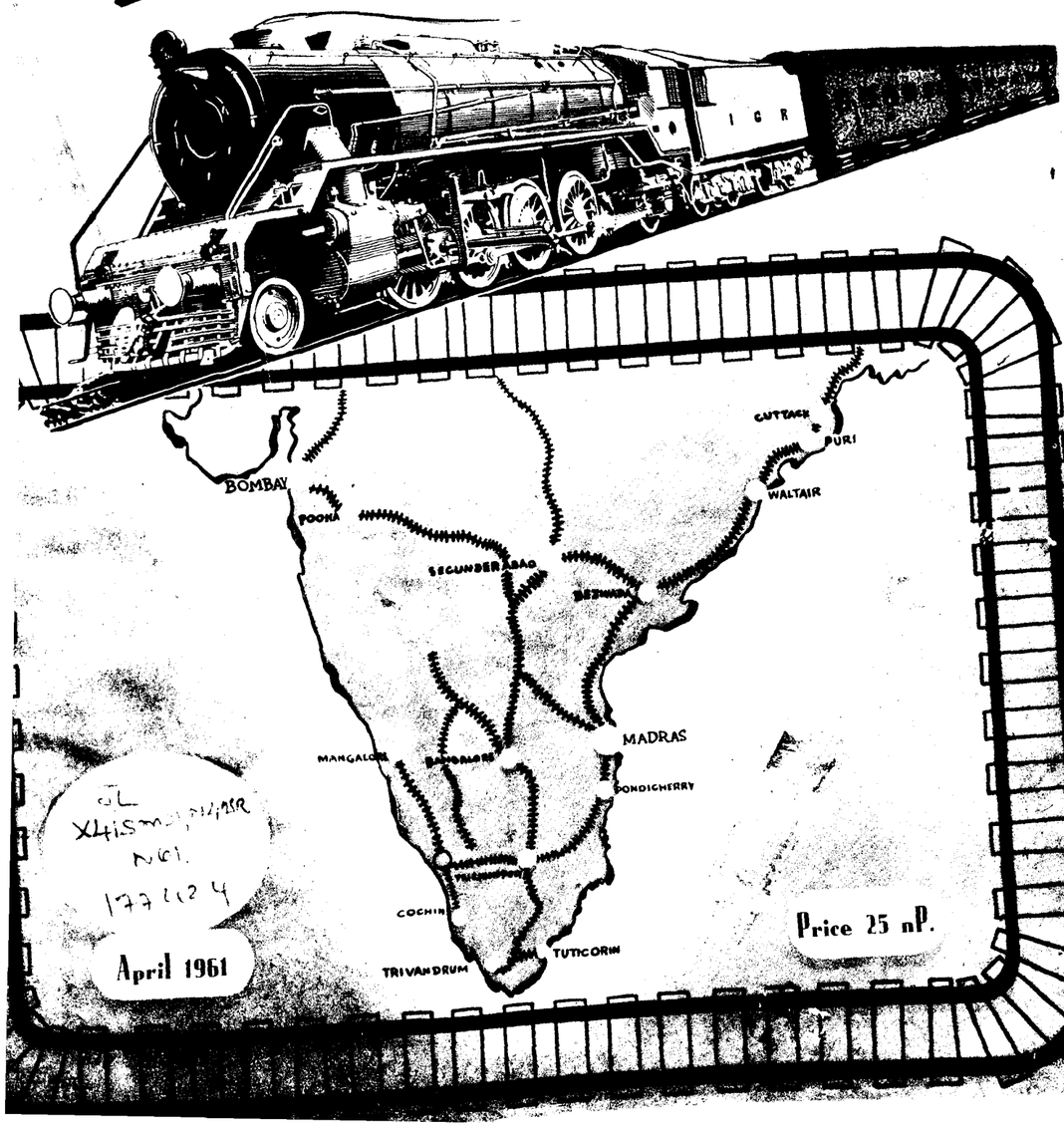
SOUTHERN RAILWAYS

Magazine



April 1961

Price 25 nP.

IN YOUR OWN INTERESTS

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(Inserted in the interests of Travelling Public)

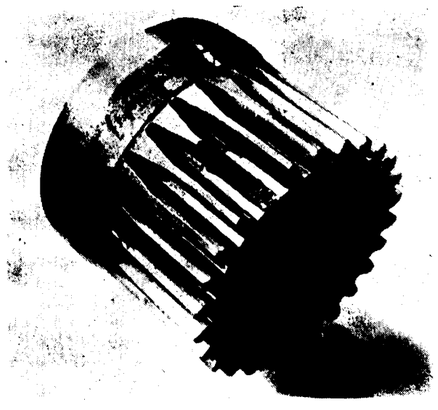
25/94

Welding Repairs in Railway Maintenance

By E. Christie, M. INST. W.

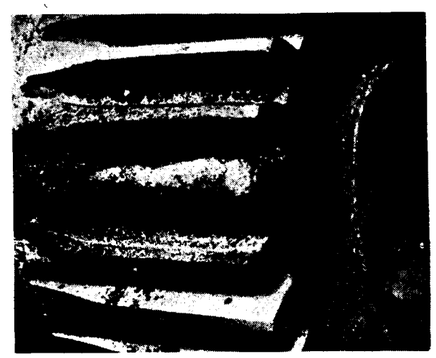
OXY-ACETYLENE Gas Welding and Cutting are essential features in all engineering and maintenance workshops. The value of a skilled welder is always very high but in emergencies, when broken or damaged parts may involve schedule delays, he and his plant can effect reliable repairs which not only keep the wheels turning but are very economical in both time and money.

The track and rolling stock is made up of many parts and many metals and alloys. Almost without exception the Oxy-Acetylene process can be used to weld steel, cast iron, malleable iron, S. G. iron, aluminium, stainless steel, copper, brass and a host of other comniercial metals.



Heavy cast iron pinion showing broken tooth.

In general terms most steels and alloy steels are subject to wear in railway service and the welder's work involves the building up of worn sections to restore original dimensions. Such building up is common practice on rail track frogs, points and crossings, where SIFSTEEL No. 12 (wear resisting) alloy steel welding rods, containing Silicon, Manganese and Chromium, are deposited by the Oxy-Acetylene flame. The rebuilding is carried out on the track during normal services and causes no delay in train schedules.



Tooth rebuilt by welding with Super-Silicon No. 9 welding rods. Deposit metal is soft and Machinable.

Other steel parts such as shackles, hooks, links and pins can be salvaged in the workshops using the same rods and technique. The reclaimation of these parts is sound practice and a very economical procedure.

Castings in all shapes and sizes may break under abnormal shock loading and in this field of activity, the Oxy-Acetylene welder can be of immense value by reason of his ability to effect speedy repairs at a fraction of the cost of new replacements.

Two welding methods are available. First, the full fusion method which employs grey cast iron

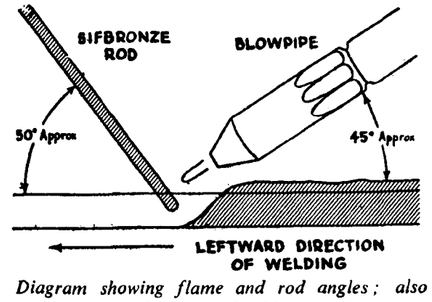
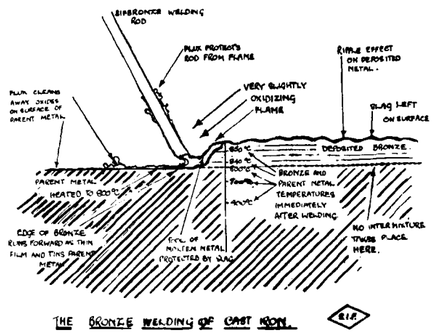


Diagram showing flame and rod angles; also direction of welding.

Super-Silicon welding rods and, when correctly used, will produce a welded repair with full physical properties of the parent metal. The structure of the deposited weld metal is high grade grey iron with average tensile strength of 14—16 T. P. S. I.



Diagrammatic sketch showing special features in the bronze welding technique.

This method of fusion welding iron castings generally requires that the whole casting should be preheated to a red temperature of 700—800°C. and, after welding is completed, the whole repaired unit should be allowed to cool as slowly as possible, preferably inside the preheating muffle, and the average cooling time should be about 24 hours.

The second method for welding castings is the LOW TEMPERATURE BRONZE WELDING PROCESS. This is a process which does not always require preheating of the casting and many repairs can be effected without any preheating at all. Some may require partial or local preheating and, in rare cases, general preheating but, in any case, the preheat temperature need never go beyond 400°C. (Black Heat).

The advantages of bronze welding lie in the fact that bonding of the SIFBRONZE filler rod takes place at a temperature of 850-900°C. This is far below the melting temperature of the cast iron and, in consequence, the parent casting does not expand to the same degree as when using the higher temperatures. The lower expansion means lower contraction too and as the Sifbronze deposit metal has some ductility, any stresses created by temperature changes can usually be absorbed by the bronze.

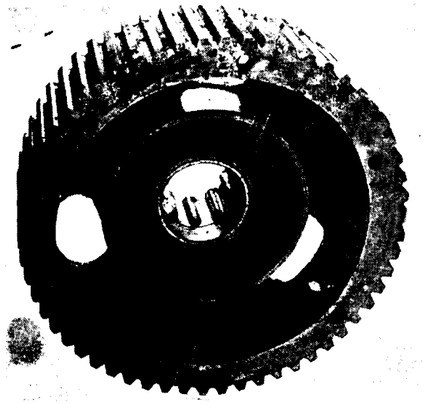
The strength of Sifbronze deposit metal is from 28 T. P. S. I. to 35 T. P. S. I. according to grade, the nickel bearing Sifbronze rods being the stronger.

The main disadvantage of bronze welding is that of colour, for the deposit metal is usually a yellow colour which shows up against the grey cast iron but, when set against the ease of welding and the high strength and reliability of the welded joints, such a disadvantage is of little consequence.

In the case of malleable iron castings of which a great number are used on railway rolling stock, bronze welding is generally acknowledged to be the best and most reliable method. Malleable iron castings have been subjected during manufacture to a special heat treatment which imparts a degree of ductility and special physical properties to the castings. Any fusion welding method which may be used to repair malleable castings has a tendency to destroy the special properties and produce a weld that may be brittle and spongy.

Bronze welding by reason of its LOW TEMPERATURE application maintains the full high

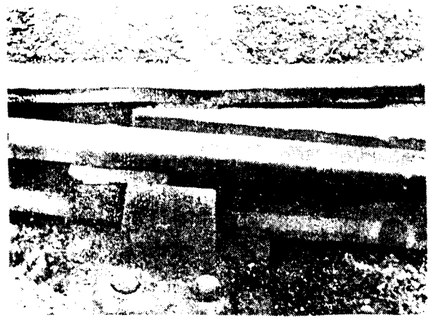
Action Picture of a Welder Rebuilding Worn Rail Track.



3½ teeth were broken from this gear wheel. They have been rebuilt with Sifbronze nickel bronze rods and machined to correct dimensions.

strength of the malleable casting and in no way impairs these special properties. The Sifbronze joint is strong and reliable, giving complete satisfaction in most cases.

Rebuilding and replacing gear wheel teeth are applications for Oxy-Acetylene welding which frequently brings maximum return for minimum of labour. Sometimes a valuable machine may be disabled because of one or two broken gear wheel teeth. It makes no difference if they are cast iron teeth, alloy steel teeth or even mild steel teeth, all can be repaired by welding using either cast iron Super-Silicon filler rods, alloy steel rods or Sifbronze rods.



Rail track showing worn section BEFORE rebuilding with Sifsteel No. 12 wear resisting rods.

The rebuilding or replacement can be carried out speedily, sometimes without dismantling the machine, and the welded teeth can be relied upon to give many years of good service.

Generally speaking, the nickel Sifbronze filler rods are ideally suited to this class of welding work. They will bond a low temperature on all classes of ferrous metals, the deposit metal is soft enough to be shaped and dressed to accurate dimensions and due to the Nickel and Manganese content in the deposit metal, they have a high degree of wear resistance and a low frictional ratio.

Rail track AFTER rebuilding by gas welding. The deposit metal work hardens in service.

Some measure of the reliance placed upon bronze welding may be gauged from the fact that one railway system alone uses upwards of 1 ton of bronze welding rods each month in the various maintenance workshops. The rods are used for a great variety of repair welding and, without doubt, they are a most valuable economic factor in the whole system.

Widney Windows for Rail Transport

By An Engineering Correspondent

THE selection of the right window for a particular type of Railway Carriage is the problem of the Railway Engineer. He is offered a considerable variety of types, styles, in different materials and finish, the advantages and disadvantages of which must be thoroughly assessed before placing his contract.

This is the task of his technical staff, who will carefully examine and consider the characteristics of the available types in relation to the carriage body structure, the customary, or preferred method of opening and closing by the travelling public, the ease of maintenance and broken glass replacement, bearing in mind the service facilities available in the Railway Repair Depots.

In addition before placing the contract consideration must obviously be taken of the initial cost per window, plus the cost of its installation.

The Company of Hallam, Sleigh & Cheston Limited, founded 1898 were early pioneers in the development and production of windows for Passenger Service Vehicles. Over 60 years of specialised knowledge in the production of windows for the strenuous service called for by users is embodied in the present day design of this Company's products.

The registered trade mark 'WIDNEY' is used throughout the world on all manufactured articles.

Widney Phantom Mark IV Ventilating Window with Outside Glass Louvre.

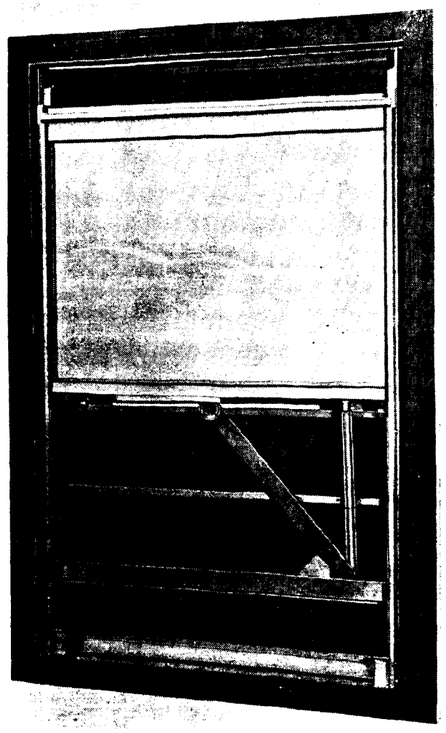
Types of windows available in their range include—Half-Drop, Half-Lift, Full-lift, Full-Depth Sliding, Top Sliding and Hinged Windows all suitable to practically any condition of coach structure. The

Widney Twin Slider with Lower Portion Double Glazed.

materials used in forming the window frame is now mainly Aluminium Alloy, which has been carefully selected to offer the maximum resistance to corrosion within an economic commercial possibility.

Some windows are available in Stainless Steel, which is polished and retains its appearance for the normal life of the unit. Stronger than Aluminium, it is completely free from corrosion and virtually trouble free in service.

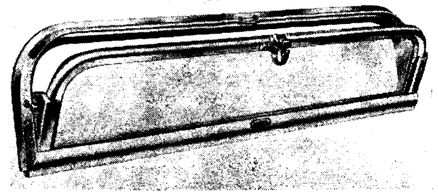
Toughened Glass manufactured to British Standard Specification No. 857/1954 is normally used, and is acceptable to all known transport regulations. This



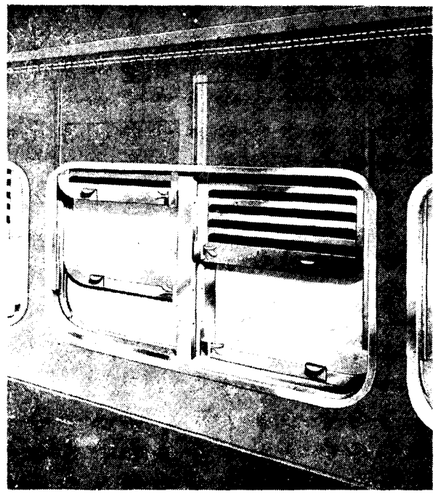
Widney Full-Drop Window.

is similar to the European Glass 'Securit' and when smashed breakes into a honeycomb pattern of not less than twenty particles per square inch. Various types of toughened Glass with resistance properties against Ultra Violet Rays is also available.

The chief method of glazing used today by 'WIDNEY' is their patented 'Simplastic' System. The glass is completely framed in a Mild Steel, or Aluminium Pan of special section, by using a preformed rubber glazing, strip, so designed that when glass and rubber is fitted into the section the rubber is compressed to give a perfect water seal without the aids of screws, fillets or mouldings. The complete frame is now ready for fitting to the structure, the need for outside finishers is eliminated. This



Widney Phantom Mark III Ventilating Window.



Widney Full-Lift Window Combined with Jalousie.

method can be adapted to suit either outside or inside glazing, i. e. the glass being fitted from the outside or inside of vehicle as preferred.

The various windows illustrated from the 'Phantom' Ventilator to the Full Drop Window show the wide application available to the modern coach designer.

Hallam, Sleigh & Cheston maintain a large technical staff to solve any problems in ventilation.

Torque Converters for Railway Traction Applications

By Lt. Col. L. F. R. Fell

Manager - Railway Traction Department

AS projects involving torque converters are now becoming more numerous and wide-spread, so more and more people in Service and Sales departments throughout the world are finding themselves concerned with this new equipment. Whilst it is obviously impossible to circulate detailed design and experimental reports to all who might be interested, it was felt that a need could be served by publishing at regular intervals a Newsletter giving a brief resume of the work which has been carried out, or is in progress, in the various departments at Crewe.

It will be assumed that the reader is familiar with our publication TSD 710 and hence can appreciate the distinction between the CF, DF and CO types of converter. These machines are, in general, similar to the original Twin Disc converters; Twin Disc adhere to the same nomenclature of designation as ourselves.

CONVERTERS FOR RAILCARS

Design Work

This machine was designed originally for use on British Railways railcars. It is based on the Twin Disc DF design and is similar to the DF machine back to the rear turbine bearing.

The double freewheel assembly was designed by Rolls-Royce. It will be seen that the forward freewheel serves the same purpose as the freewheel in the DF machine, that is to say it allows the turbine member of the converter to remain stationary when running in direct drive, the rear freewheel is in the output drive and permits the output shaft to over-run the engine and converter. The freewheel units themselves are of robust design and are of the cam and roller type, having eleven individually sprung rollers each. The ordinary DF machine has one freewheel only; this has twenty-two rollers set in a sprung cage.

Since our first entry into railway business we have fervently advocated the use of the double freewheel for the following very good reasons. It allows economical operation through judicious costing, it prevents engine damage due to overspeeding down gradients, it provides a safety disconnection in the unlikely event of engine failure or seizure and finally it enables a much easier change to be made from hydraulic to direct drive. The change can be made with the engine at idle and with the output freewheel over-running, hence the duty demanded of the clutch plates is mild in the extreme.

As a result of both our own running experience and the experience of operators, we have made some detailed design changes to the DF and DFR types of machine. In the main these consist of niceties such as changes of hardness and material and reducing stress raisers wherever possible. Whilst such alterations are not spectacular in themselves they contribute to the increased reliability of our products. Experimental work has shown that it is desirable to maintain the clutch application oil pressure at about 140 p.s.i.; thus ensuring a slipfree drive at very low engine speeds and also providing a rapid take-up of the clutch during changes from converter to direct drive. The increase pressure was achieved by making a modification to the relief valve in the clutch oil pump supply line.

In applications where a reverse gearbox is attached to the rear of the converter we now install an oil cooler to ensure that the clutch oil is not heated to an objectionable temperature by the gearing. The converter has been modified to provide an inlet and outlet to an oil cooler and the cooler itself can be supplied as an appendage to the main converter fluid heat exchanger.

REVERSE GEARBOX

It has become clear that operators are by no means agreed on the most suitable type of reversing gearbox for railcar use. For those adherents of the frame mounted reverse box we have recently designed a unit which can be bolted directly on to the back of a converter. The prototype box has been built and is undergoing test at the Crewe factory.

In the design of this new reverser we have sought to produce a robust and reliable unit. Before the design was commenced a close study was made of the failures experienced by users of similar reversers by other manufacturers.

The designed capacity of the box is 300 h.p. at 2000 r.p.m. Lapped spiral bevel gears are mounted in pressure lubricated bearings. Large diameter pinions have been used so as to give modest rotational speeds. At the rear of the box gear drives are provided for a Woodward Governor and tachometer.

OUTPUT SHAFT GOVERNOR

In applications using the F, CF or CO types of converter where the vehicle has a low rolling resistance there is a danger that the converter might be run at an output speed beyond the upper 70% efficiency limit with the engine rack fully open There are cases where this could occur and it would be difficult for the driver to appreciate that anything was amiss. In conjunction with C.A.V. we have designed an output shaft governor which will begin to close the engine rack at some predetermined output speed and hence prevent damage by overheating. The governor is essentially a gear type oil pump driven by the output shaft of the converter. Oil from this pump is fed to a unit mounted on the engine fuel pump governor and is arranged so that at some predetermined pressure the rack will begin to close.

This governor is being designed so that it can be used as an output shaft speed controller. A duty could arise where it would be desirable that the driver should be able to select a fixed output shaft speed regardless of the fluctuating load. In this case the driver would control the governor setting and the governor would adjust the rack to give a constant output speed within the capacity of the engine. Such a device could be useful on a hump shunting locomotive.

The first output shaft governor unit received from C.A.V. is now running on the test beds at Crewe.

CLUTCH DEVELOPMENT

Much work has been done in testing the clutches of the DF converter. Continuous periods of 'Hot Shifting" have been carried out in order to ascertain the effect on the clutch plates. Tests have been very encouraging and are continuing.

As a result of this development work we have now increased the maximum torque ratings for our DF and DFR machines as follows:

For the 10,000 series DF machine we now limit the maximum input torque to 750 lb. ft. This limit is subject to the proviso that the clutch oil is cooled if a reverser is fitted and that some indicating device is used to ensure that clutch oil pressure is always present. Further, for the DFR machines we are prepared to raise the limit to 800 lb. ft. for 10,000 series converter and to 900 lb. ft. for an 11,500 converter provided the machine is protected from torsional vibrations by a suitably damped spring drive.

We have for some time been running experimental converters at 1000 lb. ft. input torque.

We are now able to consider individual applications which require 'Hot Shifting' of the converter clutches. However, these must be referred to the Railway Traction Department for consideration by our engineers at Crewe who will deal with each case on its merits.

* * *

PROTOTYPE RAILCAR

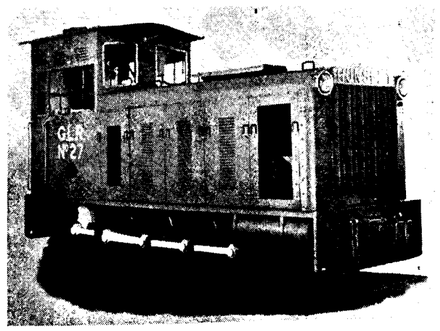
We have now had a torque converter railcar in regular passenger service for some months. This vehicle was built as the prototype to a production batch of railcars. On completion, it was made available to Rolls-Royce for a specialised development and to allow us to gain some running experience. As a result of this, several modifications have been made. The control system has been modified in details and further attention was necessary to achieve a desirable degree of silence and smoothness. The engine mountings were changed and the exhaust system modified.

Throughout the initial projecting stages of the prototype vehicle, we kept in mind the high vertical accelerations imposed at railjoints and crossings. Later, we were able to measure these accelerations, together with the effect they had in inducing torque variations in the prop-shaft.

A maximum vertical acceleration of 40g was obtained at the bearing cap of the driving axle; A

'HUNSLET' again supplies Sudan with locomotives

Against strong foreign competition the Hunslet Engine Co. Ltd., has received a further order from The Sudan Gezira Board, (Consulting Engineers, Messrs. Livesey & Henderson, 1–2, Finsbury Square, London, E.C.2) for eighteen 135 h. p. 0-8-0 type diesel-mechanical locomotives required for the Managil extension.



'HUNSLET' 0–8–0 Type Diesel Locomotive 18 of which are now on order for the Sudan Gezira Board

This is the sixth repeat order received from The Sudan Gezira Board, for 'Hunslet' locomotives specially designed for their cotton plantation narrow gauge railway system.

The 'Hunslet' 17¼ ton 8-wheel locomotives are powered by Gardner diesel engines. Transmission is through a 'Hunslet' multiplate friction clutch and a flexible coupling to a 'Hunslet' constant mesh gearbox giving four speeds of 5, 8¾, 14½ and 20 m.p.h. in either direction of travel. Maximum tractive effort at site is 8620 lbs.

The first diesel locomotives were supplied over thirty years ago and still continue to give good service.

During the last ten years, a complete locomotive fleet has been developed comprising fast main line 0-8-0 locomotives and smaller 0–6–0 units for local lines and shunting operations.

The photograph shows the class of 0–8–0 locomotive to be supplied against the current order.

propeller shaft fitted with strain gauges was used to measure the torsional variations within the shaft. It was found that a very high torsional of constant frequency was excited at each rail joint. Damping in the system was small and the whole transmission vibrated at the one node natural frequency. The vibration persisted almost without decay between impulses, and its frequency was of course, independent of railspeed, although its magnitude increased as the railspeed increased and hence the forcing impulses became greater.

It was immediately apparent that a means of isolating the impulses from the clutches and free-wheels of the converter unit must be sought.

A flexible rubber coupling was introduced at the end of the prop-shaft. This reduced the stiffness of the system and hence the frequency, but had little damping effect. Weights were added to the final drive in order to move the centre of percussion over the axle. This had little effect.

Finally, a propeller shaft of very low stiffness was used. The shaft was a torsion bar surrounded by unstressed tube; The relative angular movement between the shaft and its sheath was used to provide the required amount of damping by filling the annular space with a viscous fluid.

This reduced the amplitude of the vibration to 20% of its original value and was considered to be a satisfactory solution to the problem and will be used in a refined production form on future installations.

Doubling of Line Between Ratlam and Nagda Stations on Western Railway

Partial doubling of Ratlam-Nagda line consisting of two sections viz. Ratlam to Bangrod (six miles) and Birwania to Nagda (five miles) was sanctioned in March 1958 at an estimated cost of Rs. 79.79 lakhs. The work on the remaining portion between Bangrod and Birwania (14.5 miles) was also sanctioned in October 1960 at an estimated cost of Rs. 101.55 lakhs. The former has already been opened to goods traffic and is expected to be opened to passenger traffic in March 1961. The latter work is expected to be completed by December 1962. This information was given by the Deputy Minister for Railways, Shri S. V. Ramaswamy, in a written reply to a question by Shri Damar, in the Lok Sabha, on 18th November 1960.

FIRES

By R. G. Hardikar
Dt. Electrical Engineer (Steel Foundry)
CHITTARANJAN LOCOMOTIVE WORKS, CHITTARANJAN

HAD I taken a couple of minutes longer to emerge out of the carriage bathroom I might not have lived all these 20 odd years to write this article. It was a hot April morning. Nearing beer time. The carriage in which I was travelling, at full speed, was the 5th or 6th from the engine of the mail train. I started doing my bed, bending by the lower berth of the coupe with my back towards the two 12″ wall-mounted fans. I heard a sudden "ting" from behind. I turned round and was attracted by a lighted cinder flying out of the fan at the back of my left shoulder. It landed on the pillow. The pillow slip started smouldering. I smothered it with my wet face towel. I had just then finished my shave and wash. I was the sole occupant. The glowing cinder from the loco entered through one of the slots of the ventilator and struck the revolving blades and fell on the pillow below.

Some couple of years ago an armed sentry outside a locked Cash Office noticed an electric light go out. This happened a little before changing guard at zero hour (Saturday/Sunday). The outgoing company had entered this fusing of the lamp in their Log Book. Some three hours later another sentry from the second company reported emergence of thick smoke from the strong room (also locked) inside the Cash Office. The fire fighting squad, led by two Gazetted Officers, discovered a biri stump deep in the pile of heavily card-board bound Registers inside the strong room. Could the biri have been planted there? The strong room was locked at 16.45 hours on Saturday. Over 10 hours before the emergence of the smoke and 2¾ hours after the fusion of the metal filament and bursting of the electric lamp.

Just imagine what would have happened either to the carriage or to the Cash Office had there been no eye witness available to smother the burning matter and timely put out what would have been a blazing fire in a matter of minutes. Being one of the members of the 3-man Fact Finding Enquiry Committee which enquired into the second of the two incidents narrated hereabove, I have no doubts in classifying the causes of these two fires as purely "accidental".

But the cause of fire that gutted a motor garage in Bhowanipore (Calcutta) some years ago because one of its mechanics was fool hardy enough to locate or look for trouble under the bonet with a naked light, most certainly cannot be argued by any defence counsel however clever and smart to be as "purely accidental". A well trained and properly recruited mechanic would never have given cause for this fire resulting in loss of life and valuable property. More serious from the point of view of sheer negligence, than this garage fire was the fire which broke out round about 02.00 hrs. in an IOW's godown in a Divisional Headquarter. The officially estimated damage due to this fire, also detected in time, luckily was a little under four figures. The fire was attributed to charging of automotive batteries without the knowledge of the electrical department. In this engineering department's godown there was timber (scantlings), cotton waste, umbrellas and benches for push trolleys, empty and half empty tins of ready mixed paints, oils, varnishes and methylated spirit. There was understandable unwillingness on the part of the engineering department to hand over this battery charging to the electrical department. The accredited specialists for such work. And what excuse can there be for a similar fire on the very same organization, but at another headquarter's station, after a span of hardly half-a-dozen years? By this fire inside a motor garage, where battery charging was being done within 100 feet of petrol tins, a lac of rupees-or-more worth of assets were gutted and had to be written off. The responsibility for these two fires can most certainly be fixed. It rested with the inspecting authorities. Not only that; but one has to admit that these two fires ought never have been given the cause to occur. They have been caused both by ignorance and lack of forethought.

Ignorance has to be eradicated by a high powered drive and campaign at all levels. On being asked by

a breathless Works Manager who had run fast 200 yards or so to put out a rising fire inside a boiler shop the Nepali watchman standing there on the spot calmly answered that he did not press the fire alarm as he thought "It was meant for Fire Drills only". And meant not to be pressed in the event of actual fire. In another instance a Foreman, transferred from Power House to Workshops replied that he did not seggregate inflamables from combustibles in his Stores as the orders to do so were received by him when he was in the Power House. He did not think that those orders were applicable to Workshops as well. Official records will bear me out that a Divisional Operating Superintendent (Class II) on being called upon to report by his Senior Deputy General Manager on the Fire Fighting facilities available in Goods Sheds and Parcel Godowns in his Division mentioned that "the water was green" at a certain Station but failed to report on the distance, quantity available in summer and winter, etc.

The experience gained during the war years as a civilian railwayman in A. R. P. duties first in Chittagong and later on in Trans-Brahmaputra Danger Zone has left no doubt in me that men give better account of themselves if they are first trained in their specific duties in a language they understand. Supervisors are trained in First Aid and their increment is withheld if they fail to pass the First Aid Examinations. Why not train all supervisors, and not necessarily only those of Fire Fighting squads, in fire fighting too. Advanced countries educate school children in how to cross roads in big metropolitan cities so that they can stand up to the inevitable hazards of the road. Training in fire fighting can be begun in schools & carried on to Trade Apprentices & Apprentice Mechanics. They must be taught how to prevent & fight fire.

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Doubling of Balharshah - Vijayawada Line

The deputy Minister of Railways, Shri Shah Nawaz Khan said in a written reply to a question by Shri T. B. Vittal Rao in the Lok Sabha, that the doubling of 25 miles portion between Vijayawada and Yerupalayam had been approved at an anticipated cost of Rs. 265 lakhs. Shri Shah Nawaz Khan added that the necessity of further doubling would be considered when the pattern of traffic development became clear.

Electrical-Resistance Welded Steel Tube Industry in India

By An Engineering Correspondent

THE adaptability of Steel, the basic material of Modern Industry, has been nowhere more effectively proved than in the manufacture of Steel Tubes. With the rapid growth of new Industries, and the expansion of existing ones, the need for Steel Tubes of all varieties in India, has considerably increased; hence, the evolvement of the two large scale Plants engaged in the manufacture of Tubes, and it is no accident that the two leading British Manufacturers are behind these ventures; neither would it be an exaggeration to remark that it is to mutual and infinite advantage that British technique and 'know-how' have been combined with Indian skill, capital and management.

In the past, Steel Tubing was considered as a material used primarily in the manufacture of Bicycles and Bedsteads, but since 1928, many developments and much research have taken place in Industry generally. These developments have involved the use of manipulated and formed tubes for a very much wider variety of purposes.

At the beginning of the Twentieth Century, a demand for Steel Tubes of high quality arose in the West, particularly from the Bicycle Industry, and the Boiler Trade. It came to be realised that the potentialities for demand would indeed be enormous, provided the Manufacturers could ensure a constant supply, together with a uniform quality at a reasonably low price. A solution was ultimately found by using the continuous electric-resistance welding process. An idea of the enormous importance of this new process, can be gained from the fact that Tube Products, Oldbury, (the pioneers of this type of tubing in Britain and Europe), have increased their output from a few thousand feet a week in the early 1930's, to five million feet per week, today. Tube Products of India, situated at Avadi, near Madras, is an associate of this famous British Tube Manufacturing Firm. A second Factory, located in Jamshedpur, engaged in the production of E.R.W. tubing, is that of Messrs. Tata, the well-known Industrial Concern of this Country, operating in association with Messrs. Stewarts and Lloyds, of the U.K.

Tubes are made by very many different process, so designed that the end product will be suitable for its eventual application. Although the E.R.W. tube is a relatively new product, welding as such, is not a new thing. All over the world, a common feature of any village economy is the Blacksmith carrying out manual welding in his smithy. This he does by heating two pieces of steel until red hot, and then hammering them together so that a weld is effected. This is the basis of the E.R.W. process, except that the steel is heated electrically. The E.R.W. tube is a precision made tube, with all its dimensions kept within precise limits, and with the bore being maintained concentric with the outside diameter. It also has a high grade surface finish and the best qualities of the E.R.W. tube need only the lightest of polishing processes, to render them suitable for chromium plating. The E.R.W. tube is used widely for the manufacture of bicycles, transformers, tubular furniture, automobile and motor cycle components, boilers, flush pipes, pumps, ladders, hospital equipment, tubular structures, etc., and is today even being used for the heat exchangers in the atomic power stations.

The E.R.W. tubing is produced from coiled strips; long coils of strips are fed through a series of rolls, and whilst passing, they assume the shape of 'U' and then 'O', with an eventual narrow gap at the meeting of the two edges. The actual welding of the seams is done by raising the temperature through a pair of rotating discs which feed electric current across the gap, heating it locally to welding temperature. Simultaneously, pressure is applied to close the gap and forge the weld. Any surplus metal known as upset, is removed and the tube is then straightened and cut into convenient lengths. All the operations are continuous and automatic.

After manufacture, tests are carried out to ensure that the weld is in all respects, stronger than the

parent material. These tests take the form of expanding the tube over a cone and observing that the point where the tube bursts is away from the weld, subjecting the tube to high internal hydraulic pressures, sometimes to the point of bursting and again noting that bursts take place away from the weld. There are many more tests generally used in the E.R.W. tube trade, which are designed to ensure that the tube will be satisfactory for its eventual use.

For special applications where a particularly hard tube may be needed, the welded tubes are subsequently cold drawn on a draw bench.

Different qualities of steel may be used in the E.R.W. process. If a high grade finish is required in the tube, cold rolled steel is used. Tubes of this description would be used for high grade work, requiring enamelling or chromium plating. These tubes are called Bright tubes. In addition to Bright and semi-bright qualities, steels of various carbon contents can be used to give different mechanical properties. If a tube is required to be completely soft for further manipulation, e.g., bending, flattening, tapering, etc., tubes are generally annealed after manufacture. For a tube of equal mechanical strength, but whose surface finish is of less importance, e.g. automobile exhaust pipes, hot rolled stripe is pickled and then subsequently made into E.R.W. tubing, which is known as semi-bright tubing.

E.R.W. tubes are extremely versatile. They can be bent, flattened, tapered, shaped and jointed, either by mechanical or welding processes. Joining by mechanical means can be effected by using threaded sections, bolts, rivets, compressed or sweated types of fittings, self-tapping screws, clip fastenings and various other methods dependent upon the form and material to which the tubes are to be joined. Welding methods are controlled largely by the thickness of the tube walls and design of the joint; Argon arc, Oxyacetylene, brazing or arc welding are the usual means employed.

The properties of the welded steel tubes today, have enlarged the demand and the scope, and tubes upto 60 ft. long are prepared for special purpose applications.

A major advantage offered by the E.R.W. Tube, apart from its relative cheapness, is its freedom from eccentricity. The nature of the process makes it simple to produce a concentric tube as this depends on the accuracy of the rolling of a flat strip, which is normally within close limits. Concentricity is valuable in many ways; first of all, when high speed rotation is involved, as in the making of motor car propeller shafts, there is no need to secure individual balancing in order to obtain smooth running. This means a substantial saving in time and labour. Rockets now require tubes, and the speed or accuracy of flight is attributable to the material used.

Continuous practical research has yielded results calculated to inspire faith in E.R.W. Tubes, for which the demand is still growing. Customers' needs are taken into account by the Manufacturers, who, with their background of years of technical experience in tubing, are able to advise a customer on the best type and quality tubing for his particular needs.

Amongst the numerous and diversified Industrial uses to which tubing can be applied, its adaptability for use in the Sports sphere also, is quite well-known and cannot be discounted. All over the world there is a greater use of tubular sports equipment, such as tubular billiard cues, tubular bows and arrows, tubular golf shafts, etc., all these items of sports equipment have been used by the respective champions.

The development to date, of the Tubular Steel Industry in India, can be said to be very satisfactory. In fact, it is keeping pace with the ever-increasing demand of the other Industries. The indigenous manufacturers are in a position to meet the present and future requirements for E.R.W. Tubes, and with the expansion schemes under implementation, they are more than assured that it will be possible to serve the Industries' requirements fully. It is also certain that with the availability of good, cheap E.R.W. tubing, Indian Engineers will find far wider uses for this tubing, than they have found in the past, thus repeating the pattern of E.R.W. tube development, which has been witnessed in other parts of the world during the last thirty years.

[By Courtesy: The Indian Railway Engineer, Bombay]

Two Oceans will be Linked with unbroken Railway Line

THE century-old railway gauge muddle which has bedevilled Australia's communications is being tackled by the Federal Government in co-operation with the governments of the various States.

To meet the demands of Australia's spectacular national development, particularly its industrial growth, a unified gauge is seen to be essential.

Just how muddled the gauges have been can best be seen in a single journey from Cairns in the north-east to Perth in the south-west.

In Cairns the traveller settles himself into a train running on a 3 ft. 6 in. gauge and travels as far as Brisbane. There he transfers into a train running on 4 ft. 8½ in. gauge and travels through the State of New South Wales to Albury on the Victorian border.

Here he crosses the platform and finds a seat in a train running on Australia's king-size gauge, the 5 ft. 3 in. of the Victorian Railways. There is another change of trains in Melbourne until he is settled in the express for Adelaide, South Australia, but again this is the 5 ft. 3 in. and on this gauge he can go as far as Port Pirie.

At Port Pirie he joins the Transcontinental Express which runs on 4 ft. 8½ in. and enjoys this width of rail until Kalgoorlie, the gold town. For the remainder of the journey to Perth he is back where he started on a 3 ft. 6 in. gauge.

Except for an insignificant mileage of private line at some mines and other industrial enterprises, the nation's railway systems are operated by Governments, State and Federal. Today for 28,000 miles of track, no fewer than five gauges exist—2 ft., 2 ft. 6 in., 3 ft. 6 in., 4 ft. 8½ in. and 5 ft. 3 in.

Ignoring the occasional 2 ft. track in Victoria and the 2 ft. 6 in. ones in Queensland, the division of existing Australian railways is 6116 miles of 5 ft. 3 in. gauge mainly in Victoria, 7309 miles of 4 ft. 8½ in, in New South Wales and on the Commonwealth lines, and 13,645 miles of 3 ft. 6 in. in Queensland, Tasmania and Western Australia.

South Australia, which began with 5 ft. 3 in. but changed to 3 ft. 6 in., now has the distinction of having three different gauges following the Federal Government's construction of the 4 ft. 8½ in. in the Commonwealth transcontinental line.

It is not easy in these days of quick air communication between State capitals for Australian people to understand why their forefathers should have bequeathed them this absurd and costly legacy. It is a sorry story of isolation, misunderstanding, prejudice, obstinacy and bickering.

The story goes back to 1846 when the present Australian States were British colonies governed from London, and the Colonial Secretary was William Ewart Gladstone. In that year England adopted the Railway Gauge Act prohibiting future construction of lines other than in the new 4 ft. 8½ in. standard gauge, and Mr. Gladstone recommended that Australia should follow Britain's lead.

South Australia passed an Act for its Adelaide to Port Adelaide railway to be 4 ft. 8½ in. and all might have gone well if the Chief Engineer of the Sydney Railway Company had not been an Irishman. But an Irishman was Mr. F. E. Shields and whether it was an inborn love of the standard Irish gauge or a dislike of Mr. Gladstone which motivated him, he succeeded in convincing the Legislative Council of New South Wales (which then included Victoria) that the 5 ft. 3 in. Irish size was the best.

Accordingly in 1852 an Act authorising the change received Royal Assent from Britain, South Australia and Victoria (by now a separate colony) were advised accordingly, and both these latter colonies began building lines and ordering rolling stock to the 5 ft. 3 in. Irish standard.

Again all might have gone well, but the Irish engineer's salary was cut and he resigned and returned to Ireland. Replacing him was a Scot, James Wallace, who urged the great economies of the 4 ft. 8½ in. gauge, not to mention its speed, safety and convenience, and in 1853 the Legislative Council in New South Wales made the use of the 4 ft. 8½ in. gauge imperative in that colony.

Both Victoria and South Australia protested, and when their protests went unheard, they sought comfort one from the other in proceeding with their Irish gauge construction programme.

To make matters worse, Queensland, Western Australia and Tasmania decided on 3 ft. 6 in. because they found it was cheaper to construct and operate.

Soon after the colonies became federated as States in 1901 and railway traffic boomed, the tremendous cost of this muddle came to be realised. But it was World War II which demonstrated forcibly the perils of the break of gauge in war and the handicap to national development in peace. Labour corps had to be established at break of gauge points like Albury to transfer vital war materials from one train to another on the nation's most important link between Melbourne and Sydney. Ammunition supply dumps concentrated by necessity at gauge breaks presented easy targets for enemy air attacks. Supplies and men could be moved only with the greatest difficulty and time-wasting transfers from one set of tracks to another.

Between 1897 and 1929, twelve major conferences had been held to discuss standardisation without result. And, when in 1930, a section of track between Grafton (N. S. W.) and Brisbane (Queensland) was converted to 4 ft. 8½ in. to give an unbroken line between Sydney and Brisbane, the immensity of the job was seen in true perspective.

Not only was it a matter of relaying tracks and obtaining new rolling stock, but bridges, tunnels, culverts, cuttings, platforms and even railway stations had to be altered, shifted or rebuilt because new South Wales rolling stock is 10 ft. 6 in. wide and is six inches wider than Victorian, 1 ft. 6 in. wider than South Australian and 1 ft. 2 in. wider than Queensland.

Finally, on November 4, 1957, work began on conversion of the 200 miles between Melbourne and Albury. The task is expected to be finalised for preliminary use by freight trains at the end of 1961 by which time £10,750,000 will have been spent on 27,000 tons of rails, 450,000 sleepers, 650,000 cubic yards of ballast, 4,500 tons of bridging steel not to mention the moving of 1,500,000 cubic yards of earth from cuttings and the raising of embankments.

Australia's railway authorities are agreed that modernisation must accompany standardisation and plans have been drawn up for two luxury trains of 14 carriages each pulled by 1,800 h. p. diesel locomotives. Cost of the two trains will be £2,000,000.

Each train will include sleeping carriages with roomettes and twinettes with private shower and toilet, dining car, club car, brake van and power unit to provide power for heating, lighting, cooking and air-conditioning.

The carriages are being built by commonwealth Engineering Company Ltd. at Granville, New South Wales, and will be sheathed with the first Australian rolled stainless steel manufactured for railway carriages. The use of steel will mean a saving of 84 tons weight for each train, equal to the weight of two sleeping carriages, and there will be further economies as they will require no painting.

Next step in the standardisation plan is to bring Adelaide into direct railway contact with sydney through Broken Hill, New South Wales. This entails the conversion to 4 ft. 8½ in. of the 254 miles between Broken Hill and Port Pirie (now 3 ft. 6 in.) and the 130 miles between Port Pirie and Adelaide (now 5 ft. 3 in.). The cost is estimated today at £25,000,000.

Completion of the Broken Hill-Port Pirie section will link Brisbane with Kalgoorlie, a distance of 3000 miles, and leave only 300 miles between Kalgoorlie and Perth before the Indian and Pacific Oceans will be linked for the first time in history by an unbroken line.

New Rail Line between Udaipur and Himmatnagar

The Railway Board has sanctioned construction of a metre gauge railway line from Udaipur to Himmatnagar covering a distance of about 137 miles.

The construction work of the new railway line, which will connect north Gujarat with southern Rajasthan and will also bring Udaipur in direct contact with Ahmedabad, will be carried out by the Western Railway. The new railway line is expected to benefit the backward and under-developed Adivasi tracts of Rajasthan and Gujarat.

BETTER RAIL TRAVEL

By K. Swarup

(Chief Administrative Officer, Integral Coach Factory, Madras)

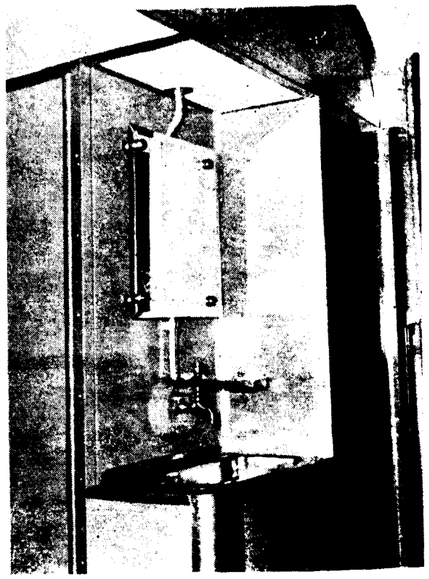
ONE of the results of World War II was an increase in traffic making abnormal demands on transport capacity. Faced with the problem of coping with the unprecedented increase in passenger traffic, accentuated by the depleted and overaged stock and the inadequacy of capacity in railway workshops for manufacture of coaching stock, the Government of India decided that a separate railway coach building factory should be established to enable the Indian Railways to become self-sufficient in the matter of passenger coaches. The Integral Coach Factory at Perambur was accordingly set up as a commitment under the First Five-Year Plan, with technical collaboration of the Swiss Car & Elevator Manufacturing Corporation, Ltd., Switzerland. The initial capital outlay for the Shell Factory was Rs. 7.35 crores and a further sum of Rs. 3.69 crores was sanctioned during the Second Five Year Plan for putting up a Furnishing Annexe. The Factory including its furnishing annexe and the township covers an area of about 500 acres and at present employs over 7,000 workers.

DESIGN OF THE COACH

In the earlier years the design of railway stock was inspired by the road vehicles of that period. It was soon found, however, that the railways could cope with heavier loads, and the evolution of railway rolling stock tended towards increased capacity together with the provision of comfort—a factor which was ignored till then. The constantly increasing speeds also made greater strength of coaches imperative. The growing competition from road and air transport forced the railway to revise its passenger service policy, which has resulted in the appearance of passenger coaches of light construction.

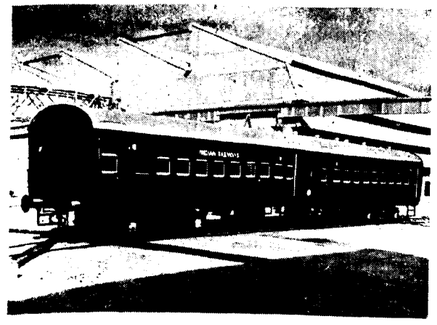
The Integral coaches produced in this Factory are of the modern light-weight all-welded steel construction, designed to give the maximum comfort and safety to the railway passengers. Being 7 tons lighter than the conventional coaches of 42 tons, considerable economy is effected in operational costs, as more number of integral coaches can be hauled per train, thus reducing the overcrowding in trains. Another important feature of this coach is its anti-telescopic end construction. The ends being plastic, i. e. designed to carry less stresses and strains, get buckled in the event of an accident, thus absorbing most of the collision energy and reducing the possibility of the carriages telescoping and causing risk to passengers. This special feature has been subjected to trials and the two photographs below will illustrate what happens in the event of collision or telescoping. The carriage is also designed for improved riding by provision of shock absorbers, spherical roller bearings, special design of springs, etc. The inside of the coach is sprayed with limpet asbestos to provide insulation against heat and sound.

The interior design is so planned as to afford maximum comfort to passengers. Unlike the previous



Some of the amenity fittings provided in our Third Class Sleeper Coach.

third classes, the integral coach has been split up into 8 compartments, each compartment providing seating capacity for 10 passengers. The upper luggage rack provides enough room for carrying luggage that our passengers are accustomed to carry. On the top is again a light luggage rack, where small articles could be kept. Similarly, luggage racks have been provided on the corridor side. The provision of these extensive luggage racks would ensure that the floor and the seats will be free for occupation and moving about, thereby giving more comfort to the passengers.



Third Class Integral Coach ready for despatch.

Each compartment has been provided with two fans to give sufficient air to all the passengers. The compartments are well-lit to enable passengers to read at night time if so desired.

The seats and back rests were originally well curved to provide comfort to long distance passengers, but have now been made flat increasing the width from 19″ to 22″ to enable passengers to spread their bedding and make themselves more comfortable.

Lavatories are also well equipped and have all the modern amenities like wash hand basins, mirrors, squatting pans, lotah holders, towel racks, etc.

PERFORMANCE DURING THE SECOND PLAN PERIOD

(i) *Increased Output*: According to the Technical Aid Agreement with the Swiss collaborators, this Factory was to achieve its maximum production of 350 coach shells a year, in progressive stages, in the 5th year from the start of production. Production was inaugurated by the Prime Minister on the 2nd October, 1955 and since then, year after year, the performance improved and in each year the record of the previous year was broken. The 1000th coach was turned out early in 1960—far ahead of schedule. The comparison of the targets and the actual output during the five years of production is indicated in a chart given below.

(ii) *Improved efficiency*: The efficiency of the Shops has been increasing from year to year as the men have been gaining experience and skill. The manhours spent on each coach shell have come down steadily from about 19600 at the start of production to about 8600 in the latest batch. The present manhours compare very favourably to those taken for similar coach production in Europe. Efficiency is expected to further increase as a result of the Incentive system of payment which has been introduced in I. C. F. from January, 1960.

(iii) *Reduced cost*: The unit production costs in the I. C. F. have been coming down steadliy from the initial Rs. 186 thousands to the present about Rs. 80 thousands inclusive of overheads and depreciation.

(iv) *Self-sufficiency*: Before the I. C. F. went into production, most of our coaches and underframes were imported from abroad and considerable amount of foreign exchange was required to meet the demands of the Indian Railways. In the 13 years since our Independence, the Indian Railways have become self-sufficient in their railway coach requirements and not a single coach is now imported.

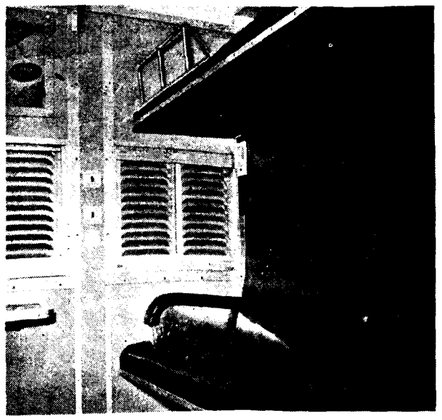
(v) *Diversified production*: The original idea was that the I. C. F. would produce only a standard shell, which could be furnished to any class of coach required. With the rapid industrialisation of the country and resulting higher standard of living of the masses, the demand for better amenities and comforts also increased. While laying stress on the improvement of amenities and comforts to third class passengers who constitute the bulk of the traffic on the

Indian Railways, this Factory has also now geared up for meeting the varied requirements and standards of the travelling public by designing different types of coaches. The types of coaches produced till the end of the Second Five Year Plan are indicated below :

Type of coach	Number
'T' (Integral)	1047
'TLR' (Integral)	121
'TCN' (Integral)	150
'T' (Conventional)	115
'TLR' (Conventional)	150
'F' (Integral)	155

To give an idea of the amenities and comforts provided in these coaches, the interior layout of the various classes of coaches is shown in the sketches.

(vi) *Export market*: Having achieved self-sufficiency for the Indian Railways, this Factory is now tapping the export markets. The I. C. F. has already quoted against Pakistan and Argentine Tenders for coaches. In Pakistan, we were the lowest out of the 7 countries that competed in the global tenders and in the case of Argentina, quotation for I. C. F. coaches was the second lowest out of 28 tenders received from 15 different countries. The results of these tenders are not yet known, but the very fact that the cost of I. C. F. coaches is competitive in the world-market proves that the Government undertakings can run efficiently and earn the badly needed foreign exchange for the country.



An interior view of a First Class Coach recently built by I.C.F.

The two photographs above will illustrate what happens in the event of collision or telescoping.

PROPOSALS FOR THE THIRD FIVE-YEAR PLAN

(i) Encouraged by the excellent performance during the Second Plan Period and the good teamspirit existing amongst all grades of staff at I. C. F. this Factory has embarked on the ambitious plan to produce 3735 coaches during the Third Five-Year Plan commencing from April 1961. This programme includes coaches even for the Metre Gauge, Electric Multiple Unit Stock and also Diesel Railcars required for the Indian Railways. The proposed programme is as follows :

Type	B. G.	M. G.	N. G.	Total
Ts.	23	1198	—	1221
TLRs	235	—	—	235
Fs.	462	—	—	462
FTs.	592	—	—	592
Motor & Parcel Vans	—	343	—	343
Motor Vans	—	73	—	73
EMU (12 ft. wide trailers)	612	—	—	612
Railcars	67	120	10	197
Total	1991	1734	10	3735

(ii) The construction of the Permanent Furnishing Factory is now in full swing. Rs. 1.5 crores out of Rs. 3.69 crores has already been spent in the II Plan and the balance of Rs. 2.19 crores will be spent during the III Plan to complete the Permanent Furnishing Unit. By providing a furnishing unit, all the shells that would be turned out from the Shell Unit will be furnished and made available to the Railways without any loss of time. It will also enable standardisation and providing better comforts to the passengers.

(iii) For full working of the Second Shift which will enable obtaining further increases in production, extension of certain workshops and additions in machinery and plant at a total cost of Rs. 45 lakhs is envisaged during the III Plan.

(iv) The factory has built a Staff Colony provided with about 841 units of quarters. Another 257 units are programmed to be built in the Second Shift scheme. Further, in view of the acute shortage of accommodation in this part of the Madras City it is proposed to build 500 more staff quarters during the III Plan at the rate of 100 per year at a total cost of Rs. 52.5 lakhs. Thus, the number of quarters provided in the Staff Colony would be nearly doubled at the end of the III Plan.

(v) Since October 1955 when this Integral Coach Factory first stirred into productive life, its story has been one of continuous development and growing productivity. The object with which this factory was set up has been more than fulfilled. Having achieved self-sufficiency in matters of passenger coaches for the Indian Railways this factory is now looking forward to building coaches for the export market. Our cost as well as quality in production is very competitive and we have full hope that very soon we will be able to get orders from some foreign countries for their coach requirements and thus become one among the foreign exchange earners for India.

PUBLIC ENCOURAGEMENT AND CO-OPERATION

It is not for me to indulge in self-praise, but it can perhaps be said with a measure of truth that this factory has already come to be looked upon as a shining symbol of India's industrial development in post-Independence period. Thousands of visitors from this country and from abroad went their way through this factory in appreciation of our efforts. We are continually striving to improve the layouts and provide more and more comforts and amenities to the passengers, and hope that our efforts in this direction will also be appreciated by the public and they will co-operate with the railways in maintaining these integral coaches well. Our experience of today when costly fittings and improved finishes are removed or spoiled by vandalism discourages us from further improving our finish. I, therefore, beseech the public to treat these coaches as their own property and look after them well.

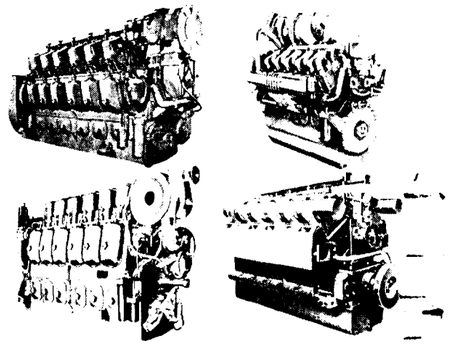
Paxman—Alco Agreement

ON the 18th November 1960, it was announced in a statement about the agreement reached between Davey, Paxman & Co., Ltd. of Colchester, England (a member of the Ruston Group), and Alco Products Inc. of New York, which will be made public on November 28th. In this statement the reciprocal agreement which has been made between these two Companies for the manufacture and sale of each other's diesel engines in certain markets is outlined. We are now able, however, to give you some additional background to this announcement and further details of how this agreement will operate in practice.

Alco Products Inc. (formerly known as the American Locomotive Co.) is one of the largest builders of locomotives and locomotive diesel engines in the U.S.A. Alco locomotives have played a major part in the dieselisation of American Railways and have also found a ready sale in other parts of the World. Apart from their use in locomotives, Alco diesel engines have found numerous industrial, oilfield and marine applications, and have reached a very high state of development covering a power range of from 900 to over 3000 b.h.p. in 6, 12 and 16 cylinder models of 9 in. bore. Alco engines can also operate as dual fuel engines burning natural gas (or other gaseous fuel) with pilot injection.

Davey, Paxman & Co., Ltd., of Colchester has specialised for many years in compact medium and high speed, vee form, diesel engines. The Paxman 7 in. bore range of diesel engines, and the high specific output 7¾ in. bore Ventura range developed from it, have established a world-wide reputation in traction, industrial, marine and oilfield applications and cover a power range from 150 to 2300 b.h.p.

The agreement between these two Companies has been inspired by their mutual appreciation of the emphasis that present day conditions give to the need for



Top left: ALCO 12 CYL. 9 in. Bore Engine Series 251

Top right: PAXMAN 12 7¾ in. Bore Engine Ventura

Bottom left: ALCO 6 CYL. 9 in. Bore Engine Series 251

Bottom right: PAXMAN 12 CYL. 7 in. Bore Engine Series Rph

co-operation between Companies whose produ markets are complementary. Such co-operatio only advantageous from a selling point of view enables the product range of the collaborating nies to be extended without involving du costs in design and development.

Paxmans will therefore manufacture and sel designed engines in their traditional world mar covered by the Ruston Paxman sales organisati

Correspondingly, Alco will have the right t nd make Paxman engines of the Ventura and o pes in the U.S.A. for all purposes, including a ons in American equipment for export and in ives of sizes other than now manufactured by Alco.

DIAL GAUGES

The Indian Standards Institution has prepared a draft specification for Dial Gauges. The draft standard deals with commonly-used dial gauges of unit of measurement 0.01 mm. and also gives information on high accuracy dial gauges required in the inspection of machine tools. The draft specification will shortly be put into wide circulation to manufacturers, consumers, technologists and others interested, for their critical comments and suggestions for improvement. The comment will be given due consideration before finalizing the draft as an Indian Standard.

GOLDEN RULES OF CONDUCT FOR RAILWAYMEN

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

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

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

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

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

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

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

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

CLEANLINESS LEADS TO HEALTH AND HAPPINESS

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

Cleanliness prevents disease; medicine only attempts to cure.

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

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

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