THE INDIAN RAILWAY ENGINEER

VOL.9 NO.2 OCTOBER 1961. PRICE 50 NP.

CONTENTS

Managing Editor

T. S. N. Rao

Advertisement Manager

B. Amruta

(197)

Analysis of Integrated Transport for the Third Five Year Plan

IF the targets of the Third Five Year Plan are to be fulfilled, and it should be endeavour of the nation to do so, there is no doubt that these will impose an enormous strain the transport capacity of the country.

Passenger Travel

Air Travel : With the rapidly growing population there will be more people wanting to travel whether for business or pleasure or religious pilgrimages. Very few of this vast travelling population would have the financial means of travelling by Air, because that mode of transport is practically monopolised by the rich, and the business executive to whom time is money. But with the establishment of new businesses, the growth of new ones and the expansion of old ones, the number of business executives seeking air travel will throw a big additional burden on air travel, so that many more and faster planes will be required for internal travel alone leaving aside those required for foreign travel where other than Indian Air Companies could meet the demand. The increase in planes for in country travel would mean tighter timing schedules and more air post facilities and amenities. As the country does not yet build transport planes, it would mean purchase from abroad at the cost of much foreign exchange. There is considerable scope in this country for the building of transport planes, with foreign collaboration on the same lines as our Hindustan Aircraft Co. which is now producing the right type of planes for the defence department. U.S.A., U.K., Germany and may be a few other countries would be prepared to come into the Indian Aviation business with capital and technical knowhow if proposals backed by our Government are put up to them. If planes are built in the country, the cost of air transport would undoubtedly be very cheap, and thereby provide an attraction to a larger number of air travellers.

Rail Travel : The Rail Travel is undoubtedly doing its best to meet the increased demand made on it every year with the growing population. But even here there is a physical limit leading up to the saturation of the railway tracks. In the long run it will call for the doubling of our single lines, quadrupling of our double lines at very high capital expenditure where the density of traffic justifies such an expenditure. But the Railways now being a monopolistic Government, concern, the capital expenditure can be found by increasing fares and thereby increasing earnings within reasonable limits.

Road Travel : With the stepping up of road building in the country, there is plenty of scope of Inland State Transport to expand its capacity, by going in for more buses and even luxury buses which would attract in addition to Third Class Rail Travellers even the Upper Class travellers. One has only to go to the U. K. and the Continental countries to see the enormous strides made by road transport. In England for instance, there is hardly any city or town of any importance or places of enjoyment and sight seeing which are not approachable by the ubiquitous luxury bus. On

AXLE-SUSPENDED TRACTION MOTOR FOR D.C. AND RECTIFIED A.C.

A SELF-VENTILATED axle-suspended traction motor has recently been developed by Crompton Parkinson Ltd., the motor, designated type C.152, being suitable for operation on D.C. systems and on rectified single-phase A.C. at industrial frequency. Commutation is very satisfactory even with ripple up to 30%, and with terminal voltage 20% above rated voltage, this being the result of skilful detail design. It is designed for a rated voltage of 750 volts, but is insulated for operation on a 1500 volts supply, and is therefore applicable to rectifier vehicles in dual operation on single-phase 50-cycles A. C. systems as well as on 1500 volts D. C. systems.

The motor conforms in every respect with B. S. 173, and is Class 'B' insulated throughout, armature and field coils being fully bakelised. Field weakening is obtained by means of tappings.

The ratings of the C.152 motor on rectified single-phase, 50-cycles A. C. are shown below.

Similar motors can be supplied for larger outputs—as required for main line locomotives, with forced ventilation and suitable flexible transmission. Alternative versions available have special high speed construction and lower outputs for use with cardan-shaft drives to high-ratio right-angle drive gearboxes.

The following ratings are those of the prototype machines having Class 'B' insulation; Class 'F' insulation is also available, and correspondingly higher ratings can be expected.

Self-ventilated axle-suspended traction motor type C 152, made by Crompton Parkinson Ltd. This motor has been designed for operation on D.C. or on rectified single-phase A.C. at industrial frequency, with up to 30% ripple.

C.152 Ratings at 57.5% Full Field on Rectified Single-phase 50 c/s A.C.	*One Hour*	*Continuous*
Output, h. p.	205	175
Amperes	225	190
Volts	750	750
Speed, r.p.m.	1500	1620

Maximum Service Speed—2580 r.p.m.

Weight complete with pinion and gearcase—4214 lb.

WORLD'S LONGEST ELECTRIC RAILWAY

Work is nearing completion on the electrification of the world's biggest railway line from Moscow to Irkutsk. Its length is 5,3000 kilometres. It is almost 50 per cent longer than all the railways of the United States using electric traction. The annual coal economy on this line will amount to 18,000,000 tons. The speed of trains will be much greater. Some 204,000 posts and 194 substations were needed to switch over the line to electric traction.

New locomotives will be used on the Moscow-Irkutsk stretch. For the first time in the practice of railroad building, for instance, the line uses alternating instead of direct current on a big stretch. This, among other things, has yielded a big economy of copper.

BRITISH RAILWAYS TO USE ELECTRONIC SIGNAL INTERLOCKING

By An Engineering Correspondent

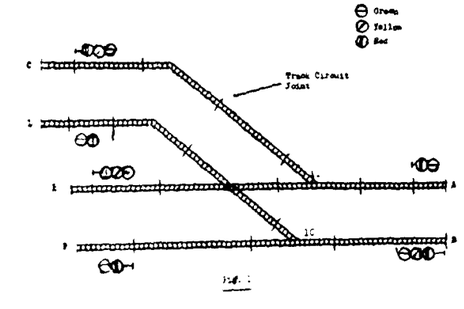
AS part of the Railway's modernisation programme, the British Transport Commission recently awarded a contract to Mullard Equipment Ltd. for the development of an electronic signal interlocking plant. The equipment will be the first plant using electronic interlocking to be used on British Railways and will replace the mechanical interlocking on the lever frame at Henley-on-Thames Western Region signal box. It will be installed during the summer of 1961.

The technique used has the substantial advantage that it employs solid state electronic circuitry throughout resulting in a system which eliminates the use of moving parts, thus greatly reducing long term maintenance costs.

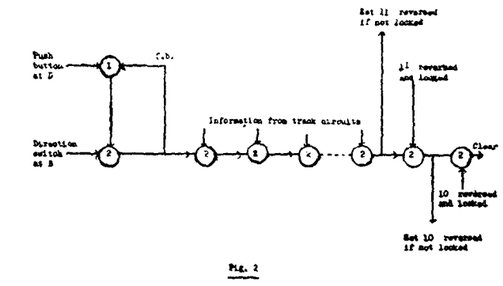
In December last the system was demonstrated to British Railways' Signal Engineers using a model of a double junction.

The model works on the conventional "entrance-exit switch and push button" system, and track and point indication is provided. The only relays used are track relays and, for convenience in the demonstration, these are of the Post Office type.

To set up a route on the model, for instance, in the direction B to D (see Diagram 1), the direction switch at B is set to direction B to F and the exit button at D is pressed. This action results in the points 10 and 11 being moved to the reverse position. These points are interlocked and the sequence is that 10 is reversed first and when it has been detected as being reversed, the points 11 are reversed. However, this route B to D can only be called provided that the information from the track circuits involved indicates that there is no vehicle on the track and also that the points are not locked — that is to say, that a conflicting route has not already been set up.



A simplified example of a sequence of events is shown in diagram 2.

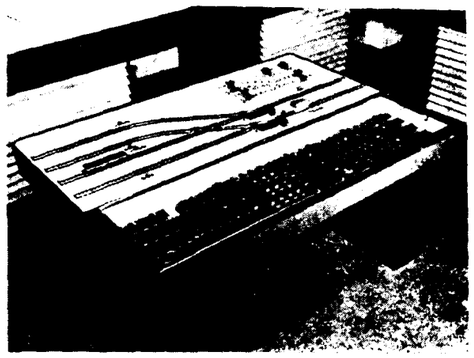


The pulses from the push-button at D is fed to an "Or" gate which sets up a feedback path to maintain the circuit. The output from the "Or" gate is fed, together with the signal from the switch at B, to the "And" gate which then — and only then — gives an output to the first track circuit "And" gate.

This input together with the input from the track circuit (providing this is clear) will result in an output to the next track circuit "And" gate and so on. After 11 the track circuits have given the information that they are unoccupied, the points 11 are reversed, providing they are not locked, and the signal from the track circuits together with the information that 11 is now reversed and locked is fed to another "And" gate. The points 10 are now reversed and locked, and this information, together with the output from the last "And" gate, is fed to the final "And" gate, the output of which clears the signal at B (see Fig. 1).

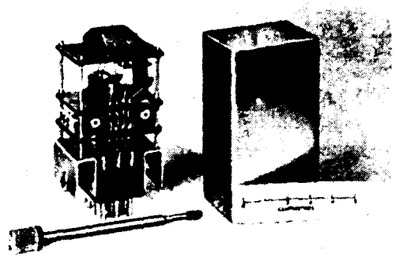
This is a logical process and if for any reason the required information does not reach any one of the "And" gates in the chain the sequence will be broken and the route will not be cleared. When a route has been cleared and a train travelling in the direction B to D, for example, has passed over the first track circuit in the route, the signal is automatically returned to red. Although the direction switch is still set, this route cannot be used again, by pressing the exit button, until the whole sequence of calling has been repeated.

In addition to the interlocking of the points and the use of track circuits, there is also a device whereby if a signalman has set up a wrong route (B to F instead of B to D for instance) he is unable to reset the route immediately if a train has already entered the approach track circuits. He can however set all the signals to



Model of a typical double junction layout controlled by the system. Developed by Mullard Equipment Ltd. for British Railways, the system uses transistorized plug-in electronic logic units (seen in the foreground).

red, and after a suitable time delay to allow the train to stop the route can be reset. Obviously if this device were not included a signalman would be able to reverse the 10 points, which may not complete their movement before the train reached them and thus cause a derailment.



The system of electronic signal interlocking developed by Mullard Equipment Ltd. for British Railways is constructed from transistorised plug-in logic units.

The logic system can therefore provide an anti-preselction device and an approach locking device to meet signalling requirements.

Track circuits of the normal type are used.

The electronic logic units from which the system is constructed are of the plug-in type They are designed to operate safely in ambient temperatures between -20°C and +50°C. They employ Mullard transistors, semi-conductor diodes and ferrite cores.

The "fail-safe" electronic technique outlined is based on the Company's experience in the application of modern electronics to safety problems. The present equipment has been designed to meet the requirements of British Railways, but it is generally applicable to railway systems anywhere in the world.

RAIL ELECTRIFICATION RENEWAL CONTRACT FOR AEI

Associated Electrical Industries Ltd. has been awarded a £ 105,000 contract by the British Transport Commission for renewing existing power feeders on five sections of Southern Region track in the Brighton and Sevenoaks areas.

The five sections lie between Keymer Junction and Pangdean, Lancing and West Worthing, and Chelsfield and Sevenoaks. The contract involves the supply, supervision of the laying and jointing of 33 kilovolt, 3-core, oil-filled cable, with aluminium conductors and corrugated aluminium sheath.

The work will be carried out by AEI Construction (Cables and Lines) Division. The cable will be manufactured by AEI Cable Division at its Gravesend Works.

Petzing & Hartmann's Range of Bandsaws

By An Engineering Correspondent

RANGE HS CUT-OFF BANDSAWS

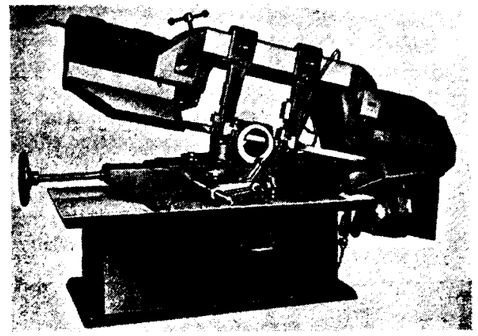
FOR sawing off bars, profiles, tubes etc. of steel, hard and light alloys up to 250, 330 and 530 mm 0 Messrs. Petzing & Hartmann delivers a number of *Horizontal band-sawing machines for metal cutting*, fully automatic up to 200 mm 0 .

The horizontal bandsawing machines excell in great economy, a minimum of cutting loss, continual cutting process and reduced tool costs.

The advantages of these horizontal cut-off bandsaws most clearly come forward in the fully automatic model *Roboter 200 S.* With a cutting section of 12 mm the cutting loss is abt. 10%, with other cutting methods, it is as high as 25-40%. The daily saving of man-hours is quite considerable as one operator can be in charge of several machines at one time, no supervision is necessary, the Roboter even does its work at meal times and after works have closed!

The *combined horizontal and vertical bandsawing machine model HVS 260* is adapted for horizontal cuts up to appr. 260 mm 0 , just as type HS 260, and with a simple manipulation it can be changed to a vertical bandsaw. For contour sawing a further set of saw guides with inserts for 6, 8, 10 and 13 mm width are available. A hydraulic feed regulating valve guarantees an automatic accommodation of cutting pressure and feed to the different kinds of material. This machine has a stepless variable cutting speed of appr. 20-60 m/min.

The Heavy cut-off bandsaw model HS 530 works with bandsaw blades of 38 mm width and cuts solids and tubes up to 530 mm. When cutting on this machine a shaft of for inst. 500 mm 0 14 kg. costly material, otherwise lost as chip waste, are being saved with each cut compared with a circular saw. The saving of material comes up to many tons a year. This bandsaw has a cutting speed range from appr. 12-60 m/min. stepless variable, for cutting of steel, cast iron and hard alloys.



Model HS 260

As *model HSL 530* this horizontal bandsaw is equipped with a cutting speed range of appr. 12-350 m/min. for the supplementary sawing of light metals.

The range of production of Petzing & Hartmann includes the *heavy duty contour bandsawing, filing, grinding and polishing machines*, 400 and 900 mm throat capacity, in various executions, light metal-cutting bandsaws in various sizes and friction cutting bandsawing machines of 400, 600, 800 and 900 mm 0 of saw pulleys, woodcutting bandsaws (artificial material, bakelite etc.) of 400—1250 mm 0, 66 types altogether.

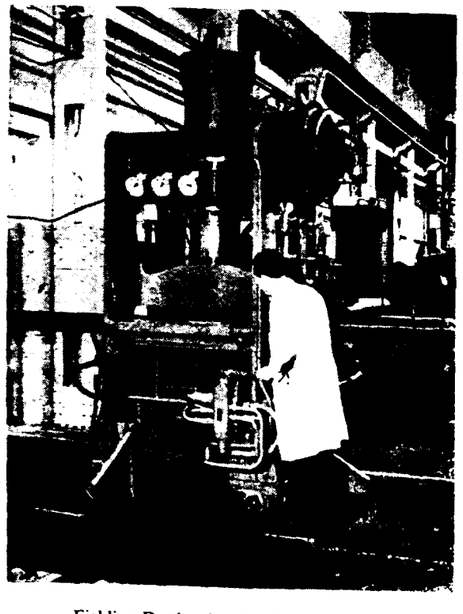
'Fielding' Duplex Hydraulic Rail Straightening Press for Continuous Welded Rail

THESE machines were designed and developed by Fielding & Platt Limited, to meet a growing demand for a type of machine which would be suitable for straightening either individual rail ends prior to welding or continuous lengths of welded rail. Following discussions with British Railways it was decided to manufacture either a fixed type of machine for the former purpose or a mobile machine for the latter purpose which could be moved along a railway track which would form the basis of the rail welding production line.

An important feature of these machines is their ability to straighten rails bent about either the major or minor axes without the need to turn the rails over. The former is carried out by means of a vertical cylinder and ram assembly, whilst the latter is effected by a horizontal cylinder and ram assembly mounted in the back of the press frame. Both presses are of the closed frame type. The frame comprising two main side members profiled from rolled steel plate of suitable thickness. The cylinder housings and the resistance crossheads for both the horizontal and vertical ram assemblies are fabricated integral with the frame, thus resulting in a substantial and rigid structure. Machined guideways are provided for the moving beams which are attached to the face of the vertical and horizontal rams.

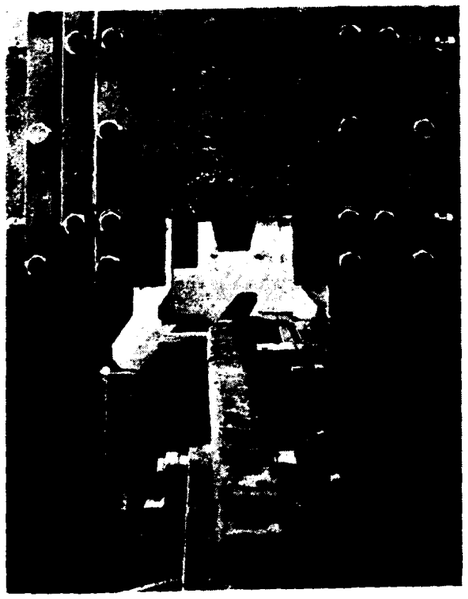
The cylinders are of cast steel and accommodate rams of the double acting piston type. To facilitate withdrawal of the rams for maintenance purposes removable end plugs are provided in the ends of both cylinders. The working faces of the vertical moving and fixed resistance beams are provided with longitudinally dovetail slots to accommodate flat faced dies. These are adjustable so that either 'hogged' or 'dipped' rails can be treated.

The working faces of the horizontal moving beam and fixed horizontal beam also accommodate dies which are provided to treat various types of flat



Fielding Duplex Rail Straightening Press
Mobile Type

Fielding Duplex Rail Straightening Press
Fixed Type



Bent Length of Flat Bottomed Rail Placed in Press
Prior to Straightening

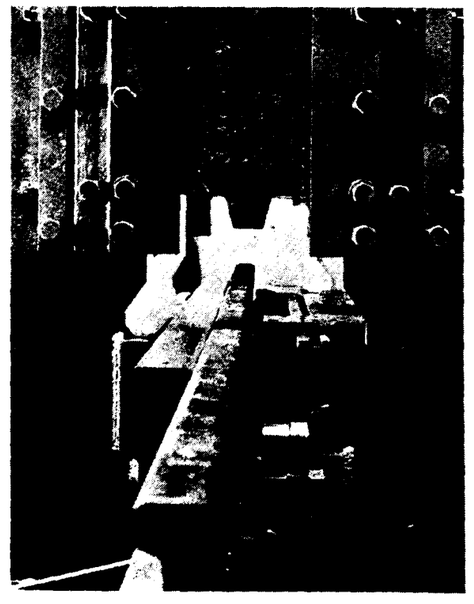
bottomed rail. The centres of these horizontal dies are adjustable for either outward or inward bent rails simply by adjustment of the centres of the dies. The minimum centres which can be obtained is $1\frac{1}{2}$" and is thus arranged to accommodate the weld flash.

Adjustment of the top vertical dies is carried out by hand and loose pins are provided for location purposes. The adjustment of the bottom vertical dies together with the front horizontal dies is also carried out by hand using hand wheels situated on the operator's control desk, as also are the back horizontal dies, although by means of a separate hand wheel.

Rail support rollers are provided one on either side of the press for lifting the rail being straightened between straightening operations. These rollers are of the lifting and lowering type and actuated by pneumatic lifting and lowering cylinders which are controlled by air valves on the press control desk. The roller on the ingoing side of the press is of the flanged type and these rollers are provided with a mild steel ramp to prevent damage when rails are fed into the machine.

The press is controlled by two valves of the 'Deadman Handle' piston type, one for controlling the vertical ram and the other for controlling the horizontal ram. Upon release of the control levers the rams are arrested, the valves being returned to the neutral position. No further movements taking place until the control levers are put to the pressing or return positions.

The complete mobile machine is carried on four flanged wheels suitable for mounting on rail track and the left hand front wheel is coupled through a chain drive to a hand wheel placed adjacent to the operator's control desk thus facilitating adjustment of the complete press along the track. The machine is completely self-contained with its own Fraser Derisine pump unit together with a combined pump supply and air charged tank and a suitable motor driven air compressor set. This compressor will also provide the



Flat Bottom Rail in Press after Straightening

necessary supply of compressed air for operating the rail lifting and lowering support rollers. A suitable air filter and lubricator together with all self-contained air and hydraulic piping and electrical wiring is included.

(Continued on page 10)

REFUELLING OF DIESEL LOCOMOTIVES

*By E. L. Knowelden**

REFUELLING WITHOUT SPILLAGE

THE increasing use of diesel locomotives and the need to refuel them as rapidly as possible to obtain maximum utilization has brought with it refuelling problems.

When the percentage of diesel engined stock was small, refuelling was usually the concern of one man who was able to devote sufficient care and attention to ensure that such spillage was minimised. However, with larger numbers of locomotives requiring replenishment at an establishment with multi hose points, it has been found impossible to prevent considerable quantities being vented. The usual practice of filling until fuel issues from the vents is highly undesirable, but is understandable when one considers that the air space will perhaps be as low as 2½% of tank capacity and gauges totally inadequate to detect the fuel level in time to either shut down the pump or disconnect the self-sealing coupling.

Such spillage brings with it many disadvantages. The obvious fire risk can be guarded against to some extent if sufficient regulations can be enforced, but the disfigurement of the refuelling installation leads to the shifting of track ballast and the eventual pollution of streams and drinking water, together with the psychological disadvantages of personnel working in dirty surroundings which leads to slovenly maintenance. The cost of the fuel saved is of course considerable and usually shows up as a sudden improvement in fuel consumption figures when quantities are booked to individual locomotives. A valve will save its own cost in fuel in six months on a main line locomotive which is fuelled once per day.

If the locomotive has a connected tank system it is impossible to fill all tanks at a uniform rate even with large dia balance pipes. The manufacturing tolerances present in the various refuelling galleries, bends, elbows etc., mean that one tank at least will lag behind the remainder. We have proved this point by rig testing with piping manufactured under close tolerances conditions. It is therefore essential for locomotives having several fuel tanks to fit Refuelling Control Valves.

These problems are not peculiar to locomotives and have been met and overcome by my own company for example in a variety of installations commencing with the refuelling of the "Empire" Flying Boats in 1937. These aircraft were the first to be refuelled through self-sealing couplings and, as may be expected, suffered from venting problems due to asymmetric pipe runs. The solution was found to be float controlled tank mounted shut-off valves. Subsequently all military and commercial aircraft were fitted with similar valves making spillage a thing of the past. Similar spillage problems were encountered on naval coastal craft, luxury yachts, oil installations and static fuel tanks and were solved with Refuelling Control Valves. It has been estimated that twenty-five thousand valves of our design and manufacture shut off every day.

*General Manager, Alan Cobham Engineering Ltd., England

(Continued from page 9)

A terminal box is supplied, suitable for fixing to the upper part of the machine for connection to a flexible cable drop from an over head pick-up trolley bringing the main electrical supply to the machine. Wire mesh lifting and lowering press guards are provided; these guards covering the front and sides of the press and interlocked with the hydraulic control valves thus prevent operation of the press with the guards in the open position.

The main characteristics of these machines are as follows:

Power of vertical ram	150 tons
Power of horizontal ram	75 tons
Hydraulic working pressure	2000 p. s. i.
Hydraulic medium	Oil
Width of track	4'8½" (variable)
Maximum centres of dies	3'3½"
Minimum centres of dies	1½"

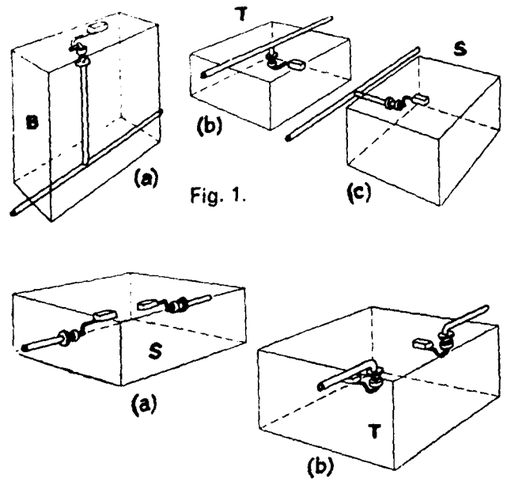


Fig. 2.

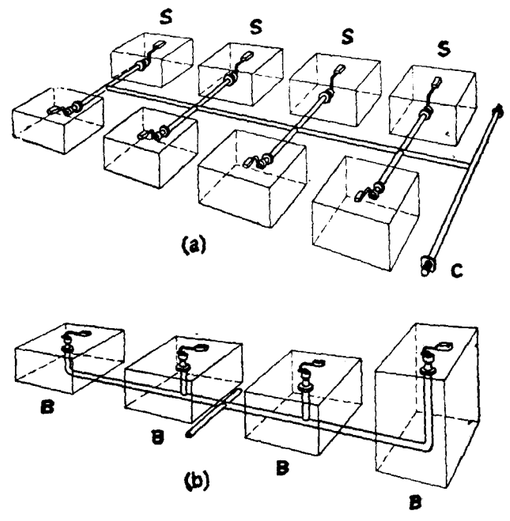


Fig. 3.

One cannot, however, take an aircraft valve or a boat valve and indiscriminately apply it to locomotives. It is no use fitting an aircraft valve and assuming that it possesses sufficient strength merely because it will withstand 10g. shock loads. It can be used but must be made sufficiently robust to withstand heavy handling during fitting and above all it must be foolproof since inspection standards for locomotives are different to those used on aircraft. Shock loading in the region of a locomotive fuel tank rarely exceeds 1g. whereas fighting vehicles are in the neighbourhood of 2g. and high speed launches, when planning in rough weather, are about 4g. However, shock loads are only half the problem since locomotives are subject to low frequency, high amplitude vibration and this must be taken into account when designing valves.

Valves were first fitted to an 0–6–0 diesel electric shunter of British Railways, Midland Region, in 1956 and were later fitted to all types of mainline locomotives of British Railways—(Type 1, 2, 3, 4 and 5). A British Railways railcar has also been fitted with valves, but in general it is overseas railways that have led with the fitment of Refuelling Control Valves to railcars.

Where refuelling is through an open orifice similar to those embodied in road vehicle fuel tanks, it is not possible to attach a valve to the filler cap and utilise the existing trigger nozzle. The method adopted in these cases is to add a self sealing coupling and Refuelling Control Valves adjacent to the existing filler cap in order that the rolling stock may utilise either method of replenishment. On a long train containing many motor units and consequently many widely spread fuel tanks, it would be possible to fit a gallery running the entire length and refuel all tanks from any one filling point.

Refuelling Control Valves can be built into new rolling stock or may be added to existing stock. With the large range of available valves little or no alteration is required to existing systems, although two valves are sometimes required compared with one where valves are considered at the design stage.

The simplest system is a single tank with dual refuelling points. Three possible solutions are shown in *Figure 1*.

Due to space limitations, it may not be possible to fit the cross feed pipe, and *Figure 2* presents a solution.

Filters have not been shown, and, although the valves will cope with particles up to 350 microns in considerable volume and are unaffected by normal scale, the usual practices should be followed to safeguard the engine supply. Filters can be placed

just after the self-sealing coupling, or, if accessible, a single filter can be used in the line between the tee and the valve.

Where a screw down gate valve is considered for fitment after the filter to prevent spillage during filter changes, it is suggested that a leak-tight, non-return valve, supplied by Alan Cobham Engineering Limited is installed—thus rendering this an automatic operation.

The pipe line between the self-sealing coupling and the Refuelling Control Valve will be full of fuel when the valve shuts, and the refuelling coupling disconnected. As the tank's fuel is used the float will drop, and if the pipe run from the coupling to the valve is downhill, the fuel in this pipe will drain into the tank. As with every pressure refuelled system air locks can be ruled out—they cannot occur.

In a multi-tank system each tank should be fitted with a valve fed from a common refuelling gallery connected to refuelling couplings on either side of the locomotives. Two possible systems are shown in *Figure 3*.

The refuelling rate and type of pump will vary from installation to installation. The simplest possible is to have an overhead tank and refuel by gravity. This method is perfectly suitable and a 20 ft. head should be aimed at if possible. However, if one is planning a new installation and spillage is impossible whatever the flowrate, due to valves being fitted, it is possible to consider higher flowrates and pumps having a capacity of say 70 gallons per minute are frequently found. These pumps should preferably be of the centrifugal type since they will be unaffected by a sudden stoppage on the outlet. The tank mounted Refuelling Control Valve shuts in one second and the pump relief valve must be adequate. A surge pressure (hammerblow) is generated by the valve closure and this pressure is additional to the relief valve setting or the stall pressure of the pump. Typical pump refuelling pressures are in the order of 30 p. s. i. This pressure is dependent on the velocity of flow and the mass of fuel in the line and in practice does not give rise to problems.

When fuel is pumped into a tank the air must be allowed to escape and equally well as the fuel is used air must be allowed to enter the tank. This is briefly the essence of all venting problems. With an open orifice air escapes from the orifice as the fuel is fed in and with the filler cap closed a small vent pipe allows air to enter during running. With a pressure refuelled system the problem of venting is similar, whether valves are fitted or not, except that with valves fitted the probability of the vents being used is enormously diminished. The vents exist for two purposes; firstly to carry away the displaced air during refuelling and admit air during running and secondly to carry away fuel in the event of too much entering the tank. Since the tank pressure, in the event of the vents carrying fuel, will be equal to the pressure drop over the vent pipe (including entry and exit losses) at the rate at which fuel is entering the tank it is particularly important that they should be adequate. Since most pressure refuelling systems use 1½" bore pipe it will usually be found that 18" of vertical 1½" pipe is sufficient. This vent should have a gauze and mushroom head to protect the tank against fire and foreign bodies respectively.

Before selecting the most suitable valve from our existing range, to apply to locomotives, discussions were held with all British manufacturers and users and it was decided that a valve must be capable of fitment at any angle within the tank if the maximum freedom was to be given to the locomotive engineer. Three variants were therefore made available for top, side, bottom or intermediate tank positions. A fourth type, in which the valve is fitted to the base of a tank and the float unit at the desired cut-off level, has been in service with British Railways since 1957 and can be used should the standard versions be unsuitable. All the valves will withstand shocks and vibration encountered when the valve is unsupported by fuel.

A valve mounted close to the top of a tall fuel tank will cause the fuel to fall as droplets and the possibility of foaming, or a build-up of static electricity, under these conditions may be neglected with locomotive fuel tanks. The use of such a valve with large unbaffled static tanks should be avoided and a bottom mounted version used instead. Valves should not be mounted where they are free to discharge through the vents.

From the above it will be seen that Refuelling Control Valves have progressed far beyond the trial installation period to the position where they are beginning to be universally accepted as standard equipment. Perhaps we should be grateful for a piece of standard equipment that actually saves money rather than a piece that " gilds the lily ".

Safety Notices and Overhead Electrification

By Peter Charlesworth
Lamigraph Limited, Hove, Sx, Eng.

A major part of the difficulties to be overcome when introducing railway personnel to overhead electrification is familiarisation with new hazards. Naturally, all equipment is designed from the outset to be safe as possible, but employees need to realise that electrical equipment, particularly electrical equipment of this nature, is always potentially dangerous under certain circumstances: there are definite 'do's' and 'dont's' involved, especially with new equipment. Apart from preliminary instruction, poster campaigns etc., the safety notice proper has a very important part to play.

A common failing encountered in the design of safety notices is the use of too many words or clumsy phrasing, resulting far too often in ambiguity. A notice of some 10 lines of 'dont's' cannot possibly be retained in the mind of the employee as a picture: the ideal is a pictorial type of sign, easily remembered and remaining identifiable under all circumstances.

Fig. 1

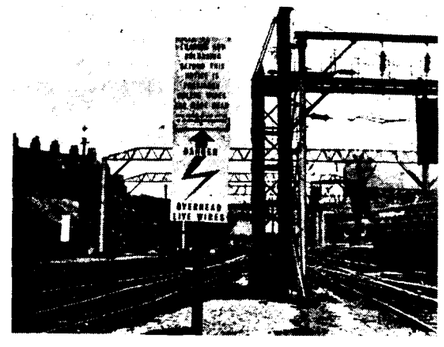


Fig. 2

Several railway systems are currently using variations of the 'Flash' notice (fig., 1.) These are erected wherever access to live equipment is available to railway employees or members of the public. Particular attention needs to be paid to goods yards and to station areas and some systems, in these situations, are erecting a dual notice (fig. 2). This is a particularly good example of intelligent safety-promotion. The 'loading' notice alone could very easily be overlooked, or at least forgotten, but the appearance of the 'flash' motif, conveying not only the existence of a hazard, but the nature of the hazard, acts as a title to draw attention to the instruction contained in the 'loading' panel. In Britain the majority of locomotives and a great deal of the rolling-stock are now displaying a smaller version of the same 'flash' notice (fig. 3).

These are primarily intended to warn of the hazard involved in approaching too closely to the catenary overhead, but advantages accrue from the continual and repetitive appearance of the simple motif: a 'flash' notice 2 feet square at once conveys the same message another, say 2 inches square. This is not always the case with notices consisting entirely of text matter; two similarly worded notices of differing size may well have to be read carefully before the similarity can be established, and dangerous situations have occurred when two worded panels have been taken as identical, when in fact a slight difference in the text gives a completely altered meaning. This is difficult to avoid, but where pictorial signs are used, the problem is readily solved.

In railway applications a further problem associated with safety notices comes to the fore. A large proportion of movement on a railway system occurs at night or in partial darkness, and there is a danger, where the illumination of safety notices is by conventional means, of the actual light source above the notice to tend to become a part of the overall background illumination. This particularly applies in goods and marshalling yards, where the level of lighting is often very poor. A notice 50 or so feet away may not be seen, as the light source over it fades into the overall floodlit background, and the actual notice-panel is no more strongly illuminated than many other flat

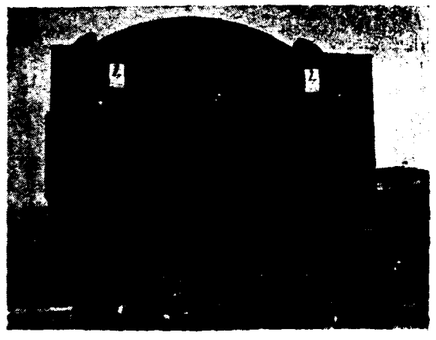
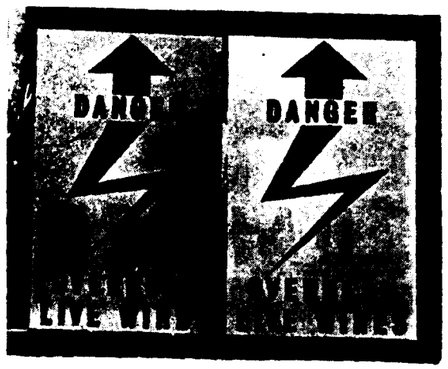


Fig. 3.

surfaces which happen to catch the light. In addition, there is a technical objection to providing separate lighting fittings and their associated cable runs for a large number of notices. Some means, therefore, must be found by which the notice itself can be made to stand-out, and the less complicated the method, the more practical it becomes. One solution, and perhaps the best, is in the use of reflective surfacing on the sign. Such a sign does not become apparent until viewed directly, in the path of a separate light source. As an example, a shunting loco might proceed past any number of electrically lit safety signs, the driver being aware of signal lights and other items of direct interest only. If, however, reflective notices are substitued, placed as near as possible to the driver's eye level, the loco's oil lamps are quite sufficient to make a virtual procession of signs 'switch-on' in his field of vision, as he approaches. Experiments are being carried out in Britain to evaluate the safety-promotion potential of reflective 'flash' notices, with, so far, markedly successful results. (fig. 4)



Night Exposure Daylight Exposure

Fig. 4. These photographs compare the effectiveness of reflective signs with the more conventional non-reflective type.

The notice on the right of each photograph is of the latter kind, that on the left is a reflective surfaced laminated plastic panel. As will be seen from the daylight photograph, there is some loss of clarity due to the off-white background of the reflective surface. The night photograph however, shows off the advantages of a reflective sign very well indeed.

This particular photograph was taken by the light of the side lights of a motor car. The light source was at distance of 26 feet from, and at an angle of 70 degrees to the surface of the sign. The height of the sign above the ground was 6 feet, area of the sign 5½ square feet.

The use of reflective signs follows current road sign and mining practice, and there appears to be little doubt that numerous applications exist in the railway field. Experimental orders are already in hand for items covering applications as diverse as tunnel chainage plates, reflective discs and strips for outlining hazards, unmanned-level-crossing notices and others. Refective notices are particularly suitable in areas which are not normally served by electricity for lighting: in such areas it is common practice to use oil lamps as a source of illumination, but the replacement of these by reflective signs renders frequent maintenance and servicing unnecessary. The life of the materials at present available is known to be considerably in excess of 10 years, and if combined as a surface bonded to a backing of a plastic laminate, the whole panel structure becomes totally resistant to corrosion and moisture, and additionally possesses the added advantage of being non-conductive. From the signmakers own point of view, there is at the moment in Great Britain, evidence of a steadily increasing tendency for industry to change from the more conventional metal backed signs to those fabricated in the newly available plastic materials.

In our opinion there is room for considerable more thought to be given to the use of safety signs and notices on railway systems. The tendency in the past having been apparently, merely to erect a notice bearing cautionary wording which in too many cases has been so densely laid-out that it has been necessary for the employee to approach the danger-area closely in order to read the instruction and make out the nature of the hazard. We feel it is almost impossible to lay too much stress on the need for symbolic or stylized notices which are more easily recognised. We also feel that it is unfortunate that there is so little standardization between different railway systems on the question of safety precautions generally and safety notices in particular.

"AIR-HOUSE" AT INDIAN INDUSTRIES FAIR

A gleaming white, 35,000 cu. ft. air-house will be used to house the display by British Nylon Spinners Ltd. at the Indian Industries Fair in New Delhi this winter.

Looking rather like a vast igloo, the air-house consists of a waterproof skin of tough but light-weight PVC-coated nylon fabric which is held up solely by air blown in by powerful fan units. There are no poles or guy ropes.

Measuring 70 ft. by 40ft. by 20ft. externally, the air-house is easy to handle and can be readily moved from site to site. Bigger versions can also be produced. Their uses include temporary warehousing, portable canteens and offices, emergency hospitals, and so on.

In Britain, a house has been built beneath one, and another is in use as a 500-seat theatre. Another was used recently as a refreshment marquee for VIPs during the fourth Test match between England and Australia at Manchester.

The air-house is well-lighted and airy. The white fabric is translucent, so the light inside is generally as good as it is outside. As the air is constantly being changed, it never becomes stale.

Altogether, about a hundred different industrial uses for nylon will be shown at the Indian Industries Fair by British Nylon Spinners, who are the largest producers of nylon yarn in Europe and the Commonwealth.

*** *** ***

SMALL ENGINE RUNS ON VARIETY OF FUELS

A German-born resident of South Australia has developed a combustion motor which is claimed to run on a variety of fuels, including high octane fuel and peanut oil, and which puts out one break horsepower for each pound of its weight.

He is Mr. F. E. Heydrich of Gordon Road, Prospect, who demonstrated his new engine recently in Adelaide.

He showed a small prototype engine which weighs about 15 lb., and which puts out more than 18 b.h.p. at 7,000 r.p.m. He claims that it can be manufactured for about half the cost of the normal type of engine. Wear on parts was much less than in reciprocating two or four stroke motors because of the unit's turbine—like operation.

A South Australian company making a lawn—mowers is to test the engine for use in these machines.

*** *** ***

Silicone Treatment of Overhead-Line Insulators

H. L. Halstrom)*
Ktas

A summary is given of the behaviour of ordinary telephone insulators and silicone-treated telephone insulators under adverse weather conditions.

It is shown that the silicone treatment gives satisfactory results when performed IN SITU on dirty insulators.

THE primary constants of an overhead telephone line are unfortunately not to be regarded as constants in all the senses of this word. Although the capacitance and the inductance do not change very much under ordinary conditions, the resistance varies with the temperature of the surrounding air or by the effect of direct sunshine, and worst of all : the leakance may vary suddenly and abruptly within very great limits and can, under adverse weather conditions, attain such low values that the telephone line becomes practically unserviceable.

As it seemed possible to improve the figures for the leakance by means of silicone treatment, we became interested in the matter as early as 1952 when these oils became commercially obtainable in Denmark.

A preliminary investigation in the laboratory proved that the expected increase in insulation resistance could be realized, when the insulators were given a suitable silicone treatment before they were measured in a humidity chamber under varying conditions of artificial rain and high humidity.

Fig. 1 shows two insulators mounted on a bracket after having been exposed to artificial rain. The left one is treated with silicone and the right one is an ordinary untreated insulator. Though they look alike when dry, there is a marked difference in the way they react when being exposed to artificial rain. The untreated insulator is wet all over, while on the silicone treated insulator the moisture is broken up into small droplets, so that no continuous leakage path exists between the wire attached to the insulator and the earth-connected iron pin on which the insulator is fixed. This explains the surprisingly high insulation values measured on the silicone treated insulators.

An experiment was therefore begun in June 1953 to find out if equally good results were obtainable in practice.

Ten new insulators of the smallest type were carefully cleaned by mechanical means, degreased by means of a solution of a suitable detergent, washed several times with distilled water and dried.

Fig. 1. Telephone insulators after having been exposed to artificial rain

Five of the insulators were dipped in a 2% solution of a silicone oil in purified trichlor-ethylene, after which they were baked in a thermostat for 2 hours at 200°C. The five silicone treated insulators were together with the five untreated insulators mounted on an iron bracket attached to the railing of the balcony just outside the windows of the laboratory.

Insulation measurements were made on the insulators from time to time under different weather conditions from June 1953 to June 1955.

At the beginning of the experiment the insulation resistance of both the silicone-treated and the normal insulators were well above 1 million megohms, but after a lapse of 2 months, the untreated insulators

*) Assistant Chief Engineer, Technical Department, Copenhagen Telephone Company.

showed a very low insulation resistance value during a heavy rainstorm. Dry weather and sunshine brought the insulation up again, but not to the high level at which the insulators started, and every subsequent rainstorm or other adverse meteorological condition, which might give rise to a deposit on the surface of the insulators, seemed to decrease the insulation of the insulators even during dry periods. Towards the end of the experiment the insulation resistance of the untreated insulators tended towards 10—30 megohms in overcast, dry weather, while every much lower values were obtained during humid conditions.

During the first year, i.e. from June 1953 to March 1954, the insulation resistance of the silicone treated insulators was above 10^6 Megohms, this being the upper limit of the range of the measuring instrument.

Fig. 2 was taken just after a snowfall in the spring of 1954. The insulation resistance values indicated above the insulators show that the values obtained for the untreated insulators were of the order of 20—30 Megohms, while values for the silicone treated ones were above 1 million Megohms, even though all the insulators were heavily covered with snow.

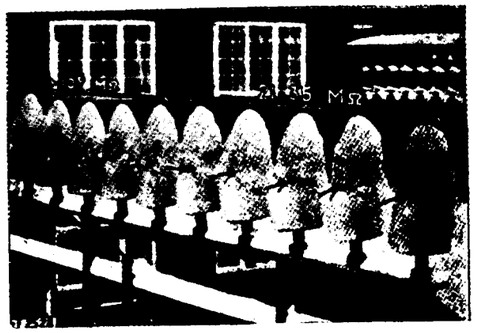


Fig. 2. Telephone insulators covered with snow. Spring 1954.

This was satisfactory, but unfortunately the effects of the silicone treatment were not sufficiently long lasting.

After about a year the insulation resistance of one of the silicone treated insulators dropped to the same level as for the untreated ones and after about 2 years all the silicone treated insulators had lost their excellent properties as regards insulation resistance and had become quite as bad as—but no worse than—the untreated insulators.

A renewal of the silicone layer would necessitate a cleaning and heat-treatment of the insulators, an operation which it would be impossible to perform if the insulators were mounted on the crossarms of poles or in other equally in accessible places.

As the effects of the silicone treatment were of too short a duration and as a renewal of the treatment was impracticable, it did not seem possible to advocate the use of this treatment, even where its effects were greatly needed.

The appearance of silicone grease MS 4 seems to have altered the situation completely.

In the autumn of 1957 we got hold of a sample of silicone grease MS 4. which does not need to be "fixed" on the insulators by means of a heat-treatment, and we therefore decided to repeat the experiment with the insulators in a slightly different way.

The stores were asked to supply us with ten brand new insulators and ten of the most rough and dirty insulators they could find among the insulators returned to the stores, i.e. insulators which had been in use for a number of years and which were considerable the worse for wear.

All the twenty insulators were mounted on an iron bracket placed as in the previous experiment. The silicone was applied by means of a small garden-spray, five of the new and five of the old insulators being sprayed with a 10% solution of silicone grease MS 4.

Fig. 3 shows the ten new insulators on their bracket. The five insulators to the right are the silicone-treated ones. Owing to the thin layer of grease on the surface they have accumulated a certain amount of dust, for

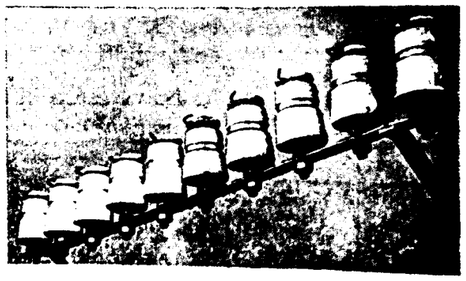


Fig. 3. New telephone insulators after two years' service.

which reason the untreated five on the left look much whiter.

As in the previous experiment, the insulation resistance was measured from time to time, but not at definite intervals. As the insulation was always well above the requisite values during good weather no measurements were made at these times, as the absolute value of the insulation resistance would then have been of no interest. The measurements were therefore only made under adverse weather conditions, the values thus obtained indicating the benefit obtained by the silicone treatment.

The results of these measurements will appear from Figs. 4, 5 and 6. It is worth notice that it has been necessary to use a logarithmic scale with six decades for these curves in order to accommodate the values for the insulation resistance for relatively the silicone treated and the untreated insulators, a fact that speaks for itself.

The vertical lines above each date connect the highest and the lowest of the insulation values and the length of this line therefore gives an indication of the deviation of these values. The mean values are connected by means of a line, which of course cannot be regarded as a curve from which values of the insulation resistance can be read. This line is only to be regarded as a "tendency-line" which makes it easier to follow the variation with time of the insulation resistance of the insulators.

Fig. 4 shows a comparison between new and old insulators under adverse weather conditions. None of

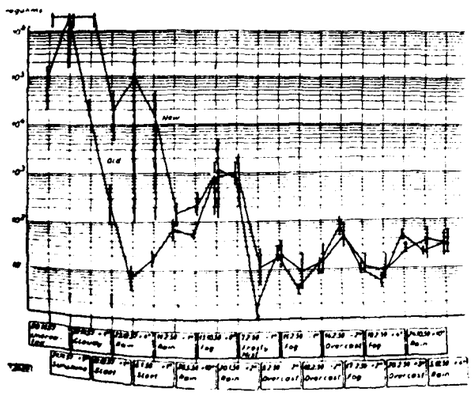


Fig. 4. Untreated insulators under adverse weather conditions.

these insulators have been silicone-treated. It can be seen from the curves that after having been in use for about 3 months during the winter. no difference can be observed between the values obtained for new and old insulators. A change-over from old and dirty insulators to new and clean insulators will therefore only mean a better performance for a very short time. The re-fitting of an overhead-line with new insulators is a very costly procedure, and if it mainly serves to satisfy an aesthetic need for cleaner insulators, it is a little doubtful if such an expenditure is warranted. It is also a question if it really pays to clean old insulators that have been returned to the stores. If this has to be done, the necessary mechanical cleaning ought be done without scratching the glaze unduly as, from a transmission viewpoint, an insulator with a few dark spots is better than a white insulator with a thoroughly scratched glaze.

Fig. 5 shows the difference in insulation resistance for new insulators with and without silicone treatment. While the untreated insulators lose their good insulating properties in about 3 months, the silicone treated ones are not affected. The "tendency-line" for the untreated insulators goes down until it reaches about

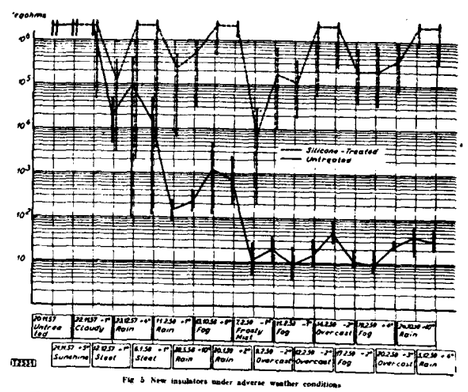


Fig. 5. New insulators under adverse weather conditions.

10 Megohms, while the "tendency-line" for the silicone-treated ones still (May 1960) is on the 10^5–10^6 Megohms. The two "tendency-lines" are showing the same fluctuations, obviously as a function of the same variable, i.e. the weather, the only real difference being that the insulation resistance is 10,000 to 100,000 times higher for the treated insulators than for the untreated ones.

Fig. 6 shows the result of the silicone treatment an old and dirty insulators. Here also a pronounced difference is found between treated and untreated insulators. The silicone treatment increases the insulation resistance 100 times and even after the lapse of 2½ years there are no signs of deterioration of the silicone layer.

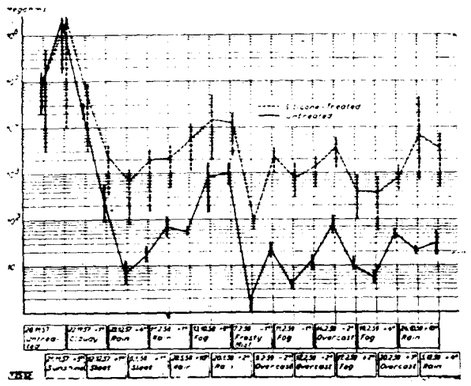


Fig. 6. Old insulators under adverse weather conditions.

On the basis of the above measurements it seems therefore reasonable to draw the following conclusions :

(1) The silicone treatment causes a very considerable increase in the insulating resistance of the insulators under adverse weather conditions.

(2) Under normal conditions the effects of the silicone treatment will last at least 2 or 3 years.

(3) If the silicone layer on a silicone treated insulator deteriorates, it does not leave the insulator in a worse condition than if it had not been treated.

(4) In case of a deteriorated silicone layer a new treatment can be given by spraying. This might even be done from the ground by means of an orchard spray working under pressure. In such a case proper precautions may have to be taken against high tension when spraying on joint constructions.

Normally a silicone treatment of telephone insulators will not be necessary, but there are cases where it might be an advantage to treat the insulators even at the cost of higher maintenance charges, if the silicone treatment can keep lines serviceable, which otherwise might not be the case.

Among such cases are :—

(1) Overhead lines, exposed to frequent rain of long duration, snow, rime, hoar frost or white frost, mist, fog and "blue fog", etc.

(2) Overhead lines which have been sufficiently good for local battery working, but where a change-over to automatic working might necessitate putting the overhead lines in cable and this latter eventuality is not desired at the same time.

(3) Overhead lines with carrier channels.

(4) Long overhead lines through sparsely populated regions with poor facilities for maintenance.

(5) Overhead lines under tropical conditions.

(By Courtesy of Off-print of TELETEKNIK, English Edition, Vol. IV, 1960 No. 1)

Instrument for Measuring Meteorological Factors

An instrument which records variables like temperature, rainfall, wind speed, and water levels has been developed in Australia by Dr. C. J. Sumner, of the Australian Commonwealth Scientific and Industrial Research Organisation in Melbourne. It was developed at the Organisation's Division of Meteorological Physics, and will record information on the variables for periods up to twelve months while unattended. The measurements recorded appear as a line of small holes on a chart, and they can be converted to a form suitable for automatic analysis on a computer. The instrument is powered by dry batteries, and includes a lens so mounted as to focus the sun's image on the chart each day and to burn a hole in it.

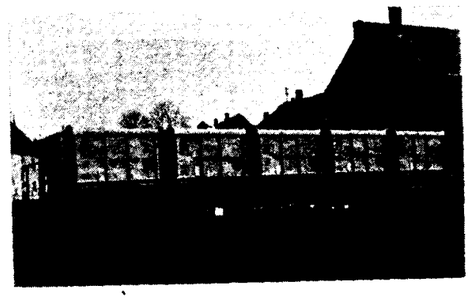
Faster Transhipment of Goods with less Expenditure of Work

By Aa Engineering Correspondent

THE transhipment of goods particularly from rail to road vehicles is very expensive. Any savings achieved are of advantage to the loaders and forwarders, as well as to the railway-companies. A most interesting new design of goods wagon, coping with the modern traffic requirements, is the two way tipping, multi-purpose lifting type tipper. This new open goods wagon permits the discharge of bulk goods into bunkers or at rail-level, as well as into lorries and trailers. During discharging

Seag two way tipping wagon.

the out-flow of goods can be stopped at any tilting position by three flaps on either side, so that proportional distribution can be ensured. Owing to the high speed of discharge the wagon circulation is significantly reduced. The tipper can easily be handled by every workman or lorry driver. Compared with a normal open-type freight wagon, the savings in costs in the discharge of bulk goods from wagon to lorry are of the order of 95 per cent. The hydraulic lifting and tipping mechanism enables the superstructure to be lifted up to 1.6 m and to be tilted and stopped at any position. The loading can therefore be discharged directly into road vehicles without ramp. The stability of the vehicle is fully assured regardless of the position of the body. The side walls of the superstructure are divided into three equal panels. Their bottom parts are designed as hydraulically-operated flaps. All three flaps on either side can be opened and closed either simultaneously or individually. The upper part of the central panel contains a double swing door so that an opening is available over full height of the wall.



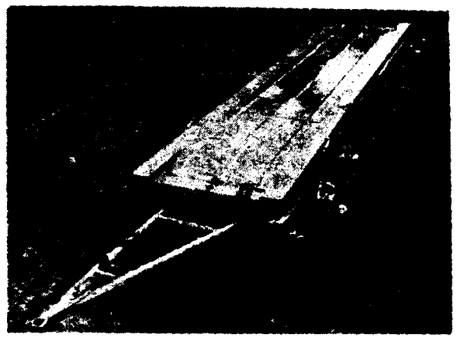
Seag container carrier wagon.

Another remarkable design, the SEAG — two way tipping wagon "type Hamborn" is a special vehicle for the transport of bulk goods in mining concerns and iron and steel plants, as well as of material which tends to adhere. The wagon body reaches a maximum angle of tilt of 80° and even in this position — which until now, was not achieved — the wagon stands absolutely firm. The wagon has a capacity of 32 tons and a volume of approx. 20 cbm. The body has a pan-shaped bottom and sideflaps hinged at the top are opened automatically when tilting and therefore enable an easy discharge of the load. The accumulator is

Seag lifting type tipper.

automatically recharged during the transport. The time necessary for tipping and returning the body to normal position is less than one minute. More than 500 two-way tipping wagons are already in service, another series of these wagons will be started in the nearest future.

In order to increase the economy of container traffic SEAG developed in collaboration with the German Federal Railways a new container carrier wagon which enables the transport of five containers of standard



Seag Road Transporter.

type at the same time. Serial frame is a frame construction in steel Class St. 52 without diagonals. The longitudinals are of hollow shaped sections, the outer portions of which are extended towards the bottom in order to increase the stability and rigidity of the underframe. The center sill in which draft gear and the brake equipment are mounted, as well as the main longitudinals, are connected together by the running rails and their stiffeners for the containers. The locking device for the container comprises the spindles located in brackets, hinged locks which stop the containers in their end-position, the hook for the running rails and the safety device. The latter only permits an opening of the hinged locks, when the external running rails are hinged. Provision is also made to avoid the loss of these rails. The tare weight is approx 8000 kg.

For further rationalisation of the more and more increasing door to door traffic multi-purpose road carriers have been developed in conjunction with the container carrier wagon by SEAG which mainly will be used for the container traffic but which can also be used for any other road traffic. By these vehicles

Seag — road container carrier.

being equipped with the air-hydraulic suspension device — already known by SEAG road transporters— the chassis can be lifted up by approx. 600 mm. Loading and unloading of container wagons at different heights over ground are therefore facilitated. The turn-tables on which the running rails for the container are seated permit a turning of the container on the vehicles up to 180°. Furthermore the containers can be tilted on the turntables towards the sides and the end.

The SEAG road-transporter carries wagons and all other heavy loads on the road. The loading capacity of the standard type is 40 tons. The speed has been increased to maximum 60 km/h, thus increasing service. The width of the vehicle is 2.5 m. The axle pressure on the twin wheeled axle is maximum 8 t. and the minimum radius in curves is 6, 5 m. referred to center of the vehicle. The hydraulic system being coupled through a control valve to a motor pump permits the frame of the vehicle to be lifted up to 755 mm.

The wheel groups and either side of the vehicle can be lifted individually.

TRAVELLING THE PLASTICS ROUTE

By An Engineering Correspondent

ONE hundred and fifty years ago letters from London to other parts of England could take up to a fortnight to be delivered. In 1961 an Englishman can ask a question of colleagues in, say, India and receive an answer the same day. Such facilities are commonplace.

The speed of modern communication is as remarkable as it is easily accepted. This goes for everything from people and parcels to ideas and instructions. It has been made possible not only by the use of new techniques but also the development of remarkable new materials. The first industrial revolution was based on natural resources like coal and iron ore. The second springs from the ingenuity of modern chemists and engineers. They have perfected means of creating materials into which they build just those qualities they require. One of these man-made, versatile materials is FORMICA Industrial laminated plastic. Originally developed early this century for electrical insulation it can now be found in virtually every branch of contemporary industry. The expansion and improvement of railway systems throughout the world has given it a vital market.

MAKING THE GRADE

Great strides have been made in the development of laminated plastics for industrial use, and advances in technique together with the development of other synthetic resins such as the "epoxies" and "silicones," now allow this type of material to be used for a growing variety of applications. The advantages of plastic laminates over other materials, lie in their high strength to weight ratio, their dimensional stability, their resistance to heat, moisture and chemicals, and their electrical properties.

In the manufacturing process, a fibrous filler, such as paper, asbestos paper, cotton fabric or glass fabric is passed, from a continuous reel, through a solution of resin in a suitable solvent. The amount of resin picked up is controlled by passing the impregnated web between adjustable rollers. The web then passes through an oven in which the solvent is driven off and the resin is advanced to an early state of 'cure'. The impregnated material is cut into sheets which are stacked between the platens of a hydraulic press and then consolidated at a high temperature and pressure. To ensure a consistent product, rigid control must be exercised at all stages, from the raw materials used in the manufacture of the resins, through the impregnating and drying processes, to the pressing of the stacked sheets.

The resulting sheet material has physical properties which depend on the type of resin and filler used, on the proportion of resin to filler, and on the heat treatment received during pressing. A very definite improvement is achieved in the properties of the individual resin and filler, e.g. the reinforcement with fibrous materials confers toughness, flexibility and strength on the resin which is usually very hard and brittle; at the same time the moisture resistance, resistance to chemical attack and the electrical insulating properties of the resin itself are retained in the laminate.

SCOPE OF LAMINATED PLASTICS

The variety of fillers and the range of synthetic resins enable a plastic laminate to be tailor-made to meet any one of an immense number of sets of physical properties. Classification is normally with reference to the filler and resin. The range of FORMICA material includes paper-phenolic, glass-epoxy, fabric-phenolic, glass-silicone and composite laminates.

ON THE RIGHT LINES

Perhaps we might take two or three examples of the actual use of FORMICA Industrial material on the world's railways to show the principal types of use in this field.

INSULATION, STRENGTH, SPACE

Ask any designer of electric traction equipment for railways his requirements and he may well put them under three headings: insulation, strength and space. A further requirement so far as English Electric's Traction Control Design Department at Bradford, England is concerned is that "high technical excellence must never be sacrified". Two facts support this. The traction equipment made by The English

Electric Co. Ltd. is built for very long life. Secondly, although the amount of power involved in each unit is rising the space for the machinery remains the same—on British locomotives the maximum weight is 20 tons per axle and so the weight and size is limited by axle loading and loading gauge. There can be either four or six axles to each unit. All this means precision and refinement in design. Every component must justify itself in terms of size and efficiency. This summarises the reasons for the use of formica material in such equipment. The principal grade used is DLE-1, a paper-based laminate which combines good electrical and mechanical properties besides, of course, being suitable for use under oil and having a relatively low water absorption. One application of this grade is in contactors, in which it is used for side plates. Contactors form one of the principal items of switchgear in the power circuits of electric traction equipments. When the motor is started resistance must be inserted to ensure a gradual build-up of power. The contactors gradually cut out this resistance until

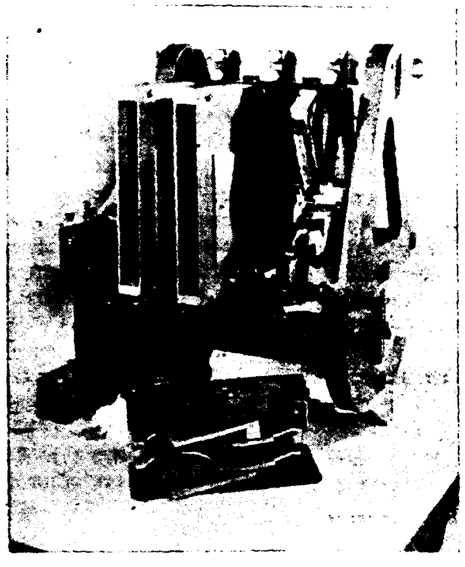


Fig. 1. One of the guard units in FORMICA industrial material is shown in front of this Contactor unit.

(By courtesy of English Electric Company Limited)

the motor is running at full power. The mechanics of this are that an electro-magnetic valve releases air at pressure to close the contactor until the coil is de-energised and the valve opens. The voltage ratings on this equipment range from 600 D. C. to 1,500 D. C. and 3,000 D. C., whilst in British Railway's modernisation scheme A. C. voltages of 6.25 kV and 25 kV are now in use. The FORMICA DLE.1. material meets the need for small size, low weight, economical price and, naturally, high insulation properties which are to rigid specifications. Also shown in Fig. 2 is a 3,000 volt contactor using DLE.1. which is of the type used in locomotives supplied by " English Electric " all over the world, including, for instance, Spain and India.

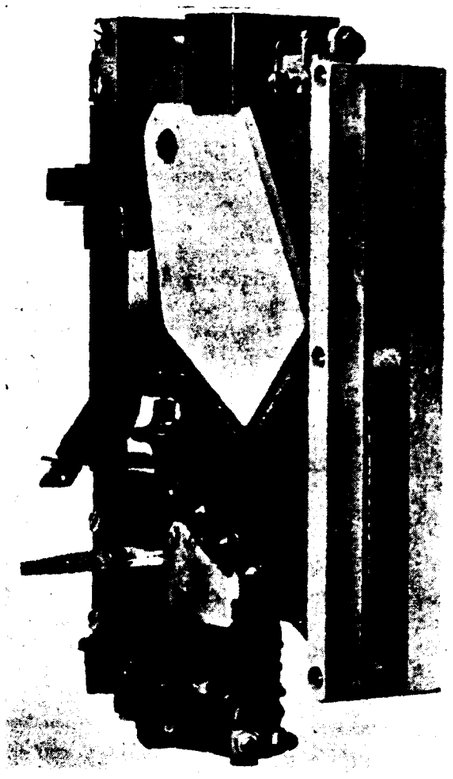


Fig. 2. A 3,000 Volt Contactor.

(By courtesy of English Electric Company Ltd.)

These types of contactor units are used on both diesel-electric and electric locomotives. A random selection gives us some idea of the variety.

DLE-1 has been used, for instance, in motor coach and locomotive equipments supplied by British Railways (Southern Region) which have been in service for

Fig. 3. FORMICA material is used for insulating guard and other components in the Contactor case used on British Railways locomotives.

(By courtesy of English Electric Company Limited)

several years now. The same material has been used widely for relays. In this application DLE-1 is in the form of a panel containing the contacts and bridge contacts with the terminals piecing the FORMICA material. Again it has been used as an insulating sheet in a motor connection box. This kind of junction box is also used on the Southern Region of British Railways. Once again the FORMICA material meets the requirements of space and insulation.

An entirely different kind of service to the railway engineer by FORMICA material is provided by Mimic designs. These follow the same manufacturing processes of the industrial and the decorative laminates. Almost any design, however large or complex, can be incorporated to exact specifications. Nor is size a barrier, since we have produced mimics as little as six inches in length up to 30–40 feet.

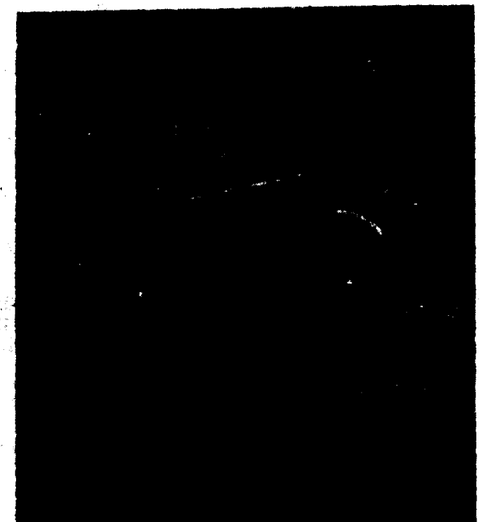


Fig. 4. One of the English Electric locomotives supplied to the Spanish National Railways.

(By courtesy of English Electric Company Limited)

Fig. 5. Centralised Traffic Control Panel at Dett. Rhodesia Railways.

(By courtesy of S.G.E. Signals)

How does one run a railways system on an economic basis? This is an endlessly topical subject these days and it is opportune to examine methods in vogue in other parts of the world. Perhaps the most remarkable development is the introduction of remote control systems, particularly in cases where a railway network has a vast distance to cover.

Some time ago we produced some mimic diagrams for the Siemens and General Electric Railways Signal Co., Ltd. These are now in use as part of a Centralised Traffic Control system—a modern method which the Company have developed of remotely controlling the movements of trains from a central supervisory point.

POINTERS TO EFFICIENCY

A problem in rapidly developing territories is to discover a means of increasing traffic capacity without expending capital and incurring maintenance charges on the provision of a double track. The C.T.C. system has been developed very extensively to meet this problem and is usually applied to long stretches of

track with crossing and overtaking of trains. Apart from allowing great traffic and operating efficiency, the safety element is increased and labour cost for operating staff can be cut considerably.

Under this method all train movements are governed by fixed signals from a supervisory central office, which can also operate or lock all essential points along the lines. No costly multiple line wires are used as signals are transmitted in the form of selective code impulses over one pair of line wires. The maximum length of track controlled from one point by direct coding is usually about 125 miles, and this can be handled by one or sometimes two operators.

The control room is the hub of the system. The supervisory equipment consists of a central control machine which serves "*field units*", located at crossing loops of stations through the section, able to receive and transmit the coded impulses.

MANY-SIDED MARKET

One territory in which the C.T.C. system is now successfully operating is Southern Rhodesia, and recently we produced a number of mimic diagrams for use on control machines for Rhodesian Railways. These diagrams are fixed along the top of the control panels. They indicate tracks, loops and control points and contain individual lamp indications for each track circuit, thereby giving the operator a comprehensive guide to any specified section of track.

The advantage of FORMICA plastic in such cases is that the design stands out conspicuously. The rugged melamine skin protects to all important design from fading and surface damage which would be incurred by using almost any other material.

Another factor is that, apart from producing the basic sheet, our Cricklewood fabrication factory is fully equipped to undertake fabrication tasks such as cutting or punching to the requirements of the customer, leaving the finished mimic ready for wiring and installation on site.

CURRENT DANGER

Silent, odourless and unseen, one of the most dangerous of natural phenomena courses through its man made channels in separate net-works, through countries of the world ready to be tapped where and when its masters wish. Electricity, at one time the only way it showed itself to man was in the form of frightening thunderbolts and signs of a God's wrath that brought terror and superstition, is now harnessed by mortals to become their strongest and most relied upon servant. But like most things captured from nature, if not respected and kept under careful surveillance, electricity can jeopardise, can be a killer.

This power is still changing the lives of men, and currently thousands of miles of electric wiring are being suspended and tautered down the main Manchester and Liverpool to London railway line to make the country's longest electrified line.

On the railways of Britain several men have lost their lives to this merciless killer, and the British Transport Commission have spent large sums of money erecting guards at points where their employees, during the course of their work, came into close proximity with the wires, and fixing warning signs on rolling stock and locomotives. These now familiar red and white danger signs are made of laminated plastic-Formica Ltd. have supplied over a quarter of a million to the B.T.C.

Impervious to soot and weather dirt, they can be seen on the sides and on the leading faces of steam, diesel & electric locomotives and trains, where the weather hazards are accelerated to a high degree.

Formica's factory at Cricklewood cut the 8" by 5" notices from large sheets, router and drill the holes, making them ready to be fixed without further ado. A larger notice, 21" by 35" in the same design is also manufactured by Formica Industrial Division. These have also been made with the sign on both sides. These large Formica printed signs are erected where there is more possibility of workmen coming into contact with the overhead wires—on signal gantries or water filling points.

It could never be estimated how many lives have been saved by these signs, which are constant, permanent warnings that there is "Danger. Overhead Live Wires."

EXPANSION

Railway expansion is as much a symbol of growth as new buildings and mechanized agriculture. The use of 'made-to-measure' FORMICA laminates is part of such expansion, especially wherever electricity is used. In a small but effective way it is making movement for millions of people a cleaner, quicker, safer experience.

Modern Railway Refrigerating Vehicles from the German Democratic Republic

By An Engineering Correspondent

ONE of the most important industries in the German Democratic Republic is the waggon building industry and within this sector refrigerating vehicles account for a considerable portion of the export volume of our foreign trade organization Transportmaschinen Export-Import, Deutscher Innen- und Aussenhandel, Berlin W 8.

The following explanations are given to make you acquainted with our eight-wheeled machine refrigerating car type Mkw 60/1 :—

This machine refrigerating car which is also called STANDARD machine refrigerating car is an entirely new design. According to its various possibilities of application it can be employed.

1. as a single refrigerating car with own power supply, or
2. in train units of up to 20 refrigerating cars and with central power supply, or
3. as cold-storage and store room, the power for the refrigerating or heating device being supplied by an external source.

This multi-purpose car is particularly suitable for transporting and storing all perishable goods requiring loading room temperatures from—18°C+12°C (0°F to 54° F) at outside temperatures from +45°C to —45°C (+113°F to —49°F).

The technical equipment of this car permits to use it as follows :—

(a) Cooling of fresh goods during transport ;

(b) transport of pre-cooled goods ;

(c) transport of low-temperature frozen goods at a loading room temperature down to-18°C (0°F) ;

(d) transport of goods sensitive to cold at a loading room temperature up to +12°C (54°F).

In accordance with modern engineering the car is equipped with fully automatic power supply and refrigerators.

Two easily interchangeable Diesel-electric units of 2×14 kw for generating three-phase current 380-volts 50 c/s are installed below the car if the machine refrigerating car is employed as single refrigerating car. Each of the two air-cooled four-cylinder Diesel-engines included in the units has an output of 25 H. P. An automatic control device protects the engines from damage.

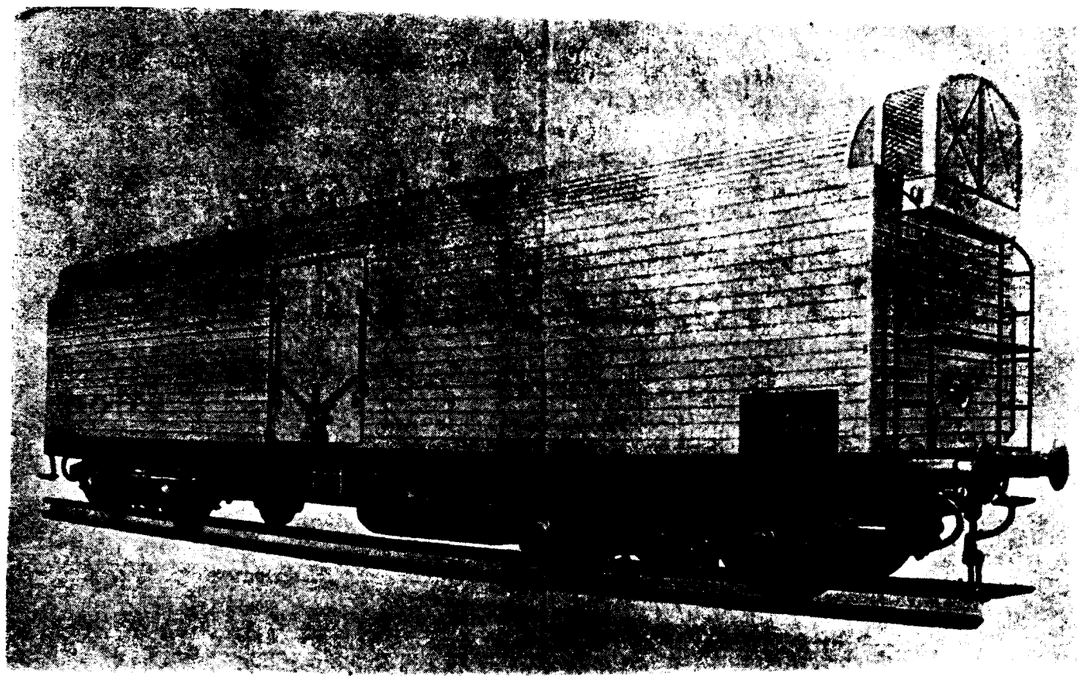
Two-stage air-cooled refrigerators are interchangeably installed in the roof space of the car. F 12 (frigedohn) is used as refrigerating agent, while air which can be circulated in the loading room for cooling as well as for heating is used as cooling agent. No loading area will be lost in the loading room by placing the refrigerators in the roof space. The semi-thermitic compressors as well as the condensers, evaporators, and pipings are made from light metal.

The electrical equipment is designed in conformity with the various applications and the car is provided with continuous electric connections for being used in trains with central power supply.

The loading room temperature necessary for the goods is regulated by means of the thermostat when the car is used as single refrigerating car. The thermostat regulates the operation of the refrigerator or that of the loading room heating device automatically as required. The Diesel units are started by hand. The operation of the machine is controlled by an automatic device.

The wagon body is made in light construction. The loading room is built without using wood so that the inner wagon body has no thermal bridges leading to the outside. The outer side walls and end walls of the wagon body are provided with horizontal beads. The inner loading walls of the car are self-supporting and have vertical beads.

The floor is strong enough to carry transport means



having a wheel load up to 1.2 tons. The loading room doors are designed as one-winged swivel doors. The brake system will be installed in accordance with customer's specification.

Special equipment such as floor grates, devices for the transport of meat, continuous steam piping, and electric heating connections can be provided if so desired.

The principal technical data are as follows :—

Gauge	1435 mm. or 1524 mm. (4′ 8½″ or 5′)
Length of car	17,000 mm. (55′ 9¼″)
Width of car	3,000 mm. (9′ 10″)
Distance between centre pins	12,000 mm. (39′ 4½″)
Loading area	41 m² (440 sq. ft.)
Useful space (at a loading height of 1,900 mm. (6′ 2¾″)	78 m³ (2,750 cu. ft.)
Axle load (admissible)	20.5 metric tons
Loading weight	52 metric tons.
Deadweight	abt. 30 metric tons
Speed with suitable brake equipment	120 km/h (75 miles per hr.)
Coefficient of heat transmission of wagon body	.3 kcal/m²h grd. (13 B.T.U./sq. ft. hr. grd.)
The quantity of fuel is sufficient	for 100 service hours

This standard machine refrigerating car is built in the nationally owned factory VEB Waggonbau Dessau in the German Democratic Republic. The manufacturers at Dessau as well as the exporters of these vehicles—the foreign trade organization Transportmaschinen Export—Import of Berlin W 8 will be glad to give any additional information on request.

Measurement of the Force exerted on the Track by Railway Rolling Stock

*By H. A. W. Rietjens**

(Reproduced from "Philips serving science and industry")

SUMMARY

A method is described for the measurement of the force exerted by railway rolling stock on the railway track. The measurement is carried out by means of strain gauges mounted in specially designed chairs which are placed under the rails in the normal way.

The changes in the electrical resistance of the strain gauges caused by the varying forces exerted on the track are measured by recording electronic instruments. Some typical records of such measurements are also shown in the article.

MANY theoretical and experimental studies have been made on the forces exerted by railway rolling stock on the track. Until recently, experimental studies were limited by the nature of the measuring equipment available; nearly all measurements had to be carried out by mechanical devices. The development of the modern electrical measuring devices now allows many more of the experimental problems to be solved.

A modern method of measurement, developed by the Research Department of the Dutch Railways, is described in this article. This method allows the horizontal and vertical components of the forces

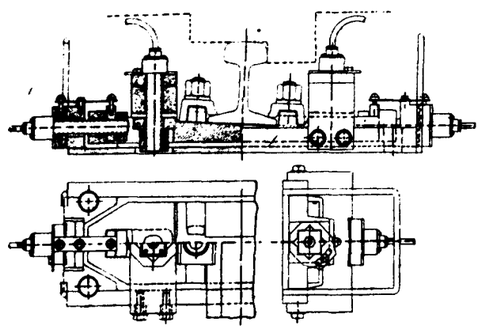


Fig. 1.

exerted by the wheels on the rails to be measured separately. The measurements are made by means of a specially designed chair, which is interchangeable with the 50 mm-high cast-iron chair used for fastening the rail to the sleeper on some sections of tract which are subjected to heavy traffic (50 mm is the distance between the bottom of the rail base and the top of the sleeper).

Figs. 1, 2 and 3 show this measuring chair. Each chair is fitted with four measuring pins, two of which measure the horizontal component of the force, while the other two measure the vertical component.

These pins are made from special high-quality V. C. M. O. 140 steel. The horizontal pins are constructed to measure forces of up to 10 tons, and the vertical pins for forces of up to 14 tons. Each pin is fitted with four strain gauges, which are placed in a hole extending from the head of the pin deep into its interior.

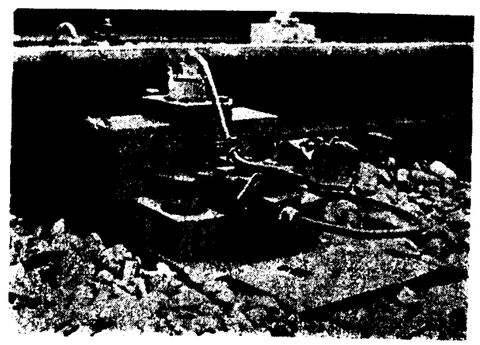


Fig. 2.

* Technical Inspector 1st Class, Dutch Railways.

Fig. 4 shows how the strain gauges are placed in the holes. The equipment needed for this operation consists of a small pipe closed at one end and fitted with a manometer and a valve at the other end. A rubber bulb is placed over the end of the pipe and fastened in place with string. There is a small hole in the pipe just under this bulb. The strain gauges are attached to fine wires, and the upper side of each strain gauge is stuck on to a paper carrier which is wrapped round the rubber bulb. Both the walls of the hole in the pin and the strain gauges are now thoroughly cleaned and covered with the special GM 4479 glue, and the rubber bulb is placed in the hole. The bulb is pumped up to a pressure of 2.5 atm. via the tube, and therefore expands, pressing the strain gauges against the walls of the hole. The whole assembly is placed in an oven at a temperature of 50°C for 24 hours, and the pressure is then reduced to atmospheric. After another 24 hours, the bulb with its attachments can be removed.

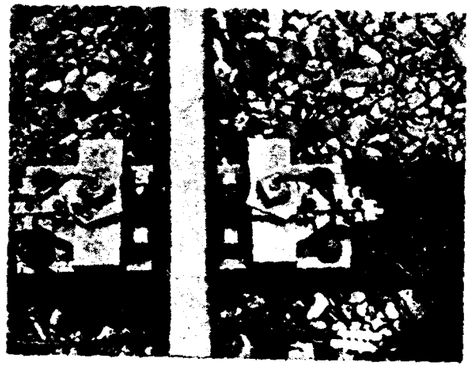


Fig. 3.

Fig. 5.

Fig. 4.

Two 300 ohms strain gauges type PR 9213 are placed along each measuring pin; these form one arm of a bridge circuit. Two others are placed across the pin; these measure the contraction, and form another arm of the same bridge; thus all four strain gauges form a half bridge, with a resistance of 600 ohms in each arm. This half bridge is connected to a cable with a plug on the end.

The pins are then calibrated on a draw-bench in the laboratory, the results for each pin being expressed as strain per ton load. For the horizontal pins, the calibration constant is about 230×10^{-6} per ton for the vertical pins about 150×10^{-6} per ton. A complete chair was also calibrated dynamically on the pulsator bench; there was good agreement between the results of the static and dynamic calibrations.

Fig. 5 shows a curved stretch of track of radius 250 metres, with several measuring chairs placed along it. The van containing the measuring and recording equipment which is used in conjunction with the measuring chairs is shown in the background. The electronic equipment is shown in fig. 6; it consists of a carrier wave amplifier and a d.c. amplifier connected to an 8-channel pen recorder. The amplifiers also deliver

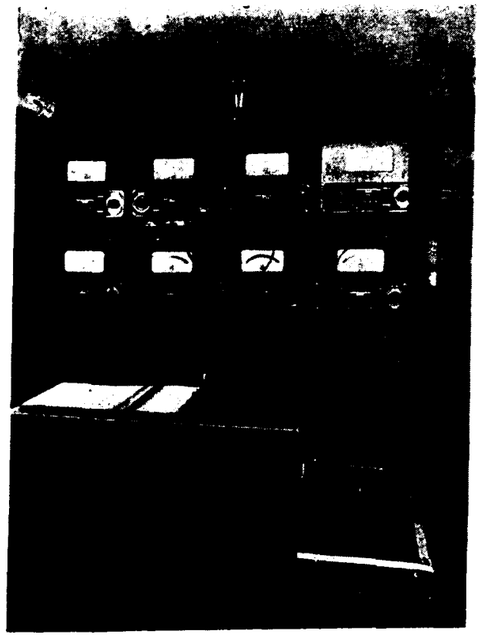


Fig. 6.

a calibrating signal to the recorder, so that the experimentally recorded deflections can be compared directly with the calibration.

Figs. 7 and 8 show recorder diagrams produced during the passage of trains round a curved track of radius 400 metres, at an average speed of 40 km/h. The two diagrams were produced by trains with locomotives of two different types. In this experiment, one measuring chair was placed at each end of the same sleeper, and the eight measuring pins connected to the eight channels of the recorder. The numbers of the pins corresponding to the various channels are given in

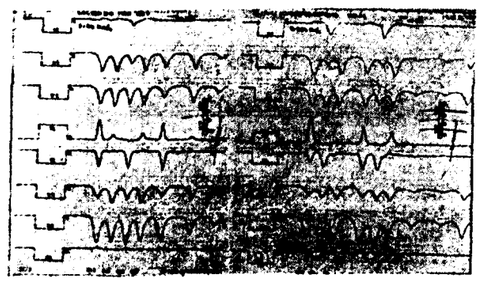


Fig. 7.

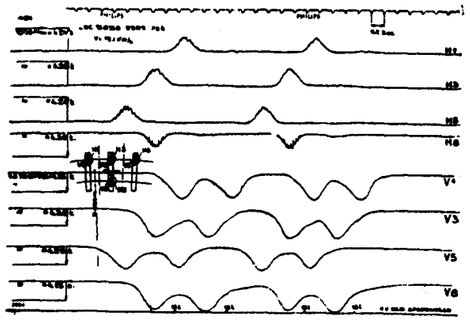


Fig. 8.

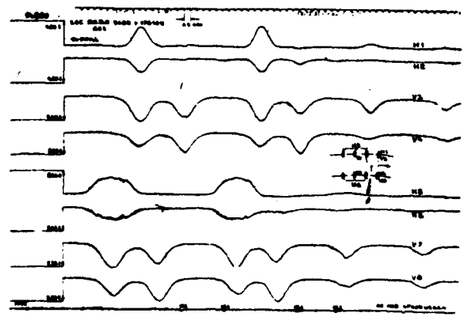


Fig. 9.

the diagrams. Nos. 1, 4, 5 and 8 are horizontal pins, Nos. 2, 3, 6 and 7 are vertical. A downward deflection in the diagram represents a tensile force in the pin (except in pin nr. 4). This is because a tensile force in pin 4 corresponds to a centrifugal force on the rail, while a tensile force in pin 5 corresponds to an inwardly directed force. The forces given here are, of course, those which would be transmitted to one sleeper by one rail, i.e. not the total wheel pressure. It is possible to couple the measuring pins with each other so that the sum of the readings from the two vertical pins of the same measuring chair, and the difference between the readings from the two horizontal pins, is obtained. One chair then occupies only two channels on the recorder.

Fig. 9 shows a recorder diagram produced from four measuring chairs, the horizontal and vertical pins of which have been electrically coupled as described above. These chairs were disposed around a curve of radius 150 meters, three under the upper rail and one under the lower rail. The horizontal forces H1, H3 and H5 are nearly equal, while the vertical forces V1, V3, V5

and V8 are different. This is to be expected from the unsymmetrical disposition of the sleepers in the ballast bed. The sign convention in this diagram is as follows: for the horizontal forces, an upward deflection represents an outwardly directed force on the upper rail (see channels 1 (H1), 2(H3) and 3(H5), while a downward deflection represents an inwardly directed force on the lower rail (channel 4 (H8).

This measuring method should usually be adequate for comparing the forces exerted by locomotives of different types. In order to determine the wheel pressure, the forces on all the sleepers affected by one wheel can be recorded, and the total effect found by addition (the place of the sleepers can be marked in the diagrams). Experiments have shown that as a result of the make-up of the track the vertical force arising from one wheel is distributed over about 5 sleepers, while the horizontal force is distributed over 3 sleepers. By electrical coupling of the horizontal or vertical pins from several chairs, it is possible to determine the wheel pressure directly. Fig. 10 shows the result of an experiment where the horizontal pins of 3 chairs were coupled, so that the horizontal wheel pressure occurring in a curve of 150 metres radius can be read off directly from the recording. Measuring with the measuring chairs described above has been effectuated on request of the "Office de Recherches et d'Essais" of the "Union Internationale des Chemins de Fer" by the Research Department of the Dutch Railways in international collaboration to study the force exerted on the track by locomotives of different types, on an experimental stretch of line at Giornico, Switzerland.

Stanvac Refinery completes arrangements to take Ankleshwar crude ahead of schedule

Stanvac Refinery is ready to take Ankleshwar crude ahead of time. Whereas the Oil and Natural Gas Commission had advised Stanvac that the Stanvac Refinery would receive crude oil from Ankleshwar from January 1, 1962, Company officials have now advised the Oil and Natural Gas Commission that they are in a position to receive crude oil upto 100 tons a day from November 18 onwards. This was possible because of the completion of some parts of the crude receiving facilities ahead of schedule. This has placed the Company in a position to store up to 1,250 tons of crude oil during the period November 18, 1961 to January 1, 1962.

Subject to agreements being reached on the pricing of Ankleshwar crude and other contract terms, Stanvac Bombay Refinery will begin processing their share of the crude oil from January 1 of next year.

A CORRECTION

In our July 1961 Annual Number in the "Signalling, Interlocking & Telecommunications Supplement" on page S.I. 19 in the last paragraph of the article entitled "Standard RPg Batteries for our Railways", it was published that "every component part of the battery is manufactured by Messrs. Standard Batteries Ltd., Bombay except Pg tubes." This is not correct. M/s. Standard Batteries are fabricating the Pg tubes as well in their factory. We regret for the error. Ed. IRE

Track Laying with Preassembled Panels

By Gunnar Ruding

RECENT developments in track-laying techniques have led to a greater interest in mechanised track-laying methods.

A contributing factor to the increased mechanization of track-laying and other work on modern railways is the introduction of concrete sleepers for constructing permanent ways. The weight of concrete sleepers is so much greater than that of wooden sleepers that mechanical handling methods have become increasingly necessary, particularly in relieving the individual platelayer from the need to lift heavy weights. Bigger and heavier rail sections, as well as longer rail lengths, have accelerated development in this direction.

If handling methods in the transportation and laying of concrete sleepers thus necessitate a higher degree of mechanization than previously employed, this same mechanization has also proved to be highly suitable for work with wooden sleepers. In certain cases it has been found that wooden sleepers can be replaced by concrete sleepers cheaper than the renewal of wooden sleepers by traditional methods. Mechanical track laying has therefore won increasing application, chiefly for concrete sleepers, but also for laying wooden sleepers.

Mechanized methods may take many different forms, but all are based on the principle that the actual lifting work is performed by mechanical means. In the following, emphasis is primarily laid on a system of track-laying with preassembled rail panels.

PREASSEMBLY OF RAIL PANELS

If a temporary station for the assembly of sleepers, rails and fasteners is erected along the section of line where track renewal (or even new track laying) is to be carried out, several important advantages are gained:

1. Organization is simplified and can be systematized.
2. Better supervision is possible and thus leads to better standards of permanent way.
3. Checks can be carried out as necessary.
4. Normal traffic does not interfere with the assembly of permanent way.
5. Materials handling is cheaper.

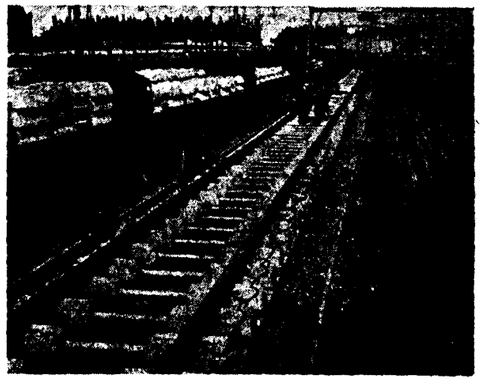


Fig. 1.

A temporary assembly station erected on the Swedish State Railways.

TRANSPORTATION TO THE TRACK CONSTRUCTION SITE

Listed below are some possible conditions under which track laying work may take place.

Alt. I. Complete availability of track (i. e. no traffic)

Alt. II. Single track with traffic (2 hours between trains) — 15 km. from assembly station in both directions.

Alt. III. Normal practice (2 hours between trains— 25 km. from assembly station.)

Alt. IV. Panels assembled in daytime. Old Panels also disassembled in daytime. Track available 4–5 hours at night when panels relaid. Capacity and equipment as in Alt. III.

Alt. V. *New Construction*
New track — full availability, greatest track-laying capacity.

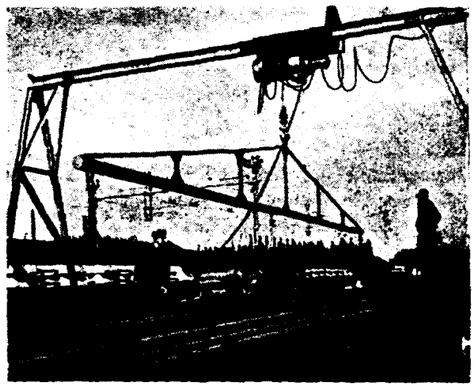


Fig. 2.

Pictured here is a device that may be employed when lifting rails (rail weights of 50–60 kg/m. in lengths of 40 meters are lifted in this manner).

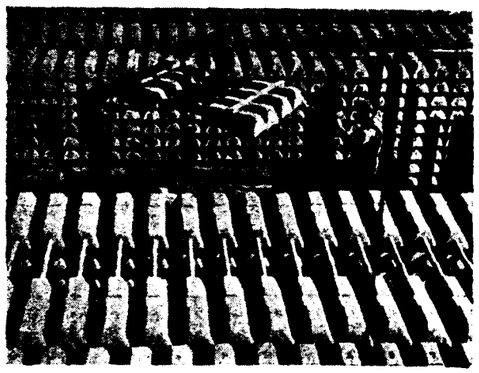


Fig. 3.

Cranes are also used for lifting concrete sleepers.

TRANSPORTATION EQUIPMENT

The use of cranes should be avoided as much as possible at the actual tracklaying site, since they often hinder normal and unavoidable traffic. Cranes also preclude the use of this track-laying method in tunnels and on electrified lines. With the aid of hydraulic and mechanical jacks it is possible to lift a panel at the assembly station to enable platelayer's trolleys to be rolled under it. With this equipment it is also possible to jack up the panel at the tracklaying site, withdraw the trolley from underneath it and then lower the panel into place on the ballast.

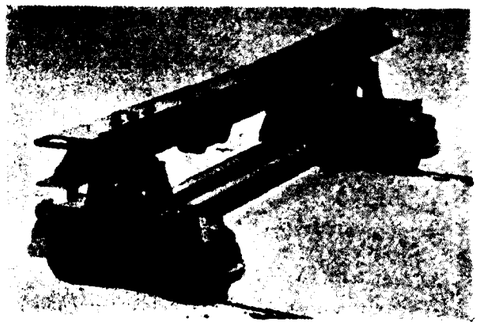


Fig. 4.

Fig. 5.

Illustrations 4 and 5 show a platelayer's trolley specially constructed for use in connection with pre-assembled track panels. The axles can swivel relative to the longitudinal member and the panel-supporting beam is free to move horizontally on the top of the trolley. With the aid of this trolley, designated Hul-2, sharp curves and points can be negotiated without dismembering the assembled panel.

Fig. 6.

These trolleys can, of course, also be used for removing old wooden sleeper panels or for transporting new ones.

WORKING METHODS

Track-laying equipment must be chosen with regard to the various times and degrees of availability as outlined in the above 5 alternatives. In principle, the same equipment is used in all alternatives; except, of course, for new tracklaying as in Alt. V., where there are no old wooden panels to remove for dismantling.

Track-laying equipment should, as far as possible, have sufficient capacity to keep pace with the manufacture of concrete sleepers or the supply of wooden sleepers and rails.

Work at an assembly station will naturally flow considerably smoother if co-ordination can be achieved between rail supplies, sleeper supplies and tracklaying capacity. Stores at the assembly station should neither be too large nor too small. After a fairly short period of working, all links in the chain generally find the best way to schedule deliveries so that work is carried out without hitches.

Supposing a stretch of about 100 km. of track is to be renewed, an assembly site should be chosen that lies as centrally as possible, at a small station with a goods yard permitting direct shunting to the main line. Equipment, consisting of templates for sleeper spacing, cranes, etc., is erected in 2 or 3 days. Two travelling portal cranes are set up and assembly jigs complete with hydraulic jacks located at the assembly site. The trolleys (Hul-2) should be placed in readiness, etc. The sleepers are now unloaded by the portal crane straight from the wagon onto the assembly jigs. At the same time the rails are brought up in 40-meter lengths, for example, and placed on the sleepers.

Normal practice in Sweden is to mount two 40-meter lengths simultaneously, giving a total panel length of 80 meters. In order to install the rubber pads the rail is lifted slightly and then finally lowered into its seats in the sleepers.

The photographs show a station at which Swedish type-101 sleepers are being fitted with FIST rail fasteners. After the rail has been located a hydraulic device is used to mount the rail-fastening and hold the rails at the correct distance during the mounting to ensure accurate gauge. The entire panel is then lifted, using the hydraulic jack incorporated in the assembly jig, so that the Hul-2 trolleys can be inserted underneath. 80 meters of new track is now ready for transportation.

Out on the stretch of permanent way where the new panel is to be installed, 80 meters of the track is raised by mechanical jacks so that auxiliary rails can be laid directly on the ballast under the panel.

Fig. 7.

The old wooden sleeper panel is then carried back to the temporary assembly station for disassembly. The new concrete sleeper panel is taken to the site from which the wooden panel was removed, where the new panel is lifted with jacks to allow removal of the auxiliary rails and the Hul-2 trolleys, after which the new panel is lowered into place on the ballast. The auxiliary rails and Hul-2 trolleys are now introduced under a fresh 80 meter length of wooden sleeper panel, which has been lifted meanwhile, and this is transported back to the assembly station, where a new concrete sleeper panel is collected. Track laying continues in this way, interrupted only for the passage of trains.

Rail welding and ballast work is, of course, carried out in the same manner as is normally employed on the railway concerned.

ELLIOTT HYDETSCO OPEN SIDED PLANERS

By An Engineering Correspondent

THE Machine described in this article is an Invicta-Hydetsco Open Sided Planing Machine. Hydraulically operated, it is one of a range of opensided and Double Column planing machines produced by these manufacturers. The whole range of machines, which covers sizes varying from a 3 ft. to a 14 ft. stroke, are powered by Oil Hydraulics. For the purpose of this article an 8 ft. stroke machine has been selected.

CONSTRUCTION

The machine as a whole has been designed with a view to compactness. The hydraulic controls are

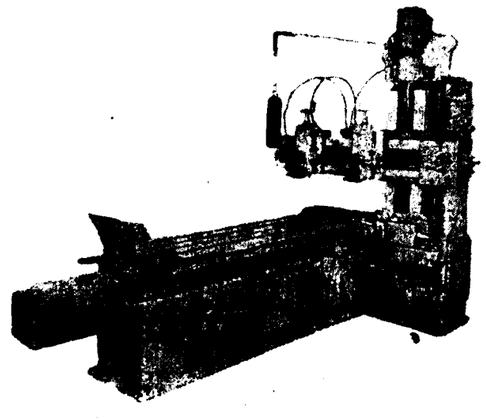
grouped conveniently on the base of the machine within easy reach of the Operator and the electrical control buttons are suspended from a pendant also within easy reach of the Operator. The stop and start control handle is duplicated on the opposite side of the machine and this in conjunction with the switch pendant, which can be swung across the machine, enables the Operator to control the machine from either side.

The base of the machine is of rigidly constructed box section and in this type of machine the oil reservoir, pump, motor and hydraulic control gear are fitted within it. The design is such that the equipment can be housed completely without loss of rigidity. The length of the base ensures that the working surface of the table is fully supported throughout its length of stroke.

The column which is attached to the side of the machine is also of box section and carries within it the counter-balance weights for both the Cross Rail and Side Tool Head.

The Cross Rail is supported at the rear by a brace and this brace being in contact with both the Cross Rail and Column ensures that the fullest possible support is given.

The Tool Boxes are of the planer type and are rigidly constructed and specially designed to absorb the cutting forces of the tool. All tool boxes can be swivelled through an angle of 60° either side of centre, accurate graduation being provided. Automatic hydraulic tool lift is a standard feature, the activating cylinder is incorporated in the tool box swivel pin and acts centrally, directly behind the tool. The tool is capable of relief through 7° from vertical.



RAPID TRAVERSE

Power rapid traverse for raising and lowering the Cross Rail is a standard feature and can be fitted if required to the Tool slides for rapid horizontal traverse along the cross rail. The Cross Rail gear box, through which all movement of the cross rail tool heads are actuated is fitted with precision cut gears. When rapid traverse is fitted, helical gears are used for transmission to ensure quite running, and a friction over-load clutch is incorporated to safeguard against over-run.

FEEDS

Automatic feeds to the cross rail tool boxes are standard both in the horizontal and vertical direction and can be varied whilst the table is in motion. All feeds are derived from the Feed Cylinder, which in this model is a single action hydraulic cylinder with spring return.

Feeds are actuated hydraulically and a non-slip ring clutch is fitted to obviate back feed.

SLIDEWAYS

All slideways are of hand scraped finish. In the smaller range of machines the flat type is general but in the larger and heavier machines the table and base slideways are of the Vee and Flat Type.

LUBRICATION

The table slideways are lubricated by means of a small auxiliary pump. This is operated by servo pressure from the main hydraulic circuit and supplies lubricating oil under pressure to various parts along the bed. All other slideways are lubricated by hand.

The gear box is fitted with a 'single shot' plunger type hand lubricating pump, the oil for which is contained in a reservoir in the bottom of the gear box.

HYDRAULIC TABLE DRIVE

By using hydraulic table drive extremely high quality finishes are available and because of the smoothness of operation and elimination of vibration, longer tool life. An additional advantage is the great reduction in wear of essential parts as these are constantly lubricated by the oil itself. It is impossible to overrun the bed in the manner of the 'rack' type because it is constrained completely for longitudinal movement by the main cylinder which is fitted with dashpots to reduce reversal shocks.

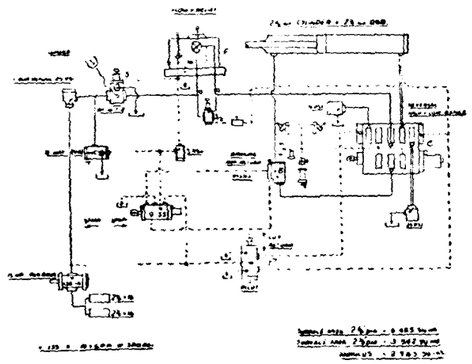


Fig. 1

CIRCUIT

The standard hydraulic circuit for the 8ft. stroke machine is shown in fig (1).

The pump is a constant delivery type and is powered by a directly coupled 15 HP 960 r. p. m. Motor. The pump is rated at 18.9 gallons at 500 P. S. I. and develops a total thrust of 4,540 lbs. at 700 P. S. I. The cylinder which is double acting has a bore of $2\frac{7}{8}$" dia and a piston rod of $2\frac{1}{8}$" dia.

With the machine in stop position, pilot pressure passing through the stop and start valve 'SS' is ported to the Two Way Valve 'T' and allows oil from the pump to pass through this valve at near zero pressure back to tank. At the same time pilot pressure is ported to the braking valve 'B' keeping it closed.

In the 'Start' position the Braking Valve is relieved of pilot pressure and the Two way valve is closed thus allowing oil to pass through the sequence valve S, through the Flow Control Valve 'F' to the Combination Valve 'C'. Dependant upon the flow setting of valve 'F', the built in relief valve operating under line pressure causes the sequence Valve 'S' to close thus diverting surplus oil to tank.

The pilot valve 'P' is operated by the table and in the 'cut' position ports the combination valve C so that oil passes to the large diameter end of the cylinder. When in the 'low' range i. e. of speeds from 10 to 65 ft. per min the oil from the rod end of the cylinder passes through valve C to tank. When in the 'high' range of speeds i. e. from 10 to 125 ft. per min the oil from the rod end of the cylinder is re-ported back to the large diameter end thus giving the greater volume of oil necessary for the faster speeds.

The total developed pressure in the Low Range at 700 P.S.I. is 4,540 lb. and on the 'high' range is 2,480 lb.

On the return stroke of the table the pilot valve 'P' re-ports the combination valve C and directs the oil to the rod end of the Cylinder and the flow is reversed.

The return speeds are in direct ratio to the cutting speeds. On the low range they can be calculated for any cutting speed by multiplying by a constant of $2\frac{1}{2}$ and on the high range by using a constant of $1\frac{1}{8}$.

If required, the circuit can be modified to give a constant return speed of 135 ft. per minute irrespective of cutting speeds. This is obtained by bridging the points marked 'O' with a sequence valve (S2), pilot operated so that it opens when the combination valve ports for return. This enables the full pressure discharge from the pump to by-pass the Flow Control valve and pass directly into the combination valve. The advantage of a constant return speed is that it reduces the time of the idling stroke and simplifies calculations for machining operations. A disadvantage is that in the case of a large and heavy work piece, where the full stroke is used, excessive reversal forces are experienced.

Supply oil for actuating the Tool reliefs and feeds is tapped from the Combination Valve as shown. Operation is during the return stroke and adjustment is by means of needle valves incorporated in the line.

The high speeds of the machine do not effect stability but at speeds approaching 10 ft. per minute there is a certain amount of instability. As these speeds are not planing machine speeds the fault is not serious. Where however speeds of from 1" per minute to 30" per minute are required for use with Milling attachments, modification is made to the circuit and these speeds are attainable under stable conditions.

The use of the compounded circuit giving a series of 'Low' and 'high' range speeds enables pressure to be available when required for very heavy workpieces and cuts, or allows higher speeds where the work pieces and cuts are both light. Where the speed ranges over-lap it is more economical to use the 'Low' range as is shown in the test results below :—

Weight of Workpiece = 1,200 lb.
Material = 25 Ton tensile Carbon Steel
Tool $\frac{3}{4}$ 'Stag Major'
Feed = .020"
Depth of Cut = $\frac{1}{4}$"

HIGH RANGE	—	LOW RANGE
Speed 50 ft. per minute		Speed 50 ft. per minute
Pressure in cyl in lb/0" 584		Pressure in Cul in lb/0" 327
Total Thrust 2,069 lb		Total Thrust 2,121 lb
Total Horse Power consumption of Machine = 10 H. P.		Total Horse Power consumption of Machine = $7\frac{1}{2}$ H. P.

With the constant delivery pump the H. P. required for any given cut is, for practical purposes, independent of the speed of the cut. A continuation of the above test showed that the H. P. required for a speed of 20 ft. per minute was $7\frac{1}{2}$ H.P. (Low range) and this remained unchanged when the speed was increased to 65 ft. per minute. The maximum test cut taken on this machine was $\frac{1}{2}$" deep × .100" feed ; the pressure being 700 P. S. I. with a total thrust of 4,543 lb.

ELECTRICAL EQUIPMENT

Main Motor	—15 H.P. 960 RPM 3 Phase 50 cycles, Newman Industries Squirrel Cage – Induction.
Cross Rail Raise & Lower Motor	—1 H.P. 245 RPM 3 Phase 50 cycles, Neco Geared Motor. Squirrel Cage – Induction.
Rapid Traverse Motor	—1 H.P. 930 RPM 3 Phase 50 cycles, Newman Industries. Squirrel Cage Induction.

The Control Gear is housed in a cabinet attached to the column of machine and comprises automatic Star Delta Contactors for the Main Motor together with Direct on Line Reversers for the Rapid Traverse Motor. Built in protection fuses and an isolator are incorporated.

Limit Switches are fitted to the column of the machine to prevent damage through over-run of the Cross Rail whilst Raising and Lowering.

EXTRAS

Attachments which can be supplied as an extra include Milling Heads, Grinding Heads and Hydraulic copying devices.

The Milling Heads are manufactured in two sizes Mark 11 and Mark 111. Mark 11 is powered by a 5 HP Motor and has 12 speeds covering a range of from 26 to 920 RPM. The spindle Taper is international Standard No. 50. The Mark 111 is powered by a 3 HP Motor and has 9 speeds covering a range of from 53 to 992 RPM. The spindle taper is International Taper No. 40. All heads are driven by precision cut gears manufactured from Nickel/Chrome/Molybdenum Steel. Lubrication is automatic. The Low table speeds obtainable with the modified hydraulic circuit were developed for machines fitted with Milling Attachments.

Grinding Heads are available and when fitted to standard machines will give a good finish on general work. If machines are required primarily for grinding work they can be supplied built to alignments based upon Schlesingers limits for Grinding Machines. Either Vertical or Horizontal spindle type of grinding head can be supplied. Drive is by a 3 H. P. Motor running at 2,800 RPM on the former and at 1,400 RPM on the latter. Wet grinding equipment can be supplied to order. All machines using grinding attachments are fitted with concertina guards covering all slideways and where dry grinding is employed dust extraction equipment is fitted.

The great advantage in the use of these attachments is the saving in both loading and setting times that can be obtained. Once the machine is loaded the various operations can be performed in sequence with very little loss of time.

Two or three dimensional copying attachments are available. Operated by a separate Hydraulic system they consist of a pumping unit and accumulator, control valves and control cylinder, servo mechanism, styles and templates. The control cylinder is mounted upon the Cross Rail apron and carries the Tool Slide. An extension arm from this has at its extreme end the stylus, which is in contact with the template. Any movement of the stylus in transferred instantly by means of the servo mechanism to the control valves and control cylinder causing this to reproduce the movement of the stylus. Extremely accurate reproductions can thus be machined and a wide variety of forms can be readily produced.

panel working on the trunk route of the Indian Railways, the problem posed by the availability of power at road side stations and the availability of electrical signalling materials and the comparison of staff requirements will all be dealt with in the subsequent paras.

PANEL INTERLOCKING AT ROAD SIDE STATIONS

The schematic diagram of a road side station having the facility of simultaneous reception and operated by electrical point machine and detected electrically is attached (Fig. 1). Colour light signals are provided for homes, starters, advance starter and outer. Outer signals can either be kept as approach lit to save the

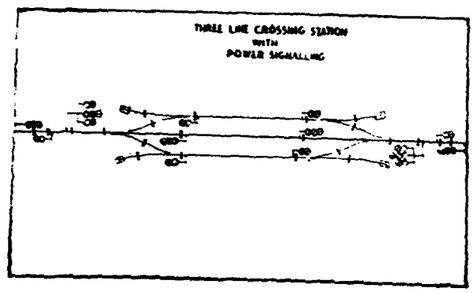


Fig. 1

power or permanently lit itself. A small panel is provided in SM's office with switches controlling the point movements and signals being cleared after the correct routes are set. Adjoining to the panel kept in the station building a separate cubicle containing all the relays which are pre-wired in a factory is also provided. The three lines at the road side stations and the connected lines right from advance starter to advance starter on either end is also track circuited involving 13 track circuits in all. The power is supplied for all these operations from the central place at the station building. Heavy duty cells are provided at the stations and are charged by petrol driven or diesel driven generators.

An estimate for the experiment of the electrical signal installation, item 327 of the 25th report of the Signal & Telecommunication Standards Committee was prepared by the Western Railway in the year 1952. In this scheme (annexure 'A' attached) instead of a panel having switches controlling the points and signals it was proposed to have a 24 slide control and each slide having circuit breakers ('D' contacts as known on the Western Railway) so that the slides will be controlling the 8 points and 16 signals with SM's lock up. Search light signals has been included in this estimate. The estimate that has been prepared amounting to Rs. 2.42 lakhs in 1952 will cost about Rs. 3.5 lakhs at the present day cost. In this estimate there has been no provision for keeping the cells charged, as heavy duty primary cells had been included like AD 513. In the scheme of panel interlocking it is also essential for the advance starter being controlled by the line clear condition of the block instrument, i.e. having obtained permission from the other station for the train to enter the block section.

The easiness of operation in a panel interlocking can be understood with the movements of points and signals for a particular route setting can be completed within 1 minute, and immediately getting the indications of correct route setting. The necessity for the SM to go to the point will arise only in the event of failure of electrical point machine wherein local cranking has to be done for turning the point and normally such a case is rare to occur in an electrical signalling installation.

It is also essential in such a scheme of panel interlocking with colour light signal to have a token less block working since with such an arrangement of expeditious movement of trains, the token working is liable to delay the movement. With regard to the tokenless block working, the existing Neale's Ball Token Instrument standardised by the Railway Board, for single line working can itself be converted into a tokenless block since with such a panel interlocking section the necessary track circuits will all be available. Such an arrangement of Neale's Ball Token Instrument was tried in Wireless Laboratory, Southern Railway under the guidance of late Shri M. S. Viswanathan the then DSTE (retired CSTE, Central Railway). Even the existing Tyer's Tablet block instruments of the Western Railway can be converted into a tokenless block working avoiding the various failures like tablets getting crossed tablet exhaustion and tablet failing to release the half block to enable the slide to be put in. Of course it will be desirable to have tokenless block in a compact and a small unit manufactured in a decent manufacturing organisation like Indian Telephone Industries. The block instrument can be subject to tests and trials in the National Physical Laboratory a number of times prior to its being commissioned.

The movements of trains in the stations will be indicated in the panel by means of visual indicators

while the train occupies a particular track. No doubt the problem of getting wooden sleepers for these 13 track circuit in every road side station will confront a major problem.

WORKING OF TRAINS BY MECHANICAL SIGNALLING VIS-A-VIS PANEL WORKING

Let us now consider the method of working of the single line crossing station by means of the mechanical signalling having (a) lower quadrant and (b) upper quadrant central cabin scheme. In some important trunk routes of the Indian Railways we have two cabins with rod operated points and lower quadrant signalling (in the M&SM Railway) and for this, 8 hours of duty i.e. one SM in the station building and two cabinmen in the two cabins is required. The block instrument is provided in the station building and the station master is having electrical control by means of SM's slide on the reception and despatch signals. The advance starter signal is controlled by means of the line clear position of the block instrument. In this system it cannot be denied that the staff required is quite heavy and in the event of a failure, the SM has to personally go out and then allow for the train to be piloted.

In the case of a central cabin with double wire operated points and multiple aspect signalling no doubt the various aspects are given to the driver at the respective places where he should get the indications and in actual practice it is found that the trains run faster in MAUQ territory in view of the driver being indicated regarding his going on the main line or on the loop line nearly a mile away. In this case of signalling, there will be a SM in the station building and a cabinman to operate the points and signals. Where there is a very dense traffic the shift of working may be 8 hours instead of 12 hours.

With the introduction of Panel interlocking in certain places, the advantages will be obvious since only the SM will be operating the relevant points and signals and only in the event of a failure he will be required to personally crank handle the points machine and operate the points. The time factor with the operation of points by electrical point machine and colour light signals and mechanical operation of points and mechanical signals may not be very big, but when tokenless block is added to the panel interlocking arrangement there will be a vast difference. The formula used for the capacity of the section of train working on the Indian Railways is 24×60 divided by the greatest time taken by a slowest train in the longest section plus 7 minutes into 70%. Assuming that 20 minutes is the greatest time taken in a particular section it will be observed that only 20 trains each way is the maximum possible number of trains that can be run on the single line section. In actual practice while crossing trains on a particular section, the first train which has been received and being crossed by the other train waits for about 15 minutes in the case of token working, but in the case of tokenless block working and colour light signals, it takes only about 4 minutes since the block instrument can be put to normal as soon as the last vehicle has arrived ; after obtaining the line clear on the block, the signals can be immediately lowered. The time taken in the tablet or token being brought from the driver of the first train manually by the pointsman and for taking the tablet from the block instrument to the other engine driver is found that it takes a minimum of 6 minutes for the station staff. Further as far as percentage factor is concerned for the purpose of calculation of the total number of trains run on a particular section—which is 70% in the case of mechanical signalling it can be increased to 80% with the token less block and colour light signal working. In fact it can even be increased to 90% but that depends upon the availability of number of trains and the manner in which it can be crossed. Assuming that the efficiency with the token less block working and colour light signals on a particular section of 80% of the normal capacity, it will be observed that 26 trains can run each way. This means 30% of extra capacity is available in the section. It is worthy of consideration that apart from the sectional capacity being increased by about 30%, the staff required for the operation of this system of working is reduced. It cannot be denied that the lethargic method of working of some of the pointsmen and subsequently by the drivers after their obtaining the tablet has been the cause for the sectional capacity to get reduced or the controller getting into mess by the bungling of these staff. The token less block with colour light signals will impress upon the drivers that the clearing of the signal is to be obeyed immediately just as it is observed in the suburban sections of the Western, Central and Southern Railways. If the driver obeys the signals of the token less block arrangements with colour light signals the capacity of the section can be maintained to the theoretical possible figure.

From the above comparison between the mechanically operated signalling and panel interlocking it will be observed that upto about 50 trains in all in a particular section can be easily run on a single line section with easiness of operation. There are cases in foreign countries, particularly on Japanese

National Railways, where for upto 40 trains each way they have only a single line working. This is of course by reducing the sections between stations to about 2½ miles to 3 miles on an average. In a country like India, it may not be worthwhile to reduce the section to such an extent particularly on the trunk routes, where it is very thinly populated and traffic does not warrant.

IMPLICATIONS INVOLVED IN INTRODUCING PANEL INTERLOCKING ON THE TRUNK ROUTES OF THE INDIAN RAILWAYS

A map showing the trunk routes (BG) on the Indian Railways linking 4 important cities given in the form of a parallelogram with diagonals is enclosed (Fig. 2). From this it will be observed that in the important routes of Bombay to Calcutta there is a proposal for complete doubling the whole section during the Second Five Year Plan. Of course the section Bombay to Calcutta due to various Steel Plants and other heavy industries the doubling has already been contemplated and it will be executed also during the Second Five Year Plan. The section Howrah to Allahabad in the route of Howrah—Delhi is already a double line section. The chart indicates the number of single line sections between Poona and Arkonom on the Bombay—Madras route, Nagda to Mathura on the Bombay—Delhi route (via Western Railway). Mathura to Bezwada on the Delhi—Madras route (excluding Nagpur—Wardha), Bezwada to Kharagpur on the Madras—Howrah route and Itarsi—Mughalsrai on the Bombay—Howrah (via Allahabad) route, and Allahabad—Delhi in the Howrah—Delhi section. The total number of stations in these various sections of single line is approximately 500. A detailed estimate prepared for the working of single line stations with 2 loops having simultaneous reception facilities points operated by Electrical Point Machines and Signals by colour light signals and the whole control being done from a small panel operated by SM has been thought of as the best scheme for working the important trunk routes on the Indian Railways.

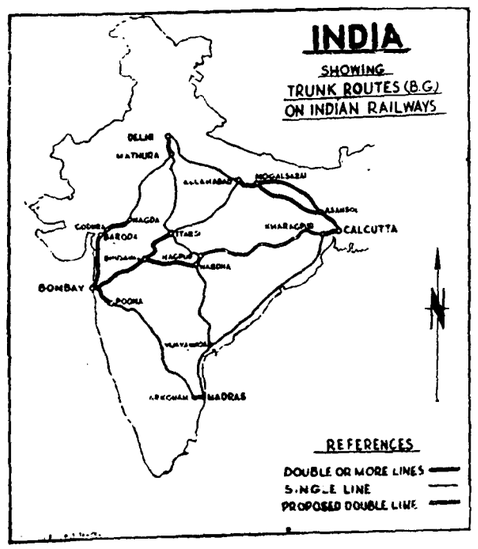


Fig. 2

The above scheme of providing electrically operated layouts for each of the stations has the following implications :

(i) The cost of installation of each of the station will amount to about Rs. 3.5 lakhs at present day rates.

(ii) The power supply at various stations which will pose a difficult task will have to be solved by forming a unit of 25 stations in which the supply will be made available in the form of heavy duty secondary cells charged by either a portable generator made available at each station or from a central place from which the heavy duty cells duly charged will be taken to various stations once in a week for replacement and the working battery taken for charging. This is quite easily possible by having a special store van and by the shunting train once in a week the batteries can be easily replaced.

The supply of power poses the most important problem in the implementation of the scheme on the trunk routes of the Indian Railways. It will be observed that section of 500 stations will be split into about 20 sections (centralised) wherein the power supply will have to be met with by duly charging these batteries from a place where electricity is available or a central diesel or petrol set which will be available for charging these batteries.

Once the power problem is solved the working of such a scheme on the single line sections of the Indian Railways will not present any important task in the execution of the above scheme.

(iii) Availability of the electrical point machines, signalling relays, railway signalling cable and colour light signals lenses :

Out of the above 4 items a beginning has already been made in the manufacture of signalling cables in India by Siemen's at Bombay and I.C.C. at Calcutta. The manufacture of electrical point machine is possible in the Railway workshop itself duly utilising 3/8 to 1/2 H.P. motors which can be designed to work on 60 volts D.C. There are number of factories in this country which can undertake this job. Requirements of total number of electrical point machines in the above scheme will be about 4000 to 5000 Nos. and it will not be out of place to mention that the above number of points machines to be manufactured in the Railway workshop with the existing capacity already available will not be a difficult job and only arranging for 1/2 H.P. motors from suppliers (Light Electrical Manufacturing Industries already available in India) it will be possible to tackle the availability of point machines with the local resources.

As regards the availability of the relays, it may be mentioned that the plug in type of relays as used in the route relay interlocking system in the Churchgate installation (Western Railway) can be got manufactured from the Telephone Industries, Bangalore, if an order of huge nature can be available and the corresponding requirements of such relays exist ; it will not be out of place to state that a separate wing attached to Indian Telephone Industries or the Heavy Electricals, Bhopal, with an investment of about 4 crores in the initial instance, can start manufacturing the two vital items of electrical point machines and signalling relays required for the Indian Railways. Private firms have already started the manufacture of signalling cables and the major portion of the foreign exchange can be entirely eliminated. Signalling lenses for the present may have to be imported only till suitable lenses are available from indigenous sources.

(iv) Availability of competent staff and the financial implications of the existing arrangements vis-a-vis new proprosal :

In the existing arrangement of signalling on the Indian Railways with standard II or III interlocking the strength of staff at each of the road side station is about 1 SM, 2 ASMs and about 9 Pointsmen including platform porters. In the MAUQ territory on the Western Railway three pointsmen for every 8 hours in addition to the platform porters are working. Normally with a central cabin of double wire operation the staff in such station will be about 3 levermen one for 8 hours shift and one working as platform porter for receiving Guard's arrival certificate etc. In addition to such staff the technical staff of a section of 25 stations will comprise of 1 Chief Signal Inspector, 2 Signal Inspectors with 6 Mechanical Signal Maintainers and 4 Electrical Signal Maintainers. A separate chart showing the existing strength of staff on the single line section of the Western Railway which it is assumed is the strength of staff available on the various sections of other Railways is prepared.

If the scheme of tokenless block with colour light signals and electrically operated point machines from a central panel is implemented, the requirement of non-technical operational staff at each of the above stations will be brought down to 1 SM, 1 ASM, and 3 Pointsmen including platform porters etc., the reason being all operations being done personally by the Master and only in the event of a failure the necessity of pointsmen being available is there. Even then the requirement of the SM to proceed to site for cranking will be essential. However, the number of such cases will be extremely rare hardly once in perhaps 6 months at a station.

The availability of the technical staff for managing such layout comprising 25 such sections has also been considered and proper type of technical staff will be easily available since there are existing facilities to train people on this aspect of signalling on the various railways in addition to the help given by the All India Signalling Training School, Secundarabad. The number of inspectors' category will not assume any greater proportion of increase as for a section of 25 stations with such installations the number of technical people will practically remain the same. The only extra staff needed for each of the above section will be the staff required to make available the power and working petrol generators for charging heavy duty cells.

Each of these 3 points (i) power supply, (ii) availability of materials for such a scheme and (iii) implications of the staff of the existing installations vis-a-vis the proposed installations will all be dealt with in the next 3 paras in great detail.

POWER SUPPLY

For a single station of tokenless block with colour light signals number of heavy duty cells required is about 200 Nos. of cells AD 513. Including the tokenless block working about 240 cells of this type will be quite sufficient for meeting the needs. Today on a single line working stations with standard II interlocking installation of the type that is existing on the Western Railway about 36 cells are used at each station for the Hepper's Control. On an average at any single line working station with 2 cabins having intercabin controls about 60 primary cells are in use. Today the carbons of all the primary cells are still being imported and this involves foreign exchange. If instead of these primary cells or even heavy duty cells, accumulators made in India are utilised and proper charging facilities are made available, the element of foreign exchange will be considerable reduced. The heavy duty primary cells can be used as a standby in case of the secondary batteries and the power supply failure.

Whereas the life of the primary cell, particularly the carbon is about a year and a half and at least 3 to 4 times the zinc has got to be renewed within this period, the life of accumulator either acid cells or nickle-iron cells (NIFA) is quite longer and it is possible to reduce the element of foreign exchange and maintain a constant power supply. In actual practice there may be come sections on the trunk routes where the electric supply is available at a number of stations due to various hydro projects which are being implemented. If the power supply is available conveniently Seliniam Rectifier can be used for charging of the batteries. For charging of the various accumulators provided at road side stations instead of heavy duty primary cells, the compact petrol driven generator or diesel driven generator are available readily in the market made by Kirloskar and other firms. The availability of 1000 such sets one for each station and one as a standby will not confront difficult task in procurement. If however, even if decision is taken to have a central place of charging, higher capacity diesel driven electrical generators are also available and they can be provided at a central place each such unit comprising 25 stations.

AVAILABILITY OF ELECTRICAL SIGNALLING MATERIALS

As earlier indicated, the above scheme for 500 stations in the trunk routes (BG) of the Indian Railways requires about 4000 electrical point machines combined with the detectors, about 25,000 Nos. of relays neutral and about 20 drums of cables for each station, i. e. 10,000 drums of cables of sizes. It has to be pointed out that cables are being slowly manufactured in India and it may be possible to meet the demand both from the Siemens—Cable Corporation of India, Bombay as well as Indian Cable Co. Ltd., Calcutta.

As regards the relays a bulk order of such nature if required, it can be obtained from the factories like Indian Telephone Industries or with the special efforts one of the recently developed workshops in the Railways itself to start manufacture of such relays in collaboration with one of the foreign firms. The electrically operated point machines can also be completely manufactured in one of the railway workshops with only electrical motors being obtained from light Electrical Industries, manufacturing such loom motors in India itself.

It need not be thought that availability of all these materials is very imaginary as stated herein. In actual fact if efforts are taken it will be possible for manufacturing all these equipments in India itself with already available capacity. However, a Central Factory under the control of the Railways can be started with initial investment of about 4 to 5 crores for purely manufacturing electrical signalling equipments in collaboration with some foreign firms; it will not be improper to indicate that these equipments can all be made locally and the element of foreign exchange can be considerably reduced. Further an installation of such a factory with an investment of about 4 crores will in the long run enable the Indian

Railways to meet considerable portion of their demand from the local manufacture itself. A scheme of this nature will be possible to be executed only when a factory controlled by the organisation handling these equipment is also started side by side. It will be imperative to have such a factory during the course of atleast the third five year plan which will enable this country to be self-sufficient in the manufacture of electrical signalling equipments which in turn will induce the Indian Railways to install a number of stations with electrical signalling equipments facilitating considerable easy operation. It may be stated here that the element of foreign exchange in implementing the scheme of this nature with the existing capacity available in some of the factories mentioned above, will not exceed 4 to 5 crores. In the long run installation of such signalling system will be of a great advantage to the Indian Railways who will be able to reap the advantage within a period of about 10 years. Alternatively it can be expressed that the scheme will be financially justified if we go in for implementation of this type of installation.

Another major problem that will be faced is about the availability of wooden sleepers for these 500 stations which will amount to about 4000 sleepers for every station i. e. 20 lakhs of sleepers costing about 7 crores of rupees. No doubt this problem can only be solved by either having insulating pads underneath the rails (between the rails and sleepers) or by having concrete sleepers as developed in some of the foreign railways and utilising the insulating pads or alternatively the wooden sleepers which may be received for various other works and which are used in some places where they need not be used for the purpose of renewals etc. can be diverted to the track circuiting purposes of these lines.

The major factor which has got to be considered is the safety available at every station—the impossibility of receiving a train on an occupied line through the trunk route if such a scheme is implemented.

THE IMPLICATIONS OF STAFF

Consideration of such a scheme giving a great facility in the routine operations at various stations and a great flexibility in the movement of trains will of course result in the reduction of the expenditure on the operating staff with corresponding increase on the expenditure on certain categories of technical staff. An analysis has been made of the basis of a section of about 25 stations as one unit and for a period of about 25 years. (Annexure B) It will be observed there will an over all saving of about 3 to 4 crores in the expenditure on the operating side. It is not intended to propose the scheme with a view to reduce the operating staff, but such a scheme like this will only reduce the class IV categories of operating staff. The saving resulted by such a scheme can always be ploughed back to the general revenue or to the development of the railways in various other forms wherein these people can all be alternatively absorbed. There should not be objection from the operating side just because the reduction in operating staff will be resulted by the implementation of such a scheme. The staff rendered surplus by such a scheme can always be utilised for various type of work and it cannot be helped if we have to avoid doubling which is not normally justified.

The implementation of the above scheme will benefit the railways by a very simple method of working and the safe signalling for running fast trains. The delay caused by the crossing of the trains on single line for a period of about 15 minutes and also the delay in picking up of tablets in the event of missing of a tablet and even in the normal course a little reduction of speed to pick up the tablet will all be entirely eliminated. This will result the quicker handling of traffic and safe method of working.

Considering the necessity for quick movement of trains for handling of heavy traffic on the Indian Rlys and competing the road traffic in handling goods for longer distances this type of signalling will offer a very great flexibility. Today the average speed of goods trains works out to about 11 miles per hour. If a pilot scheme on atleast one of the railways is introduced based on this type of electrical control, we can form an opinion as to the speeding of trains due to such signalling arrangements and availability of extra capacity. In actual fact there is no necessity even to have a pilot scheme and then observe results due to the mere fact that the Estimate Committee in their 33rd report have clearly observed that the standard III signalling arrangements existing on the Indian Railways is not as expeditious type of signalling as existing on the foreign railways.

When Railways have planned in the 2nd Five Year Plan 1175 crores expenditure and for Civil Engineering works like doubling etc. approximately about 100 crores, it is not improper to say that the expenditure of about 20 crores on the improvement of the existing signalling on the trunk routes BG of the Indian Railways will not be a great expenditure made for speeding of goods trains.

From the various details discussed in the subsequent paras it will be observed that the scheme of this nature costing 20 crores on the improvement of signalling on the trunk routes is offset by the reduction in operational recurring expenditure to the tune of about 4 crores and extra capacity available on these sections will justify the expenditure that will be involved by the implementations of such a scheme.

One important factor to be considered with regard to the foreign exchar ge is that if the requirement of the point machines and relays are all of considerable nature and recurring demand is also of high order, it should be possible to get these materials manufactured in this country as allied units to one of these factories like I.T.I, of light electrical manufacturing industries attached to Heavy Electricals, Bhopal since the firms like MVGRs are the unit of AEI who are the consultants in the Heavy Electricals, Bhopal.

Doubling of a section of 120 miles today depending upon of course the type of section, costs about 8.9 crores including the signalling portion of works. As a matter of fact the utilisation of these 9 crores on the improvement of signalling will offer practically 200 stations greater flexibility in operation and 30 to 40 percent increase in traffic, over a length of approximately 8 times the mileage of the doubled section. Hence it can be calculated that over sections where doubling is *not* absolutely essential within a period of 15 years, it will be more worthwhile to have a scheme of tokenless block with colour light signals giving 30% extra capacity for 8 times the length of doubled section of 100 units (doubling of a section giving 100 percent increase in capacity), it will be observed 2½ times benefit will accrue by going in for advanced type of signalling over a longer section.

The analysis that has been made above with regard to the justification for the implementation of a scheme of this nature should be viewed in the present day trend of rail-versus-road competition. In foreign countries when the highways were developed they had experienced considerable financial loss on section where they have keen competition with the railways working. It will not be possible for the railways, however efficiently they may run the trains, to compete with the road traffic for certain type of commodities as door to door delivery and other facilities and quickness of transport for important business centres can always be ensured by the road transport and not by the railways. The railways invariably will require marshalling yards, engine changing stations etc. which are all places of bottlenecks. Considerable time is spent in these bottlenecks. Inspite of planning to run 'crack' trains and 'star' specials from a point to point without undue detentions, it will not be possible to achieve that standard as obtained by the road transport particularly on busy sections e.g. ADI to Indore, Madras to Bangalore, Agra to Delhi etc.

To a great extent installations of the advanced signalling system, not to talk of CTC which of course will be one of the best schemes of control, like tokenless block and colour light signals on the trunk routes will give greater easiness in operation. The prerequisite for implementation of any such scheme is the starting of a factory under the control of railways for the manufacture of Electrical Signalling Equipments in collaboration with some foreign firm with an initial investment of about 4 to 5 crores. The effect of such a scheme being implemented will always be felt only when such schemes are actually brought into commission and not by merely wishing for such scheme to have been done on the Indian Railways. With proper initiative and far sighted thinking it will always be possible to implement such a scheme with the resources available in this country itself and it is hoped that during the course of next 10 years Indian Railways will have their trunk routes on the BG with tokenless block and colour light signals on the single line portions.

I have not gone into the details of the system of working in the above discussion. It is purely an analysis on the economical aspects and a minimum expenditure obtaining maximum efficiency and safety. It may look fantastic when it is suggested that the whole trunk routes of the Indian Railways (BG) to be completed into a tokenless block with colour light signalling working on the single line portion. No doubt in the case of mechanichal signalling with a central cabin the recurring expenditure by way of the requirements of imprest stores is less but the Members are aware the number of failures that are normally caused in a mechanical signal installation and the amount of attention may be the number of bulbs to be changed and the relays being constantly watched. The consumption of electric supply in terms of units for the contant burning signals as well as the actually worked

48

points will not exceed above 24 units in one day. Assuming the cost of a unit is about 50 nP. in a month it will be about Rs. 360, which will amount to Rs. 4000 per year for one station. For a unit of 25 stations 1 lakh of Rupees will be the expenditure on account of the electric supply charges. This will amount to extra expenditure for 25 years with all the 500 stations about Rs. 5 crores. The saving of Rs. 5 crores is effected by reduction in the staff particularly in Class IV category. In any case the overall expenditure on account of this type of signalling compared to the extra capacity of 30—40% available will not be more than the existing recurring expenditure. In actual practice the number of failures of an electrical signalling installation is far less compared to the mechanical installation.

Various points that will occur from the above discussion which can be briefly pointed out are :

(1) A device to introduce lock and block working on a single line portion of the Indian Railways.

Even if the above scheme is not implemented if the proving of the home normal prior to giving line clear is done as in the case of double line instruments costing about Rs. 500 for each station having central cabin, it will go a long way to achieve the lock and block working on the single line. The giving of a line clear ensures that the home signal has been put back to normal after the arrival of the previous train. The despatch of a train into a section i.e. lowering of the advance starter ensures that a tablet has been obtained as otherwise paper authority will have to be given.

(2) The Guard's arrival certificate which today is demanded by actual receipt of the certificate from the Guard after which the block instrument is restored back to normal.

This should be improvised by either providing telecommunication between the end of the yard and the SM or by adding "*an axle counter*" so as to ensure complete arrival of the train without any physical receipt of the arrival certificate. In a tokenless block and colour light signal working with track circuit at the yard, the arrival of the train, inside fouling mark, will be normaliy indicated in the panel provided before the SM.

(3) The main difference between mechanical and electrical installation is the adjustment of the wicks and the lighting of the lamps every day whereas in the colour light signalling scheme the lamps are not required to be lighted except the replacement of lamps will be necessary once in every 4 months. Since most of the working is by means of relays, the number of failures that are normally experienced in a mechanical signalling territory will not be observed.

(4) Even with the existing double wire operation with the central cabin if the tokenless block working with axle counters and track circuiting on the berthing tracks are all added, the safety aspect—the impossibility of receiving a train on an occupied line in a yard, in addition to the fast movement of a train by avoiding the token, can be obtained. A number of manual block systems in use in foreign countries, one among them of Ericsson's type wherein 3 different frequencies are used and 2 line wires without grounding connections can also be used to avoid any token.

In conclusion I would recommend this signalling to be introduced immediately on those sections which have already electric supply available at various stations e. g. sections like Tambaram to Villupuram and other sections where electrification is being done and the availability of power supply is not a problem. Even if on the trunk routes (BG) full doubling is contemplated in the next 20 years, it is worthwhile to have a scheme of panel interlocking at every station to have easiness of operation. If it could not be implemented on the BG system, atleast on important routes on the MG, such schemes will be of a great asset to the Indian Railways. Of course the essential factor before entering into any such implementation of a scheme is a setting up of a Central Manufacturing Organisation.

ANNEXURE 'A'

SIGNAL DEPARTMENT — BROAD GAUGE SYSTEM

Estimated cost of experimental power signalling installation at a single line crossing station

Sl. No.	Description of work	Quantity	RATE		CASH	
			At	Per	Cash	Stores
1.	24 slides Slide control with D style contacts and locks on all slides and with visuals etc.	1 No.	10000	each	10000	10000
2.	Structure for relay cubicle	1 No.	5000	,,	5000	5000
3.	Illuminated diagram complete with twin holders and 6 volt 4 W. bulbs for track indication etc.	1 No.	1000	,,	1000	1000
4.	Searchlight signals	18 Nos.	3000	,,	54000	54000
5.	Combined DC point machines and detector for operation on 30 volts.	8 Nos.	4500	,,	36000	36000
6.	Tubular post 18'-0"	8 ,,	70	,,	560	560
7.	Tubular post 30'-0"	6 ,,	130	,,	780	780
8.	Side brackets for home signals	4 ,,	50	,,	200	200
9.	Relays point indication	4 ,,	350	,,	1400	1400
10.	Relays point contactor	8 ,,	300	,,	2400	2400
11.	Relays neutral style D-1000 W	30 ,,	200	,,	6000	6000
12.	Relays track style D 4-W	13 ,,	200	,,	2600	2600
13.	Cable 12 C.L/.064	8 drums	3250	,,	26000	26000
14.	Cable 9 C.1/.064	2 ,,	3000	,,	6000	6000
15.	Cable 7 C.1/.064	5 ,,	2800	,,	14000	14000
16.	Cable 2 C.7/.029	3 ,,	2500	,,	7500	7500
17.	Cable 2 C.7/.064	1 ,,	3000	,,	3000	3000
18.	Cable VIR 7/.029	5000 Yds.	40	100 Yds.	2000	2000
19.	Cable VIR 7/.064	2000 ,,	30	,,	600	600
20.	Battery cubicle	2 Nos.	4000	each	8000	8000
21.	Battery wells with cover	13 ,,	80	,,	1040	1040
22.	Adjustable resistance OW-1W	13 ,,	15	,,	195	195
23.	Pot head boxes complete with connections	26 ,,	80	,,	2080	2080
24.	Cells AD 218	150 ,,	50	,,	7500	7500
25.	Cells AD 513	132 ,,	50	,,	6600	6600
26.	Junction boxes	12 ,,	40	,,	480	480
27.	Insulation block joints comp.	50 sets	20	set	1000	1000
28.	Wire G. I. No. 3	10 bdls.	125	bdl.	1250	1250
29.	Channel pins	4500 Nos.	10	Nos.	450	450

ANNEXURE 'A' *(Contd.)*

Sl. No.	Description of work	Quantity	RATE At	Per	CASH Cash	Stores
30.	Fuses comp. on fuse bases	250 Nos	10	each	2500	2500
31.	A. R .A. Terminals	500 ,,	7	,,	3500	3500
32.	Insulation for switch brkts.	16 sets	20	,,	320	320
33.	Insulation for 1¼" rod joint	16 ,,	15	,,	240	240
34.	Gauge tie plates (insulated)	16 ,,	200	,,	3200	3200
35.	Insulated stretched bars	16	50	,,	800	800
36.	Bracket for flexible stretcher bars	32	20	,,	640	640
37.	Lug Eye	8	10	,,	80	80
38.	Switch extension bracket	8 sets	80	,,	640	640
39.	Stretcher blades	8 ,,	80	,,	640	640
40.	Screw joint adjusting	16 ,,	15	,,	240	240
41.	Screw joint butt end 1¼"	24 ,,	10	,,	240	240
42.	Joint soild 1¼"butt end	10 sets	8	each	80	80
43.	Joint screw 3/4"	16	8	,,	128	128
44.	Joint solid 3/4"	16	8	,,	128	128
45.	Rodding solid 1¼"	50 ft.	1/8	ft	75	75
46.	Relay cubicle	1	2000	each	2000	2000
47.	Cement	200 bags	4	,,	800	800
48.	Sand	400 cft	10	100cft	40	40
49.	Metal	600 cft	10	,,	60	60
					223986	223986
50.	Sundries				3000	3000
51.	Labour				10000	10000
			10000		236986	236986
52.	Contingencies at 5%		500		11349	11849
			10500		238335	248835
	Labour for dismantling		500			500
	Contingencies @ 5%		25			25
			525			525
	Less credit for material to be released				-8000	-8000
			524		-8000	-7475
			11025		230335	241360
	Add for establishment as per list attached		1075			1075
	Total		12100		230335	242435

ANNEXURE 'B'

IMPLICATION OF STAFF FOR A UNIT OF 25 ROAD SIDE STATIONS

Roadside station staff description	Authorised grade	Average pay	Scheme 'A' Single line with two cabins Nos.	Monthly pay	Scheme 'B' Single line with Central Cabin M.A.U.Q. Nos.	Monthly pay	Scheme 'C' Single line panel working Nos.	Monthly pay
1. S. M.	150—280	310	25	7750	25	7750	25	7750
A. S. M.	130—225	258	50	12900	50	12900	25	6450
Pointsman	80—110	134	150	21100	75	10550	—	—
Porters	70—85	114	75	8550	75	8550	75	8550
			TOTAL	50300		39750		22750
2. C. S. I.	350—485	512	1	512	1	512	1	512
SI	250—380	393	2	786	2	786	2	786
ESM	130—212	234	4	936	4	936	6	1404
MSM	110—180	199	6	1994	6	1994	6	1994
Helper	70—85	114	24	2736	24	2736	28	3192
			TOTAL	6964		6964		7888
3. Chargeman	250—380	393	—	—	—	—	1	393
Mistry	130—212	234	—	—	—	—	4	956
Fitter	110—180	199	—	—	—	—	25	4925
Helper	70—85	114	—	—	—	—	50	5700
			TOTAL	—		—		11974
			GRAND TOTAL	57264		46714		42612

Differences	Monthly	Yearly	25 years
Between A & C (A–C)	14652	1,75,824	43,95,600
Between B & C (B–C)	4102	49,224	12,30,600

1) Hence overall saving in recurring expenditure between Scheme C & B for 20 such units .. 2.5 crores

2) Hence overall saving in recurring expenditure between Scheme C & A for such units .. 8.8 ..

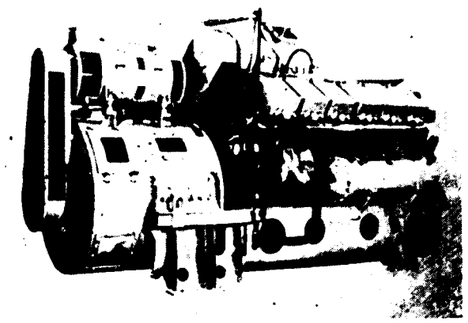
ITALIAN LIGHT BOGIE LOCOMOTIVES

Diesel-electric design for 13-ton axle loads and 50 m.p.h. top speed

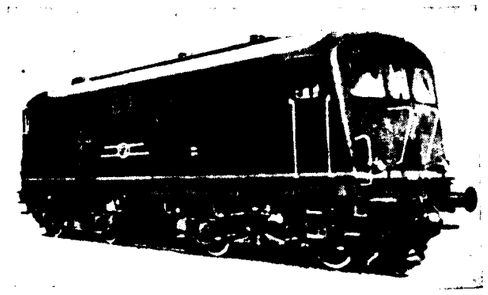
INCREASING construction of diesel motive power by Italian builders is not merely to orders of the Italian State Railways and of certain foreign railways; but is also for Italian private railways, both on the mainland and in Sardinia. Among these last-named are 13 double-bogie standard-gauge diesel-electric locomotives of 825 b. h. p. and 13 tonnes maximum axle load now in course of delivery to the Ferrovie del Sud-Est, a system almost 300 route miles 1475 km. in length, and which already has ten or a dozen diesel railcars in traffic. These locomotives are being built by Nuove Reggiane as to the mechanical and engine portions, and by Ercole Marelli for the electrical transmission and control equipment. Nuove Reggiane has, and has had for some long time, an M. A. N. engine licence.

A Bo-Bo double-cab design with full-width superstructure has been adopted, but multiple-unit control is not normally embodied, though facilities for its installation have been provided. General dimensions and layout of equipment are shown on the diagram elsewhere in this article. All power, control and auxiliary equipment is installed in one large machine room extending between the two cabs, and includes a train heating boiler with a capacity of 300 kg. (660 lb.) an hr. plus two side boiler water tanks holding about 1,500 kg. (330 gal.) total. Fuel tank capacity is 1700 kg. (450 gal.), and the fuel tank is slung below the underframe between the bogies. The bogies themselves are on the principles widely adopted for Italian diesel locomotives and railcars, with hollow box-section frames, roller-bearing axleboxes supported on each side by helical springs, and a bolster supported on each side by an inverted laminated spring. Westing-house air brakes, with Breda distributor are fitted—straight air brakes for the locomotive and automatic equipment for the train, and the straight

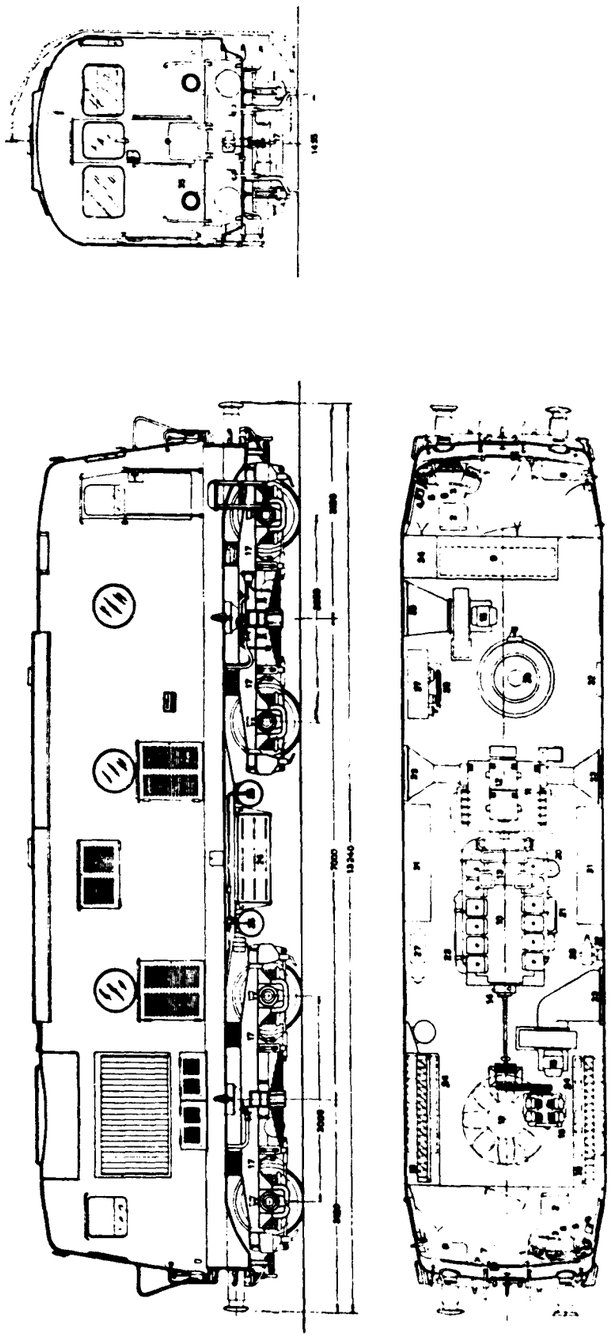
Another view of the Generator.



A view of the Generator

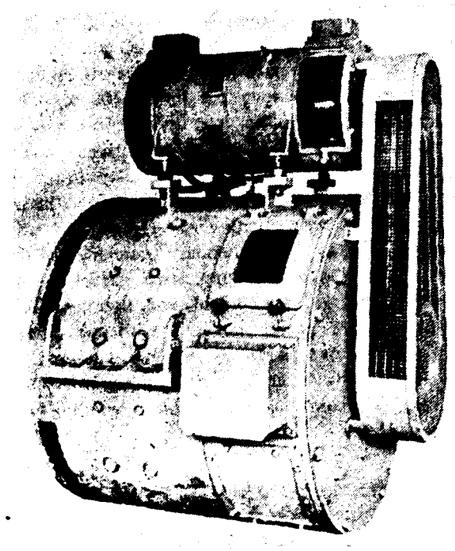


Diesel-electric Locomotive for "Ferrovie Del Sud-Est-S.p.A." Rome



LOCATION OF PRINCIPAL PARTS

1. Operator's controls
2. Seats
3. Master controller
4. Independent brake valve
5. Automatic brake valve
6. Sander foot push button
7. Handbrake
8. Fire extinguishers
9. Equipment cabinet
10. Diesel engine
11. Main generator
12. Auxiliary generator and exciter
13. Turbocharger
14. Woodward governor
15. Traction motor electric blowers
16. Air compressor
17. Traction motors
18. Water radiators
19. Radiator fan
20. Prelube oil pump
21. Lube oil filters
22. Fuel oil filters
23. Heat exchanger
24. Batteries
25. Air reservoirs
26. Fuel oil tank
27. Diesel engine pre-heating boiler
28. Fuel oil pump
29. Train-heating boiler
30. Train-heating boiler pump
31. Train-heating water tank
32. Train-heating control panel
33. Traction motor and main generator air filters
34. Service cupboard
35. Headlight



Main Generator type MCL 140 D 60 with auxiliary group.

brakes apply two blocks per wheel. Air from the brake system is used for the sanding, applied to the outside of each wheel.

Empty weight of a locomotive is 49.4 tonnes, fully-laden weight 53.25 tonnes, and weight with two-thirds supplies about 52 tonnes. Starting tractive effort is 14,000 kg. (30,800 lb.), equal to about 27 per cent adhesion, but this value is available up to approximately 10 km. p. h. (6.2 m. p. h.). Top designed speed is 80 km. p. h. (50 m. p. h.) and at this speed 2,100 kg. (4,625 lb.) of tractive effort are available at the wheel rims. Continuous rated tractive effort at the wheel rims is 7,300 kg. at 23 km. p. h. (16,050 lb. at 14.6 m. p. h.). and one-hour rim tractive effort is 8,400 kg. at 20 km. p. h. (18,500 lb. at 12.5 m. p. h) Wheel dia. is 1,000 mm. (39.37 in.) and traction motor gear ratio is 14 : 67. Curves of 80 metres (262 ft.) radius can be traversed at slow speed.

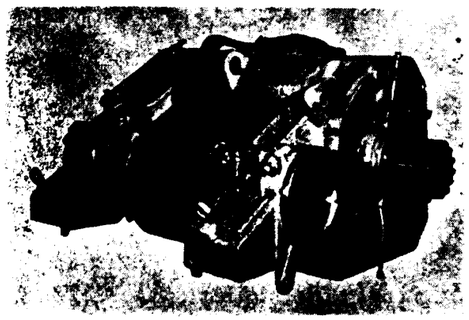
Motive and auxiliary power is furnished by a Nuove Reggiane M. A. N. type L 12 V 17.5/21A engine, a 12-cylinder V of the model preceding the L 12 V 18/21A engine now being used in Great Britain

and Germany. Though it is considered to have a one-hour output of 920 b. h. p. at 1400 r. p. m., in this particular installation the traction rating is 825 b. h. p. at 1,300 r. p. m. Dry weight of this turbo pressure charged unit is 3,500 kg. (7,700 lb.), or

Driver Cab.

4.25 kg. (9.4 lb.) per h. h. p. An auxiliary-drive shaft is taken off the front of the engine, a furnish power to the four-cylinder V reciprocating air compressor and the cooling radiator fan. The radiator banks are on the locomotive sides and the fan in the roof, and a preheater is included in the water circuit. A heat-exchanger is attached to one side of the crankcase for the cooling of the engine lubricating oil, and the oil is passed through a bank of Savara filters on the other side of the crankcase.

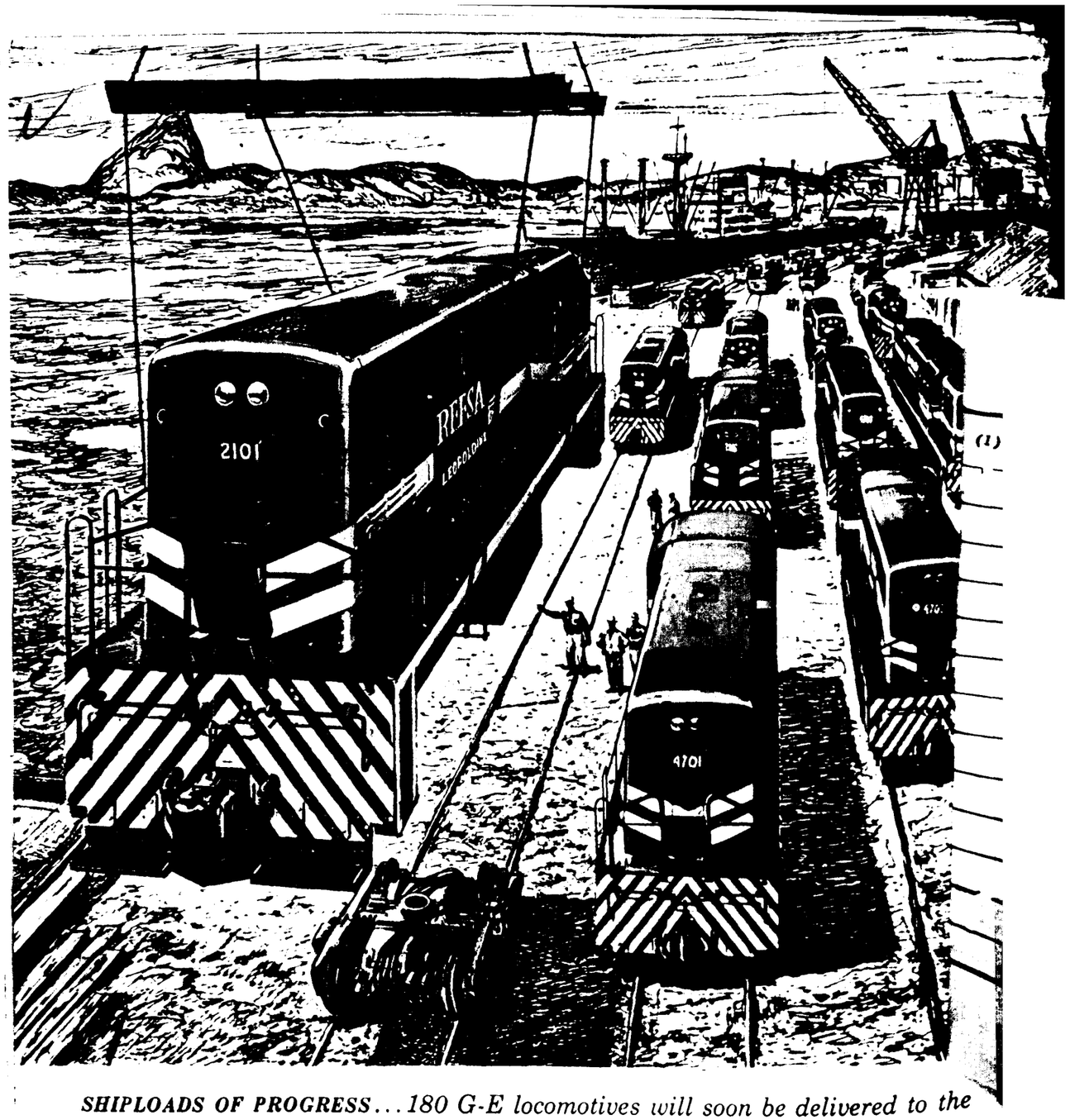
Engine and generator group are supported on a common welded steel underbed carried on the locomotive underframe through four semi-resilient mountings; and this underbed is unusual is being carried right round under the engine crankcase and sump. The Marelli main generator is an eight-pole separately-excited machine weighing 3,400 kg. (7,500 lb.), and traction input to it is up to 770 h. p. This machine, and its over-mounted belt-driven auxiliary generator-exciter unit, though self-ventilated machines, draw in their air through panel filters on the locomotive sides, with ducting thence to the main generator intake. The auxiliary machine provides current for battery-charging, two traction-motor blower groups, and the control and lighting circuits. The exciter is a special machine with six poles on which are carried three groups of windings, viz., self-exciting, a differential field winding carrying the current of the main generator, and a winding excited



Traction motor type MCT 80 B 60

by the storage battery and regulated by a rheostat on the Woodward PG-type governor on the engine. The four nose-suspended traction motors are four pole series-wound force-ventilated machines with cast-steel frames, and, with pinion and gearcase, weigh 1,660 kg. (3,590 lb.) each. Automatic shunting of the fields comes into operation at a predetermined track speed. The two ventilating blowers have individual electric driving motors, and each draws its air through a panel filter on the locomotive sides. Control is on the Marelli-Westinghouse Autoload system, and its auxiliary circuits include an automatic wheel-slip correction embodying automatic application of sand and reduction of current as well as other conventional features.

Printed and published by S. Sundaram at S. R. Press, Tanjore and Edited by T. S. N. Rao for "The Indian Railway Engineer"
15, Ghodbunder Road, Santacruz West, Bombay-54.



SHIPLOADS OF PROGRESS *... 180 G-E locomotives will soon be delivered to the Brazilian Railway System. These versatile workhorses will provide a total of 577 General Electric locomotives to form the heart of a vital transportation system. For greater railway efficiency, economy and profits ... specify General Electric.*

120-18

PIONEER IN
MOTIVE POWER PROGRESS
FOR OVER HALF A CENTURY

GENERAL ELECTRIC

REPRESENTED THROUGHOUT THE WORLD BY THE INTERNATIONAL GENERAL ELECTRIC COMPANY