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OUR ACHIEVEMENT

IT was not far-off when the Locomotive Workshops was christened, amidst grandeur and prideness of feeling, at Chittaranjan, a new City named after the greatest patriot of Bengal, revered Desabandhu Chittaranjan Das. Recently the Railway Board celebrated the Centenary, on the occasion of the 100th Locomotive to be put on wheels and turned out of this modern Works. Sri Lal Bahadur Sastri in a Bahadur style, acted as the driver with the regulator handle pushed up with his left, the right on the Vacuum Ejector handle. A panorama of General Managers stood guard of honour, as the engine steamed out.

It was but right that a review of our capacity to make ourselves self-sufficient as regards our requirements of Locos. and Rolling Stock were concerned. Our Railway Minister did not mince words when referring to the opposition, though well-meant, to place orders for building of Rolling stock in the country. He was unable to understand the apathy of the technical men in and around the Railway Board. We may add, the general man, also does not. But, is it not a well-known fact that somehow, for reasons which are not well appreciated, the rehabilitation programme on a post-war period has been set apace far ahead of the indigenous capacity and no doubt in excess of our immediate requirements to keep apace with our First Year Plan.

English Locomotives are proverbial for their long lives—some of them give satisfactory service even after 40 to 50 years solid run. Should not, then, we slow down condemnation and replacement programme so as to fit in with our all-out efforts to increase capacity of Loco erection and building. More emphatically can one safely say the same thing with regard to Rolling Stock. The common man is told that the various Railway Workshops in India are not in "full swing" on building of carriages. With additional resources, equipment, plant and machinery the present out-turn could easily be doubled in two years and trebled before the 2nd five year plan is launched.

But a change of outlook is necessary. Ten years later, steel coaches may become the order of the day, when once India is able to cater for all, steel products. To have entered into an agreement for Swiss type coaches should not retard our progress and keeping our Railway Workshops engaged to the maximum by using local labour which even foreigners have testified, is highly efficient and intelligent, for building wooden carriages and turning out new Wagons and Boilers. Ajmer built as long ago as a quarter of a century boilers and we have deteriorated now to undertake only repair work in even modern Workshops.

May we plead that the Railway Minister appoints a High Power Committee consisting of workshop officers, of proved ability and have a fad for production efficiency and problems to go deeply into the question of equipping for increased out-turn in all Railway Workshops for undertaking ever-increasing production work, formulating a scheme to build as an ancillary a "machine-tool" manufacturing Shops for the Railways. A machine tool factory is now under the control of Defence Department in Bombay. How the Railways who have wonderful technicians and talent, had been cheated out of this concern, it is difficult to explain. Let us rationalise our resources and capacity and take measures to just "fill the gap" and enlarge facilities in the remaining period of the 1st year plan, so that at the commencement of the 2nd

stage, we are on firm grounds and except for importing, in a small quantity, small items of proprietory value, let India achieve its object of "Everything our own."

This is one of the ways to reduce unemployment. Let us in the interim suffer if need be; let us sacrifice; let us wait for better days to travel in greater comfort. Let our transport be worked in great austerity, till we achieve self sufficiency. Thus we would become less and less dependent on foreign technical aid, imports and designs not suited to our genius.

Let the first things be put first. Improve Third Class to Inter Class standards; but let us not think now, of "Air conditioned" travel facilities. Of course, for tourists have by all means special trains. The abolition of Ist Class does not serve any purpose as India yet has different stratas of society, anyway far more than three. Let the common man get more comforts and ease of travel. But let us not lose the coins of the richer whose pockets are full and who can afford to pay to the Railway more for 'secluded' travel and first class amenities. Let our standard of living rise high before we launch on gorgeous schemes, just to please a few whose voices unfortunately are set at a loud pitch.

Hasten slowly. India will soon shine in splendour. The grandeur can come later, when every Indian has had a decent living.

THE INDIAN RAILWAY ENGINEE

INDIAN STANDARDS AND RAILWAYS

By S. O. Shukla, M. Sc., Ph. D., M. S. E., Technical Officer, Indian Standards Institution

"STANDARDIZATION may be broadly defined as a kind of formulation intended to define or specify a particular object or procedure with a view to attaining uniformity and accuracy in its production and utilization. It is a science of wide applicability with its main roots lying deep in commerce and industry". Standardization requires relevant knowledge of an industrial process, techniques of sampling and of interpretation of working data. Standards provide acceptable basis for transactions between buyers and sellers, enabling them to speak the same language. From time to time, the standards are revised and brought up-to-date to keep abreast of technological experience and advancement.

STANDARDIZATION—BRIEF HISTORY

Standardization movement in India may be taken to have been initiated on a group basis with the appointment of an Inspector of Local Manufacturers in 1909 by the Railway Board. This officer inspected materials ordered from firms in the Calcutta area, and encouraged the purchase of local industries by railways which conformed to Railway Specifications. The next important stage was the setting up of the Metallurgical Inspectorate by the Railway Board for the efficient inspection of a 20,000-ton yearly supply of rails and fishplates which the newly started Tata Iron and Steel Co. Ltd. had contracted for five years. This inspection and testing organization laid the foundation of group standardization in India. Among other organizations which have grown up since then to develop standards in their own spheres, mention may be made of the Central Standards Office of the Railway Boards; Directorate of Technical Development, Army Headquarters, Directorate General of Supplies and Disposals; etc.

STANDARDIZATION ON NATIONAL SCALE

Standardization work on national scale began with the setting up of the Indian Standards Institution (ISI) in 1947, in pursuance of a Resolution of the Government of India, to serve as the central standards organization for fixing Indian Standards for commodities, materials, structures, practices, operations, etc. Prior to this, purchase and, therefore, manufacture were based on British and, to a lesser extent, American Standards, or on departmental standards issued by various Government departments and other purchasing agencies. This led to diversity in specifications and conflicting evaluation of quality of materials. The conditions of manufacture and supply in India were not always kept in sight, and the impetus which Indian industry had a right to expect from Government patronage was not always forthcoming in full measure. One of the main objects for which the ISI was established was to promote production in the country both in respect of quality and quantity.

FORMULATION OF INDIAN STANDARDS

The technical work of ISI is distributed among its Division Councils, four of which have been set up and are functioning, namely the Engineering Division Council, the Chemical Division Council, the Textile Division Council and the Building Division Council. For preparing a particular standard or a group of standards, the Division Council concerned appoints a Sectional Committee. The Central Standards Office of the Railway Board is invariably represented on all ISI Committees concerned with the preparation of standards on subjects of interest to the Indian Railways. A draft standard, drawn up by a Sectional Committee, is first issued for comments generally for a period of three months. It is circulated to (a) National Standards Bodies of all Commonwealth countries, (b) Research Laboratories in India, (c) all sustaining members of ISI who are interested in the subject, (d) all Indian firms concerned with the material, (e) principal users and producers, and (f) to any one else who may ask for it in response to the press note published when a draft is issued. The opinion of National Standard Bodies outside the Commonwealth is also sought when the sectional committee concerned considers it necessary. The comments so received are carefully considered by the sectional committee, which finalizes the draft and authorizes its publication subject to the approval of the chairman of the Division Council concerned, who endorses the draft on behalf of the Council and the chairman of the Executive Committee of the ISI who approves the draft on behalf of the Institution. During the preparation of Indian standards all ISI committees on such items which are of interest to Railways make it a point to recognize the requirements of the Railways and incorporate them in the Indian standards. Almost invariably, therefore, the Indian standards on these items are issued in full collaboration with the Railway representative on the various ISI committees.

Indian standards are voluntary and great care is taken in their formulation to consult industrialists, technologists, scientists, various Government departments and consumer interests where such interests have been organized. It is an invariable practice with the ISI to give weightage to consumer interests in the formation of its technical committees. While manufacturing interests extend their co-operation in the formulation of standards and are willing to adopt the Indian standards voluntarily, their course of action is naturally determined by the extent to which the consumer interests insist on their purchases to be made on the basis of standards published by the ISI. To a layman every article is good enough so long as it claims to serve his purpose and has not been proved by trial to be unsatisfactory. The Indian Railways, on the other hand, constitute one of the few very big organized consumers in the country and have the necessary facilities for inspection and testing. Their purchases in accordance with Indian standards play a vital role in popularising them and encouraging production of goods of standard quality.

INDIAN STANDARDS ADOPTED BY CSO

The ISI has so far issued about 400 Indian Standards, and the work is gathering momentum. Of these, 95 standards, as listed in the Appendix, have been adopted by the Railway Board according to the extent of their interest; the largest group of these standards relates to the standardization of colours for ready mixed paints, pigments, extenders, drying oils, thinners and solvents for paints, ready mixed paints and enamels. Railways in India consume a little more than one-sixth of the entire production of paints and varnishes in the country. Two other important subjects, the Indian Standards on which have been adopted by the Railway Board, are lubricating oils and refractories. It is recognized that in some of the applications concerned with the railways, refractories are required to meet service conditions peculiar to the railways. The tentative Indian Standard Recommendations for "Refractories for Railways" (IS: 194–1950) takes full cognizance of such requirements. For instance, in addition to high temperature, refractories used for constructing locomotive boiler arches are subject to excessive vibration during service. Trial experiments to establish suitability of the recommendations contained in IS: 194–1950 are being carried out by the Eastern Railways. So far the results of investigations have proved to be satisfactory.

One of the important Indian standards to be adopted by the Railway Board is the specification for structural steel (IS: 226–1950). Owing to the present difficulties in obtaining proper raw materials, rigid adherence to the existing specifications, where phosphorus in steel is limited to 0.060 percent, has been found difficult. The maximum phosphorus content in this specification has, therefore, been raised to 0.065 percent. However, a provision has been made that when steel is required for structures subject to dynamic loading, such as bridges, parts of railway rolling stock, etc., phosphorus should not exceed 0.060 percent. This will make possible the use of raw materials containing higher phosphorus content which otherwise would have been wasted.

Another important Indian standard to be adopted by the Railways is the Specification for Ordinary, Rapid-Hardening, and Low Heat Portland Cement (IS: 269—1951). Formerly, the Railways used to get their cement according to the British standard on the subject, the main difference between the two specifications being in magnesia content and insoluble residue. During the preparation of the Indian standard advice had been sought from America and other countries that magnesia and insoluble content within the limits mentioned in Indian standard were not harmful to the strength and durability of cement. Other Indian standards to be similarly adopted are on porcelain insulators for telegraph and telephone lines, padlocks, sliding door bolts for use with padlocks, dry cells and batteries, plain austenitic manganese steel castings, mild steel wire, miscellaneous chemicals like heavy acids, potash alum, aluminium sulphate, copper sulphate, road tar, coal tar pitch, acetone, etc. have been recognized.

CSO AND ISI—THEIR MUTUAL CO-OPERATION

Standardization of items of special interest only to Railways such as railway coaches, rails, locomotives, etc is carried out by the Central Standards Office. On the other hand, there are items, such as cement and structural steel paints which are of interest not only to the Railway Board but also to other agencies. The standardization of these items is carried on by ISI. However, there is no sharp border line between the items to be handled by the CSO and those which are to be standardized by the ISI. A carriage fan, for instance, has a similar purpose to fulfill as an ordinary ceiling fan for which the ISI has already issued the Indian Standard. The standardization of carriage fan can be taken up either by the Central Standards Office or by the ISI.

The purchases on behalf of the Railways are made by the Controllers of Stores and Directorate General of Supplies and Disposals. There is, however, a certain time lag involved in taking not of the new Indian standards and in getting them considered for adoption for future purchases by the Railways. With a view to reducing this delay and providing a means for their automatic adoption, the ISI has proposed to the Government that a suitable policy directive be evolved for the guidance of its purchasing agencies and departments.

ISI LIBRARY

The ISI Library maintains complete sets of standards issued by all the various national standards organizations of the world as well as of other well known standardizing bodies such as the ASTM, IEC etc. It also receives proceedings of committees and conferences of standardizing bodies of other countries of the world, and drafts of codes of practice of these countries. These may be of help to the railway organization.

QUALITY CONTROL AND CERTIFICATION MARKS

In the pre-war days, most of the railway stores were imported from abroad through firms of Consulting Engineers in London and their agents in India, and a small balance was purchased from indigenous sources. Now-a-days about 23 percent are imported through the agency of the DGS&D in London and New York, 12 percent from overseas firms through their agents in India, and the balance of 65 percent from indigenous sources. One of the complaints sometimes made against local supply, however, is its quality. The recent statutory recognition which the Parliament has bestowed upon the Indian Standards Institution empowering it to establish Certification Marks and to grant licences for their use to manufacturers producing goods conforming to Indian standards is a noteworthy forward step in promoting the quality of Indian manufactures. To carry out the purposes of the ISI (Certification Marks) Act, 1952, rules are being framed, and when the Act comes into force and certification marks become available to the industry of the country, the Railways and other purchasing organizations would be assured of the quality of all goods which carried ISI Certification Marks.

1	IS: 5—1949	Colours for Ready Mixed Paints
2	IS: 6—1949	Moderate Heat Duty Fireclay Refractories, Group 'A'
3	IS: 7—1949	Moderate Heat Duty Fireclay Refractories, Group 'B'
4	IS: 8—1949	High Heat Duty Fireclay Refractories
5	IS:16—1949	Shellac
6	IS:34—1950	Dry Pigments and Extenders for Paints
7	IS:35—1950	
8–14	IS:37 to 43—1950	
15–21	IS:45 to 51—1950	
22–24	IS:55 to 57—1950	
25–28	IS:61 to 64—1950	
29	IS:66—1950	
30–34	IS:75 to 79—1950	Drying Oils for Paints
35	IS:81—1950	
36	IS:83—1950	Thinners and Solvents for Paints
37	IS:84—1950	
38–41	IS:86 to 89—1950	Oil Pastes for Paints
42–50	IS:91 to 99—1950	
51	IS:102–1950	Ready Mixed Paints and Enamels
52	IS:117–1950	
53–60	IS:119 to 126–1950	
61	IS:130–1950	
62	IS:170–1950	Acetone
63	IS:194–1950	Recommendations for Refractories for Railways
64	IS:195–1950	Fireclay Mortar for Laying Fireclay Bricks
65	IS:203–1950	Leclanche Type Dry Cells and Batteries for Flash Lamps
66	IS:215–1951	Road Tar
67	IS:216–1951	Coal Tar Pitch
68	IS:218–1952	Creosote and Anthracene Oil for Use as Wood Preservatives
69	IS:226–1950	Structural Steel
70	IS:258–1950	Potash Alum, Technical
71	IS:260–1950	Aluminium Sulphate, Non-Ferric
72	IS:261–1950	Copper Sulphate, Technical
73–75	IS:264 to 266–1950	Heavy Acids
76	IS:269–1951	Ordinary, Rapid-Hardening and Low Heat Portland Cement
77	IS:275–1951	Padlocks
78	IS:276–1951	Plain Austenitic Manganese Steel Castings
79	IS:278–1951	Galvanized Steel Barbed Wire for Fencing
80	IS:280–1951	Mild Steel Wire
81	IS:281–1951	Sliding Door Bolts for Use with Padlocks
82	IS:283–1951	Porcelain Insulators for Telegraphs and Telephone Lines
83	IS:285–1951	Laundry Soap
84	IS:302–1951	General Requirements for Electrical Appliances for Domestic Use
85	IS:304–1952	High Tensile Brass Ingots and Castings
86	IS:305–1952	Aluminium Bronze Ingots and Castings
87–91	IS:311 to 315–1951	Lubricating Oils
92	IS:316–1951	Oil, Cylinder, Compounded, Filtered
93	IS:317–1951	Automotive Hydraulic Brake Fluid
94	IS:325–1951	Threephase Induction Motors for Industrial Use, with Class 'A' Insulation
95	IS:380–1952	French Chalk, Technical.

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The Trend of Locomotive Development Abroad

By C. H. de Sousa, M. I. Mech. E., M. Amer. S. Mech. E., Consulting Engineer, Bombay

AT the expense of many crores of rupees, the Government of India has installed a Factory at Chittaranjan, for the manufacture of steam Locomotives in this country. For the design and construction of this Factory, the selection of its machinery, plant and equipment and the choice of its personnel, the Government has had the advice and co-operation of the Locomotive Manufacturers Association of Great Britain. This Factory will this month be producing its 100th locomotive, and the auspicious occasion will be celebrated in a fitting manner by the presence of Ministers and the cream of the locomotive technical staff of the country.

As a private enterprise, the great house of Tatas has invested a considerable sum of money in building the Locomotive and Engineering factory at Jamshedpur. The Consultants to Tatas on this large enterprise has been the German firm of Kraus-Maffie of Munich, Germany. The superior posts of the principal departments of this factory are manned by German Engineers at considerable cost to the firm.

The combined output of these two factories when they are in full swing is expected to be about 200 locomotives per annum which should meet the country's annual demand.

The purpose in view in the planning and execution of these vast projects was to make India self sufficient in the availability of locomotives produced in the country and thereby save foreign currency and at the same time provide employment to a large number of our countrymen in the various departments of these factories.

Looked at from the above points of view, no one will deny that the establishment of these two major projects was a step in the right direction and will remain to be so, provided the steam locomotive can hold its own as the most efficient tractive unit in the field of locomotive power.

All engineers are aware that a Reciprocating steam engine is a very inefficient unit of power but inspite of this great handicap it still remains popular because of its many other advantages not the least of them being its great dependability under the most adverse conditions of working. It is particularly for this reason that the steam locomotive has held the field so long. But while the steam engine has remained static for a considerable time, other forms of power are progressing with giant strides and their application to the locomotive is becoming more and more reliable.

This is the time therefore that the following questions have to be asked. What is going to be the position in our country if the steam locomotive is ousted from its premier position as a tractive unit on our Railways? Can the two factories built up with so much expenditure, be converted within reasonable cost to produce other

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forms of power? What will happen to the vast amount of expensive machinery which has been purchased from abroad for the manufacture of locomotive boilers? Could sale be found for them in the country or abroad, or will they have to be written off as obsolete plant at a great loss to the nation?

The day for the consideration of these problems may not be imminent, but it is as well to look ahead. According to an old English saying " To be forewarned is to be forearmed.

If India is to hold its own in the development of Locomotive power against the more advanced countries of the world it is incumbent on the people at the helm of affairs to study the trend of development and to orientate their policies in such a manner that the transfer from one type of power to another may be smooth.

DIESEL LOCOMOTIVES

It would be necessary to note that for the first time in June 1952 the Diesel Power Units have exceeded the steam power units for domestic purposes in the U. S. A. The exact figures in that month were 19082 Diesel Units of motive power for rail traction against 18489 units of steam power. Whereas in August 1951 the figures of Steam and Diesel Units were 23469 and 16231 respectively in August 1952 they showed the following returns, Steam Units 17693 and Diesel 19488, showing in one year a loss to Steam of 5776 units whereas the gain to Diesel was 3257 units.

It was at first surmised that the rate of replacement of steam locomotives by Diesels was just a flash in the pan, and that once the manufacturers had taken the cream off the business, the pace of replacement would slow down. This assumption has not been borne out by facts. The Diesel Locomotive building activity is proceeding apace, nor is there any indication to show that the saturation point will be reached soon. On the other hand there is evidence to show that as the operating personnel and management of the diesel locomotive become more familiar with this form of power, they will demand more of it and that quickly.

In the United Kingdom, the Diesel Locomotive has passed the experimental stage and there are some firms who build this type of power unit who are now putting out feelers to compete in the markets abroad. For domestic use the Diesel Locomotive will not be much in demand because diesel oil will have to be imported from abroad and Britain's oil bill to meet the automobile and air power units is already high. On the contrary coal is one of Britains great assets and as long as coal supply is plentiful the steam locomotive will retain its supremacy with however this one proviso, that the reciprocating engine may make way for the steam turbine. Investigations are being pushed forward to apply turbine power to the locomotive. Diesel engines are however being used for railcars and switching locomotives in the domestic sector.

On the Continent of Europe both the French and the Germans are building Diesel locomotives both for their own use and for export to foreign countries. For domestic use diesel power is being adopted for rail cars, shunting locomotives and locomotives for metre and narrow guage services.

Australia is building diesel locomotives for domestic use on the Commonwealth Australian Railways particularly in the south and west of Australia. Some of these locomotives are being built by private enterprise and others in the Australian Railway Workshops.

Diesel locomotives are best suited to countries which have long runs through extremely dry or desert regions where water is bad or scarce. They are also suited to countries where oil as fuel is readily available. On both these courts, India seems to be a suitable place for the development of the diesel locomotive. Although we have coal it is concentrated in one or two places and its lead to distance places raises its costs even for steam locomotive traction. Whereas with the establishment of refineries in our country the position of diesel oil, especially if oil investigations in India are successful, will be much easier than it has ever been before.

BUILDERS

The principal builders of diesel locomotives in America are the Electro-Motive Division of General Motors, the General Electric Company in co-operation with the American Locomotive Company and the Davenport Besler Corporation, using the Caterpiller engine.

On the Continent the German firm of Kraus-Maffic is building diesel locomotives using the Maybach engine whereas in France the French Railways are building diesel locomotives in their shops using the Renault engine.

In England the well known firms of Ruston and Davey Paxman have combined to build diesel locomotives for shunting and for traction for markets abroad.

The Australian Commonwealth Railways are building diesel locomotives in their shops in conjunction with the English Electric Co. and the Clyde Industries Ltd. build the diesel locomotives with the engine from the General Motors Corporation of the U. S. A.

DRIVES

In America the Diesel Electric drive holds the promient position, and it is not likely to be affected by any other form of drive for some time to come. Mechanical and Hydraulie drives have been restricted to low power rail cars and switching locomotives. Hydraulic Torque converters are being built by various firms but their success is not yet assured and for this reason they have not yet been offered to the public.

European designers and in particular the Germans have adopted a combination of a Mechanical-Hydraulic drive, using what is known as the Mekydro transmission. This transmission is a combination of a mechanically clutched gearing and a hydraulic coupling automatically control led as regard gear changes by the locomotive and engine speeds. The hydraulic coupling also contains the reversing gear and gear changing is accomplished with the minimum shock by specially shoped clutch profiles and by the automatic disengagement of the hydraulic coupling during the gear changing operation.

The engines of European designers are mostly of the high speed low specific weight type. They are built in units of relatively high horsepower rating compared with those obtainable for Rail locomotives in America. The engine ratings vary from 650 to 1200 H P and from 1200 to 1600 r. p. m. Australia has adopted the straightforward Electro—Mechanical drive and in this respect follows closely the American practice.

The French Railways appear to prefer the Mechanical Hydraulic system.

STEAM LOCOMOTIVES

In America difinitely the manufacture of the steam locomotive is at its lowest ebb, and unless some revolutionary change takes place in the steam engine there it is likely to remain.

English and European builders are however continuing to build the steam locomotive. A recent order has been completed by the well known firm of Messrs Beyar Peacock for 50 Garrat type of locomotives and these are probably the most powerful steam locomotives built in Europe.

The German Federal Railways have recently built 2 steam locomotives using the Franco-Crosti system of boiler water preheating and have reached a thermal efficiency of 10%.

Henschel & Sons the famous steam locomotive builders have built locomotives for foreign service in which low axle loading in combined with high horsepower.

The French National Railways have evolved a novel design of a steam locomotive having four cylinders with compound working but employing only two sets of valve gearing for actuating the four piston valves on each side of a centre line, where the maximum horsepower developed at the drawbar is 4000.

The use of the steam turbine in a locomotive is not yet a successful proposition. There is no doubt that the reciprocating steam engine has succumbed to the steam turbine in the field of stationary power plant and for ship propulsion, but for locomotive power the proponents of the spinning blade are pressing hard to oust the reciprocating engine from its complacent position. Only time will show if success can be achieved.

ELECTRIFICATION AND ELECTRIC LOCOMOTIVES

The French Engineers have electrified an extensive part of the south of their country and are now tackling the north. Encouraged by the results of the experimental 50 cycle system of electrification they are adopting the same in the north in a heavy freight hauling industrialised area. A mixture of mercury are rectified motive power and motor generator locomotives are contemplated.

British Railways are going to experiment with 50 cycle frequency electrification on a section of their line.

A 50 cycle electrification is in the process installation on a narrow guage of the Belgian Congo.

Rail road electrification in the U. S. A. is characterised by abandonment rather than by extension, and a study is being undertaken to adopt the commercial frequency.

The Spanish National Railways have electrified a portion of their line and are using 3600 H P locomotives, built for them by the English Electric Company.

The rehabilated Railways of Holland are using U. S. A. designed locomotives built in Holland for some parts of their line.

The Swiss Federal Railways who are well ahead with their electrification have developed a 5190 H. P. locomotive to operate on the A. C. Lines.

The metre gauge railways of Brazil have adopted the design of the Metropolitan-Vickers on their 3000 volt line.

GAS TURBINE LOCOMOTIVES

The application of the gas turbine to the locomotive is still in the experimental stage in U. S. A. U. K. France and Sweden.

In America encouraging results have been obtained with the six 4500 H. P. units built by the General Electric Company and supplied to the Union Pacific Railroad. The Westinghouse Baldwin gas turbine locomotive which was supplied to the Pennsylvania Railroad has had its fuel control system modified and is back again in Service for further operating experience and indicates greater reliability of the 27, 775 miles of revenue service logged. The cost of fuel and lubricating oil was found to be the same as that of a Diesel Electric Locomotive.

The 2500 H. P. Brown Boveri gas turbine electri-locomotive, built for the British Railways has been having evtensive test runs. At the present this form of motive power is disappointingly low in thermal efficiency and high in fuel consumption.

The 3000 H. P. British built gas turbine electric locomotive of Metropolitan Vickers built for the British Railways has certatn novel mechanical features and is in the early stages of its trial.

The North British Locomotive Company has under construction a 1600 H.P. coal burning gas turbine electric lcocmotive using two turbines. The high pressure turbine will drive the compressor and the low pressure turbine will furnish the traction power through a two stage gear box.

The French National Railways are experimenting with a gas turbine locomotive with a mechanical drive. It is a 1000 H. P. unit weighing about 60 tons in a length of about 50 feet.

The Swedish firm of Motola Verkstad has under construction a 1000 H. P. gas turbine locomotive using a diesel engine to produce its gas and supply it at 60 pounds per square inch to the turbine. The locomotive is expected to develop a tractive effort of 27,000 lbs. and weigh 78 tons.

It is yet early to predict the final success of the gas turbine as a motive power for rail traction on any large scale, and considerable amount of experimental work will have to be accomplished before it can compete with the diesel engine as power unit for railways.

We are now at the treshold of the Atomic Age, and once scientists and engineers divert their minds from producing instruments of distruction and apply them to constructive purposes, the production of power in various forms will be undoubtedly their first consideration, and then the application of that power to locomotives traction will not be a very distant goal. The prospect of the application of steam power for locomotive traction therefore appears to be somewhat dim in the age that is now dawning upon us.

International Electrotechnical Commission in Yugoslavia

By E. D. Johnson

THE International Electrotechnical Commission (IEC) is the Electrical Division of the International Organization for Standardization (ISO), of which the Central Office is situated at Geneva. The IEC was formed in 1904, and although a division of the ISO, it is an autonomous body having its own President, General Secretary and Treasurer.

The functions of the IEC are the formulation of international standards, specifications, symbols and testing requirements for all forms of electrical equipment and the essential raw materials appertaining thereto. An example of the importance of its work is that the IEC Standard for High-Conductivity Copper now provides the constants for resistivity, tensile strength, elongation with temperature, weight, variation of resistivity with temperature, etc. which constitute the bases of all calculations connected with high-conductivity copper that appear in the standard specifications of National Standards Bodies throughout the world. Similarly, the IEC is the origin of standard basic temperatures for international use in engineering standard specifications having electrical associations.

Each year, when international conditions permit, the IEC holds a group series of meetings, and those of 1953 were held, on the invitation of the Yugoslavia Electrotechnical Committee, at Opatija in that country. There was, immediately after the announcement, some doubt as to the suitability of Yugoslavia for such meetings, and whether there would be a sufficiently good attendance of delegates. In actual fact, the attendance at the meetings, which were held at Opatija between 22 June and 1 July 1953, constituted almost a post-war record. The delegates from abroad totalled nearly 250, and there were about 70 from Yugoslavia. In all 17 countries were represented. The Indian Delegation consisted of Shri T. V. Ramamurti of the Council of Scientific and Industrial Research; Shri P. L. Verma, Chief Electrical Engineer, Central Railway; Mr. C. W. C. Plummer of Merz and McLellan (India); Dr. Lal C. Verman, Director, Indian Standards Institution; and the writer representing industry.

Opatija is situated on the Dalmatian Coast, at the head of the gulf of Kvarner, and on the eastern coast of the Istrian Peninsula. The nearest large railway station is at Rijeka, which is the present name of the one time famous port of Fiume. A combination of trolley bus and autobus services connects Opatija with Rijeka, the distance being about 9 miles. A small steamer also connects the two towns but the intervals between sailings are rather long.

The problems of travel to Yugoslavia, which at first appeared considerable, proved simple of solution. A Yugoslav visa is obligatory for the nationals of all countries, but such visas were found to be readily, and speedily, available from all Yugoslav Consulates throughout the world.

Air services to Yugoslavia are infrequent, but it is possible to fly to Belgrade on certain days. A main railway line, with international connections across Europe, and along which run the regular services of such trains as the daily Simplon-Orient Express, extends along the entire north-eastern side of the country, from the university city of Ljubljana in the north, through Zagreb to Belgrade, and subsequently to Sofia and Istanbul.

Most delegates arrived by rail, but some had crossed Europe by road, driving, or being driven in their own cars. Railway entry was usually by international lines to Zagreb, Ljubljana or Venice and Trieste, and then by branch lines to Rijeka. The most attractive method of arrival was by one of the comfortable steamers of the Adriatic Line from Venice to Rijeka.

Opatija is a well-known seaside and health resort with many large hotels and was thus suitable for a large number of visitors. One of the largest hotels was the Central Office for the IEC meetings; and the meetings of the fifteen Technical Committees and Sub-committees, together with the meeting of the Committee of Action, were held in three of the largest hotels.

The range of technical subjects covered by the Committees were as follows:—

Graphical Symbols	Components
Radio-Communication	Insulating Materials
Measurements	Switchgear and Controlgear
Electric Cables	Lamps and Related Equipment
Power Converting Equipment	Lamps
Ionic Convertors	Lamp Caps and Holders
Electric and Magnetic	Auxiliaries for Fluorescent
Magnitude and Units	Lighting
Letter Symbols and Signs	Lightning Arresters
	Electronic Tubes and Valves.

The discussions varied over a very wide field, some objectives being the creation of international symbols to cover the entire range of light and heavy current engineering, the formulation of an international testing specification for high voltage cables and the possible economic life of a tungsten filament lamp.

The most interesting feature of the meetings was the opportunity for discussions during "off duty" hours with engineers from other countries, and to hear of their problems and their achievements. After the first few days, during which delegates had been able to discover the specialised interests of other delegates, there was much reading of the badges worn by them in an endeavour to ascertain if a common language was possible to facilitate the interchange of ideas on specialised interests. Much can be gained by both parties to such private discussions and very much can be learnt. It is at times quite an agreeable surprise to find that men of other countries, often of a country that one has looked upon perhaps as being somewhat technically and industrially backward, can manufacture, install and operate electrical equipment and heavy plant much in the same way as it is done in one's own country.

Yugoslavia may be an interesting political experiment, but it is also a happy country. There were no restrictions of any kind on the delegates, and it was very obvious that this was not a special form of privilege extended only to the IEC delegates. Customs and frontier officials were helpful and courteous on all occasions, and in Opatija itself, the Yugoslav Electrotechnical Committee, with the support of the Yugoslav Government and the local authorities, spared no effort to make the visit of the IEC to that town a memorable one.

Every evening during the session there was some form of collective entertainment. These included receptions by municipal committees, an official banquet, several excellent performances of native dances and songs in colourful native costumes, a ballet performance, symphony concerts, where only Yugoslav music was played, and an evening cruise down the gulf of Kvarner.

There were visits to such national beauty spots as the Lake of Bled and the Lakes of Plitvice. The extensive caves of Postojna, which are additionally beautified by a very artistic lighting installation, were visited by one party of delegates. On the Saturday afternoon an opportunity was given to the delegates, and to any lady guests who were interested, to inspect the hydro-electric scheme at Vinodol named after Nikola Tesla who was born in Yugoslavia. The work on the dams is in progress at Lokve, and the underground power plant was at Tribalj. The total capacity of the scheme is three generating sets, each of 35 MVA capacity, and two of those sets were seen in operation.

At Lokve, a considerable use of modern earth-moving equipment was made, and there was also a vast quantity of work being done by direct human effort. Young people of both sexes were working on the dams with hand tools and wheelbarrows. They looked bronzed and fit, and the delegates could freely talk with them. There was no evidence of forced labour or discontent, and the youthfullness of the workers was explained on talking with them. Every boy and girl there was on holidays from school and each of them was giving at least three days of free labour on a national project without there having been any coercion for any of them to do so. At 5 P. M., when it was time for the work of the day to terminate, each gang of mixed sexes lined up in threes, and with their tools at the slope on their shoulders and with a huge red flag on a very stout pole carried ceremonially in front by one of their number, they marched away to their huts with military precision singing national and political songs. Their departure was not arranged specially for the delegates and was obviously a daily procedure. One felt convinced that they were young people that any country would be proud to own, that Yugoslavia was rich in such a possession and that a country can be as great as its citizens.

In the mountains around the dam the scenery was magnificent and the valleys showed evidence of agricultural profusion and cleanliness. Roads in places were still primitive with rough stone surfaces that must be severe on rubber tyres, but the coaches transporting the delegates made their way almost to the dam site even if their passage through some of the final narrow roads did result in sweeping from the trees on the roadside some of the unripe plums, apples and pears.

The underground power station was nearer to the coast at Tribalj with the prime movers, generators and transformers constructed underground and deep into the hillside. The approach was through a long stone-lined tunnel which had naturally been made sufficiently large for the transportation of all the power-house plant. The transmission from the transformers in the power-house to the overhead line on the summit of the hill was by 100 kv single core cables carried by a perpendicular shaft.

Yugoslavia has very ambitious plans for the development of her electrical power systems and expects to be in a position to export electrical power to adjacent countries. With that prospect in view, an international body known as Yougelexport has been formed under the auspices of the U. N. Economic Commission for Europe with Austria, Italy and Western Germany as interested parties, in addition, of course, to Yugoslavia. In 1951, the installed capacity of the Yugoslavian thermal and hydro-electric systems was about 1000 MW. A recent study suggests that only from 2 to 3 percent of the

economically exploitable hydro-electric resources of Yugoslavia have yet been exploited.

When the technical meetings had been concluded and the Council of Action had held its final session, the Yugoslav Government placed at the disposal of such delegates who desired to participate, a steamer of the Adriatic Line for a 3-day cruise down the Dalmatian Coast. The cost of the passage was borne by the Government, and the delegates paid only for overnight accommodation, meals and drinks.

The first day was spent cruising from Opatija to Split, calling at the Island of Rab where Marshal Tito once met Brig. Fitzroy Maclean during the War. The second day of the cruise was from Split to Dubrovnik. Dubrovnik was left at 11.30 A. M., and the Saturday return journey made to Rijeka in 21 hours' continuous cruise, including a half-hour call at Split to enable some of the delegates to leave the steamer there.

The evenings spent in Split and Dubrovnik gave scope for the usual hospitable arrangements of the Municipal National Committee and the Engineer's and Technicals' Association of each town. At Split there was a reception at the Mestrovic Gallery which is the museum and art gallery of the township. A great surprise there was an excellent short ballet performance and the discovery of the existence on the Adriatic Coast of a Ballet School with young pupils from many countries throughout the world, including a girl born in Juhu, Bambay. With the creation of the Iron Curtain, Yugoslavia has apparently taken the place of Russia as the training ground of international ballet.

On the morning of Sunday the 5th July, on the stone jetty of Rijeka, and again at the railway station of that town, there ended a group of international technical discussions of which the IEC Headquaters and the Yugoslavia Electrotechnical Committee have every reason to be intensely proud. From those meetings must have emerged much that will be of material gain to the electrical industries and systems of the world. Of equal, if not of greater importance, were the many friendships that were created and the mutual goodwill and understanding which were thus born.

TRAIN SPEED RECORDERS

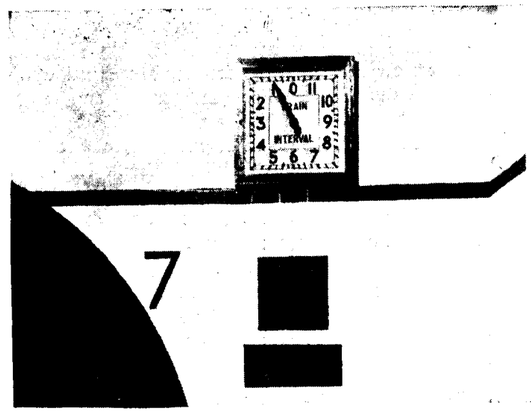
By H. C. Towers, M.I.E.E., M.I.R.S.E., M. Inst. T.

THE evolution of transport has shown the desire for ever increasing speed. Both in fiction and fable, speed has always been the goal. One of Jules Verne's famous novels describes a journey round the world which took eighty days while in fairy tales, we find the seven league boot and the magic carpet. In the early days of railways, legislation compelled the railway administration to provide a man with a red flag who had to walk in front of every train. In the present era, where speeds up to 100 M. P. H. are not uncommon, safety precautions of a more advanced nature are necessary!

Modern signalling provides maximum protection and coupled with automatic train control ensures that drivers respond to signal indications. Accidents fortunately few, do happen and some of these are caused by drivers taking turn-outs at too high a speed resulting in derailment. In order to keep a check on train speeds tests are necessary and these vary with the degree of accuracy desired and the number and regularity of them.

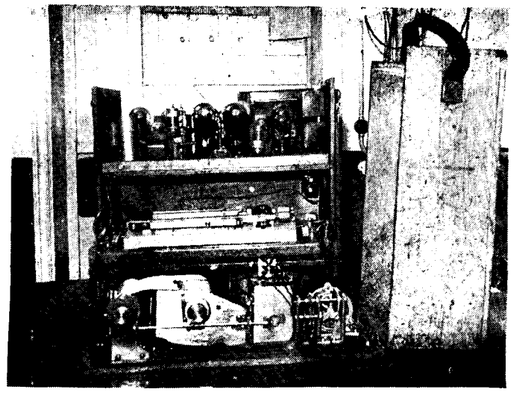
In the absence of measuring instruments, the usual method is by means of stop watch. In checking speeds of trains over turn-outs two posts can be erected at each end of the turn-out preferably to the nearest round figure in yards e. g. one hundred or one hundred and fifty yards. Two observers are necessary, one at each post. The observer farthest from the approaching train has the stop watch. When the engine front buffers are level with the first post, the observer signals to his partner who starts the watch. When the buffers arrive at the second post the watch is stopped. The speed of the train can then be worked out by calculation or read straight off from a previously prepared graph. These tests are naturally not very accurate as they depend upon the person making the observation. They have, however, a more serious disadvantage. If a test is to be taken, it should certainly cover a period of not less than 24 hours and it is not usual for any person making such tests to remain for this period. If a test lasting for 24 hours is not taken all the trains running per day will not be recorded with the result that not only will the record be incomplete but only a portion of the drivers at fault will receive censure.

The usual recording devices used on railways for registering speeds of trains are dependent for their action on the operation of a track circuit which makes a mark on recording paper driven by a clock. One type of instrument consists of a pendulum clock rotating a drum on which is secured the recording paper. The ink pen is driven at right angles to the direction of rotation of the drum with the result that it records continuous lines around the periphery. The section over which the speed restriction is to be checked is provided with a track circuit (if one does not already exist). The shunting operation of the track circuit relay energises an electro-magnet on the recording clock which causes the screw operating the ink pen to be slightly deflected to the right. When the train has left the track circuit the magnet is de-energised so that the ink pen returns to the normal position. The time taken by the train to traverse the track circuit is therefore measured by the length of the deflected line. The graph paper is printed in divisions recording hours and minutes.



Train interval clock used at platform starting signals by London Transport Executive. The clock shows that one minute has elapsed since the starting signal changed to "Proceed".

While this apparatus may be regarded as being suitable to indicate roughly the speed of any train passing over the restricted area, it will be seen that it is possible for errors to occur. Where more accuracy is desired, it is necessary to eliminate such discrepancies. The operation of the instrument is dependent upon the occupation and clearing of a track circuit. The line recorded on the graph paper is therefore deflected as soon as the front wheel of the



Speed recorder used by London Transport Executive.

train passes on to the track circuit and it remains deflected until the last wheel has left.

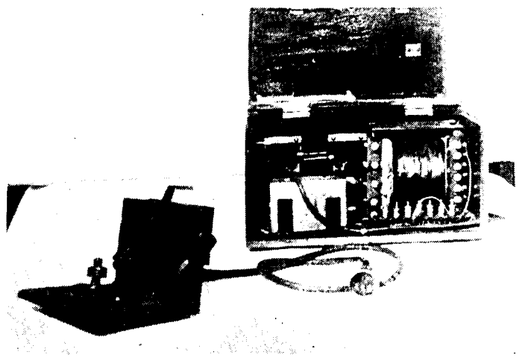
The principle of calculation is the time taken by a train to pass through the track circuit as measured by the length of the deflected line (in seconds) and the length of the track circuit, which is a constant. It will be seen that although the length of the track circuit is constant it becomes variable owing to different lengths of trains. It therefore follows that although two trains travelling at the same speed pass over the track, due to a wide difference in their length it will appear from the records that they were actually travelling at different speeds. As another example, it is possible for a train to enter a test length of track at a high speed and then slow down in order that the recording line will not show the train as having passed through the restricted area in less time than actually allowed. As these devices are usually installed where speed restrictions have to be observed, due to engineering requirements, an example of this nature would remain undetected and at the same time might possibly cause dangerous stresses on the track or bridge where the restriction is required to be observed.

Another method is by checking the passage of trains over track circuits again using the stop watch and observing the indications on the signal cabin illuminated diagram. For example, track circuit 49T may have two turn-outs and the length of the track is 600 ft. The stop watch is started when the track section on the diagram shows occupancy and stopped when the next track is occupied. The time taken by the train to travel over the track circuit 49T is therefore obtained but if it is accelerating or slowing down it will be the average speed only.

This method of checking the speed of trains over restricted areas was used by the then London Underground Railways for many years until in 1925 experiments were initiated in building a speed recorder which would check the speed of every train and not just a few. The objective was the automatic recording on a continuous roll of graph paper the passage of every train throughout the day, the speed of trains being checked by the traffic department by a special celluloid scale. As the London Underground Railways operate an intensive service, the apparatus had to be extremely accurate otherwise incorrect train numbers and timings would be obtained and wrong drivers censured.

Various methods of driving the paper band were tried. Clockwork could not be considered on account of winding and small variations in speed. Finally it was decided to drive the paper by a small synchronous motor the current supply being arranged through tuning fork control to ensure extreme precision. The tuning fork, contact, etc. were housed in one case and the synchronous motor, gears, graph etc. in another. The hours and minutes of the day are printed along the edge of the paper at both sides and when the apparatus is started up, the paper is wound forward at a constant speed.

Two small mechanical treadles are clipped to the running rail at the location where the test is to be made. When the train arrives the depression of the first treadle energises an electro-magnet in the instrument which causes a small metal arm to be brought into gear and this travels across the paper at a constant speed. Every depression of the second treadle releases a high voltage spark which jumps across the gap between the point on the arm and the brass plate over which the paper passes



Treadle and auxiliary apparatus used for London Transport speed recorder.

causing a small hole to be made. When the pointer attains the end of its travel, it automatically resumes its original position while the passage of the train is recorded by a series of dots, one dot for each wheel.

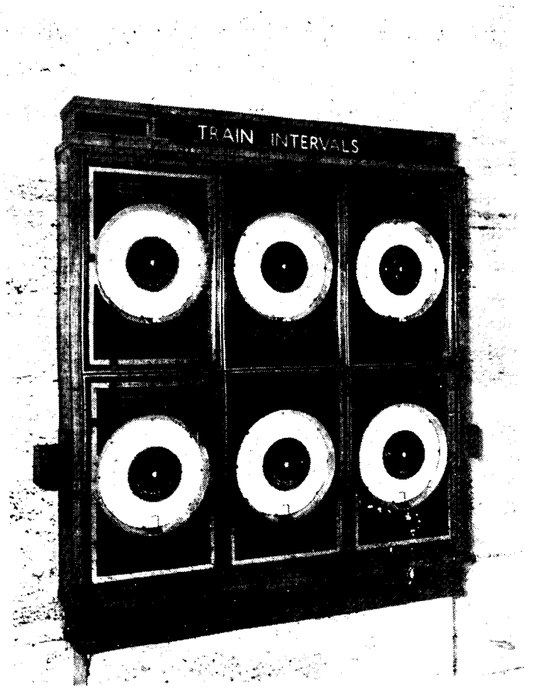
Readings are simplified by the fact that the wheelbase of all the Underground stock is constant and only one scale is required for reading off the speeds. The greater the speed of the train, the closer the wheel dots and vice versa.

Should the speed of the train be so low that the arm cuts out before recording all the wheels the speed can still be read by the wheel marks already recorded. At the end of the day the graph is removed and dispatched to the Traffic Superintendent's office while the apparatus is installed at another location. Energy is obtained from a small portable battery which energises the coils vibrating the tuning fork, drives the synchronous motor and energises the high tension coil producing the spark. The apparatus was tested by the National Physical Laboratory and reported to be extremely accurate. This type of recorder, although now of improved design, is still used by the railways of London Transport.

Another type of speed recorder designed by this organisation is an instrument to give drivers an idea of the speed of their trains. This is always difficult to judge in tunnel sections. The apparatus, so far as the driver is concerned, is a small screen fixed to the side of the tunnel. After the train had run over a section of pre-determined length the actual speed of the train is displayed in white figures on the screen.

The recorder consists of a cast iron case bolted to the tunnel wall with a lens enabling the figures to be focussed on to the screen. Inside the box is a circular wheel capable of rotation with numbers cut in the edge. On a train entering the test section an electro-magnet is energised causing a brake on the wheel to be released which starts to rotate due to the action of the weight and cord. On the train leaving the test section, the brake comes into operation again and at the same time a small electric bulb projects a beam through the number where the wheel has stopped, through the lens and on to the screen. On the driver's cab passing the screen the lamp is extinguished and the wheel rotated to the start position.

At certain locations in the Underground tunnels there are sharp curves approached by steep down grades. It is necessary to ensure that motormen obey the speed restrictions of these places and this is done by means of speed control signals. These signals are placed at the



Train interval recording clocks worked from various stations on the London Transport Railways.

approach to the curves and are normally at danger. The track circuit approaching the signals is used to time the speed of the trains through a time element relay. If a train approaching too fast the signals do not clear, the automatic train stop working is conjunction with the signal "trips" the train and it is stopped before the curve is reached.

The importence of train speed recorders is brought out by the fact that British Railways appointed a committee under the chairmanship of Mr. W. M. Bond of the London Midland Region to consider the various instruments available and to enquire into the possibility of obtaining an improved design. This has brought about the design of a new recorder by Everett Edgcumbe & Co. Ltd., of Hendon. The principle of this recorder is the generation of an electric current directly proportional to speed and comprises a rotary potentiometer driven by a synchronous motor enerigised from a

(Continued on page 20)

TWO NOTABLE RAILWAY OIL ENGINES

The Paxman four-strokes covering a range of 160 to 2,000 h. p. for railcars and locomotives

IN the earliest days of diesel traction use had to be made of oil engines built primarily for other purposes. First, heavy slow-speed engines designed for submarine service were installed. Their power was high for those days—1,000 to 1,200 b. h. p.—but their bulk and weight also were high, so that not many loading gauges could pass them, and they required a heavy axle load or a multiplicity of wheels.

Then an approach was made from the other end of the scale, and engines based on aviation practice were tried. They were lightweight and high speed. Thus they were small enough to go inside a railcar as well as in a locomotive, but with the standards of design and construction then possible the maintenance costs tended to be high, which offset to a large extent the improvement in vehicle design which such engines made practicable.

Once the transmission question was settled—and it was a big question that needed ten years to provide the two or three right answers—concentrated attention could be given to the design and production of engines specially designed for railway traction. Beginning on a small scale, one of the most notable of the early types was a 200 h. p. engine with all-welded steel frame evolved by Davey, Paxman & Co. Ltd., for shunting locomotive installations. The first of this type, built in 1934, is still at work in Britain in a 30-ton six-wheel diesel-mechanical shunter.

However, the very considerable advantages of railcars and multicar diesel trains led the Paxman company to concentrate on engines of higher speed, higher power and lighter weight, and with frames of cast iron or even aluminium alloy if the lightest weight were required for advanced railcar designs. A V-type of engine with 12 or 16 cylinders was adopted, along with a standard cylinder size of 7 in. dia. by $7\frac{3}{4}$ in. stroke. As long ago as 1938, the company was able to build 16-cylinder 1,000 b. h. p. engines running at 1,500 to 1,750 r. p. m. and weighing only 9 lb. per h. p. in cast iron and 6 lb. per h. p. with aluminium-alloy framing.

The enormous experience gained during the war with Paxman engines of this general type in naval and military installations showed that for railway work it might be preferable to have an engine not so highly rated, which would not need the highest skill and close attention in its maintenance, and which would be able to give 20 to 22 hr. a day service in main line and branch line locomotives and railcars, or 24 hr. a day service for two weeks on end in shunting locomotives; and yet which would do all these things on a variety of fuel oils and with only average skill available

(Continued from page 19)

vibrator. The instrument is controlled by track switches situated on the measured length of track over which the test is to be made and may be spaced 75 to 200 yards apart. The actual record is marked on a paper band with an evenly devided scale.

In connection with speed, the London Transport Executive carries out a very efficient and systematic system of brake testing. These trials have the double object of testing the brake equipment under emergency conditions and also determining whether the brake rigging and maintenance is of the required standard. Once a week a train is taken out of service from one of the lines for the making of the test which is conducted on a stretch of specially equipped line $1\frac{1}{2}$ miles long. It includes a stop signal, with train stop equipment and beyond this signal posts are erected at 10 ft. intervals marking the distance from the stop signal up to 550 ft. Before the test trip pressure gauges and speedometers are checked. In the test the stop signal is maintained at danger and the train is driven "at the signal" at full speed. Due to the train stop arm being at danger, it engages the trip cock on the leading motor truck and allows all the air to escape from the main train line pipe (Westinghouse air brake system) thereby effecting a full brake application. The time between the operation of the trip gear and the stop is carefully noted together with the distance from the signal, measured by means of the distance posts.

The test is repeated ten times in each direction; during these operations the tyres gradually heat and as they do so the stopping distance is reduced until after a temperature rise of 50 degrees F. the distance between signal and stopping place may have come down from an initial 500 ft. to 360 ft. or so. At the conclusion of the test the braking efficiency is calculated from data available.

in driving and maintenance personnel. To that end the experience gained with the thousands of Paxman engines in the most intense and arduous war-time operation under almost incredible conditions was collated, and the war-time V engine redesigned in its details specially for railway work, becoming the RPH-1 type, built particularly in its 12-cylinder and 16-cylinder forms, giving a power range of 500 to 833 b. h. p. according to whether a pressure-charger was fitted or not.

Rehabilitation and turn-over from war-time production was an urgent matter at first, and the minimum number of changes in design were made in the first engines. These showed themselves capable of working 7,000 to 8,000 hr. a year in steelworks shunting locomotives, and in medium-power line-service locomotives and trains, under the most diverse conditions such as the heat and humidity of Ceylon and the East, the snow of Norway, and equatorial sand and heat in Peru.

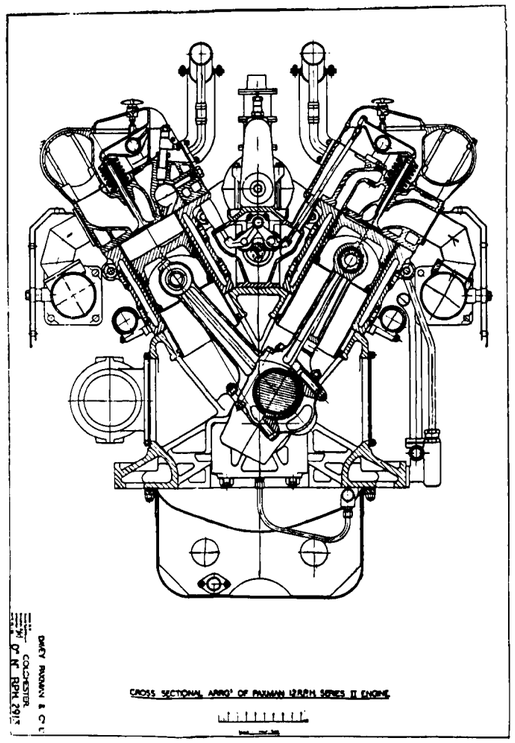
But in the desire to get an engine which could be offered honestly to railways as in the top flight of real rail traction diesels, requiring only the minimum of simple maintenance, and of a medium weight and speed suited both to railcars and locomotives, close observation was kept on the RPH-I engines, and sundry modifications made, principally by increase in crankshaft diameter, the provision of an outer bearing to suit the engine for coupling direct to a single-bearing main generator, and the substitution of chain-drive for gear-drive to the camshaft.

Moreover, the range of engines was increased and now comprises nine models from 167 to 833 b. h. p. as listed in the accompanying Table I. Two features are at once apparent. The first is that all the models are of the V type. This, with the four-, six-, and eight-cylinder engines gives a very short and stiff crankshaft and frame structure. The second is that the engines being of only

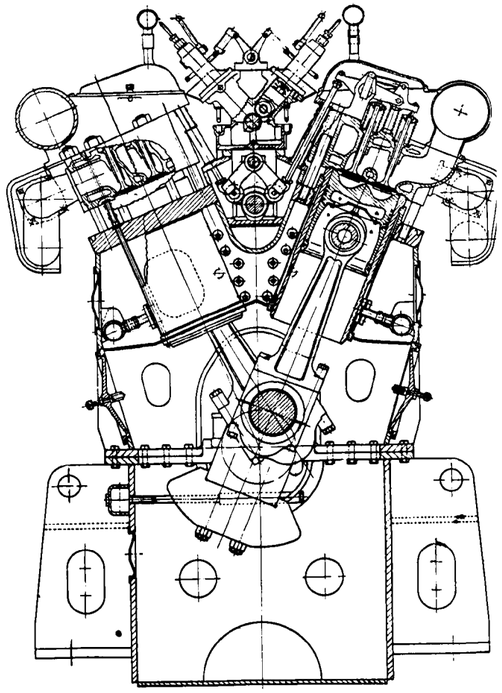
One of ten 80-ton shunting and freight transfer locomotives, New South Wales Railways, each with two Paxman 12 RPH–II engines.

medium weight and bulk, it is quite practicable to instal two of them in an ordinary main-line locomotive; and so, with exactly the same pistons, rings, cylinder heads, main and big-end bearings, valves and other wearing parts it is possible for a railway to cover all of its requirements from a 150/170 b. h. p. shunter or railcar up to a 1,660 b. h. p. main-line locomotive, a degree of standardisation of immense benefit to maintenance and repair staffs, as well as in the invested cost of spares.

This is the type of engine now being installed in the 20 locomotives of 605 b. h. p. for the new Kandla-Deesa link of the Western Railways, India, and which is used in locomotives of 500 to 1,000 b. h. p. in Ceylon, New South Wales, Western Australia, Tasmania, Mauritius, Great Britain, Norway and Peru; and which is even now just being introduced into Bolivia for service entirely at 10,000 to 13,000 ft. above sea level.



Cross section through Paxman RPH–II engine giving 42 b. h. p. per cylinder at 1,250 r. p. m., or 52 b. h. p. per cylinder when pressure-charged.



CROSS SECTIONAL ARRANGEMENT OF YL-XL ENGINE

Cross Section of the Paxman YL engine giving 89 b. h. p. per $9\frac{3}{4}$ in. by 10 in. cylinder, or 125 b. h. p. per cylinder when pressure-charged.

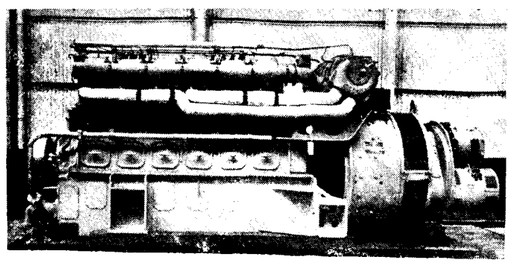
Right through from the pre-war years the 7 in. by $7\frac{3}{4}$ in. cylinder heads and Ricardo combustion chambers have been retained. These cylinders are set in banks with an angle of 60 deg. between, with cylinders exactly opposite one another, fork-and-blade connecting rod construction being favoured. Cylinder liners are of the dry type, of cast iron hardened and tempered. The cylinder castings themselves are in blocks, but the cast iron crankcase below is a single casting for the whole engine. This last-named piece is notable for the trouble taken to get extreme lateral rigidity at crankshaft center-line level, thus promoting quietness and also good bearing and crankshaft performance. Further, the underslung main bearing caps are let into the main crankcase casting and so lateral

thrusts are not taken up merely by studs in shear. This, again, helps to provide bearing stiffness and maintain the original manufacturing standards of centre lines and clearances.

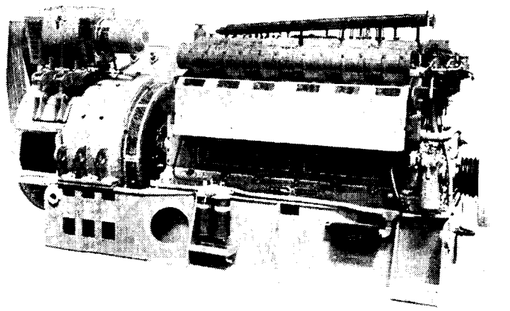
Two valves per cylinder are fitted. These valves are operated by conventional mechanism from a single camshaft located in the neck of the V. The camshaft has plain pressure-lubricated bearings and cam followers; and this pressure lubrication is extended also to the rocker gear enclosed in light alloy casings above the cylinder heads. From the camshaft a gear drive goes to the two C.A.V. fuel injection pumps housed in the V.

The crankshaft is not hollow-bored through either pins or journals; but its journal diameter is over 70 per cent that of the cylinder bore. It is carried in main bearings comprising steel shells lined with copper-lead. The same bearing type is used for the big ends, in which a block attached to the fork ends rides on the pin with a copper-lead internal bearing surface, and over the chromium-plated external surface of this block for the looseshell copper-lead bearing of the blade rod. Main and big-and bearings are lead plated to ease running-in conditions. There is nothing unusual about the aluminium-alloy pistons which carry three pressure and two scraper rings. Pistons and connecting rods are withdrawn through the large steel plate inspection doors in the sides of the crankcase.

At the front end of the engine is carried the centrifugal hydraulic serve governor, using the engine lubricating oil pressure as a medium to operate the fuel injection pump control. Pressure lubrication is along normal methods, making use of two engine-driven gear-type pumps, one for engine circulation and the other for cooler circulation. The type and arrangement of cooling



Paxman 12YLX engine with welded steel crankcase and framing, coupled to a main generator having two auxiliary generators, Engine output 1,500 b. h. p. at 1,000 r. p. m.



A 500 BHP Paxman 12 RPH engine driving a B.T.H. generator all mounted on a fabricated steel under base.

Two of these units were each fitted in locomotives recently delivered to the New South Wales Government Railways.

equipment for the oil depends upon the particular locomotive installation, but a Vokes cloth filter in the pressure-feed circuit and an Auto-Klean strainer in the oil-cooling lines are considered as standard equipment.

Other ancillaries also depend upon the exact locomotive or railcar installation in regard to their grouping or drive, but from the illustrations presented with this article will be seen the neat incorporation of the air intake manifolds with the cylinder head castings, and the arrangement of the exhaust manifolds below them in a separate insulated casing, both of these being modifications made in recent deliveries.

Not content with this range, the Paxman company felt that the general trend towards larger and larger main-line locomotives should be met with designs incorporating the great fruits of their experience during the war and later in the most varied kinds of railway work. To that end the company introduced in 1951 what is known as the YL range, intended specifically to cover the high-power end of railway requirements, and which forms the British answer to American highly-rated engines. Here, again, only V types are used, but to get the high power needed without over-loading the engine the cylinder size adopted is $9\frac{3}{4}$ in. by $10\frac{1}{2}$ in. Five models are made at the moment, the eight-and 12-cylinder models being built with or without pressure-chargers, and the biggest 16-cylinder engine only with a pressure-charger. Leading data of these engines are :—

Model	8YL	8YLX	12YL	12YLX	16YLX
Railway top h. p.	710	1,000	1,070	1,500	2,000
R. P. M.	1,000	1,000	1,000	1,000	1,000
Weight lb. per h. p.	$29\frac{1}{2}$	22	$23\frac{1}{2}$	$18\frac{3}{4}$	$17\frac{1}{2}$

Thus the medium-weight medium-speed principle has been retained, and the range is the only British-built railway one to retain these features, which have valuable weigth-reducing qualities in the transmission also, compared with the low-speed 750/850 r. p. m. designs, which reflects in locomotive design.

In bringing these engines up to the 2,000 b. h. p. mark some notable features have been introduced, and yet ones which have already been well tried out in diesel practice generally. The cylinder banks are set at an angle of 45 deg. The engine framework is of welded steel plate, and the lower part of it carries the main bearings which are secured by top caps. Main and big-end bearings are steel-backed copper-lead shells, lead-plated for quick and easy running in. Fork-and blade connecting rods are used, but the big-end joints are serrated to give maximm strength and precision. The crankshaft is of alloy steel with a bearing between each crank throw and two nearings at each end; and at the front end is a viscous vibration damper.

A four-valve cylinder head is fitted, and contrasted with the RPH-II engines, it incorporates direct injection of the fuel through a central nozzle. Another new feature is the use of centrifugally cast high grade cast iron liners surrounded by individual water jackets of galvanised steel. Aluminium-alloy pistons are used. Duplex chains drive the camshaft, which is located in the neck of the V, and a gear drive goes thence to the fuel pump camshafts above.

TABLE I
PAXMAN RPH-II ENGINES

Model	Max. Railway Setting B.H.P.	Corres-ponding R.P.M.	Corres-ponding B.M.P., lb. per sq. inch.	Corres-ponding piston speed,ft. per min.	Dry Weight lb.
4 RPH-II	167	1,250	$88\frac{1}{2}$	1,610	4,800
6 RPH-II	250	1,250	$88\frac{1}{2}$	1,610	5,975
8 RPH-II	333	1,250	$88\frac{1}{2}$	1,610	6,800
12 RPH-II	500	1,250	$88\frac{1}{2}$	1,610	9,000
4 RPHX-II	208	1,250	111	1,610	5,050
6 RPHX-II	313	1,250	111	1,610	6,350
8 RPHX-II	416	1,250	111	1,610	7,190
12 RPHX-II	625	1,250	111	1,610	10,400
16 RPHX-II	833	1,250	111	1,610	12,950

Non-Destructive Methods of Testing Metals and Alloys

By Dr. G. P. Chatterjee† and K. C. Som‡

INTRODUCTION

METAL and alloys are the most important engineering materials of construction. For the sake of safety as well as satisfactory service different testing methods are adopted to check the properties of metals and alloys before these are put to use. Many of these tests, like the tensile or the Izod test, are destructive in the sense that the piece is either distorted and or broken and can no longer be used. Destructive tests have of ten to be and in many cases must be employed for the sake of getting some specific informations. But for obvious reasons these tests cannot be employed for all the finished materials. Nor can they supply any information about the material during the process of manufacture or while it is in actual service. Sometimes the quantities involved run into millions and yet the failure of a single item may be disastrous. In many cases it is necessary to salvage standard and useful portion from a heap of substandard and useless materials and destructive tests in such cases may not be helpful. Apart from saving wastage of materials, time and labour in the preparation of specimens, many of the non-destructive methods of testing of ten supply informations which cannot otherwise be obtained. Minute cracks, defective joints and welds, inclussions of sand, slag and other substances or deep seated blowholes, effects of abnormal hot or cold work, maldistribution of stress and strains either due to defective material or wrong design, bad surface finish, uneven thickness of deposited materials, non-homogeneity of materials and a host of other informations may be obtained by one or other of non-destructive testing. An attempt has been made in this article to describe briefly some of the useful non-destructive methods of testing which may be employed with advantage.

DIFFERENT TYPES OF NON-DESTRUCTIVE TESTING

An outline of the different types of non-destructive testing methods is shown in Fig. 1. It is beyond the scope of this article to describe all these methods. Brief descriptions of the following important and useful methods are given in this article :—

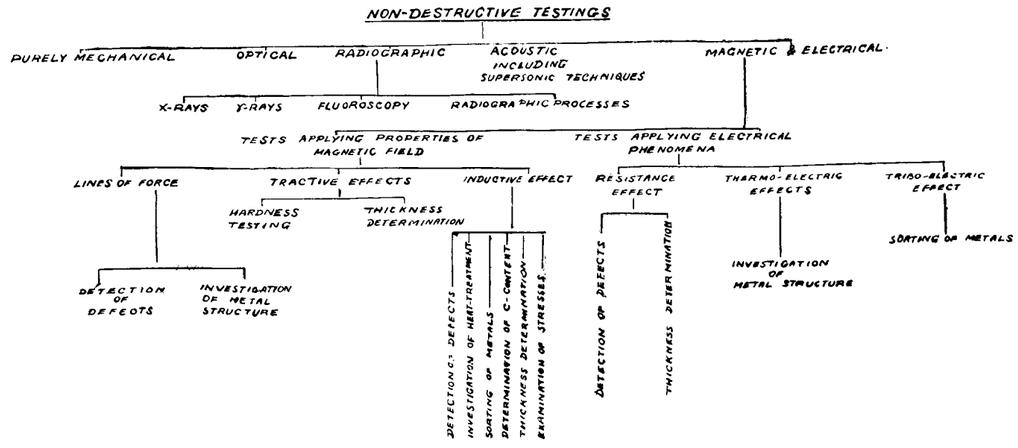


FIG. 1 AN OUTLINE OF THE DIFFERENT TYPES OF NON-DESTRUCTIVE TESTING METHODS.

1. Liquid Penetration Method
2. Stress-sensitive Varnish Method
3. Magnaflux or Ferrographic Method

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4. Electromagnetic Method
5. Strain Gauge Method
6. Potential Drop Method
7. Accoustic Method
8. Supersonic Method
9. Radiographic (X-rays & r-rays) Method
10. Autoradiographic Method.

LIQUID PENETRATION METHOD

In this method the part to be tested is soaked with a suitable penetrant either by spraying or immersing. The excess liquid is removed by washing or wiping the surface. The subsequent seepage of the penetrant locates the cracks. The Chalk test is commonly practised in most of the machine shops. Recently the so-called "Black light" or the Fluorescent method of crack detection have been devised to inspect the inside of tubes, borings and springs. The piece to be tested is cleaned thoroughly and then immersed in a liquid which contains a small amount of some soluble, strongly fluorescent compound such as anthracene. After thorough immersion the job is taken out of the solution, rinsed with water and dried. It is afterwards subjected to ultraviolet light which causes fluorescence of any penetrant remaining in the cracks upon the general background of the metal. Shrinkage, grinding or fatigue cracks and porosity open to the surface may be easily detected by this method.

The Chromate Anodizing method which is used for the detection of cracks in many aluminium alloys is based on the penetration technique. The advantage of this method is that it may be applied to both magnetic and non-magnetic materials.

STRESS SENSITIVE VARNISH METHOD

The distribution and intensity of local strains can be detected by using a brittle coating of some stress-sensitive varnishes. The surface of the piece freed from loose scale, dirt, rust grease and moisture, is covered with a smooth and thin coating of the varnish (about 0.0003" to 0.0008" thick) and dried. In like manner a standard calibration strip is also prepared. The test piece and the standard calibration strip are loaded, to the same stress intensity. From a comparison of the cracked patterns of the two the intensity of stress can be easily calculated, the standard piece having already been calibrated.

MAGNAFLUX OR FERROGRAPHIC METHOD

This is now in extensive use particularly in detecting cracks, non-magnetic inclusions and folds at or the near the surface in castings, fogings, and welds in many rail-road components. In practice, the sizes of the flaws which are to be detected depend on their ability to produce an external field sufficiently strong enough to hold the particles against normal disturbing forces. It is adjusted experimentally to produce optimum sensitivity for the test of a particular shape of specimen.

The part to be tested is immersed in oil in which iron filings are in suspension. The collection of the magnetic particles in the region of cracks easily determine the location of cracks or flaws as shown in the Fig. 2.

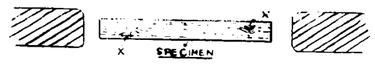

FIG. 2 ARRANGEMENT OF MAGNETIC FLUX IN A SPECIMEN HAVING CRACK AND NON-MAGNETIC INCLUSIONS (X)

The fine particles of magnetic materials are attracted and this forms a dark mark. The parts are sometimes subjected to subsequent passing through a demagnetising coil in the case of residual magnetism. The sensitivity of this test depends on various factors : viz. the size and orientation of the flaw with respect to the direction of the magnetic field, the field strength, the permeability, the size and shape of the particles and the viscosity of the medium in which these are suspended.

Different methods may be adopted to produce Magnetic flux as illustrated in fig. 3. Some of these methods are indicated below :—

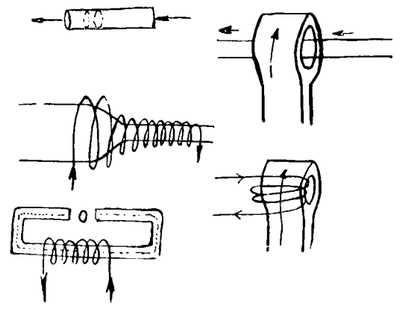

FIG. 3. DIFFERENT METHODS ADOPTED TO PRODUCE MAGNETIC FLUX

(i) a heavy current passing through the length of the specimen produces a circuital magnetic flux which is perpendicular to longitudinal cracks,

(ii) in the case of hollow test pieces a circumferential field may be produced by (a) passing current through a bar, (b) through a number of turns of cable linked with the test piece,

(iii) by passing current through a cable wound round the test piece, cracks may be very easily detected,

(iv) by placing the test piece between the poles of an electromagnet.

Current required to produce Magnetic flux may be A.C. or D.C. but the flux generated with A.C. penetrates less deeply below the surface. Therefore D. C. excitation is more convenient for the detection of subsurface defects.

Since 1930 most of the more important locomotive parts are examined by magnetic particle testing in railways workshops. Fatigue cracks and presence of transverse flaws in locomotive slide rods, vax valve motion components, crankpins etc. can be easily detected by magnetisation method using a current of about 500 amps. at 6 volts and dry powder. Longitudinal flaws in crankshafts, crankpins and axles are tested under heavy current. Those days the so-called fluorescent magnetic ink is extensively used for the inspection of axles.

As fatigue cracks frequently occur in threads and studs, bolts etc. are tested by circular magnetising flux. Fluorescent magnetic particles are being increasingly used in U. S. A. For the examination of gudgeon pins the magnetising current and magnetic fluid spray over the slowly rotating specimen are utilized in an automatic machine.

On many occasions "Spalling" on Railway wheel tyres on case-hardened parts is due to the elastic and plastic shear stress waves set up in advance of the contact surface between the matting materials. If the design is not satisfactory fairly large flakes may even come out of the surface. Great differences in magnetic saturation will locate the region of high internal stresses which lead to subsequent cracking. After tread machining and sand blasting of the wheel, a complete inspection of all its surfaces with special attention to the tread, flange, the plate and the hub is done. Pedrick tested the tread surface by using a rectangular coil of 100 turns fed from 110 volts A. C. wound on a wooden former and placing the same over a segment of about $\frac{1}{3}$ of the wheel. Magnetic ink or powder can be sprayed on the projected portion of the wheel through the coil.

The importance of inspecting rails by electro-magnetic methods may well be judged from the figures for the track examined in the U. S. A. and Canada between 1928 and 1940 as indicated below :—

Total length of track examined	..	5,97,000 miles
Number of defective Rails found	..	3,04,000
Number of rails containing serious fissures	..	1,10,000

The metal in the rail head (being severely overheated by the friction of a braked wheel) become the major target of rail fissures which are usually tested by the Sperry Rail Testing Apparatus, Schematic lay out of the Sperry Rail Testing Apparatus is shown in fig. 4.

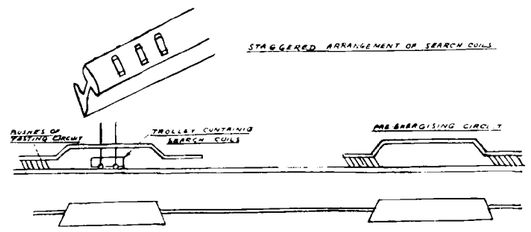

FIG. 4 ARRANGEMENT OF CURRENT BUSHES AND SEARCH COIL

This testing equipment records all sorts of discontinueties much like a current carrying bar causes a distortion of the surrounding magnetic field. A searching unit consisting of many small coils and being differentially wound with their axes at right angles to the rail can easily scan the heavy direct current passing through the rail. Defects in the rail indicate changed e. m. f. in the search coil system. These are recorded by pen on paper and by painted spots on the defective portion of the rail by a suitable device. This recording device during inspection is usually possible to operate when the cars move at above 7 m. p. h. This type of testing is suitable when the normal reduction of sound cross-sectional area exceeds 5%. For lesser reduction in cross-section the search coils used by the former apparatus are replaced by a special form of diode valve device. By this means the sensitivity of the apparatus is of the order 0.2% and it is independent of the speed with which it moves over the rail.

ELECTROMAGNETIC METHOD

This method essentially consists of an outside Power source and two sets of secondary coil circuits (see fig. 5). The first set called the "Flaw detection" circuit consists of two secondary coils C_1 and C_2 which are set to balance each other. Any variation in magnetic properties of the material due to a defect throws these coils out of balance and the resulting impulse is fed into the indicator through suitable filters and amplifiers. In the second set called the "Grade Detection" circuit the magnetic properties of a standard bar are balanced against the outside power source. By this circuit materials of irregular analysis, mixed grades and even mixed structure may be sorted out. Even the differences between pearlitic and spheroidised structures may be detected.

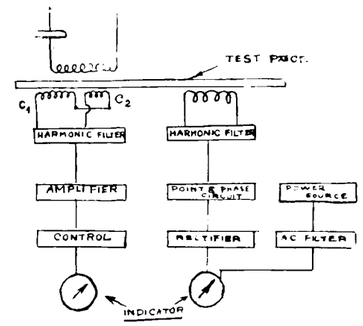

FIG. 5 LINE DIAGRAM OF THE ELECTRO MAGNETIC ANALYSIS METHOD

The Carbometer for the determination of carbon is Steel based more or less on this principle is also extensively used.

STRAIN GAUGE METHOD

The method is based on cementing a fine grid of wire to the surface of the piece so that the wire experiences the same elongation as the surface. The deformation of the wire by the straining or vibration of the piece causes a change in resistance in the wire which is measured by some convenient out-of-balance circuit and feeding the impulse to an oscilloscope or some indicator through amplifying systems. In a static system a simple Bridge-circuit with a dummy gauge is used to measure the strain. Informations about fatigue creep, vibration Damping capacity, residual stresses, distribution and analysis of stresses on loaded structures may be obtained by this method. Instruments based on Straingauge methods have been very useful to the Test Engineer.

POTENTIAL DROP METHOD

A fixed potential difference is always available between two points at a fixed distance apart of any metal of uniform cross-section carrying electric current A.C. or D.C. The p.d. across the two points will be increased by the presence of a crack or defect. A. C. gives considerable enhanced sensitivity for surface cracks and D. C. gives good results in detecting the presence of deep-seated defects. A large number of similar castings which are manufactured under very close dimensional tolerances and close composition control may with advantage be subjected to this type of testing.

ACCOUSTIC METHOD

One of the oldest forms of non-destructive testings for the detection of cracks and other defects was based

on the natural frequencies of sound emitted on striking an object. Although these frequencies are dependent many variables like the elastic properties, size, shape, mass of the object and the type of vibration induced, two bodies having identical dimensions & material should have identical sound emitted on striking. Any abnormality in the sound indicates differences in the nature of the material and or dimensional factors. Thus the objects are tested in comparison with accepted standards.

To excite vibrations by impact is not so satisfactory due to variations in the nature of the impact itself. The electro magnetic methods for magnetic materials and the induced current methods for non-magnetic metals of good conductivity are more convenient to excite vibrations.

Inspite of some of the advantages of sound waves in detecting metal-soundness, it has been found that sometimes serious internal defects may not produce discordant notes. The different components of a complicated shape vibrating at different frequencies may often mask the effects of serious internal defects. On the otherhand slight dimensional variations may cause more discordant notes than internal defects. To avoid these difficulties supersonic waves are used those days in the detection of internal flaws.

SUPERSONIC METHOD

Supersonic waves have frequencies greater than 16000 cycles sec-the upper limit of perception by the human ear. Like light these waves tend to travel in divergent beams and have different velocities in different media. For example the velocity of sound in air is about 3.3×10^4 cm/sec compared to 44×10^3 cm/sec in brass, 58×10^3 cm/sec in steel and 62×10^4 cm/sec in aluminium. Thus the wave length of a million cycle/sec supersonic wave in steel will be about 0.58 cm. Supersonic wave like sound waves are transmitted more easily with increase in density and the so-called stiffness in the path. When these waves strike an air-gap within a metallic specimen, a large part is reflected and thus very little sound energy is transmitted through the gap. A quartz piece crystal is used to send and receive a signal of supersonic waves of 2 to 5 millon cycles/sec intermittently i. e. the crystal sends out a signal—say for a millionth second—and then waits to receive the waves which on striking the opposite surface of a sound steel or crack in an unsound steel are reflected back. The returning waves oscillate the crystal producing electrical impulses which are fed into an Oscilloscope. Irregularities in the sepecimen are thus easily detected by the nature of the vibrations in the oscilloscope. This method is being applied in the continent and U. S. A. for testing railroad axles and other materials.

RADIOGRAPHY (X-RAYS AND R-RAYS)

The high penetrating power of X-rays and R-rays are extensively used in the inspection of the internal flaws of metals. Photographs of inclusions, flaws, cracks blowholes etc. can be taken and defective materials easily rejected. For high production X-Ray inspection work, the parts can be passed between X-ray tube and a Fluorscope on a conveyer. Accurate control of thickness of strips in very fast strip mills has been effected by X-rays. Mobile X-ray units are extensively useful in detecting flaws in heavy structures at site. The R-rays emitted by radio-active isotopes like Co etc. are also being used for detecting flaws in heavy structures. This simple method which does not involve much initial cost may well be taken advantage of for testing railway parts.

AUTORADIOGRAPHIC OR TRACER TECHNIQUE

The location of an insoluble constituent in an alloy viz. Radio-active tungsten has been used to locate the tungsten in a nickel-chromium-tungsten alloy by its action on a photographic plate. It is similar to chemical prints and electrographs with a considerable increase in sensitivity. In the near future the utility of radio-active isotopes to non-destructive testings will be found in addition to their uses as sources of R-radiation for radiography.

CONCLUSION

In conclusion it may be stated again that while destructive tests are useful for specific informations and standardisation, some of the non-destructive methods of testing are equally indispensible not only for routine checking and inspection of materials but for the development of new alloy steels and other alloys with reference to elements available in this country. Wastage of time, labour and materials which may run into lakhs of rupees may be saved by the use of some important non-destructive testing methods. Some of these methods are already in use in industries and testing laboratories in this country. And there is no doubt that along with the national planning and with the growth of industries many more of such tests will be used for development, research and control purposes.

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DIESEL ELECTRIC LOCOMOTIVES

Technical details of the 25-1000 H. P. Diesel Electric Locomotives at present in use on the Ceylon Government Railway

GENERAL DESCRIPTION

THE locomotive is of the type designated AIA—AIA, the superstructure being mounted on two bogies, each bogie having three axles of which the two outer axles are motored whilst the centre axle is for carrying purposes only.

The locomotive superstructure has a driving cab at each end mounted behind a short, streamlined, nose end compartment. The power unit with its auxiliary equipment and control gear is mounted in the main body of the locomotive. A partition separates the engine from the generator and control equipment, and unobstructed walk-ways are provided on both sides of the power unit.

Both driving cabs are fitted with a driver's position and controls on the left-hand side of the cab with an assistant driver's position on the right-hand side of the cab. All instruments essential to the driver are mounted on a panel in front of the driver and his assistant. Unobstructed vision for both men is provided by large driving windows, fitted with pneumatically operated windscreen wipers. A powerful headlamp is fitted into the nose at each end of the locomotive.

Immediately behind No. 1 cab is the main radiator ducting carrying the radiator fan motor and runner. Air is drawn through the radiator panels, which are mounted vertically on either side of the locomotive, and after passing through the twin branches of the ducting is ejected upwards through a grille in the roof.

Access to the main body of the locomotive is provided by doors in the cab bulkheads. At No. 1 end, the centre walk-way through the radiator ducting branches on either side of the diesel engine; the generous loading gauge of the Ceylon Railways allowing sufficient space

between engine and locomotive sides for the withdrawal of the engine pistons and connecting rods from the sides of the crankcase.

Doors are provided in the partition separating the engine and generator compartments and the walk-ways continue on either side of the main and auxiliary generators, exhausters, compressor and control equipment cubicle. Doors in No. 2 cab bulkhead give access into No. 2 driving cab.

The nose end compartments in front of each driving cab contain a traction motor blower, electrically driven, which supplies filtered air to the two traction motors in the bogie beneath. Access to the nose compartment is by removable panels inside the cab and by hinged louvre panels on the outside of the locomotive nose.

All auxiliaries are electrically driven with the exception of the engine cooling water circulating pump, which is belt driven from the free end of the crankshaft, and the engine lubricating oil pumps, which are gear driven from the crankshaft. Power for the auxiliary machines is taken from the auxiliary generator, which is mounted on an extension of the main generator shaft.

The main fuel tank and batteries are slung beneath the locomotive between the bogies. A separate fuel service tank is mounted in the roof of the locomotive.

Due to the bad weather conditions encountered in Ceylon, which include tropical rain and heavily corrosive salt atmosphere, special care has been taken to make all ventilating and air inlet louvres water-proof and anti-corrosive materials have been used throughout the construction of the locomotive.

DIESEL ENGINE

The locomotive is powered by a Mirrlees, Bickerton and Day, Vee-type 12 cylinder, turbo-charged four-stroke oil engine; with a rating of 1,254 B. H. P. at 850 r. p. m. under normal temperature and altitude conditions.

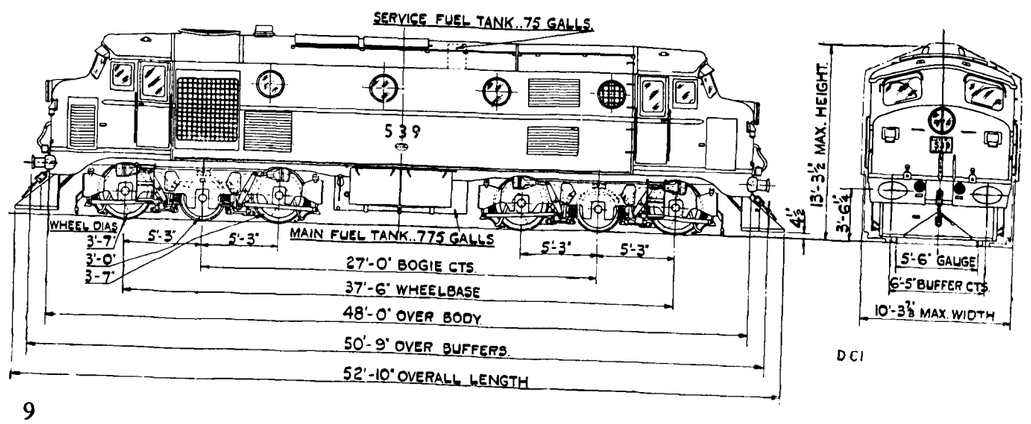
Under site conditions in Ceylon, the engine develops 1,000 H. P. at 850 r. p. m.

The bedplate is of welded construction, and carries the crankshaft bearings. The cylinder housing and upper part of the crankcase are also of fabricated construction and the complete crankcase assembly is solidly bolted to the bedplate. The cylinders themselves are of the "wet" type.

The crankshaft is of solid forged steel and is supported by main bearings of steel, white metal lined. The pistons are of light alloy fitted with compression and scraper rings. The piston pins are of the floating type. The connecting rods are of steel "H" section and carry marine type large end bearings consisting of steel-backed white metal shells.

The twin camshafts are mounted in the cylinder housing and are driven by spur gears from the flywheel end of the crankshaft. They are located on the outer

1,000 H.P. DIESEL-ELECTRIC LOCOMOTIVE
FOR
THE CEYLON GOVERNMENT RAILWAYS



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sides of the two banks of cylinders, and operate the valve and fuel pumps through roller ended push rods and tappets.

The engine is force-lubricated from gear type lubricating oil pumps, and a shutdown device is incorporated which automatically stops the engine when the oil pressure falls below a certain point, or when the engine speed exceeds a certain limit.

The engine cooling water is circulated by a water pump, belt-driven from the forward end of the crankshaft.

The engine and generator, which are bolted together to form a single unit, are mounted on three pedestals carrying Silentbloc bushes, thus eliminating any possible distortion of the locomotive underframe being transmitted to the diesel engine.

ENGINE AUXILIARIES

The engine is started by motoring the main generator from starting batteries slung beneath the underframe. Starting connections cannot be made until sufficient oil pressure has been built up in the diesel engine by an electrically driven priming pump.

Fuel oil is delivered to the engine fuel rail under pressure by an electrically driven fuel transfer pump. In the event of failure of this pump, fuel is supplied from a service tank under gravity feed. A semi-rotary fuel transfer pump is provided for filling the service tank from the main fuel tank.

Suitable radiators are supplied for the diesel engine oil and water cooling circuits.

The radiator fan which draws air through the radiators and expels it through the roof, is driven by an electric motor fed from the auxiliary generator.

ELECTRICAL EQUIPMENT

The main generator is directly coupled to the diesel engine and provides power to the four traction motors, which are axle hung on the outer axles of the two bogies. The motors may be connected in series-parallel, full-parallel, or arranged so that an initial connection in series-parallel is re-grouped automatically to full-parallel.

Control of the locomotive is effected by varying the excitation of the main generator and the speed of the diesel engine. Current for the field excitation of the main generator, auxiliary machines, battery charging and operation of the control equipment is supplied from the auxiliary generator which is overhung from the main generator.

The main control cubicle is mounted in the generator compartment and is provided with doors giving full access to all equipment mounted in the cubicle. The cubicle is dust-proof, and special care has been given to the design of the control equipment to make it suitable for the arduous conditions of railway working.

The locomotives are arranged for multiple unit operation by which means two locomotives are coupled electrically as well as mechanically and operated together by a driver in the leading locomotive.

A single handle on the Master Controller enables the driver to select Engine Starting, Forward and Reverse positions and all running notches.

Lead acid batteries of 192 ampere-hour capacity are provided for starting the main power unit and for supplying the necessary auxiliary power when the diesel engine is not running.

The driving axles are fitted with tubes for the axle suspension of the traction motors, the nose of each traction motor being suspended by a flexible link from the centre transom.

The traction motors are fitted with roller bearings for both the armature and suspension bearings. The drive from the motors to the axles is taken through single reduction gearing; a pinion on the armature shaft meshing with a resilient gear wheel on the road axle.

BRAKE EQUIPMENT

The locomotive is fitted with twin Westinghouse reciprocating exhausters, electrically driven, to provide vacuum for the train brakes. The locomotive itself is braked by compressed air brakes, four brake cylinders being fitted to each bogie and operating clasp brakes on all wheels. A Westinghouse compressor provides compressed air for the locomotive brakes, and also for the control and other auxiliary equipment.

The driver's brake, controls consist of a vacuum brake valve which operates the train brakes and automatically operates the locomotive brakes through a proportional valve. This valve ensures that the locomotive air braking is applied in direct proportion to the vacuum braking on the train. A separate brake valve is supplied which gives independent braking on the locomotive when required.

A hand brake for the locomotive is also provided in each driving cab.

CONSTRUCTIONAL DETAILS

Underframe

The underframe is constructed of four main rolled steel "I" sections, which are reduced in depth over the bogies by means of flame cutting and welding along the neutral axis, in order to provide clearance for the bogies between underframe and rail head.

The two outer main members terminate at the bogie centre cross members, to which they are welded, but the inner main longitudinals continue and are welded integral with the fabricated drag box.

Cross members, which are riveted to the main longitudinals at various points along the underframe, carry channel section sole-bars and an unbroken deck of steel plate covers the underframe skeleton.

SUPERSTRUCTURE

The superstructure is constructed in sections compris ing the two cab ends, two sides, and three roof sections.

All the superstructure is constructed of 14 gauge stee sheet welded to frameworks of angle and top hat section

Entrance doors to the locomotive are provided on eacl side of both driving cabs. Top hatches in the roo section permit easy access to the cylinder heads of th diesel engine, and the roof itself is easily removable fo major overhauls or complete removal of the power unit

Port-hole type windows are provided in the sides o the engine and generator compartments, and full dro windows are provided in the cab doors and sid windows.

BOGIES

The bogies are constructed from box type side frame of welded construction joined by a heavy fabricated stee

centre transom, and by two channel members as headstocks.

The weight of the locomotive is carried on the centre bolsters of the bogies. Each bolster rests on eight nests of coil springs carried on two spring planks, one on each side of the centre carrier axle of each bogie. The spring planks in turn are suspended by swing links from the bogie side frames.

The leaf springs for the axles are carried internally in the hollow side frames, suitable openings being provided for inspection and withdrawal, whilst the coil springs are situated below the bogie frames.

Roller bearing axle boxes are fitted in manganese steel horn guides, which are replaceable.

Electro-pneumatic sanding gear, operated from a foot pedal in the driving cabs, is provided for the outer axles of each bogie.

PRINCIPAL DATA

LOCOMOTIVE DETAILS

Locomotive Weight	..	87 tons
Track Gauge	..	5′ 6″
Maximum Height	..	13′ 3½″
Maximum Width	..	10′ 3⅞″
Length over Buffers	..	50′ 9″
Bogie Wheel Base	..	10′ 6″
Bogie Centres	..	27′ 0″
Minimum Curve Negotiable		5 chains
Clearance from Gearcase to Rail Head	..	4½″
Capacity of Fuel Tank—main		775 gallons
—service	..	75 gallons
Wheel diameter—motored	..	3′ 7″
—carrier	..	3′ 0″

LOCOMOTIVE PERFORMANCE

Maximum speed	..	55 m.p.h.
Starting Tractive Effort (26% Adhesion)	..	33,700 lbs.
Tractive Effort (1 hour rating)	..	30,000 lbs. at 9.2 m.p.h.
Tractive Effort (continuous)		24,600 lbs. at 11.7 m.p.h.
Estimated Range with Full Fuel Tanks	..	750 miles

DIESEL ENGINE DETAILS

Maker	..	Mirrlees, Bickerton & Day
Type	..	JS12VT
Output at Sea level and normal temperature and Humidity conditions	..	1,254 H.P. at 850 r.p.m.
Developed continuous Power at Site	..	1,000 H.P. at 850 r.p.m.
Bore	..	9¾″
Stroke	..	10½″
Number of Cylinders	..	12
Superchargers	..	Two, Napier type TS200/1
Exhaust Temperature (Cylinder outlet full load)		750°F./850°F.
Lubricating oil pressure	..	30 lbs./sq. inch

ELECTRICAL EQUIPMENT DETAILS

Main Generator	..	Brush Electrical Engineering Co. Ltd.
Continuous Rating	..	850 r.p.m. 652 kW. 630V. 1,035A. 850 r.p.m. 652 kW. 750V. 870A.
Anxiliary Generator	..	Brush Electrical Engineering Co. Ltd.
Continuous Rating	..	850 r.p.m. 35 kW., 110V. 318A.
Traction Motors	..	Brush Electrical Engineering Co. Ltd.
Number per Locomotive	..	4
Continuous Rating	..	196 H.P. 315V. 517.5A
1 Hour Rating	..	226 H.P. 315V. 610A.
Gear Ratio	..	82 : 16
Radiator Fan Motor	..	Brush Electrical Engineering Co. Ltd.
Continuous Rating	..	110V. 3.1 H.P./12.6 H.P. 32/115A. 600/960 r.p.m.
Traction Motor Blower Motors	..	Brush Electrical Engineering Co. Ltd.
Continuous Rating	..	110V. 5 H.P. 1980 r.p.m.
Exhauster Motors	..	Brush Electrical Engineering Co. Ltd.
Continuous Rating	..	110V. 3/6.05 H.P. 29/55A. 600/1,115 r.p.m.
Compressor Motor	..	Westinghouse Brake & Signal Co. Ltd.

AUXILIARY EQUIPMENT DETAILS

Compressor	..	Westinghouse Brake & Signal Co. Ltd.
Working Pressure	..	85/100 lbs./sq. inch

(Continued on page 38)

A New Model Dining Car Fitted with Radiogram

A dining car built in the Carriage & Wagon Works, Lower Parel, Bombay has just been issued to the Traffic Department for use on the Frontier Mail.

This dining car is a complete departure from the old cars and incorporates many new and novel ideas, on pains having been spared to ensure a comfortable and pleasant journey for the passengers. It has been built to the new 10′-8″ profile and is much wider than the older cars thus giving more room to the passengers and servers.

The exterior panel plates have been completely welded by a new process developed in the works. With this method, it has been possible to reduce the incidents of corrosion by 90% besides giving a smooth flush exterior.

Latest Type of Dining Car built in the Carriage & Wagon Works, Lower Parel, Bombay.

(Continued from page 36)

Exhausters	..	Westinghouse Brake & Signal Co. Ltd.	Capacity	..	192 amp.-hours @ 5-hour rate
Type	..	4-cylinder reciprocating (4V110)	Traction Motor Blower	..	Sturtevant
Normal speed	..	600 r.p.m.	Output	..	2,940 cu. ft. per min. 2,170 r.p.m.
"Release" speed	..	1,115 r.p.m.	Radiators	..	Serck Radiators Limited
Batteries	..	D. P. Battery Co. Ltd.	Axle Box Bearings	..	The Skefko Ball Bearing Co. Ltd.
Number of Cells	..	48			

Contrary to the conventional practice the windows of this Coach are built to open upwards and the glass window is equipped with a self-balancing arrangement.

The entrance to the dining compartment has been completely re-designed to give maximum facilities and comfort to the passengers whilst entraining and detraining. The provision of an embarkation light over the entrance door further facilitates safety of passengers using the car at night.

The flooring of the dining compartment is laid with thick interlaced cork slabs to match the interior decoration and give a soft cushioning effect whilst working.

The eight tables provided have glass tops with a Vynide base and rounded corner to prevent injury to passengers from sharp corners. Instead of the usual stereotype commercial table lamps provided in the older coaches a suspended bracket light is provided above the window level so as to give a soft illumination of the table surface. The shades of the bracket light are of frosted glass with attractive natural scenes tastefully painted on them. This bracketed light was exclusively designed and manufactured in the works.

The interior panelling of the dining compartment is of attractive blue Vynide pasted to masonite sheets and secured to the pillars covered by dust-proof polished mouldings. The interior end panels of the Coach are artistically decorated with four handpainted murals of historical places in the country. These murals have been painted by workers in the works.

The ceiling is of usual type with sunken lights to blend with the soft melodious music which will be provided by a Radio.

The exterior colours of the Coach is Azure Blue, the windows being painted aluminium outside and polished inside to match the interior of the coach.

It is the ambition of the Western Railway Administration and Parel Works in particular to produce coaches of better design affording maximum comforts for the patrons of the Railway. Watch for the next issue early in January, 1954.

The Western Railway authorities deserve richly all congratulations for having provided these amenities to the travelling public.

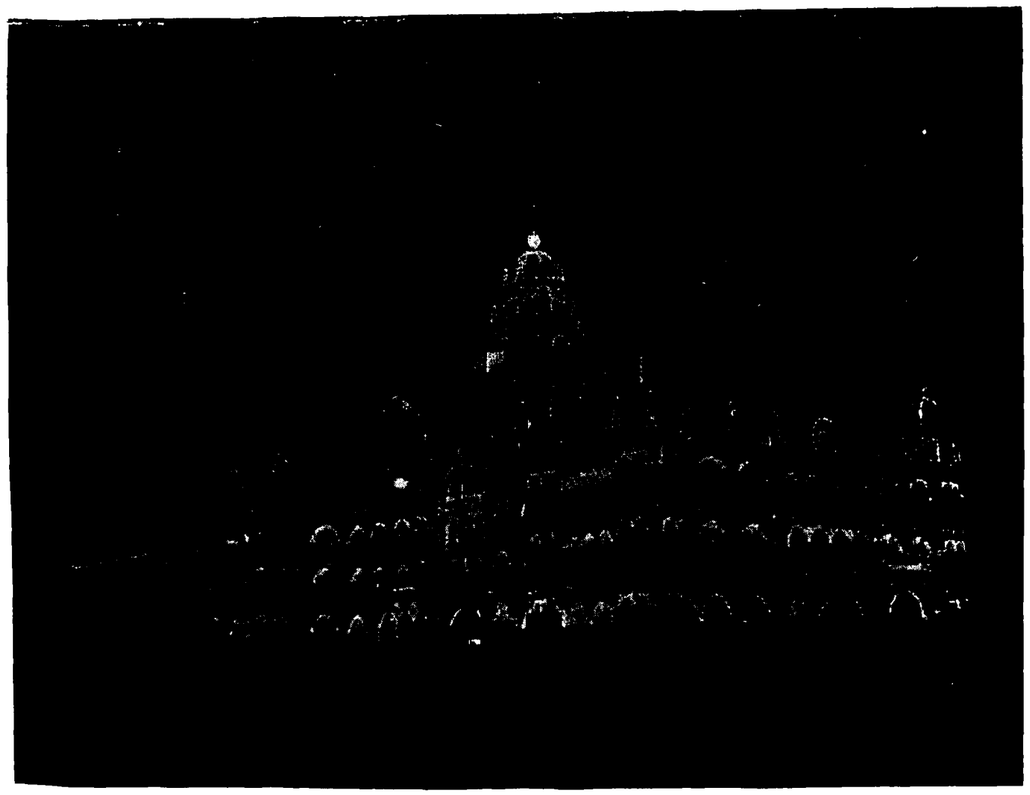
West Bengal Legislators Visit Chittaranjan Loco. Works

SPONSORED by the Development Department of the West Bengal Government, a study tour of the Chittaranjan Locomotive Works, Damodar Valley sites and other development projects in West Bengal was recently uedertaken by about 80 State Legislators led by the West Bengal Minister for Irrigation, Shri A. K. Mukherjee accompanied by about 20 Pressmen and Photographers.

Shri Lal Bahadur Shastri, Union Minister for Transport and Railways in a message extended a hearty welcome to the West Bengal Legislators to the Chittaranjan Locomotive Works, whom he said had undertaken such a study tour in a group for the first time and characterised it as a remarkable achievement.

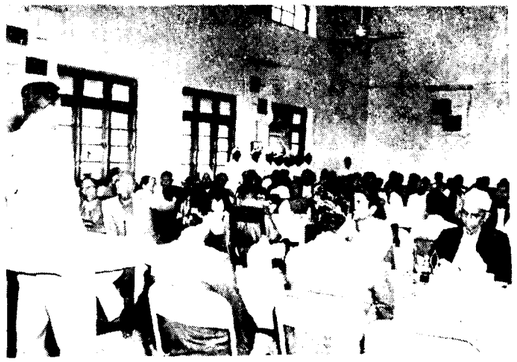
Welcoming the group of Legislators the General Manager Shri P. C. Mukherjee of the Chittaranjan Locomotive Works who took them round the various sections of the huge plants, traced the early history of the agitation for the manufacture of Locomotives in India in various stages upto the actual establishment of this giant factory thus realising the dreams of millions of Indians.

Speaking of the production highlights of the Chittaranjan Locomotive Works Shri P. C. Mukherjee said that in August 1951, the first Locomotive with 50% of its components manufactured here left the workshops. In 1952, 30 Locomotives were turned out in the Works including two with all their components manufactured

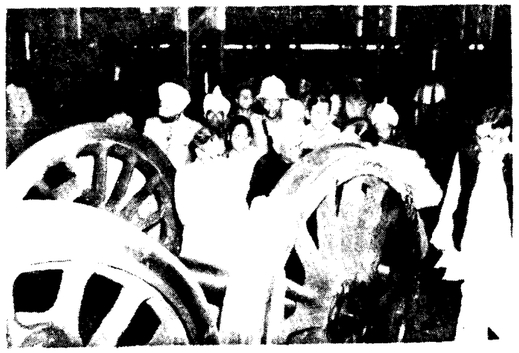


Headquarters Office of the Western Railway illuminated on Republic Day.

Sri Ajoy Kumar Mukherjee, West Bengal Irrigation & Waterworks Minister, and some visiting Legislators enjoying a joy ride in one of the newly built Locomotives at Chittaranjan Locomotive Works.



General Manager of Chittaranjan Locomotive Sri P. C. Mukherjee welcoming the visitors at the Technical School auditorium.



Inside the wheel-shop at Chittaranjan.
(Photographs By courtesy of Calcutta Railways.)

A stage in the manufacture at Chittaranjan Locomotive Works.

in the Shops at Chittaranjan. For 1953 the target of production was 52 Locomotives and there is every reason to believe he averred that this would be well-maintained.

The Legislators were taken round all the sites of the Township including primary Schools, Mihijam Hill, Administrative Offices, Basanti Institute, Sewage Disposal Plant, Kasturba Gandhi Hospital and Staff Quarters.

Shri Ajoy Kumar Mukherjee, West Bengal Irrigation Minister praised the efforts of Shri P. C. Mukherjee General Manager of the Chittaranjan Locomotive Works in successfully running the huge national enterprise, the first of the kind and added "It is a wonder to me how a magnificent edifice could be raised in this desolate land and how the General Manager and the humblest of workers here worked to give shape to this edifice. They all richly deserve our respects and gratitude".

The Minister was all praise for the excellent Sanitary arrangements made at Chittaranjan Locomotive Works and said it was a glowing a tribute to the men in charge of this enterprise that this big township was free from epidemics.

Paint Protection and Railways Capital Equipment

By G. H. Gates-Reed, M. I. A. M. A.

IT is hoped that India's two Locomotive Works, Chittaranjan and Telco, will between them be turning out more than 200 complete engines from 1956 onwards—that is about two-thirds of requirements. Regarding wagons, about 7,400 were manufactured during 1952/53 in the four old-established wagon workshops in Bengal—the objective by 1956 is at least 12,000 annually. Passenger coach output is increasing annually; when Perambur comes into operation the indigenous capacity for building complete passenger coaches will then exceed 1,500. Hindusthan are also developing their capacity.

The object of this rather lengthy pre-amble quoting possibly familiar figures is to emphasise the important part the indigenous paint industry must to play in supporting this programme—for locomotives, wagons and passenger coaches, like almost every other manufactured article, require paint protection and decoration. In fact, they need very special attention. Additionally, there is of course, the constant repaint and overhaul programme which if implement must make huge demands, (250,000 wagons alone should be in this regular repaint programme) as well as the paint protection and decoration of railway stations and other buildings, signal boxes, signals, bridges, cranes, etc.—at present generally speaking sadly in need of immediate attention. The extent and varied nature of the demands on the Paint Industry becomes immediately apparant.

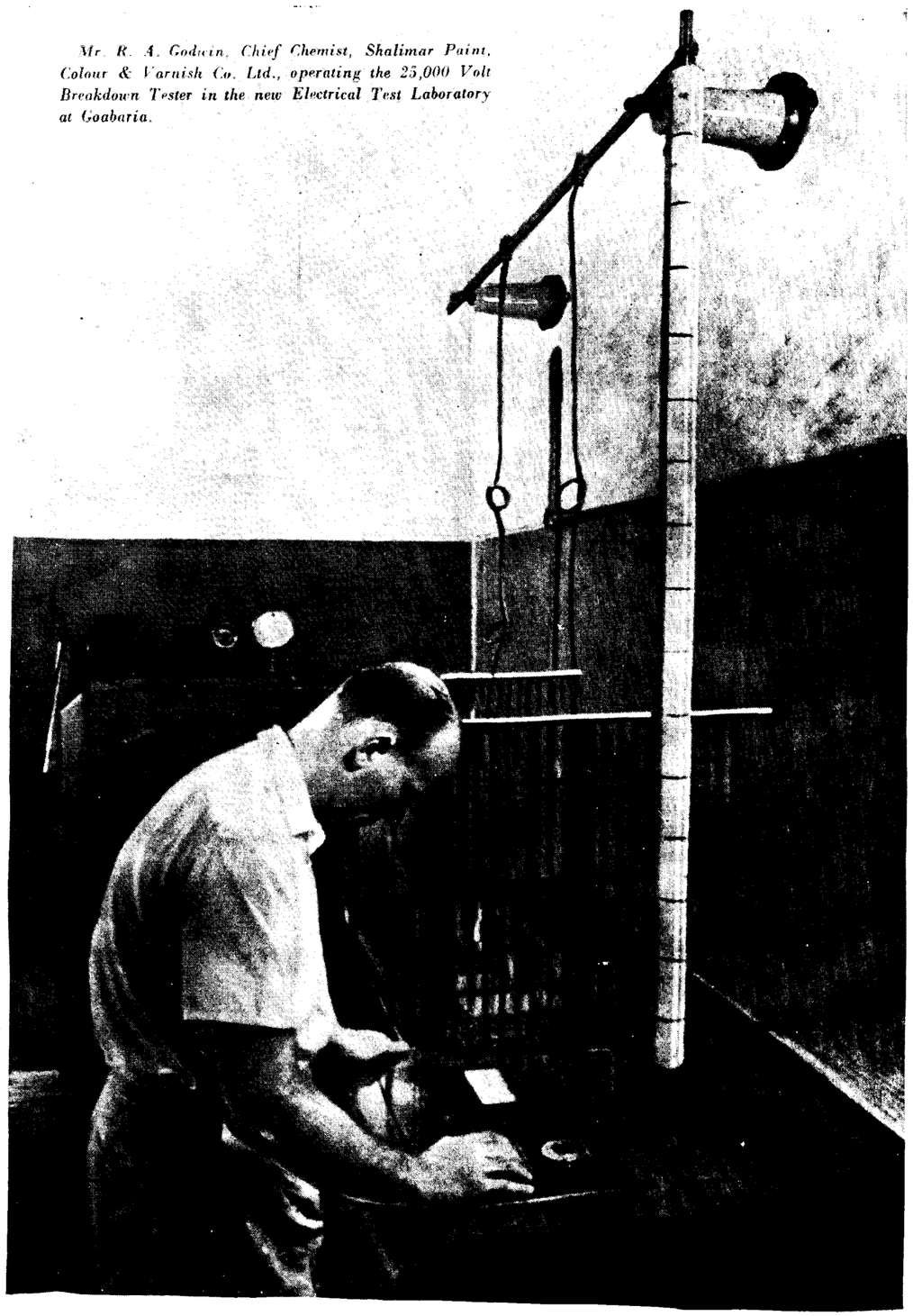
The Export Group of the Paint Industry of Great Britain estimate that on British Railways the "annual consumption of paints for the maintenance of the permanent way, including stations, amounts to nearly 20 tons per 1,000 miles". In other countries they estimate the figure to be around 10 tons per 1,000 miles. Applied to India, where there are approximately 34,000 miles of railway, this truly emphasises the need for a strong indigenous Paint Industry if one is to be independent of imported supplies, an actual and natural objective. It is as well therefore, that all in all, the Indian Paint Industry is well organised and during recent years has expanded and re-equipped itself to meet the demand for the most modern finishes in sufficient quantities. Synthetic resin based paints, cellulose finishes, insulating varnishes, and emulsion paints have all now been added to the industry's programme.

BREAKDOWN COSTS RUPEES

The painting of railway rolling stock and locomotives affords an outstanding example of paint being used as an indispensable protective agent. The useful life of such equipment can be directly related to the durability of the paint finishes used and to the regularity and standard of re-paint maintenance. "Paint and varnish films - - - skilfully applied may - - - remain in a state of usefulness about five to six years - - - although the appearance naturally deteriorates earlier, depending on the degree and extent of exposure". (Manfred Hess). Without this paint protection the effects, of corrosion of the varied and stringent climatic influences and of abrasion from dust, the chemical action of smoke and oil, in addition to rough usage, would soon bring about a general breakdown of the basic construction materials themselves. Top quality paint finishes are constantly required, therefore; as is expert supervision of application and maintenance. "The total losses caused by rusting throughout the world have been estimated at more than one million tons of iron every year—an estimated value of £500 million" (H. W. Rudd)—to which India, with difficult climate conditions, must be contributing a large share.

Apart from the coach paints, varnishes and bituminous paints used for the exterior of rolling stock, including special paints for the under-parts, there are many other special purpose paints required by the railways. These include those for general and interior decoration of rolling stock and of buildings, fabric enamels for upholstery, polishing paints to prevent dusting of cement floors, paints for steam jointings, light reflecting and heat resisting paints for the roofs of coaches and for petrol wagons, as well as locomotive paints specially formulated to withstand not only smoke and oil but also hot blast and sulphur fumes. There is a demand also for anti-sulphuric enamels for battery boxes. Varieties of insulating varnishes which "maintain efficient insulation between the conductors by sealing the fibrous covering and preventing the entry of moisture or oil, and in the case of rotating windings to cement the turns together to eliminate movement and prevent chafing, and finally to increase heat resistance" are also required and now supplied by the Indian Paint Industry. India's oldest established paint factory at Goaparia near the Shalimar Railway Marshalling yards, Howrah, has a fully equipped electrical test laboratory, with breakdown test equipment, etc. It is realised that if the insulating varnish fails the equipment on which it is used will also fail—standards of test are high.

The Railway paint technician is confronted with many special problems. For example there is the question of



Mr. R. A. Godwin, Chief Chemist, Shalimar Paint, Colour & Varnish Co. Ltd., operating the 25,000 Volt Breakdown Tester in the new Electrical Test Laboratory at Goabaria.

one sided exposure of say wagons always travelling so that one side is subjected to less favourable conditions in mountains or near a seaboard, or on the weather side". To be done well the job then, is a big and truly important one.

TEST STANDARDS

It is important to emphasise here that in all respects the manner in which paints are tested and tender standards arrived at must be treated with the utmost seriousness. The Paint Federation have been to great lengths to emphasise to all concerned that accelerated weathering tests, using the Weather-o-meter, upon which a great deal of reliance was once put, should not be used to produce a permanent standard for specification. The Weather-o-meter should only be used for checking the durability of bulk supplies in comparison with a tender sample originally approved after an outdoor exposure test. The final test of any finish must be usage under the conditions for which it has been prepared.

Some time back, after discussion with the Government Test House authorities and a meeting with the Director General of Supplies and Disposals it was agreed that in future paint maunfacturers may send the Test House samples of paints for exterior use for outdoor exposure tests and that reliance would be placed upon the results of these tests rather than on Weather-o-meter results. It was also made clear that in the opinion of the Federation even this concession did not refute the need for full scale trials on railway coaches operating in normal services. Whereas the exposure of panels to weather conditions in Calcutta is a testing stage better than simply relying on the use of stimulated conditions, it is still obvious that "the effects of atmospheric conditions, friction and abrasion, fumes, handling and cleaning can really only be tested over time"—and in day-to-day action.

For instance, it was found with the "Weather-o-meter" test that synthetic based paints which had weathered exposure tests well discoloured under the simulated conditions of the meter whereas the reverse happened with ordinary paints. Testing practice has been laid down in that bible of the railway paintshop the Fancutt Report just as is the proven procedure for the application during construction and maintenance of synthetic based and nitro-cellulose finishes. There have indeed been considerable advances since 1938 (when the report was issued) in paint formulations but the need for thorough and correct application methods must still hold good as it always must. However, as it is true also that there have been radical changes in

rolling stock design since 1938 with particular reference to the use of stressed skin structures and of aluminium coaches or parts of coaches and that these innovations must reflect not only on production methods and the application of paints, as well as detailed procedure in repaint and repair shops it might now be time to re-consider and revise the report and the procedure to be recommended. As an example some time back the Paint Federation indicated that with the modern synthetics they are producing the Primer recommended in the Fancutt report was not necessarily the answer. They suggested the composition should be left to the discretion of the supplier, but that it should consist of not less than 25% Zinc Chrome. That is of course a point of detail. However, it does indicate the possible need to revise the survey.

The growth in the meantime of the influence and work of the Indian Standards Institution (formed 1947) is of the utmost importance. The I. S. D. specifications which have been drawn up are invaluable to all concerned. One might even say that they are on the side of being too elaborate particularly with reference to the tests they include. However, that is a fault on the right side.

RETURN TO WISDOM

To a great extent this article has generalised for regarding paint usage on India's railways, broadly speaking, it is at persent more a matter of policy and control that is at fault (and that requires airing) rather than one of lack of knowledge or ability in the paint and repair shops. The Railway Engineer in India will surely agree that at present a great deal of paint "rehabilitation" requires to be done with particular reference to railway buildings—stations, stores, signal boxes—as well as equipment generally. (Incidentally, this is equally true of British Railways, although there a start has been made: Euston and King's Cross Stations, etc.). It is true that the war years took their toll and that just when the problems of repair and replenishment were being faced up to the set-back of Partition occurred but at least where policy is concerned, there can never be any excuse for the use of cheap paints (cheap in price because of their inferior quality) or buying on price alone as was current at one stage. Although the purchase of quality paints means that the paint finish will last years longer with a consequent reciprocal gap before a fresh order is placed, all reputable paint manufacturers will urge this point: quality pays. According to Manfred Hess, all else apart, "the use of cheap paints is not worth while because the costs of cleaning, labour, or in case of structural painting, also of scaffolding, are paramount. As an instance the Corrosion Committee of the British Iron and Steel Institute paid themselves one-eleventh for the paints whilst ten-elevenths were absorbed for the labour involved in cleaning and painting" - - - - and for the decorating of buildings "the labour alone is responsible for some 60 to 80 per cent of the cost of painting work" (this time the Ministry of Works, U. K., is quoted). To which must be added allowances for the replacement cost produced by the breakdown of basic materials through lack of adequate paint protection. Additionally, it should be realised that the use of high grade finishes actually provides substantial economies by enabling equipment to remain much longer in service before coming into shops for repainting. A matter of considerable importance.

The railway engine was invented and developed in the United Kingdom—paint manufacturers there must therefore have had considerable practical experience of meeting railways' demands for protective coatings. In a desire then to doubly emphasise the urgent importance, the eventual good economy of buying tested quality finishes may I quote at length the Export Group of the Paint Industry of Great Britain: "Economy in painting is achieved, not by the use of cheap materials but by using a paint which has a long life and gives the best protection against losses by corrosion. In a painting operation the cost of the paint itself is small compared with the cost of labour in applying it and the indirect cost caused by the suspension or withdrawal from operation of the object being painted. There is therefore a saving in cost by the use of a more expensive but more durable good quality paint in preference to a cheaper one of inferior quality. In the case of structures such as railway bridges★ it is the frequency of repainting and the effectiveness of the anti-corrosive qualities of the paint that determine the cost of maintenance. The wastage by corrosion already being incurred by transport undertakings as a result of orders for paint placed on the basis of the lowest tender, without adequate consideration of the economy which would ultimately result from the technical superiority of the more expensive products must be considerable".

(Continued on page 47)

★ *"One railroad repaints bridges, signal gantries on main lines every four and on branch lines every five years, probably because of the destructive effect of train smoke". R. H. Wampler, "Modern Organic Finishes".*

The Most Suitable Type of Signalling and Interlocking for Main Line Sections

By L. C. Mohindra, M. I. R. S. E. (Eng.), F. P. W. Inst. (Eng.), A. M. I. E. E. (London).
Assistant Chief Controller of Standardization, Central Standards Office for Railways, New Delhi.

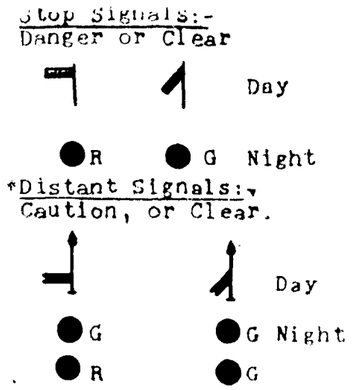
"In this article a novel method of providing Multiple Aspect Signalling, operated from two cabins—one at each end of a yard—is proposed for road side stations on Main Line Sections to meet the requirements of high speed traffic and the present trend of long loops on the Indian Railways, particularly at stations where there are level crossing gates near the facing points which could be operated by the Cabinmen to save Gatemen".

THE question of determining the most suitable type of signalling and interlocking for main line sections has been engaging the attention of Signal Engineers as well as Transportation Officers for many years past. The subject has been quite controversial i. e. whether the system should be two aspect or multiple aspect, single wire, double wire or power operated, worked from one central cabin or from a cabin at each end of the yard. The whole thing has been studied in some detail and the observations, conclusions arrived at and the recommendations made are as follows:—

Relative merits of two aspect and multiple aspect signalling: (i) *Drivers' point of view:* (a) *Aspects and indications:*

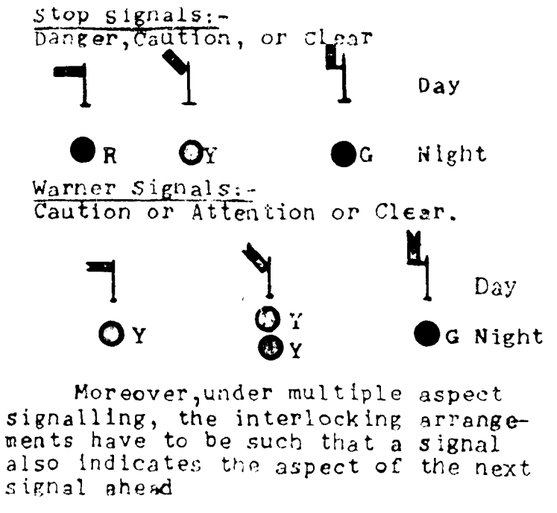
Two Aspect Signalling

A signal displays either of the following two aspects:-



Multiple Aspect Signalling

A signal ordinarily displays any of the following three aspects:-



(Continued from page 46)

The fact that the paint industry itself is propagating this attitude implies that they are also formulating the paints to achieve the objective of maximum protection for a maximum effective life—and this can be said of the paint industry in India.

It is to be hoped therefore that those responsible for the development and operation of the new locomotive and carriage works, and for the expansion of the existing one's will have been indoctrinated with these truisms. It is not sufficient to be technically aux fais with correct application and maintenance procedure ("it is obvious that the life of the paint and varnish films can be considerably prolonged by regular attention to the coatings" German State Railways Chemical Testing Station) unless one is also convinced of the positive need to work to that knowledge without taking either financial or operational short cuts. Fancutt should not be forgotten: he was an authority.

* *According to the draft General Rules, the existing warner signals are to be replaced by 'Distant' Signals located in rear of first stop signal.*

From the above, it will be clear that multiple aspect signalling affords better indication of the state of the section and the drivers are in a better position to control their trains.

(b) Two Aspect Signalling and high speeds :

† According to the draft of new General Rules, Distant signals are to be provided at all Block posts where trains run through at speeds in excess of 30 m.p.h. and the distant signal is to be located quarter of a mile in rear of the first stop signal. To begin with, where the maximum permissible speeds are in excess of 60 m.p.h. on broad gauge and 45 m.p.h. on metre gauge, separate distants will have to be provided straight-away and similar work is to be done on other sections on a programme basis.

The above change in signalling would be quite suitable when a distant signal is 'OFF' for running a train through a station yard, but when the Distant signal is in the 'ON' position, the driver has got to get prepared to stop at the first Stop signal. This is so because the distance between the Distant signal

† *Extract of the Draft General Rules, para D. 95 is as below :—*

D. 95. *Two Aspect Signals—Provision of—*

X X X X X

(c) On double and single lines. A distant signal is provided at all block posts, where trains run through at speeds in excess of 30 m.p.h. The Distant signal is placed at minimum braking distance in rear of the first stop signal.

A sighting board is provided half a mile in rear of the Distant Signal.

X X X X X

Note : X X X X X

(2) At stations where distant signals are required, the existing warner signal, if any, may remain on sections where the speeds are 60 m.p.h. or less on broad gauge and 45 m.p.h. or less on metre gauge until replaced by distant signals on a programme basis. On sections where the maximum permissible speeds are in excess of 60 m.p.h. on broad gauge and 45 m.p.h. on metre gauge a Distant Signal must be provided.

X X X X X

(e) The minimum braking distance referred to in D(c) above is normally 1/4 of a mile. This distance may be increased on account of local conditions such as gradients visibility etc.

* and the * first stop signal is not sufficient for a train to stop with normal application of brakes, when running at high speed with long load. The driver would, under the circumstances, have to slacken his speed as soon as he sights the Distant signal in the 'ON' position and it is not until the driver has sighted the stop signal ahead that he knows whether to stop at that signal or to proceed at the maximum permissible speed of the section. Thus a driver runs from signal to signal. This may be alright for medium speeds, but where trains run at high speed, it inevitably results in the driver not being able to maintain the same high speed throughout and loss of time.

Under multiple aspect signalling, on the other hand, from the very position of the warner signal the driver gets clear indication whether he has to stop outside the first stop signal ahead, or at the station on the main or on the loop line, and receives correct indication of speed. This enables the drivers to maintain the required speed, consistent with safety.

(ii) Traffic point of view :

Two Aspect Signalling

At 'B' class stations, which form a large majority of stations on the Indian Railways, the first stop signal is an outer signal, located as under :—

** *(a) Single Line*—**1920 ft. from the facing point.

Double Line— 1320 ft. „ „ „

* *This distance should rightly have been full braking distance, which is approximately 2,800 ft. for trains running at 60 to 65 m.p.h., but compromise has had to be made as locating the Distant signal so far away from the station would have created very great difficulties of operation, lighting etc.*

** *(a) This distance of 1920 ft. comprises of—*

1320 ft.—as adequate distance required under absolute block working for two aspect signalling, and
600 ft.—for shunting in the face of approaching trains or for permitting the taking "off" of the reception signals from one direction while permission to approach has been given for trains in the opposite direction.

Multiple Aspect Signalling.

At 'B' Class stations, the first stop signal need only be a home signal, located as under :—

Single line :

* (i) Where shunting in the face of approaching trains is permitted. — *(b) 1200 ft. from the facing points.

** (ii) Where shunting in the face of approaching trains is not permitted. — **(c) 1000 ft. from the opposing starter (about 700 ft. from the facing points).

Double Line : — 600 ft. from the facing points.

From the above, it would be observed that under multiple aspect signalling the first stop signal is located closer to the station than under two aspect signalling and this helps to move the traffic faster and reduces inconvenience to the operating staff as illustrated below :—

(i) When a train approaches a station and reception signals are in the 'ON' position, the train stops nearer the station.

(ii) In the event of approach signals being defective, a member of the traffic staff deputed to pilot the train has to walk over a shorter distance.

(iii) For the lighting and extinguishing of signal lamps, the distances to walk are shorter.

* *(b) This distance of 1200 ft. comprises of—*

600 ft.—as adequate distance required under absolute block working for multiple aspect signalling, and

600 ft.—for shunting in the face of an approaching train.

** *(c) This distance is actually 1000 ft. from the opposing starter where shunting in the face of approaching train is not required. The distance is worked out as under :—*

600 ft.—As adequate distance required in absolute block working for multiple aspect signalling, and

400 ft.—as overlap distance required to be clear beyond the relevant starter for taking off corresponding reception signal.

(iii) Trend of Signalling in other countries :

In all progressive countries multiple aspect signalling has been recognised as more or less essential for high speed traffic. In fact, on the American and the Continental Railways, signals capable of displaying four or even five aspects are in common use.

In conclusion, it may be stated that both from the driver and the traffic points of view, multiple aspect signalling is superior. To the driver it conveys better indications for more effective control of the trains and to the traffic it provides greater operating facilities.

3. Comparative operating efficiency of single wire double wire and power signalling installations :

(i) Single Wire Installation :

The operation of signals by single wire and points by rodding is the simplest and the cheapest method of working. Operation of points by rodding is quite suitable for points situated normally within a range of 1050 feet. The operation of signals by single wire is also suitable for signals upto half a mile. Where, however, the distance exceeds this limit or the run of wires is on a curve, the working of the signal becomes difficult, the signal is liable to droop and is not considered entirely dependable. This is so, as inherently in the single wire system, the wire is normally slack and no compensator is provided to take up the variations in its length due to changes of temperature, during day and night, winter and summer.

Single wire operation of signals has, therefore, its limitations.

(ii) Double Wire Installations :

Another method of working points as well as signals is by double wire system. In this also the working of points is considered quite as suitable as by rodding. The working of signals in this system is more reliable and almost eliminates drooping. This is achieved by the signal or points mechanism being operated by two wires laid in the fashion of an endless loop and the wires are normally kept tight by compensator weights. This automatic compensation takes up variations in the wire lengths due to changes of temperature, thus avoiding the need of wire adjustments being effected by the Transportation or the Signal Department staff. Moreover, the double wire lever has * a long stroke and provides considerable mechanical advantages.

The double wire system is thus a very suitable method of operating points up to 800 yards and signals upto nearly a mile.

(iii) Power Signalling Installation :

In this system, points and signals are operated electrically, controlled from a Power Frame or a 'Panel' suitably located in a cabin or Station Master's Office. The signals may be either semaphore type, operated by electric signal Machines or colour light type which show a light both during day and night.

Power signalling enables points and signals to be operated from any distance and, when installed in conjunction with track circuits and electric repeaters, provides the highest possible safety and reliability. Economy in operating staff is also possible, by controlling the points and signals in an area from one location, where otherwise, under the mechanical working, two or more cabins would be necessary. As regards the source of electricity, the most convenient is electric power supply, but working with batteries or hand generators is also possible.

Installation of power signalling is more expensive than mechanical signalling and besides, at road-side stations there is also the difficulty of non-availability of power supply. In India, it has so far been installed only at large stations, or at locations where working of points or signals is not conveniently possible by single or double wire.

4. Relative merits of two cabin working and central cabin operation :

* *Stroke of single wire lever generally provided for of signals is 1'-2" and mechanical advantage is 2.5. Stroke of double wire lever is 1'-8" and mechanical advantage is 4.5.*

A. Ensuring complete arrival of train :

(a) The usual method of working an installation under two aspect signalling is by the provision of two cabins, viz., one at each end of the yard. This system has been found quite satisfactory. This also enables the ** station master to ascertain the complete arrival of a train from the cabinman, without loss of time, and this is particularly important when trains have to cross.

(b) Where central cabin working is provided, the following are the different procedures in force for ensuring complete arrival of a train :—

(i) The guard of a train indicates to the station master the complete arrival of his train by waiving his arm four times overhead from side to side by day, and by waiving a white light in a similar manner by night. The station master must demand compliance with this procedure before closing the line for the train. These are the rules in force on the Southern Railway, as per S. R. 359 (d) of ex. South Indian Railway, or

(ii) A member of the traffic staff is deputed to collect the arrival certificate from the guard and bring it over to the station master without any delay. The station master must not close the line until he has received the "arrival certificate". This is the practice in force on the Western Railway.

On the North-Eastern and the ex. B. N. Rly. portions of the Eastern Railway too, a similar practice is in vogue. Where the Station Master cannot see the last vehicle of a train himself, he sends out and "intact Register" to the guard for his signatures in it and it is only on return of the register with the guard's signatures, that the station master closes the line, or

(iii) Where the station master is unable to see the last vehicle, the guard of the train has personally to assure the station master of the complete arrival of the train by signing in the train register book. These are the rules in force on the Central Railway as per S. R. 336-1, or

(iv) Telephones are provided at either end of the station and the guard on arrival of his train gives the station master the train number and the time of arrival of his train, together with a verbal assurance about its complete arrival and also about its being clear of other lines. The Station Master acknowledges such an assurance by giving a private number to the guard, who records the same in his train journal. This is the procedure in force on the ex. E. I. Railway portions of the Eastern Railway.

From the foregoing, it will be seen that the procedure outlined in A (b) (i), (ii) and (iii), appears suitable only on metre gauge sections or on such broad gauge sections which are light, where train loads are short and enough time is provided for crossing of trains and not on busy sections.

The other procedure of the guard telephoning to the station master may be the best alternative offering, but even in this system the guard will have to leave the brake van and proceed to the telephone post which may not always be near the brake van. The delays are, therefore, bound to occur and the rules may not always be followed. Moreover, telephone parts in the yard are likely to be frequently interfered with and possibly pilfered.

In conclusion, the method of ensuring complete arrival of a train under central cabin working scheme is not at all so suitable as that under two cabin working.

(To be continued)

** *Although General Rules do not lay down cabinman's responsibility in respect of complete arrival of a train, but on most of the railways Subsidiary Rules do require him to give an assurance about it to the Station Master as soon as a train arrives. In fact, the cabinman is not to put back his reception signals until he has assured himself that the train has arrived complete and at stations equipped with key transmitters, transmission of the key back to the station master is considered cabinman's assurance that the train has arrived complete.*

Progress and Competition of American Railways

The American railway system, now 123 years old, is privately owned. Literally millions of citizens own shares in the nearly 700 railway companies. The system employes over 1,237,000 workers, comprises more than 225,000 miles of track, some 43,000 locomotives of all types and nearly 2,000,000 passenger and goods coaches.

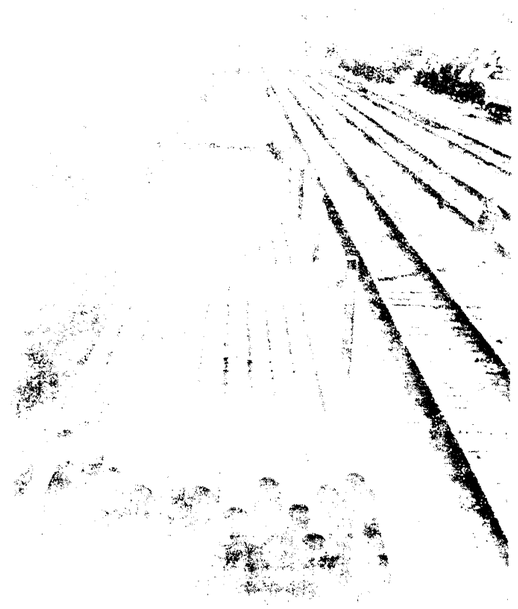
LOCOMOTIVES driven by atomic power may be some years off, but the Association of American Railroads has a competent research scientist accredited to the U. S. Atomic Energy Commission. His duty, in so far as security regulations permit, is to forward the time when atomic power will become practicably useable for hauling trains.

Atomic power plants already are being built to propel submarines. It is only a question of time until trains, too, will be driven by atomic power.

This looking ahead to the use of atomic energy to drive trains is only one—although admittedly spectacular—evidence of the constant effort of America's railways to improve their equipment.

Research conducted by American railways has resulted in a steady flow of technical improvements. These improvements have produced railways vastly superior to those of half a century ago, and intensified research is bringing about still further advances.

Shri L. A. Natesan, Economic Adviser to the Ministry of Railways, India, and Samuel W. Anderson, U. S. Assistant Secretary of Commerce, are looking at the book "Indian Railways—one Hundred Years" which Mr. Natesan has just presented to Anderson in Washington.



Five different kinds of typical U. S. railroad freight cars are shown in this picture.

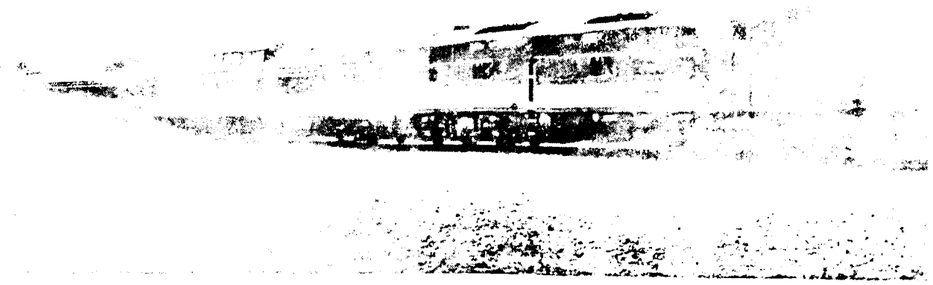
So wide in scope is railway research that it is almost impossible to define its limits. Just as the railways draw upon practically every section of American industry for their materials and supplies, so do they also cooperate with many industries in carrying out technological developments.

Almost every advance in technology, however, remote it may seem, soon is put to use somewhere by the American transport system. For competition between the different privately-owned American railways systems is severe. If one line falls behind another line serving the same area, it finds patronage going to its competitor. Among the most severe competitors of American railways are the country's 49,000,000 automobiles—one to every 3.1 persons. For distances 50 of 1,000 miles, or more, people have the choice of going by train or in their own cars. So the railways strive in every way they can to provide attractive competitive service.

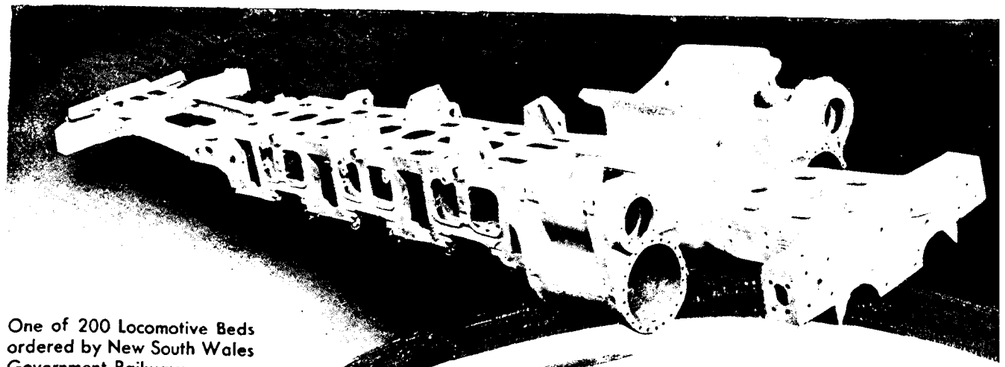
Rates, both passenger and freight, are fixed in America by the Federal Interstate Commerce Commission, and allow a margin of income over expense for a prosperous line of only 3 or 4 per cent. This, also, keeps the railways alert to cut costs, for dividends can be enlarged only by keeping operating costs at a minimum level.

Radar and television recently have attracted railway attention. The Baltimore & Ohio Railway is taking the lead in this experimentation. Television, for example, permits the dispatcher in his tower to check on the speed, progress, condition, and make-up of a train that is still several miles away.

Through the use of electronics, several of the great railways have adopted "centralized traffic control", a remarkable installation which enables one man to direct



The experimental train designed and sent on a tour of the United States by the General Motors Corporation. This train is now popular in U. S. as a latest model.



One of 200 Locomotive Beds ordered by New South Wales Government Railways.

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Accelerate Locomotive Construction
Insure Minimum Maintenance
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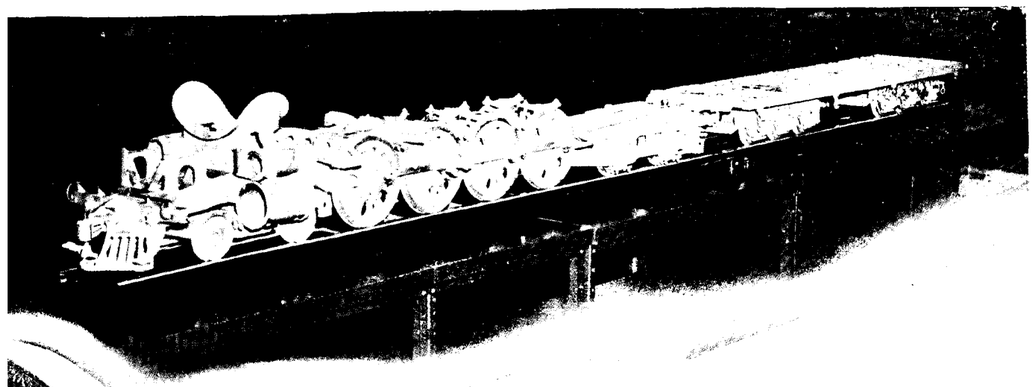

Illustrated above is an exact scale model of the running gear for a steam locomotive and tender. This model was displayed at the Indian Railways Centennial Exhibition and is currently being seen throughout India on the Centenary Exhibition Train. It is equipped with the following one-piece cast steel COMMONWEALTH Products:

Locomotive Bed	Delta Type Trailing Bogie
Front Bumper	Boxpok Driving Wheels
Front Bumper Beam	Waterbottom Tenderframe
Leading Bogie	Tender Bogies

Many of the well-known WP, WG, and YP class locomotives in service on the Indian Railways are equipped with COMMONWEALTH products known the world over for their dependability and economy in railway operation.

The COMMONWEALTH Locomotive Bed incorporates in one rugged casting many parts, including main frames, cylinders, cross braces, cradle, various brackets, and many other parts. The unit bed eliminates welded, bolted or riveted connections with the accompanying maintenance problems, thereby permitting permanent alignment of moving parts and highest availability of equipment. Great strength with less weight is assured by the economical distribution of metal to sections where it is needed most for strength. Furnished completely machined, ready for application, COMMONWEALTH Beds greatly simplify locomotive construction. Hundreds of locomotive beds have been in service for many years in Australia, France, Mozambique, South Africa, Turkey, Canada, and Mexico as well as thousands in the United States.

COMMONWEALTH One-Piece Cast Steel Products have been proven in service on the railways of 55 countries. They keep locomotives in active service longer with a minimum of maintenance, permitting most efficient operation with fewer locomotive units.

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REPRESENTED IN INDIA BY JESSOP & CO., LTD.

the movement of all trains over as much as 200 or 300 miles of track. There is an electrically-activated map before his eyes, on which all trains antomatically report their positions with flashing lights. The operator lines up switches and sets signals to guide trains at any point in his division, simply by pushing buttons at his desk.

In a "push-button yard", long strings of cars are pushed over a raised "hump" by a switch engine. Beyond the crest, the cars roll by gravity on to a huge fan of classification tracks. Their speed is regulated by "retarders" controlled electrically from the "hump" tower, and switches are opened and closed ahead of the cars by the same means. Entire trains can be broken up and reassembled without ever being touched by the yard crews.

The operation of such a yard is coordinated by radio contact between switch engine and tower, and through a system of loud speakers (with "talk-back" facilities) spotted throughout the yard.

Not long ago, Mr. James H. Aydelott, vice-president of the Association of American Railroads, announced that approximately 10,000 radio sets were in operation on trains, in yards and terminals, and at wayside stations throughout the United States. Incidentally, several express trains now offer radio-telephone service for passengers, who can call almost any phone number in the country while speeding between cities.

The advantages of the Diesel-electric locomotive over conventional steam-engines is widely recognized, and a number operate successfully in India. In America, Diesel-electrics provide more than 65 per cent of all freight service, 70 per cent of the passenger service, and nearly 80 per cent of all yard service. A steam locomotive has become something of a rarity.

"Right now we are seeing still further dovelopment in the use of turbine locomotives of three different types-oil-burning gas turbines, coal-burning gas turbines and steam turbines," says Mr. William T. Faricy, president of the Association of American Railroads.

The oil-fired gas turbine is still relatively now, but shows considerable promise. The hot gas generated by the burning oil turns a turbine, which in turn drives a generator to supply current for the traction motors. The Union Pacific Railway has been testing such a locomotive on its transcontinental lines for two years, and recently placed an order for 10 more.

Development of the coal-burning gas turbine is a joint project of eight rail systems, two equipment manufacturers, and the Bituminous Coal Institute of America. Finely pulverized coal is burned to produce the hot gas that drives the turbine. Railways are doubly interested in this project, first because of the possibility of operating economics, and second because of the prospect of increasing the market for coal, an important item of freight revenue.

A third type of turbine-electric drive under study is the coal-fired steam turbine. This is already in trial use on one railway system, and considerable hope is held for its future. Important developments in this field are anticipated during 1953.

Many of the changes and advances in railway equipment in recent years are not apparent to the casual viewer.

"Take, for example, the steel rail, which is the very foundation of our commerce," says Mr. Faricy, president of the A. A. R. "To the naked eye, the only change in the past 30 years has been an increase of about 20 per cent in average weight. But this increase is the smallest part of the change.

"As the result of protracted research carried on jointly by the railways and the steel companies, the advances of metallurgy, manufacture and design have been such that rail laid today is only one-fourth as much subject to breakage and will give 50 per cent more service life than the rail of 30 years ago".

American railways and, through them, railways all over the world benefit from the fact that the entire 225,000 miles of the U. S. rail system constitute a "proving ground" for new ideas. Sections of track do not have to be set aside for test purposes, because any or all of it is available to try out under test conditions new ways of construction, new types of equipment, new

(Continued on page 57)

INDIAN STANDARDS INSTITUTION NOTES

REVISED Indian Standards for Moderate and High Heat Duty Fireclay Refractories have been issued by the Indian Standards Institution. As before, the specifications for the two types of moderate heat duty fireclay refractories designated as Group 'A' and Group 'B' have been detailed in separate standards.

These standards were first issued in 1949. In the light of the experience gained, it has been found possible to make some of the provisions more stringent and these revised standards would, it is expected, assist in the supply of higher quality refractories.

Advantage of the revision has been taken to separate the methods of test, which originally formed part of this standard, for inclusion in a new Indian Standard (IS:485-1953) dealing with the methods of sampling and testing of refractory materials.

The revised standards were prepared by ISI's Refractories Sectional Committee which includes nominees of the Tata Iron and Steel Company Ltd., Refractories Maker's Association, Calcutta and various other manufacturing Interests as also representatives of Central Glass and Ceramic Research Institute, Ministry of Railways, Indian Bureau of Mines, National Metallurgical Laboratory, Directorate General of Ordnance Factories, Directorate General of Supplies and Disposals and Naval Headquarters.

The revised standards are now available at the ISI's office at 19 University Road, Delhi 8 at a price of Re. 1/- each.

*** *** ***

An Indian Standard for Silica Refractories for General Purposes, has been issued by the Indian Standards Institution. This standard, which is one of a series of Indian Standards for refractory materials, covers the requirements of silica refractories for general purposes, such as in the steel and glass inauddustries for coke ovens.

This standard prescribes the technical requirements for silica bricks and shapes and the methods for evaluating these have been included in a separate Indian Standard covering the methods of sampling and testing of refractory materials.

The standard has been prepared by ISI's Refractories Sectional Committee which includes nominees of the Tata Iron and Steel Company Ltd., Refractories Makers' Association, Calcutta, and various other manufacturing interests as also representatives of Central Glass and Ceramic Research Institute, Ministry of Railways, Indian Bureau of Mines, National Metallurgical Laboratory, Directorate General of Ordnance Factories, Directorate General of Supplies and Disposals and Naval Headquarters.

This standard priced at Re. 1/- is now available for sale at ISI's office at 19 University Road, Delhi 8.

*** *** ***

A Standard Specification for Mild Steel and High Tensile Steel Bars and Hard-Drawn Steel Wire for Concrete Reinforcement has been issued by the Indian Standards Institution. This Standard is one of a series of Indian Standards for reinforced concrete and for basic steel products.

The standard, keeping in view the present difficulties in obtaining proper raw materials, has fixed the maximum permissible phosphorus content of steel to 0.65 percent with the proviso that when steel is required for structures subject on dynamic loading, such as railway and highway bridges, the phosphorus content should then not exceed the present limit of 0.060 percent.

The standard does not cover medium tensile steel bars, hard-drawn steel wires of high strength, deformed bars, rolled twisted steel bars, hard-drawn steel wire fabric and twisted steel fabric.

This standard has been prepared jointly by ISI's Sectional Committees for Cement and Concrete and for Basic Ferrous Metals with the co-operation of leading manufacturing interests in the country, scientific organizations and a large number of Government departments concerned.

This standard priced at Rs. 1/8/- is now available for sale at ISI's office at 19 University Road, Delhi 8.

(Continued from page 56)

methods of operations, or any other new idea or combination of ideas which offers enough promise in the laboratory to warrant testing in service.

The American railways, in short, are engaging in research as never before, for as technology progresses, more and more research is required.

RAILWAY OFFICIALS' GAZETTE

MR. H. C. TOWERS RETIRES

MR. H. C. Towers, M. I. E. E., M. I. R. S. E., M. Inst. T., Chief Signal and Telecommunication Engineer, Western Railway, proceeded on leave prior to premature retirement on 31st December, 1953. Mr. and Mrs. Towers sailed home in the s. s. "STRATHMORE" on January 7, 1954, and were seen off by a large circle of their friends.

Mr. Towers who had held an assignment for some time with the London Transport Executive came to India in December 1926 and was posted to Ajmer on the then B. B. and C. I. Railway as an Assistant Signal Engineer. After ten years service in this capacity he was promoted as a Senior Signal Engineer in 1936 and was placed in charge of the Bombay Suburban Section. In this capacity he had opportunities to exhibit considerable technical skill and engineering acumen and Mr. Towers rose to the occasion and effected several improvements in the Signalling System by his original research work in this branch. Two years later he was posted to Ajmer on the Metre Gauge System as Signal Engineer and in January 1947 was promoted to the rank of a Deputy. On the formation of the Western Railway in November 1951 under the reorganisation of the Indian Railways, he was promoted as the Chief Signal and Telecommunications Engineer of the Western Railway with Headquarters at Bombay.

In the course of his 28-year-service with the Indian Railways Mr. Towers was connected with several technical improvements and innovations in the Signalling & Communications branches of the Railways and these were possible wholly through his indefatigable efforts and research activities. He took keen interest in the development of colour light signals and continuous track circuits between parel and Mahim and at stations between Borivli and Virar on the Bombay Suburban Section while he was in charge of the Installation work. While at Ajmer as Signal Engineer he introduced a new method of keeping up the life of porus pots of batteries as these could not be obtained during world war II and thus kept up vital communication circuits in operation during the critical years. He was also responsible for the introduction of a system of last vehicle Detectors for Goods Trains to augment the capacity of Block Sections on the Metre Gauge Main Line where there were several restrictions owing to gradients.

Mr. Towers was entirely responsible for, and credit goes to him for his original ideas in this respect, the installation of the first power-operated Lifting Barrier Gate for Level Crossings at Santa Cruz, a very busy Crossing leading to the International Air port, and this enabled movement of rail and vehicular traffic uninterruptedly.

Apart from professional activities, Mr. H. C. Towers was also very influential in social circles of Bombay. A man of genial temperament and ever-active Mr. Towers endeared himself to one and all with whom he came into contact.

Mr. Towers is a Freemason holding senior rank in the District Grand Lodge and District Grand Chapter of Bombay.

In 1942 he founded the Metre Gauge Signal Sports Club at Ajmer for the benefit of the Staff with whom he mixed freely. In 1947 he founded a similar club for the Broad Gauge. On the formation of the Western Railway under the reorganisation of the Indian Railways he set-up the combined Signal and Telecommunication Sports Club for the whole zonal unit under the new system. The credit for the existence of the Bombay Railway and Signal and Telecommunication Society also goes to him, and of which he was the Chairman from 1950. Mr. Towers was also Chairman of the Western India Section of the Institution of Railway Signal Engineers and a Member of several committees not connected with his profession.

Mr. H. C. Towers.

A keen Technical Journalist, Mr. Towers had an unbounded flair for writing and the contribution he has made to Technical Journalism in India is immense. There is no Technical Journal in India to which he had not contributed articles on diverse engineering subjects of much interest.

We wish a happy and prosperous life to Mr. & Mrs. Towers in their retirement.

NEW CSTE FOR WESTERN RAILWAY

We welcome the appointment of Mr. J. S. Fiddes, as Chief Signal & Telecom. Engineer, Western Railway in succession to Mr. H. C. Towers, who has sailed home on leave prior to retirement.

Mr. J. S. Fiddes.

Educated at Bath and at the Northampton Polytechnic Institute, London, Mr. Fiddes had his early engineering training at the Horstmann Gear Company, Bath. Later he worked for some time with the Westinghouse Brake and Signal Company of Chippingham as a Technical Assistant. For some time he was also associated with the Siemens & General Railway Signal Company of London.

Commencing his early railway career with the Egyptian State Railways in 1927, Mr. Fiddes spent three valuable years on construction work including the installation of the Electro-Pneumatic signalling arrangements at Cairo, where he exhibited his engineering skill to the appreciation of his superiors.

After the Egyptian assignment he left for India where he joined the Signal Department of the former Madras & Southern Mahratta Railway in 1931 and had acquitted himself creditably in various responsible assignments given to him. Recognising the technical skill and engineering acumen inherent in him not to speak of his abilities as an administrator the Railway Board ultimately promoted him as the Chief Signal & Telecom. Engineer of the Southern Railway in October 1952. Before joining the Western Railway as the Chief of the Signalling & Communications Department he was given a short assignment on the Eastern Railway.

During the World War II he was commissioned in the Corps of the Indian Engineers and saw active service with the Middle East Forces, PAI Force and the South East Asia Command and earned the admiration of his Superiors.

Shy, unassuming and pleasing in manners, Mr. J. S. Fiddes, carries with him vast technical knowledge and administrative ability which admirably make him fit for the new position of responsibility and we have no doubt that he will make himself a thorough success in his new assignment. We congratulate him on this occasion and hope the Railway Board would utilise his valuable services in positions of higher responsibility in the years to come.

THE END-ROCK TIPPLER

The Tippler was designed and manufactured by M/S. Strachan & Henshaw Ltd., to facilitate the rapid unloading of closed and open wagons for those countries, especially India, where it is customary for loose bulk materials to be carried in box type closed wagons as well as in open wagons, and having side doors only.

The Tippler will empty such wagons through their side doors at the rate of 12 wagons per hour, which is equivalent to 240 tons per hour per tippler with wagons holding 20 tons. All the attendant has to do is to open the doors on one side of the wagon and the tippler does the rest. Free flowing materials such as coal and coke are completely discharged without hand assistance. One man at the control point moves a single lever in the direction of movement desired, and limit switches provide protection against over rotation.

During all movements the wagon is shocklessly but firmly gripped by means of its buffers so that no undue strains come on the wagons.

The Tippler is electrically driven, the main motions being performed by two motors each of 30 H.P. The consumption of electricity is very small and works out at less than one tenth of a unit per ton.

EDITORIAL NOTICE

Contributions are invited from the Engineering Profession in India and abroad in the form of original articles, research write-up, Summary of papers read before Technical institutions etc. relating to Civil, Electrical, Mechanical, Signal & Interlocking and Telecommunication Engineering sections and of particular interest to the Railway Engineers. Besides, suggestions for the technical improvement of various aspects of Railway Engineering Practice are also invited with suitable write-ups and photographs wherever possible.

Contributions are accepted on the distinct understanding that they are sent solely to the "Indian Railway Engineer". The Editor accepts no responsibility for the views and statements of the Contributors.

All contributions intended for publication in any particular issue should reach the Editor at least 30 days prior to the scheduled date of the publication. The Publishers reserve the copyright of contributions published in the journal and reproduction either in full or in part will be permitted only with the previous permission of the Editor.

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EDITOR.

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