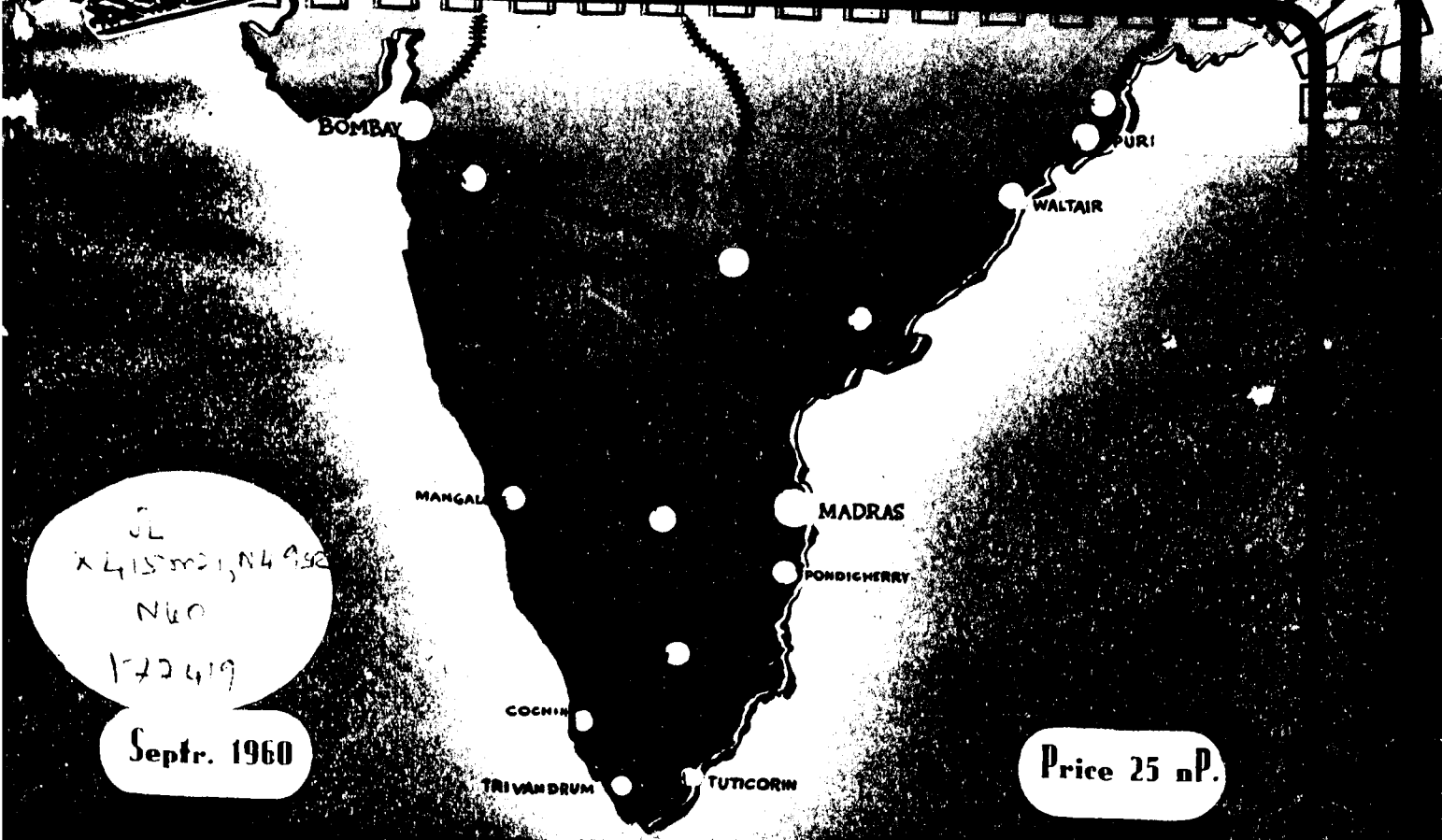
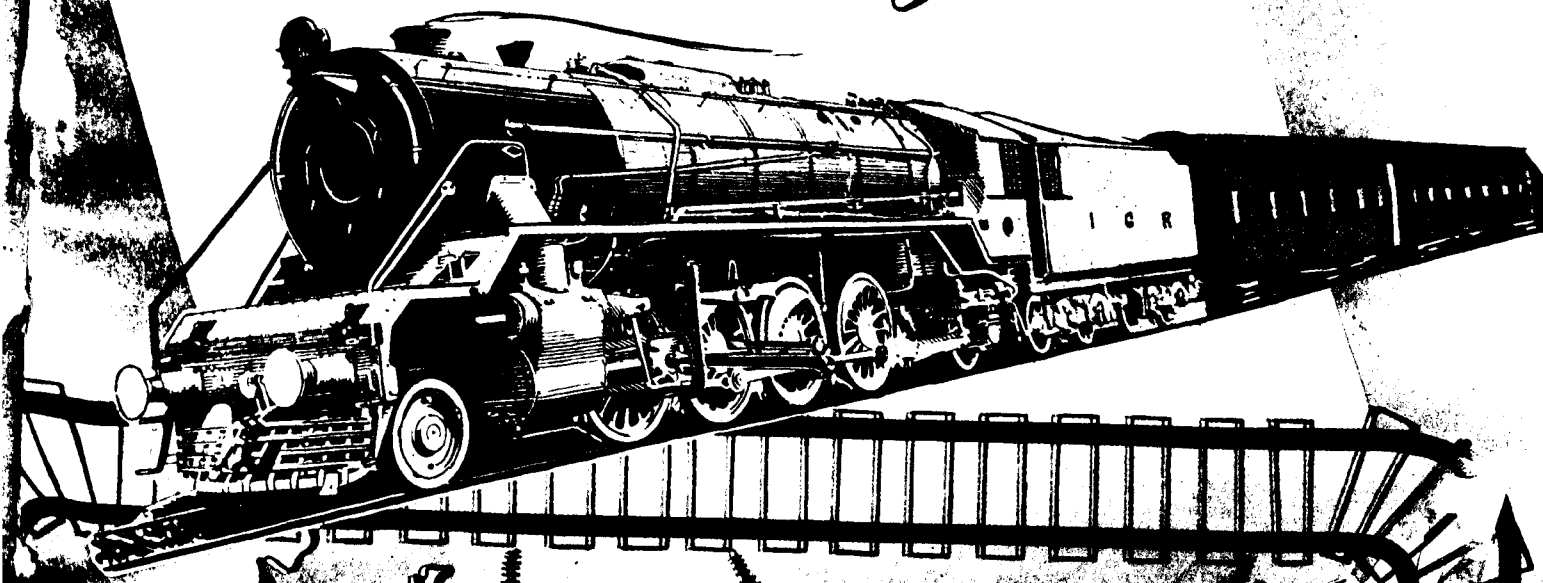


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SOUTHERN RAILWAYS

Magazine



52
K415M21, N4952
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Sept. 1960

Price 25 nP.

INDIAN RAILWAYS

another 300 track miles of A.C. Electrification

The Indian Railway Board has awarded another overhead equipment contract to the BICC Group. The new section, to operate at 25kV 50 cycles, is part of the Eastern Railway's main line from Calcutta towards Delhi, and will be ready for use by July 1961.

The BICC Group is already working on a contract for 400 track miles of similar equipment on the South Eastern Railway and after only twelve months an electric locomotive made a demonstration run over a part of the line. The new order, worth over a million pounds, is a demonstration of the Indian Railway Board's confidence in BICC.

railway electrification by the

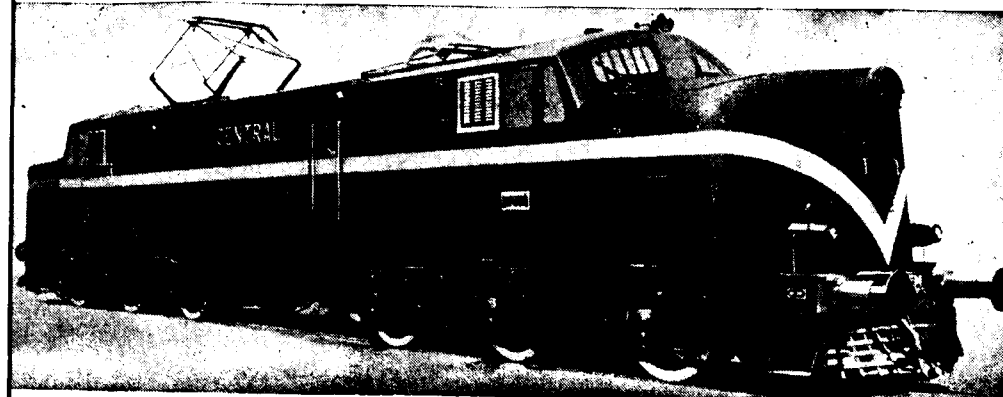
BICC GROUP

DESIGN SUPPLY & INSTALLATION
OF OVERHEAD EQUIPMENT

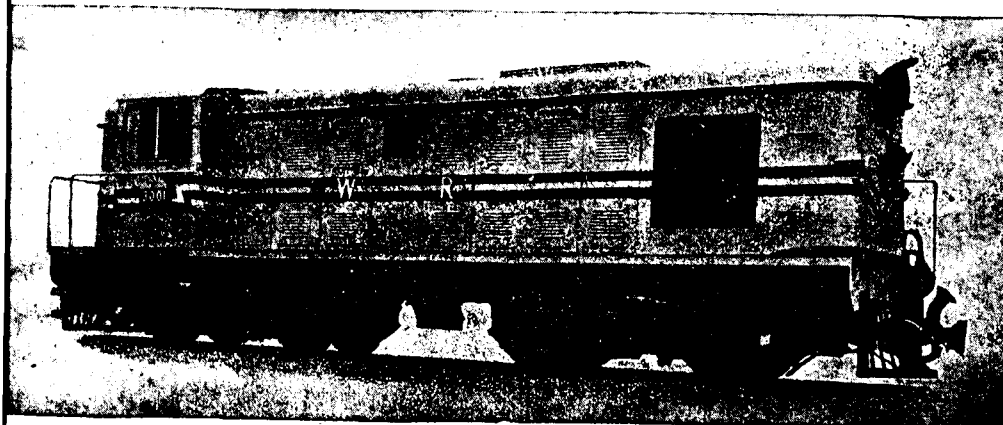


BRITISH INSULATED CABLES LIMITED 21 BLOOMSBURY STREET LONDON WC1 ENGLAND

WESTINGHOUSE BRAKES ON MODERN INDIAN LOCOMOTIVES AND MULTIPLE UNIT TRAINS



One of seven electric Locomotives for Central Railway of India built by The English Electric Co. Ltd., with mechanical parts by The Vulcan Foundry Ltd., and fitted with Westinghouse Vacuum Controlled Straight Air Brakes.



One of twenty 625 h. p. diesel-electric locomotives built by North British Locomotive Company for the Western Railway and fitted with Westinghouse vacuum/ Air Brakes.



One of many Motor Coaches built by Metropolitan-Cammell Carriage & Wagon Co. Ltd., for Indian Government Railways and fitted with Westinghouse Electro-Pneumatic Brakes.

WESTINGHOUSE BRAKE AND SIGNAL CO. LTD., 82, York Way, King's Cross, London, N. 1.

ASSOCIATED IN INDIA WITH: SAXBY & FARMER (INDIA) PRIVATE LTD., CALCUTTA



SOUTHERN RAILWAYS MAGAZINE

Contribution to the Diesel Electric Locomotive Industry

By O. G. Dellacanonica

Chief Engineer - Transportation Products
ALCO Products Export Company

THE FIRST UNITS

THE history of diesel railway traction begins early in the century. It is well known that the first diesel locomotive, the 1000 BHP diesel Sulzer Klose, direct-drive locomotive of 1913, was a failure, but it served to prove conclusively that the future of diesel traction was directly linked with the development of a flexible transmission.

Almost simultaneously after this failure, the development of electric, hydraulic and mechanical transmissions began.

The year 1924 saw the first diesel-electric locomotive built in America, enter service in the lines of the Jersey Central Railway. It was built by ALCO.

This locomotive is illustrated in Figure 1. It was powered by an Ingersoll-Rand, 6-cylinder, 4-stroke, normally aspirated diesel engine, of 10 inches bore and 12 inches stroke, developing 300 BHP. This locomotive weighed 56 long tons; its maximum speed

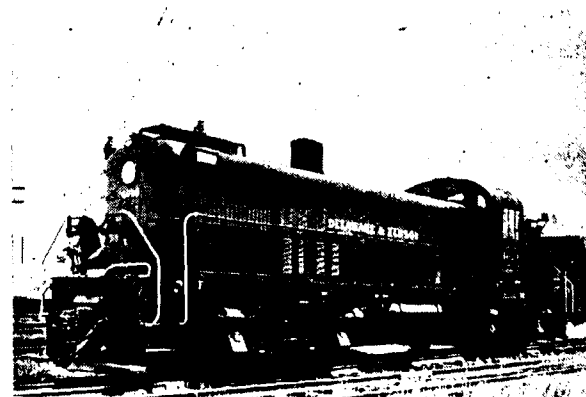


Figure 1 is a picture of the first diesel-electric locomotive built in America, which went into operation on the Jersey Central line in 1924 and gave 34 years of continuous service. It was built by ALCO Products, Inc.

was 30 MPH, and its continuous tractive effort was 7,900 pounds.

The Jersey Central locomotive, at 10 MPH for a rail horsepower of 210, gave 34 years of continuous service, a notable record for a first unit.

It was followed by a number of units of the same characteristics, that were built from 1924 through 1930.



A typical ALCO road switcher of the post-World War 2 era is shown in Figure 2.

Various railways in the United States were at that time becoming more and more interested in diesel traction and the American Locomotive Company, as ALCO was then known, turned out 300 and 600 BHP shunters; three-power locomotives able to operate from diesel engine power, batteries or third rail, and other units of a more or less experimental nature.

ALCO's OWN DIESEL ENGINES— THE FIRST PASSENGER LOCOMOTIVE

The management of ALCO concluded very early that diesel traction would soon become an accepted form which would compete with steam on equal terms and gradually displace it. It was decided that the development of diesel engines suitable for rail traction should be undertaken without delay.



From the ALCO collection: write for 20 x 12 1/2 inch color reproduction, suitable for framing.

Proved around the world, this ALCO "World" locomotive is built for any gauge track, and operates in high-speed passenger or freight service.

INDIA GOES DIESEL WITH 100 ALCO "WORLDS"

A major step in the dieselization of the Indian Railways has been completed. Deliveries of ALCO diesel-electric "World" locomotives have been made on one of the largest locomotive orders ever placed from India.

The 100 new streamlined "World" locomotives are the first broad-gauge, main-line diesels to be used in India. Designed exclusively for overseas service, these 1950-hp ALCO locomotives are contributing to the economic progress of forward-looking countries throughout the world. Now also operating in Argentina, Spain, Peru,

Pakistan and Australia, they have been proved in service on nearly every continent of the globe.

The "World" locomotives are powered by the turbo-supercharged ALCO 251 diesel engine and utilize ALCO's famed running gear. They operate in high-speed passenger or freight service and feature high availability, simplified maintenance and low operating cost.

Built by the world's most experienced locomotive manufacturer, established in 1848, ALCO diesel-electrics mean progress the world over.

ALCO PRODUCTS, INC., 30 Church St., New York, U.S.A. • Cable Address: Locomotive, N. Y.
FOREIGN ASSOCIATES AND LICENSEES: ALCO Products Export Company, Inc., 25 Victoria St., London S.W.1, England; Montreal Locomotive Works, Ltd., P.O. Box 1000, Place d'Armes, Montreal, Que., Canada; A. E. Goodwin, Ltd., 315 Parramatta Rd., Auburn, N.S.W., Australia. Agents throughout the world.

ALCO

Briefly, engines had to be made lighter and quicker running, but dependability and good specific fuel consumption could not be sacrificed.

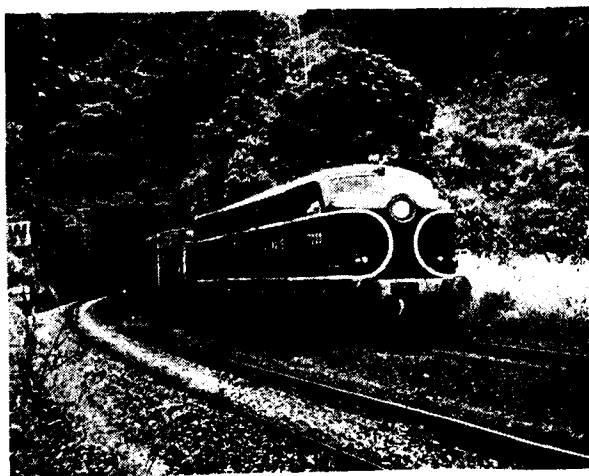
Two major designs appeared then in the early thirties. One was a $9\frac{1}{2}$ by $10\frac{1}{2}$, 700 RPM, 74 psi brake mean effective pressure normally-aspirated engine, of which quite a number of 6-cylinder units were built and installed in shunting locomotives.

The $9\frac{1}{2}$ x $10\frac{1}{2}$, 700 RPM engine is of particular interest because it must be considered the direct ancestor of the 1000 RPM post-war ALCO engines, the Models 244 and 251 of which several thousand are in service all over the world.

The other was a 12 $\frac{1}{2}$ in. by 13 in. 4 stroke engine, first built for railway service as a 6-cylinder, normally-aspirated unit developing 600 BHP at 740 RPM. It was a particularly successful design, and quickly became well known for its reliability.

By this time, however, experimentation on turbosupercharging was well under way, and by the beginning of 1936 a number of 900 BHP turbosupercharged engines had been installed in heavy shunting locomotives.

Early in 1940 the supercharged engine was pushed to 1000 BHP. These engines have been in constant production, the turbosupercharged unit to this day.



An ALCO "World" locomotive in operation between Dhanbad and Moghalsarai was photographed for Figure 3. One hundred of these locomotives are in service on the lines of the Indian Railways.

THE ROAD SWITCHER DESIGN—THE CONCEPT OF STANDARD LOCOMOTIVES

An interesting ALCO "first," dating from the war years, was the "road switcher" or hood type, all-purpose design. These were built first for the U. S. Army on a CoCo wheel arrangement and saw service in various war theatres, particularly in Iran. Figure 2 shows a typical road switcher of the post-war era.

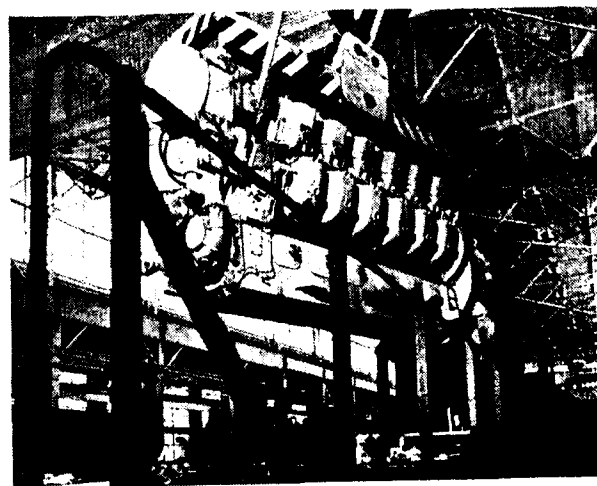


Figure 4 shows a 12-cylinder, 1500 BHP engine being lowered by crane onto a diesel-electric locomotive frame in the erection shop at ALCO's Schenectady, New York plant.

THE 244 ENGINE

About 1935 ALCO started experimentation of turbosupercharging on a 3-cylinder, $9\frac{1}{2}$ x $10\frac{1}{2}$ engine. This work was continued through 1940, when a 2-cylinder, vee-type 9 x $10\frac{1}{2}$ engine was built, to study scavenging and other matters. Finally in 1943 a prototype locomotive engine was built, but by then the war was on and ALCO was ordered to build steam locomotives, and to limit its diesel locomotive production to shunters and hood type general purpose units of the type described above.

As soon as hostilities ceased, ALCO put on the market a 12-cylinder, 9 x $10\frac{1}{2}$ engine, turbosupercharged, developing originally 1580 BHP at 1000 RPM, 157 psi brake mean effective pressure. The 244 engine, as it was called, was the first truly modern diesel engine for locomotive service, using fairly high (for the time) brake mean effective pressures and high pressure turbosupercharging.

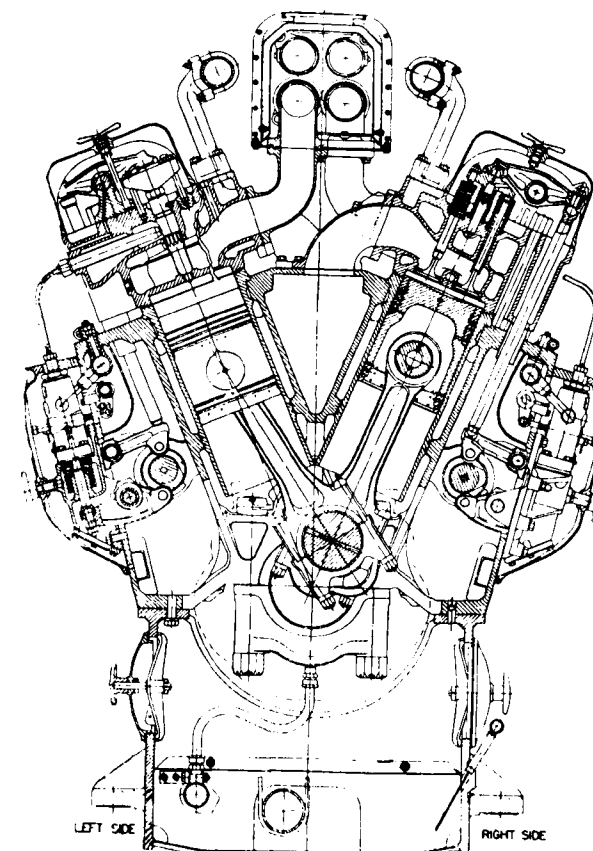
single 16-cylinder engine and geared for speeds up to 120 MPH.

THE INCREASE IN EXPORT BUSINESS—THE FIRST STANDARD EXPORT MODEL

The post-war period saw the beginning of the expansion of ALCO's export business. Strict adherence to the basic principles of standard locomotive production, in large numbers by assembly-line methods, had resulted in the availability of models of well-tried and proven features, offering a degree of economical and dependable operation unattainable in custom-tailored locomotives.

During the Pan-American Railway Congress in 1953 ALCO unveiled the "World" type locomotive. This was a streamlined cab unit of very moderate axle load (from 16 long tons), with the same power plant and auxiliaries of the United States locomotives. It fully met the limitations of the Berne Conference International clearance diagram.

The locomotive was fitted with six traction motors, giving it a continuous tractive effort of 45,900 pounds,



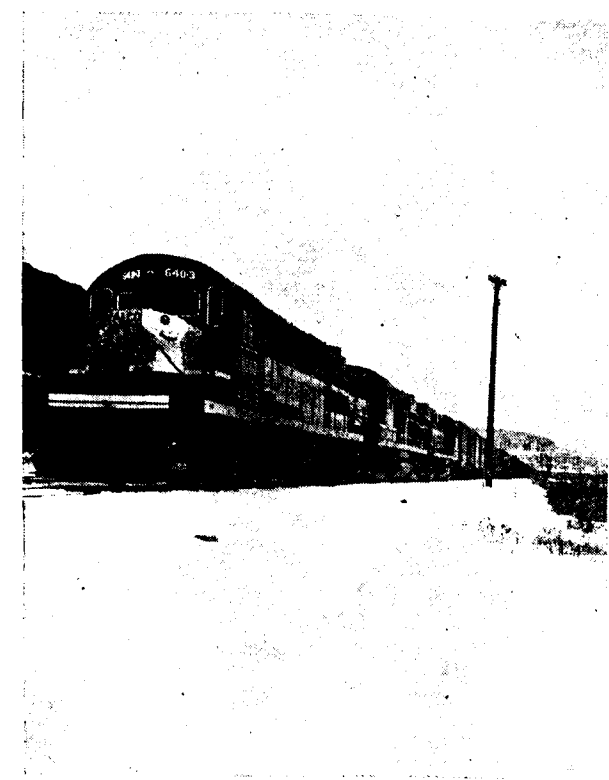
CROSS SECTION THRU VEE 251 ENGINE
LOOKING FROM GENERATOR END

The cross section in Figure 5 is that of a vee-type Model 251 diesel engine, which was designed and put into production by ALCO Products, Inc. during the last decade.

The first locomotives powered with this new engine were four axle streamliners for goods service, weighing 108 long tons. The continuous tractive effort was, even then, as high as 42,500 pounds. These locomotives were used four "in multiple" and greatly increased the tonnages hauled by railways throughout United States and Canada.

At that time passenger locomotives, with an approximate power requirement of 2,000 BHP per unit, were built with two power plants. The reason for this was (and still is, in those cases where twin-engine locomotives are still being built) the unavailability of a reliable single engine power plant of sufficient capacity.

This led to yet another ALCO "first." In 1946 ALCO delivered the first of many passenger locomotives of 200 HP net generator input powered by a



Three of the ALCO DL-640 locomotives are shown in Figure 6 at the head of a goods train in the snow near Schenectady, New York.

more than sufficient for the requirements of the great majority of overseas railways. The "World" locomotive was carried on two high-speed bogies of ALCO design. These 3-axle, 3-motor, double-suspension, swing-bolster, cast steel bogies could provide an excellent ride at all speeds on tracks in poor condition or lightly ballasted.

About 300 "World" locomotives have been built since, including 100 units now operating on the Indian Railways. One of these is illustrated in Figure 3 working a goods train between Dhanbad and Moghalsarai.

These locomotives have a CoCo wheel arrangement for 5 ft. 6 in. gauge track; overall length is 58 ft. 11 in., with weight of 246,000 pounds, all on drivers. Their axle load is 18.3 long tons and they have a continuous tractive effort of 45,900 pounds at 11.7 MPH, and a maximum speed of 65 MPH.

These locomotives are powered by a 12-cylinder 1950 BHP Model 251 engine, and are earning high daily mileages and have contributed greatly to the working of heavy goods trains in graded sections of the Indian Railways.



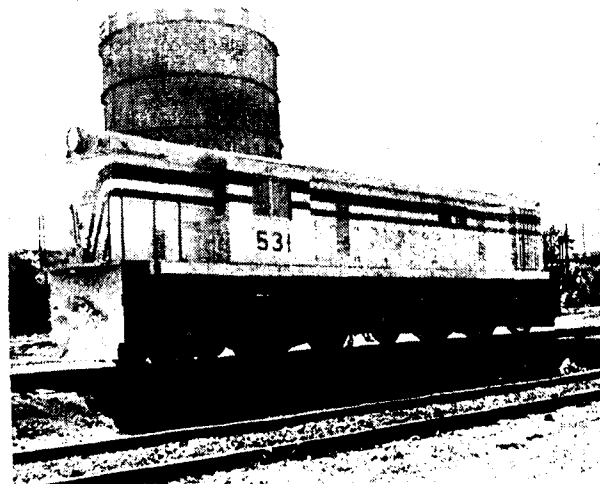
Figure 7 shows a picture of the DL-600, which is a 2600 BHP, 6-motor all-purpose, heavy-duty locomotive. The design pictured here is one of the new low-hood models which affords increased visibility for the engineer.

THE 251 DIESEL ENGINE

ALCO decided that, in order to put to best use the invaluable experience gained in building several thousand Model 244 engines, a new engine should be built which would incorporate the advances made in design and metallurgy, and utilizing charge air cooling.

In 1951 the prototype engine was assembled in the laboratory at Schenectady, New York, and a very long period of experimentation began.

The 251 engine retained the basic dimensions of the 244, that is, 9-in. bore by 10½ in. stroke, and carried its rated load at 1000 RPM and 193.5 psi BMEP. From the beginning the 251 engine was built in three sizes: six cylinder, in-line rated at 975 BHP; twelve cylinder, vee-form rated at 1950 BHP, and sixteen cylinder, vee-form rated 2600 BHP. The present rating



The lightweight, 1050 BHP all-purpose locomotive which appears in Figure 8 has been put into service by railroads in many parts of the world.

for the 6-cylinder engine is 1050 BHP at 1025 RPM, but the ultimate power output of this basic engine configuration is far from reached. Advances are made every day in fuel and air handling and improvements are introduced in the mechanical features of the engine.

Figure 4 shows a 12-cylinder, 1950 BHP engine ready to be lowered onto a locomotive frame. Figure 5 is a cross-section of a vee-type engine.

In order to give this engine the long life, reliability and economical operation that are essential for railway service the following features, among others, were incorporated in the design:

1. The welded steel block was made especially rigid and strong, having in mind future horsepower gains through higher mean effective pressures.
2. Grooveless design bearings were introduced, to increase their load-carrying capacity.

3. The combustion chamber design was carefully studied, and a form was adopted promoting intimate mixing of fuel and air.
4. Air flow patterns were studied until perfect scavenging with reasonable air economy was obtained.
5. Hard alloy replaceable valve seat inserts were used in the cylinder heads.
6. The aluminum oil-cooled pistons were fitted with a nickel alloy (Ni-resist) carrier for the top compression ring.
7. The efficient water-cooled high-pressure turbo-supercharger of ALCO design and construction used in the 244 engines was improved.
8. As explained before, after cooling, or charge air cooling as it is sometimes called, was incorporated.

scavenging and moderate peak pressures and exhaust temperatures.

The combination of all these factors has made the ALCO 251 engine an exceptionally successful one.

As the 251 engines begin to reach high mileages, the results of these features are beginning to appear. Although it is outside the scope of this article to analyze operating results, it can be mentioned that periods of three and even four years of heavy service between light overhauls are being reached, with cylinder wear rates in the range of 0.0002 in. /100,000 miles.

The present ALCO standard line covers locomotives basically suited to United States needs and others designed specifically for export, ranging from a 975 BHP U. S. A. type shunter to a 180-ton, 6-axle, 6-motor, 2600 BHP heavy-duty, all-purpose locomotive.

It is impossible within the confines of this article to describe in detail all of these locomotives, but we refer the reader to Figures 6 and 7, which illustrate the two most powerful locomotives in the United States-type ALCO line. They are the 2600 BHP 4-motor DL-640 high-speed goods locomotive, and the 2600 BHP 6-motor, all-purpose, heavy-duty DL-600 locomotive. The DL-600 develops the highest continuous tractive effort among all present-day diesel-powered locomotives. Figure 8 illustrates a 1050 BHP lightweight, all-purpose locomotive in use by many railways of the world.

BOOKLET DESCRIBING LIGHTWEIGHT G-E DIESEL-ELECTRIC LOCOMOTIVE

General Electric's (U. S. A.) new lightweight, high power model U6B diesel-electric universal locomotive is described in a specification made recently by the firm's Locomotive & Car Equipment Department in Erie, Pennsylvania.

The publication gives complete specifications of the 700 gross horsepower, 52-ton U6B locomotive, the lightest in G-E's line-up of universal type units. Speed-tractive effort and speed-dynamic braking curves are presented as are details concerning the diesel engine, traction motors, generator and other major components.

Copies of the 14-page, well illustrated specification may be obtained by railroad officials and technical personnel, and government transportation officers by writing to General Electric Company, Locomotive & Car Equipment Department, Erie, Pennsylvania, and asking for specification number 4836A.

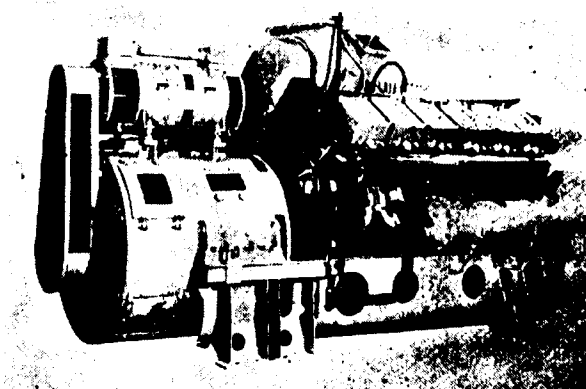
ITALIAN LIGHT BOGIE LOCOMOTIVES

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

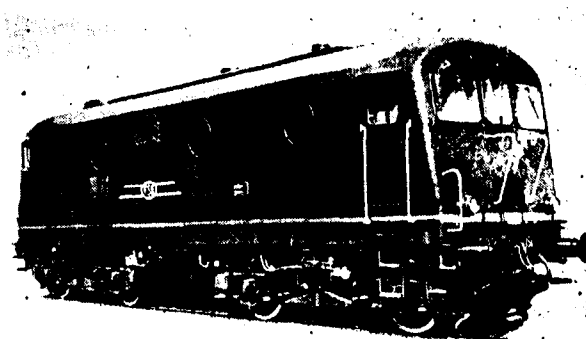
INCREASING construction of diesel motive power by Italian builders is not merely to orders of the Italian State Railways and of certain foreign railways; but is also for Italian private railways, both on the mainland and in Sardinia. Among these last-named are 13 double-bogie standard-gauge diesel-electric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

A Bo-Bo double-cab design with full-width superstructure has been adopted, but multiple-unit control is not normally embodied, though facilities for its installation have been provided. General dimensions

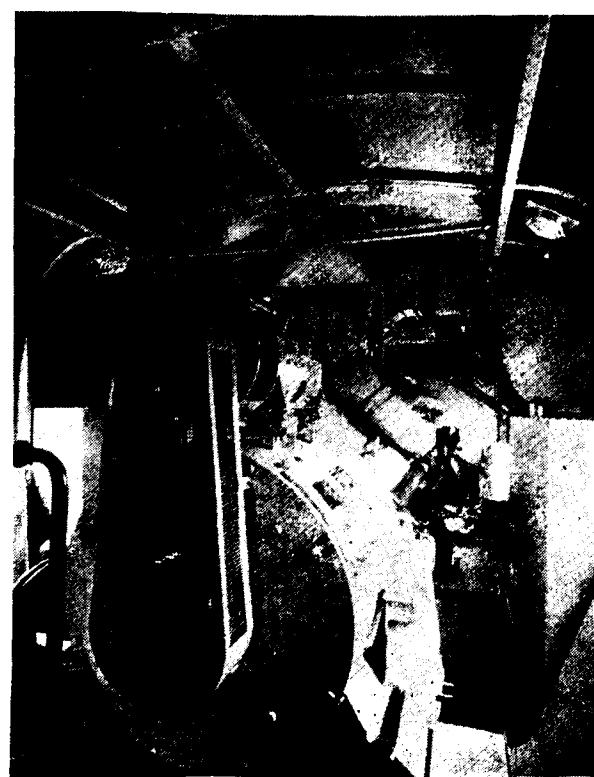
and layout of equipment are shown on the diagram elsewhere in this article. All power, control and auxiliary equipment is installed in one large machine room extending between the two cabs, and includes a train heating boiler with a capacity of 300 kg. (660 lb.) an hr. plus two side boiler water tanks holding about 1,500 kg. (330 gal.) total. Fuel tank capacity is 1700 kg. (450 gal.), and the fuel tank is slung below the underframe between the bogies. The bogies themselves are on the principles widely adopted for Italian diesel locomotives and railcars, with hollow box-section frames, roller-bearing axleboxes supported on each side by helical springs, and a bolster supported on each side by an inverted laminated spring. Westing-house air brakes, with Breda distributor are fitted—straight air brakes for the locomotive and automatic equipment for the train, and the straight



A view of the Generator.



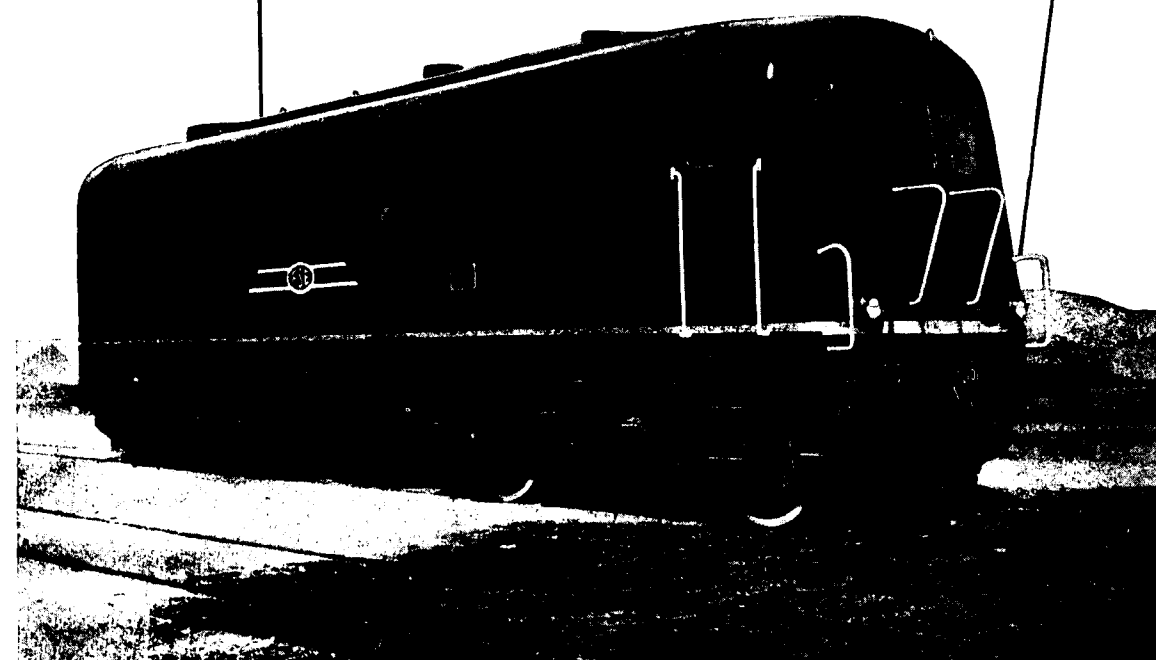
*Diesel-electric Locomotive
for "Ferrovie Del Sud-Est - S.p.A." Rome*



Another view of the Generator.

Marelli

COMPLETE ELECTRICAL EQUIPMENT FOR D. C., A. C.
DIESEL-ELECTRIC LOCOMOTIVES
AND FOR METROPOLITAN RAILWAYS



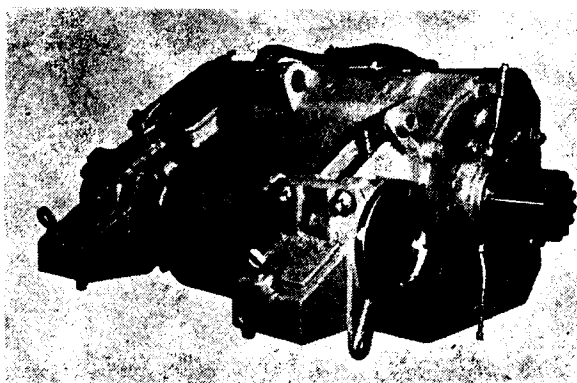
DIESEL-ELECTRIC locomotive built by MARELLI-NUOVE REGGIANE for the South-East Railways S. P. A. Type Standard « UNIFER B 13 ». — U. I. C. continuous power 825 HP — 13 units are being built.

280 I 350 HP DIESEL-ELECTRIC locomotives, type Co-Co, are being constructed for the Argentine Railways by the ITALIAN and ARGENTINE group G. A. I. A. Projects and design are by E. MARELLI & C., S. P. A. The electric traction equipments are of the same design as above.

ERCOLE MARELLI & C. - S.p.A. - MILANO



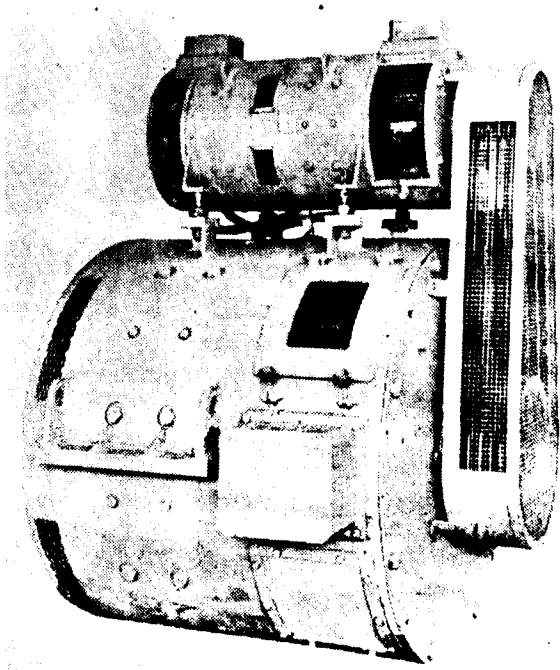
Driver Cab.



Traction motor type MCT 80 B 60

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

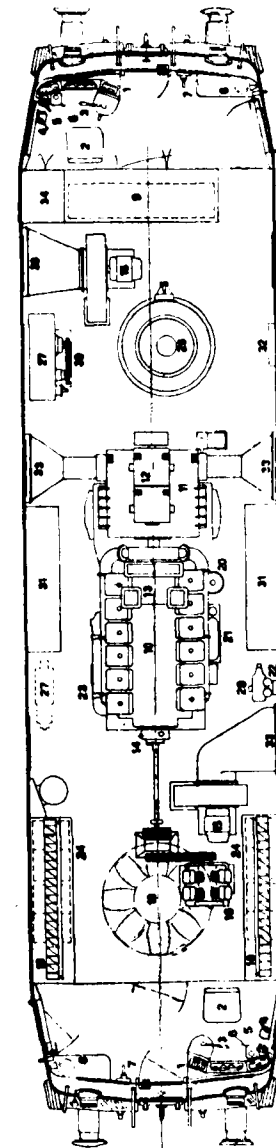
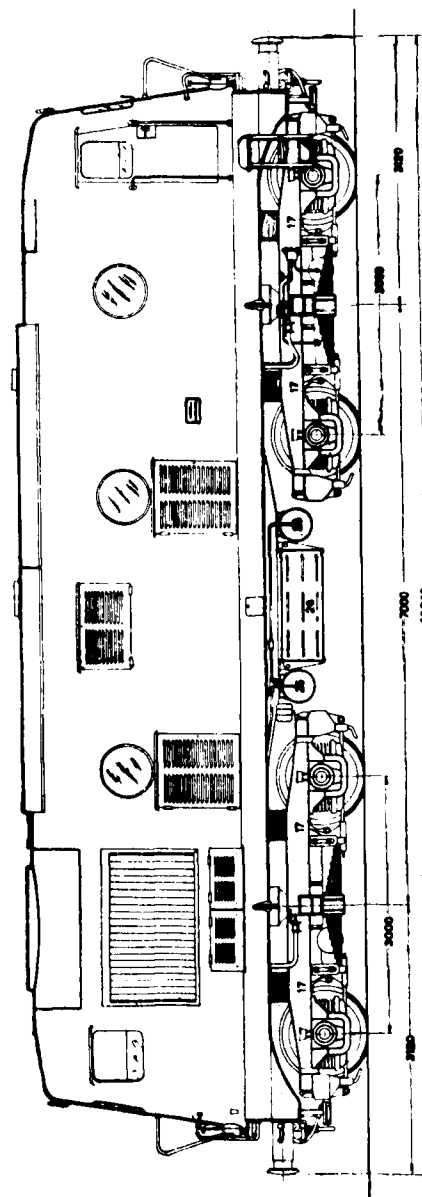
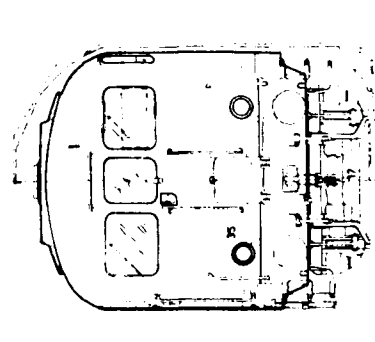
Empty weight of a locomotive is 49.4 tonnes, fully-laden weight 53.25 tonnes, and weight with two-thirds supplies about 52 tonnes. Starting tractive effort is 14,000 kg. (30,800 lb.), equal to about 27 per cent adhesion, but this value is available up to approximately 10 km. p. h. (6.2 m. p. h.). Top designed speed is 80 km. p. h. (50 m. p. h.) and at this speed



Main generator type MCL 140 D 60 with auxiliary group.

2,100 kg. (4,625 lb.) of tractive effort are available at the wheel rims. Continuous rated tractive effort at the wheel rims is 7,300 kg. at 23 km. p. h. (16,050 lb. at 14.6 m. p. h.) and one-hour rim tractive effort is 8,400 kg. at 20 km. p. h. (18,500 lb. at 12.5 m. p. h.). Wheel dia. is 1,000 mm. (39.37 in.) and traction motor gear ratio is 14 : 67. Curves of 80 metres (262 ft.) radius can be traversed at slow speed.

Motive and auxiliary power is furnished by a Nuove Reggiane M. A. N. type L 12 V 17.5/21A engine, a 12-cylinder V of the model preceding the L 12 V 18/21A engine now being used in Great Britain and Germany. Though it is considered to have a one-hour output of 920 b. h. p. at 1400 r. p. m., in this particular installation the traction rating is 825 b. h. p. at 1,300 r. p. m. Dry weight of this turbo pressure-charged unit is 3,500 kg. (7,700 lb.), or 4.25 kg. (9.4 lb.) per b. h. p. An auxiliary-drive shaft is taken off the front of the engine, a furnish power to the four-cylinder V reciprocating air compressor and the cooling radiator fan. The radiator banks are on the locomotive sides and the fan in the roof, and a pre-heater is included in the water circuit. A heat-exchanger is attached to one side of the crankcase for the cooling of the engine lubricating oil, and the oil is passed through a bank of Savara filters on the other side of the crankcase.



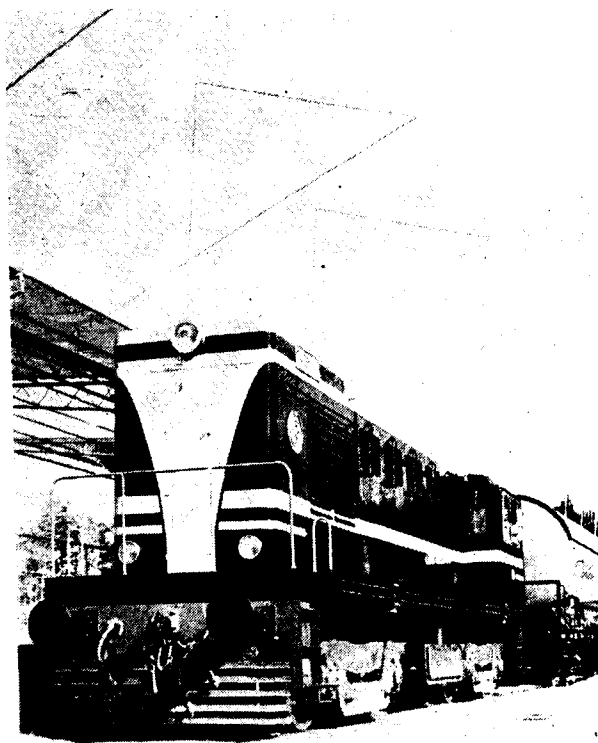
LOCATION OF PRINCIPAL PARTS

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

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

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

ČKD T 435.0 TYPE HEAVY DUTY DIESEL-ELECTRIC LOCOMOTIVE



The works manufacturing the ČKD T 435.0 Type diesel-electric locomotive has a 30-year old tradition in making diesel traction vehicles.

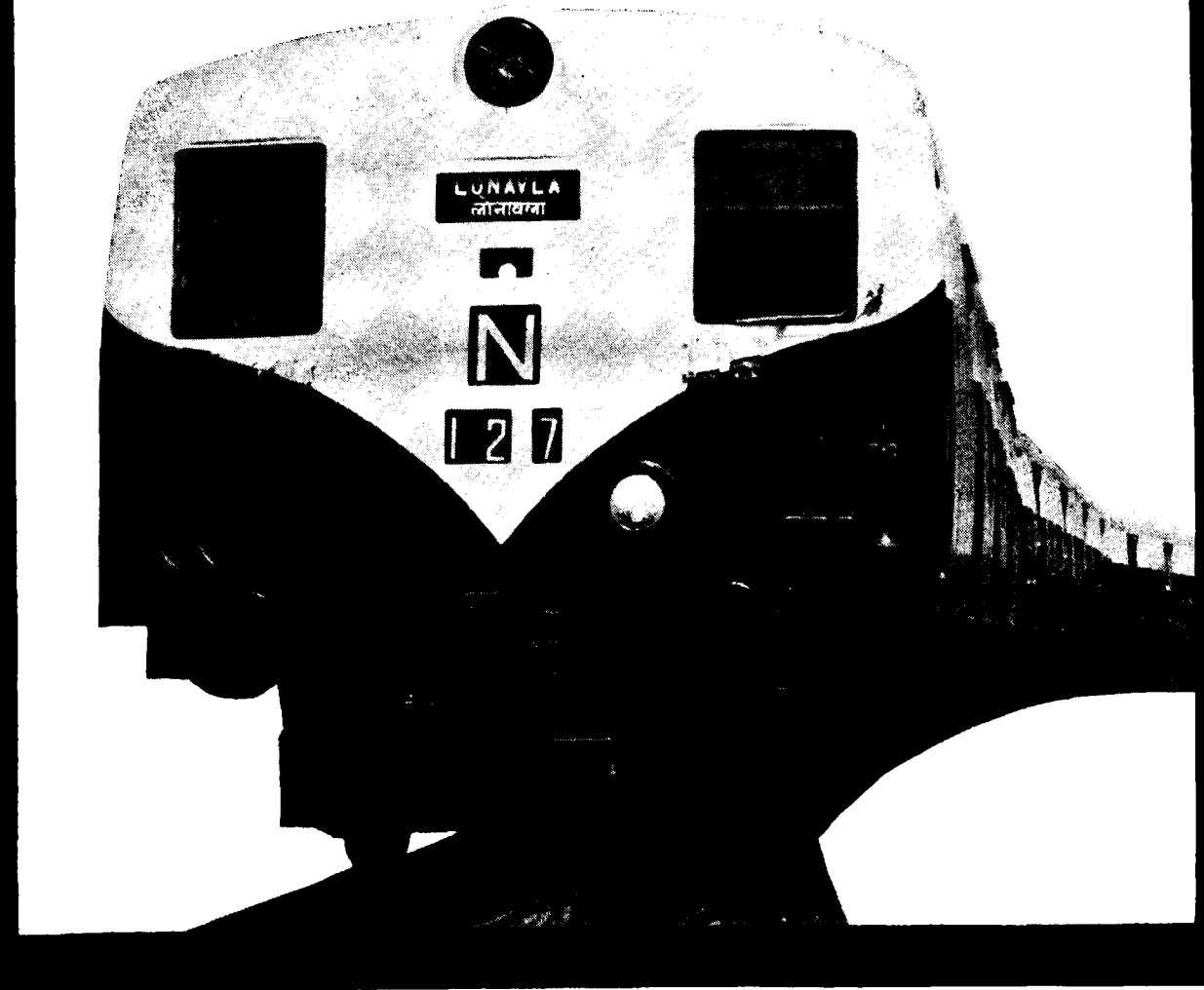
This locomotive is used mainly for shunting purposes in railway shunting yards but it is also well suited for servicing main and branch line freight trains and for shunting work in plant yards. Its maximum speed, tractive force and axle load correspond to the said versatility of the locomotive.

Its engine is a robust ČKD low-speed engine which secures a faultless supply of power even under the most difficult conditions encountered in the shunting yards.

Here are the main technical data: wheel arrangement Bo' Bo', rail gauge 1,435 mm to 1,676 mm (4'—8 1/2" to 5'—6"), output 750 HP, weight 60 tons (59 long tons) maximum speed 60 to 70 kms/hour (45 to 49 miles/hour).

If required, this ingeniously designed locomotive can be adapted for work in extreme temperatures varying between +40 and —50 grades Celsius (+ 104 and —58 grades Fahrenheit).

ELECTRIC COACHES



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The Recent Tendencies in Japanese Railways

By Mr. T. Kawai

Technical Section, Overseas Division, Hitachi Ltd., Tokyo, Japan

ELECTRIFICATION of the Japanese National Railways (herein after referred to as J. N. R.) on A. C. 20 KV, single-phase 50-cycle system is progressing at a fairly rapid pace. A long-term comparative test which has been conducted on the Tohoku line, Japan's first A. C. electrified trunk line, to determine the type of mercury rectifier to be used on Type ED 71 electric locomotive has ended recently to prove the superiority of "Excitron" system over "Ignitron" system. The "Excitron" system mercury rectifiers now in use on the J. N. R.'s A. C. locomotives have all been supplied by Hitachi, Ltd.

This 64-ton, Type ED 71 locomotive with the one-hour rating output of 2,040 kW is designed for service of both passenger and freight cars (i. e., dual purpose type). It should be able to start on 1% upgrade hauling 1,200-ton load. In order to fulfil these conditions, various new mechanical and

electrical designs have been incorporated in this locomotive whereby to increase its adhesive character.

Another new electric locomotive has recently been developed. This is an A. C.—D. C. two-way Type ED 46 locomotive and is intended for use on the Jobal Line which will be changed over to A. C. this year. Joban line is connected with D. C.-electrified sections. However, by the use of this new locomotive, the train can run from A. C. sections to D. C. sections or vice versa without changing its locomotive.

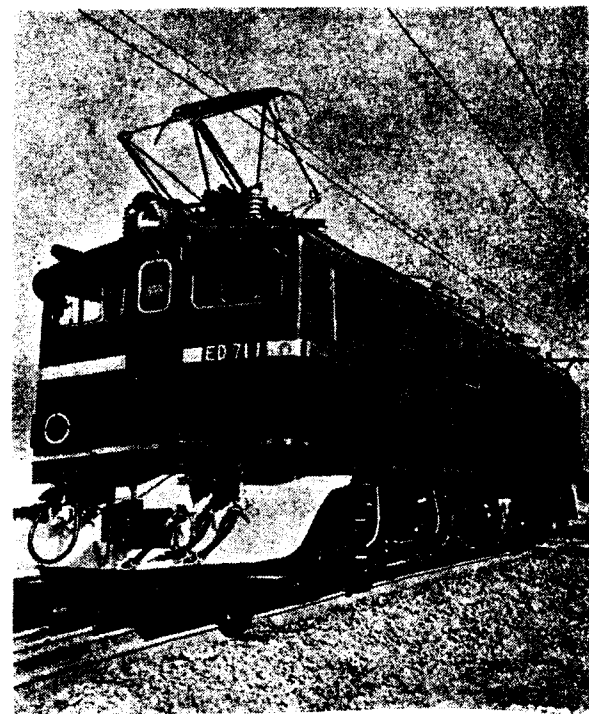


Type ED 46, AC 20 KV, 50 $\frac{a}{b}$, AC, DC, Two Way Electric Locomotive.

This locomotive is operated as an "Excitron" mercury rectifier locomotive so far as it is within A. C. 20 kV section. In D. C. 1,500 V section, its mercury rectifier are used as inverter from which to obtain A. C. source for train heating equipments.

This 64-ton electric locomotive has an output of 1,400 kW and is designed as one truck-one motor system powered by two 700 kW traction motors.

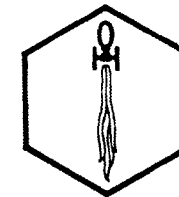
Changing-over between A. C. and D. C. can be performed by means of a commutating switch installed on the locomotive, without bringing the car into a stop.



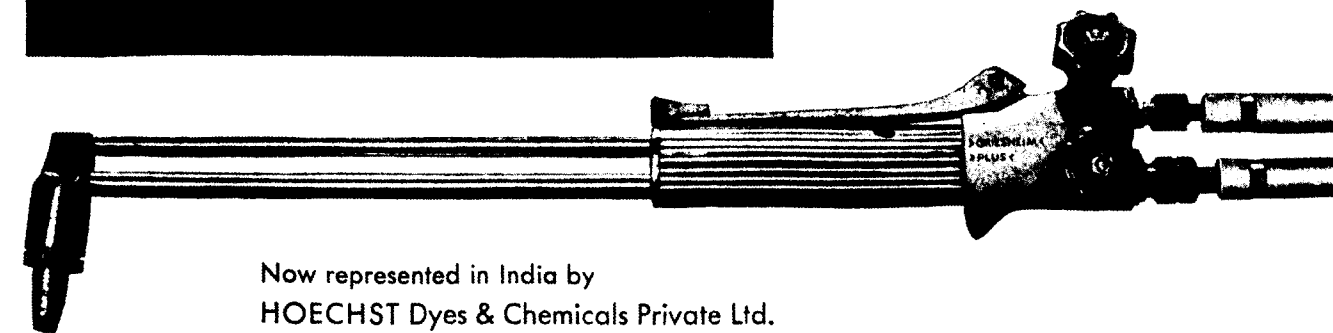
Type ED 71, 'Excitron' Mercury Rectifier system AC. 20 KV, 50 $\frac{a}{b}$, Electric Locomotive.

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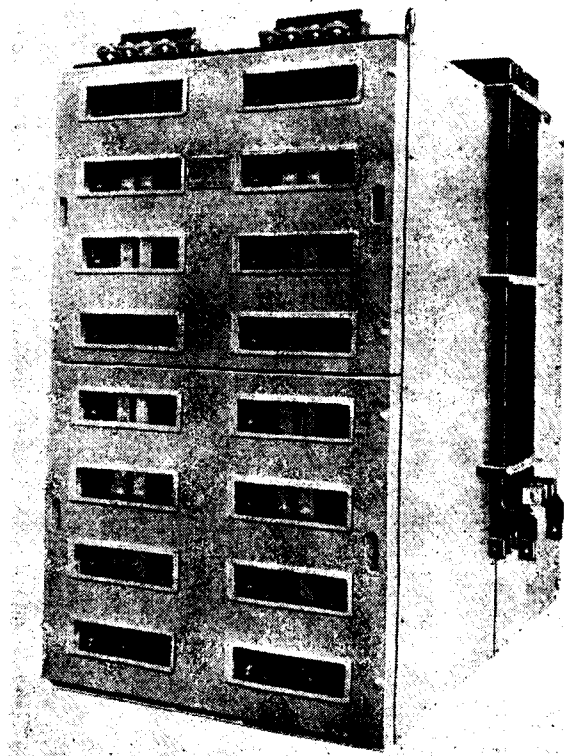
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Type ED 4521 A. C. electric locomotive is originally manufactured as an "Excitron" mercury rectifier system and has proved its excellent performance during its service run since 1957. In 1959, the mercury rectifier on this locomotive was changed to a silicon rectifier, which was designed and manufactured by Hitachi, Ltd. Its specification is as follows: 1,600 kW, 650 V, 2,460 A (continuous), forced ventilation system.

This ED 4521 locomotive is 60 tons in weight and has a continuous rating output of 1,500 kW. With



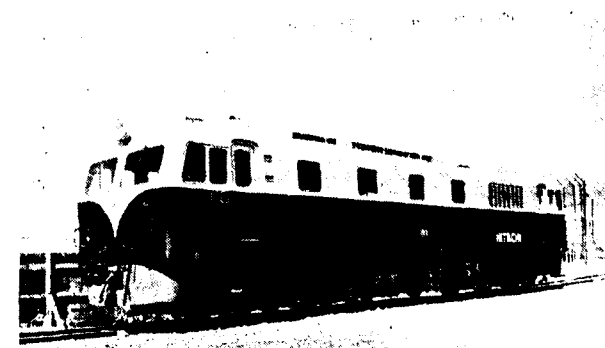
1,600 KW Silicon Rectifier for ED 4521 AC, 20 KV, 50 $\frac{1}{2}$, Electric Locomotive.

a high tension tap changing system incorporated, this is the first silicon rectifier system locomotive ever built in Japan, capable of starting on 2.5% upgrade hauling 500-ton load.

In view of its small size, light weight and simple construction as well as easy handling characteristic,

this silicon rectifier is expected to be favoured increasingly for use on A. C. locomotives and coaches in the world.

Dieselization is another world-wide trend, noticeable in the South East Asian Nations, too. Hitachi exported many Diesel electric locomotives to Thailand and Taiwan. These locomotives are powered by



1,100 HP Diesel Hydraulic Locomotive for J.N.R.

Type Hitachi-M. A. N. Diesel engines, and those supplied to Thailand are of 72-ton, 950 BHP and those for Taiwan are of 81-ton, 1,560 BHP.

As compared to the Diesel electric locomotive, the Diesel hydraulic locomotive is simpler in construction and more economical, and because of these favourable features, this type of locomotive is being manufactured for large HP ratings, partly due to the recent improvement of hydraulic torque converter.

The J. N. R. is proceeding with a plan for replacing the present Diesel electric locomotives with the Diesel hydraulic locomotives in the range not exceeding 1,000 BHP class, with the objective of cutting down railway expenses.

Hitachi, Ltd., being well aware of this trend, has recently developed a 1,100 HP Diesel hydraulic locomotive in which a torque converter of Hitachi's unique design is used. This locomotive is scheduled to be run on the J. N. R.'s network for trial.

A NEW KIND OF RAILWAY SIGNAL

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

THE title of this article is the one used for a column published in a London morning paper more than 33 years ago. It reads:—

"That common object of the British railway landscape, the signal 'semaphore,' or arm, has been declared a back number and is being replaced by an appliance which does not to the lay mind appear to be a signal at all. This new device, which is being used both on steam and electric lines, is known as the day colour light signal, and its indications are merely by colour. The familiar signal-post, with its ladder and counter-weights, is no longer required, and in its place is a stumpy metallic case containing one or more electrically lighted discs of coloured glass. In one type a separate glass is used for each colour to be displayed, (of which there may be three, including the caution indication), but there is also in use a most ingenious form in which all the required colours are indicated by a single glass disc.

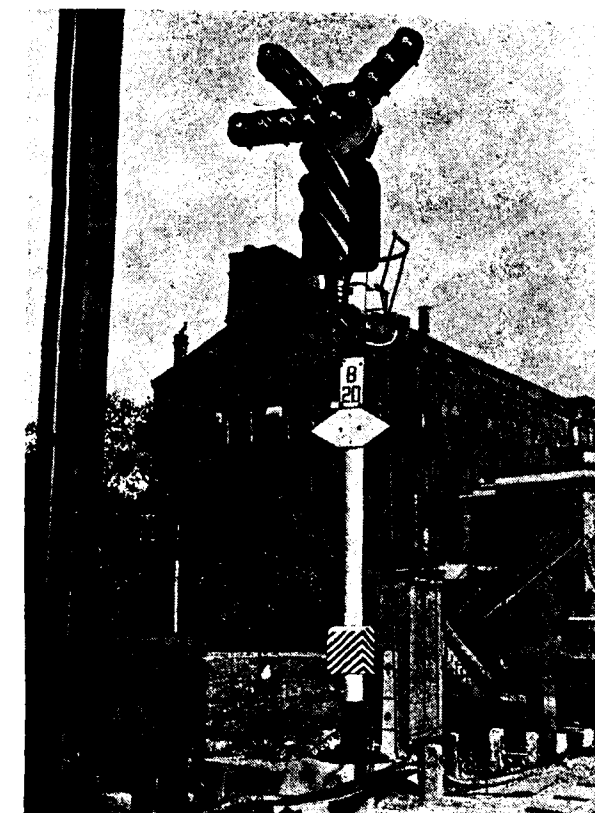
"It might be thought that the elimination of the semaphore was a disadvantage to drivers, but in fact this is not the case. Under normal conditions both light and semaphore are not visible at the same time, as the semaphore is invisible by night and the lamps are not lit in the daytime.

"Moreover, it has been proved that only a fifth of the reported cases of running past danger-signals takes place at night, which would seem to show that colour is a more certain indication to the driver than the angle of the signal arm. In point of fact, tests have shown that these day colour light signals are visible at a distance of over half a mile in the strongest summer sunshine, while they are far more easily picked out in foggy weather than a semaphore.

"The early railway signals, in which England led the world, as it did in the railway and the locomotive, were square or round disc, such as are still used on some Continental lines, but the type with which every railway traveller is familiar soon replaced these primitive forms.

"Signalling, as we understand it, really dates from the day when a lazy porter, who detested the job of continually walking up to the signal in order to set it, hitched a piece of string round it so that he could operate it at his leisure without bestirring himself."

At the time, that article stated that the semaphore signal had been declared "a back number" but in the three decades that have passed the installation of colour light signalling has been remarkably slow and mainly confined to stations where remodelling has occasioned alterations in signalling. In 1938 there were 3,000 colour light signals in use on British railways, 5,000 in 1948 and 9,320 in 1957 or



Three aspect colour light signal with junction direction indicator.

approximately 3 per cent of the total signalling installation.

From these figures it will be seen that semaphore signals are by no means obsolete though in suburban areas they have been superseded by the light signal. The semaphore signal has to use lights at night. The light signal is sufficiently powerful to be observed in daylight and has the advantage of showing the same type of aspect by day and night.

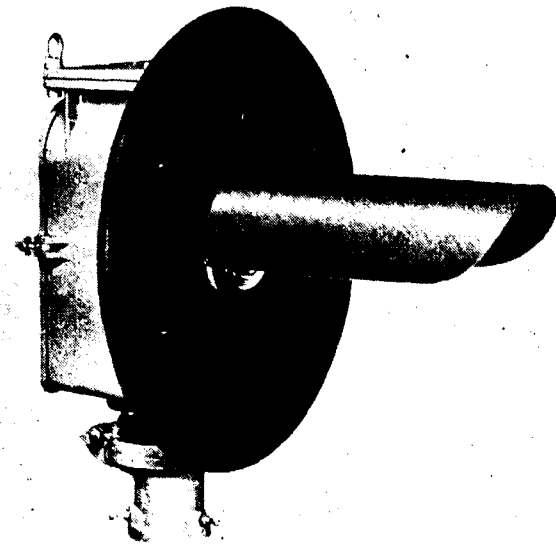
Experiments with colour light signals were made as long ago as 1913 but they were not too successful. The London Underground introduced a type of light signal for use in daylight about that period. It was an ordinary lamp signal as used in the tunnels, fixed on a post and surrounded by a deep hood to produce artificial shade to emphasise the aspects. Although used in daylight, it was mainly found in cuttings or sheltered places, not in direct sunlight.

The Liverpool Overhead Railway was the first in the Commonwealth to introduce colour light signalling and these were brought into use on July



First colour light signals installed in United Kingdom. A two aspect signal on the Liverpool Overhead Railway.

27, 1921. The railway (now closed) ran from Dingle to Seaforth Sands, along the west bank of the River Mersey, and for most of the way the tracks were elevated above street level. The signals were therefore displaying their aspects against a predominantly sky background and their success was never disputed.



Searchlight Signal.

All the signals were of the two-aspect type, the lamp case having three compartments. The top compartment held the equipment for the red indication and the middle for the green. The bottom compartment held the lamp transformers and terminal cases. The inner lens for the upper lamp was red and that for the lower-lamp green, the outer lens being clear glass. All the lenses were manufactured to a specification that ensured a true colour. The inner lens was 5½ in. dia and collected the greater portion of the light which was projected on to the outer lens reducing the rays to a nearly parallel beam. There were two bulbs in each lamp. The smaller was the focal lamp and nearer the lens consisting of a 12 V gas-filled lamp having a special filament which was normally under-run at 11 V. A larger lamp was behind the focal lamp and was rated at 110 V and obtained current through a relay direct from the a. c. supply. This was used as a stand-by source in case the local lamp burnt out.

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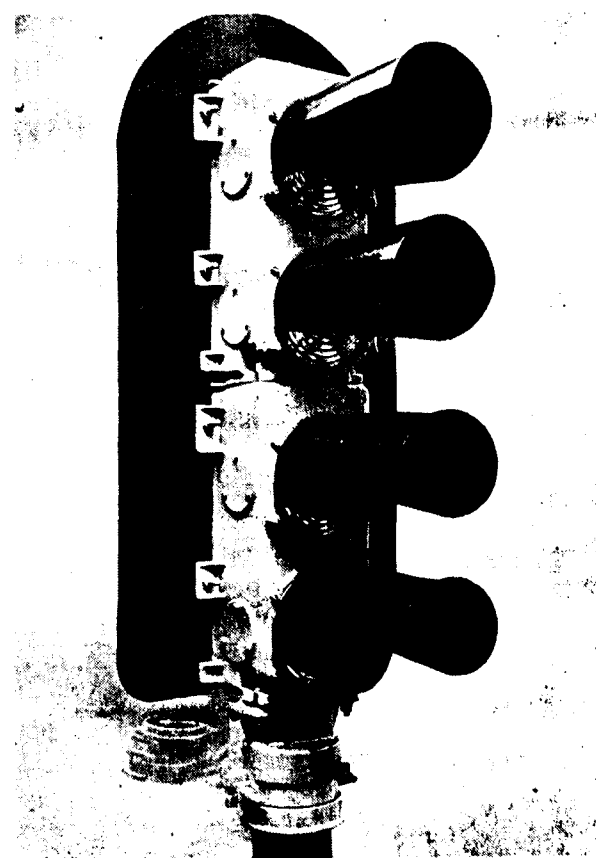
In 1923 the London Underground adopted two-aspect colour light signals for their extensions from Golders Green to Hendon and Edgware. At that time this type of signal was often referred to as a daylight signal. This installation was followed by others on the main line railways. Since its first appearance, the shape and form of the colour light signal has not changed but there has been constant development in lamps and lenses. Other types of light signals have since emerged and today there is the multi-aspect colour light signal, the searchlight signal, the position light shunt signal and the junction direction indicator.

Multi-aspect colour light signal lamp cases are generally of cast iron though some have been made of aluminium. A peep-sight device is usually placed at the top which enables the light beams to be focussed on to any desired point. They have a hinged, gasketed door at the back and a socket at the base to mount on a $4\frac{1}{2}$ in. or $5\frac{1}{2}$ in. dia pole. The lenses are usually of the doublet type with a stepped clear outer lens and a smaller coloured inner lens also stepped. This combination of lenses gives a highly concentrated beam. In order that drivers halted at signals can still observe their indication, a sector of the lens is so arranged that a strip of light is projected downwards.

Some railways use a side lamp for each indication. These comprise a small lamp case and lens fixed outside the main lamp case, one for each aspect. A transformer is mounted in the lamp compartment of each aspect the usual operating voltage being 110 V which goes to the primaries of the lamp transformer. The secondaries deliver 12 V which illuminates the signal lamp which can be either single or double filament but generally the latter is standard. This type of signal can be used for any number of aspects but in this country one to four aspects is normal practice.

The searchlight signal has only one lens, the actual colour of the light beam projected through the lens being changed by the mechanism inside the signal. This enables the signal lens to be positioned immediately adjacent to the driver's eye. Another advantage is that they can be operated by battery power enabling light signals to be used on installations where a power supply is not available. The upper portion of the case is provided with a peep-sight device as in the case of the multi-aspect signal. The signal consists of a lamp the concentrated filament of which is located at one of the focal points of an

ellipsoidal reflector which collects about 80 per cent of the light flux given off from the lamp and concentrates it at the second focal point of the ellipse. Near this point, which is coincident with the focal point of a clear, optical lens, the light passes through a coloured roundel, enters the lens and emerges as a beam of great power. Signals situated on curves can be provided with a half toric lens which produces a spread beam. A relay mechanism is placed inside the signal which operates a miniature spectacle bearing red, yellow and green glasses. The relay may be of



Four aspect colour light signal.

either the a. c. or d. c. type. The signal control circuit is arranged to give a polarised feed to the relay. When the control circuit is de-energised the red lens is in front of the lamp. When the control circuit is energised by one polarity the red lens is removed and the yellow lens takes its place. When energised by the opposite polarity the green lens appears before the lamp. Proper gravity bias on the spectacle ensures that beam flashes do not take place. The relay mechanism is provided with proving contacts which are used for lighting repeating lamps in the signal box.

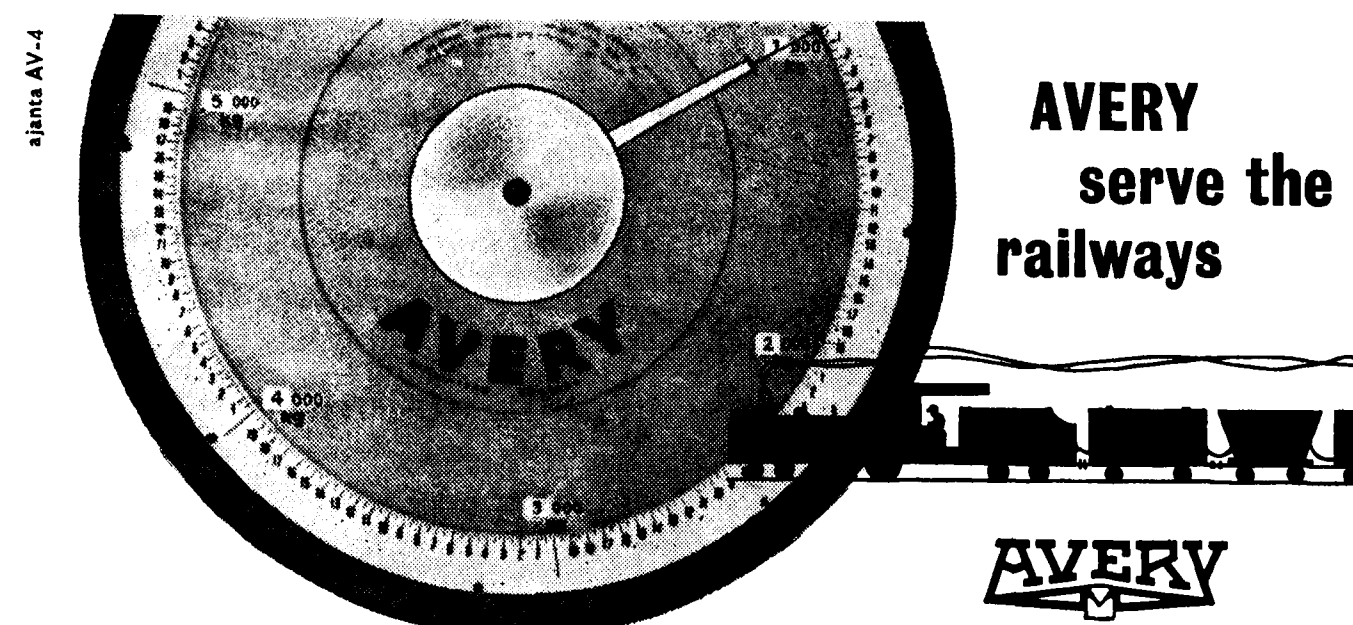
Where no power supply is available searchlight signals can be operated from primary or secondary cells. This is arranged by the use of a special compound lens in the signal, and a low power bulb. Light beams up to 1,500 ft. can be obtained. It is usual to arrange for such signals to be approach lit, that is by the occupation of the track circuit immediately in front of the signal.

The junction direction indicator signal was introduced some 13 years or more ago. Before this signal, a separate signal had to be used at junctions for each route. Besides being expensive and taking up a lot of room there was also difficulty in observing a green aspect with red aspects each side, these red aspects always appeared to be stronger than the green so that it could not be satisfactorily observed from a distance. The principle of the junction indicator signal is a row of white lights, which point to the right or to the left according to the direction of the divergence. The indicator is not used for movements along the straight line the driver being guided by the yellow or

green aspect of the signal. The advantages of the junction direction indicator are that it is cheaper than a number of signals one of which would be required for each route, it occupies less space and, as only one signal is used in conjunction with it, drivers are not required to pass a red aspect as would be the case when a separate signal is used for each route.

Compared with the total number of signals in use of British Railways, the use of the colour light signal has not been so extensive as envisaged when they were first introduced. What is certain, however, is that on the completion of the 15 years modernisation programme on British Railways, all main lines will be equipped with this type of signal.

India was not slow in adopting the colour light signal. Only six years after their appearance on the Liverpool Overhead they were introduced on the former B. B. & C. I. & G. I. P. Railways on the Bombay suburban section. These signals are now used extensively on the Indian Railways.



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Keyset-operated Centralised Traffic Control System

(I BOBERG, L M ERICSSONS SIGNALAKTIEBOLAG, STOCKHOLM)

By An Engineering Correspondent

The first C.T.C. installation in the world was put in service some 30 years ago. Since then many new C.T.C. systems have been developed in different countries, each of which has brought some improvement in rapidity of operation or general reliability. But the systems of operation, and the design of the control and indication apparatus, appear to have been neglected and still look roughly the same as they did 30 years ago. This article describes an entirely new system of C.T.C. operation by means of a keyset. In the last few years LM Ericsson has introduced C.T.C. in Sweden, Denmark, Norway, Poland, Yugoslavia and India.

CENTRALIZED Traffic Control—or C. T. C.—has proved an admirable means of improving railway operation. The introduction of C. T. C. on a line will both increase its capacity and reduce the station staff requirements. C. T. C. means that the train despatcher directs all train movements within his section by direct operation of the entire signalling system in that section from a central point, which may be located wherever desired but is usually placed somewhere along the line.

The degree to which C. T. C. can contribute to rationalized railway operation is admittedly little affected by the design of the controlling and indicating equipment at the C. T. C. office. This equipment does, however, appear to have been grossly neglected over a long period. It was not until a few years ago that it began to be realized that C. T. C. could, in fact, be put to very much more effective use if the controlling and indicating equipment were improved. This need has been accentuated by the tendency to place larger and larger sections of track under the control of one office. A more efficient system of control and indication will then lead to direct savings in staff at the C. T. C. office. (This will obviously not apply to small offices which can be managed by one man). The most important benefit to be derived from greater efficiency in the organization of C. T. C. offices—although not always easy to demonstrate in terms of money—is perhaps the possibility afforded of further improvement in the directing of train movements.

DEVELOPMENT OF CONTROLLING AND INDICATING EQUIPMENT FOR INTERLOCKING PLANTS

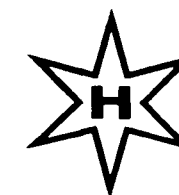
In studying the design of various controlling and

indicating apparatus for C. T. C., it may be of interest to consider the development of corresponding equipment for interlocking plants. Interlocking machines came before C. T. C. machines, and there is reason to believe that they influenced the design of the latter. Recently, however, a certain influence in the reverse direction has been noticeable.

It is obvious that the design of the controlling and indicating equipment of interlocking plants has been, and still is, greatly dependent on the devices to be controlled by and indicated to the signalman. When mechanical interlocking plants were usual, and both points and signals (semaphores) were mechanically controlled, the system could operate only over very short distances. Indications to the signalman were not considered necessary, nor did resources for transmitting them exist. The work was physically heavy. Later, when points and signals could be controlled electrically, the control machines were reduced in size. Control could be effected over greater distances, and the control equipment for a large area could be combined in one interlocking plant. This brought the necessity of indications; they were of a simple character, and the indicating lamps were usually placed on the control machines. When indications became more and more complete, and track circuit control was introduced, the indicating equipment had to be placed on a special track diagram behind the control panel so as to be visible to the controllers from their operating positions.

The interlockings required between the various controls for points and signals, to ensure that faulty operation did not imperil traffic safety, were initially set up by mechanical means in the control panels. Electrical interlockings were introduced in the thirties and in due course led to all-relay interlocking plants.

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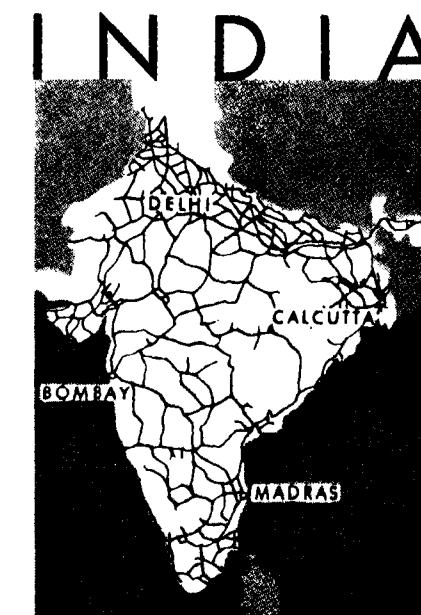
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The size of control panels could now be greatly reduced. Once again the indicating equipment could be placed on the control panel, and the methods of control could be simplified. The usual procedure was that signals and points along an entire train route were controlled by a single manual operation (possibly using both hands simultaneously). There are several designs of such equipment. The only method mentioned here is L M Ericsson's LTL (Line-To-Line) method with keys on the miniature track diagram on the control machine. The simultaneous operation of two keys controls the signals and points of the route on which the keys are placed (fig. 1).

With the advent of relay interlocking plants, larger and larger territories could be controlled from one office. The question now arose whether the control panel and track diagram should still be combined or whether they should again be separated. Different methods were adopted by different railways, but the most practical

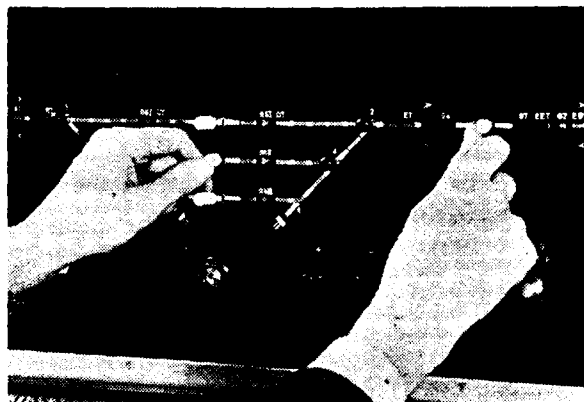


Fig. 1. Close-up of control machine of modern design for relay interlocking plants.

Line-To-Line control of an entire route is effected by throwing two keys simultaneously in the same direction. The keys are placed on the miniature track on the control machine as shown in the photograph.

procedure now appears to be to use a single panel provided that it is not larger than that the operator can reach all controls from his chair. If the panel is too large for this to be possible, it should be split into control panel and track diagram. If the control machine can have the controls placed on a sub-miniature diagram, this alternative would seem to be preferable.

It will be apparent that the initial goal of the designers of interlocking apparatus was to eliminate

the need of physical strength in the operator. Later efforts were aimed at the design of controlling and indicating equipment of a kind that permitted every operator comfortably and efficiently to control as large a territory as possible from his position at the machine.

THE DEVELOPMENT OF C. T. C. OFFICES UP TO THE 1950-IES

The first C. T. C. system in the world was installed in the U. S. A. in 1927. The line controlled was a very short one, and the little control machine was designed for individual control of points and signals, roughly as illustrated in fig. 2. It probably fulfilled all reasonable requirements at that time. But it is remarkable that the C. T. C. machines produced during the following thirty years closely followed the design of the original model. Most machines delivered even up to 1957 were probably almost identical in appearance and in operating principles to the machine produced 30 years back. In large C. T. C. offices the control machines have admittedly

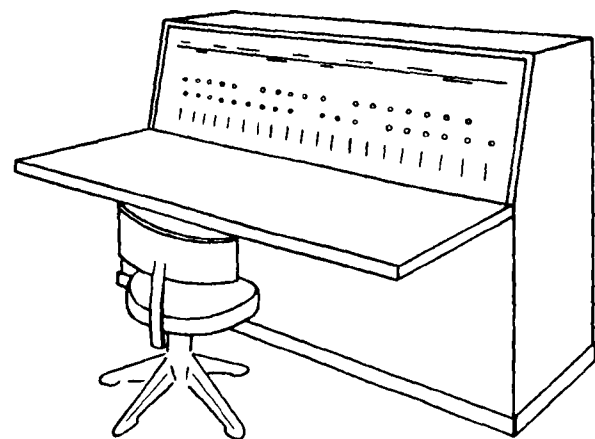


Fig. 2. Control machine in C.T.C. office, 1927 model.

assumed a horseshoe shape and the operator's chair now has runners, but the advance has not been rapid (fig. 3).

It would seem an important point that the C. T. C. operator should have a constant view of the entire track diagram of the territory for which he is responsible. This is quite clearly impossible with the "conventional" design of control machine and operating system. Moreover, according to the notions of our time, it is considered an advantage if the operator can sit still—even if a certain amount of

motion has points in its favour. The drawbacks of the conventional design are likely to become more serious in future owing to the tendency to enlarge C. T. C. areas. Quite soon a single C. T. C. office may control an entire railway district covering thousands of miles of track. The track diagram will then have to be divided into sections, as admittedly is done now, but the sections will have to be much larger. It should be possible to cover at least 300 miles and 50 stations from a single control machine of suitable design.

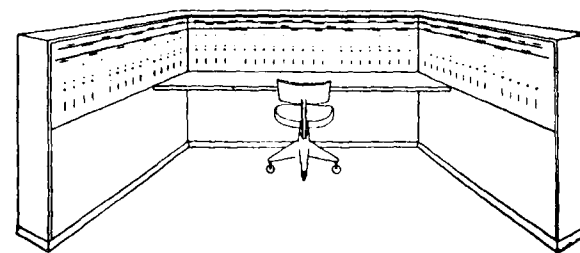


Fig. 3. Control machine of conventional type, model 1927-1958.

Most C.T.C. offices in the world are still of the design illustrated, and as a rule every point and every signal is still individually controlled. The operator cannot reasonably be expected to have the entire track diagram constantly under his eye while moving about. His chair is normally fitted with runners.

Individual control of points and signals is admittedly fully acceptable for a short length of track. But for large C. T. C. offices the method does not appear satisfactory. In the latter the control must cover entire routes, and should perhaps to some extent be automatic. The larger the C. T. C. office, the more important do these factors become. The introduction of route control on the LTL principle, as described for interlocking plants above, is a case in point. Systems of this kind have been installed by LM Ericsson in Denmark, Norway and Poland.

KEYSET OPERATION

LM Ericsson's first C. T. C. system was delivered in 1938. The control machine was of conventional design, although with equipment for control of complete routes. The equipment is still in service and operating efficiently.

When LM Ericsson started to redesign its C. T. C. system around 1950, primarily in order to step up the rapidity of operation, it was considered advisable at

the same time to modernize the control and indicating equipment and the method of operation. After careful deliberation and study the following criteria for a C. T. C. office were set up.

1. The operator should be able to actuate controls from one position.
2. The operator should have a good view of the entire track diagram from his desk.
3. The operator should be able to actuate controls with one hand (preferably the left hand).
4. The control panel must be capable of standardization for all C. T. C. offices and several control panels should be capable of operation in parallel, temporarily or permanently.
5. The normal procedure should be control of entire route. But individual control signals and points should also be possible.
6. If indication of category of train on track diagram is desired, the same control panel should be used for this purpose for other C. T. C. operations.
7. The track diagram should be semi-circular.
8. The operator should be able to transmit from the control panel information which permits automatic control of the C. T. C. system to a varying extent. The track diagram should possess the necessary indicating lamps for this purpose.

Requirements 1 and 2 meant that, at least in large C. T. C. offices, the track diagram must be separated from the control panel. Since it was also required that the control panel should be standardized, followed that this separation must apply to small offices as well. An example of the placing of the controller and his control panel in relation to the track diagram is shown in fig. 4.

The control panel would meet the requirements of universal applicability (standardization) and operable with one hand (requirements 3 and 4) if it was designed as a keyset of the type used on calculating machines. The keyboard could be large or small, with one or more sets of keys for each di-

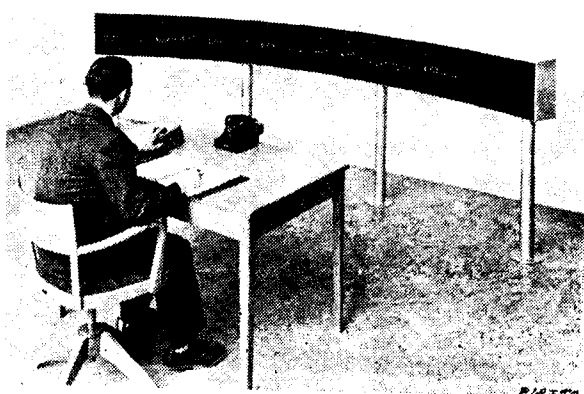


Fig. 4. Keyset and track diagram for C.T.C. office as supplied by LM Ericsson. All controls are effected by keying a multidigit number on the keyset. The operator has a full view of the entire track diagram in all situations. (This track diagram was delivered to the Swedish State Railways).

The small keyboard would require a rather more complicated intermediate relay set than the large one, but the advantages from the control aspect appeared so great that the small keyboard was adopted (fig. 5). Requirement 4, that several control panels could be used in parallel, was thereby easily met.

Since control was to be exercised through the keying of numbers on a keyboard, the numbers would have to be simple enough for the C. T. C. operator to remember at least those in common use. This did not prove difficult, particularly since, for reasons of rapid operation, an entire route would normally be controlled by keying a single code (requirement 5). An example of a logical numbering system for all routes on a single-track line is shown below. This is only one way of arranging the numbering. Many other systems would be equally logical and equally easy to remember. Easily memorable numbering systems can likewise be made up for double-track lines.

Keyset control nos.	Route
11	Approach from south (northward) main track
13	" " " " first siding
15	" " " " second siding
	etc.

21	Exit northward from main track
23	" " " " first siding
25	" " " " second siding
	etc.
12	Approach from north (southward) main track
14	" " " " first siding
16	" " " " second siding
	etc.
22	Exit southward from main track
24	" " " " first siding
26	" " " " second siding
	etc.



Fig. 5. Keyset for C.T.C. operation. The operator keys a four-digit number to control an entire route. When desired, however, he can control points and switches individually by keying other numbers. With other numbering schemes the operator can indicate the category or destination of each train on the track diagram, after which the indication moves with the train from track section to track section. A trained C.T.C. operator, of course, need not look at the keyset when manipulating the keys.

Odd numbers are used for all controls of trains in one direction, and even numbers for all controls of trains in the other direction. The first digit of all controls is odd for approaching trains and even for departing trains.

Each control, however, must consist of four digits, of which the first two represent the station number. The station number can be indicated on the track diagram so as to be easily visible to the controller from his working position. The control of a route for a train entering the main track at station 34 from the south will be effected by keying number 3411 (fig. 6).

Train categories (goods, express etc.) or train numbers (requirement 6) are indicated on the track diagram by the track circuit lamps or by lamps placed beside them. When a new train enters the C. T. C. section, the category of train must be indicated on the track diagram by operation of the keyset. This can be done for instance in the following manner. The controller first keys the number of the station and of the track on which the inbound train has entered the C. T. C. section. He then keys a letter, signifying the category, or numerals, signifying the number, of the train. The combination 0112G would provide the following information.

0 signifies that the subsequent digits and letter refer to the category of train. (The

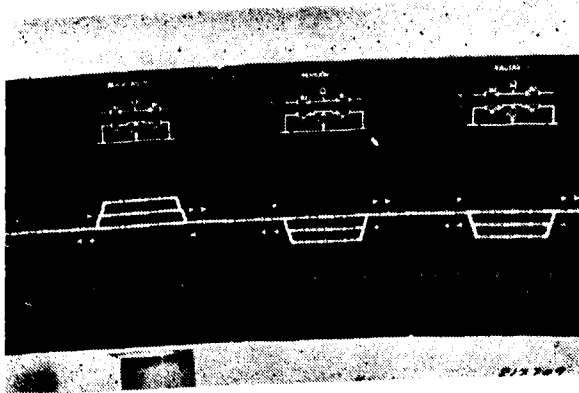


Fig. 6. Part of C.T.C. track diagram. Every station has its number, which the C.T.C. operator keys when transmitting a control. This track diagram also shows the positions of circuit-breakers and disconnecting switches in the rail-road overhead line and auxiliary transmission line. The control of circuit-breakers and disconnecting switches is effected with the keyset in the same way as control of routes etc.

information is not to be transmitted to the C. T. C. control register.)

11 signifies indication of the category of train at station 11.

2 signifies indication of the category of train on track 2 (at station 11).

G signifies goods train.

When using a train number system, the combination 0112324 would permit the entry of train number 324 to track 2 at station 11. The indication of train category or number moves along the track diagram automatically from track section to track section as the train advances.

Requirement 7 needs no special comment. The track diagram is semi-circular as shown in fig. 4.

Requirement 8 stipulated that the control system should permit automatic operation to varying degrees, and that whatever automatic methods were employed should be adequately indicated on the track diagram. This requirement is dealt with in the following section.

AUTOMATIC OPERATION

The execution of a C. T. C. control takes very little time. It amounts to a few seconds, and in a small office the actual operating time is a relatively insignificant factor. But it must be remembered that the main job of a C. T. C. operator is to plan train movements, not to execute the actual controls. In a large C. T. C. office, therefore, it may be necessary either to use several C. T. C. operators or to have a single operator and give him additional technical aids. We may take as example a single-track section comprising 25 stations and carrying 60 trains a day. During the period of heaviest traffic the operator would have to execute controls about twice a minute. (In assessing the amount of work to be performed by a C. T. C. operator, the number of occasions on which he has to execute controls would appear to be a better gauge than the number of controls to be executed.) Even if every action by the C. T. C. operator controls an entire route, he should hardly be made responsible for so great a number of operations if he is at the same time to do his main job of planning train movements.

But the capacity of a train despatcher can be increased by giving him additional technical equip-

ment. This can be arranged in several different ways without needing to add unduly to the expense of the C. T. C. equipment. The Swedish State Railways, for example, have introduced local equipment at the stations for storage of routing orders from the C. T. C. office. The C. T. C. operator can then give advance orders for control of several train movements, and the number of occasions on which he has to execute controls can be easily reduced to less than half. If considered preferable, the storage equipment can naturally be installed equally well in the C. T. C. office. It can also be combined with a certain measure of automatic operation by having station signals and points automatically set for a meet if two trains approach from opposite directions.

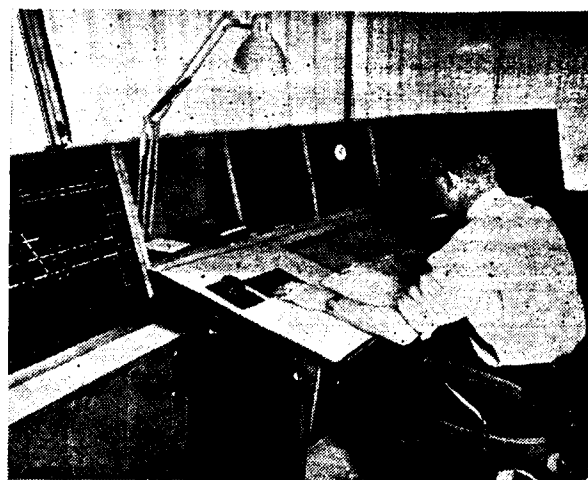


Fig. 7. C.T.C. machine and track diagram with Line-To-Line system

In the centre of the machine, beside the traingraph, are certain keys with which the controller can perform all normal operations. For special operations, however, he must move over to the track diagram. (This equipment was delivered to the Danish State Railways).

The Danish State Railways have chosen another method of reducing the work of the C. T. C. operator. It has been called the "destination indication system"; the destination of every train entering the C. T. C. area is marked on the track diagram by means of the track circuit lamps, or by lamps placed beside them, in the same way as the category of trains. When the train arrives at its destination, the destination lamp on the track diagram darkens and the C. T. C. operator keys a new destination. All signals and points are operated automatically by the destination marking equipment.

Keyset operation of the destination indication system could be carried out for instance in the following manner: When the C. T. C. operator wishes a train on track 2 at station 12 to move to track 2 at station 34, he keys 0122342:

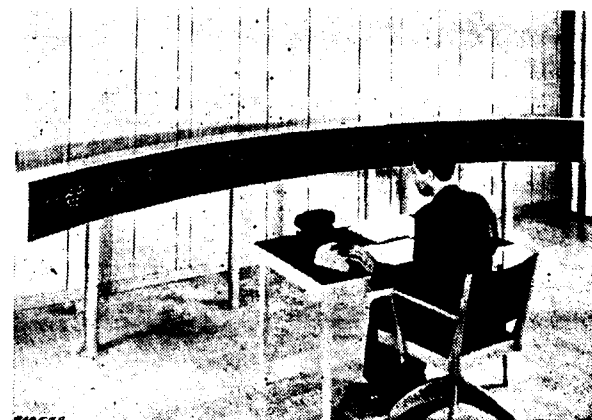


Fig. 8. C.T.C. equipment delivered to Yugoslavian Railways

This office, situated in Doboj, controls the roughly 100 kilometres of single-track line between Doboj and Zenica. The main part of the installation will be completed this year and the remainder during 1959.

- 0 signifies that the subsequent digits refer to destination marking. (The information is not to be transmitted to the C. T. C. control register.)
- 12 signifies indication of the destination of a train at station 12.
- 2 signifies indication of the destination of a train on track 2 (at station 12).
- 34 signifies that the train will proceed to station 34.
- 2 signifies that the train will proceed to track 2 (at station 34).

If for any reason the destination of a train requires to be cancelled, this is done by keying the track number and station number of the present position of the train, followed by 0. Number 01120 would mean cancellation of the destination of a train on track 2 at station 11.

Like the storage system employed by the Swedish State Railways, the destination marking system can be

combined with automatic equipment which sets signals and points at a station for a meet if two trains approach the station from opposite directions.

OTHER DESIGNS

Even if L M Ericsson has found that C. T. C. operation can best be effected by means of a keyset, it is obvious that other methods may be preferable in special instances. The aforementioned principles of indication of train category and of automatic control by means of storage or indication of destination can be applied to other methods as well.

Particular mention may be made of a method employed by the Danish State Railways, involving the control of entire routes by means of a Line-To-Line system on the combined control panel and track diagram. In parallel with the Line-To-Line controls, however, are keys which are placed in the centre of the control machine beside the traingraph (fig. 7). These keys can only be used for normal

control operations, but preclude the necessity of the C. T. C. operator moving from one part of the control machine and track diagram to another, apart from exceptional cases. The use of the destination indication system, with the controls placed beside the traingraph, means that the C. T. C. operator should in practice never need to leave his normal working position.

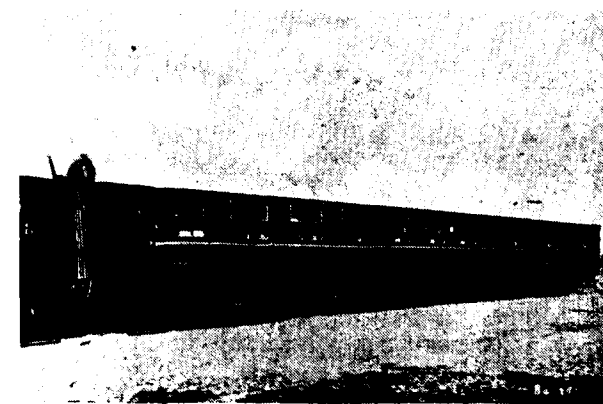
EXPERIENCE OF KEYSET OPERATION

L M Ericsson's first keyset-operated C. T. C. system was installed on the Swedish State Railways in 1955. The overall experience during these three years has been very satisfactory. The personnel have had no difficulty whatsoever in learning the numbering system, and it has found to be a manifest advantage that the C. T. C. operator should have the entire track diagram constantly under his eye and be able to perform all operations while sitting at his desk.

(Reprint 1163 from ERICSSON REVIEW)

BUFFET CAR BRa TATRA

In connection with the increasing claims on railway travel the Czechoslovak Wagon Industry has added to its assortment of products the type BRa car which has



been derived from the basic range of I-st and II-nd class passenger carriages. It has four 2nd class compartments and a buffet compartment separated from the corridor and fitted with a buffet table, a kitchen and a dining compartment seating 17 passengers.

The underframe and body of the carriage form an electrically welded self-supporting structure. The side

walls and roof are perfectly insulated against heat and sound. The interior arrangement is tasteful and modern, the panelling, moulding, fittings and



up-holstery forming an agreeable and harmonious whole.

The Tatra BRa car enables improvement of the comfort of passengers even on those railway lines on which the use of a dining car of classical construction would be uneconomical.

Steel Tubes in the Industrial Development of India

By An Engineering Correspondent

THE Steel Tube is an example of a design based on nature's precepts. The bamboo, the corn stalk and the bird's quill demonstrated to the primitive man the strength of a cylindrical shape.

In this mechanical age, man has adopted the Steel Tube in obedience to the natural law.

Steel Tubes are essential in almost every kind of Industrial expansion, for the provision of domestic amenities and for an increasing number of new end uses. Industry cannot exist without service pipes and mains. Locomotives, land boilers and ships need boiler tubes and many other types of pipework. The oil industry would stagnate without great quantities and varieties of pipes. Modern mining techniques rely on pipes for water and compressed air and for stowage and dust suppression.

As the industrial development of India progresses, more and more tubes are required, and in 1955 The Indian Tubes Company (1953) Limited commenced the manufacture of tubes at Jamshedpur. The first tubes to be produced at Jamshedpur were by means of the Fretz Moon process, with a capacity of 90,000 tons per annum of Screwed and Socketed Tubes, 1/2" to 3" nominal bore.

Screwed and Socketed Tubes are used mainly for carrying gas, water and steam but also increasingly as structurals, scaffolding, tubular point rodding and in the manufacture of materials handling equipment.

Since the Fretz Moon Mill was inaugurated, the Electric Resistance Weld Tube Mill, the Cold Rolling Mill, the Seamless Tube Plant and the Pole Plant have gone into production, and output has steadily increased. Last year it approached 100,000 tons and in 1960, with adequate supplies, this figure should be exceeded by a comfortable margin.

The Electric Resistance Weld Mill with a capacity of over 13,000 tons per annum meets the demand for quality tubes such as boiler tubes, cycle tubes, furniture tubes, transformer tubes, automobile tubes and electrical conduits.

The Cold Rolling Plant is capable of rolling strip as a raw material for the Electric Resistance Weld Mill, and has a capacity of 36,000 tons per annum. The excess capacity of this mill is used for the production of Cold Rolled Steel Strip and High Tensile Box Strapping.

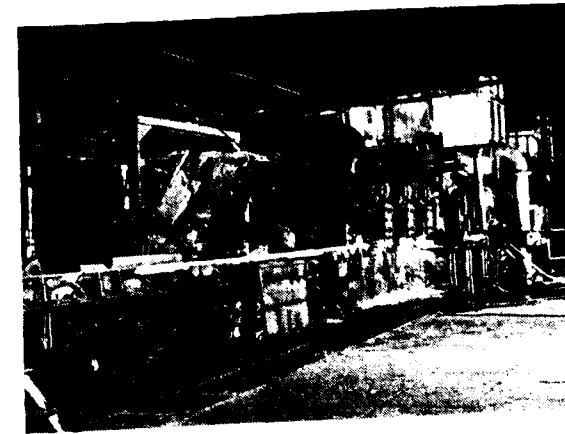
The Cold Rolled Steel Strip has, again, a wide variety of applications, and it is used in the manufacture of cycle wheel rims, mudguards and a multitude of small pressings.

To meet the demand for large diameter tubes, a Rotary Forge Seamless Tube Mill with a capacity of approximately 30,000 tons per annum has also been installed at Jamshedpur. This mill meets the demand for commercial pipes in the range of 4" to 6" nominal bore and also supplies Hot Finished and Cold Drawn Seamless Tubes for Flue Tubes, Casing, Steam Lines, Linepipe, mechanical and hydraulic purposes. A certain tonnage of this production goes to the Tubular Pole Plant which has a capacity of 150,000 Poles per annum on a 3-shift operation.

A brief description of the various processes is given below :—

FRETZ MOON PROCESS

The raw material is Hot Rolled Skelp in varying widths and thicknesses, depending on the size and thickness of the tube to be produced. Coils of Hot Rolled Skelp are drawn through a leveller where the strip is flattened, through the shearers where the ends are trimmed and then through a flash welder where successive coils are welded together end to end to form a continuous strip. The strip is next heated in a continuous furnace to a temperature of about 1300°C and then passed through forming rolls which roll it into tube shape and weld the edges together. The flying saw, mechanically linked to the mill drive, cuts the continuous tube into the required lengths and, beyond the saw, a sizing mill ensures that the tubes are correct in diameter and within the tolerances which are a feature of this process.



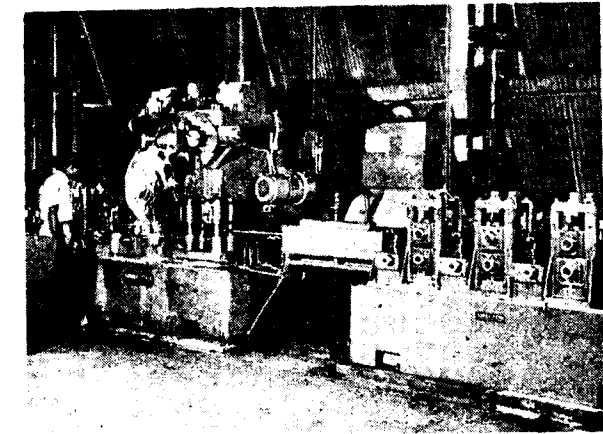
Fretz Moon Tube Mill—Showing the flying saw cutting the tube.

Tubes are often required galvanised, and equipment of the most modern design is available including a galvanising bath, holding nearly 100 tons of molten zinc and magnetic roller discharge gear and equipment to remove excessive zinc deposits from the tubes.

Finally, the tubes, either galvanised or black, are passed on to the finishing shop which is equipped with a range of automatic and semi-automatic units to undertake the various processes required, viz. straightening, screwing, socketing and hydraulic testing.

ELECTRIC RESISTANCE WELD PROCESS

For the manufacture of Electric Resistance Weld Steel Tubes, again, Hot Rolled Skelp is the principal raw material. This skelp is first cold rolled through a Cold Rolling Mill before being fed into the Electric Resistance Weld Tube Mill. The Cold Rolled Strip passes through a Rotary Slitter which takes off the side-trim to obtain a perfect edge for subsequent welding operations and then on through a series of forming rolls which form it into a tubular shape and with the edges pressed together. It is then passed under a high frequency Electric Resistance Welder. This Welder consists of an oiled cooled rotary transformer fitted with copper alloy electrodes which run on the surface of the formed and guided strip, one on each side of the seam. Power to the Welder is supplied at 300 K. V. A., 200 cycle frequency and the seam is welded at this point at speeds reaching 150 feet per minute on thin wall tubes. All traces of the bead resulting from the weld are removed from both inside and outside surfaces of the tubes by scarfing tools positioned after the Welder. Subsequent to the welding operation,



Electric Resistance Weld Tube Mill.

a cold sizing mill is employed, which controls the final size of the tube to the close limits required by modern specifications for boiler and other precision tube categories. The tube is then cut to lengths and depending on its final application, it can be subsequently annealed or normalised in a continuous gas-fired furnace.

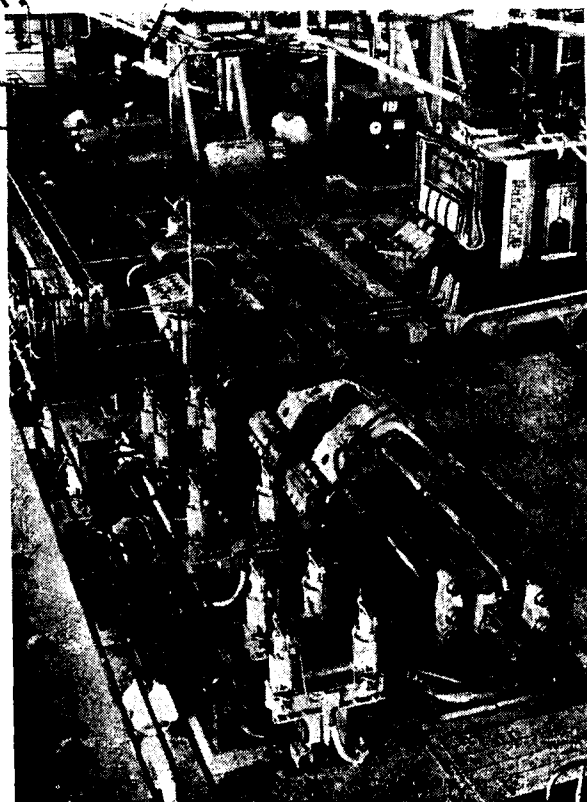
The plant is provided with all the necessary ancillary equipment, consisting mainly of modern strip handling machines, e. g. coil crane, uncoiler, leveller, shears, flash welder and edge slitter, so as to ensure uninterrupted delivery of suitable strip to the mill to keep the process continuous. The finishing plant is also provided with necessary equipment to ream the ends of the tubes, where the tubes are subsequently welded together end to end, straightening machines and equipment to swell and reduce the ends of the tubes for subsequent use in boilers.

SEAMLESS PROCESS

The main producing plant consists of a Rotary Forge Mill (Pilger Mill) producing Seamless Steel Tubes in the range 3 1/4" to 6 5/8" outside diameter.

This range is covered by nine basic tube sizes rolled direct on the mill. Intermediate sizes and sizes from 3 1/4" down to 2 3/8" outside diameter are obtained by subsequent reduction in a Reducing Mill.

The raw material consists of Hot Rolled Blooms upto 30 feet in length which are flame cut into billets by equipment which cuts four billets simultaneously. After cutting, the billets are heated in a gas-fired rotary furnace of 10 tons per hour capacity to a temperature of about 1250°C.



Billet Piercing Machine—Seamless Plant.

After discharge from the furnace the billets are calibrated in a 2-roll mill to produce a tapered corner profile which ensures accurate fit in the container of the subsequent piercing operation.

The Hydraulic Piercing Press of 550 ton capacity transforms the approximately square billet into a cylindrical hollow or "bottle", which is then passed to the Rotary Elongator of 1,600 h. p. The inclined rolls reduce the diameter and thickness.

This operation produces a short thick walled tube

which is then fed to the 1,000 h. p. Rotary Forge Mill where it is forged on a mandrel into the final tube, which may be upto 70 feet long.

In the outlet conveyor system from the mill are located hot saws which trim the ends of each tube and where multiple lengths are rolled, split them into final tube lengths.

The Finishing Bay is provided with machines for straightening, cutting, threading, swelling and swaging, machining ends and testing hydraulically tubes of various categories.

In order to meet the demand for other quality products including flue tubes, where cold drawn finish and dimensions are specified, a separate bay is provided which is equipped with a 150,000 lb. Cold Drawbench and a Tube Annealing Furnace.

Adjoining the Finishing Bay, facilities are provided for production of Transmission Poles and small Lighting Poles.

The picture at the moment is that the Steel Tube industry in India is comparatively highly developed and prospects appear to be almost unlimited as the industrial tempo quickens.

The present installed capacity of the Industry is around 175,000 tons a year of which about 140,000 tons are accounted for by the project at Jamshedpur.

At Rourkela, an unit is going up with a capacity of more than 100,000 tons a year for manufacturing welded pipe in the larger sizes, ranging from 8" to 20" diameter. Thus, the Third Plan will see India manufacturing substantial quantities of tubes in sizes ranging from ½" to 20".

Copper Sheet and Strip

The Indian Standards Institution has recently published IS: 1550-1960 Specification for Copper Sheet and Strip for the Manufacture of Utensils and for the General Purposes which covers the requirements for two grades of copper sheet for the manufacture of utensils and for general purposes, such as roof coverings, flashings, weatherings, gutters, damp-proof courses in buildings, etc. Grade 1 includes copper sheet and strip for pressing quality while Grade 2 includes the same for hand worked articles and general purposes.

The standard is one of a series of Indian Standards on copper sheet and strip. Another standard on copper sheet and strip for electrical purposes is under preparation.

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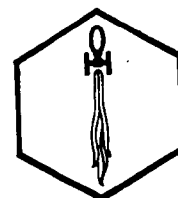
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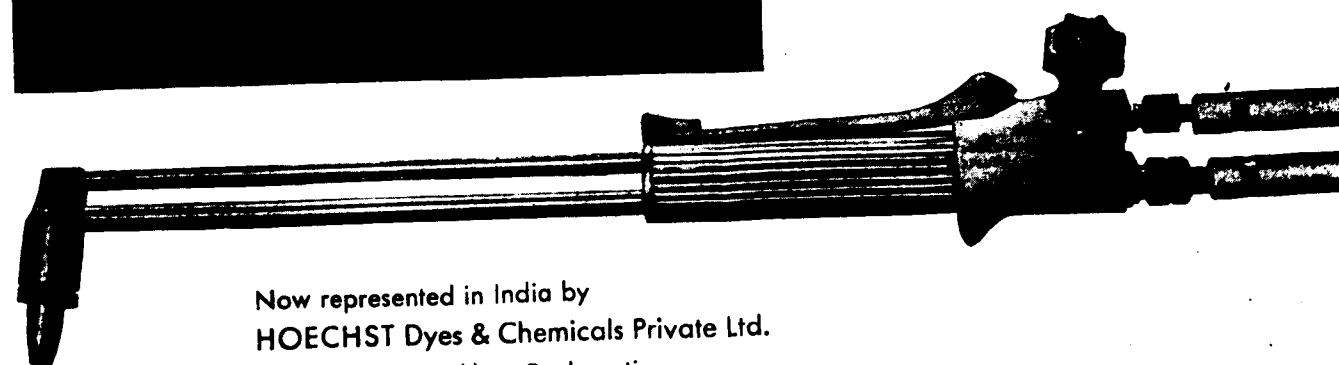


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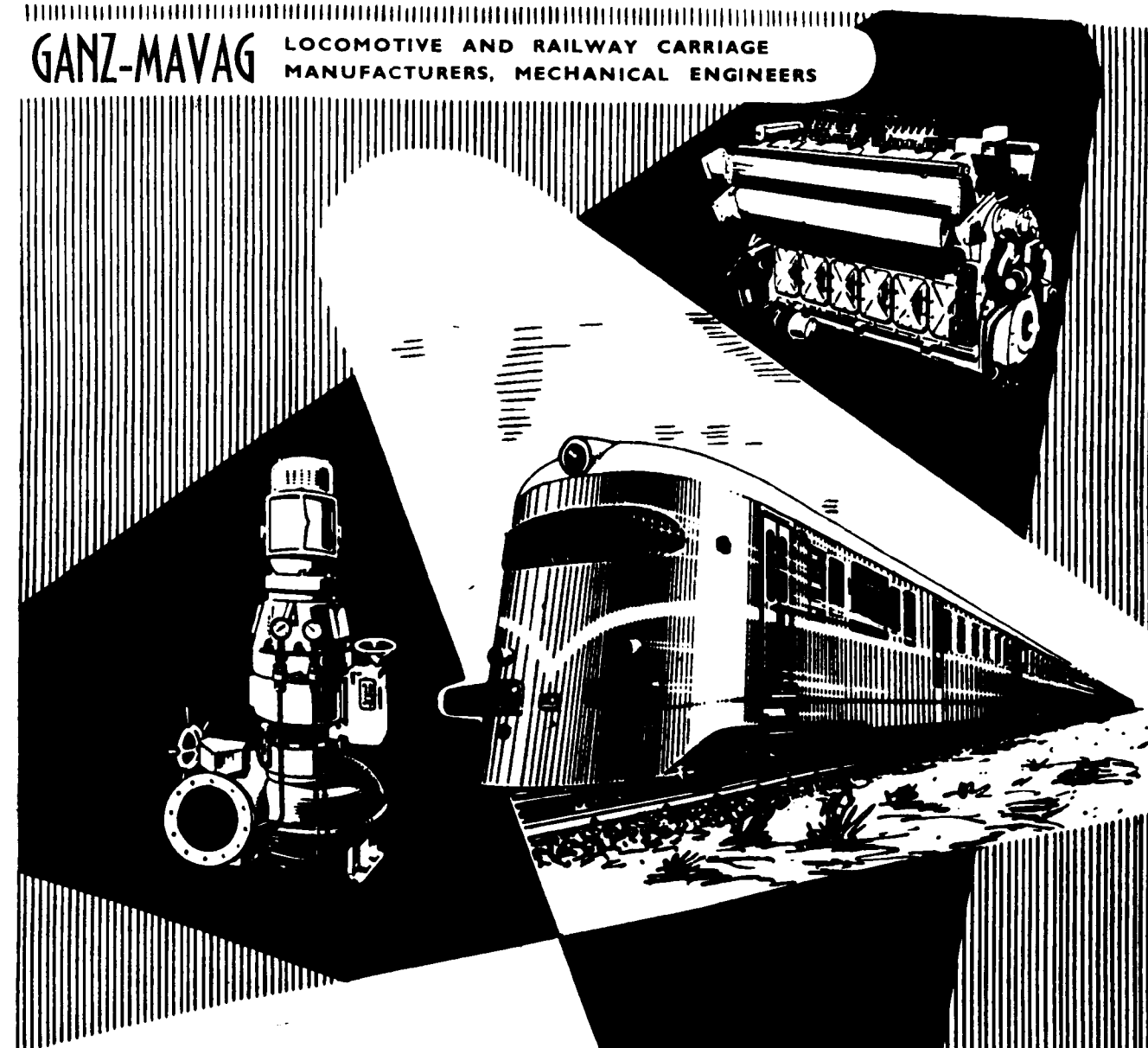
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NOHAB-GM 1950 HP DIESEL-ELECTRIC LOCOMOTIVE STREAMLINER, TWO CABS

By An Engineering Correspondent

SINCE 1865, when the first steam locomotive left the works of Nydqvist & Holm Aktiebolag, rolling stock for the railways in the form of locomotives, railway coaches and wagons has been one of that firm's foremost lines of manufacture.

During the past years, locomotives have been supplied to a great number of countries. After the first world war, the largest order in the history of the locomotive industry, was received from Russia, and 500 locomotives were delivered from Trollhattan during the years 1921—1924. Two years later an

At NOHAB, as the firm is generally called, the locomotive designs have developed in pace with the requirements of the times.



NOHAB-GM diesel-electric locomotives being manufactured in the NOHAB shops.

The first electric locomotive built by NOHAB was supplied as early as 1897.

NOHAB has long been interested in diesel locomotives. An agreement was made in 1950 with Electro-Motive Division, (EMD), General Motors Corporation, (GM), USA, covering the manufacture of diesel-electric locomotives. Through this agreement NOHAB was offered the delivery of EMD's well-known and well-tried diesel engines and electric equipment. Diesel-electric locomotives using these components were introduced in Europe by the Danish State Railways, DSB, who ordered four locomotives from NOHAB. The first of these locomotives was supplied in February, 1954.

Thanks to the good test results and later based on experience with the first four locomotives, DSB estimated that they saved 678,000 Danish Crowns (£ 35,300:— \$ 97,900:—) per locomotive per year as compared with steam locomotives of the same size. On this basis, operation of these locomotives resulted in

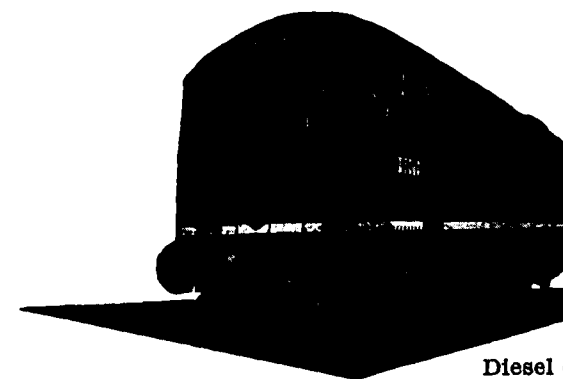
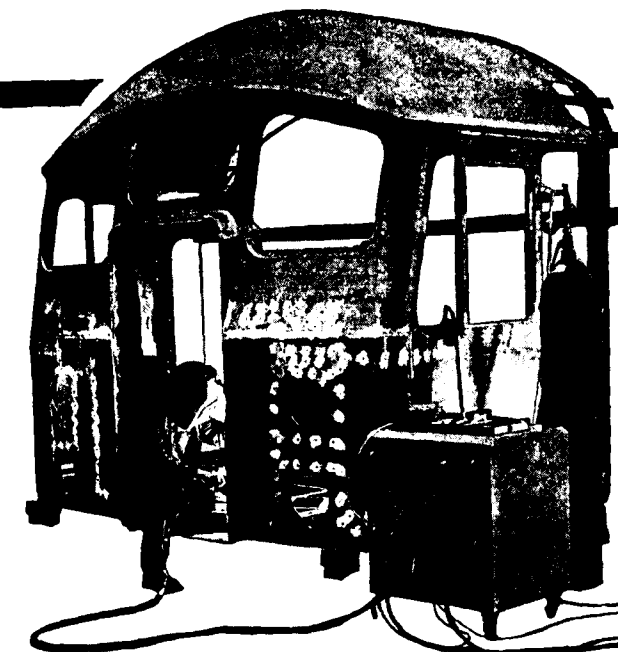


Lowering the car body of a NOHAB-GM diesel-electric locomotive in the NOHAB shops.

order was received from Turkey for 100 locomotives and 1500 coaches. Other large orders have been received from the Argentine, Persia and other countries.

British Railways Diesel Unit

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Surge Injector Welding Units

One of the most modern British Railways locomotives in production today in this 1160 H.P. Diesel electric type, which is being constructed at Derby under the supervision of the Chief Mechanical Engineer (London Midland Region). Saturn-Hivolt argon arc welding equipment and Saturn High purity argon are being used extensively for the important welding of aluminium alloy which is being used to lighten the construction.

The Saturn-Hivolt argon arc surge injector has proved itself invaluable wherever first class welding of aluminium and its alloys is required. Ask for a demonstration in your own factory.

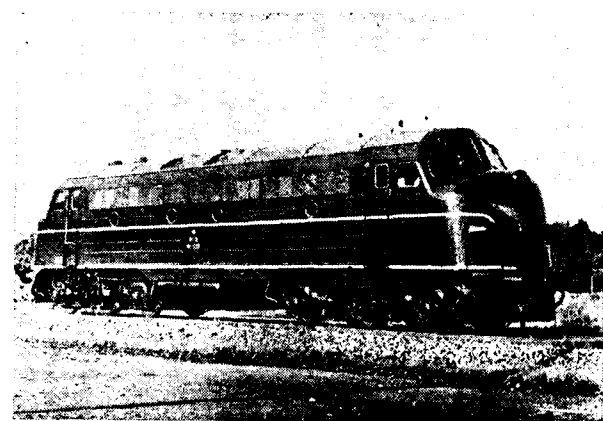
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One of the NOHAB-GM diesel-electric locomotives, delivered to the Danish State Railways.

savings over a two and a half year period equal to the purchase price of the locomotives.

As per the latest information from the Danish State Railways, the savings which have been attained, only with regard to fuel costs, imply a yearly reduction of about half-a-million Danish Crowns per locomotive.

Due to the operating economy of the locomotives and their reliability in operation, DSB have placed another three orders with NOHAB for a total of 85 diesel locomotives. After one year's test run with a NOHAB-GM locomotive the Norwegian State Railways, NSB, found it so robust and reliable as well as economic that they decided to introduce 22 such locomotives on their most exacting lines.

In Belgium a large number of diesel locomotives of this type have been manufactured to NOHAB's design.

Also the Swedish State Railways have been supplied with diesel-electric locomotives of the NOHAB-GM type. These are of the road switcher hood type rather than the streamliner type supplied to DSB and NSB and, although smaller and lighter, they have proved to be capable of handling all tasks assigned to them. Thanks to the good results, obtained by the first NOHAB-GM locomotives on the Swedish State Railways, NOHAB received a repeat order for 25 locomotives of the same type.

TEN NEW HYDRO-ELECTRIC STATIONS

The USSR will build 10 more big hydro-electric power plants, in addition to those envisaged by the Seven-Year Plan to keep up with the rapid advance of the national economy, and of the heavy industry particularly. The total capacity of the new electric stations will run into 10 million kw.

At the power plant designing administration, it was learned that one big hydro-electric station will be built on the Vakhsh River, near the city of Stalinabad, capital of the Tajik Republic. The station will have the world's tallest dam—300 metres high.

The blueprints have been completed for a hydro-electric station that is to go up near the city of Cheboksary on the Volga. It will be the third largest project on the Volga, after Stalingrad and Kuibyshev. This station's annual output will equal practically the total production of all the electric stations in tsarist Russia in 1913.

* * * * *

AUTOMATIC CHECKING MACHINE

The Kalibr plant in Moscow is a major supplier of control and measuring instruments. So far a big army of checkers are working in the national

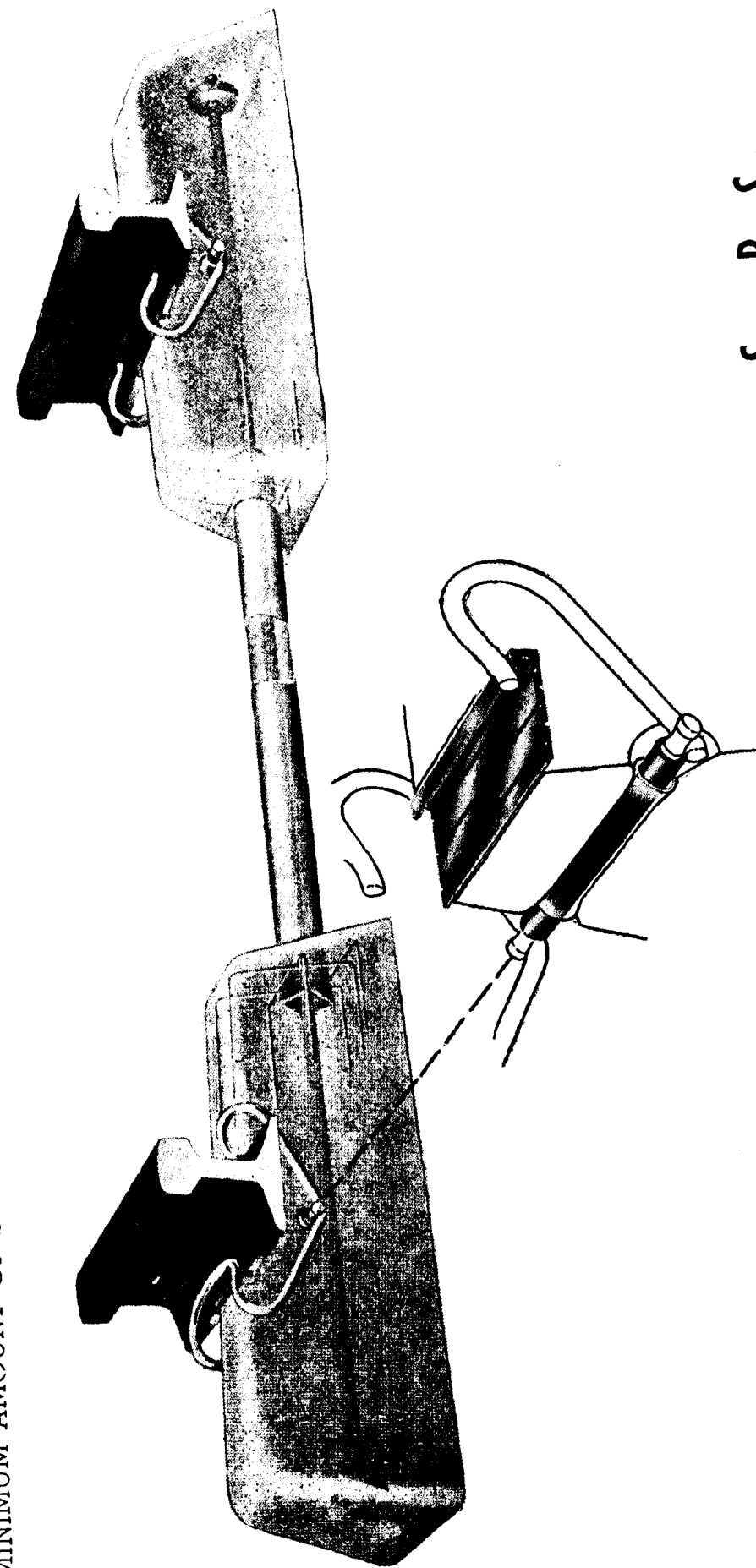
economy. However, in many places this responsible and painstaking job has been taken over by automatic machines bearing the Kalibr plant's trade mark.

Recently a test model of an automatic electronic checking machine which measures and sorts out high-precision bearings was manufactured and delivered to the bearing industry. One such machine replaces ten checkers. Another important work of the factory designers are standard units for automatic checking machines. This will make it possible to design and launch serial production of such machines much faster.

* * * * *

MACHINE FOR PATTERN MAKING

Pattern making is one of the most labour-consuming jobs in foundry work. Highly skilled pattern-makers have to perform a great deal of work by hand. The Institute of Woodworking Machinery decided to try and improve on the work of pattern-makers. A group of research workers together with rationalizers and engineers of the Stankolit plant has produced an automatic unit for cross-cutting sawed timber. Recently two such units went into operation at the plant's pattern-making shop.



PRESTRESSED CONCRETE SLEEPER 101
with intermediate steel tube
BOLT-LESS RAIL FASTENING **FIST**
resilient and with great clamping force
RELIABLE ELECTRICAL INSULATION
infallible method of mounting
MINIMUM AMOUNT OF STEEL

Swedish Rail System
 Sveavägen 25 • Stockholm • Sweden
 Cables: Rallsystem • Stockholm

Articulated Double-deck train to solve traffic problems

THE VEB Waggonbau Gorlitz — German Democratic Republic — exhibited at the Leipzig Spring Fair 1958 as a reconstruction an articulated 5-car double-deck semi-train with bufett car, which attracted the interest of all exports being a first-class manufacture. This new unit is characterized among others by an enormously increased economy in operation. It is possible to make up trains according to presented needs and demands. The car length is chosen most favourably in proportion to the capacity, making it possible to convey a considerable number of passengers. The utilization of a special light-weight construction resulted in a seat weight of 200 kgs. never attained before by international standard.

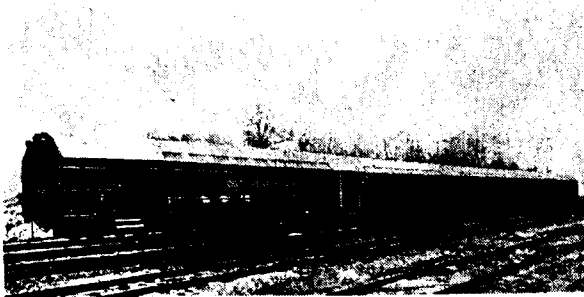
A capacity of 640 seats in seat order 2+2 was taken as basis for the semi train, the train being equipped without electric heating.

Proceeding from the results of the meanwhile carried through clear tests and wishes presented by clients, the articulated double-deck train has been further accomplished in serial construction and has been provided among others beside the former low-pressure steam heating also with an electric heating 1000 volts. The travel comfort being even remarkable before has been increased, the semi train now having 620 seats in favour of higher convenience.

These trains are mainly used in the tourist and commuter service of the GDR, i.e. according to need as 5-car semi train or as 10-car train. A special bufett car at the end of the train or in the middle (in the latter case it is called an articulated 11-car double-deck train) with its up-to-date kitchen and bufett installations secures the gastronomical needs of the traveller. The 5-car train consists of 2 end and 2 middle cars of double deck construction, as well as of 4 intermediate sections of one-storey construction which serve as entrance vestibules. On the whole 6 two-axle bogies without axle holder take up the superstructure. The separate cars are connected articulatorily and the transition from one car to the other is not particularly conspicuous from the outside. In the interior of the car the transition is fluent. Upper



and lower deck are large areas with together 124 seats each car. The double-seats have high back rests and head cheeks and are soft and upholstered. 1200 mm windows and the tube lamp lighting render best light conditions by day and night. The brake system laid



Length of each intermediate section	2 350 mm
External car width	2 870 mm
Height of car from rail top to top of roof sheet	4 650 mm
Foot height over rail top : upper deck	2 391 mm
lower deck	371 mm
intermediate section	1 185 mm
Wheelbase of bogies	2 500 mm
Shortest curve radius in operating installations	100 mm
in open line	150 mm

out for 120 km/h speed A loudspeaker installation permits the transmission of broadcast programs and other serviceable informations.

In addition to the aforementioned the following particulars of the semi train of the present construction series are interesting :

Length over buffer	104 300 mm
Length of each end car over front walls	21 275 mm
Length of each intermediate car	16 550 mm

The above described articulated double-deck train has also roused great interest abroad and will increasingly be exported in the next years. At the Leipzig Spring Fair 1960 the VEB Waggonbau Gorlitz will show such a semi-train again.

A Chain of Hydropower Stations on the Angara River

Engineering preliminaries have been started for the construction of a hydropower station at Ust-Ilim on the Angara river in Siberia.

With a design capacity of 4.5 million kilowatts (as against the 2 million kilowatts of the Grand Coulee Dam, the largest water power development outside the Soviet Union), the station will be built 250 kilometers down from Bratsk where the Ilim river meets the Angara. The river at that spot is not wider than 800 metres, while the bed and banks are of strong rock providing an excellent foundation for the power plant.

The design drawn up by Moscow engineers envisages the installation of the world's largest turbine-generator sets, each rated at 500,000—600,000 kilowatts.

The project will take from four to five years to complete. Its output will be pooled into the mammoth Siberian power grid to boost above all the expansion of non-ferrous metallurgy.

The Ust-Ilim hydropower station is a third link in the Angara chain of water power developments. Already operational is the Irkutsk station (660,000 kilowatts), and the Bratsk station (4.5 million kilo-

watts) is under construction. Plans are afoot to build several more of them on the Angara. Their aggregate power output will be upwards of 10 million kilowatts.

At present, the Soviet Union is the second biggest power producer in the world. In nine months of this year electricity production in the Soviet Union amounted to 187,000 million kilowatt hours.

* * *

GLOSSARY OF TERMS FOR ELECTRICAL CABLES AND CONDUCTORS

The Indian Standards Institution has just published IS : 1591—1960 Glossary of Terms for Electrical Cables and Conductors. With the progressive formulation of Indian Standard Specifications on many types of cables and conductors, the need for following uniform definitions in all the standards was felt. With a view to facilitating this and to avoiding repetition of definitions of terms in each standard, these have been reviewed and brought under one cover. While drafting this standard, the definitions recommended by the International Electrotechnical Commission (IEC) have also been taken into consideration.

SLEEPER PLANT OF DURGAPUR STEELWORKS

THE initial trials at the Sleeper Plant of Durgapur Steelworks were successfully carried out when the sleepers were produced for the first time at the Plant Site.

This plant is designed to produce sleepers for both Broad Gauge and Metre Gauge railways.

Sleeper bars are produced in the Continuous Billet and Sleeper Bar Mill and cut to length in the Sleeper Plant by a down-cut shear and transferred by means of a conveyor to a walking beam type of furnace for reheating. This furnace is fired by Mixed Coke Oven and Blast Furnace gas obtained from the works system, and is capable of heating 15 tons of sleeper bars per hour.



The Sleeper Plant



The Lighting up of No.2 Battery of the Coke Ovens Plant by Mr. Malcolm MacDonald, High Commissioner for the United Kingdom in India, on 12th October at the Durgapur Steelworks now being built by the British Consortium—ISCON

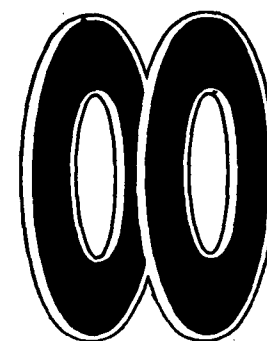
From the furnace, the bar goes directly to the 250 ton press, where both the sleeper forming and hole punching are carried out in one operation.

The sleepers are carried by conveyor to the tar dipping tank being descaled enroute by means of high pressure water jets. After dipping and cooling, they are weighed, inspected and stacked to await despatch.

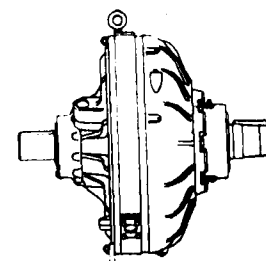
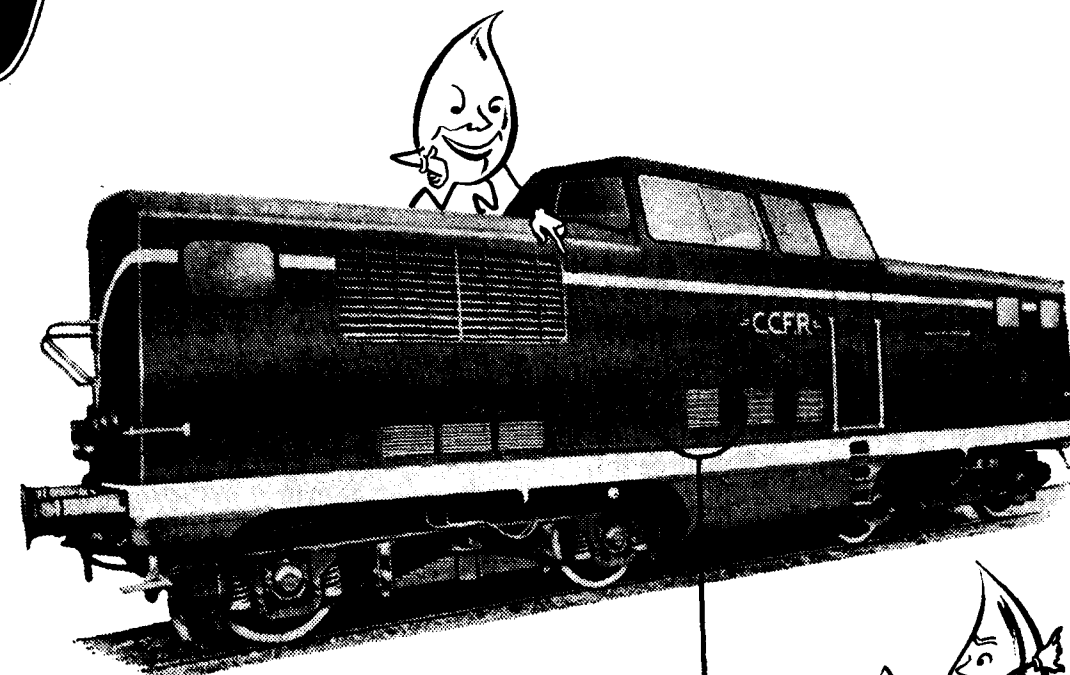
The Sleeper Plant has been built by Davy and United Engineering Co. Ltd.—a Member Company of ISCON—the British Consortium constructing the Steelworks at Durgapur.

Soviet Air Conditioners

Air conditioning is used widely at Soviet factories. It helps improve working conditions of steel-makers, miners and chemists. Air conditioners are manufactured by a plant near Moscow. "Our air conditioners", Alexei Myerkin, an engineer of the plant, said, "create normal temperature and air humidity at steel-smelting furnaces, in foundries, chemical plants and mines. A push of a button produces the desired warmth or coolness. We have prepared a new portable air conditioner for mass production. It can be placed, for example, in the cabin of a crane operator in a hot shop of an iron and steel plant. "Air conditioners will be used in dwelling houses as well. Our factory has produced an air conditioner working on semi-conductors. Resembling a radio receiver, it will maintain any given temperature and replace steam heating".



Look, Henry, this 1000 HP diesel-hydraulic line locomotive has a simplified transmission!



This new locomotive, produced by "Reggiane" Officine Meccaniche Italiane S.p.A., in Reggio Emilia, Italy, uses a TWIN DISC 16 000 Series three stage torque converter... assuring tractive effort and speed well above average at a fraction of normal cost. No wonder the owner is delighted. To find out how TWIN DISC converters can help you solve your power transmission problems, just write to either of the addresses below.

TWIN DISC equipment is backed by a world-wide network of dealers and parts stations.

Our representative in India is:

ASSOCIATED EXPORTS IMPORTS CORPORATION
8B Lal Bazaar Street
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TWIN DISC CLUTCH AG TECHNICAL OFFICE ZURICH SWITZERLAND KALKBREITESTR 33

BICC Group Railway Traction Research Laboratory at Tolworth

E BICC Group designs, supplies and installs overhead electrification equipment for British Railways as well as railway modernization in overseas countries and has naturally, in d of its activities, a special interest in the mecha- problems peculiar to the operation of such ent. Foremost among these is that of achieving ely uniform current collection from a static d wire traversed by a pantograph mounted on g train.

problem arises because the contact pressure i the two components is continually changing. as been recognized for a long time, but it s more important as higher supply voltages and, lighter overhead wires are used, and as running ncrease.

formation on the performance of his equip- he designer has hitherto had to rely almost on observations made on the actual railway it such observations are difficult, lengthy and of accuracy. The BICC Group has, therefore, ted its already extensive research facilities by p a new laboratory designed specifically for of this nature by means of a scale model of reproducing faithfully all the dynamic cal characteristics of the full-scale equipment ated speeds up to at least 100 m. p. h. Believed e only one of its kind in the World, this model i operational for some months in the laboratory orth, which was visited by the overseas dele- British Railways Electrification Conference.

boratory housing the models measures about y 20 feet. The track is in the form of a op with two straight sides 144 feet in length ing curves 14 feet in diameter. The middle the straight sides, the actual test sections 80 ngth, are enclosed and temperature controlled. /, about 12 inches long, driven by a 50-volt or supplied with current from the rails, is used icle for the pantograph and the necessary nation. The motor is underslung to lower the 'gravity and avoid the risk of derailment at s. The scale of velocity is such that an actual ed of 100 m. p. h. is represented by a model speed of nearly 18 m. p. h.

The model pantograph follows closely the articulated design of the prototype. Each member was designed with the correctly scaled bearing length and approxi- mately the correct centre of gravity, but with a lower mass than required. The necessary additional mass was then added by two separate weights which were so positioned that each member possesses the correct centre of gravity and moment of inertia. The two working springs are steel helices and the springing of the pantograph head is achieved with leaf springs.

The three arrangements of overhead equipment— simple catenary, compound and stitched catenary— which have been designed and are being installed by BICC for the British Railways 25 kV a. c. system are being reproduced. The solid contact wire and the stranded catenaries are represented by fine wire on which closely spaced cylindrical beads are fixed to give the correctly scaled mass and elasticity.

In all, more than 300 beads are used in each one- foot length of model contact wire so that there was a considerable manufacturing problem. Similarly, the assembly operation was a tedious one requiring a high degree of precision and patience. Every 6-foot length was tested for extensibility and flexural rigidity, after which the separate lengths were joined, with a bead covering the joint position so that mechanical unifor- mity was preserved throughout. The droppers were also manufactured from wire carrying beads or frac- tions of beads.

The first form of support to be studied is the “hinged cantilever”, consisting of a diagonal strut tube supported from porcelain insulators by a stranded tie-wire and hinged at the vertical mast. The upper end of the strut tube holds the main catenary, the auxiliary catenary and contact wire being attached to hinged “registration” and “steady” arms. The latter, which can move independently of all other hinged members, are arranged to be always in tension and are reserved at alternate supports to give the necessary stagger of the contact wire. The inertial mass and distribution of mass are scaled in the model.

Position, velocity and acceleration of the panto- graph trolley are essential data which must be known at all times. These are gathered from devices which

feed back high frequency signals to a receiver from a transmitter carried underneath the trolley. The trans- mitter aerial consists of two underslung flat plates spanning a receiver aerial wire carried by the support- ing structure.

The movements and displacements of the wires in the model are measured in several ways which may be used separately or in combination; they are either optical or electrical. The optical methods are high speed cinematography, and a method which registers the position of a wire by casting a shadow of it on to a photo-sensitive device. The favoured electrical method employs a capacitive coupling to a high fre-

quency signal carried by the model wires. The results of the last two methods, together with signals from the trolley instrumentation, are simultaneously dis- played on a multi-trace oscilloscope with recording camera, or on a multi-channel chart recorder.

Practical experiments have been in progress at Tol- worth for only a few months but, already, consider- able progress has been made. Results so far achieved show that the method of approach to the problem is the correct one and BICC scientists are hoping that their findings will soon be guiding the design of improved overhead equipment for all forms of electric traction.

INDIAN INVENTION MAKES HISTORY—WORLD EXPLOITATION BY W. GERMAN FIRM

The Government of India have granted a licence to a well-known West German firm of diesel locomotive manufacturers for the world exploitation of a major Indian invention which promises to revolutionise the manufacture of diesel locomotives the world over.

The inventor is 32-year old Shri M. M. Suri, Deputy Director (Diesels) in the Indian Railway Research, Design and Standards Organisation at Simla.

Shri Suri has been responsible for the invention of a new system of diesel locomotive power transmission which has officially been named as “Suri-Transmis- sion”. The invention of the Suri-Transmission puts Indian “knowhow” in the field of diesel locomo- tive design ahead of contemporary knowledge in advanced countries like U.S.A., West Germany, U. K. and Japan.

In locomotives of the future, the introduction of the Suri-Transmission will be a substantial factor in saving manufacturing and recurring operating costs. For instance “Suri-Transmission” if fitted on to loco- motives similar to the 2,000 H. P. diesel-electric locomotives recently imported for U. S. A. and now in service in the eastern region of the country, would secure a saving in fuel costs of something like Rs. 16,000 per year per locomotive.

The manufacturing cost of the ‘Suri-Transmission’ locomotives is also expected to be substantially cheaper than current types because of its lighter and simpler and more compact construction. When fully developed, the ‘Suri-Transmission’ would pave the way for the construction of very powerful locomotives of 3,000 H. P. to 4,000 H. P. as compared to the 2,000 H. P. locomotives now currently in use in India and other countries of the world.

Shri M. M. Suri joined the Indian railways as a Special Class Apprentice in the Superior Establishment of the Mechanical and Transportation Department of the Indian railways at Jamalpur in 1945. In 1950 he was appointed Production Engineer at Jamalpur. In early 1954 he was sent abroad on deputation with the Director-General, India Store Department, London as a Junior Railway Inspecting Officer. Mr. Suri was abroad from 1954 to 1957 during which time his official duties carried him to Italy, Germany, Switzerland, Australia, France, Belgium, Sweden and U. K. It was in 1956 in London that he filed an application for a patent on his invention, on which he had been privately working approximately for two years. On return from deputation abroad Shri Suri was posted as Deputy Director (Diesels) in the newly- created Diesel Department of the Research, Design and Standards Organisation of the Indian Railways.

RAILWAY BRONZE INGOTS AND CASTINGS

The Indian Standard Specification for Railway Bronze Ingots and Castings (IS : 1458—1959) prepared recently by ISI covers the requirements of the follow- ing five classes of bronze ingots and sand castings :

Phosphor bronze	Class I
Gunmetal	Class II
Leaded Bronze (78-7-15)	Class III
Leaded Bronze (83-7-10)	Class IV
Leaded gunmetal (85-5-5-5)	Class V

The classification is based on the typical purposes for which these bronzes are employed.

In view of some of the special requirements of bronze ingots and castings not being exactly met by IS : 28—1958, IS : 306—1951 and IS : 318—1952, the necessity was felt that there should be a separate standard for covering the requirements of bronze ingots and castings used by the railways.

BRITISH RAILWAYS ELECTRIFICATION CONFERENCE AND EXHIBITION

THIS exhibition will take place at Battersea Wharf from 3rd October to 7th October, 1960. It is devoted to products and materials for use in 25 kV 50 cycles a.c. railway electrification schemes, with the accent of contracts carried out for the British Transport Commission as part of their modernization programme. The BICC Group, largest contractors to the B.T.C. for the supply, design and installation of overhead equipment and various types of cables, will be exhibiting on Stand No. 15.

Their extensive range of individual exhibits can be divided into four main classifications.

OVERHEAD EQUIPMENT

A comprehensive selection of individual components installed on 25 kV a.c. electrification schemes throughout the country will include catenary and contact wires, all types of registration and supporting fittings, cantilevers, the latest types of insulation, different types of section insulators, turnbuckles and line fittings with rail bonds and miscellaneous items.

Inside the main entrance to the exhibition a section of track will be equipped, though not energised, for 25 kV a.c. traction, showing the practical significance of many of the items displayed on the Group stand. Adjacent to the track will be a 55-foot self supporting flood-lighting tower of the class developed by the BICC Group, on behalf of the B.T.C., for low level use in shunting yards and similar situations.

TELEPHONE CABLES

Samples of the specially screened aluminium sheathed telephone cables, installed on the Manchester/Crewe and Liverpool/Crewe routes, will be available for inspection. An interesting demonstration illustrates the protection afforded by cable screening against the effects of interference from the traction system. Sections of cable troughing and accessories may also be seen.

POWER CABLES

The most up-to-date 25 kV concentric track feeder cables are on show comprising:— (1) An oil filled, corrugated aluminium sheathed cable with a fully sectioned sealing end. (2) A gas-filled concentric cable and its associated straight through joint. Other subsidiary displays embody examples of aluminium and lead sheathed cables, rubber and plastic insulated and sheathed supply cables, train jumper cables and a complete assembly of a 25 kV pantograph cable with end bushing.

SIGNALLING CABLES

P.V.C. insulated and sheathed multicore cables are shown together with glo-ester straight joints, glass fibre dome type inspection joint, and other relevant accessories and also a selection of cabin wiring cables.

VISITS

Delegates to the Conference will visit electrification schemes on the Eastern Region of British Railways and will also be conducted on an extensive tour of Crewe Junction and part of the Crewe-Manchester route on the London Midland Region.

The delegates will be able to inspect practically every facet of the planning and implementation of these electrification projects. Throughout BICC Group equipment, planning and erection facilities will be in evidence and no doubt the mechanical aids to the installation of overhead equipment will arouse particular interest.

Invitations will also be extended to delegates to visit the numerous Group production units and laboratories engaged on aspects of this work. Among these are the factories at Prescott, Erith, Helsby, Leigh, Trafford Park, Hereford and Renfrew, and research laboratories at Wood Lane, London, and Tolworth.

The British Railways Electrification Conference and Exhibition will demonstrate the wide interests of the BICC Group in the development, manufacture and installation of equipment for the railway electrification.

INDIAN RAILWAYS

another 300 track miles of A.C. Electrification

The Indian Railway Board has awarded another overhead equipment contract to the BICC Group. The new section, to operate at 25kV 50 cycles, is part of the Eastern Railway's main line from Calcutta towards Delhi, and will be ready for use by July 1961.

The BICC Group is already working on a contract for 400 track miles of similar equipment on the South Eastern Railway and after only twelve months an electric locomotive made a demonstration run over a part of the line. The new order, worth over a million pounds, is a demonstration of the Indian Railway Board's confidence in BICC.



railway electrification by the

BICC GROUP

DESIGN SUPPLY & INSTALLATION
OF OVERHEAD EQUIPMENT

BRITISH INSULATED CALLENDER'S CABLES LIMITED 21 BLOOMSBURY STREET LONDON WC1 ENGLAND

Self-Contained Air Conditioning Unit for Railway Cars

By An Engineering Correspondent

Messrs. Luwa GmbH, Frankfurt am Main, German Federal Republic have developed a new self-contained air conditioning unit for railway cars. The unit, which is 2 ft. wide, 3 ft. 9 in. long and 6 ft. high, is especially suitable for coaches without sufficient space in the bogie to carry the components of an air conditioning equipment. The Luwa unit may be installed in the inside of the car.

The design of this new unit was based on various considerations. It was the aim to build a plant where all components are assembled in one housing. Moreover, a unit was needed for installation into cars which are already in operation and which are subsequently to be air conditioned. This new Luwa unit has also the advantage of being favourable in price.

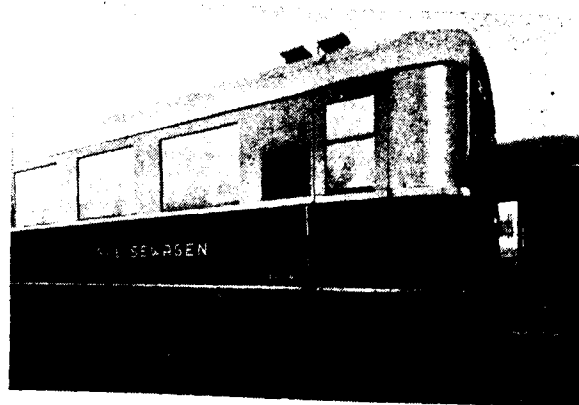


Fig. 1

As mentioned before, the unit includes all air conditioning parts. It is installed in the hall or in one of the rooms adjacent to the passenger compartments. The unit is divided into 3 parts. The upper part contains blower fan with drive motor, evaporator, hot water, electric or steam heating batteries and air filters. In the middle part a suction gas cooled compressor with drive motor and control box are mounted and the lower part includes condenser and condenser fans.

In order to obtain the relative small dimensions of

the unit all drive motors and controls were designed for three-phase current. The possibilities for installing the unit are shown on fig. 1 and more clearly on fig. 2. Fresh air is drawn in through a grill in the side wall of the coach (see fig. 1 and 2). It enters the upper part of the unit through regulating dampers which are



Fig. 2

set once for all before putting the unit into operation. Here the fresh air mixes with the recirculated air of the compartments, passes as mixed air the air filters, evaporator and heating battery and then flows into the ceiling duct via the blower fan. Slot-type distributors (fig. 3) or multiple-hole distributors in the duct supply the air to the various compartments. The exhaust air leaves the coach via the toilets or other adjoining rooms. The ratio between fresh air and circulating air is approx. 1 : 2.

The condenser cooling air, also, is drawn into the unit through the body side grills, passes the condenser fans and the condenser and is then discharged again through the coach floor.

Heating of the air conditioning unit is provided according to the requirements by a hot water, steam or electric battery. The whole unit is regulated by means of a central control device to which the basic heating of the car — either by steam, hot water or electric — can be connected, ensuring thus an automatic control of the entire coach.

The input of the unit at maximum operation is approx. 10 kW; the weight is 600 kg.

The unit is available with 2 different refrigerating capacities :

Model SKE 7 17,500 kcal/h

Model SKE 5 11,000 kcal/h

(at an evaporating temperature of + 10 deg. C and a condensing temperature of + 55 deg. C)

The air conditioning unit is supplied by Messrs. Luwa GmbH ready for installation with all piping and wiring. The only thing the customer has to do is to



Fig. 3

mount the unit in the car and provide the central electrical connections as well as the connections for the air ducts.

ALL ELECTRIC LOCOMOTIVES SEEN TAKING OVER INTERCITY TRAFFIC

Delegates to the Tenth Pan American Railway Congress have been told that electric locomotives may in the future take over a bigger and bigger share of high speed intercity rail service.

The prediction came from D. R. MacLeod of the General Electric (U.S.A.) Locomotive & Car Equipment Department and was contained in a technical paper delivered to the Congress by the engineer.

MacLeod's paper traced the progress of electrification of railroads in the United States, something that his company, General Electric, has been intimately associated with for 65 years.

MacLeod's prediction about the possible future expansion of electrification was based on the belief that higher and higher speed intercity traffic will be required in the future. Diesel-electric locomotives

that can supply the horsepower to attain the required speeds may be prohibitively heavy, the engineer said.

Trains of over a mile in length pulled by several diesel-electric locomotive units and moving at 60 miles an hour are not uncommon in the U.S., MacLeod said. In the future, even more power may be necessary to meet speed and load requirements. Electric locomotives can supply this higher horsepower without the same kind of weight increases that would be necessary in more powerful diesel-electric locomotive designs. Recent design favors the rectifier-type electric locomotive for alternating current electrification. This type of locomotive uses mercury arc rectifiers to convert the alternating current supplied from the trolley wire to direct current for the traction motors. Looking to the future, according to MacLeod, the rectifier-type locomotive using silicon rectifiers is a distinct possibility.

Screen-Cleaning Equipment for Transport

By An Engineering Correspondent

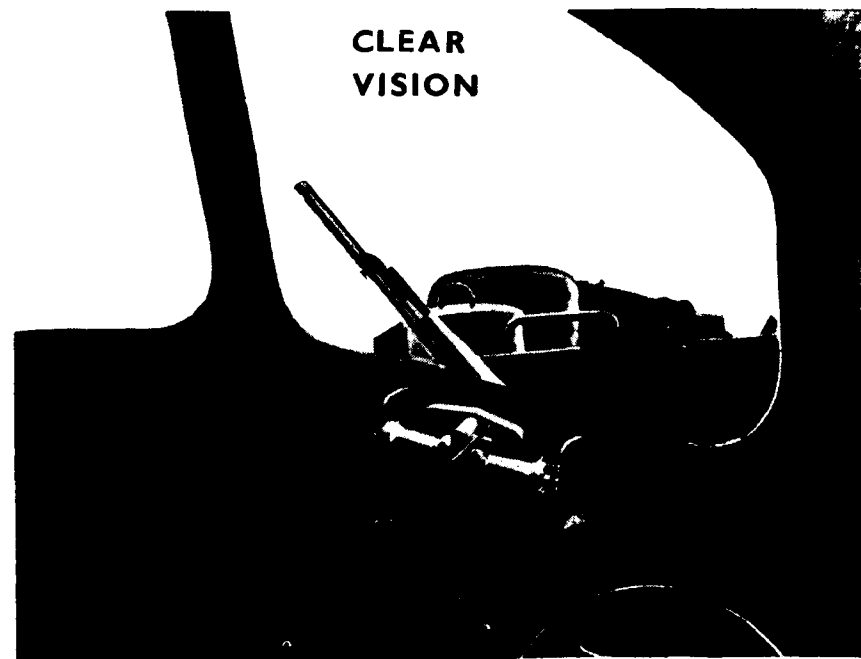
ONE of the essentials of any form of transport is optimum visibility. When the driving compartment was enclosed to improve the comfort of the driver of road vehicles, attention had to be given to keeping the front window free from rain, snow and fog. Thus, the windscreen wiper has become one of the essential components of a road vehicle, and its design and manufacture a complete technology of its own.

One of the foremost companies in this specialized field is Trico-Folberth, Ltd., Great West Road, Brentford, Middlesex. This company manufactures a complete range of parts and accessories for windscreen wiping, including motors—electric, vacuum and air pressure—linkages, arms and blades of all types. Originally, the greatest interest in efficient screenwiping was vested in the passenger car, and here the demands of styling led to the solving of many unusual problems. There has been a tendency in the case of heavier vehicles to regard the screenwiper as an after-thought, brought out and fitted without great consideration. However, the advent of more advanced cab designs has been accompanied by new thoughts on maintaining the improved visibility provided by these designs. The windscreen-wiper manufacturer is

now consulted at the design stage so that the best possible cleaning action can be provided.

In this way, Trico engineers have been able to apply their knowledge to heavier and heavier vehicles, acquiring new techniques at the same time. Thus, when modernization of the British railways system commenced, and locomotives with enclosed cabs and railcars were produced. Trico were in a favourable position to supply the very essential equipment necessary to supply the driver with a clear view. From a small start this field of activity has grown until it is a sizeable section of the business. Trico equipment is fitted by most British locomotive and railcar manufacturers, and some continental producers. Many of these locomotives have been made for use in overseas countries.

At first locomotive engineers, used to massive construction, were somewhat sceptical of the light construction of Trico motors and arms, but experience showed that these components more than exceeded their estimated life and performance. Trico engineers are now called in at an early stage in the planning of a new design and are able to suggest the best motor location, the appropriate linkage, length of arms and



View from the cab of a type 4 2,000-H.P. diesel electric locomotive showing Trico FPK compressed air windscreen wiper motor.



for every
type of
locomotive

for **ALL**
operating conditions

In the interests of rail safety, designers of all new locomotives, rail-cars and electric motor coaches, should remember the positive reliable sweep given by TRICO heavy duty window wipers.

Higher speeds . . . more exacting requirements . . . means drivers must have the confidence which clear vision . . . TRICO vision . . . provides even under the worst possible conditions.

Let our experience gained throughout the world assist you in your designs. Our engineers are always ready to call upon you for consultation.

be safe . . . right from the start with

TRICO WINDOW WIPING EQUIPMENT
and two-tone warning horns

TRICO-FOLBERTH LIMITED • GREAT WEST ROAD • BRENTFORD • MIDDLESEX • Phone: Isleworth 5111
Grove's TFI 02

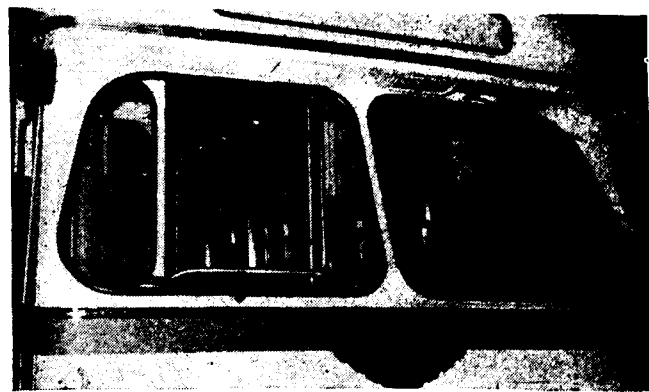
blades, and so on. Another fitment necessary for the provision of adequate visibility under all conditions of operation is the screenspray, and Trico have developed an air-pressure operated heavy-duty unit to accompany the compressed-air windscreen wiper motor which is widely used for locomotive work.

The £1,500 million modernization scheme of British Railways includes the electrification of many lines as well as the provision of diesel and diesel-electric locomotives to replace steam, and speeds of over 100 m. p. h. (161 km. p. h.) are contemplated on main lines, which have introduced many problems. The experimental and development resources of Trico-Folberth, Ltd., have been used freely to design suitable window-wiping equipment to operate satisfactorily at such high speeds and in addition, to provide a stream of water to remove track dust that is deposited on the glass by the air turbulence created in tunnels by passing trains.

Locomotives Nos. 10201—2—3 were the first diesel-electric type built by British Railways at their Ashford Works in 1950 and the driver's cab had windows which were curved in the horizontal plane. Suitable wiper units had to be found which complied with the following conditions:

- (a) to give adequate vision to a short driver sitting down.
- (b) to be equally satisfactory for a tall driver standing up.

Nine years ago this was a formidable proposition, and with the co-operation of the Chief Mechanical and

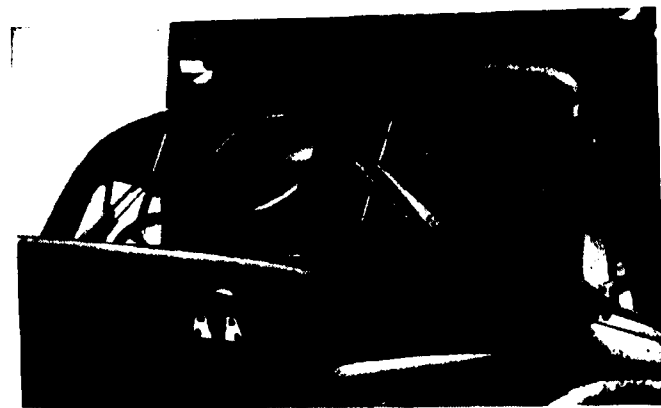


Crossley left-hand drive coach with Trico wipers in an unusual "Diagonal" arrangement.

Electrical Engineer's Department of the Southern Region of British Railways a complete window was brought back to the Trico works for the development of a suitable wiping movement.

It was evident that with simple arcuate motion a curved blade would be necessary but for traction speeds of 90 m. p. h. mechanical strength of the blade was an essential requirement, such as would be provided by a strong one-piece straight blade. Examination of the glass itself showed a slight curvature in the vertical plane due to the heat treatment of the glass when formed, but this condition could be met by the design of a suitable rubber moulding which would allow the trailing edge of the rubber to follow the slight deviation from a straight line in the vertical plane. The blade was maintained in a vertical position throughout its travel by the adoption of pantograph motion for the wiper arm, and with the introduction of a completely new compressed-air-wiper motor into the Trico range it was found that all conditions of operation had been met subject to high-speed trials proving satisfactory.

When the first locomotive went into service it was found that there was a tendency for the blade to lift from the glass at speeds in excess of 65 m. p. h. (105 km. p. h.) caused by the massive displacement of air created by the comparatively broad front of the locomotive which did not have the aerodynamic styling which has proved so advantageous in the modern car. In addition, the outward thrust of the arm and blade caused by wind pressure at high speeds was unlike anything experienced before with cars or commercial vehicles and, to overcome this effect, pneumatic controls were introduced into the motor



On a snow-plough supplied by All Wheel Drive, Ltd., compressed air powers the wiper arms on the Quarter-screens.

to restrict the movement at the end of each stroke so that the operating unit was well-behaved even at high traction speeds. Further development was then given to the arm to increase the spring tension sufficient to overcome the lifting effect, but the limit was reached when it was found that the arm-piece itself curved under this heavy tension so that most of the pressure was lost. A completely new arm design was indicated, with the adoption of Tee-section high-grade steel for the arm-piece and a positive attachment of the arm head to the output shaft, and this took the form of an accurately-dimensioned tapered coupling with a fine-pitched knurl. As this could not be sufficiently accurately machined, an iron sintering process was used and subsequently found to be most satisfactory after a few early failures.

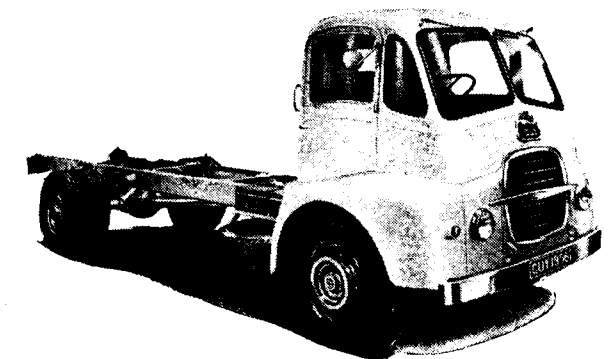
By this time it was realized that most of the problems associated with locomotive work had been overcome, but it was evident that very careful planning of each wiper installation would be necessary, with full consideration being given to:

- (a) maximum operation traction speed.
- (b) aerodynamic features of cab styling.
- (c) if curved windows were to be used they should only be curved in the horizontal plane.
- (d) nominal arc of wipe of wiper unit when measured on a stationary test bench was not indicative of the true arc of wipe when affected by wind pressures at high speed.

Failure to observe these essential requirements of operation, in the opinion of Trico engineers, would cause trouble in service and the necessity of careful design has been confirmed by the large number of locomotives that have been fitted with pantograph arms and suitable blades which operate quite successfully at speeds of over 90 m. p. h. (145 km. p. h.). However, all locomotive windows are not approximately square in shape, which is the ideal proportion for pantograph motion, and bonnet-type locomotives invariably use windows shallows in height and of considerable width. This led to further developments in wiper design for fitting to the prototype 3,300-h. p. diesel-electric locomotives designed and built by the English Electric Co., Ltd., which is now in service on British Railways.

These windows, which had some similarity to those of a car, were provided with two wiper arms and

blades operated by a single power unit, but as the shape was not truly rectangular and sloped to a shallower depth at each side, differing lengths of arms and blades were used on each pair of wiper shafts which were coupled to the driving-motor mounted



Guy warrior cab equipped with two TPM compressed air motors and screenspray.

between. A very compact unit was finally produced, operated by compressed air, which proved highly satisfactory at the high speeds which this well-known locomotive achieved. Twenty-two more of these locomotives have now been ordered by the British Transport Commission.

In this application the destructive effect of wind pressure at speed was made evident by the rapid wear on the mechanical parts of the linkage mechanism and, contrary to car practice, which uses resilient bushes at points of movement, metal bearings were found to be essential with limiting controls to counteract the sideways thrust on the arm and blade at high speeds.

A large number of Type 2 A1A-A1A diesel-electric locomotives built by the Brush Electrical Engineering Co., Ltd., are now in service on the British Railways. One corner of the cab window has been reduced by an angle and, as a consequence, a pantograph wiper action would have restricted movement. Maximum window coverage was provided by selecting a corner position for the wiper motor and with single-arcuate motion gave excellent vision to the driver through the required angles of observation. These locomotives are also fitted with compressed-air windscreen washers with the jet position towards the inside lower corner so that the water spray is assisted across the window by the natural air flow of traction movement.

Window wipers for diesel railcars and electric motor coaches do not require the same serious consideration of design, as speeds exceeding 70 m. p. h.

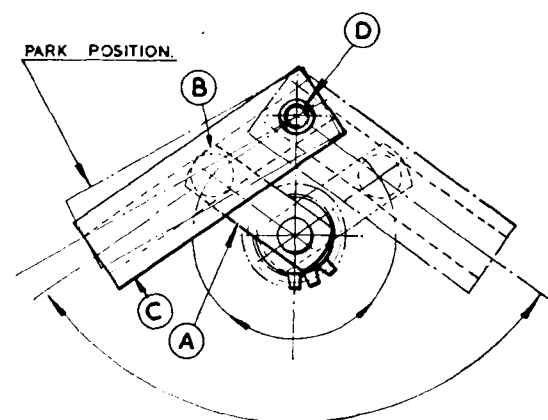


Diagram showing the driving of the FPK motor

a. Driving lever. b. Roller bearing.
c. Driven lever. d. Output shaft.

are seldom achieved. Invariably, pantograph motion for the wiper movement is decided upon, as generally the windows are narrower in width than in height, with vertical sides. A bold radius at each corner is not desirable if maximum width of pantograph motion is required as well as the highest possible wipe of the window. It will be appreciated that if the windows are left perfectly square at the top corners it will be possible for the top of the blade to enter these corners fully so that the maximum travel of the blade would coincide with the maximum width of the window. Allowances would have to be made for manufacturing tolerances and slight discrepancies in fitting, but in theory maximum wiping efficiency would be obtained with such a design of window, especially if height of wipe is considered important.

A most unusual application of window-wiping occurred during the design and construction of the prototype British Railways track-recording coach, built by D. Wickam & Co., Ltd., and equipped by Elliott Brothers (London), Ltd., in conjunction with the British Transport Commission's research and development engineers. In addition to the traditional window-wipers at each end of the coach, one particular side window was required to have similar treatment, necessitating an exceptionally long pantograph arm. The purpose of this window was to observe track conditions in all kinds of weather and, although high speeds were not possible with a 55-m. p. h. (89-km. p. h.) max, limited to 30 mp. h. (48 km p. h.) when operating, the unequal thrust of wind pressure on the side of the coach would have overloaded the whole mechanism unless consideration was given to the wiper design.

In this instance, tests were carried out reproducing operating conditions as far as possible and which confirmed first thoughts that special modifications to the wiper motor would be necessary. These took the form of a spring-loaded air restriction in the exhaust system of the motor so that any acceleration of a rear-ward travelling wiper stroke would cause an increase in back pressure in the exhaust air and so create a braking effect. The spring was included to permit foreign matter obstruction to be expelled when the exhaust pressure was sufficiently high. The whole arrangement proved to be exceptionally smooth-working and self-compensating even for such a severe application of window wiping.

Compressed air for the operation of auxiliary devices on road and rail vehicles has undoubtedly proved its many advantages when an abundant supply is available, as is usually the case on most forms of rail stock, but it is not always realized that the power derived from such a source is a product of volume as well as pressure. Volume, as represented by a closed cylinder, is allowed to expand by a piston which is free to move under the pressure applied to its operating head and, unless this movement can be related to time in linear proportions, violent acceleration of the piston will occur. In a wiper movement, which is an oscillating motion, such acceleration is most undesirable, especially if there is borne in mind the exceptional frictional properties of rubber on glass when dry and conversely its free running qualities when adequately lubricated with water.

Well-designed compressed-air wiper motors should include simple features which will control the comparatively enormous power which can be released when a wiper movement is suddenly freed after a temporary stall, and in such cases a single shock load can destroy the whole wiper mechanism, including the arm and the blade. Some form of self-compensation must be interposed between the wiper motor piston and the output shaft, and the system adopted by Trico-Folberth, Ltd., in its design of FPK wiper motors has proved its ability to deal with shock loadings of this character.

A short lever, A, as shown in the schematic drawing, is geared by rack and pinion to the operating piston and this lever carries a roller bearing at point B, which engages with a slot milled in the long lever C, which in turn operates output shaft D. Subject to the piston speed being constant, as also lever A, lever C would decelerate from mid-point of its travel to each side. At top dead centre it would, in fact, be

stationary. Further movement of lever A would have the same effect on lever C as if it were moving in the opposite direction.

It is known, however, that the piston speed is not constant and acceleration is inevitable, which may be assisted by the inertia of the arm and blade, especially at times of inadequate water lubrication. The deceleration of the wiper-output shaft, which would occur if the piston speed were constant, is therefore in direct opposition to the acceleration with actually occurs and the effect is virtually self-cancelling.

A further feature of this system of levers is the facility with which it provides a mechanical lock to park the arm and blade when not in use. The control valve when turned to "Park," permits the piston to travel slightly further in the cylinder than is normal, which, in turn, moves lever A over centre relative to lever C. This secondary lever cannot then be moved by any outside means, such as an arm and blade, and only movement of the primary lever A will effect an unlocking action. This, of course, can be achieved by operating the control valve or the emergency manual

handle, which is always fitted in railway work. There is then no need to maintain air pressure on the wiper motor, so that all the piston seals are preserved in their lubricating grease without the harmful effects of water contamination, which is difficult to eliminate in any compressed-air installation. This is of particular benefit when air wipers suffer long periods of unuse, which can cause piston seals to harden and so immobilize the piston.

A feature of the Trico service to users of their equipment is the provision of complete aids to service during the life-time of a component. Due to the variations which may be necessary to suit a particular application, each such application is covered by a complete installation drawing and a schedule of parts, which are available to any engineers concerned.

The development of the passenger transport and commercial vehicle aspect of Trico-Folberth, Ltd., business is the responsibility of J. A. Clark, sales engineer, to whom we are indebted for the information on which this article is based.

(Courtesy : British Engineering & Transport)

STANVAC WANTS TO EXPLORE FOR OIL IN RAJASTHAN

It is now revealed that Standard-Vacuum Oil Company has submitted proposals to the Government of India for exploration of oil in the Jaisalmer area of Rajasthan. This follows the official statement in the Lok Sabha recently that the Government of India was at present studying the proposals submitted by a foreign oil company for exploration in the Rajasthan area. Asked to comment on this statement, the Standard-Vacuum spokesman pointed out that the new proposals had been submitted before the formalities were completed for the termination of the search for oil in West Bengal under the Indo-Stanvac Project.

The proposals were submitted in response to the Government of India's appeal to foreign oil concerns to engage in the search for oil in India.

Recalling that the abandonment of the search for oil in West Bengal had meant the loss to the Company of crores of rupees, the spokesman went on to say

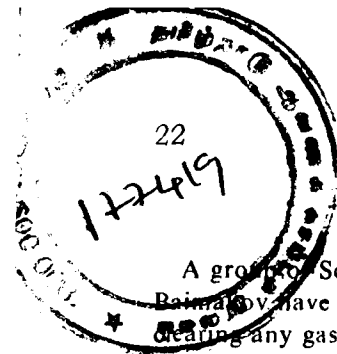
that it in no way lessened Stanvac's intention to look for oil elsewhere in India.

In the best of circumstances, the search for oil was a big gamble and all private companies looking for oil had to reckon with such huge losses.

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VICKERS HARDNESS TEST FOR STEEL

The Indian Standards Institution has recently published IS: 1501—1959 Method for Vickers Hardness Test for Steel. This standard belongs to a series of Indian Standards for mechanical testing of metals. For all practical purposes, this standard is a reproduction of Draft ISO Recommendation No. 120 Vickers Hardness Test for Steel which represents the consensus of international opinion on the subject.



ELECTRIC GAS FILTER

A group of Soviet scientists led by Professor Yuri Paimanov have designed an original electric filter for clearing any gas of harmful admixtures.

The new filter is 8 to 10 times more compact than the filters now in use and can be easily fitted into any, even small premise. It works 10 times faster than the existing installations as the speed of the gas stream in it can reach 10 to 15 metres per second.

The filter consists of a hollow tube with thin germanium wire strung inside. A 50,000 volt current is passed through the wire. The resulting electric field electrifies the particles of foreign matter and throws them to the walls of the tube whence they drop into a special bunker.

The new filter catches 99 per cent of the foreign matter.

The electric filter will find extensive application in the metallurgical and chemical industries where the removal of harmful admixtures from gases is a big problem.

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FERRO ALLOYS

The Indian Standards Institution has recently published the following two specifications covering the general requirements, sizes, chemical compositions, sampling and supply for ferro-vanadium and silico manganese.

IS : 1466—1960 Ferro Vanadium

IS : 1470—1960 Silico Manganese

These standards belong to a series of Indian Standard Specification for Ferro Alloys. Standards covering ferro silicon, spiegeleisen, ferro chromium, ferro manganese, ferro tungsten, ferro titanium, ferro molybdenum and ferro phosphorus have already been published.

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Automatic Welding is Leaping Ahead

With 12,000 automatic and semi-automatic arc welders and more than 40,000 contact welders in operation the Soviet Union has leaped ahead of any European country and of the United States as well.

Depots and shops are being set up to specialise in centralised manufacture of welded semi-finished units and supply them to machine building works. The Urals heavy machinery building works, for instance, is erecting the biggest block of welding shops in Europe with an annual capacity of 135,000 tons, and an even bigger welding plant will be started in 1962 in the Ukraine. Within the nearest future it would be possible to create a new system of controlling welding processes, using modern means of radio-electronics; a special programme-controlled automatic machine tool are to be created for mass production of welded structural units.

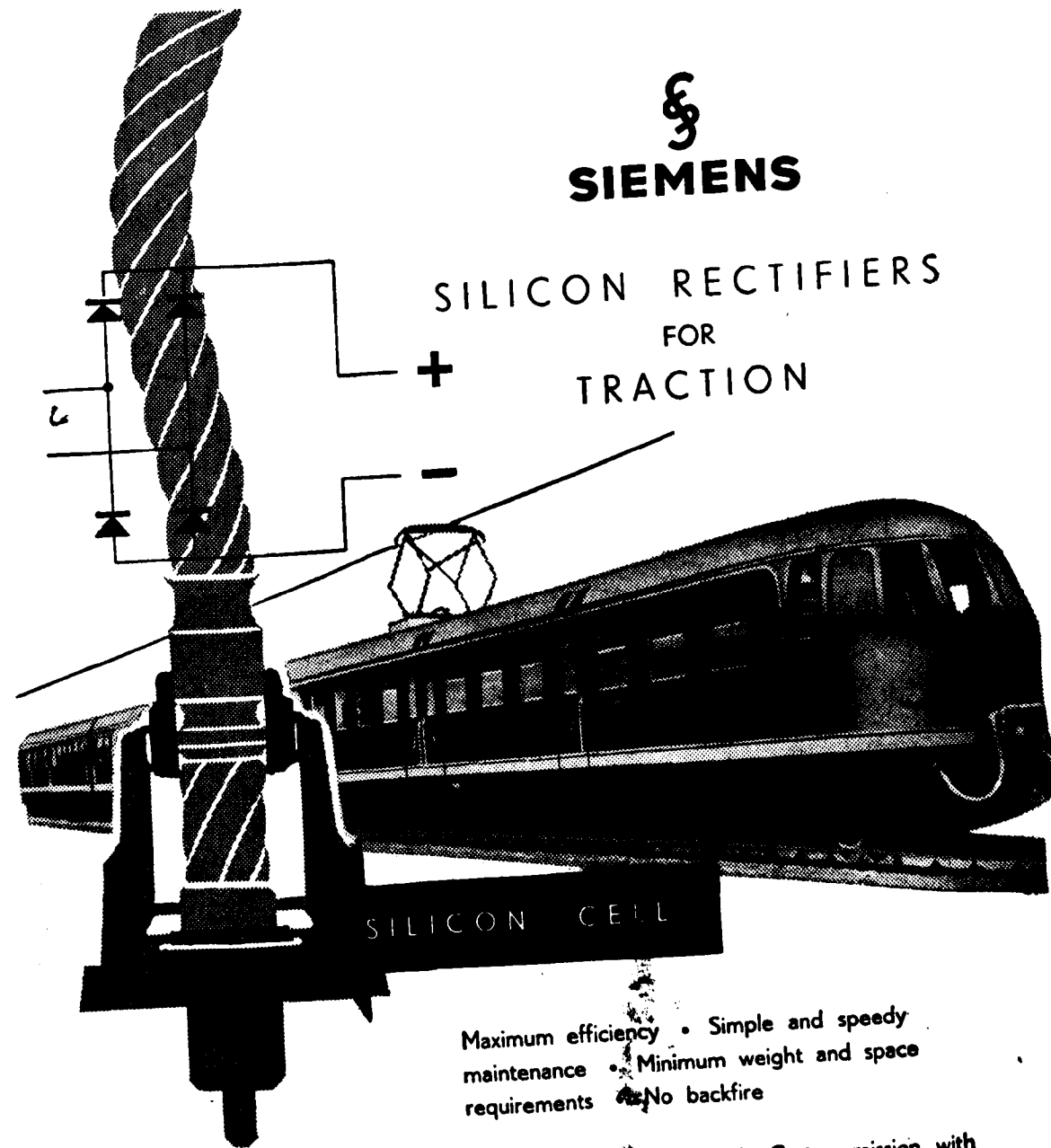
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METRIC COPPER WIRES AND CONDUCTORS

The Indian Standards Institution has recently published IS : 1594—1960 Metric Sizes of Copper Wires and Conductors for Electrical Purposes. Consequent on the decision of the Government of India to introduce metric system of weights and measures in this country, it became imperative for the electric cable industry to evolve rational sizes for wires and conductors in the metric system. This standard gives the diameters of copper wires for electrical purpose in metric system. It also gives the sectional areas with the number and diameter of wires of copper conductors for use in insulated cables and for overhead transmission purposes.

The present cable manufacturing practices in this country follow mostly the British practices and the existing Indian Standards, based on corresponding British Standards, are in the fps system. The conductor sizes specified in this standard are derived from the CEE series as well as the sizes in vogue at present in this country. This step has been taken with a view to bringing about the minimum amount of dislocation in the cable industry in this country in changing over to the metric system, although the advantages of adopting a series which follows a geometric progression are fully realized. It is, however, hoped that with the efflux of time, the need in this country will tend towards an ideal series and that, at a later date, it will be possible to delete many of the sizes representing the present practice.





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