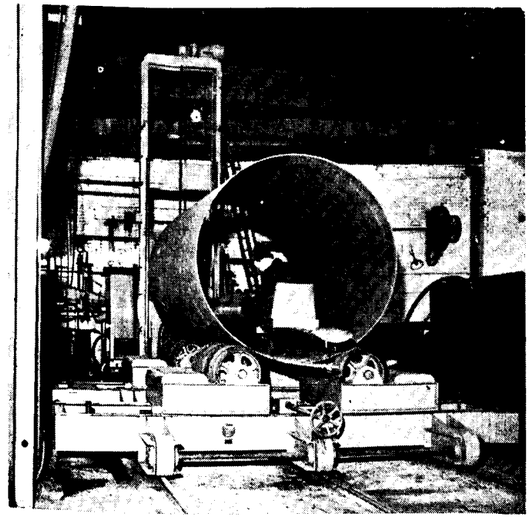


A comprehensive vessel welding installation. A FUSARC automatic welding head is mounted on a cantilever which traverses for welding longitudinal seams. The vessel is rotated on the roller bed for welding circumferential seams. A traversing internal welding boom is used for welding the internal seams.

local control over the welding and the traverse of either the internal welder, or, where this is of a fixed type, of the roller bed. Operator-carrying internal welding apparatus of this type is obviously limited to vessels with a minimum internal diameter of 2ft. Equipment for welding narrower vessels has, however, been developed without the need for an operator to be carried.



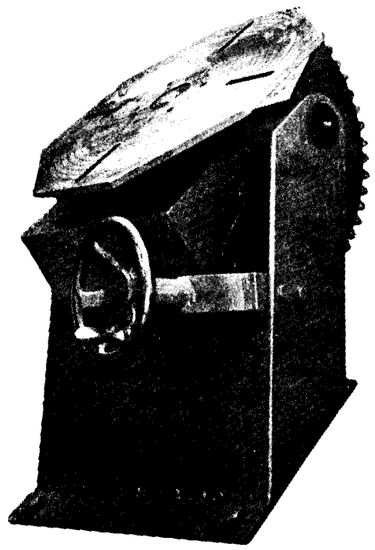
A fixed type of internal welding boom using a FUSARC automatic welding head. Provision is made for raise and lower of a few inches and for cross traverse for centering.



A high lift welding boom. This apparatus may be equally well employed for internal or external seam welding. The vessel is either rotated or traversed on a roller bed.

Another alternative, and one which combines, in some instances, the functions of the cantilever and internal welder is the high lift boom welder. This again comprises an automatic welding head mounted on the end of a slender boom but the boom is arranged for motorized raise up to 12 ft. 6 in. or

A 1 ton manipulator which has motorized rotation. The table can be tilted through 135°.



A 2 cwt. manipulator for positioning smaller fabrications. The table can be tilted through 135° and has motorized rotation.

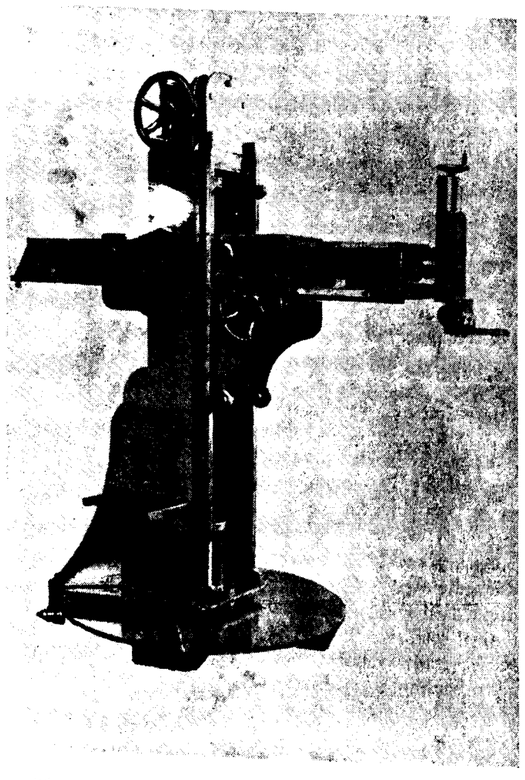
lower within a vertical support. Here, again, two versions of the boom are available, one in which the operator is carried and the other not, depending on the diameter of work regularly encountered. The principal advantage with this type of equipment is, however, that it can be used both for internal or external welding of cylindrical vessels.

Roller beds are, of course, essential equipment for the welding of circumferential seams on cylindrical work, not only for speedy and efficient handling but especially where a constant speed of rotation is necessary—as it is where automatic welding heads are employed. Where motorized traverse is incorporated they can be equally well used for the longitudinal seam welding. There are three types of roller bed generally available these being light, (for weights up to one ton): medium, (for weights up to 24 tons): heavy, (for weights up to 100 tons). Idler units are also available to give either extra load-carrying capacity or to give additional support to obviate deflections in excessively long vessels. By the combination of either drive or idler units within each series the most flexible and versatile arrangement can be assembled to take vessels of varying weights and sizes.

Other manipulating equipment in use for automatic welding is the range of positioners and manipulators

designed to take loads between 1 cwt. and 6 tons. These are designed to position fabrications in the most convenient way for welding and to rotate them where necessary at welding speeds. A turntable is incorporated which tilts through 135° and which is rotatable. In most models rotation is by electric motor and this can be electronically controlled to give constant rotational speed even with eccentrically balanced loads.

Another useful item of equipment is the radial beam positioner. The beam on which the automatic welding head is located is adjustable in height and reach and can be locked in any required position. The whole beam and the supporting vertical column can also be rotated on its base. Thus it can be used where several different welding operations are necessary and all that would be usually needed would be to swing the beam carrying the welding head, over the required location.



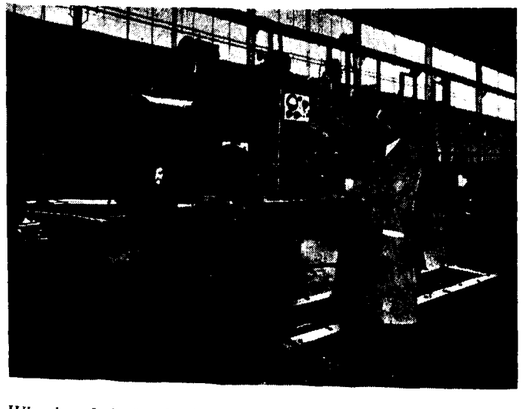
The radial beam positioner. Most types of automatic welding heads can be mounted on this. The arm may be raised or lowered and can be extended outwards and the whole positioner can be rotated on its base so that the same welding head can be employed at several different adjacent locations.

Specialised welding machines can be built for many purposes. One distinct field for this in railway work are machines for building up worn components by depositing weld metal on the surface so that after final machining, the worn part is restored to its original dimensions. Another use in which the technique is identical in many respects is the depositing of hard surfaces to components that are subject to exceptionally hard wear as is frequently the case with railway stock. The descriptions of such typical installations follow :

WHEEL AND SHAFT REBUILDING INSTALLATION

The machine is used for rebuilding wheels up to 4 ft. diameter and shafts up to 8 ft. long. Typical items of the latter include brake shafts, dip rods, brake cross stays and intermediate buffers. These vary in diameter between 1⅝ in. and 4 in. and can be mounted between centres using a head and tailstock. The bearing surfaces are first roughly turned, and then built up with weld metal, being finally turned to finished size.

The installation comprises a welding machine



Wheel and shaft rebuilding installation used for items such as brake shafts, dip rods, brake cross stays, intermediate buffers. The turntable rotates the workpiece and the FUSARC automatic welding head traverses the length of the machine so that the weld metal is deposited helically and evenly on the surface of the component.

consisting of a FUSARC automatic welding head on a traversing carriage. This is propelled along the runway of a beam approximately 13 ft. 6 in. long by means of a lead screw. Thus the shaft is being rotated and the welding head traversed at the same time so that the weld metal is deposited helically on the surface of the shaft.

One of the supporting columns carries a tilting turntable suitable for supporting a wheel 4 ft. in diameter. This can be tilted through 90° and also raised and lowered by handwheel for appropriate welding heights.

When this turntable is tilted to the vertical position it forms a headstock which, together with a tailstock at the other end of the machine, is used to support and rotate the shaft. The tailstock is adjustable to accommodate shafts of various lengths.

A change speed gear box is provided so that the rotation of the turntable is locked with the traverse of the welding head to maintain a continuous weld.

General Data for work of this nature, using NORMEC electrode is as follows :—

Diameter (ins.)	Current (amps.)	Electrode Gauge	Forward Travel per. rev.	Rotary Speed of job in revs. per. sec.	Arc Voltage
1⅝″ – 1¾″	120	10	3/16	40	25
1¾″ – 2″	120	10	3/16	45	25
2″ – 2½″	150	8	¼	63	25
2¾″ – 3″	200	6	¼	68	25
3″ – 4″	200	6	¼	83	25

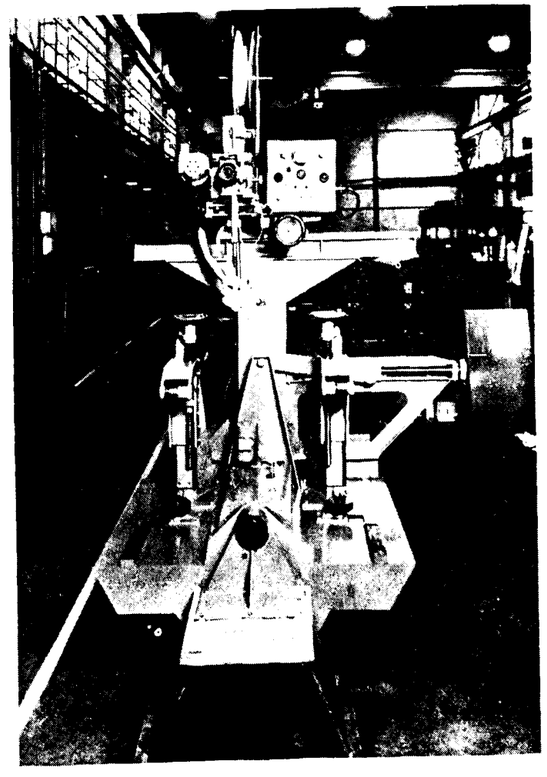
On smaller diameter work the welding current is lower since overheating of the workpiece would occur at higher currents. The speed of rotation is also slower for the smaller diameters since the weld deposit would tend to run away at higher speeds.

The depth of deposit is approximately ¼ in. with the first run and 3/16 in. on succeeding runs. Two runs are, of course, usually sufficient for building-up most classes of work.

The same equipment may also be used for the rebuilding of grooves and edges of piston heads and the rebuilding of the inner faces of bogie wheels.

WHEEL TYRE REBUILDING

The railway wheel tyre rebuilding installation is designed for rebuilding tyres where the wheels remain on the axles throughout the operation. In the U. K. this is used only for welding wagon wheels, where the carbon content is in the order of 0.4%. It is not practicable to weld locomotive wheels since they have a higher carbon content and are prone to cracking. FERROMEC continuous covered electrode is most suitable for welding wagon wheels and the welding speed would be 6 in. per minute at 350 amps. and 20–22 arc volts. The welding time for one layer would thus be 20 minutes. The minimum thickness of tyre



Wheel tyre rebuilding installation. The wheels remain on the axles throughout the operation. The lower part of the machine comprises a bed which may be tilted in either direction so that the welding nozzle may be applied at the correct angle to the flange of the wheel.

(N.B.—The machine here shown is a demonstration set-up on trestles : in practice the tilting bed would be sunk within a pit and the wheels would be rolled onto the bed on rails laid in the workshop floor.)

which can be welded is 1¾ in. and, since most tyres take four layers to complete the build-up, the total welding time per tyre would be 1 hr. 20 mins.

The machine illustrated on page 5 is suitable for wheels having a gauge of 3 ft. 6 in. and a range of diameter across the thread from 700 mm. to 1000 mm. It comprises a vertical column carrying a runway along which traverses an automatic welding head. The carriage carrying the head can be traversed by a handwheel for positioning the head correctly in relation to the wheel.

The lower part of the machine comprises a bed which swings by means of pivots. It may be tilted in either direction and the welding head can be applied at the correct angle to the flange of the wheel. The tilting action is operated through a worm and worm-wheel by a handwheel. The tilting bed is provided with two hardened drive rolls which are rotated by a variable speed geared motor unit to give a welding speed range of 5 in. to 20 in. per minute. The speed variation of the rollers is controlled from an instrument panel incorporated with the welding head.

In operation, the wheels on their axles are rolled onto the bed from tracks which would be laid in the workshop floor. After positioning on the tilting bed they are located by adjustable rollers which engage with the axles.

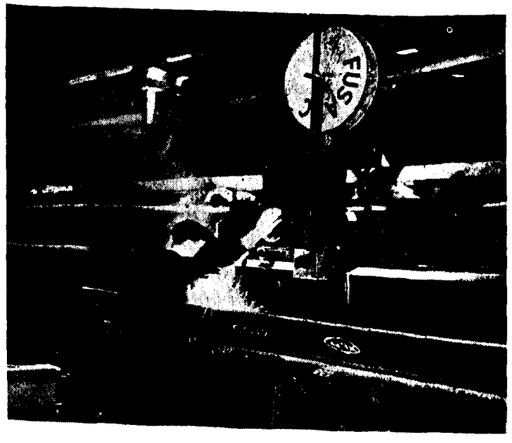
ADVANTAGES OF AUTOMATIC WELDING

There are several automatic welding processes in general use but they all have certain features in common. The principal advantages of automatic welding are, firstly, much faster actual welding speeds are possible since much higher welding currents can be used than is possible with manual welding. Currents up to 2000 amp. are increasingly being used with automatic machines. Secondly these automatic processes all employ continuous electrode which permits a greater duty cycle. Welding for long periods is possible uninterrupted by the changing of electrodes. Thirdly, by the use of higher welding currents, deeper penetration is possible and the number of passes required is greatly reduced. This deep penetration also means that less edge preparation of the plate is usually required. In addition to these major advantages is the reduced distortion due to its speed that is a feature of automatic welding and the smoothness of the welds means that less finishing is required. All these points combine to mean that the ratio of actual welding performed to total time spent on the job is enormously increased.

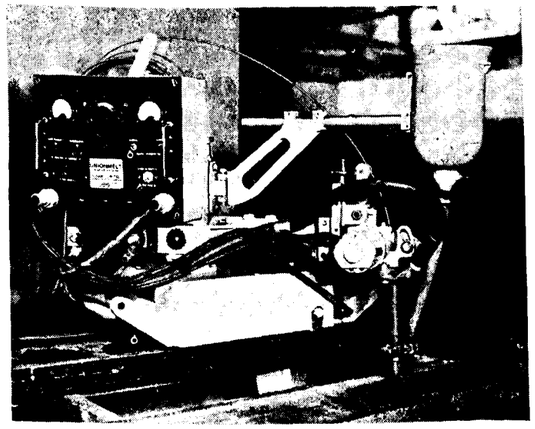
The smoothness of automatic welding is achieved by the way in which the arc length is kept completely constant. The means of this constancy, despite variations in welding current, plate undulations and other irregularities is somewhat complex and differs slightly with the various processes but the result is the same, and smooth, consistent, high quality welding is assured.

In the UNIONMELT process, the submerged arc principle is used whereby weld metal from a continuous bare wire electrode is deposited through a blanket of powder which acts both to protect the molten metal from atmospheric contamination and as a fluxing agent. Some of this powder fuses during welding to form a slag which easily peals off the weld when cool. There are thus no losses by spatter and vaporisation and, as the arc is submerged, no protective accessories are required.

The FUSARC process is an open or visible arc method. The continuous electrode comprises a core wire surrounded by a number of helically opposed auxiliary wires into which the flux is extruded. A recent development is the FUSARC/CO_2 process in which the welding head is basically the same and the same type of covered electrode is used. In conjunction with this, however, a shroud of carbon dioxide gas is used to give additional shielding of the arc. The combination of flux and gas shielding allows further increased welding speeds. An outstanding feature of this process is that high-quality horizontal-vertical fillet welding can be



A FUSARC automatic welding machine making horizontal-vertical fillet welds. The fabrication is positioned at the correct angle and the welding head traverses along the beam.



A UNIONMELT self-propelled welding machine. This is particularly useful where long straight lengths of weld deposit are required. For other applications, the machine may also be used stationary and the workpiece manipulated.

performed very rapidly. Great depth of penetration is possible and, just as important, an extreme degree of control can be exercised over the penetration; the process can thus be equally well employed on thick or thin material.

The other principal method of automatic welding is SIGMA where a bare wire electrode of comparatively thin diameter is used. The arc and weld metal are protected from contamination by a shield of inert gas, largely or entirely argon. Extremely fast welding speeds are possible and this results in the minimum of distortion. No fluxing agents are used and de-slagging is thereby eliminated. The welds are to the highest radiographic standards with a clean, smooth appearance and may be painted immediately the metal is cool. Most metals over 16 gauge and aluminium down to 18 gauge can be successfully welded by the SIGMA process.

Automatic welding heads of all the foregoing types, of course, need to be used in conjunction with automatically controlled relative movement between the welding head and the workpiece. This, in fact, provides the welding speed and the movement may be achieved, as was mentioned earlier, by rotating or traversing the workpiece on some form of mechanical manipulating equipment. Alternatively the work may be kept stationary and the welding head itself may be traversing. Where it is built into a machine it may be propelled at the required speed through a lead screw. It may be preferable for certain applications, particularly where long straight welding runs are required, to have a portable self-propelled welding machine into which the welding head is built. In the case of UNIONMELT welding heads these may be incorporated in a tractor which travels along a length of track which is aligned with the seam. FUSARC and FUSARC/CO_2 welding heads may be built into machines, that require no track, but can have car-type steering so that the operator merely guides the machine along the seam. These too, however, may, if necessary, be adapted for running along a track.

A FUSARC self-propelled welding machine. No track is required with this machine, since it is fitted with car-type steering, the operator merely guiding the machine along the joint.

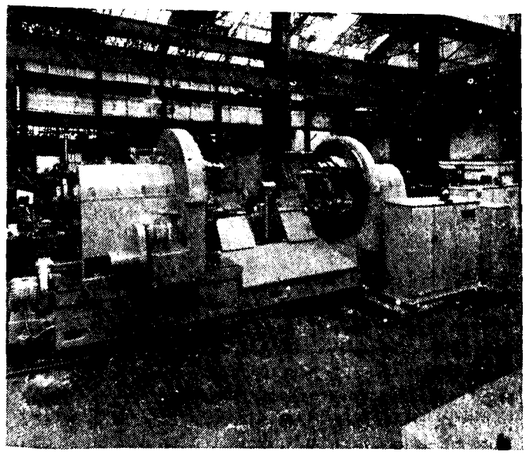
The choice of the type of equipment required will, of course, depend on many factors; a principal one being the amount and frequency of any particular class of work.

Scottish Machine Tools for Railway Workshops

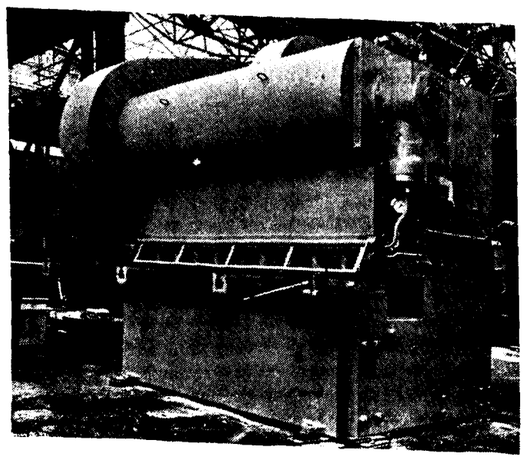
[Scottish Machine Tool Corporation are represented in India by Rallis India Limited.]

SCOTTISH Machine Tool Corporation continue to maintain their close association with Railway Workshops both in India and elsewhere. Among the recent developments which they are now offering for sale are fully automatic profiling attachments for heavy Wheel Lathes using tungsten carbide tooling and high speed rail planing machines of exceptional strength and power designed to utilise tungsten carbide tools.

Among some of the more interesting contracts recently obtained from the British Railways in connection with their modernization programme has been one for supplying approximately half of a large quantity of Axle Journal Re-Turning Lathes fitted with grinding heads. These machines will be employed exclusively in the conversion of axles intended for plain bearings to be suitable for mounting the roller bearings which are being generally adopted now through British Railways. The Corporation are also building a batch of standard Railway Planing Machines for a Central Railway Shop and these Planers are provided with speeds up to 120 f. p. m.



LOUDON Rear View of 6'–3" Locomotive Wheel Lathe



Bennie 8' × ½" Guillotine Shearing Machine

Owing to the diversity of the range of machines built by Scottish Machine Tool Corporation they are also able to provide a variety of other machines in connection with rail working such as rail curving rolls, fishplate punching machines and heavy duty bearing plate punching and cropping machines while for carriage and wagon works they can also supply guillotines, gang punching presses for working on the coach frames, press brakes and plate folders, notching machines and spring plate finishing presses for the cold working of spring laminations. This last machine has been supplied to a number of Indian Railway workshops where it is achieving valuable economies by eliminating the expense of heating the spring steel bars and by making simpler handling possible. Other machines recently delivered to the Indian Railways include an Axle Journal Lathe for working with mounted locomotive wheel sets and a heavy duty wheel lathe having 6'—0" diameter faceplates.

Role of Asquith Machine Tools in Railway Workshops

THE range of machine tools manufactured by member companies of the Asquith Machine Tool Corporation includes many machines applicable to the construction and maintenance of railway locomotives, rolling stock and equipment.

Asquith O. D. Type Radial Drilling Machines are to be found in railway workshops all over the world. These machines are made in a wide variety of sizes up to a maximum radius of 12 ft. and capacity to drill from the solid in mild steel up to 5 in. diameter.

Asquith Radials are well-known for their high productive capacity and a design aspect which contributes to this advantage is the grouping of controls for convenience of operating and for visual as well as manual simplicity.

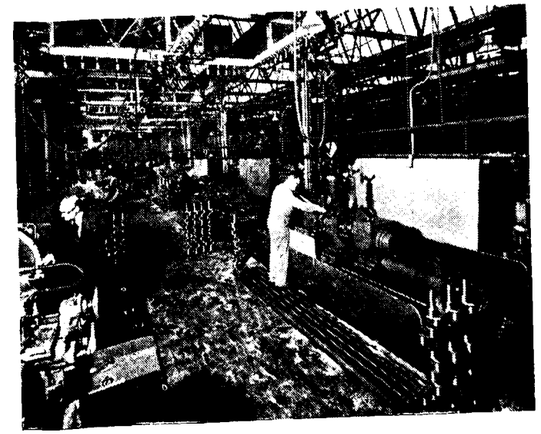
The O. D. 1 Type Radial has a nominal drilling capacity of up to 3 in. from the solid in mild steel. A range of 12 spindle speeds is provided and 4 spindle feeds are available as standard. If required, a 6-feed box can be supplied.

For tapping operations reverse to the spindle is obtained electrically, eliminating mechanical clutches with their incidental conditions of wear and adjustment. The efficiency of this principle is demonstrated in the works of many users where quite often twenty reversals a minute are made continuously on production operations.

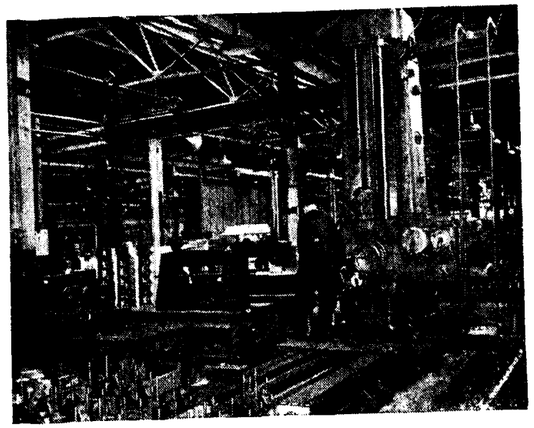
Anti-friction bearings are introduced wherever they can be usefully employed on O. D. Radials and a highly efficient system of lubrication is another feature which contributes to the long, accurate, trouble-free operating life of the machine.

Another Asquith Radial which is widely used for railway applications is the Structural and Plate Drilling Machine, type E. G. C. This may be regarded as a simplified version of the O. D. Radial, specially designed to provide structural engineers with simple, fast, holemaking equipment. This machine is available with a variety of mountings such as traverse bed for drilling loco frames, large structural members, etc.; bogie base for plate drilling; box bed for general purpose work, etc. Drilling capacity of the machine with three speeds, is up to 2 in. from the solid in steel. If required, 12 speeds can be provided and a capacity of 3 in. in steel is then possible.

Machines of particular value for repair work and for holemaking in large workpieces, are the Asquith Portable Universal Radial Drilling Machines. These are designed so that the machine can be brought to the work and positioned as required. This type of Asquith Radial is made in two types. The smaller capacity machine, which drills up to 2 in. from the



A double line of DRUMMOND "Maximatics" employed for crankshaft turning for diesel engines.



ASQUITH H. R. G. 4" Spindle Horizontal Boring Machine, set-up to work with three worktables.

HOW TO RESERVE ACCOMMODATION

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

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

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

Tickets will be issued only if accommodation is available.

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

Reservation fee is not refundable.

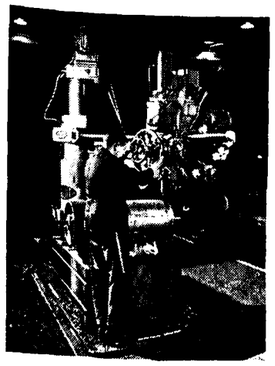
III Class seats are also reservable on Express and certain other important trains for long distance passengers from the train-starting stations on payment of a reservation fee of 4 Annas per seat.

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

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

(Inserted in the interests of Travelling Public)

solid in steel, is provided with bogie bed allowing horizontal traverse to the column on the bed itself, which has wheels and screw jack supports to take the weight when drilling.



ASQUITH O. D. 1 Radial Drilling Machine, drilling a drum.

ASQUITH E. G. C. Radial Drilling Machines drilling large girder for structural engineering.

The larger type of machine for drilling up to 2½ in. from the solid in steel, has a radius of 7 ft., and a bed giving 5 ft. 6 in. horizontal traverse is supplied.

Horizontal boring is another field of railway engineering where Asquith machines figure prominently. A very wide range of types and sizes of Asquith Horizontal Boring Machines is manufactured and covers every requirement. In fact, the latest Asquith machine of this type is one of the largest in the world, with a 10 in. spindle and 100 h. p. spindle driving motor.

The H. R. G. machine is a popular general engineering machine with 4 in. spindle. All operating controls are grouped on the front of the spindle slide, and a good selection of speeds and boring and milling feeds is available.

Machine tools manufactured by Drummond Bros. Ltd., Guildford, of interest to railway engineers, include Gear Shaping Machines, Automatic Multi-tool Lathes and Copy Turning Lathes. With the increasing employment of diesel traction, machines for gear cutting and crankshaft turning are of growing interest.

The Drummond " Maxicut " No. 3A Gear Shaper is essentially a heavy duty machine for cutting spur and helical gears up to 18 in. pitch dia. by 3/4 diametral pitch.

A 3 h. p. motor mounted in the base casting at the rear of the machine provides the main drive by vee belt to the gear box. Stepped pulleys enable two speeds to be obtained, and these, together with speed changes from the gearbox, permit a choice of eight speeds.

SWIFT Lathes turning ball joints in a British locomotive works.

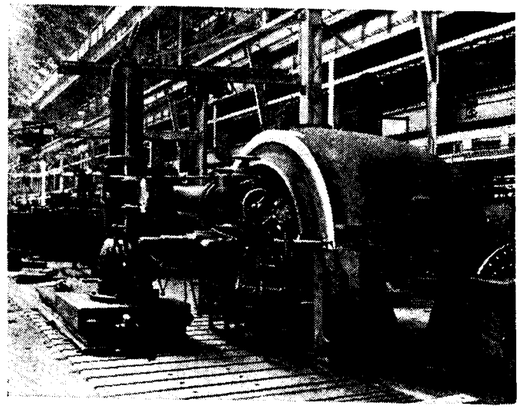
Drives are taken from the gear box to the cutter reciprocating crank and to the feed control box. Two cams on the main drive shaft operate the relieving mechanism.

The feed motions are direct to the cutter spindle and through pick-off gears to the work spindle, enabling them to rotate in unison according to the gear being cut.

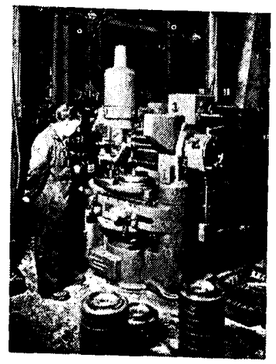
When setting the machine, the required speed and feed are quickly obtained with direct-reading hand wheel selectors.

Non-productive time has been reduced to a minimum by the design features of the No. 3A " Maxicut ", and it has proved ideal for the production of various types and sizes of gears in batches, as well as for long-run high-output production.

Drummond " Maximatic " Automatic Multi-Tool Lathes are essentially high-production machines and



ASQUITH 7′ 0″ Portable, Type PD. 5, drilling a large casting.



DRUMMOND No. 3-A "Maxicut" Heavy Duty Gear Shaping Machine, cutting gears for diesel engines.

are widely employed for petrol and diesel engine crankshaft turning.

The " Maximatic " operates on an automatic cycle. After loading the workpiece, the main control lever is pulled forward and the tool slides commence their cycle of quick infeed, turn and quick return. All motors automatically stop ready for the workpiece to be removed.

Drummond " Maximatics " are made in a range of sizes with capacities up to 15 in. by 8 ft. 6 in.

Lathes manufactured by George Swift & Sons Ltd., Halifax, are to be found in many railway shops for manufacture and repair work. These modern lathes are made in a wide range of standard types with maximum swing up to 72 in. and with bed length to meet requirements.

Surfacing and Boring Lathes are a feature of the range, in addition to the normal types of centre lathes, and hydraulic copy turning has been applied to many types and sizes as required.

The illustration shows a typical installation of Swift Lathes in a British locomotive building works.

INDO-JAPANESE TRADE AGREEMENT

India and Japan have signed a Trade Agreement on Feb. 4 under which both Governments agree to accord each other most favoured nation treatment on a wide range of subjects which include customs, tariffs, imports and exports, and foreign exchange transactions etc. The agreement is valid for a period of two years and will continue in force thereafter subject to three months notice.

According to the schedules attached to the agreement, India will export to Japan, inter alia, industrial raw materials (tanning materials, iron and steel scrap etc.), minerals (iron ore, manganese ore, mica, coal and magnesite etc.). India will import from Japan among other things commodities, such as, iron and steel and other metals (galvanized steel plate and sheets other than iron and steel mill products, aluminium rolled products, copper alloy rolled products, insulated electric wire etc.)

Swing-Over Transfer-Finger Loading

Versatile Method for Automatic Loading of Centreless Plunge-Ground Pieces

AMONGST the numerous methods which have been evolved for the automatic loading of shouldered and similar pieces to the workplate of a centreless grinder, the swing-over transfer-finger method which is now being considerably used by Arthur Scrivener Ltd., of Tyburn Road, Birmingham, has a number of points of interest. The photograph Fig. 1 shows this type of loading mechanism applied to a No. 2 Scrivener controlled-cycle machine, and it will be seen that the action bears a certain resemblance to that of a human hand selecting a piece from a tray or chute and transferring it to the grinding throat of the machine.

The simplified diagram Fig. 2 will serve to explain more clearly the action of the mechanism. The headed pieces are first of all placed in an inclined workchute correctly positioned, that is, with the heads downwards, the end of the chute being fitted with a hook stop. From this chute, the end piece is picked up by the spring-loaded transfer fingers which grip the end of the piece, and under the action of the pinion " C " and the fixed rack " B " swing it over to the workplate between the wheels of the centreless machine. As soon as the piece is in position on the workplate, the forward movement of the piston of cylinder " F " and the push rod " D " open the fingers to free the piece, while

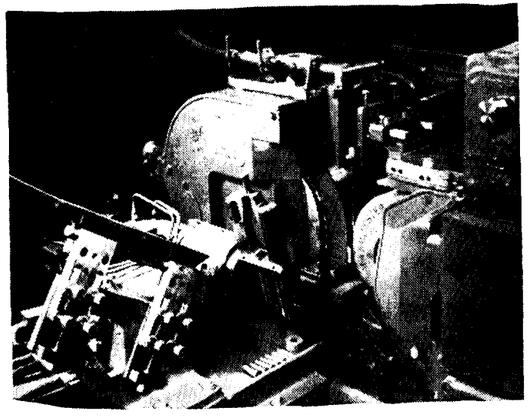


Fig. 1. Automatic transfer-finger loading applied to Scrivener No. 2 controlled-cycle centreless grinder.

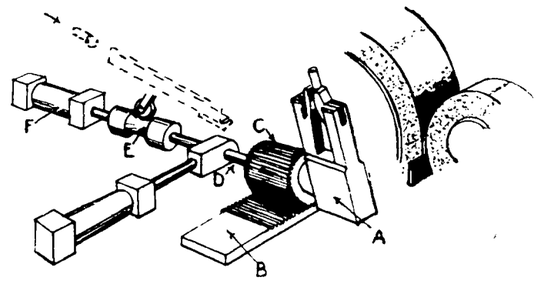


Fig. 2. Diagram showing principle of mechanism.

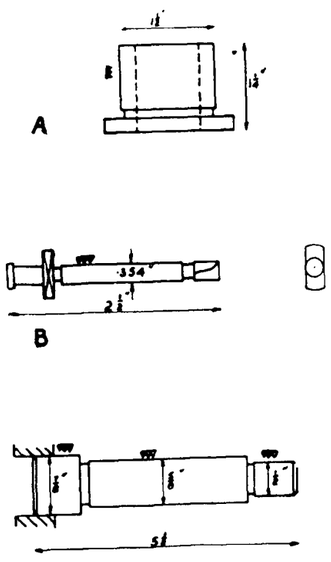


Fig. 3. Some typical pieces and their difficulties.

at the same time the forward movement of cam " E " actuates a limit switch setting in motion the controlled-cycle of the machine which causes the control wheel to close in, thus advancing the piece on to the grinding wheel. While the grinding operation is proceding, the transfer fingers swing back to the delivery end of the inclined workchute, and when the grinding operation is

finished they grip the next piece, while simultaneously the wheels of the machine open again to allow the ground piece to be ejected, thus completing the cycle.

One of the main advantages of the method is its versatility, as a mere change of the removable jaws enables it to be used for a wide range of pieces differing widely in characteristics, such as the types shown by Fig. 3, all of which present certain difficulties for loading by a normal push feed. The piece "A", for instance, has a square shape (diameter and length approximately equal) which is always troublesome to locate or handle automatically; "B" has a head which would rule out the possibility of rolling it into position into the path of a push feed; "C" which is a multi-diameter piece, when handled by the swing-over method, is laid on the workplate with the large diameter slightly over the edge of the workplate clear of the wheels, and is fed forward into position by the so-called "plunge-and-run" process of centreless grinding, the piece being fed into position by the pulling action of the tilted control wheel.

On pieces of the types shown, assuming a stock removal of some .004" and a tolerance for size and roundness of .0002" the normal setting is a 10-second cycle.

GOLDEN RULES OF CONDUCT FOR RAILWAYMEN

1. Do you plan your work daily? Get the more essential things done first and do not neglect the important ones sidetracting them to the fag end of the day.
2. Do not express casually careless opinion. Never venture forth an opinion unless asked for it.
3. Remember that most of our mental worries come either from trying to fight life hard or from trying to run away from life. Do neither.
4. Learn to accept people as they are, love them, respect them, praise them, encourage them, differ with them, but above all, learn the priceless art of give and take.
5. Cry neither for the moon, nor over spilt milk.
6. Accept the things that you cannot change; have the courage to change the things that you can, and possess the wisdom to know the difference.
7. Do not drive too hard a bargain with yourself.
8. Accept life as it is—its wonders, changes, disappointments, frustrations etc., etc.

★

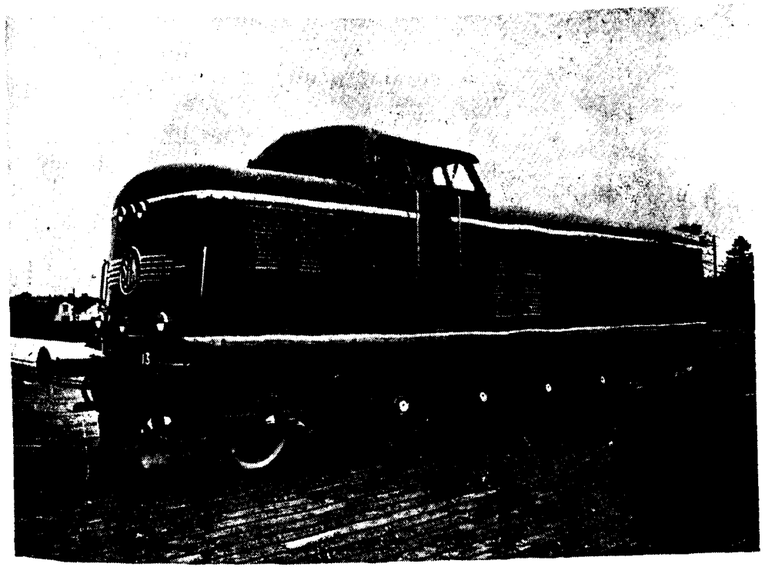
A Locomotive with Diesel-Pneumatic Transmission

Swedish-built Unit on the Geislinger Principle

AKTIEBOLAGET Motala Verkstad, established in 1822 and now belonging to the large Axel Johnson organization, is one of Sweden's dominating engineering works. It built its first locomotive in 1861 and is since then one of the country's largest locomotive manufacturers. A couple of years ago the works delivered a loco. of new type to the Stockholm-Nynas Railway Company in Sweden.

The transmission system in this locomotive was carried out under licence from Doktor L Geislinger's patent. As shown by the adjoining picture the loco. is of type 1D1 with centrally arranged cab with two driving positions. In the front portion of the locomotive is located the cooling apparatus, whilst the engine is installed behind it, followed by the gearbox. Compressor and turbine are mounted on this gearbox. The total weight of engines, gearbox, compressor, turbine, combustion chamber and auxiliaries is 11.4 metric tons.

In the loco., the engine has 16 cylinders and is constructed by Hedemora Verkstæder, also belonging to the Johnson group, under licence from S. E. M. T.—Pielstick. It is a four-stroke engine of the pre-combustion-chamber type (bore 175 mm., stroke 210 mm.); normal output is 1.060 b. h. p. between 1.000 and 1.400 r. p. m. Features of the design include welded-steel engine frame, four-valve cylinder heads, manifolding within the vee between the cylinder banks, separate water pumps for (a) jacket circuit and (b) charger cooler and oil coolers. The engine is three-point mounted in the loco-frame, with fan air compressors at its "free" end. Two flexible couplings are used between the engine and gearbox.



The gearbox connects engine, compressor, turbine and transmission shafts. The differential and the planetary gearing are of Stoeckicht patents. The differential is driven from the engine through a speed increasing gear.

Reducing gear on the turbine side is arranged symmetrically to the differential; it reduces the turbine speed in the ratio of 7.93 : 1.

On the output shaft are arranged two disc couplings giving change from first to second speed. Passing from the first to second speed, for instance, fuel injection in the engine is first reduced to zero; when the engine slows down the first speed is disengaged and the second engaged. Only when the second speed is completely engaged is the injection gear returned to normal working. Special measures have been taken to ensure smooth gear changes without shocks. It is possible to change gear quite automatically as a function of the normal running speed. Drive to the axles is taken symmetrically on each side, using cardan shafts.

Compressor and turbine were constructed by Brown Boveri and Co., of Baden (Switzerland). The two groups are developed from a normal turboblower; all essential parts such as compressor and turbine rotors, inlet housing and outlet of turbine, have undergone no modification. The air conduit from the

compressor is divided into two branches. One portion of this air passes through the air cooler and pressure-charges the engine; the remainder passes to the combustion chamber and thence into the turbine.

Now we turn to the general operating principles of the design. The output of pneumatic transmissions increases considerably if the heat contained in the exhaust gases of the engine is utilized. Moreover, it is of advantage to combine the pressure-charging of the Diesel engine with the pneumatic transmission, so that part of the compressed air is absorbed by the engine. In fact, the output of an air compressor absorbing the whole power of a Diesel engine is much in excess of the amount of such air taken in by the engine, especially if the engine is of the four-stroke type and the charging pressure does not exceed from 14.2 p. s. i. to 28.4 p. s. i.

At high loads the charging pressure increases automatically if the engine speed decreases.

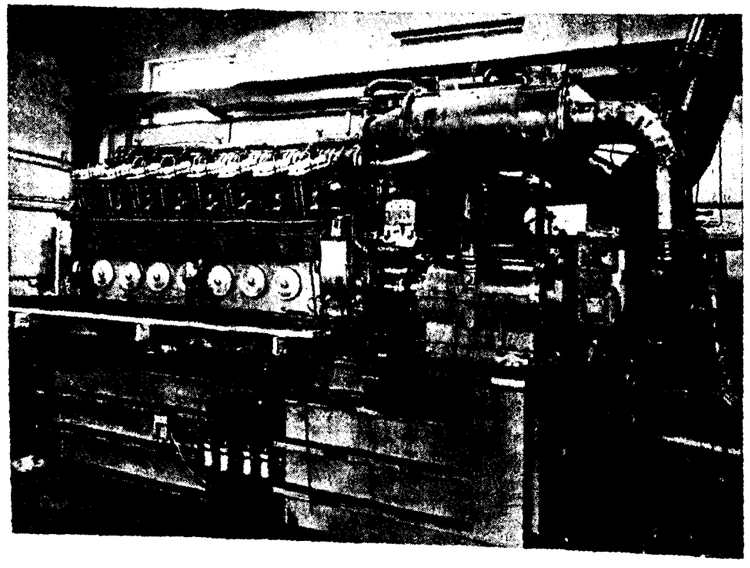
Development tests have shown, on the other hand, that a four-stroke Diesel engine works without difficulty against a back-pressure in the exhaust manifold equal to the charging pressure; in this case the engine can be considered as a non-pressure-charged engine working in a high-pressure atmosphere. With this method of working it becomes possible to mix the exhaust gases with that portion of compressed air not taken in by the engine; this mixture then passes into the turbine. The heat contained in the exhaust gases is thus recuperated, and increases the output of the transmission decisively.

Greater efficiency and output can be achieved if only a portion of the power developed is absorbed by compressor and turbine, providing one succeeds in transmitting to the driving wheels of the vehicle the remainder of the engine power without noticeable loss. The distribution of the power through a differential gear allows this idea to be realized. Such mode of transmission is known and is in use with hydraulic systems.

The general arrangement is shown in the accompanying diagram. The Diesel engine (1) drives through a speed-increasing gear (2) and (3) the planet-carrier (6) of the differential (4) Pinion (5) drives the compressor (11) The crown wheel (7) of the differential has two sets of gear teeth; the inside ones engage the planetary gear wheels, the outside ones engage the gear wheel (8) fitted on transmission shaft (10). The latter drives the rail wheels of the vehicle. A portion of the engine output is thus absorbed by the compressor and the remainder transmitted to the vehicle driving wheels. By means of a reducing gear (8, 9) the turbine (12) transmits power to shaft (10) already referred to.

Part of the air delivered by the compressor (11) is discharged into the inlet manifold (16) of the engine, passing through the air cooler (14). The remainder of this air passes into the combustion chamber (15). The increase in temperature of the air in this chamber gives a considerable power augment. The exhaust gases from the engine pass from the exhaust manifold (17) into the same chamber (15) where they mix with that part of the air not used in pressure-charging the engine.

By means of the differential gearing it is possible to transmit part of the engine power direct and without loss in conversion to the driving wheels at a high degree of efficiency. This division of driving power

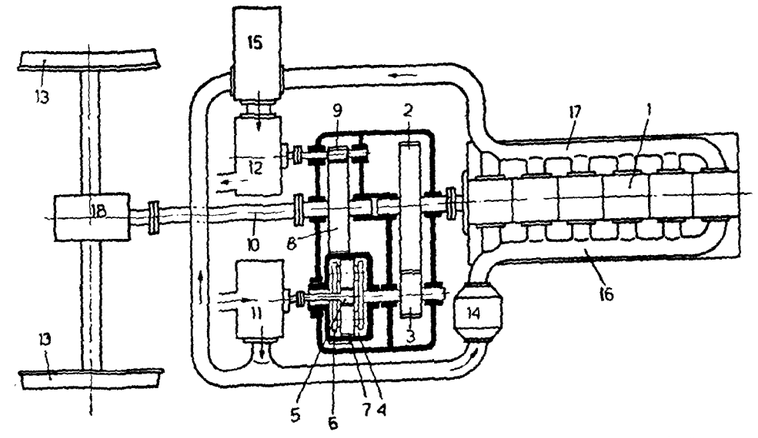


improves the efficiency of the Diesel-pneumatic transmission.

HEAT EMPLOYMENT

Let us suppose that at a given speed, 50% of the power is transmitted direct and the remainder absorbed by the compressor; the compressor then delivers half the quantity of air it would do if the power were not thus divided. The heat contained in the exhaust gases, on the other hand, does not vary. Since the weight of the gas plus air is only one-half, before the turbine entry is much increased, temperature i. e. there results, finally, an increase in the power developed by the turbine and a considerable increase in efficiency of the transmission. The power of the turbine can be possibly higher than that absorbed by the compressor, i. e., transmission efficiency exceeds 1; this is a definite advantage compared with all known transmission systems. This result is due, partly, to the fact that the useful heat of the exhaust gases at the supercharging pressures referred to is well over 40% of the heat contained in the fuel.

The temperature of the mixture of gas and air passing through the turbine is relatively low and only reaches 320°C at full load of the engine. This temperature can be raised by injecting fuel into the combustion chamber. The power of the turbine is proportionate to the absolute temperature of the exhaust gas. This increase of power involves an increase in the specific consumption. Notwithstanding this, the power applied to the driving wheels is about 10% higher than that developed by the engine, taking into account the power required for driving auxiliaries. With all other transmissions this (driving) power does not exceed 75% of the engine power. Increase in specific fuel consumption is hardly more than 10% over that with other forms of transmission. At from 2/3 to 3/4 loading, i. e. the most important state for locomotives, consumption related to power of driving wheels is better than that with other forms of transmission.



Tests of the combination of engine, gearbox and combustion chamber took place at the works of Hedemora Verkstader. The power developed was absorbed by a water brake and measured the optimum consumption to approx. 190 gr. (0,41 lb.) per h. p./hour; from this it follows that losses in gearbox, compressor and turbine are low. With normal turbo-blower the engine consumption is 170—175 gr. (0,37 to 0.38 lb.) per h. p./hour at the same loading. The power delivered by the gearbox output shaft, without the combustion chamber in operation, is from 900 to 940 h. p. at speeds of from 50 to 90 km./hour (31 to 55 m. p. h.).

Summing up it can be stated that without the combustion chamber in operation the output of this transmission, from the points of view of power and fuel consumption, is slightly better than with electric or hydraulic transmission. With the combustion chamber in operation the power transmitted to the wheels of the loco. 10% higher than that of the Diesel engine itself.

As to the power at wheel rims, this locomotive corresponds to a Diesel loco. of 1,400 to 1,500 h. p. with either electric or hydraulic transmission. One of the main advantages of this new loco. is the low consumption at moderate loads, viz. 60—80% of full, whereas the consumption at full load is slightly higher than that of a corresponding Diesel loco. with either electric or hydraulic transmission but considering that full load is seldom used, this point is of small importance. Aktiebolaget Motala Verkstad is now building a somewhat larger four-axled bogie locomotive on the same principle for the Swedish State Railways.

Indian Railways Third Class Sleeping Coaches

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

THE Indian Railways modernisation plan has been further implemented by the construction of six third class sleeping coaches in Eastern Railway workshops at Kanchrapara. These are prototype stock which will determine future designs.

The coaches are equipped with berths in two tiers. The folding upper berths are upholstered in 2-in. Dunlopillo with rexine covering, a notable improvement over the past practice and a step taken to make third class travel more comfortable and interesting. These berths are to serve as sleeping berths and kept in the closed position locked during day light hours and made available to passengers at night on payment of a small surcharge of Rs. 3/— a night. The berths are of timber.

From the point of view of amenities, these cars are a distinct improvement on the 3—tier Janata Sleeping Cars which were introduced about six years ago. These cars meet some of the passengers' complaints about the Janata Cars and add a few new amenities.

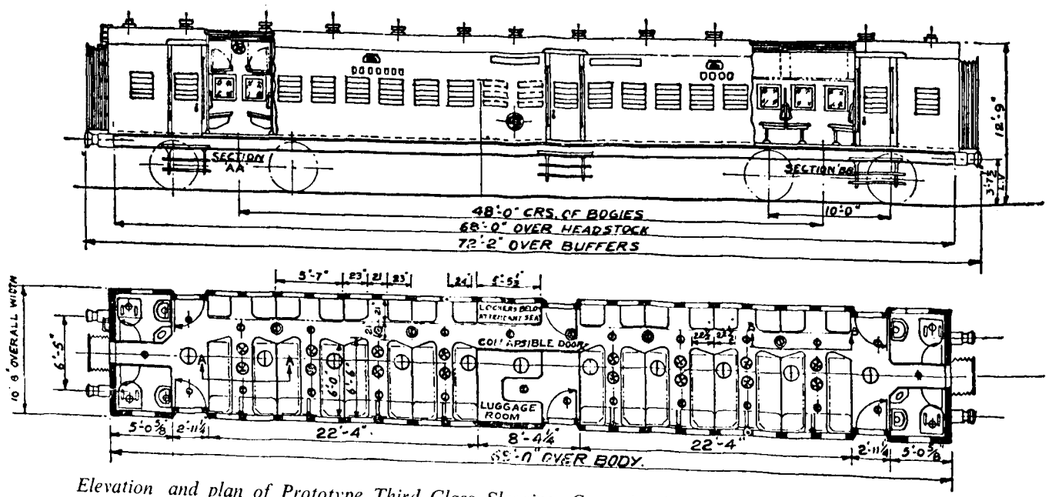
The new service is to operate on the following railways: South Eastern Railway, Northern Railway and Southern Railway, to which these cars have been allotted.

The coaches are of strong timbered construction and 69 ft. over body. Vestibules are included at each end. The bodies with straight sides are 10 ft. 7.3/16 in. over the panels. The body panelling is of 13 G. aluminium alloy sheets. The main roof carlines are of mild steel flat sections of $1\frac{3}{4}'' \times \frac{1}{2}''$ size. The principal dimensions are as follows :—

Length over vestibule end panels	69 ft.
Width over body side panels	10 ft. 8 in.
Height over roof sheets	12 „ 9 „
Gauge	5 „ 6 „
Tare weight	45 Tons. 15 Cwts 2 Qrs.

UNDERFRAME AND BOGIES

The underframe is of riveted mild steel construction to the I. R. S. design with a length of 68 ft. over the headstocks. Draw gear is of the I. R. S. type. The underframe is 9 ft. 3 in. wide over solebars and the body overhang is reduced by fixing body brackets on the sides, ends and corners of the underframe so as to extend the width over the body brackets to 10 ft. 6 in.



Elevation and plan of Prototype Third Class Sleeping Car, showing the Layout of Accommodation.

The bogies are to Indian Railways standard design with a 10 ft. wheel base. They are constructed of riveted rolled steel sections and steel plates. The wheels are rolled steel disc type 3 ft. 7 in. dia. on tread. Inside and outside brake blocks act on all wheels.

Plain bearing axle boxes are fitted in all cases. IRS heavy coil bolster springs are used throughout while the laminated side bearing springs with rubber auxiliary springs carry the individual load on each wheel.

The brake gear comprises the automatic vacuum brake and has two standard 24 in. dia. cylinders; the brake on each bogie being operated by one cylinder.

ACCOMMODATION

Accommodation in each car provides seating for 80 persons and sleeping for 24; the sleeping accommodation is obtained by the provision of hinged upper berths, 16 Nos. placed transversely and 8 Nos. longitudinally. The upper berths are trimmed in brown rexine on foam type rubber cushions.

The seats are arranged transversely affording sufficient knee room for the passengers and inclined to 4 deg. Seats are located at a height of 16" above the floor and are arranged to face each other. In place of the conventional cast iron legs, cantilever type built-up seat brackets have been provided to support the seats made up of timber frame with match boards laid on it. This facilitates easy sweeping and washing of floors. A straight through corridor 1 ft. 9 in. wide connects the vestibules located at the two ends of the coach.

Access is by fixed steps through body side doors, two Nos. of which are provided on each side very near to the ends. In addition to these, two emergency doors located near about the centre, one on each side, have also been provided.

LUGGAGE COMPARTMENT

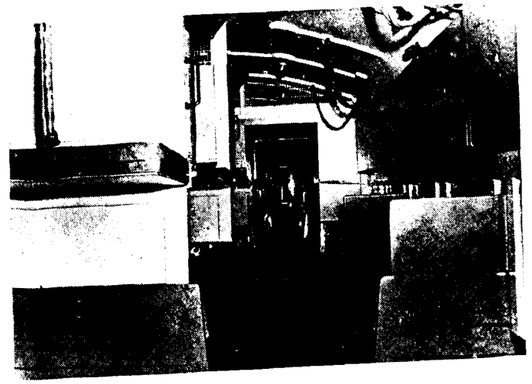
There is a small luggage compartment of $1\frac{1}{2}$ tons capacity in the centre. The intention is to take charge of the passengers' baggages at the time of entraining and return them on completion of the journey.

This compartment is 8 ft. $4\frac{1}{4}$ in. long by 5 ft. $10\frac{1}{2}$ in. wide and is provided with a collapsible gate to form the corridor. A luggage rack is provided in the compartment. Facing the collapsible gate and in line with the single seat, a seat for the attendant with locker below has been provided. The seat is 4 ft. 4.7/8 in. long × 21" wide. The locker is fitted with a sliding door.

The partitions for the luggage compartment and the lavatories, the transverse partitions and the personal luggage shelves are of block board construction and the body interior is finished with plywood. Flooring consists of oxy-chloride flooring composition laid on G. I. P. pattern floor boards.

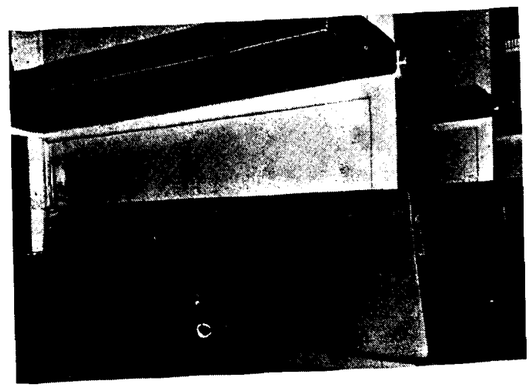
VENTILATION

To provide a free outlet for air being exhausted through the roof, the coaches are provided with 11



Interior of the Car showing the Seats along gangway and arrangement of transverse and longitudinal Upper Berths.

(By Courtesy of Public Relations & Publicity Officer, Eastern Railway)



Interior of the Car showing the Seating and Sleeping Arrangements.

(By Courtesy of Public Relations & Publicity Officer, Eastern Railway)

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CLEANLINESS LEADS TO HEALTH AND HAPPINESS

Clean orderly habits contribute to general health and welfare and as such to happiness and prosperity; they are more important than medicines.

Cleanliness prevents disease; medicine only attempts to cure.

Cleanliness of the person, of the houses and colonies, reflects discipline in the individual and the community. Discipline is the foundation stone for progress of oneself and the country. Cleanliness is a good habit. It is also cheap.

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

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