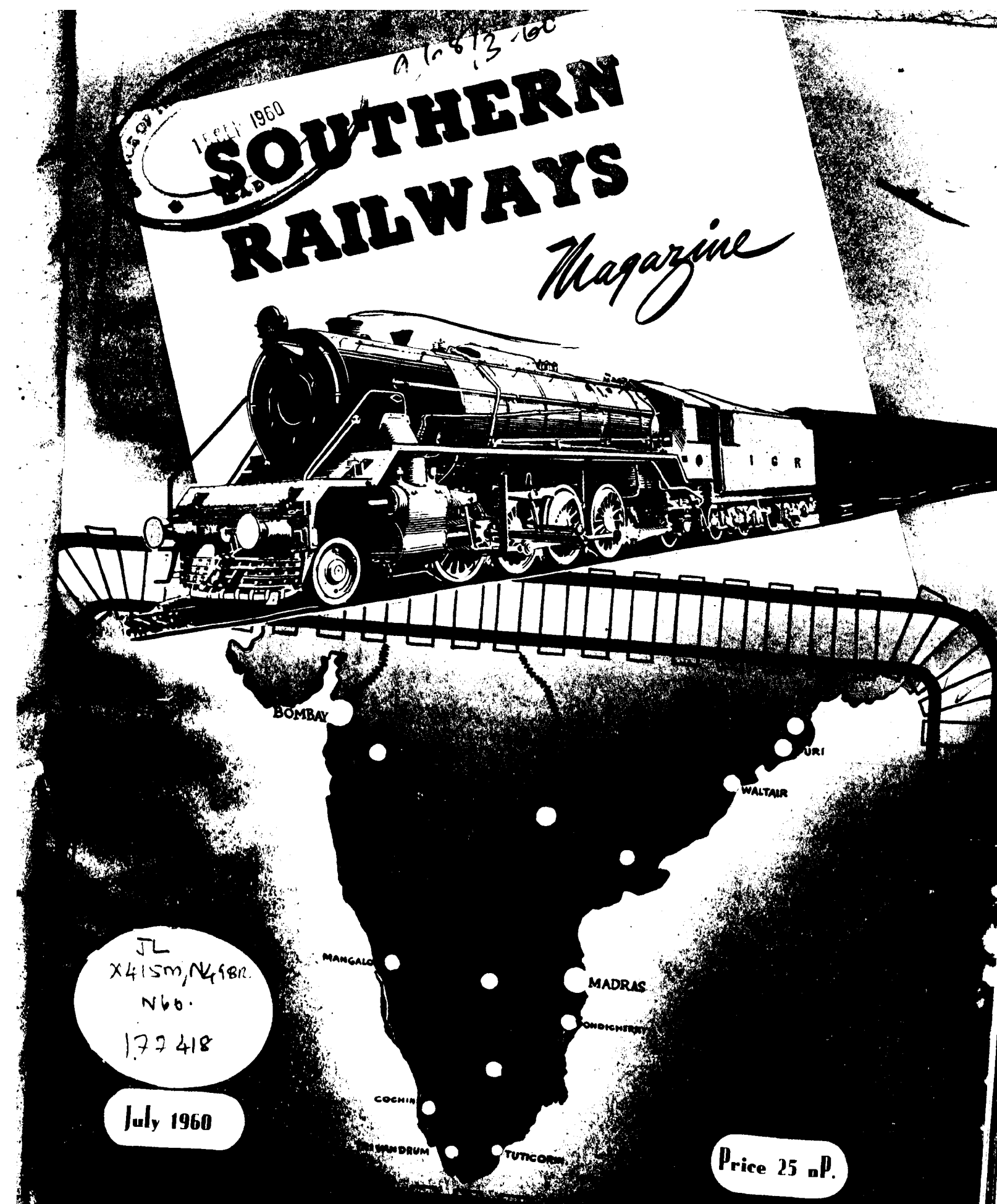




MERCEDES-BENZ RAILWAY ENGINES

THE Mercedes-Benz Diesel engine model MB 820 Bb, of which more than 100 are in service in German Federal Railways TEE-trains, V 200 main line locomotives and the VY 08 long-distance railcars, has now been in operation for 8 years. It belongs to the power unit of those vehicles which, according to the yearly survey for 1959 published by the management of the German Railways have covered as long distance vehicles an average of 723 km = 450 miles per working day (diesel locomotive) or 973 km = 604 miles per day (diesel railcar).

At the beginning of 1960 an engine from a V 200 locomotive which had covered without a break and without any overhauling 609.481 km = 378000 miles from the Summer of 1956 to December 1959, was used for thorough examination. The engine was checked for output and operating values on the Federal Railways test stand in Nurnberg. The results corresponded fairly accurately with those ascertained on the factory test stand at the time of delivery. When the engine had been stripped the wear on the most important parts (crankshaft, bearings, pistons) was so insignificant, that they could almost all be used again. The checking of the crankshaft as well as the main and connecting rod

the driving direction and 0.042 mm in the transverse direction. In the middle the figures were 0.015 to 0.022 mm and underneath 0.008 to 0.013 mm.

The fuel consumption can be considerably lessened by building in an intercooler, and in this way the economy of the diesel drive can be increased. In Mozambique in Portuguese Africa, 5 Krauss-Maffei locomotives with Daimler-Benz engines of this model have been running for several years with the greatest success. In spite of the greater room needed for the cooling system the normal outer shape of the locomotive is in no way influenced and the most important requirement for rail service—a clear view ahead—is satisfactorily fulfilled.

Hitherto the fast-running Diesel engine was—in the minds of many people—still considered as a source of noise. It was for that reason that when it was re-introduced on the railways after the least war great importance was paid to silencing.

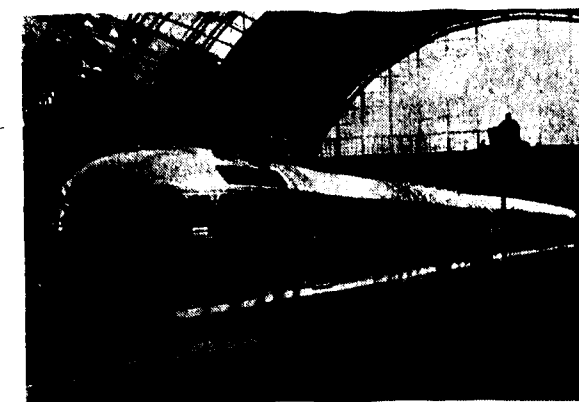
A strict request for further silencing was made with the mounting of the unblown Mercedes-Benz engine MA 820 B (600 HP, 1.500 rpm.) in the V 60 locomotive. For the silencer good use was made of the available room under the engine hood.

Measured under operating conditions :

full load 550 rpm = 69 DIN-phon
full load 1450 rpm = 87 DIN-phon
idling 550 rpm = 68 DIN-phon
idling 1550 rpm = 82 DIN-phon

Particularly worth mentioning are the rail vehicles which run for years day in day out as iron foundry locomotives with their heavy loads through fog and smoke, in very limited spaces. Every year they have to work even longer hours than the Diesel engines running in locomotives throughout the land or in the shunting yards, although these locomotive engines, the M 836 Bb (500 HP at 1.500 rpm) attain already operating times of over 20.000 hours before being completely overhauled for the first time.

In distant and tropical countries where the engines often only receive the most rudimentary maintenance service, the 6000 hour limit is always being reached or exceeded by 234 vehicles with Mercedes-Benz engines in service without overhauling for more than two years.



Express coach of the German Federal Railroads with Mercedes-Benz Diesel engine type MB 820 with supercharger.

bearings showed only insignificant wear, and the breaking-in lead layer was still completely intact on all shells. The protective layer of aluminium plating on the cylinder linings was in perfect order. The inside of the liners at the zone of the upper ring in dead centre was clean and worn evenly 0.03 mm in

Supercharged power
at 90 miles per hour

Napier MS 200 exhaust-driven turbo-blowers are fitted to the two N.B.L./M.A.N. L12V 18/21 S 1,000 b.h.p. at 1,500 r.p.m. power units of the British Railways D600 diesel-hydraulic locomotives. Napier Turbo-blowers are found in marine, industrial and rail-traction applications throughout the world—and every Turbo-blower is backed by a world-wide service organisation. Napier Turbo-blowers improve diesel power, performance, efficiency and fuel consumption.

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DAIMLER-BENZ ENGINE NOVELTIES 1960

One big engine, as well as a water-cooled and an air-cooled series of middle-sized engines.

The Diesel engine program of the Daimler-Benz AG is indeed a broad one. In addition to a selection of models proved for many years and manufactured in large numbers, Daimler-Benz presents this year nine remarkable new designs, which again broaden its extensive range. A newcomer is the type MB 835, a big 12-cylinder Diesel engine; also new is the series of four water-cooled and four air-cooled engines MB 851 to 854, and MB 861 to 864, respectively, of the Berlin Marienfelde division, which embody for engines between 20 and 80 HP to the largest degree possible the system of interchangeable parts. With the new line Mercedes-Benz now offers an engine for practically any purpose.

One of the new engines is the MB 835 Ab,

a 12-cylinder Diesel engine V-type, supercharged with 1450 HP at 1500 r. p. m. This new engine with normal charging is similar in bore (190 mm=7.48 ins.) and stroke (230 mm=9.055 ins.) to the MB 839. Here also the system of interchangeable parts is in the making.

In fact the engines MB 835 and MB 839 are similar in design. A large number of engine parts, such as pistons, connecting rods, cylinder liners, cylinder heads, valves, etc. are identical in the two engine



Diesel-powered locomotive of the German Federal Railways equipped with Mercedes-Benz engines, model MB 820, fitted with supercharger.

types. The crankcase of the new MB 835 engine consists of grey cast iron (upon request, light metal); to increase rigidity, the case goes up to the cylinder heads. The crankshaft bearing caps are each held by four clamping screws in the crankcase, with two of these screws serving as anchor bolts and extending up to crankcase top. The design of the new MB 835 engine incorporates all the experience gained



Mercedes-Benz Dieselmotor in V-Form.

throughout the many years of operation of the versatile and very successful MB 820 engine. The MB 839 Bb engine is provided with high pressure supercharger and intercooler, while the new MB 835 engine is equipped with a normal exhaust gas turbo charger, a type of engine mainly used in rail vehicles.

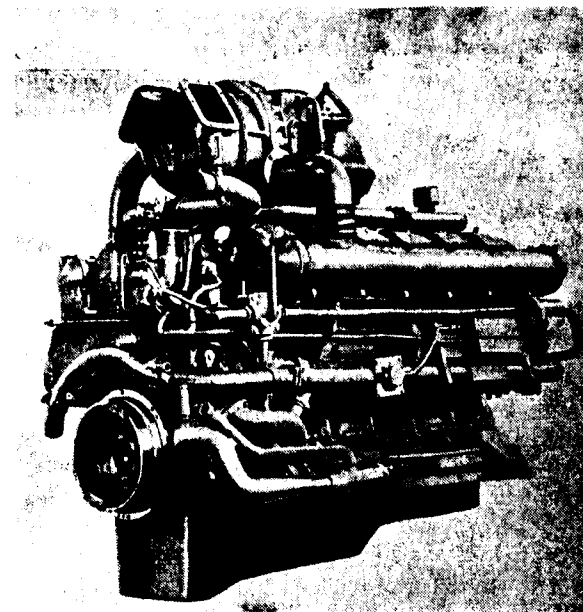
The continuous output B of the MB 835 engine is 1450 HP at 1500 r. p. m. In another version, this engine is designed as a straight aspirating engine, while still another version is equipped with high pressure supercharger and water-cooled charging air. In the latter type the continuous output B is 1800 HP at 1500 r. p. m.

Equipped with supercharger and water-cooled charging air the last named engine is mainly used to drive ships and fast boats. It is also used as a driving engine for emergency power units.

The other new engines manufactured by the Berlin-Marienfelde division of the Daimler-Benz AG are in the medium and low output field:

MB 851—1-cylinder 20 HP at 2000 r. p. m. water-cooled
 MB 861—1-cylinder 20 HP at 2000 r. p. m. air-cooled
 MB 852—2-cylinder 40 HP at 2000 r. p. m. water-cooled
 MB 862—2-cylinder 40 HP at 2000 r. p. m. air-cooled
 MB 853—3-cylinder 60 HP at 2000 r. p. m. water-cooled
 MB 863—3-cylinder 60 HP at 2000 r. p. m. air-cooled
 MB 854—4-cylinder 80 HP at 2000 r. p. m. water-cooled
 MB 864—4-cylinder 80 HP at 2000 r. p. m. air-cooled

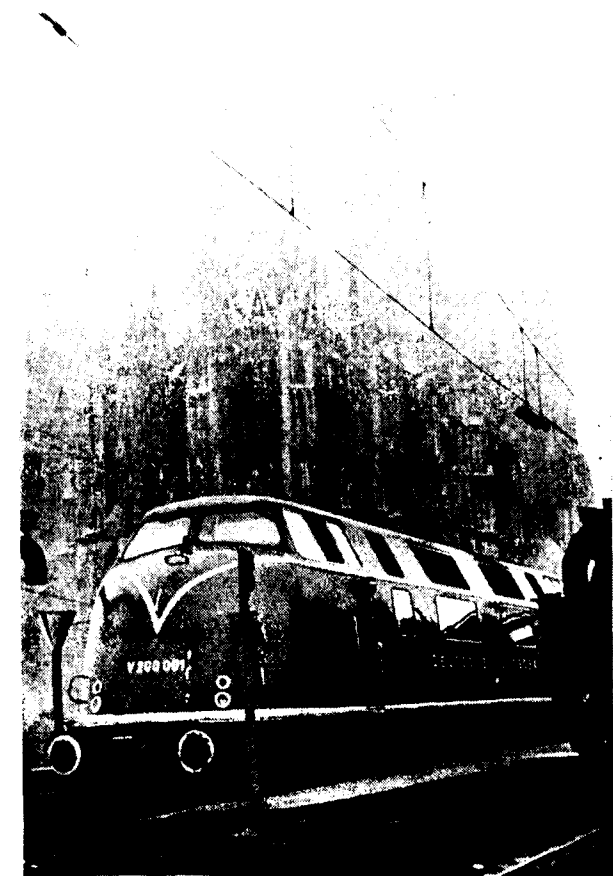
This new series embodies to the largest possible extent the interchangeable parts system. As a matter of fact in the water-cooled and in the air-cooled models, all parts of identical design are



Mercedes-Benz Diesel Type MB 835 Ab.

interchangeable. The Mercedes-Benz Diesel engine line built up to now is significantly supplemented by the new series. Used as stationary or as built-in types for a versatile number of purposes, these engines excel by their simplified and robust design which is easy to operate.

By the rigid tunnel casings, the good access and the practical arrangement of all operating elements and accessories, as well as by alternative power take-off at front or rear shaft end, these Diesel engines can be used for the most varied purposes.



F 404 : Krauss-Maffei-Lokomotive V 200 001.

The relatively high revolutions give the new engines a wide range of applicability. For example the 2-cylinder Diesel engine of the new series, either water or air-cooled, provides at 1000 r. p. m. already 22 HP and at 1500 r. p. m. even 32 HP. The engine delivers its maximum torque already at 1000 r. p. m.

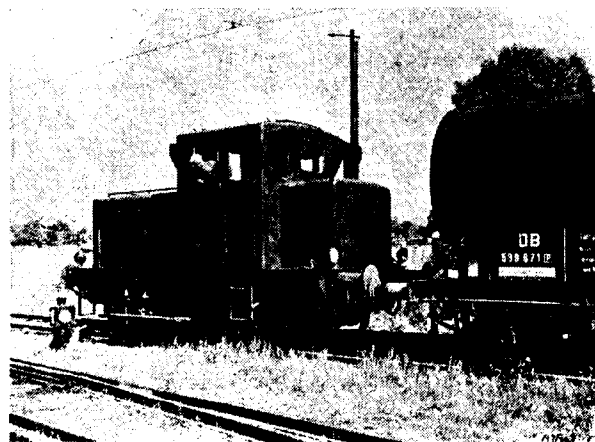
Air-cooling which in special cases is very efficient for built-in engines, has been developed thoroughly, and the engine designed in such a manner that thermal over-strain is impossible.

The multiple jet injection, which is particularly effective in combination with air-cooling, permits simplified and robust construction, completely in line with the often primitive operating conditions of these engines. Of particular interest is the fact that with the exception of the cylinders and the cylinder

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heads both the water-cooled and the air-cooled engines have identical parts. This simplifies very much spare parts storage for these new series.

With these new engines the Mercedes-Benz Diesel engine program has now an even more extended field of application. The engines are designed for any operation requiring reliable, mobile or stationary



Mercedes-Benz-Diesel type M 204 B.

power plants, such as engines for small locomotives, street rollers, cranes, dredgears, boats, pumps and supercharged Diesel generator units.

Besides the before-mentioned new models, at this years German Technical Fair at Hanover also the following already known Daimler-Benz engines are shown:

MB 839 Ab 16-cylinder Diesel engine, V-type, super-charged, with compressor inter-cooling, ZF reduction and reversing gear BW 1400 2400 HP at 1500 r. p. m.

MB 820 Db 12-cylinder Diesel engine, V-type, super-charged, with compressor inter-cooling, Renk reduction and reversing gear 1350 HP at 1500 r. p. m.

MB 837 Aa 8-cylinder Diesel engine, V-type, charged 530 HP at 2000 r. p. m.

MB 846 Ab 6-cylinder, water-cooled, for fishing boat equipment 290 HP at 1200 r. p. m.

M 204 B 4-cylinder, water-cooled boat Diesel engine, for fishing vessels 120 HP at 1200 r. p. m.

OM 326 6-cylinder, water-cooled marine Diesel engine, with ZF reduction and reversing gear 155 HP at 1800 r.p.m.

OM 636 4-cylinder, water cooled built-in engine 35 HP at 3000 r. p. m.

Performance characteristics of all engines named above refer to continuous output B, according to DIN 6270 (German Industrial Standard).

The MB 837 engine, an already well-known model, will also be shown this year at Hanover, because of its unique position in engine design. Extremely compact, it offers at minimum size and extremely low weight a most outstanding max. output. Its space requirements of only 1.45 cubic meter (1270 × 1050 × 1105 mm) or approx. 51 cu. ft. are so low that the engine is ideal for application wherever vehicles or vessels are expected to deliver a high output, with only little space available to install the engine.

Much care was taken to keep engine weight as low as possible. At the special performance of type MB 837 Aa of 600 HP at 2200 r. p. m. (exclusive fan input), when used in vehicles, the engine weighs 2860 lbs. or a power to weight ratio of only 2.17 kg/HP (4.56 lbs./HP).

Because of their high speeds, in part up to 2200 r. p. m., all large Mercedes-Benz engines have a both wide and universal field of application.

THE DELTIC STORY

By An Engineering Correspondent

THE railways of Great Britain have always prided themselves that their type rolling stock is considered the finest in the World from a general efficiency point of view, and constant research has always been the aim of the Commission to maintain the high standard in travel that is demanded by the public.

Modernisation is a hard task master to serve and in order to achieve the ultimate object in view drastic steps may have to be taken.

As we well know the diesel engine has now been a keen competitor of the steam engine and its efficiency has been proved to be so very much greater than even the modern steam turbine taking weight for weight. It is, therefore, not surprising to find that the railway engineers have looked to the makers of diesel engines to supply the answer to the modern need for high power and efficiency and lower weight.

From a survey of diesel engines available the British Railways Commission selected the Napier Deltic diesel locomotive engine as one of the types most suitable for long distance and speedy travel for general use on the various regions.

The English Electric Co. Ltd., were asked to tender for rolling stock requirements for British Railways and they received the contract to build 22 locomotives powered with the Napier deltic engine.

D. Napier & Son Limited is a member of the English Electric Group and are the manufacturers of the famous Deltic engine. English Electric Co., D. Napier & Son and the Vulcan Foundry who is also a member of the Group got down to designing a locomotive that has won itself the highest praise in railway history.

Some interesting facts emerge from the private venture of the English Electric Co. Ltd., in the designing and building of the Deltic prototype for British Railways; due to high rate of utilization of diesel/electric locomotives, these can be operated 24 hours every day and one particular type is at present operating over 22 hours out of 24. Another point is that these Deltics will perform the same duties that formally required the use of 50 steam locomotives.

Another advantage of the diesel/electric locomotive is the greater rate of acceleration, a fact that is

always in the engineers mind, since it makes for better time keeping, and this is possible only because the diesel/electric gives full horse-power throughout its speed range, whereas the steam locomotive does not.

The tractive efficiency of the steam locomotive is low—somewhere between six and eight per cent, except under skillful firing conditions when the average is slightly increased. These figures when compared with the efficiency of the Deltic, which has been defined as 27.5 per cent shows without doubt the great advantage gained on the use of diesel/electric traction.

Further the working conditions are much cleaner and the strain on the driver is far less than working under steam.

The Deltic locomotive with its two 18 cylinder engines develops a total of 3,300 h. p. making it the most powerful single unit of its class in the world, designed for a maximum service speed of 105 m. p. h. which has won for itself the enviable reputation of regularity and time keeping.

Coming on to the smaller type of diesel/electric locomotive ordered from English Electric Co. Ltd., by British Railways, these have the same fine characteristics of their big sister. These are the T9-29 type Napier Deltic 9 cylinder, rated at 1,100 b. h. p. at 1,600 r. p. m. designed for short distance passenger train working and is the first traction application of the nine cylinder, two-stroke opposed piston, pressure charged unit.

There is no doubt that the use of the diesel engine with its various applications to railway traction has come to stay and throughout the World the progress has been clearly marked by the various types, each suitable to the varying conditions of the country, now in operation on the railway systems of the World.

Many people, both young and old everywhere are keenly interested in railway engines, will feel a little sad at the thought that the steam locomotive, with its graceful lines and spectacular sense of power is passing and that a new era is quietly taking its place, will soon acknowledge the new line and graceful statistics of the diesel/electric successor.

Well done burra-mem-sahib for your long and wonderful service and success and good fortune to the new mem-sahib and what a mem-sahib!!

The Building of Diesel Locomotives in Czechoslovakia

By A Correspondent

THE revolution in railway traction actually taking place at present has resulted practically in complete stopping of the building of steam locomotives throughout the world. Though five years ago, except in the USA and Canada, steam locomotives were built almost exclusively, it seems to-day that steam traction will disappear in about twenty-five to thirty years' time, i.e. when the service life of the last steam locomotives built expires.

All steam locomotives in operation will have to be replaced by diesel locomotives—except on electrified lines—and the diesel locomotives will have to cope also with the increase in transport requirements.

The building of locomotives in Czechoslovakia proceeds in harmony with this world-wide development. The oldest Czechoslovak locomotive works has been occupied with diesel traction for thirty years already. Originally it built different types of railcars and small diesel locomotives. After the last war it started to build also heavy shunters and lately also main line diesel locomotives. In 1958 nearly 200 diesel locomotives of different types left the works.

The rich tradition in diesel traction enables the ČKD Works to fulfil the complicated tasks with which it is confronted by its customers. In serial production they have built and are building diesel electric 750 h. p. shunting locomotives, narrow gauge line-service 350 h. p. locomotives and 150 h. p. mechanical-transmission industrial locomotives.

The 750 h. p. locomotive of the T 435.0 series is supplied with a weight of 60 or 65 tons for a standard or broad gauge. It has proved successful at home and in the Soviet Union and its production will be gradually increased.

The ČKD heavy low revolutions railway diesel engine is particularly suited for heavy shunting.

The T 47.0 narrow-gauge diesel-electric line locomotive is designed for service on lines of 750 or 762 mm

gauge with low axle pressures, heavy grades and frequent curves of small radii. To eliminate the necessity of guard's van it has a guard's compartment with a space for luggage. Large deliveries of these locomotives have been effected to climatically widely differing parts of the USSR, a small number being in operation in Czechoslovakia.

The type BN 150 is being built in large series. The firm of Strojexport has exported a large number of these locomotives to Germany, China, Poland, Soviet Union, Albania, UAR and Bulgaria.

In March of 1959 long duration trials of series T 698.0 diesel-electric locomotive were begun. This main line locomotive of modern design attains speeds 120 km/h as an express train locomotive and 80 km/h as a goods train locomotive. Though it was put into service only a short time ago, a more powerful variant of 2000 h.p. is already being prepared.

The BN 150 H type of 150 h.p. and the T 306.0 type of 400 h.p. locomotives with hydraulic transmission are undergoing long duration trials. The trials of both types have given quite satisfactory results. A prototype of the T 324.0 diesel locomotive is being completed. This is a locomotive with a driving set identical to that of the T 306.0 locomotive, but with a higher speed and cardan shaft drive instead of coupling rod drive, so that it can be used not only for shunting, but also for local railway service. In 1959 prototypes of the T 444.0 diesel-hydraulic locomotives of 700 h.p. for express trains on secondary lines and the T 499.0 of 1300 h.p. for heavy shunting will be completed.

By systematic development the ČKD locomotive works are securing for the near future a wide production programme which will correspond not only with their wide assortment, but also with the quality of their products to the contemporary technical development of railway transport throughout the world.

Czechoslovak Electric Locomotives

THE lively development of railway electrification all over the world has influenced also the activity of the Czechoslovak Skoda Locomotive Works. This well-known locomotive works, which has built nearly 4000 locomotives since its foundation in 1920 stopped completely building steam locomotives a year ago and now devotes its attention exclusively to electric traction. The works has a long tradition also in this branch. The first electric locomotive left the works in 1928 and since that time, especially during the last ten years, several hundred locomotives of different types and sizes have been built at Plzen.

At present the production programme of this locomotive works includes almost exclusively heavy d. c. line-service locomotives and open cast mine locomotives. The Skoda series E 499.0 main line locomotives of 2344 kW one-hour rating weighing 80 tons are a particularly successful type. In the group of 3000 V d. c. locomotives they represent an example of the highest technique due to their specific weight, which is only 34.1 kg /kW. There are about 100 of these locomotives in service on the Czechoslovak State Railways. They have become the backbone of the electrification of the Czechoslovak State Railways, which is proceeding very quickly.

For further electrified sections of the Czechoslovak State Railways the Skoda Locomotive Works have started building an improved series E 499.1 locomotive. Its electrical part is identical to the electrical part of the E 499.0 series, but the mechanical part includes substantial changes resulting from the progress achieved in production technology and certain requirements of the railways, of which an increase of the axle pressure by one ton and an increase in resistance to the pressure of the frame are worth mentioning. Besides home deliveries a great number of these locomotives will be exported to the USSR, where two

experimental E 499.0 locomotives delivered in 1957 have proved their worth. At present tests of several prototypes of a six-axle locomotive derived from the four-axle locomotive are being carried out in Czechoslovakia and abroad.

Among open cast mine locomotives the 150 ton 1560 kW locomotive consisting of three sections, whose details are continuously being improved, is already a classical construction. Hundreds of these locomotives are already operating in Czechoslovakia, China and in different regions of the Soviet Union. Since 1957 there have been added to these locomotives smaller narrow gauge four-axle open cast mine bogie locomotives of 17 E type. Their weight is 64 tons, their one-hour rating being 520 kW. They have proved very well in difficult service in mines, which is best confirmed by a whole series of further orders.

Besides these main products the Skoda Locomotive Works supplies also different special electric locomotives, such as two- and four-axle storage battery shunting locomotives, small standard gauge 600 V trolley shunting locomotives, locomotives for coke works and line-service locomotives for electrified second class railways with low axle pressure.

The Research Department of the Skoda Locomotive Works is at present studying a number of other problems, especially those concerning the design of an a. c. locomotive, of an open cast mine locomotive of higher capacity and of the electrical part of an electrical multi-car set.

The Skoda Locomotive Works will continue to contribute its share to improvement of the operational economy of public and industrial railways.

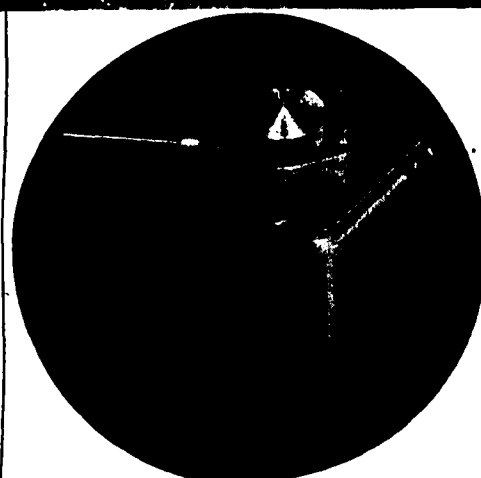
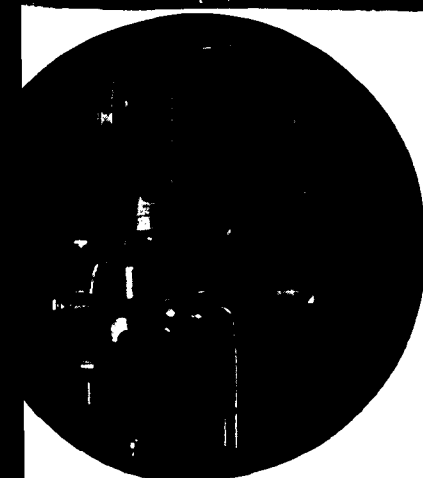
FUEL ABSTRACTS AND CURRENT TITLES

The Institute of Fuel has recently launched a new publication entitled 'Fuel Abstract and Current Titles.' It provides a monthly summary of world literature on all technical and scientific aspects of fuel and power and is intended to aid all those who are engaged in research in Fuel Technology and to those who are concerned with the many technical application of fuel. The annual subscription for this monthly publication is £ 1/12s including index and postage. It can be obtained from the Institute of Fuel, 18, Devonshire Street, Portland Place, London W.1. A specimen copy of 'Fuel Abstracts and Current Titles' is available for perusal in the British Information Services Reading Room at Mercantile Bank Building, Mahatma Gandhi Road, Bombay-1.

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The Diesel Locomotive with Electric and Hydraulic Power Transmission

ALMOST without exception, present day rail traction is dominated by the electric and the diesel locomotive. While the electric and the diesel locomotive made its appearance as early as the beginning of this century to an ever increasing extent, the diesel locomotive has advanced rapidly to the foreground especially during the last two decades. The advantages offered by the diesel locomotive in respect of operational and economical application led to the fact, that the change-over to diesel traction is taking place in almost every country of the world with great rapidity.

With the diesel locomotive, the main interest is, first of all, directed naturally enough to the characteristic part of the vehicle, namely the diesel engine. The development of the diesel engine with its various types of design for use as a prime mover in diesel locomotives has meanwhile reached such a high standard that the question of the suitability of the respective type of design is scarcely of basic importance.

Greater importance should be attached to the transmission of power from the diesel engine to the drive wheels of the locomotive as it must adapt itself to the traction requirements. The main interest is chiefly centered upon electric and hydraulic power transmission both of which conform to the requirements of railway operations. When selecting, the respective requirements of operation are decisive. It then becomes apparent, that either one or the other type of power transmission may be the more suitable for certain operational requirements. To fulfill the many-sided requirements of railway operation which differ in every country of the world, a selection concerning the type of power transmission is desirable and necessary.

Henschel supplies diesel locomotives with electric as well as hydraulic power transmission for all power ranges and normal track gauges. Naturally, diesel locomotives equipped with mechanical power transmission can also be supplied where smaller outputs are concerned which can be handled by this type of power transmission without excessive expense and complications.

With its modern type designs, Henschel takes an important part in the development and the building of

diesel locomotives. The following illustrated and briefly described locomotives show a small section of the Henschel supply range.

I. DIESEL ELECTRIC LOCOMOTIVES

Fig. 1 shows the most powerful diesel electric locomotive of its period in the world which Henschel built for the Rumanian State Railways in 1938. This

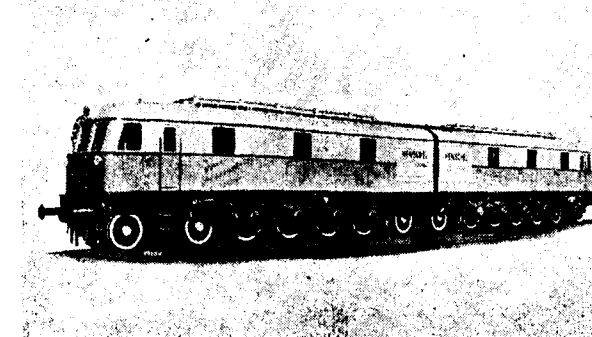


Fig. 1.

4,400 h. p. double-unit locomotive with a service weight of 115 tons with 2'D₀ 1'—1'D₀ 2' axle arrangement is a rigid frame locomotive of welded design and was built in co-operation with Gebr. Sulzer A. G., Winterthur, and BBC, Baden/Switzerland. Even today, this locomotive is in operation on mountainous railway service hauling heavy express trains.

By virtue of a license agreement concluded in 1954 with General Motors (GM), a diesel engine and a electric power transmission is available to Henschel for the building of diesel electric locomotives which are known all over the world and have excellently proved themselves to a total of more than 17,000 units.

Basically, the GM diesel engines of various output are similar and differ only in the number of cylinders. Except for the number of cylinders associated with each crankshaft, all parts subject to wear are interchangeable.

With the electrical equipment, only two different types of generators and one traction motor are provided for the entire power range of from 600 to 2,000 h. p.

For track gauges under 1,435 mm the traction motor varies. Thus, standardization has been accomplished to a great extent. The resulting advantages are of great importance when considering spare parts.

For the mechanical part of the locomotive, Henschel-Werke have developed their own design in order to comply, as far as possible, with the special requests of their customers.

Henschel GM general-purpose design locomotives with an output of 1,425 h. p. have been in service for many years with the Staatsmijnen Limburg/Netherlands (State Mines) on a continuous 24-hour around-the-clock operation (Fig. 2). Noteworthy on this loco-

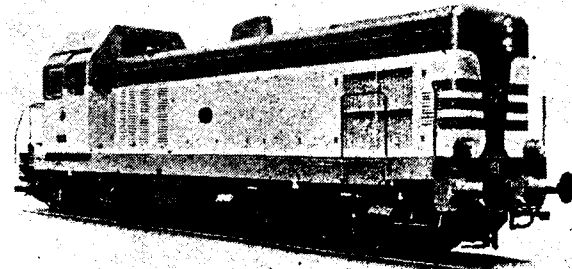


Fig. 2. Diesel electric Bo' Bo' locomotive model Henschel-General Motors, type G 12, for the Staatsmijnen Limburg/Holland, to pull heavy coal trains from colliery to harbour.

Gauge	1 435 mm
Service weight	74 000 kg
Output	1 425 HP
Max. speed	100 km/h

motive is the driver's cab with large windows offering a good view of the track, being adapted to the special operating conditions.

Since 1957, 13 heavy diesel-electric Henschel-GM locomotives type KK 16 have been in service with the Egyptian Railways (ER). On this stream-line locomotive with a driver's cab at either end and with an output of 1,900 h.p., the engine unit was sub-divided on special request into two separate and independent units of 950 h.p. each. With a permissible axleload of 22 tons, sufficient weight was available, so that the additional weight resulting from the sub-division was acceptable.

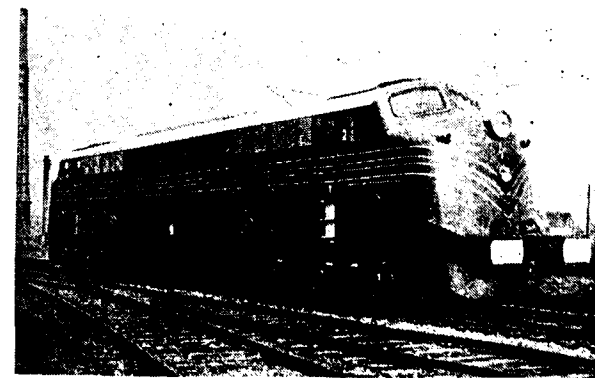


Fig. 3. Diesel electric A1A-A1A locomotive, model Henschel-General Motors, type KK, for the Egyptian Railways, to pull heavy ore trains in the Nile valley.

Gauge	1 435 mm
Service weight	132 000 kg
Output	1 900 HP
Max. speed	105 km/h

At the present time, Henschel-Werke have a repeat order from the Egyptian Railways for a further 108 diesel-electric locomotives. Out of this number, 70 locomotives are of type AA 12 with 1,425 h. p. and Bo'Bo' axle arrangement, and 38 are of type AA 16 with 1,950 h. p. and A1A-A1A axle arrangement (Fig. 4). These locomotives are now being delivered. They differ from the type KK 16 in that they are equipped with only one engine unit.

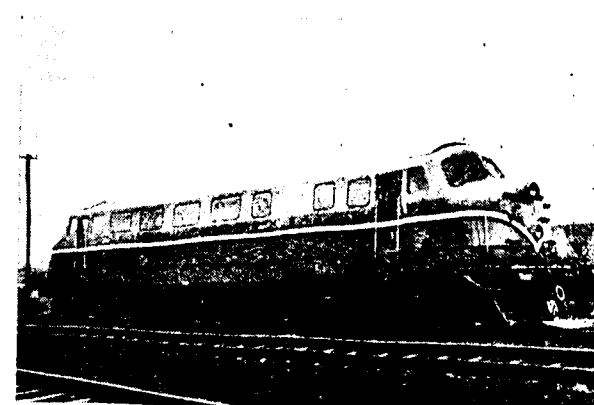


Fig. 4. Diesel-electric A1A-A1A locomotive, model Henschel-General Motors, type AA 16, for the Egyptian Railways.

Gauge	1 435 mm
Service weight	115 000 kg
Output	1 950 h.p.
Max. speed	120 km/h

The 18 diesel-electric Henschel-GM locomotives of type TT 12 with 1,425 h. p. and Co' Co' axle arrangement for the Ghana Railways are of a new design for tropical service, which is a combination of the stream-line and general purpose design. A spacious driver's cab is located at either end of the locomotive with a hood extending over the entire profile width. The central engine compartment is narrow and kept to the minimum dimensions required by the engine unit. Thus, the maintenance walkways are external and covered by the roof which extends over the entire width of the locomotive. Inspection of the power unit as well as maintenance and repair work can, as it were, be carried out in the open air. The personnel are protected against sun and rain by the roof overhang so that all work can be properly carried out. Numerous doors in the side walls of the engine compartment enable easy access to all parts of the engine unit and facilitate the dismounting and mounting of components requiring repair. The roof overhang at the same time offers protection against rain for the air-intake slits located in the side walls. With inside walkways, sun radiation as well as heat dissipation of the driving engine not yet cooled-off would complicate work in the engine compartment. As for the rest, this tropical design, which has already proved itself and gained recognition can also be applied with equal success to streamline locomotives of other operational methods (Fig. 5).

A further diesel-electric Henschel-GM locomotive of special design is the 1,425 h.p. Bo'Bo' locomotive

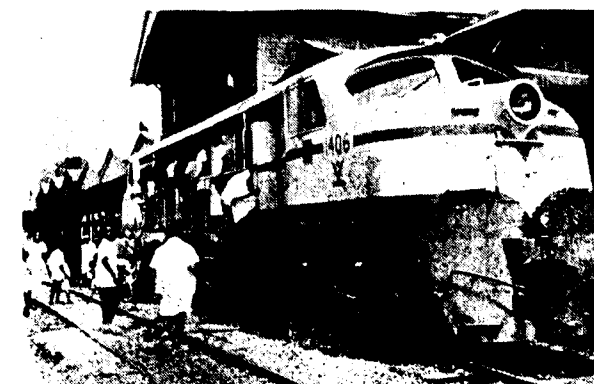


Fig. 5. Diesel electric Co' Co' locomotive, model Henschel-General Motors, type TT 12 as tropic-design of the most modern type for the Ghana Railways.

Gauge	1 067 mm
Service weight	83 000 kg
Output	1 425 HP
Max. speed	100 km/h

of type J 12 for the Österreichische Bundesbahnen (Austrian Federal Railways) (Fig. 6). At request of the Austrian Federal Railways, the outer shape of the locomotive was adapted to their latest electric locomotives.

All diesel-electric Henschel-GM locomotives are equipped with GM engines of type 567 C with 8, 12 or 16 cylinders, the output of which corresponds to 950, 1,425 and 1,950 h. p. respectively. The main generators designed as direct-current engines are rigidly coupled to the diesel engines. Starting of the diesel

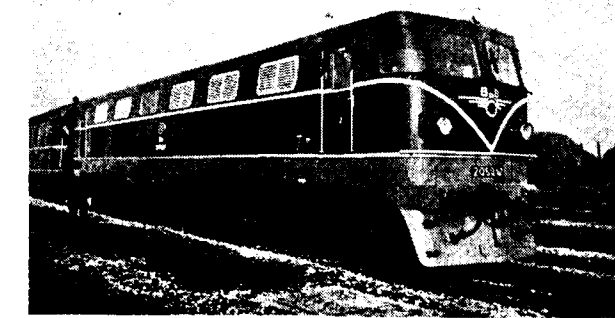


Fig. 6. Diesel-electric Bo'Bo' Locomotive, Henschel/General Motors design, Type J 12 for the Austrian Federal Railway.

Gauge	1435 mm
Weight in running order	72 000 kg
Output	1425 HP
Max. speed	100 km/h

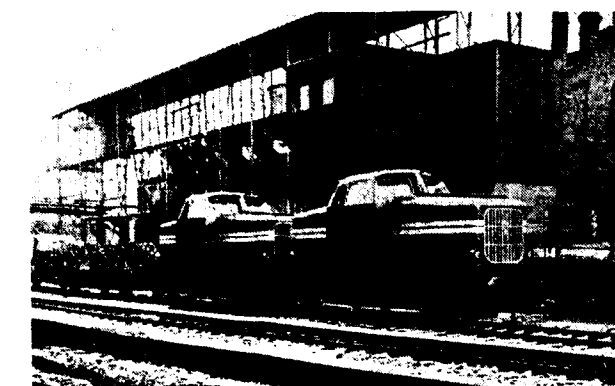


Fig. 7. DH 360 with double control

Gauge	1435 mm
Weight in running order	42 000 kg
Output	360/390 HP
Max. speed in shunting	30 km/h
„ in line service	60 km/h

engines is by the main generators which have been provided for this purpose with a special current winding. Underframe and superstructure are of welded steel construction. On the streamline locomotives as shown on Figs. 3, 4 and 6, underframe and superstructure have been welded together to a common supporting structure.

The bogies are of welded steel design of the well-proved box-type and flexicoil design. Diesel-electric Henschel-GM locomotives can be supplied with outputs up to 4,000 h. p. All locomotives may, without difficulty, be operated by multiple-unit control. Provision is made for the installation of an electric train resistance brake on all locomotives.

II. DIESEL-HYDRAULIC LOCOMOTIVES

For many years, Henschel has been active with the development of the design and the building of diesel-

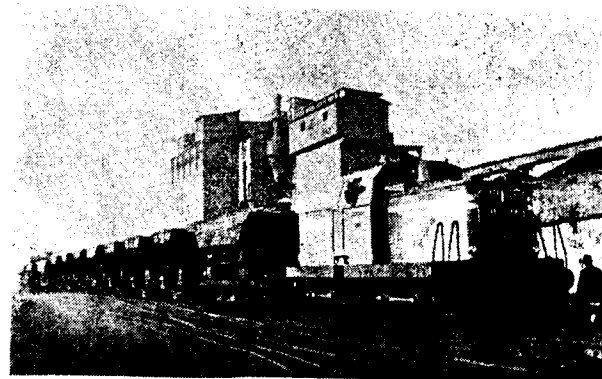


Fig. 8 Diesel hydraulic 0—8—0 locomotive with Beugnot type levers, type 650, for the Marburger Kreisbahn

Gauge	1 435 mm
Service weight	60 000 kg
Output	650 HP
Max. speed in shunting	30 km/h
„ in line service	60 km/h

hydraulic locomotives. During the course of time — and especially during recent decades—based upon the experience gained on practical operation, certain power classes of diesel-hydraulic locomotives have taken shape which range between approx. 100 and 2,200 h.p. Arising from this development, Henschel instituted a standard program for diesel-hydraulic locomotives by utilizing the building-block system. The power range can thus be met with two engine types and three

transmission types. The locomotive frame, driver's cab and superstructure, control equipment, wheel sets, axle bearings and their guides, suspension springs, brake equipment and rigging, rods and cardan shaft

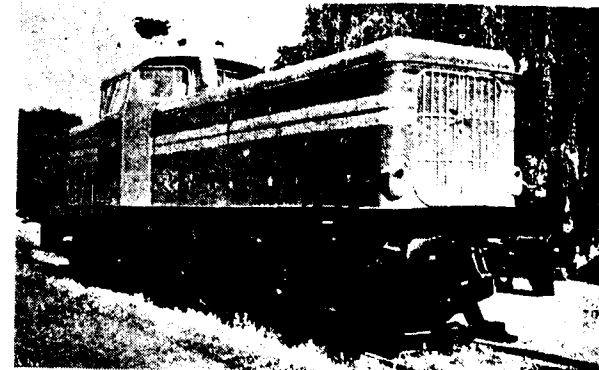


Fig. 9. Diesel-hydraulic BB bogie locomotive type DH 630 for "Hadir"

Differdingen - Luxemburg	
Gauge	1435 mm
Service weight	64 000 kg
Output	630 HP
Max. speed	35 km/h



Fig. 10. Diesel hydraulic BB bogie locomotive for the South African Railways (SAR)

Gauge	1 067 mm
Service weight	75 000 kg
Output	1 420 HP
Max. speed	50 km/h

drives as well as radiators and fan drives are widely interchangeable. Generally, the building-block system is usually only applicable within the power groups up to approx. 850 h.p.

On locomotives with more power, special Railway Administration conditions have in most cases to be taken into consideration, so that in these cases this

system can only be applied to a limited extent. Most large Railway Association such as the Deutsche Bundesbahn (German Federal Railways) have on the whole developed their own design program within the above mentioned output limits.

For example, Fig. 7 shows two locomotives with double-unit control of the three-axle type DH 360, which is utilized in large numbers at home and abroad as a light shunting locomotive.

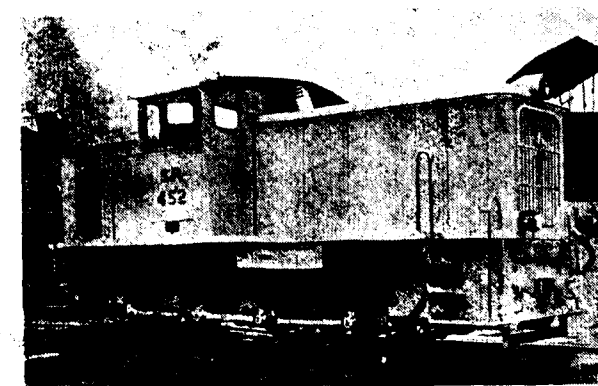


Fig. 11. Diesel-hydraulic 0—6—0 locomotive for the Sudan Railways.

Gauge	1 067 mm
Service weight	47 000 kg
Max. speed in shunting	32 km/h
in travelling	68 km/h

The same design, however with an output of 440 h. p. has been supplied in large numbers to the Railways of the Bombay Port Trust and the Steel Works Bhilai-Steel, India, to the Iranian State Railways, and to the Danish State Railways. The same design, however, with outputs of 500 and 700 h. p. has already found wider acceptance than the types DH 500 and DH 700. Fig. 8 shows the four-axle type DH 650/850 with an output of 650 h. p. and 850 h. p. respectively, with Beugnot type bogies.

The four-axle type DH 650/850 with an output of 650 and 850 h. p. respectively, however, of bogie type design and with cardan shaft drive, is shown on Fig. 9.

Fig. 10 shows the 1,420 h. p. diesel-hydraulic bogie-type locomotive for the South African Railways (SAR).

It has two independent engine units with GM diesel engines of 710 h. p. each.

Further special designs are shown on Fig. 11, one three-axle diesel-hydraulic locomotive with an output of 365 h. p. for the Sudan Railways, and on Fig. 12, one ICI diesel-hydraulic locomotive with an output of 400 h.p. for the Thailand State Railways.

This rather brief review, due to the limited space, concerning the participation of Henschel in the development of locomotives for modern rail traction may be concluded with the mention of a diesel-hydraulic

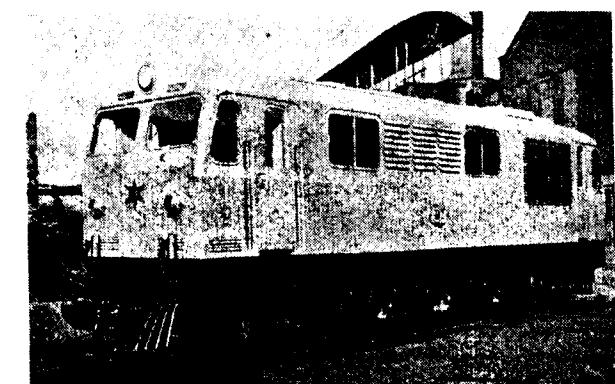
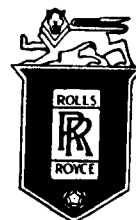


Fig. 12. Diesel hydraulic 2—6—2 locomotive in steel light-construction for the Thailand State Railways (Meklong line)

Gauge	1 000 mm
Service weight	33 400 kg
Output	400 HP
Max. speed	55 km/h

locomotive which is under construction, having an output of approx. 4,000 h.p. Up-to-date, this output is the highest being installed per unit in diesel-hydraulic locomotives. This locomotive will be equipped with two three-axle bogies onto which the output of 4,000 h.p. is transmitted by two independent engine units. The service weight of the locomotive is approximately 120 tons, the operating speed is 160 km/h, and the permissible top speed 175 km/h. Development of this locomotive is in close co-operation with the Deutsche Bundesbahn (German Federal Railways) utilising all scientific knowledge available and Henschel's decades of experience in the building of locomotives.



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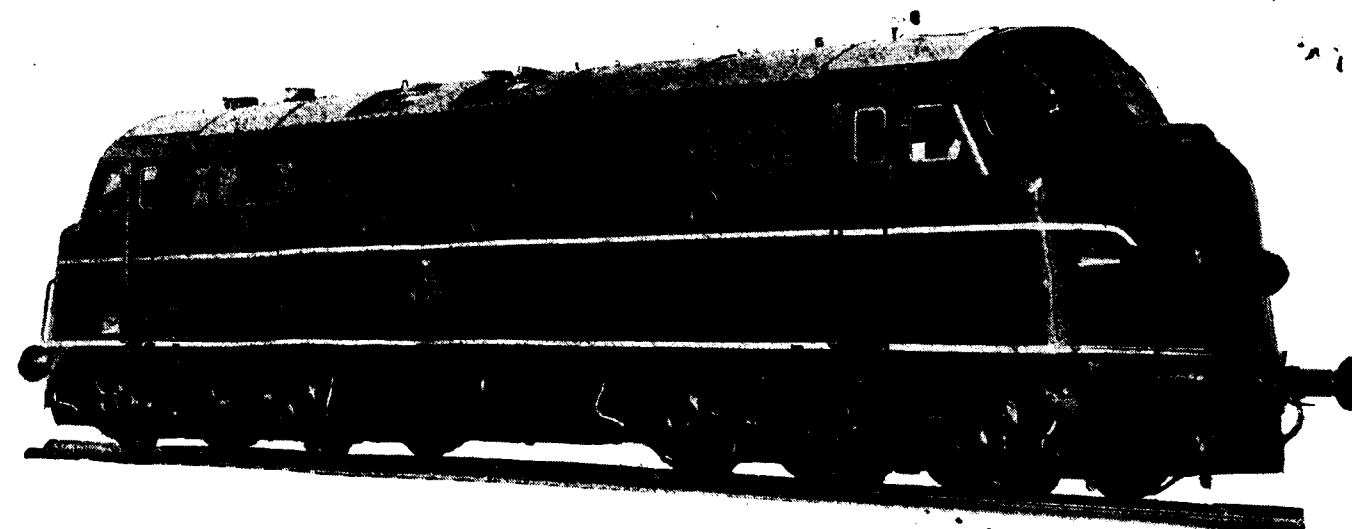
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Efficiency, reliability, and economy are outstanding features of the NOHAB-GM diesel-electric locomotives.

Interesting figures on the economy of these locomotives were obtained when the Danish State Railways (DSB) compared their operating costs for the NOHAB-GM locomotives with those of steam locomotives. The four diesel-electric locomotives first procured showed savings of 678,000 Danish crowns (£35,300) per year per locomotive. 20 NOHAB-GM locomotives delivered later have saved about half a million Danish Crowns each annually, in fuel costs only.

A new order for 45 locomotives of a similar type proves that the NOHAB-GM diesel-electric locomotives already delivered have given full technical as well as economic satisfaction.

The bogies are made according to the so called flexi-coil principle, with axles displaceable in the journal boxes, which gives the locomotives an extremely smooth and even running.



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Manufacturing Locomotives since 1885



0-6-0 Diesel-Hydraulic Locomotive—360 h.p. gauge 1435 mm., for service in tropical climate on desert railways, driver's cab at the end, remote control, equipped, with MWM diesel engine Type RH 335 S and Voith hydraulic transmission L37. Supplied: among others, 42 units to Egyptian Republic Railways

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BoBo Two-Power Electric-Diesel Locomotive gauge 1435 mm.

Weight in service order 80 tons, rated output of the traction motors 4 X 148 kW. ~ 592 kW., trolley wire voltage 600 V. Supplied: up to now 13 units to Western German metallurgical works and mining enterprises.

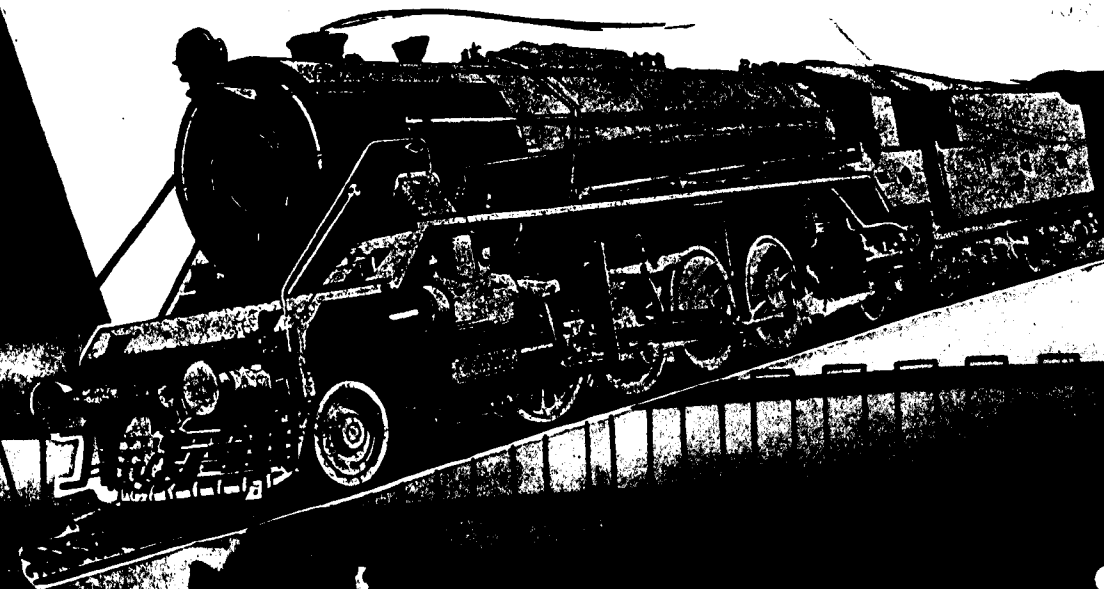


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SOUTHERN RAILWAYS

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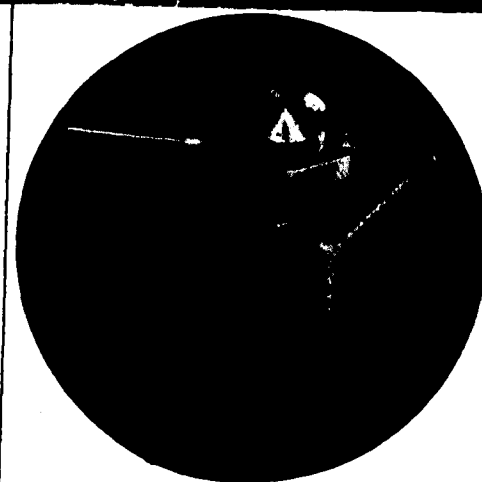
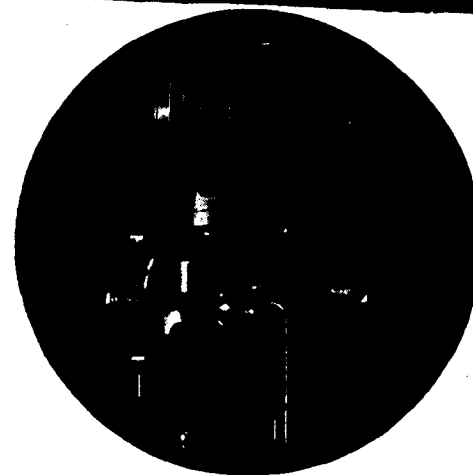
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SOUTHERN RAILWAYS MAGAZINE

1

Water Coolers for Internal Combustion Engines

By An Engineering Correspondent

A water cooler for an internal combustion engine should efficiently dissipate the heat from the cylinder jacket, whilst at the same time its weight should be as small as is consistent with good design, it should occupy the minimum space, and the power necessary for the fan and water circulating pump should be low. Finned tubing is eminently satisfactory for this type of equipment for it is reliable, possesses the requisite strength, and the heat transfer properties are good. It is particularly suitable for large scale installations, and where a robust design is required to withstand rough usage or vibration.

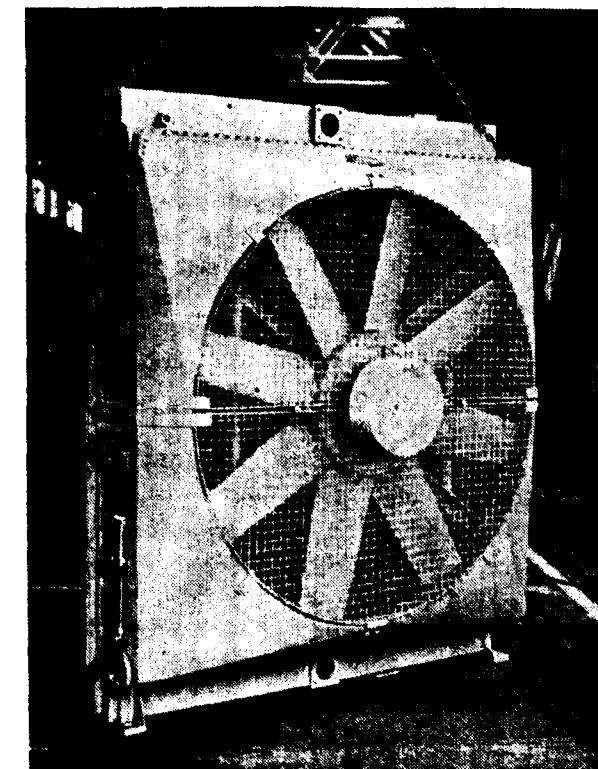
The purpose of the cooler is to lower the temperature of the water to a point which is considered to be a maximum temperature for the engine. The cooler is therefore designed to limit the engine outlet water temperature to this desired level under the warmest ambient air conditions which may be experienced on site. Cold weather, or conditions of light load, might result in over-cooling but this is countered by restricting the air quantity by means of shutters, or by providing thermostatic control of the water circulation.

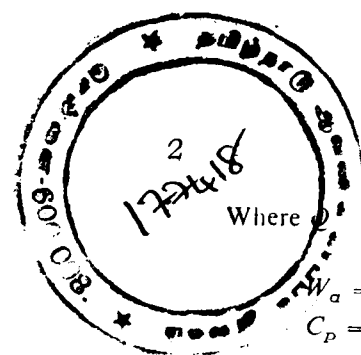
Whereas the units previously discussed have air heating as their major function, in the cases of engine coolers the hot air is a by-product (although in many instances the hot air from stationary engines is used for space heating). As the air is primarily responsible for the removal of the heat, the installation should be so arranged that there is an unobstructed passage for the cooling air and free dissipation of the hot air leaving the cooler.

It is convenient to express the heat to be dissipated in terms of B.t.u./(BHP) (hr) and this value depends on the type of engine and the conditions of the load, which may be continuous or intermittent. If the engine is not developing its maximum brake horse power continuously an estimate of the average power developed must be made and the size of the cooler may then be based on this estimate. Thus, for main line traction 85% to 90% of the continuous full load may be taken whilst for cranes, excavators or shunting locomotives 50% of the continuous full load may be ample.

When an engine is started from cold only a small proportion of the heat given off will be dissipated by the cooler, which, it will be appreciated, is due to the very small mean temperature difference at this time. The remainder of the heat is absorbed by the circulating water and metal of the pipe work and engine. A higher water temperature then results, the mean temperature difference becomes greater, and a larger proportion of heat is dissipated by the cooler. This process proceeds until the mean temperature difference becomes high enough to enable the cooler to dissipate the required amount of heat from the cooling water and, unless some change in the conditions occurs, the temperature of the cooling water from the engines will remain substantially constant. When these steady conditions exist the following equation is satisfied :—

$$Q = W_a C_p (t_2 - t_1) = W_w C (T_1 - T_2) = UA (\Delta t) \dots (48)$$





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- Where Q = quantity of heat dissipated B. t. u./hr.
 W_a = lbs. of air/hr.
 C_p = specific heat of air at constant pressure.
 W_w = lbs. of water circulated/hr.
 U = overall transfer co-efficient B. t. u./ (sq. ft.) (°F) (hr) based on the air side surface.
 A = air side surface sq. ft.
 t_1 = initial air temperature.
 t_2 = final air temperature.
 T_1 = temperature of water entering the cooler.
 T_2 = temperature of water leaving the cooler.
 (Δt) = the true mean temperature difference.

The equation shows the relationship between the variables which enter into the computation. It has been shown that the overall transfer co-efficient is dependent upon the type of finned tube, the air velocity and the velocity and temperature of the cooling water. The type of tube and the air velocity will be chosen to give the most economical ratio of heat dissipation to fan power and will for normal conditions remain a constant. It is possible for the designer to control the water velocity to some extent by arranging suitable passes for a given design of cooler, but the quantity of cooling water circulated and its temperature will decide the overall heat transfer co-efficient. It will be seen from an inspection of the equation that for a given heat dissipation and air quantity an alteration in one variable will influence all the remainder.

Consider the effect of an increase in the water quantity through a given size of cooler and a given entering air temperature. In the first place the overall co-efficient will be increased due to the increased velocity. For equation (48) to be satisfied the mean temperature difference will be reduced so that the value of $UA (\Delta t)$ remains constant. This will reduce the values of T_1 and T_2 and the drop in the mean water temperature will have an adverse effect on U . At the velocities normally encountered this is very small however. At the same time the temperature drop in the water will be decreased so that value of $W_w C (T_1 - T_2)$ remains constant. This will have the effect of lowering the value of T_1 and increasing the value of T_2 until the mean temperature difference again satisfies the equation. In order to bring the

value of T_1 to the original level A must be reduced, so that an increase in the water quantity has the effect of reducing the surface area required. In practice a smaller cooler would be used. This would have a smaller air quantity and the value of $(t_2 - t_1)$ would be increased, thus reducing the mean temperature difference (Δt) , but the cooler can be reduced in size until the equation is again satisfied.

Now consider the effect of a rise in the value of T_1 . In the first place the transfer co-efficient U increases due to the rise in the mean temperature, but the mean temperature difference also increases and the value of A would again have to be reduced to satisfy the equation. It will be seen therefore that the water quantity and the temperature allowable have a big influence on the size of the cooler.

The effect of an increase in the heat to be dissipated should be noted, as this can occur in practice due to a temporary overload. The conditions become unstable and the water temperature begins to rise until, eventually, the mean temperature difference reaches a level which will again satisfy the equation and stable conditions are restored. The extent of the rise in the water temperature depends on the increase in the load and the mean temperature difference. An increase of 10% in the heat to be dissipated would require an increase of approximately 10% in the temperature difference, or for a temperature difference of 30°F. this would be a little over 3°F. The temperature difference is usually about 50° for normal temperature conditions and may be as low as 25° for tropical conditions, and in the latter case the increase in the water temperature due to a temporary overload will therefore be negligible.

Conversely the effect of a comparatively small increase in the water temperature will have a marked affect on the size of the cooler required, particularly when operating in a high ambient air temperature. The following example will illustrate this point. A certain engine is to operate with a given water quantity in an ambient temperature of 115°F. with a maximum water temperature of 160°F. Assume this requires a cooler with a frontal area of 38½ square feet. If the water temperature is increased to 180°F. a cooler with a frontal area of 22 square feet would be adequate, a reduction of 43%. If the water quantity is doubled a cooler with an area of 27 square feet would limit the temperature to 160°F., whilst one with 18 square feet would maintain a temperature of 180°F.

The importance of an accurate knowledge of the heat emitted by the engine must be emphasised, particularly when working in tropical conditions. If, for example, the heat emitted by the engine in the above example has been over-estimated by 10% a cooler of 32½ square feet would limit the temperature to 160°F. with the low water quantity, whilst a cooler with only 14 square feet would limit the temperature to 180°F. with the higher water quantity.

Provided the engine will run efficiently with the increased water temperature the size of the cooler may be reduced by pressurising the system thus taking advantage of the increased water temperature, with its consequent effect on the mean temperature difference and increased film co-efficient on the water side. Such

coolers can be run at temperatures above 212°F. and may be desirable in certain circumstances.

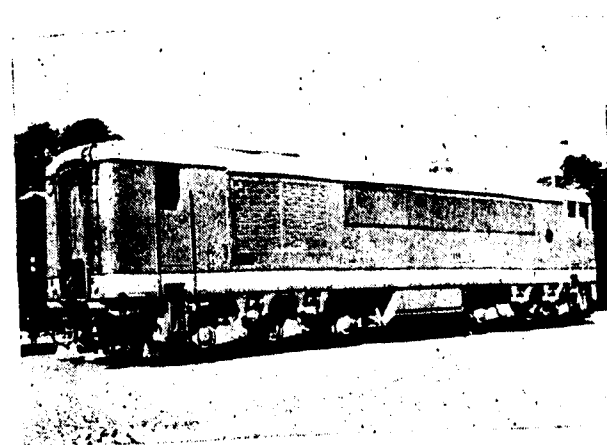
For small engines thermo-syphon water circulation may be adopted but it is inefficient and necessitates a relatively large cooler. For traction work on diesel rail cars the fan may be dispensed with, for the cooler is mounted on the roof of the car and thus the movement of the car through the air gives the necessary air velocity. With a good water circulation this type of cooler is very efficient.

It will be appreciated that the design of a cooler to meet a certain set of conditions is a complex matter and calls for the closest co-operation between the designers of the engine and cooler if the most compact and efficient cooling equipment is to be provided.

ČKD T 698.0 TYPE DIESEL-ELECTRIC LOCOMOTIVE

This is an example of a high quality locomotive made by the ČKD.

The ČKD T 698.0 Type diesel-electric locomotive is used for fast passenger trains with a maximum



speed of 120 km/h (75 miles/h) or for freight trains with a maximum speed of 80 km/h (50 miles/h). The passenger and freight train locomotives of this type are identical, the only difference being the power

transmission ratio between the traction motor and the driving axle.

The engine is the robust ČKD slow speed engine of the same cylinder bore and stroke as that used in the ČKD T 435.0 Type diesel-electric locomotives, this means that the stock of spare parts at the railway workshops is considerably reduced. The engine is provided with a turbo-charger. The output of the exhibited type is 1,650 HP, however, the new series, planned for 1960 will have a higher output of 2,000 HP, the compression ratio being increased by applying a medium pressure turbo-charger. The locomotive can be delivered either with driver's cabin at one end only, or with cabins at both locomotive ends. The multiple unit control equipment enables the driver to control several locomotives from one post. During trials at a speed of 135 km/h (84 miles/h) the locomotive travelled perfectly smoothly.

Main technical data are: wheel arrangement Co' Co', rail gauge 1435 mm (4'—8 1/2"), weight 105 tons (100,7 long tons).

General Electric introduces most powerful U. S. Diesel Locomotive

THE most powerful diesel electric locomotive ever built in the U. S. A. was introduced recently by the General Electric Locomotive & Car Equipment Department.

Developing 2,500 horsepower, the new locomotive design evolved from the universal type diesel-electric locomotives made by G-E for use on railroads outside of the United States. These locomotives have been supplying motive power for major world railways since 1956 and have completed an estimated 30,000,000 miles of operation.

The new locomotive will become an important tool of the U. S. railroad industry in its competitive struggle with other forms of transportation.

The new locomotive will enable U. S. railroads to haul freight faster and more economically and thus regain the business they have lost to competing forms of transportation.

The new locomotive develops 2,500 horsepower and weighs only 130 tons, an exceptionally favourable power-weight ratio for a diesel-electric. As a result, it is capable of hauling trains at higher speeds.

The new unit is the most powerful diesel-electric manufactured in the United States. It is also the first mainline diesel-electric locomotive offered by G-E to U. S. railroads since the company pioneered the diesel-electric locomotive in the decade beginning in 1925.

In the interval, General Electric continued to manufacture straight electric and gas turbine-electric locomotives for mainline use in the United States. However, the company has made many hundreds of mainline diesel-electrics for export to railroads in countries outside of the U. S. as well as thousands of diesel-electric switching and industrial locomotives for use both at home and abroad.

According to Locomotive Department General Manager Guy W. Wilson, important lessons were learned in the manufacturing and operation of the units made for overseas use. "You might say," he added,

"that the new unit which we are now offering to North American railroads incorporates the results of our excellent experience with our export line."

Wilson made it clear that there will be no diminution of General Electric's international business and that the addition of this new locomotive to the company's diesel-electric locomotive line does not represent any change in overseas marketing plans. "As a matter of fact", he said, "it is entirely probable that lessons learned from our experience with this new unit will be incorporated in future locomotives designed for use outside of the U. S." Wilson pointed out that he was thinking particularly of refinements relating to maintenance.

The new locomotive design, is based also on the specific needs of U. S. railroads for a higher power, lighter weight unit requiring a minimum of maintenance. These criteria were developed by researching the requirements of the railroads in an expanding economy.

Component and design concepts incorporated in the new locomotive have been tested in over 100,000 miles of actual operation on U. S. railroads. The new unit is designated U25B. The "U" indicates its universality of application—it can be used in freight, passenger or switching service. The "25" indicates its 2,500 horsepower rating. The "B" shows that it has four sets of wheels arranged in two 2-axle trucks and that all four axles are powered.

An examination of the new locomotive at the General Electric plant in Erie shows several unusual features. For one thing, a 60% reduction in electrical components establishes a new standard of reliability. Filtered, pressurized air is used throughout the locomotive, ensuring complete freedom from dirt—a principal cause of electrical and mechanical failure. A simplified engine cooling system eliminates all electrical apparatus, radiator shutters and clutch devices. Accessibility of parts for inspection and maintenance minimizes delay and expense. In addition to being supplied with filtered air, the operator's cab is even sound insulated.

Transmission Gear for Diesel Locomotives

By P. Zens

President, General Manager, Compagnie des Chemins de fer departementaux

OPERATION OF THE "ASYNCHRO" GEAR BOX

THE combination of a brake and clutch, operated through a single air piston, located at the entry to the gear box provides two positions:

	Clutch	Brake
(1)	Engaged	Released
(2)	Disengaged	Applied

(It should be noted that the piston does not require a ball joint and that the stop is called into use only for the short time during which the piston is moving).

The gear box is brought to rest when changing gears, and it is then that the sliding clutch is brought into operation. Consequently, no expedient is employed in this gear box, where the "synchros" are

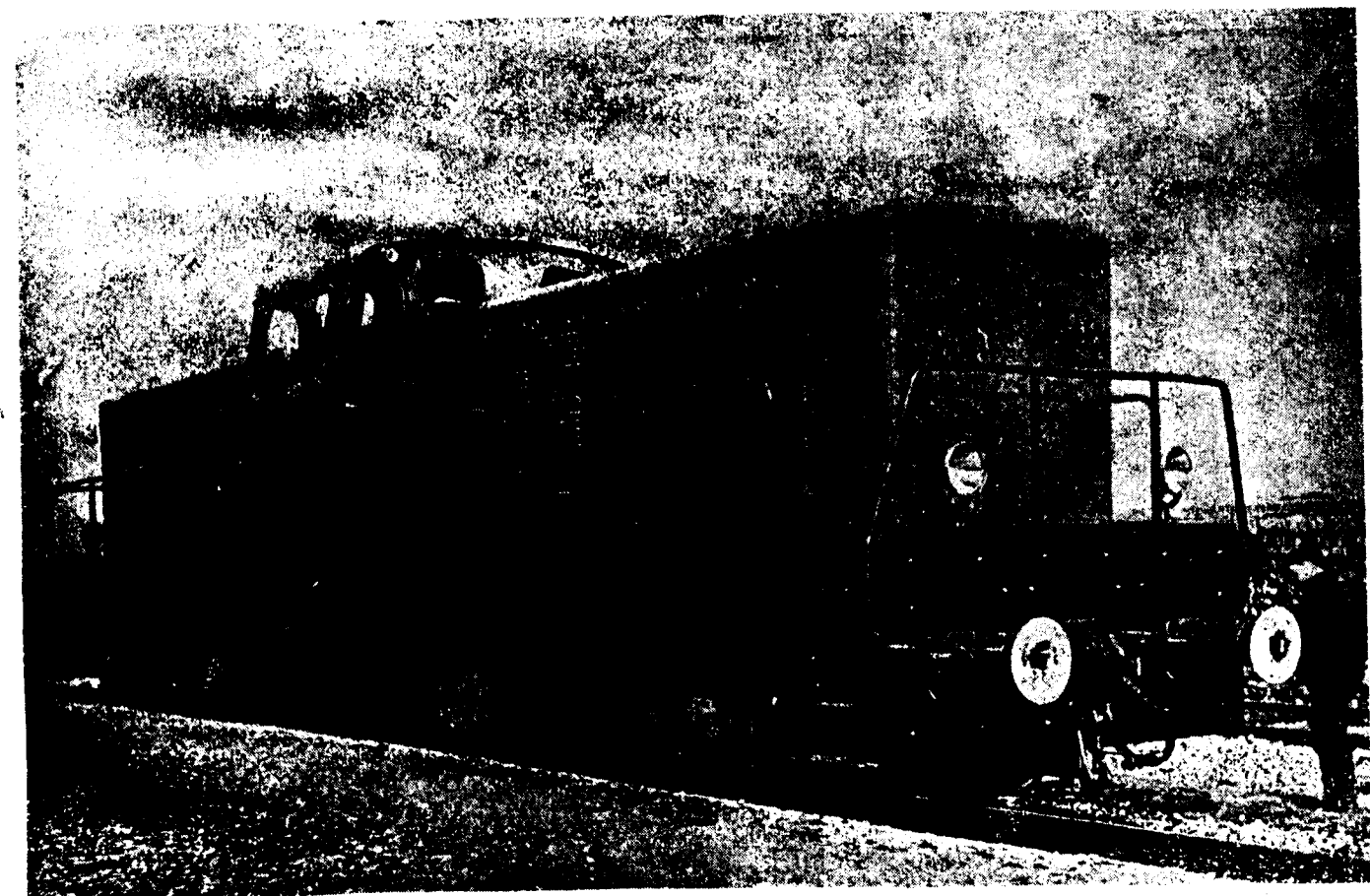
substituted by a single outside brake, which may be of any suitable dimensions, and is as reliable as that ensuring the safety of millions of car drivers.

The brake used is of the multi-disc type, operating either dry or in oil, which offers the best guarantee of long service life. The possibility of mistakes is totally eliminated by a simple device bringing the gear drive to a complete standstill.

Actual practical experience has shown that when the brake is prevented from acting, passive resistance brings the gearing to a slow stop, and that the gearchange operates, without difficulty, after a few seconds when the gearing has come to rest.

GEAR-CHANGING

We shall describe the operation of a gear box intended for engines of 500 to 600 hp.



800/1,200 h.p.—68 Ton Diesel Locomotive Hydro-mechanical transmission system—"Asynchro" patented gear box.

The gear box is provided with a pre-selective servomechanism.

The driver operates :

- (1) the speed pre-selection handle (S),
- (2) the impulse button (I).

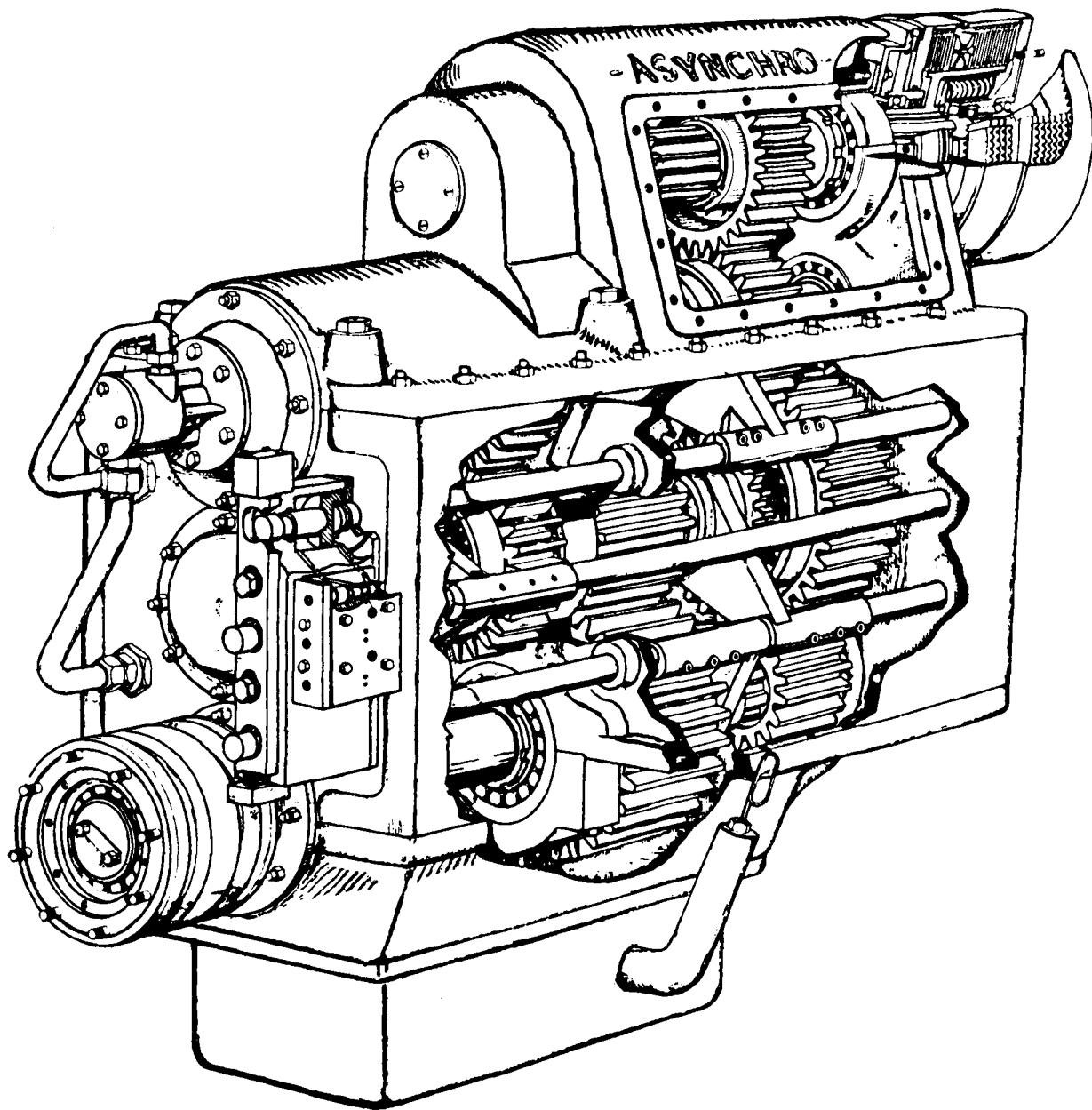
He positions the pre-selector for the required gear, and, when he depresses the button, the gear-change is effected automatically, with full reliability no matter how many gear boxes there may be, in the

case of either a twin-engine locomotive, or of locomotives working in multiple.

OPERATION OF THE CONTROL

The gear box is provided with a valve D_v directing the flow of air to the speed cylinders C_v .

The valve, being remote-controlled from the cab, through a 3-way valve A, B, C ($A_p B_p C_p$, with compressed air supply or $A_o B_o C_o$, with exhaust supply) thus providing the following combinations, each corresponding to a speed :

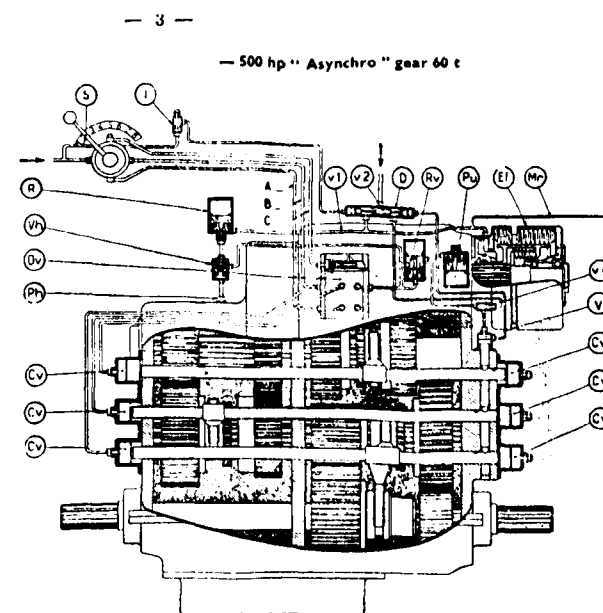


Asynchro Gear - 8 Speeds 600 h. p.

- | | |
|------------------|------------------|
| 1) $A_p B_p C_p$ | 5) $A_o B_o C_o$ |
| 2) $A_p B_p C_o$ | 6) $A_o B_p C_o$ |
| 3) $A_p B_o C_p$ | 7) $A_o B_o C_p$ |
| 4) $A_p B_o C_o$ | 8) $A_o B_o C_o$ |

A combination having been pre-selected, depressing the button causes the 2-way valve slide (D) to move to the right. Through its piping 1 this valve supplies air to the clutch-brake (E_v), the engine idling control (M_r) and the direct electro-pneumatic valve (E_v) on the supply side.

Through its piping 2 it puts the exhaust through to the rod locking mechanism (V) which, under the action of its spring, moves upwards thus unlocking the 3 rods.



C_v : Speed cylinder — D : C.P.O.A.C. valve — D_v : Gear valve — E_v : Clutch/brake — I : Impulse valve — M_r : Idling-control — P_n : Oil-pressure take-off — P_o : Interlock bleed — R : Delayed action mechanism, gear-change — R_v : Delayed action mechanism, gear-interlock — S : Pre-selector valve — V : Gear-interlock — VV : Dual valve — V_1 : C.P.O.A.C. piping No. 1 — V_2 : C.P.O.A.C. piping No. 2 — V_n : Hydraulic-control valve.

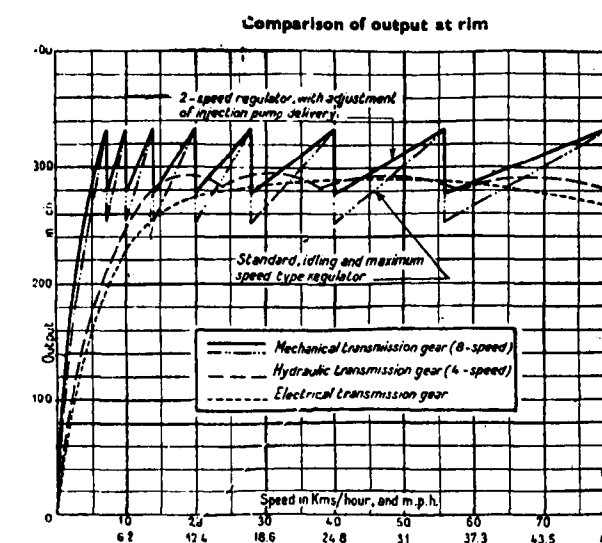
As soon as the gear box comes to rest, about 1 to 1 1/2 seconds after the button has been depressed, the pressure of oil in the gear box pump (P_b) falls to zero, the manocontact (M) energises the electro-pneumatic valve (E_v), which then admits air to the speed valve (D_v). This latter supplies the cylinders giving the pre-selected combination, whilst, due to the action of the slowing device (R), a fraction of a second after the

opening of the electro-valve, air arrives through the double-valve (V_v) bringing the rod locking mechanism (V) under pressure; when the rods are all positioned, this latter moves downward, operating valve (Z) at the end of its travel. This brings slide (D) back to the left and piping (1) is opened, to the exhaust, thus releasing the brake, engaging the clutch, and restarting the engine injection. Piping (2), through the double-valve V_v , takes over in order to maintain (V) locked. Several gear boxes may be controlled in the same way, a single depression of the button initiating the operation. It is then only necessary, in order to maintain the tractive effort, to put the pre-set braking device to the piping (1) of the valves (D) when the operating of each gear box will be initiated at the required instant.

It should be noted that, owing to the free-wheel, any combination of the gear box may be engaged, whatever the speed of the machine, and that this control enables changing over from any one combination to any other.

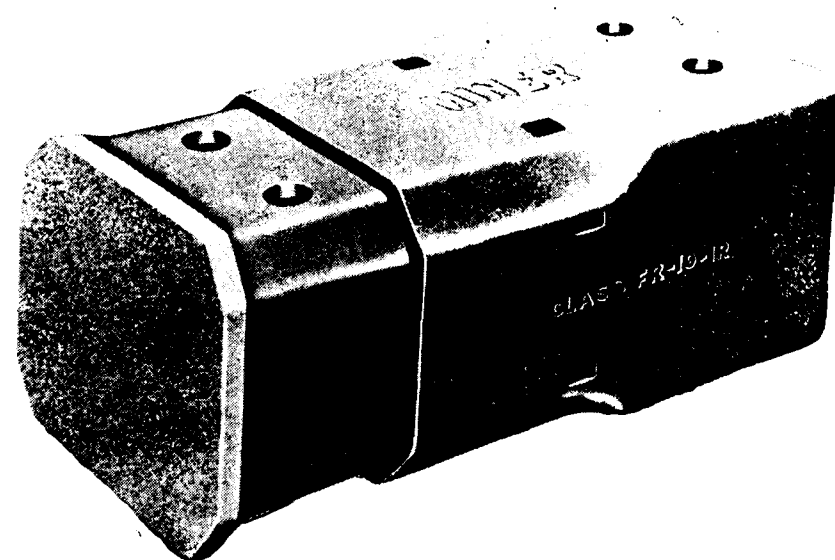
COMPARISON OF EFFICIENCY

It is often emphasized that the hydraulic and electrical transmission systems make available, at any required moment, the maximum torque and speed of the engine, hence its full power output. However,



this does not apply to the mechanical type except under rare circumstances, the engine output which mechanical transmission makes available being, at the maximum, this full power and, at the minimum, the quotient of the full output by gear box ratio.

But this advantage offered by the hydraulic or electrical transmission system is only apparent, for



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CLASS FR-19-IR RUBBER DRAFT GEAR

ENGINEERED FOR FULL-TIME PROTECTION of lading and cars. The entire 24-5/8" pocket is utilized for the superior protective action of this gear. Proper initial compression will provide slack-free operation of cars.

The FR-19-IR Gear, like all Miner gears, is fully enclosed and self-contained, giving the rubber pads protection against foreign material, and aiding in an easy application within the yoke and to the car at any shop or rip track.

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though these do actually enable the transmission to get the full output, the transmission does not make full use of it.

The rim finally gets nothing of this, and the result of the additional power supplied and not used is solely engine consumption and wear.

We shall make a comparison with the hydraulic transmission system, calling attention to the fact that when this has to handle high output, several changes of the combination are provided for; beyond a somewhat restricted range of operation, the efficiency is no longer satisfactory.

Let us consider a 400 hp, 8 cylinder, 1,500 r. p. m. engine, with a maximum 1-hour rating of 400 hp.

We shall assume that the gear box and mechanical transmission are provided with a ratio of 1/40; though this requirement is readily realised with the

mechanical type of transmission, it does not yet appear to have been achieved with the hydraulic type.

We shall, likewise, assume that the engine auxiliaries take 35 hp for the mechanical type transmission, and 40 hp for the hydraulic, i. e. an additional 5 to 8 hp for cooling the transmission gear.

This results in a loss, with the mechanical type transmission, of:

Loss in hydraulic coupler

—3 ground spur gear trains	2.5%
—1 bevel gearing	3 %
—2 spur gears on drive axle	2 %
	2 %
Total	9.5%
efficiency:	90.5%

USSR RANKS FIRST IN LENGTH OF ELECTRIC RAILWAYS

Pravda carries an article by the Minister of Railways Boris Beshchev devoted to the All-Union Railway-men's Day, a traditional national holiday.

The Minister writes that the Soviet Union now ranks first in the world for the length of electrified railways and the rate of railroad electrification. Forty-four per cent of the freight carriage on Soviet railways is done by electric and diesel traction. The volume of rail freight carriage done by electric and diesel traction in the Soviet Union this year is over three times greater than the entire rail freight carriage of Britain, France, the FRG, Italy, Austria and Spain taken together.

Boris Beshchev writes that the USSR is now accomplishing the task of developing large electrified trunk lines with a high throughput capacity. Already this year, work will be completed on the electrification of the important Moscow-Kuibyshev-Cheliabinsk-Irkutsk section of the Soviet railway system with a total length of over five thousand kilometres. It will be the world's biggest line with the world's biggest throughput, the Minister observes. It will link the central regions of the European part of the USSR with the Urals and Siberia.

The Minister stresses that the programme for the introduction of new progressive forms of traction, envisaged in the Seven-Year Plan (1959—1965) can be accomplished ahead of schedule.

* * * * *

OVERHEAD RAILWAY

Muscovites are justly proud of their Metro or the underground railway, which in less than a quarter of a century has grown to over 50 miles of lines with 56 stations. It carries on an average 2,700,000 passengers daily—almost four times as many as Berlin, and half as many again as the London tube.

Within the next few years it will stretch out in all directions to the farthest residential suburbs.

Along with their Underground, Muscovites are going to have an overhead railway connecting Moscow's main international airport, Vnukovo, with the city's underground rail system.

The line will be a double one, carrying streamlined cars 60 to 70 feet long, each seating 75 passengers. These electrically propelled cars will be suspended by pneumatic-tyred wheels from a double-rail track, laid on trestles supported by reinforced concrete props up to 40 feet high and at intervals of about 100 feet. The bottom of the car will be about 20 feet above the ground, allowing plenty of room for surface transport.

The trains will be able to develop speeds of up to 100 m. p. h., and—including the stops—will take only 11 to 12 minutes from the airport to Moscow.

DIESEL ENGINE TESTING AND TUNING

By An Engineering Correspondent

EFFICIENCY IN COMBUSTION

THE efficiency of the diesel-powered locomotive depends largely on correct fuel combustion. The factors governing this are the correct operation of the fuel injection system and sufficiently high compression in the cylinders. If either of these factors is not correct combustion will be incomplete, with a consequent loss of engine power, wastage of fuel, emission of smoke, uneven running, excessive vibration and engine noise, a tendency to stall when idling, difficult starting and engine wear.

The fuel injection system depends for its proper operation on the pump which accurately meters the exact quantity of fuel required and at the correct moment delivers it to the injectors at the necessary high pressure for correct atomisation. It also depends on the injectors which open at a given pressure and distribute the fuel in the cylinder in the form of a fine spray. The intimate connection between pump and injector means that no engine can be considered correctly adjusted when the injectors have not been balanced to the pump in question under true operating conditions.

Diesel engineers have long recognised that the ideal method would be to set injectors to the fuel pump dynamically—that is to say on a running engine rather than on a neutral hand pump, where many vital factors differ.

IMPORTANCE OF DYNAMIC SETTING

Electronic Testing: the Research Departments of most up-to-date diesel engine manufacturers are now establishing recommended injection pressures on prototype engines by the dynamic method. The Oscilloscope can also carry out tests on the fuel pump under operating conditions. But with the introduction of up-to-date maintenance instruments the testing and resetting of injectors and the testing of pump elements and delivery valves can all be carried out dynamically on the engine in all maintenance workshops. The fact of testing under true running conditions means that faults can be accurately and quickly traced without unnecessary

removal of the various components of the fuel injection system, with a consequent saving of man hours, load time, demurrage and specialist charges.

When an engine is set up and corrected dynamically it will be found to show an increase in power and engine life, smoother running, improved fuel consumption and no smoke.

Bench testers have fixed diameter plungers which cannot be altered to suit the various sizes of plunger fitted to different types of engines. But when testing injectors on the engine the correct element or plunger is used. Also different fuels will give slight differences in nozzle setting pressure and therefore by using the normal fuel on which the engine is run this difference is eliminated. Temperature changes are non-existent when injectors are adjusted with the engine running as the injectors are at normal working temperature. Finally, under working conditions the operation of an injector is affected by the following factors which are not present under bench testing: the condition of the delivery valve seat, the cut-off of the delivery valve and the condition of the plunger.

Smoke in a diesel engine is a sign of inefficiency. Only an efficient diesel engine will give the maximum advantages which the more efficient fuel combustion has to offer—greater power, longer engine life and more m. p. g. at less cost. By eliminating the wastage of unburnt fuel indicated by black smoke fuel bills are automatically reduced.

It should be noted that a worn injector needle can produce a solid stream of fuel instead of a good fine spray, resulting in poor or bad atomisation—there then being too much fuel to be dealt with by compression in the cylinder. Excessive noise is often accounted for by injection pressures being too high.

Maintenance equipment offering dynamic tuning and on-site fuel pump fault-location is the modern answer to inefficiency in diesel operation, securing rapid, accurate maintenance and peak performance to every diesel operator in all fields.

Standardized Power Equipment by Rolls-Royce

AS railway dieselization progresses, the need for a wide variety of rolling stock is likely to lead individual concerns into a danger of having too many different types of engines and transmissions. In such a situation, maintenance is bound to be inconvenient; worse still is the cost and difficulty of holding a diversity of spares.

FLEET STANDARDISATION

Recognizing this problem, Rolls-Royce are extending the scope of their familiar diesel-hydraulic installations, so that railway operators may standardize on their high-speed, medium-power diesels for virtually all powered rolling stock.

The installations on offer are suitable for shunting, freight and mixed-traffic locomotives of up to 1400 h.p. On the passenger side, single-engine or twin-engine installations can be supplied for suburban railcars; for high speed passenger trains, it is proposed that every coach should be powered.

BASIC POWER PLANT

In all these arrangements, the basic power plant is a Rolls-Royce diesel engine and torque converter. Generally speaking, locomotives call for vertical engines, whereas in railcars it is usually more convenient to use horizontal engines mounted below the floor level, where they do not occupy useful carriage space. Rolls-Royce engines are fully rationalized; that is to

say, all models, whether of four, six or eight cylinders, normally aspirated, supercharged or turbo-charged, vertical or horizontal, use common working parts. This is obviously a benefit when spares holding is considered.

CHANGE-SPEED TRANSMISSION

A brief description of the hydrokinetic change-speed transmission may not be out of place. The torque converter automatically and continuously matches the

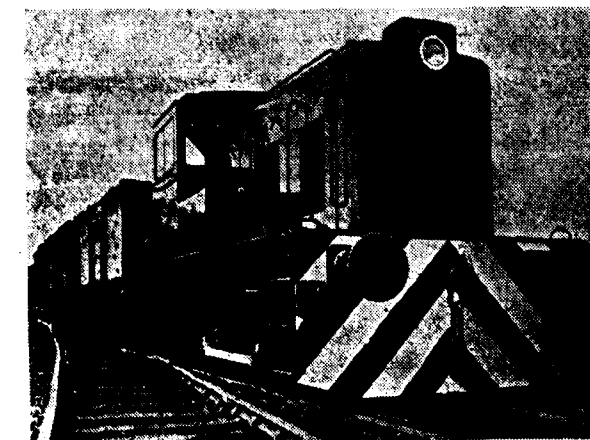


Fig. 2. Yorkshire Engine Company's 170 h.p. locomotive uses a diesel-hydraulic set: it is inexpensive to buy and easy to maintain: driving is simplicity itself.

engine speed to the load being driven, so that the engine gives of its best at all times. Since the stall torque ratio can be rather higher than 5:1, there is no need for any auxiliary gearbox, and control of vehicles is simplicity itself.

Various models of torque converter can be supplied, according to what characteristics are required. One model, which automatically allows the engagement of direct mechanical drive from the engine at a predetermined speed, is commonly used in high-speed rolling stock. All models have a similar hydrokinetic fluid circuit, comprising three members—a centrifugal impeller, a turbine wheel, and a stationary member. The turbine wheel has three stages of blades, and the stationary reaction member has two. The circuit is of the Lysholm-Smith type, torque being added in three separate stages.



Fig. 1. Typical diesel-hydraulic unit for 200 h.p. shunting locomotive. These units can be shipped from England for local installation.

JL
X415m21, N49SR
N60

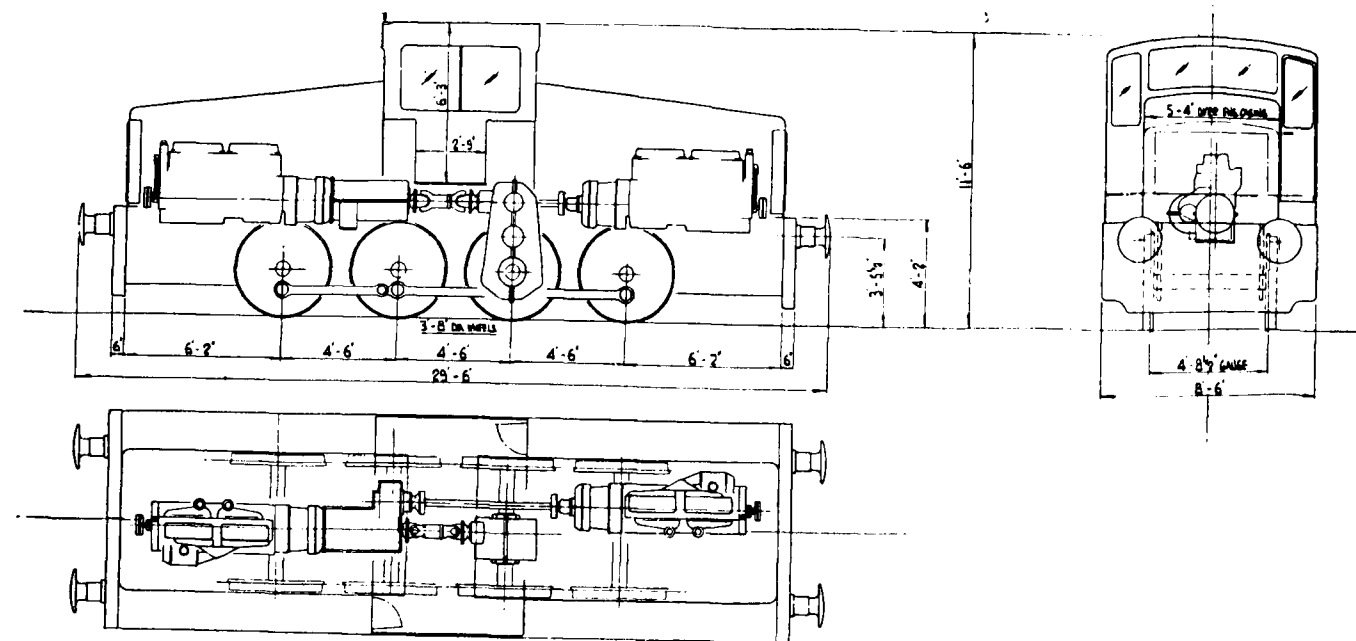


Fig. 3. Layout of Rolls-Royce differential transmission in typical locomotive.

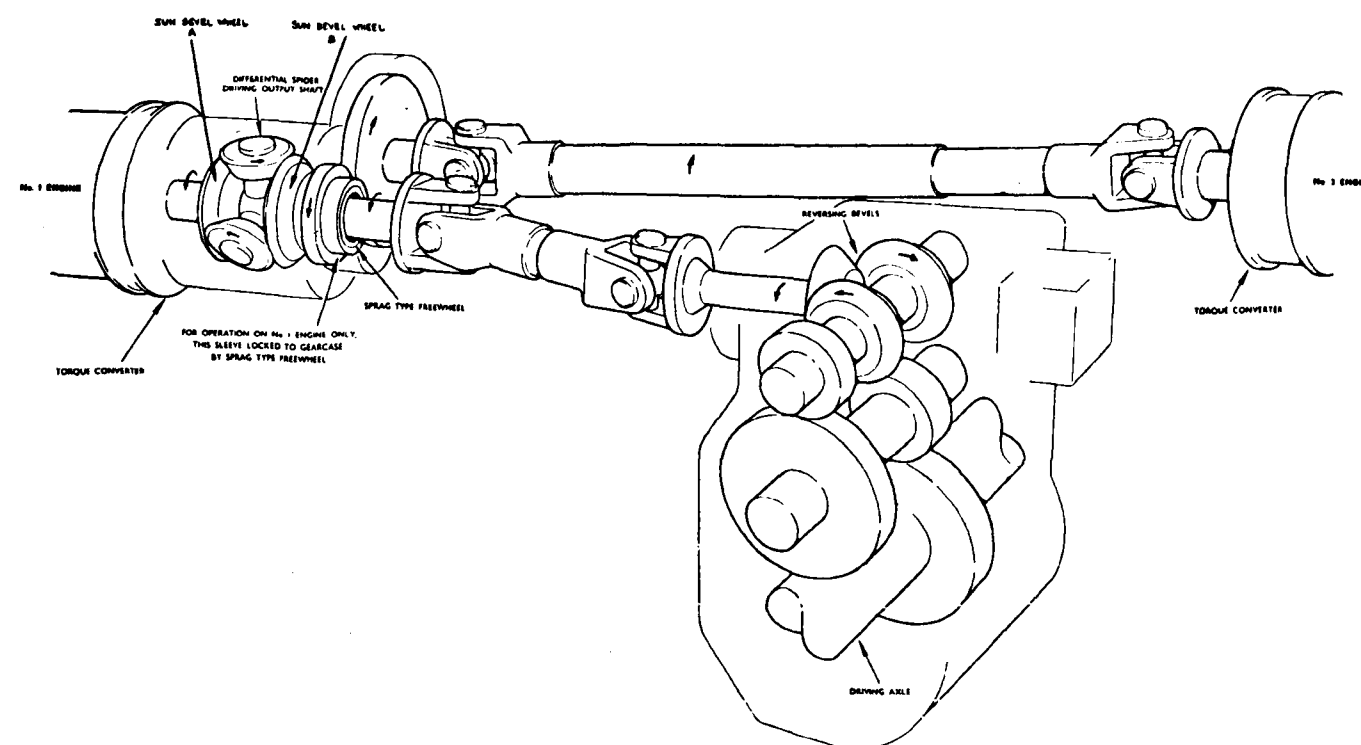


Fig. 4. Principle of operation of differential transmission.

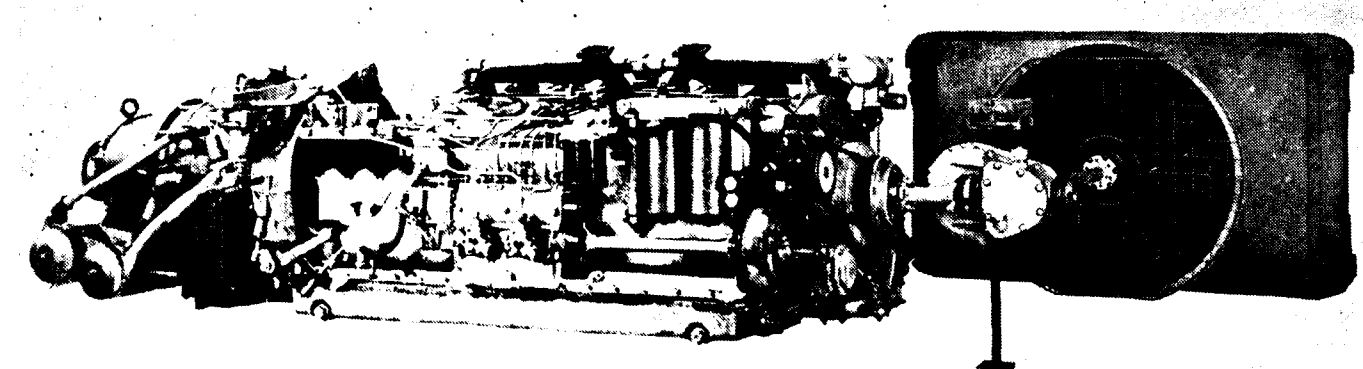


Fig. 5. Underfloor diesel-hydraulic power unit, complete with radiator and fan.

MAINTENANCE AND OVERHAUL

The Rolls-Royce installation can be serviced throughout by mechanical filters. When an engine overhaul is necessary, after the recommended interval, the engine and torque converter unit is easily detached from the locomotive or railcar frame. The unit may be manoeuvred by the small cranes and pulley blocks kept in local workshops. While one unit is being overhauled, a spare may be fitted, so that rolling stock is kept on the move.

LOCOMOTIVES

Fig. 1 and 2 show a simple diesel-hydraulic power pack and a small shunting locomotive using this type of transmission. Fig. 3 is a diagram of a new twin-engine diesel-hydraulic installation; its principle of operation is shown in Fig. 4. It uses a compounding differential gearbox and only one final drive; the latter contains a triple reduction and reversing mechanism.

It may be thought that the proposal to use more than one engine in a locomotive leads to unnecessary complication and expense. In fact, it will be found that the installation is cheaper: cheaper to buy, and cheaper and more convenient to run.

The low weight of the power equipment (about five tons per power pack) obviates the need to complicate the locomotive structure to save weight; moreover the weight can be evenly disposed over the locomotive axles.

Performance characteristics unobtainable with a single-engine or a conventional twin-engine arrangement are given by the Rolls-Royce differential system. Comparing two locomotives geared to attain the same

top speed, one with the differential and one without, the former has a higher initial tractive effort. What is even more significant is that this initial tractive effort comes from one engine only.

Up to about four miles per hour, the locomotive is always propelled by this one engine; the second engine may be engaged anywhere between about four and thirteen miles per hour. For low-speed operation, as when hump-shunting or weighbridge working, it will be unnecessary to use the second engine. Apart from preserving the second engine, a further economy is that for a given shunting speed, the overall fuel consumption of a locomotive is almost halved, because the working engine is running at a speed where its specific fuel consumption is lower, and its torque converter efficiency higher.

An extension of this arrangement is proposed for locomotives of up to 1400 h. p.



Fig. 6. British Railways' two-car unit. The power car has a twin diesel-hydraulic installation.

RAILCARS AND HIGH SPEED

PASSENGER TRAINS

For high-speed passenger trains, there is much to be said for powering every car with an underfloor, mounted horizontal engine and torque converter. Rolls-Royce are very experienced in this kind of installation in railcars (see Fig. 5 and 6).

A powered train is less expensive to buy and to run than a locomotive-hauled train. It is more versatile, since any number of self-powered coaches may be

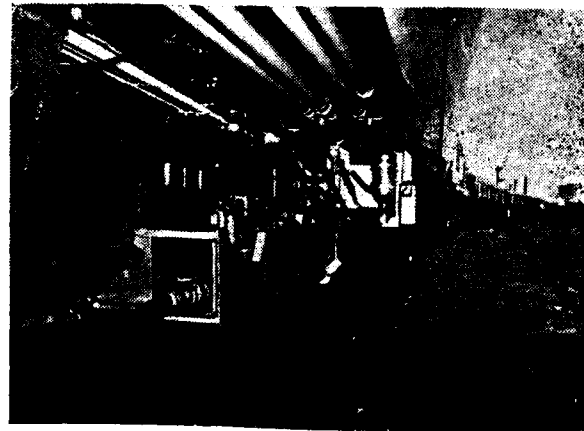


Fig. 7. Two of these horizontal engines give power for air-conditioning, heating and lighting in British Railways' new Pullman expresses.

coupled or detached for running to different destinations. It occupies less space in station platforms, and dispenses with the need to turn locomotives round at terminals.

REFRACTORIES FOR GLASS FURNACES

The purpose of IS : 1522-1960 Specification for Fireclay Refractories for Glass Melting Tank Furnaces is to fulfil a long standing need of Glass Industry for a standard on the subject. It covers the requirements for fireclay refractories for glass melting tank furnaces up to a maximum size of 60x30x15 cm (or 24x12x6 in.).

The glass manufacturers in India have been complaining about the poor quality of refractories now available for the glass industry. According to them, the most common defects noticed are that the refractories corrode rapidly, produce stone in glass, are laminated, are underfired and shrink considerably on heating. Consequently their life is generally poor and seldom exceeds a year. On the other hand, the refractories makers have pointed out that in the absence of a specification for refractories for the glass industry it would be difficult for them to satisfy the glass manufacturers. As a result of this, several tests were conducted in the Central Glass and Ceramic Research Institute, Calcutta on the refractories at present being used in the glass industry, both indigenous and imported. This standard is based on the results of these investigations.

It is not often realized that a twelve-car train of this type can have more installed horse-power than one hauled by the most powerful single-unit locomotive. It is also lighter, and since the drive is transmitted through more axles, its adhesion and braking is superior. Power from each engine may be taken for air-conditioning in individual vehicles.

OTHER ROLLS-ROYCE RAILWAY INSTALLATIONS

Although this article has discussed only the diesel-hydraulic installation, since this is the type which is finding increasing favour, it should be remembered that Rolls-Royce have supplied many rationalized engines for diesel-electric locomotives.

An interesting recent application of another kind is in British Railways' new inter-city diesel-electric Pullman expresses, in which two underfloor-mounted Rolls-Royce engines drive 150 kVA generators to provide power for air-conditioning, heating and lighting (see Fig. 7).

POWER EQUIPMENT FOR OVERSEAS BUILDERS

The international interests of the Rolls-Royce company have led to the establishment of a world-wide sales and service organization. Engines and transmissions can be supplied to overseas builders wishing to construct their own rolling stock, and the Company provides a consultant service on its power equipment and controls.

Fire Protection Equipment for Rail Vehicles

By An Engineering Correspondent

WITH the advent of diesel locomotives and rail cars Gravinor have advised, designed and supplied fire protection systems for Ceylon Railways, Ulster Transport, Coras Iompair Eireaire (Ireland), Australian Railways, New Zealand Railways and British Railways.

The Gravinor installations include Pyrocord fire detectors, resetting detectors, automatic fire extinguishers and mounting brackets, also the spray nozzles which distribute the extinguishant over the source of the fire.

The automatic extinguisher used is one from the Gravinor standard range and the extinguishant, Chlorobromomethane, is chosen because it is not only an excellent fire extinguishing medium but also, due to its high boiling point (plus 67°C), it is easily handled for recharging purposes. Filling plants for this extinguisher have already been supplied to Hindustan Air Lines who have all facilities for doing this type of work at their factory in Bangalore.

The photograph of a Gravinor automatic extinguisher is typical of the range offered for rail vehicles. It has been sectioned to show the detail construction of the operating head and method of operation.

The container is drawn from copper sheet into the form shown and it is screwed at the neck to hold the head which is sweated into position to ensure a gas tight joint. Into this head is machined a frangible diaphragm and there is a platform on which the cartridge unit is mounted.

This cartridge unit is made to suit a Plessey connector and comprises a gunpowder charge which is fired when an electric current is passed.

The head of the extinguisher is a machined brass pressing which contains a plug with an integrally machined diaphragm. It is connected to a port in the side of the head by means of an annulus. When the extinguisher has been installed it is armed by inserting the cartridge unit and connecting it into the 24 Volt electric supply line. Upon detection of a fire, the extinguisher can be discharged manually or automatically by a current passed through the cartridge unit. The gun-

powder which is fired ruptures the diaphragm in the head of the extinguisher and drives the charge plug to the bottom of the junction box to release the extinguishant into the fire zone.



The brackets used with this extinguisher are specially tested to withstand the external loads which may be encountered under crash conditions of modern equipment.

The high soak resetting detector which is used by some railways is of extremely rugged character and will withstand years of hard wear without deviation from its setting. In principle, a pair of low expansion bows are fitted with two electrical contacts held apart at normal temperatures and encased in an outer tube of high expansion stainless steel. Upon rise of temperature the outer case expands and allows the two contacts of the bows to meet to close the circuit of an electrical alarm bell. This detector will reset to open circuit when the temperature falls again.

On the photograph will be seen one of these detectors, and the case has been cut away

to show the detail of the bows construction. The contacts are silver and they are rhodium flashed to ensure good electrical contact and corrosion protection. Also both contacts are insulated from the case by mica so that there are no electrical polarity difficulties during installation.

The Pyrocord fire detector is a continuous capillary which can be wound conveniently around any vulnerable part of an engine to ensure early warning in the event of fire.

The capillary is filled with cotton thread treated with nitrocellulose varnish and impregnated with gunpowder; it is suitable for installation in engine bays and fire zones where the normal ambient temperature does not exceed 110°C. As soon as there is a rise in temperature through fire the expansion of the cordite within the capillary at this temperature operates a plunger in the switch body to close an electrical circuit to the alarm bell and warning light.

In addition to this work Graviner have interested themselves for many years in a very wide field of engineering—aircraft, marine, industrial and nuclear.

For aircraft, Graviner offer fire detectors and extinguishers, crash switches of both inertia and impact type and fuel tank protection against explosions. This equipment is standard throughout the Royal Air Force and it is also used by most civil aircraft of both British and foreign design. In fact, to pinpoint a few, this equipment is used on the SAAB DRAGEN, the BOEING 707, the SUD AVIATION CARAVELLE, the DH COMET 4, the GRUMMAN GULFSTREAM and even the SAUNDERS ROE HOVERCRAFT.

In the industrial field, that is equipment to offer which by nullifying the risk of explosion, permits production to be maintained in spite of the dust hazard associated with certain processes. Plant construction cost can be minimized and danger to personnel eliminated.

In the domestic field, thermostats of very rugged construction are available. They are suitable for use in hot water systems, heater blocks and platens for packaging and plastics industries. They are also suitable not only for over-heat control but also for low temperature detection and thermostat control for the electrical, radio, and scientific equipment industries.

Fire detectors for use with mains conduits are also available.

For marine engineering, oil mist detectors are being produced which sense the formation of excessive oil mist in diesel engine crank cases to give early warning of impending mechanical defect as well as to prevent the danger of explosion.



In the nuclear field, Graviner are fully approved by and produce all types of equipment for the United Kingdom Atomic Energy Authority. The Company specializes in precision graphite machinery for reactors and reflectors, lead shielding bricks and up to 20 tons unit weight lead containers.

In addition to supplying the equipment, Graviner have always been in a position to supply technical advice on the many problems which are associated with such a wide range of equipment and to offer to the industry the experience accumulated by their technical staff over the many years they have been associated with these engineering problems. The Graviner Manufacturing Co. Ltd. is represented in India by A. R. Haseler (Private) Ltd., Bombay-1.

STORY OF MARODA LINK

By Shri M. O. Chacko

Superintending Engineer (General), Bhilai Steel Project

THE iron ore required for the Steel Plant at Bhilai is obtained from two hills, Dhalli and Rajhara, situated about 60 miles away towards the South East in the State of Madhya Pradesh. A new railway line is laid by the S. E. Railway to connect Bhilai, the nearest railway station to the Steel Plant and the hills, and the ore is now transported in special hopper type wagons over the rail.

The different shops in the Steel Plant are connected by a network of railway lines which adds upto about 60 miles and this yard is now joined to the S. E. Railway main lines, through their marshalling yard at Bhilai from the Bhilai end.

When the Plant works to its full capacity of one million tons, a quantity of 7,000 tons of iron ore per day has to be moved from the quarry on the hill side when mechanised working also will be introduced.

With a view to minimise the wagon holdings within the Plant and improve the pace of wagon turn-round, it was decided to connect the Plant from the Open Hearth end, thereby shortening the distance of travel by about 3 miles. This new connection is from Maroda station on the Bhilai—Dhalli Rajhara line and covers a distance of about a mile.

This alignment runs between two water reservoirs which supply water to the Plant and Township attached to it, where the ground level is low and covered by water throughout the year.

The normal method of forming the bank from borrow pits, either by machines or manual labour, had to be abandoned due to the peculiar lay of the land and uneconomical working.

It was then decided to form the bank for the rail track with the slag and refuse from the different shops by laying the track from the Open Hearth yard and

extending it progressively using it as a service track for transporting and dumping the material to form the bank. As the ground is under water of varying depths, progress was slow. The work was organised so that sufficient length of bank was formed each day to permit further linking of the track the following day, and provide sufficient space for dumping slag and refuse from the shops each day. The height and width of the bank formed each day was just sufficient to extend the track above the water level, when trains could be moved with safety.

The working season was limited in that the work could not be started till the water level in the area was lowest and the track had to be linked through to the opposite end before the monsoon rains commenced. This gave a working period of a month and half commencing from the middle of May 1960 to end of June 1960. The progress of water depended directly on the quantity of slag made available from the Plant. With the co-ordinated effort of the different departments of the Plant, the track was taken through to the Maroda station by the end of June and the new connection is programmed to be used as soon as the junction arrangements are completed at Maroda station.

With the onset of the monsoon, the water level began to rise and the track had to be lifted progressively to keep it above water all the time—a special track lifting machine of USSR make was used for this and lift upto half a meter could be done at a time. The machine clamped to the rails on both sides lifts itself up along with the track, permitting the inter space being filled by manual labour. This operation is repeated over each rail length for the complete distance till the finished bank is at correct level and desired section.

The illustration shows the work in progress and gives the picture of the entire length laid through water.

Primary Batteries for Signalling Applications

By D. Krishnamurty

Asst. Development Engineer, Consumer Products Sales Division,
Union Carbide India Limited, Calcutta.

IN the early days of railways when only one or two trains were running on a track each day, the primary concern was just to move the trains. There were no signals and no movement controls because there were hardly two trains simultaneously moving on the same track. With the increase in the number of trains, signalling systems were introduced to regulate the movement of trains so that any two trains are kept at a reasonable distance from each other when they are running on the same track. Today, the number of trains and their speed have increased tremendously and the job of present-day signalling systems, therefore, does not stop at making the railways safe, but at maintaining this safety at maximum speed.

For this purpose modern signalling systems have two definite functions. Firstly to set tracks and signals to direct the train movement, and secondly to control or supervise the setting. Or, in other words, to make the signalling system fool-proof and failure-proof. Setting the signals is mostly a manual job and has been in operation for a long time. The supervisory and controlling function of the signal systems is the key note for the safe and speedy working of modern railways. This is made possible by the imposition of an automatic control on the operation of signals by electric and electronic instrument which sense the presence of trains on the lines, the setting of the track and the signal indications given to train drivers.

This supervisory operation in signalling—distinguished from the manual or power driven track setting, lowering of signal arms, etc.—consists of the modern block system, track circuits, train indicators, slot circuits etc. The mode of power chosen for this operation is electricity, because of its amenability to instantaneous communication and remote control. Three sources of electric power can be used for the control of signals—electric mains, secondary batteries and primary batteries. Electric mains power is not desirable for “supervisory” signalling circuits due to its restricted availability, unpredictable failure and consequent unreliability. Secondary batteries are generally used only where mains power is available to recharge the batteries either continuously (trickle-

chargers) or at pre-determined intervals. The ideal power source for the control equipment of signals is the primary battery. This article aims to discuss the various types of primary batteries and standardisation of the primary battery requirements of Indian Railways.

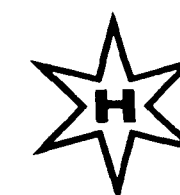
Analysing the electric energy required for operation of the signal control equipment, three broad categories of batteries are essential for the railways—small batteries for portable equipment such as the emergency field telephone sets carried on trunk route trains; medium size batteries for signal supervision; and heavy duty batteries for track circuit and physical management of signals and points. In the ultimate analysis, the total battery requirement of the Indian railways thus consists of three types of primary batteries.

However, for various reasons, largely historical, the Indian railways at present are using more than a dozen types of primary batteries. In the initial stages the railways imported all their battery requirements. Prior to the amalgamation, the railways in India were run by independent companies using different types of equipment. Each of the railways imported batteries from different countries and consequently more than one type of battery was being used for the same kind of operation. Thus the total number of types of batteries used by all the railways increased considerably.

The uncertainty of imports resulted in the need to maintain large stocks of batteries in railway stores. Due to the semi-perishable nature of regular batteries the railways preferred the more expensive “inert” type of cells which can be stored for long periods and need be activated only when required. The present Indian Railways, which combined the entire railway system of India, generally had to continue the same systems as were in use before nationalisation.

For efficient operation of battery power supplies four conditions should be fulfilled—(1) the battery should give maximum performance per unit first cost, (2) the battery should not require any maintenance (3)

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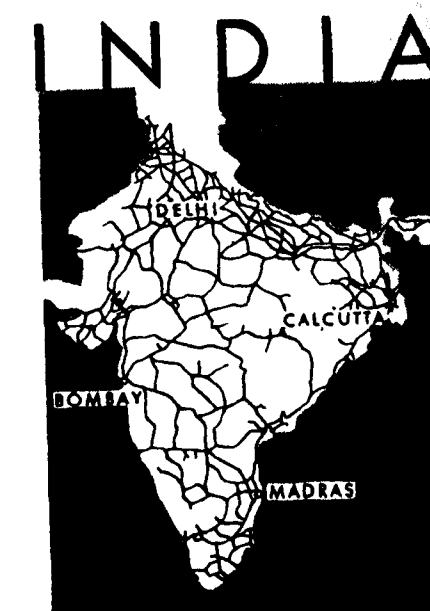
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the stores inventory cost of the battery should be minimum and (4) the battery should be readily available. To fulfil the first requirement, different types of batteries with different capacities have to be designed so that in each application the performance per unit cost is maximum. However, the number of types of batteries should be restricted to reduce the stores inventory. For example if 10 types of batteries are used and the stores has to keep a minimum inventory of 2 units of each type, the total stores to be maintained will be 20 units. If, however, the types of batteries are reduced to three sizes by using them on more than one circuit, the minimum stores inventory will reduce to six or a little more. Reducing the number of types of types of batteries automatically increases their availability because each battery can be used on more than one application. The battery should be manufactured for ready use in order to eliminate maintenance.

Efficiency of operation can therefore be greatly facilitated by standardisation of stores items. The Indian railways have realised this and established the Central Standards Organization to reduce the number of stores to an optimum level. The Indian dry battery Industry has also realised the advantages of standardization and has been working on the development of efficient batteries for the Indian railways.

The Indian dry battery Industry has been developing more and more dry batteries for the Railways to make India self-sufficient in this respect. The import of batteries was practically stopped during wartime and Indian dry battery industry supplied most of the many types of batteries required by the then separate Indian railways. At present all types of dry batteries, inert and sac type cells are manufactured in India and the industry is approaching the stage of self-sufficiency with respect to materials and processes.

The Indian dry battery industry does not stop at merely manufacturing all the types of batteries used by the Railways. It also works closely with the Railways in the standardisation of primary battery requirements for efficient operation. Investigation of

the relative economies offered by inert and sac type cells and the dry cells has shown that the performance obtainable from inert type of cells per unit cost is comparatively very low. This is because the cost of manufacture of inert cells is more than regular round cells. The sac type of cells are also expensive overall, because they require regular maintenance. On the whole, it is now generally accepted that economy can be realised from using regular day cells only.

The industry has now succeeded in developing two types of dry cells each with a wide range of application in its field. A small type of dry cell is developed for portable instruments like the portable emergency telephone sets used in the mail trains. The second type of dry cell, the Railroad and Industrial Cell (Indian Standard Institution Specification IS 586:1959 type R 401) can be used in all supervisory circuits of the signal equipment; This dry cell, which is designed to give long service in applications involving either heavy discharge for short periods or light discharge for long periods, has already been tried successfully by the Indian Railways and is rapidly becoming established as the standard battery in these applications.

These two types of dry batteries give efficient service in all signal applications except for the signal and point movement and in track circuits. These two circuits require very heavy current and can be handled efficiently only by the Air Depolarised cell. These cells, which are imported at present, are not easy to manufacture indigenously, and offer a dry cell Industry its greatest challenge at present.

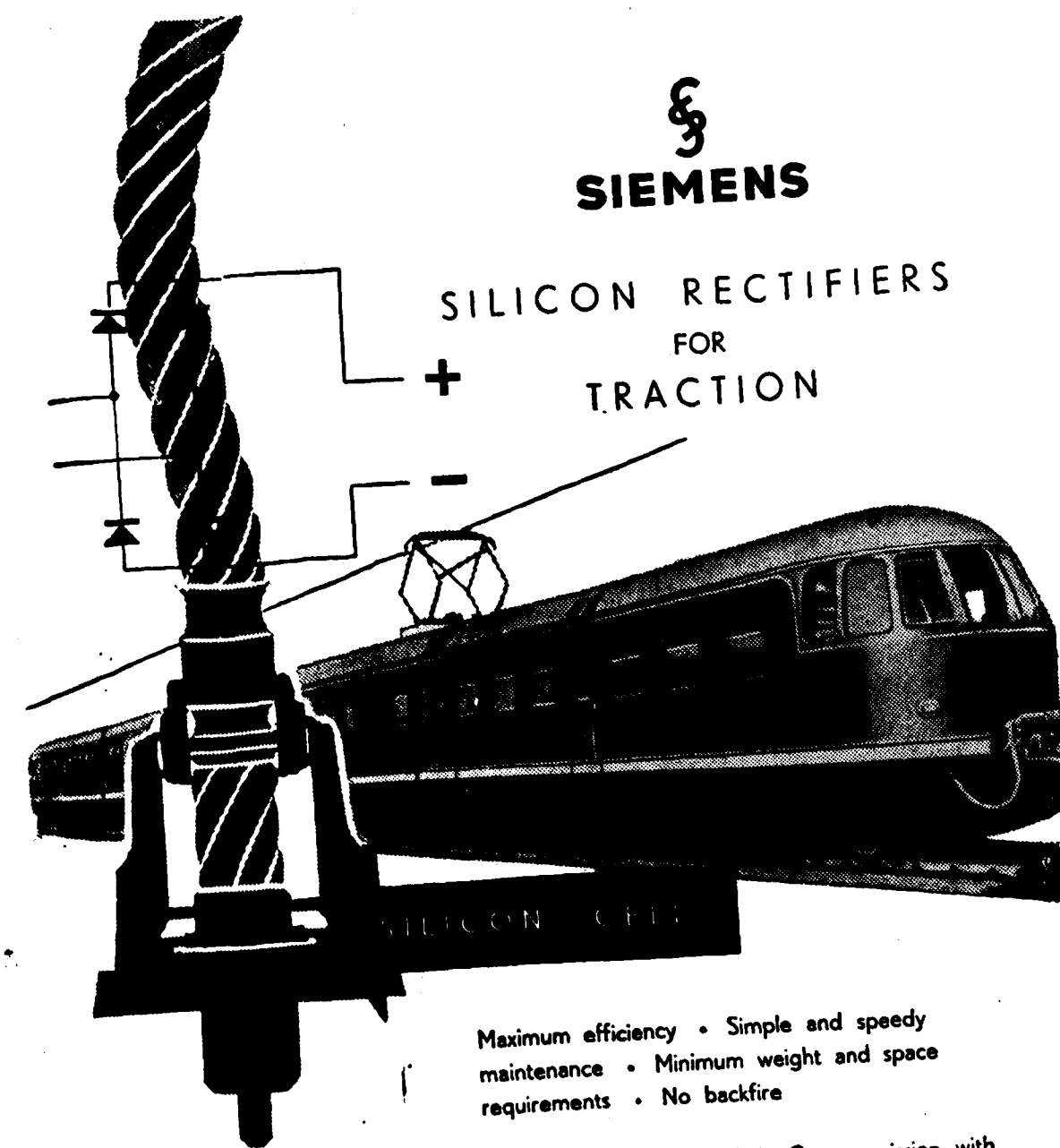
The Indian Industry by virtue of its past performance will certainly manufacture the Air Depolarised cells and will complete the range of primary batteries required by railways. The co-operative spirit existing between the Indian railways and the dry battery industry will surely result in the standardisation and efficient use of primary batteries in the Indian railways.

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