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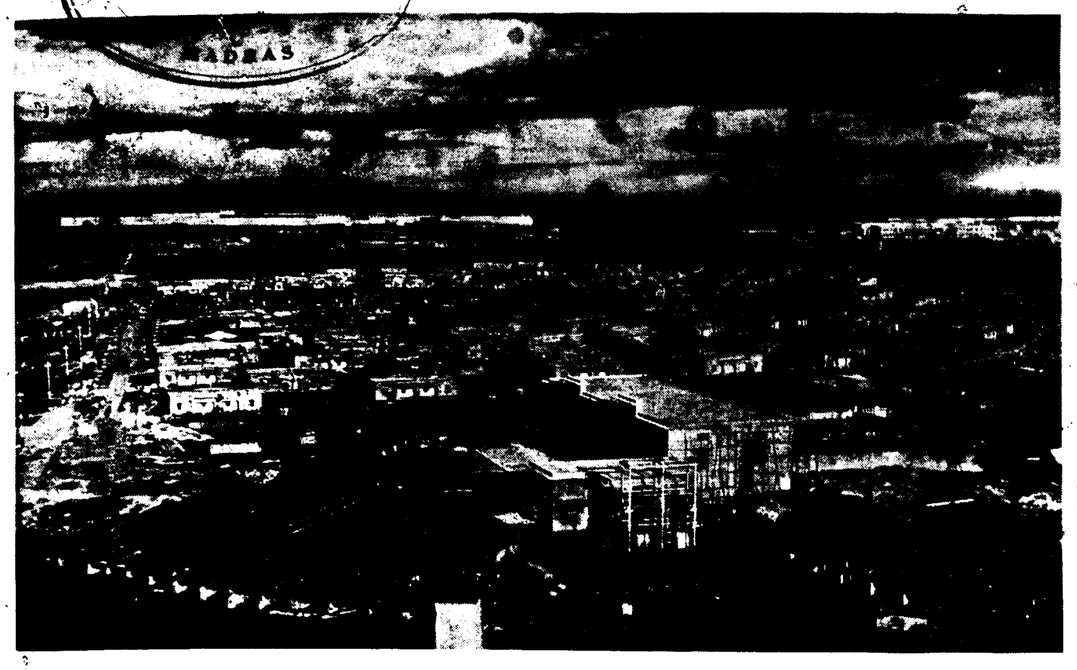
CHITTARANJAN LOCOMOTIVE WORKS SUPPLEMENT



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THE INDIAN RAILWAYS WORKSHOP MAGAZINE

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CONTENTS

New G-E Locomotive Design to haul Heavy Ore Loads Down Steep Grades

A new locomotive design has been developed by General Electric's (U. S. A.) Locomotive & Car Equipment Department for mines with steep downgrades leading away from the mine face.

The new design was incorporated in a specially-built locomotive for a G-E customer, but spokesmen for the company say that, where space is available, G-E's existing equipment can be adapted.

Chief feature of the new design is four sets of brakes—dynamic braking with the locomotive motors, standard air brakes, a special electro-magnetic brake, and manual parking brakes.

Normally, according to G-E, the maximum expected braking on tandem 27-ton locomotives with a combined weight of 54 tons would be roughly 27,000 pounds. The new design, however, can develop a braking effort in excess of 54,000 pounds.

With this extra braking, the locomotives are capable of safely hauling as much as 150 tons of ore down a grade averaging 6.5 per cent. This means a gross train weight of approximately 215 tons excluding the locomotive.

The extremely high braking effort available not only permits the locomotives to keep the train under control, but also enables them to stop it in a relatively short distance should an emergency arise.

Actual operating results in a mine have demonstrated the unusual capabilities of the locomotives. They have stopped a train of four loaded cars, weighing a total of 250 tons including the locomotive, moving down an 8 per cent grade at 8 miles per hour using only the locomotive brakes. Moreover, this was accomplished automatically without an operator at the controls, and the train was brought to a complete halt within 30 feet.

These locomotives permitted one mine to reach an ore body which for years had been considered unworkable because of the expense involved, not only in reaching the ore, but also in hauling it out and down 1800 feet of six per cent grade with a near—" U " turn at the bottom.

Ordinary locomotive brakes could not provide the margin of safety necessary for the loads that had to be hauled. To meet the need, a standard swivel-truck mine locomotive was modified by incorporating magnetic track brakes, two on each truck, giving a total of eight for the tandem locomotive.

The ore pocket at this particular mine was located 340 feet above the dumper, and the haulage way was approximately one mile long. This meant an average grade of 6.5 per cent, with some stretches over 8 per cent.

Because the run to the dumper was so short and all down grade, it was imperative that the train be under complete control. A runaway would certainly have been destructive to the rolling stock, the track, and possibly to the dumper itself. Moreover, the lives of people working along the right-of-way, on the locomotive, and on the dumper would have been jeopardized.

Not wanting to use cable hoists or dragging anchors, the customer and G-E worked out the magnetic brake system, which did not increase the locomotive's weight and did not run the risk of wheel slide. This system is roughly similar to one developed years ago for street cars.

Unlike street cars, however, these locomotives use track brakes in regular service rather than as an emergency or parking brake.

The magnetic brakes on street cars are usually operated from a 32-volt battery. For the locomotive application, the power had to be furnished from some other source during a service brake application in order to insure good battery charge at all times to take care of emergencies. Also, to keep brake shoe and track wear to a minimum, the current in the brake coil had to be varied according to the braking need.

To meet these requirements, a scheme was devised to supply the magnetic brakes from the

energy being pumped into the resistors when the locomotive was running in dynamic braking. The required variation in the excitation current on the track brakes, was obtained by simply connecting them in parallel with the dynamic braking resistors.

As each notch of the braking controller increases the dynamic braking effort, the power pumped into the resistors increases and thus increases the excitation on the track brakes.

To further conserve the track and the wearing faces of the shoes, the track brakes are not applied on the first two steps of dynamic braking. On the third step the track brakes are connected and excitation is then increased with each step.

To prevent wheel slide, the air brakes are interlocked so that they cannot be applied during dynamic braking. Since loss of dynamic brakes due to wheel slide would also cut the power supplied to the track brakes, preventing wheel slide is mandatory.

As an emergency safety feature the locomotives are equipped with a foot switch and a tip-up controller handle. When released, these place the track brakes directly across the battery. In addition, battery power also operates a magnet valve to give a service air brake application.

While the addition of track brakes means more maintenance items on the locomotives, the benefits derived from the extra braking provided far outweigh the slightly greater first and maintenance expense, G-E believes.

The same scheme can be employed on any new mine locomotive that will have to work on extremely heavy grades. Older locomotives having a long enough wheel base to accommodate the brakes can be equipped in much the same manner, although some of the convenient control features may not be available.

CO-OPERATIVE STORES ON RAILWAYS

There are 119 co-operative stores working on the Indian railways with a share capital of Rs. 8,98,420, said Shri Shah Nawaz Khan, Deputy Minister of Railways, in a written reply to a question by Dr. Shrimati Seeta Parmanand in the Rajya Sabha.

The Deputy Minister laid a statement on the table of the House showing the number of co-operative stores and their share capital according to various railway zones. There are 23 co-operative stores working on the Western Railway; 21 on the Central Railway; 19 on the Eastern Railway (including the Chittaranjan Locomotive Works); 17 on the Southern Railway (including the Integral Coach Factory stores); 15 on the Northern Railway; 14 on the South-Eastern Railway and five each on the North-Eastern and North-East Frontier Railways.

The Deputy Minister replied in the negative to a question whether the stores were a profit making concern. The Deputy Minister said, "The main object of these stores is not to make a profit, but to provide service to their members by way of supply of essential requirements at reasonable rates. The surplus income that they derive through the business is distributed to the members by way of dividend on shares and rebate on purchases, after setting apart a statutory minimum towards the Reserve Fund."

RAILWAY BOOK-STALLS

There is no proposal at present to open departmental book-stalls at railway stations, said Shri Shah Nawaz Khan, Deputy Minister of Railways, in a written reply to a question by Dr. Shrimati Seeta Parmanand in the Rajya Sabha.

The Deputy Minister said that there were 367 stations throughout the country which had book-stalls. Of these Messrs. Wheeler & Co. had book-stalls on 240 stations. There were 101 stations having book-stalls on the Southern Railway; 65 on the Central Railway; 56 on the Western Railway; 51 on the Northern Railway; 30 on the Eastern Railway; 29 on the North-Eastern Railway; 22 on the South-Eastern Railway and 13 on the North-East Frontier Railway.

Methods of Improving Utilization of Motive Power

By G. T. Bevan
Locomotive & Car Equipment Department
General Electric Company (U.S.A.) Erie, Pennsylvania.

THE greatest single contribution to the economic operation of the world's railroads during the past half century has been the development of the diesel-electric locomotive.

In the diesel-electric locomotive, railroads have available a motive power unit with inherently different characteristics than those possessed by the reciprocating steam engine. However, these advantageous characteristics must be thoroughly understood and fully utilized in order to realize maximum benefits from dieselization.

To begin with, the combination of the diesel engine and the traction generator makes constant horsepower available over a wide range of locomotive speeds. This means hauling more profitable pay loads at higher speed. This can prove so beneficial in actual operation that it permits a new approach to the problem of locomotive dispatching. Many railroads switching to diesel-electrics have found that they can double the annual locomotive mileage formerly obtained with steam engines.

This increased mileage, plus the ability of diesel-electrics to produce more gross ton miles per train hour, can lead to a reduction in the number of motive power units in service. This will, of course, lower operating costs. The net result is that diesel-electric locomotives can do one-third more work per day at approximately one-half the cost of steam locomotives for the same operation.

FULL UTILIZATION IMPORTANT

Statistics show that 50 per cent of all railroad operating costs revolve around the utilization and maintenance of locomotives. Moreover, the characteristics of the motive-power in use have a large influence on the amount of rolling stock, and the number of tracks, yards and terminals required. In fact, to a large degree the entire economic life of the railroad industry depends upon the type and number of motive power units it uses in conducting its business.

In the early stages of dieselization little effort is generally required to obtain relatively high motive power utilization. Operating advantages and savings are so attractive that the diesel-electrics are worked to the fullest possible extent. Practically any assignment where these new locomotives are in use 24 hours per day shows their economic advantage over steam.

As dieselization progresses this picture changes. The new motive power can no longer be assigned exclusively to 24-hour duty; therefore, its economic advantage over the steam locomotive becomes less marked. Evidently means must be found to increase motive power utilization if the diesel-electric is to continue replacing the steam engine with the same economic results.

Motive power utilization has been greatly simplified with the recent introduction of the "universal" or road-switcher type locomotive. The construction and operating characteristics of this locomotive have been deliberately selected to make it capable of performing all three types of service: freight, passenger and switching. Operating experience in several countries has already demonstrated its success.

In addition to its flexibility, the "universal" design has other economic advantages. The initial cost of this type of locomotive is approximately 12 per cent lower than that of the road type, or commonly called "box cab" type diesel locomotive, of comparable horsepower. Maintenance costs are also lower, often by 10 to 15 per cent.

NEW CONCEPT NEEDED

At the outset, this new form of motive power has been generally regarded simply as a substitute for the steam locomotive. This has necessarily limited the development of the diesel-electric's potential capabilities. In many instances division terminals and territories set up for steam locomotive operation are still in use. Consequently, there is some danger that the superior performance of the diesel-electric may be hampered by boundaries established earlier to meet the limitations of steam locomotives.

The entire scheme of railroad operations—including yard and terminal facilities, track capacities, and methods of train dispatching—should be analyzed to determine its suitability for diesel-electric operation. Only as this new type of locomotive is freed from the shackles of the steam locomotive's limitations can its potential capabilities be fully realized in terms of productivity and earning capacity.

With the advent of the "universal" or road-switcher type of locomotive, railroads have a motive power tool with which they can do a highly efficient job. Units of this type can be held in locomotive "pools", available for any service as required. For example, a single 1500-hp. road switcher locomotive unit can be used to replace a 1000-hp. yard switcher or a 1500-hp. road freight locomotive main line service, through the simple expedient of pooling the assignments and planning a cycle of operation with the purpose of using one locomotive for both jobs. Experience has indicated that, where operating conditions permit, greater motive power utilization can be obtained by operating a "pool" of road-switcher or "universal" type locomotives for all classes of service.

These economies can be further improved by arranging locomotive assignments so that all units operate on a cycle basis. Under this system, locomotives return to a common maintenance point for inspection and repairs after completing their tours of duty. The length of time and mileage they cover between inspections is determined by a routine schedule worked out by the operating department. In arranging such schedules an effort should be made to make sure that all units accumulate approximately the same mileage between inspections.

Under such a system, a locomotive might spend three days covering the thousand miles between points A and B and back. After the first thousand miles, it would be inspected. It would then spend three more days covering the thousand miles between point B and C and back. It would then be inspected and so on cycling back and forth through point B, the maintenance station. During its two three day runs on either side of point B, it would be regularly scheduled for various duties which can include passenger, freight and switching service.

This type of operation has several advantages. One of the most important has to do with terminal layovers. When locomotives are operated on a cycle system with maintenance being done at a central point, it is possible for them to be ready for reassignment to other duties in as little as ten minutes after arrival at a terminal. This means that fewer locomotives are required. Consequently, not only is the rate of return on total motive power investment higher, but operating expenses are reduced because there are fewer locomotives to maintain.

The cycle operation with its common maintenance point has resulted in a new concept of locomotive maintenance: centralized inspection and repair. This can result in further operation economies through the discontinuance of steam engine houses and associated facilities no longer required.

Utilization of locomotives is a phase of railroading that is now being recognized as a major component of economical operation. The high availability of the diesel-electric has permitted utilization that was not practical even with modern steam locomotives.

The difference between the terms availability and utilization as used of locomotives, can be seen from their definitions. Availability is the time a locomotive is available for service, expressed as a percentage of total time. For example, if a locomotive is in the shop for inspection and repairs two hours out of twenty-four, the availability is $\frac{24-2}{24}$ or 92 per cent. The availability of diesel-electric varies from 86 to 95 per cent. Utilization is the time a locomotive is actually in operation, expressed as a percentage of total time. For example, a locomotive is assigned to switching duty for 8 hours and then to road service for 12 hours. It is in use 20 hours out of 24, therefore, the utilization is $\frac{20}{24}$ or 83.2 per cent.

One thing affecting locomotive utilization is non-revenue service. Needless to say, this should be kept to a minimum. Wherever possible, the units should be scheduled to work in revenue service when travelling to and from maintenance points. The use of diesel-electric locomotives on work trains should be avoided except in cases of absolute necessity. Maximum use should be made of off-track equipment, thus reducing the need for work trains.

High locomotive utilization is not necessarily limited to the large transcontinental railroads of the United States, which enjoy exceptionally long-haul traffic. In fact, many smaller railroads with short hauls have done an outstanding job in this respect, sometimes operating diesel-electrics over five times the daily average mileage formerly run by steam.

Pioneers in Electric Traction

By J. C. Way, A.M.I.E.E., M.I.LOCO.E.

Supplying electric locomotives and coaches to railways in various parts of the world, including India, Metropolitan-Vickers Electrical Co. Ltd., are now applying their vast resources to A.C. industrial frequency traction.

METROPOLITAN-VICKERS Electrical Co. Ltd., and its predecessor, The British Westing house Electric and Manufacturing Co. Ltd. have specialised in electric traction since the workshops were erected at Trafford Park, Manchester, in 1902.

The first traction order, which was for the complete electrification of the Mersey Railway (an underground line below the River Mersey between Liverpool and Birkenhead) was received in 1901, and the equipment was commissioned as early as 1903. This order, together with another placed shortly afterwards in 1902 for the electrification of London's Metropolitan Railway, established the new Company in the traction field, and thereafter, right up to the present day, Metrovick and its predecessor have kept abreast of the demands and requirements of the times, and not infrequently pioneered new developments. During the First World War and in the years following, Metrovick supplied much of the existing equipment for multiple unit trains on the Southern Region of British Railways and 1500V D. C. traction equipment was manufactured and supplied in such widely separated parts of the world as New South Wales, Argentine, Holland, Spain, and Russia.

MAJOR ADVANCES

There were major advances after the first World War. The success of the 41 freight and 23 passenger locomotive made for the Great Indian Peninsula Railways and their capacity to haul and brake (regeneratively) heavy goods and express trains on gradients of 1 in 37 under most difficult conditions was an achievement that caused considerable interest in railway circles. The introduction of 3000V D. C. operation with locomotives in South Africa and motor coaches in suburban service in Rio de Janeiro and Warsaw demonstrated the ability of the Company to produce reliable designs for a system that had, up to that time, not a very wide application. Those early 3000V equipments were so successful that the Company has now made and designed more motor coach equipments operating at this voltage than all other manufacturers in the world put together, and more complete locomotive equipments than any other manufacturer.

After the second World War, large quantities of motor coach equipments were ordered from India, Brazil and South Africa to operate at 3000V D. C. Australia at 1500V D. C. and British Railways at 600V D. C. 3000V D. C. electric locomotives were supplied to South Africa and Brazil, and 1500V locomotives to New South Wales. The 3680 H. P. locomotives for New South Wales, which are still in course of delivery, are the most powerful locomotive of their type to have been built in Great Britain. In addition, British Railways were supplied with complete regenerative electrical equipments for 58—1868 H. P. 87 ton, 1500 volt mixed traffic Bo+Bo locomotives, and complete regenerative electrical equipments for 7-2760 H. P. 102 ton, 1500 volt Co-Co type locomotives. These locomotives operate over the Pennine Range between Manchester and Sheffield.

Metrovick also built one of the first gas turbine locomotive to be put into operation. Trials on the British railways showed that it could be used successfully when hauling specialised loads, and demonstrated the success of many other new features including a novel from of suspension which permitted good riding at high speed with low weight transfer characteristics.

The field of diesel traction has been covered by orders received from the Western Australian Government Railways, C. I. E. (Irish Transport Authority) and British Railways. The Irish order was one of the largest single orders for diesel electric locomotives to be placed in this country and covered the supply of 94 locomotives — 60 of 1200 H. P. and 34 of 550 H. P.

Experience has not been confined to D. C. traction only. Equipment for operating at 6.6 kV., 25 c/s. A. C. was supplied for use on the Thamshavn-Lokken Railway in Norway and the Lancaster–Heysham Line in the United Kingdom. In addition 26 traction motors and other equipment were supplied to the Hungarian State Railways for use in their Kando Locomotives in 1932.

The resources of the Company are now being applied to A. C. industrial frequency traction. A vast amount of research, design, development, and testing, is being undertaken for the purpose of providing the British Railways with sound, reliable equipment for the A. C., 25 KV., 50 c/s electrification proposals to be carried out under their Modernisation Plan. Installations in France and the Belgian Congo have given an admirable background for this work, but the demands of an intense suburban service and the peculiarities of the British main line traffic require very special consideration.

LIKE INDIAN CONDITIONS

In some ways, these traffic conditions are not dissimilar from those anticipated on the Indian Railways, particularly in suburban areas. Robustness and long life with simple maintenance are features that are needed by both British and Indian systems.

The use of industrial frequency requires the incorporation of all available modern developments, such as new insulating materials in the motors to permit them to run at higher temperatures and to enable special features to be embodied in the transformer, which must be of an unusual shape, in the rectifying equipment which has to withstand the mechanical shocks and peculiar loading characteristics of railway operation, and in traction type switchgear which must be adapted for use with alternating current.

Should it be decided to use industrial frequency traction in India, these modern developments could be adapted for use in hot, humid, and dust-laden atmosphere of the country, but the choice between this and the old established D. C. system, either for a part or the whole of the railway electrification programme, depends on many factors.

The Workshops of the Luxembourg Railways

GENERALITIES

THE Grand Duchy of Luxembourg set out a modern railway network where the old steam traction gives place slowly to the diesel traction and the electric traction.

Though Luxembourg only allows

173 km normal double track roads and
212 km normal simple track roads

the Railways of Luxembourg adhere mainly to their importance of

— their priviledged geographic situation between Germany, Belgium and France
— their railway line connecting with the very important metallurgic centres (blast furnaces, steel works, rolling mills, iron mines)
— their capital, Luxembourg, European centre since the creation of the "Community of Coal and Steel".

To satisfy all their obligations the CFL are equipped with the following motor material :

81 steam locomotives
26 diesel locomotives
3 electric locomotives 25 KV 50 per
28 diesel rail-cars
36 diesel motor-buses
18 trucks.

To these numbers there is place to add the material on the way to delivery, allowing replacement of the steam material.

12 diesel locomotives 900 CV
17 electric locomotives 25 KV 50 per.

The running upkeep of these engines is carried out in the depots and garages, while the big repairs and the large maintenance are carried out in the Workshops of the Luxembourg Railways.

The relief material necessary for the need of the traffic is actually composed of :

12 vehicles RIC for travel for express
154 „ „ ordinary
20 tows for rail-cars
96 wagons
3.682 goods wagons of which 1.580 submit to the regime "EUROP".

The running upkeep of this towing material is carried out in the "maintenance" yards of the CFL, while the big repairs and the big maintenance for the travelling material is done at the Workshops of the Luxembourg.Railways and for the goods material at the Workshops of the Petange Railway (Luxembourg).

WORKSHOP OF LUXEMBOURG

The Workshops of the Luxembourg Railways, completely destroyed during the War 1939–1944 by air bombardment, have been rebuilt on new bases and were finished in 1951.

The variety of the material for repairs going from the motor-bus to the electric locomotive, passing by the whole range of diesel engines and steam machines, has forced the CFL to build modern workshops equipped with all the novelty of the railway technicals. The methods of work have been seen again and rationalised following the modern technical progress experimented by our big neighbouring networks.

The workshops of Luxembourg have a length of 230 m and cover a surface of 12.120 m2. They are built on the Holy Franki, with metallic frame. The roof is serrated, the lateral walls are glazed on their entire length.

The workshops are composed of 4 bays, the 2 big bays are used for carrying things up and the other 2 for the manufacture and for machine tools. The Workshops are connected by 12 rolling bridges, being :

Bay No. 1. 2 twin rolling bridges of 40 t each, allowing a simultaneous raise of an engine of 80 t
2 rolling bridges of 6 t placed under the 2 first

Bay No. 2. 2 twin rolling bridges of 60 t each, allowing the simultaneous raise of an engine of 120 t.
2 rolling bridges of 6 t placed under the first 2

Bay No. 3. 1 rolling bridge of 6 t
1 rolling bridge of 3, 5 t

Bay No. 4. 1 rolling bridge of 6 t
1 rolling bridge of 3, 5 t

Between the 2nd and the 3rd bays are placed the small glazed buildings allowing their lower part for the distribution of the tools and the higher part for the offices of the personnel of the master.

The Workshops are heated by a system of "pushed air" (d'air pulse) heated by steam. The steam is supplied by a lot of 3 boilers, 2 boilers of oil fuel and one of coal-dust. These boilers provide, at the same time, the steam necessary to pre-heat the madeup trains.

On top of the 4th Bay is found, under the roof and all along its length, an intermediate storey sheltering a shop with small rooms, workshops of the apprentices, electric workshop and the electric station of the HT.

The shop with big rooms, the furnace as also the joinery are installed in the annexe buildings.

The Workshops of Luxembourg employ 450 agents. They are controlled by a head of the workshops, helped by an assistant and 4 foremen or acting.

The annual work completed is the following (figures of 1957) :

Steam locomotives :
— 2 big repairs with lifting and partial replacement of the fire-box and of the boiler is about 9.000 hours per engine
— 28 average repairs with lifting, of 6,000 hours per engine
— 8 intermediate repairs of 1.400 hours
— 4 varied repairs of 600 to 1.000 hours

Diesel locomotives :
— 22 varied repairs of 500 hours
— 12 annual tests of 1.600 hours

Diesel rail-cars :
— 17 big maintenances of 2.000 hours
— 12 varied repairs of 250 hours

Travelling cars :
— 6 intermediate repairs RI
— 17 big maintenances GE
— 69 checks Rv
— 100 varied repairs RD
— 2 general checks RG

Motor bus and trucks :
— 13 intermediate repairs
— 7 varied repairs

In addition the Workshops of Luxembourg have at their disposal a Centre of apprentices of about 45 students, allowing the Railways a supply of young workers suitably formed and allowing to cover to advantage the departure of the old agents (pensions, death, etc.)

WORKSHOPS OF PETANGE

The workers of Petange, less important than those of Luxembourg, carry out the periodic repair of goods-wagons CFL as also accidental repairs of material of POOL–EUROP. These workshops have been taken again at the old private network PH Luxembourg. Built in the beginning of the century, they have been modernised since the establishment of the National Society of Luxembourg Railways in 1945. Thus the workshops of Petange which carried out the maintenance of all the material of the old network PH before the war, have been solely specialised in the maintenance of wagons. The repair shops have been enlarged and equipped with 2 transport bridges of 50 t and of 30 t allowing more facility in the functioning of the chain work and of the erecting track.

The workshops consist mainly of
— 2 big rooms for the repair of wagons
— 1 workshops for manufacture
— 1 forge
— 1 foundry (bandagerie)
— 1 joinery
— 1 shop

They are equipped with 3 rolling bridges (15 t, 5 t and 3.5 t) and 6 electric pulley funiculars (2 to 5 t).

The heating of the workshops is done by an independent plant system, with "pushed air" (air pulse), heated with fuel oil.

The Workshops of Petange employ 300 agents, managed by 1 head of the workshops, helped by an assistant and 2 foremen.

The annual work done is the following (year 1957)
600 testing 1 and 3
240 testing 2
200 testing 4
1.050 varied repairs

CONCLUSIONS

These few lines could have given only a very brief glimpse of the organisation of the CFL workshops, of their work and of their output.

The complete reconversion, finished probably at the end of 1960, will again bring different modifications of structure in the Workshops and will permit to push again the measures of rationalisation and modernisation still further.

Asquith's Contribution to Indian Railways

THE Asquith Machine Tool Corporation Ltd., has contributed to the development of Indian Railways by supplying machine tools of progressive design for many metalworking operations.

Asquith Radial Drilling Machines are a particularly notable example and these machines have been installed in types from the well-known O. D. range with drilling capacity and radius to suit the work required. All incorporate the Asquith feature of "concentrated control" whereby all the controls are grouped compactly for ease and rapidity of operation.

Another type of Asquith Radial Drilling Machine which is extremely useful in Railway Workshops is the Portable Machine which enables the machine to be taken to the workpiece and set up for holemaking where required.

Asquith Horizontal Boring and Milling Machines, which are available in a wide range of sizes, are continually being developed to make available to heavy engineering shops the latest equipment for this type of work. The new range of Asquith Ram Type Horizontal Milling and Boring Machines is typical of progress in this field.

Heavy duty lathes manufactured by George Swift & Sons Ltd., Halifax (a subsidiary of the Asquith Machine Tool Corporation) likewise represent the latest advances in machine tool design and are capable of using carbide tooling to the utmost advantage.

COPPER AND COPPER ALLOYS

The Indian Standards Institution has published the following two Indian standards on Copper and Copper Alloys.

i) Indian Standard Specification for Copper (IS : 191–1958), which covers the requirements for the following four grades of copper metal :

   a) Electrolytic high conductivity copper (EHC)
   b) Cathode copper (KC)
   c) Fire-refined high conductivity copper (FRHC), and
   d) Fire-refined ordinary copper, divided into two sub-grades, namely FROC–1 and FROC–2.

This standard was first issued as IS : 191–1950, a tentative standard. The main modifications made in this revision relate to the inclusion of clauses on chemical analysis, resistivity test in case of copper used for electrical purposes, and to shapes in which copper is normally supplied.

Electrolytic high conductivity copper fire-refined high-conductivity copper and fire-refined ordinary copper are normally available in the form of wire bars, cakes, slabs, billets, ingots and ingot bars. Cathode copper is available in the form of cathodes. For each grade, the chemical composition has been specified.

ii) Indian Standard Specification for Brass Ingots for Gravity Die Castings and Brass Gravity Die Castings (Including Naval Brass) (IS : 1264–1958), which covers the requirements for two grades, namely Cu 59 and Cu 61 Sn of brass ingots for gravity die castings and brass gravity die castings.

This standard covers two grades of brass, namely Grade Cu 59 and Grade Cu 61 Sn. Grade Cu 59 is used extensively in the manufacture of bearings, gears, pump parts, parts for electrical industry, steam valves and general engineering fittings. Grade Cu 61 Sn, commonly known as 'Naval Brass', finds special application for parts, which are required to be stronger, tougher and more resistant to corrosion than Grade Cu 59, and is used for parts subjected to high gas and water pressure and at the same time requiring resistance to corrosion.

Copies of the published standards priced at Rs. 1.50 and Rs. 1.00 respectively, are available in English. Copies can be had from the offices of the Indian Standards Institution, located at New Delhi, Bombay, Madras and Calcutta.

Charging Turbo-blowers of Czechoslovak Manufacture.

INTRODUCTION

THE supercharging of Diesel engines by means of *charging* blowers utilizing the energy of exhaust gases is the method most frequently employed today of increasing their rated output. The combination of piston engine with an exhaust gas turbine enables the *drop in pressure* of exhaust gases to be utilized which it is not possible to use with non-supercharged engines because of their size. The output of the turbine is used for the drive of a centrifugal blower which increases the pressure and thus the weight of the engine inlet air. In this manner a larger quantity of fuel is burnt in the cylinder and the output of the engine is increased. As compared with engines supercharged by a mechanically driven centrifugal blower, it is not necessary to take the power required for the drive of the blower off the engine shaft. The full output of the turbine is added to the useful output of the supercharged engine by means of a *charging blower*, the efficiency of which is superior to that of a non-supercharged.

The higher output of the Diesel engine depends on the specific gravity of the inlet air thus being determined by its pressure and temperature. The required increase of the output of the Diesel engine as compared with a non-supercharged engine determines the turbo-blower outlet pressure.

TYPIFIED SERIES OF CZECHOSLOVAK TURBO-BLOWERS

The rapidly increasing application of supercharged Diesel engines, especially after World War II, has lead to the development of charging *turbo-blowers* of Czechoslovak manufacture. After a period of research and prototype experimentation the first typified series of water or air-cooled turbo-blowers were built in 1949.

There are being produced three types of Czechoslovak turbo-blowers:

1. For low-pressure supercharging with an *outlet* pressure of *1.35* at a rated speed of the blower. This pressure increases the output of a four-stroke engine by approximately 50% as compared with an *non-supercharged* engine. At a suitable adiabatic efficiency of the blower the temperature of the charging air is sufficiently low so that its cooling is not required.

2. For medium-pressure supercharging where the output of a four-stroke Diesel engine is increased by about 75% as compared with a *non-supercharged* engine. The outlet pressure in the blower is 1.65. In this case the compression is higher so that the temperature of the charging air exceeds considerably the temperature of *engines supercharged at a low pressure*. Cooling of the filling air is recommended provided cooling water of a temperature of 20 to 30°C is available.

3. For high pressure supercharging the pressure of the filling air is *2 atm. a.* As compared with a *non-supercharged* engine the output of a four-stroke Diesel engine is increased by 100%. Due to a high temperature of the filling air cooling is essential.

The quantity of inlet air supplied to the blower depends on the stroke volume of the engine, the volumetric efficiency, the period of scavenging as well as on the value of the *filling* pressure and the temperature. Its exact amount which is normally computed from the engine output graph, cannot be ascertained without difficulty. The required size of

Fig. 3. Turbine runner wheel made by the heated pattern moulding method.

the turbo-blower can be determined approximately by computation while the turbo-blower is adjusted accurately to the engine in the *test room*. The individual sizes of the typified series of turbo-blowers have been arranged so that after changing the blower air passages the quantity of air for one and the same type can be varied at a ratio of 1.5 : 1.

According to the quantity of air to the blower the typified series of Czechoslovak turbo-blowers covers a range of Diesel engine outputs of from 90 to 2250 HP without supercharging. The rated quantities of air to the blower are arranged approximately in geometric *progression*.

The third parameter of the *turbo-blower* is the accessible temperature of *exhaust gases in front* of the turbine. For low-pressure supercharging the maximum permanent temperature of gases in front of the turbine is 550°C, for medium and high-pressure supercharging 600°C. In low-pressure supercharged engines the temperature of gases can be increased temporarily to 600°C, and in medium or high pressure supercharged engines to 650°C for one hour during a 24-hour operation.

The main data of all types of turbo-blowers are stated in the following table. Letters N, S and V denote low pressure, medium pressure and high pressure supercharging respectively. The quantity of the blower inlet air relates to a pressure of 1 atm. a. and a temperature of 20°C.

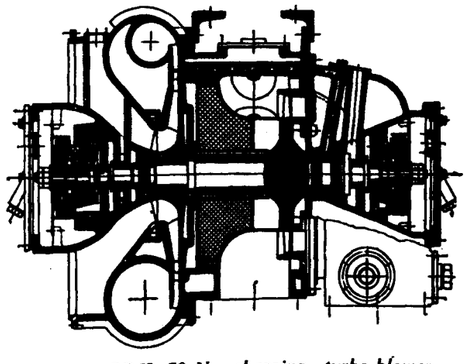


Fig. 2. PDH 70 N charging turbo-blower. Quantity of inlet air: 7,000 cu. metres per hour. Charging pressure 1.35 atm. a. Speed: 10,200 l/min.

DESIGN

All types are identical in design (Fig. 2). The stator of the *turbo-blower* is formed by the inlet and outlet turbine casing as well as the casing of the blower. The turbine casings are provided with double walls for water cooling. They are cast from *fire-proof* cast iron.

The flange of the inlet turbine casing is provided with two, three or four inlets according to the number of cylinders of the engine. Through these inlets the exhaust gases are delivered from the individual cylinders independently to the individual segments of the *guide wheel* which is located in the turbine inlet casing. The centre of the latter forms a bed for the turbine bearing. The bed provides simultaneously for the lubricating oil tank.

Fig. 4. Rotor of the PDH 35N turbo-blower.

The outlet turbine casing houses an insulating layer which prevents the heat of the exhaust gases from passing into the blower. A tube is provided in the casing along which throttling air is conducted into the *stuffing box* of the turbine thus protecting the labyrints and the bearing from overheating and contamination by exhaust gases. The turbine casings and the casing of the blower can be turned against each other at an angle of 30°. The brackets carrying the turbo-blower can also be turned at 30°. In this manner the turbo-blower assembly can be adapted to various types of engines. The blower casing is made of an aluminium-alloy. The *spiral* is sunk deep so that its diameter is considerably reduced. The bed for blower bearings is connected with the spiral by a ´rosette. An oil tank is also provided. Special attention is paid to the aerodynamic inlet part of the blower casing which is provided partially with a felt lining.

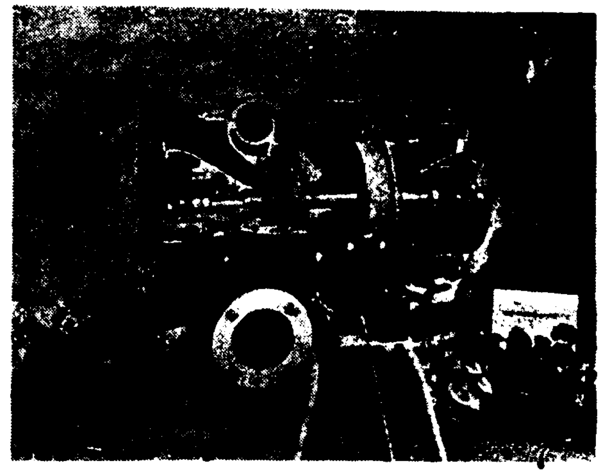
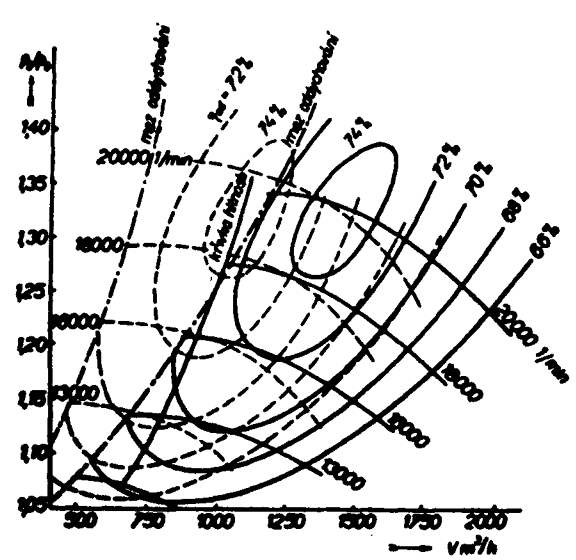


Fig. 5. Cross-section through the PDH 16S turbo-blower.

In this manner it has been possible to damp the noise of the blower which is surpassed normally by the noise of the Diesel engine. The blade diffuser of the blower is separated from the casing so that it can be changed and the characteristic of the blower altered.



Obr. 6. Charakteristiky plnicího turbodmychadla PDH 16 N s křivkou hltnosti motoru 6S 160 PN — difusor se vstupním úhlem 27° 30' .... difusor se vstupním úhlem 17° 30'

Fig. 6. Characteristics of the PDH 16N charging turbo-blower with an output curve of the 6S 160 PN engine.

– diffuser with entrance angle of 27°30' – diffuser with entrance angle of 17°30'

The air-filter is attached to the casing of the blower and provided with an oil impregnated wire screen. Under certain circumstances the filter is replaced by a *suction branch.*

The rotor of the *turbo-blower* is mounted in the turbine casing in one, in the blower casing in two high-speed compound ball-bearings with a bronze cage on the outer ring. The shaft is elastic. The *runner* is forged directly from the shaft. The blades are *made* of austenitic steel and welded to the wheel of the turbine on smaller types. The successful development or welding practice has enabled to employ this joining method. Cranks in the weld which are formed as the *runner* wheel cools down or during the initial operating stage at temperatures exceeding 500°C, are removed by applying a layer of ferrite steel to the contact surface of the turbine wheel.

For small PDH 16, 25 or other types nickel-alloy cast turbine wheels by the heated *pattern moulding process* are employed alternately (Fig. 3). The application of this new technology reduces considerably the costs of blade manufacturing, and speeds up the production of tuıbo-blowers in series.

For larger types of blowers the *runner* blades are attached to the *runner* wheel by means of the Laval *foot.*

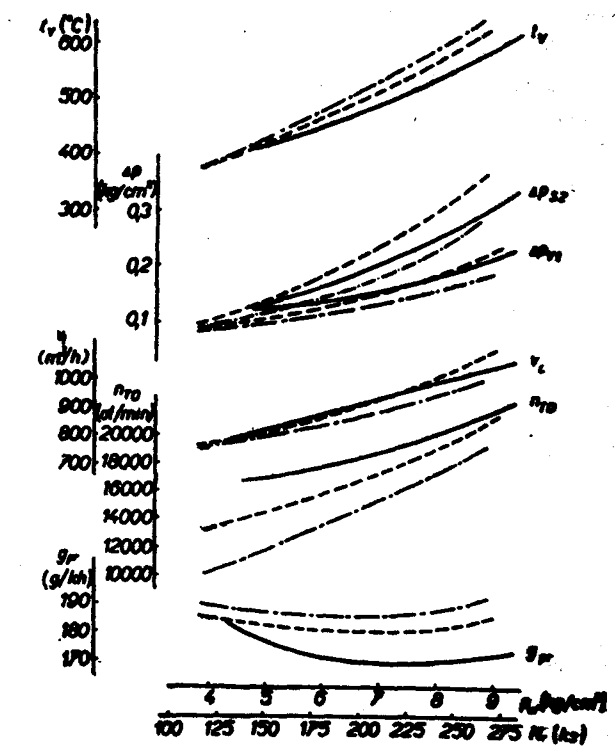
Fig. 4.

The *runner* wheels of low-pressure blowers are riveted. The *runner* blades are *bent rearwards* and attached to the bearing and covering disc by journals milled directly from the blades. Behind the *runner* wheel *diffusers with or without blades* are provided in which the kinetic energy which is left in the air after its withdrawal from the *runner* wheel, is transformed into pressure.

The bearing disc has an equalizing piston at its external side which equalizes the thrust to a considerable extent. The remaining thrust is taken up by the bearings at the side of the blower. In blowers for medium and high-pressure supercharging the covered *runner wheel* is replaced by an open wheel with radial blades. Other parts of the turbo-blower except for the diffuser of the blower are identical with those of low-pressure turbo-blowers so that a low-pressure turbo-blower can be converted into a medium or high-pressure unit.

Fig. 5.

Combustion products are normally deposited on the turbine blades during the operation of the *blower* so that the rotating masses are not distributed evenly. The bearings of the turbo-blower are subjected to variable stresses. These indesirable effects are eliminated by bearings which are *spring*-mounted on either side. *Spring*-mounting consists of a layer of synthetic rubber inserted between two steel rings at the side of the blower. The rubber at the turbine side is substituted for another steel ring which is placed between the rings and leaned with its projections against the inner and outer rings in succession. Vibrations are damped hydraulically by the oil penetrating between the rings.



Obr. 7. Charakteristiky motoru 6 S 160 PN

Fig. 7. Characteristics of the 6S 160 PN engine.

The lubrication of the bearings independent of the engine circuit. By means of centrifugal discs which are provided at the shaft ends, the oil is delivered into traps from which it flows into the bearings. The cooling of the oil in the turbine casing is effected by water while the oil tank is cooled by inlet air delivered to the turbo-blower at the side of the blower.

TESTING OF CHARGING TURBO-BLOWERS WITH THE ENGINE

All turbo-blowers are subjected to routine tests at the works where they operate as gas turbines in an

open circuit with an oil combustion chamber. All types were homologized with a Diesel engine in long-term service. The operation of the turbo-blowers throughout these homologizing tests was satisfactory and trouble-free. The tests conducted on a PDH 16 N turbo-blower with a 6 L 160 engine are described below.

Fig. 6 illustrates the *adjustment* of the turbo-blower to the *output graph* of the engine.

A turbo-blower with the original *blade* diffuser and an *entrance* angle of 27° 30′ had an unfavourable characteristic while the *output graph* was crossing the *breathing* limit (full drawn line). By substituting the original diffuser for a diffuser with an *entrance* angle of 17° 30′ the delivered quantity was reduced and the *capacity curve* of the engine transferred into the field of the highest engine efficiency (broken line).

The changed operating characteristic of the engine is shown in diagram No. 7. The original characteristics at the initial stage of the test are represented by a dot and dash line (ps = overpressure behind the blower, pvl = overpressure in front of the turbine, V = *amount* of turbo-blower inlet air, nt_D = speed of the turbo-blower, tv = gas temperature in *front* of the turbine, Gp = specific fuel consumption of the engine. The curves *were drawn in dependence* of the load of the engine and at its constant speed).

The dot and dash lines enables the changing of the operating characteristics after replacement of the blower diffuser; during the final stage the combustion space was rebuilt and the injection process as well as the turbine blading *adapted* to the adjusted blower. The final operating characteristics are represented by the full-drawn lines.

CONCLUSION

In this article the principal design features and the results of the tests conducted on Diesel engine charging turbo-blowers are briefly described. High efficiency, service-reliability, fine craftsmanship and long service-life meet the highest requirements of Diesel engine manufacturers. Smaller types of turbo-blowers up to 35 N in size are produced in series so that they can be supplied from stock at short notice. The terms of delivery of larger types of turbo-blowers manufactured in small series or in single-part production amount from 6 to 12 months.

TABLE 1

Typified water-cooled charging turbo-blowers of the PHD series.

Type	Rated amount of inlet air.	Rated charging pressure.	Speed	Maximum dimensions.
Weight of turbo-blower	Output of non-supercharged engine.		Output of supercharged engine.	

+/

At a temperature of 25°C and a barometric pressure of 745 mm of Hg.

INCREASING SCOPE OF RUBBER RAIL PADS

The Annual Report of the Natural Rubber Development Board, just published, highlights the laying of rubber rail pads "in very large numbers" carried out in various parts of the Commonwealth during 1957.

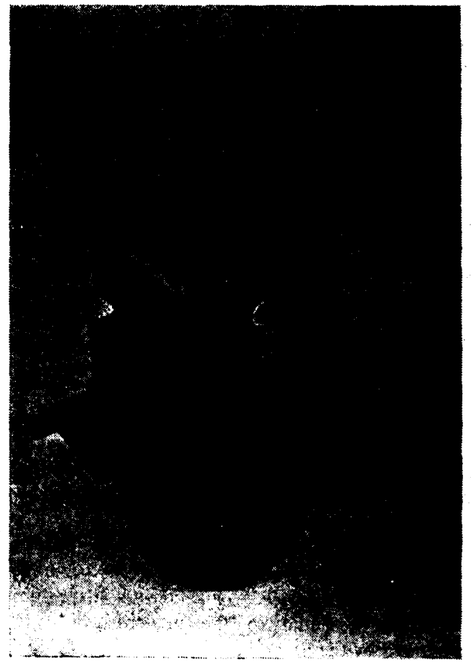
The Report continues: "In South Africa, following a successful trial, 400,000 rubber pads were ordered for use with concrete sleepers. In Australia, New South Wales Railways are using regular supplies of pads and intend gradually to introduce these to the majority of the track which they control, whilst the Queensland Railways are to commence experiments with rubber pads in connection with their electrification scheme. Following close liaison with New Zealand Railways there seems every prospect of large-scale use in that country."

In the more general engineering field the Board's policy has been "to stimulate new developments in conjunction with the British Rubber Producers' Research Association and to issue basic information to engineers on established uses where natural rubber is pre-eminent".

Copies of the Annual Report are available free of charge from the Natural Rubber Development Board, Market Buildings, Mark Lane, London, E. C. 3.

The Ceewrite Indicator

The production of accurate length and depth in a longitudinal direction is a major difficulty in lathe work. The Ceewrite Indicator has been designed to make it possible to obtain any number of lengths and depths over the whole working length of the lead screw to within limits of .001". It eliminates the use of depth micrometers, slip gauges, standard or vernier micrometers. Furthermore, no time is lost in stopping the machine for checking purposes.



The method of attachment will vary according to the lathe, but a method common to many lathes will be to attach the Indicator to the saddle so that it will work on the lead screw. The Indicator is particularly suitable for use on the Edgwick Lathe.

Operation is very simple. The lathe tool is applied to the work piece and a facing cut taken if required. The Indicator dials are then set at zero, allowing any tool movement in a longitudinal direction to be read directly from the dials. The dials can then be re-set at zero if required. The Indicator is manufactured in eight models, with either fractional or decimal dials, and various settings. Full details are obtainable from our Small Tools Department.

We believe that the accuracy and time-saving effected by the Indicator should appeal to all forward-looking engineers.

TRADE FAIRS AND EXHIBITIONS IN 1959

National Perambulator Exhibition	17—19 January
National Millinary Exhibition	30 Jan.—1 Feb.
40th Fashion and Sales Week (international) Ladies' Clothing	5—8 April
7th Great German Footwear Sample Display	26—28 April
IVth International Conference and Exhibition for Health Education	3—9 May
41st Fashion and Sales Week (international) Ladies' Clothing	14—19 June
National Millinary Exhibition	31 July—2 August
10th Hotel Trade and Catering Exhibition, with international participation	29 Aug.—6 Sept.
42nd Fashion and Sales Week (international) Ladies' Clothing	27—30 September
8th Great German Footwear Sample Display	September
PLASTICS '59—International Trade Fair of the Industry	17—25 October
Congress of Foundrymen +)	29—30 October
Workmen's Safety and Factory Hygiene Exhibition and Convention	12—14 November
Annual General Assembly of Metallurgists +)	November
43rd Fashion and Sales Week (international) Ladies' Clothing	24—29 November
Art Exhibition—Duesseldorf Painters and Sculptors	1—31 December

+) Convention only

New Self-propelled Inspection Car for Overhead Contact Lines

By Dipl.-Ing. Friedrich Drechsler
Donauwörth

THE German Federal Railways are using self-propelled inspection cars not only for the execution of all programmed contact wire maintenance jobs for the equipment erected on plain lines and at stations, but they are also employed to carry out minor repairs, to remove unexpected damages to the contact wires, and to assist and expedite the execution of new electrification projects.

To meet the increasing demands for better maintenance due to the ever extending electric traction service, a new self-propelled tower inspection car, embodying modern construction principles, was developed by Messrs. Waggon-und Maschinenbau GmbH, Donauwörth, in co-operation with and on request of the bundesbahn. With the delivery of the first vehicles of this new type the Bundesbahn have been provided with a maintenance tool being capable to meet all requirements and to solve all problems of contact wire maintenance and construction. For this reason and due to its high efficiency this railcar has found wide interest in Germany and also in countries abroad.

OPERATING POSSIBILITIES

a) Thanks to the installation of diesel engines the standard tower inspection car is self-propelled, i. e., no taking of power from the overhead contact wires. Since the permanent speed of this vehicle amounts to 90 kms. p. h. it can be worked in fast passenger train schedules.

b) The so-called "creep speed" of approximately 5 kms. p. h. which is required for overhead equipment inspections can be kept continuously on all lines—even on such with gradients up to 40 per mile—and also if a trailer, aggregating a total of 40 tons, has been attached to the railcar.

Train performances of the fully serviceable vehicle are as follows :

Gradients per mile	Trailers weight in tons	Speeds in kms. p. h.
10	40	50
33	40	35
40	25	according to the engine output

c) The inspection railcar can be employed for the haulage (push or draw) of goods wagons up to a total weight of 200 tons in case a blocked line has to be cleared from any vehicles. Moreover, it can be attached to trains without any difficulties.

d) Even in winter time the inspection car is always ready for service, and it can be stabled in the open air for an unlimited period of time, if desired.

e) The vehicle has spacious repairshop and storage rooms serving different purposes. Furthermore, there is a swing out working platform being capable to be lowered and raised to each desired height. A current collector serves to control the overhead contact line.

DIMENSIONS AND CONSTRUCTION DETAILS OF THE INSPECTION RAILCAR

Overall length over buffers	13 950 millimeters
Overall length of body	12 750 millimeters
Overall width of body over sheets	3 000 millimeters
Roof level above top of rail	3 700 millimeters
Floor level above top of rail	1 145 millimeters
Wheelbase	6 000 millimeters
Running circle diameter of wheels	900 millimeters
Gauge	1 435 millimeters
Empty weight of the serviceable vehicle	22.7 tons
Additional load consisting of workshop equipment and spare parts	3.5 tons
Total weight of the serviceable vehicle	26.2 tons
Maximum axle load	13.1 tons
Type of axle bearings	roller bearings
Draw and buffer gear	light standard type
Buffer shock	120.0 tons
Maximum speed	90.0 kms. p. h.
Power transmission	mechanical
Type of brake	air disc brake
Heating	cooling water system
Specific output	11.5 b.h.p. per ton

Thanks to the comprehensive experience the manufacturing company was able to acquire in the field of light-weight steel construction making use of tin sheets, the body is designed as a steel structure to which an outer skin consisting of steel sheets is welded. To save weight the greatest possible number of structural parts serves as carrying members, and extensive use of light profiles, edged and corrugated steel plate components as well as thin sheets is made and all these different structural elements are welded together by using different welding methods.

THE BODY

In view of the special design of this vehicle, of the additional equipment, aggregating a total weight of 3.5 tons, the dispersion of the buffer shock through the whole vehicle, and because of the different type of stresses and loads caused by the working platform being capable to be lowered, raised, and swung out, the car body has a special and all-welded underframe and consists of a continuous longitudinal girder, cross and longitudinal members, and a body suspension girder built up of normal channel sections ; only the cross member serving to carry the tower for the working platform is a welded construction made from steel plates.

The normally 1 millimeter thick corrugated steel floor sheets, the stiffening corrugations of which are arranged parallel to the longitudinal girder, are welded to the underframe and reinforced over a 600 millimeters wide area to a thickness of 1,5 millimeters to withstand the impact of the buffer shock.

Side walls and ends of the vehicles are built up from edged plates and the framework of the roof is of standard lightweight profiles. Covering panel sheets for the side walls (1.5 millimeters thick) and the walkable roof (1.25 millimeters thick) which, if possible, must be of the same size and evenly distributed are welded to the underframe so that, thanks to the welding together of all these structural parts, the car body is to be considered as a compact unit having complete resistance to any shearing and/or torsion.

THE CHASSIS

Running gear and engines are accommodated in a specially designed chassis. The frame of the chassis is an all-welded construction built up by plate metal components and rolled sections. The body structure is sprung and slung in pendulum fashion—with a four-point suspension — to the axle carrying frame. Oil-shock absorbers are fitted to damp down quickly all lateral (horizontal) oscillations, any vertical sagging of the body, and to prevent the transmission of different oscillations, caused by the diesel engines, the chassis, and the running gear, to the car body.

The wheelsets — with lightweight disc wheels, solid axles, and De Limon-Fluhme lubricators — are running in roller bearings being rigidly connected to the lubricated laminated springs arranged underneath the axle bearing casings. The laminated springs the one end of which is fixed, free of play, to the frame of the chassis while the other end slides along a spring bracket function as an axle steering device. An eccentrically arranged spring bolt ensures not only an axle disposition corresponding to the longitudinal axis but also the parallel position of both axles which is of grate importance to obtain satisfactory running conditions.

DRAW AND BUFFER GEAR

Thanks to the provision of a standard lightweight draw and buffer gear with a 12-ton train hook spring and two case buffers, arranged 1.060 millimeters above top of rail, goods wagons can be hauled by the car.

COMPRESSED AIR PLANT, BRAKE SYSTEM, AND SANDING GEAR

The tower inspection car is equipped with two Knorr air compressors. Each diesel engine drives through a V belt and with the aid of universal-joint shafts one compressor.

Several compressed-air valves serving to operate the distributing nozzles of the either-way sanding gear, the axle reversing gear, and the pantograph are arranged, together with two double air-pressure gauges, on the driver's table. Apart from this, the undermentioned facilities are pneumatically operated : the admission regulating valve for the diesel engines, the plate-type filters, the wheel flange lubricators, the warning horns, and the brake system.

Two brake cylinders are carried on the underframe and two discs are shrunk on each axle for the air disc brake. The air brake can be operated from the control table in the driver's compartment and by means of an auxiliary valve fixed to the working platform, while the emergency brake valve and a tap to connect pneumatic tools are in the repairshop compartment. Each driver's compartment is equipped with a hand brake wheel acting on the brake discs fixed to the adjacent axle.

Self-propelled standard inspection car in working position.

ACOUSTIC SIGNALS

Two sets of triple-note foot-operated Tyfon warning horns, one at each end of the railcar, are provided. The diaphragms of the horns are connected to the interior of the car body to protect them against freezing.

HEATING AND VENTILATION SYSTEMS

The inspection c r has two cooling water circuits. Connected to these circuits are four Hornkohl radiators for circulating warm air (two for each circuit), two Schultz anti-fog devices (one for each circuit), and two Webasto oil heaters (one for each circuit). Each of the above mentioned four radiators consists of two hot-water heating elements and of an easily accessible ventilator pressing the air through the heating elements inserted into the cooling water circuit ; the workshop compartment, both drivers' compartments, and the drying closet for clothes are also heated by this system.

Warmed fresh air is blown through a nozzle against the front wall windows to prevent them from being covered with moisture ; the warm air also serves to additionally heat the drivers' compartments. With the aid of change-over and stop valves the Webasto oil heaters permit to obtain the additional warming up of the heating circuit and the pre-heating and keeping warm of the vehicle engines. Four Ackermann engine heaters, two for each cooling water circuit, with specially marked sockets to connect them to the main serve to keep the cooling water warm, if the car is stabled.

The drivers' compartments and the workshop compartment have been equipped with full-drop windows or with windows the upper quarter of which can be opened only ensuring a satisfactory ventilation so that it was unnecessary to install roof fans.

ELECTRICAL EQUIPMENT

The electric system is in two groups each of which is fed from 12-volts batteries. Two Bosch 12-volt dynamos driven by the diesel engines generate the current necessary to meet normal requirements ; they also

charge the batteries to which both groups of electrically operated apparatus can be alternatively connected. Via a train mounted charging plant it is possible to recharge the batteries out of the main. The lighting of the drivers' compartments is by a lamp in the roof, and four such lamps serve to light the workshop compartment; additional lamps of this type are provided to illuminate the worktable and the auxiliary table. The work bench is lighted by an adjustable table lamp. Underframe (at a point located above the engine) and working platform are fitted with two sockets each; the instrument panel, the drivers' compartments, and the work bench (at a point located above the bench) have one sockets each. The outlook have two sockets which are primarily used to connect a portable searchlight. Four lamps serving to illuminate the working site as well as the area around the vehicle are mounted on both side walls underneath the running boards of the roof; two large and two small searchlights serve the same purpose; they can be moved from the drivers' cab and from the outlook. Apart from this equipment the following lamps are available: two normal headlights arranged underneath the front wall windows and a danger light which is located above the centre window and which is fixed to the same wall.

THE LOUDSPEAKER SYSTEM

A loudspeaker system is installed to facilitate communications between the cabs, the working platform, and the lookout; one loudspeaker is on the roof and the two others are above the cabs. The drivers' compartments and the outlook have a talk-back speaker for one direction only while the working platform is fitted with a weather-proof loudspeaker being capable to establish two relations.

SOUNDPROOFING

The surface of the corrugated steel plate floor is completely covered by a layer consisting of tiny cork morsels the purpose of which is to suppress the noise and to insulate the heat; the workshop compartment has a wooden floor covered by linoleum and the cabs have a linoleum covered plywood floor. Special attention has been given to the tight fitting of the inspection covers in the floor giving access to the engines.

LAYOUT AND INTERIOR EQUIPMENT

The drivers' compartments are lined by steel sheet panels. They are separated from the workshop compartment by partition walls with hinged doors. Each drivers' compartment has a control table with the switching apparatus, indicators, and control devices as they are usually required for railcars. The control table can be extended by a folding table; moreover, there is a drivers' seat, two folding seats, and — built into the front walls — four fixed windows. The windows have electric windscreen wipers, a sun-blind, and anti-fog devices (blowing warm air through nozzles). The windows of the drivers' compartments as well as those of the hinged entrance doors can be lowered and raised. All windows are tightly fitting.

Inner side panels of the workshop compartment are of plywood. Built into the side walls of this compartment are rubber-sealed and grid-protected windows with compound glass; the top quarter can be opened to ensure proper ventilation. The double doors on each side are of the hinged type with four wings which, in order to permit the loading of bulky goods, can be fixed paralled to the side walls by folding them.

WORKSHOP EQUIPMENT

The following items have been provided in the workshop compartment.

1 work bench with a tube vice, a jaw-vice, and drawers running on wheels.

1 shelf with various partitions to store different items; one box is lined with sheet panels to store oil cans and grease cubs.

1 shelf for the storage of insulators.

1 table with a cupboard and drawers arranged underneath its cover plate.

1 drying oven for clothings and other items.

1 locker with a special shelf for hats.

1 steel tube frame with brackets for the suspension of contact wires and wire ropes.

Various types of holding devices fixed to the ceiling, the side walls, and above the windows serve to store earth bars and tubes.

The additional equipment consists of tools and implements of various types, as e. g. 1 stretcher with accessories, various telephone sets with accessories, signals, ladders, block and tackles, different types of fastening ropes, working tools and measuring devices for earthworks, tools for mechanics and electricians, pneumatic tools and electric tools, brushes and spray diffusers, and cooking appliances.

CHARACTERISTIC STRUCTURAL FEATURES

Platform and Outlook

The workshop compartment is fitted with a 1 meter high platform with a tube railing and a staircase. This platform is adjacent to the wall separating this compartment from cab No. 1, and this platform is so designed that it can be used as a cupboard for the storage of different apparatus and for the accommodation of the washing facilities. Above this special platform the roof is bulged out to form a sheet-metal hood both sides of which are fitted with a window with an anti-fog device and a windscreen wiper for each window. The outlook affords an unobstructed view on the overhead contact wire during the inspection trips.

EXIT DOOR, GROUNDING DEVICE, AND CONTROL CURRENT COLLECTOR

The completely walkable vehicle roof is covered by a larchwood floor and the working platform can be reached by means of an upward-folding ladder made of edged sheets and through a whole which is normally provided with a double-walled cover filled up with glass wool. The locking mechanism of this cover is independent from the operation of the current collector, but it is connected to the grounding device of this current collector. Thus the exit cover can only be opened if the current collector is grounded with the aid of a disconnecting blade fixed to the underframe by means of a grounding circuit; the earthing cannot be removed as long as the cover of this hole is opened. Lowering and lifting of the current collector is accomplished from both drivers' compartments from where the foreman of the maintenance gang is always in a position to see from the indications of a voltmeter whether the current is on or not, i. e. that lengthy and dangerous measurements are no longer required for this purpose.

WORKING PLATFORM

The working platform is an all-welded structure built up from edged plate profiles being provided with lightening holes. The frame of this platform is connected to a short but wide tube. The platform floor consists of larchwood planks which are impregnated with linseed oil; it is fitted with an inclineable tube railing.

The main data of the working platform are as follows:

Platform area	4550×1300 millimeters
Swing-out angle for each side	100 degrees
Normal height above top of rail	3950 millimeters
Length of stroke	1000 millimeters
Time required to lift the platform by one meter approximately	16 seconds
Permissible stress which can be exerted on the platform in the swing-out position (with four men and the necessary equipment on the platform) approximately	400 kilogrammes
Weight of structural parts to be lifted approx.	950 kilogrammes

The platform is equipped with the following items: controls to accomplish the swinging out and locking of the working platform, the push button required to raise and lower the platform, the additional brake valve, the air-pressure gauge, the talk-back loudspeaker, two lamps, and two sockets.

TOWER

The column on which the platform rests telescopes in a 394 by 6 millimeters wide tube which has two sufficiently lubricated plastic bearings ensuring its proper guiding and safe operation; the column is carried by the cross member of the underframe and it is fixed to the reinforced roof by means of a flange. The short tube of the working platform is shoved upon and screwed to the column. On the upper part of the column slides a spine ring which rotates in relation to the roof; a horizontally arranged cross bar is welded to this ring and, to swing out the tower, a telescopic shaft and a pinion is fixed to it.

LIFTING MECHANISM FOR TOWER AND WORKING PLATFORM

A hydraulic system serves to lower and raise the platform. The following facilities are part of this hydraulic system: a pressure cylinder with a lifting capacity of 1000 kgs. at 1470 lbs. per square inch and a maximum stroke of 1020 millimeters, an oil pump driven by a Bosch starter fixed to the pump by means of a flange; thus ensuring a steady and smooth feeding, completely free of any shocks, a magnetic filter device, a six litres oil tank, and different valves which are partly electrically operated. The pressure cylinder is carried by the cross member over ball heads and the top of it is fixed to the tower column through a sheave groove bearing and by means of a flange welded to the column.

A limit switch cuts out the pump motor as soon as the working platform has reached the maximum length of the stroke. In case of major jobs a cut-out valve prevents abrupt lowering of the platform if there is a sudden drop in pressure. The working platform is lowered by releasing a magnetic valve which can be manually operated as well. A throttle valve, installed between the magnetic valve and the oil tank, regulates the lowering speed.

SWINGING OUT AND LOCKING OF THE PLATFORM

Both operations are performed on the platform by manually operating a worm gear with a telescopic shaft (already mentioned above) and a pinion serving as driving mechanism. The pinion mates with the ring gear fixed to the roof. The working platform is locked and unlocked by a spring-loaded bar via a cable line; the operating lever for this bar which is arranged adjacent to the worm gear is locked in the release position by a ratchet wheel.

ENGINE-DRIVE EQUIPMENT

There are two engine-transmission groups. Each comprises a water-cooled Büssing six cylinder underfloor diesel engine with a continuous output of 130 b. h. p. at 1800 r. p. m.; they are started by means of an electric starter.

As a consequence of the required slow running speed (four to five kms. p. h.) both engines are equipped with a combined Bosch speed regulating device/admission regulating valve. By pressing a foot switch in the driver's compartment the admission valve of the loaded engine is pneumatically adjusted in accordance with operating requirements which is done in such a manner that it is impossible to fall below the permissible idling speed and to exceed the permissible maximum speed. If the pneumatic control fails the engine speed can be regulated by a hand lever which can be reached from the interior by removing the cover of a hole in the floor. Engine stopping is accomplished electro-pneumatically over a miniature magnetic valve and the engine regulator. The air for the combustion is cleaned by Delbag drawer-type filters which can be reached from the workshop compartment; they can be exchanged at any time.

Both Behr cooling plants—inclusive the fan clutch—are fixed to the underframe at a point located in front of the axles. Each cooling water circuit is equipped with an Ortlinghaus fan clutch which is thermostatically controlled and pneumatically operated. It is cut in at 79 degrees Cels. and cut out at 72 degrees.

By means of a fluid coupling, built into a flywheel, each engine is connected with its transmission gear; the fluid coupling is cut in if the speed of the driven shaft of the engine or that of the transmission primary shaft exceeds 8 r. p. m. The six speeds of the convential and serially manufactured bus (mechanical) gear drive (Zahnradfabrik Friedrichshafen) are shifted through a gear-control switch in the driver's compartment and five electro-magnetic disc clutches, thus permitting a very satisfactory utilization of the engine output.

Both Gemeinder axle reversing gears are mounted on the driving axle and supported by a girder of the underframe; they are pneumatically controlled by means of air cylinders; the control facilities are on the driver's table. Manual operation is also possible. For this purpose it is necessary to open a cover in the floor.

The fuel tanks are fixed to the car body.

LAMINATED TIMBER FOR RAILWAY SLEEPERS

Hungary is to build a new factory for the manufacture of bonded railway sleepers following upon the conclusion of successful tests under working conditions.

Jointly developed by the Research Institutes of the railways and timber industry. These sleepers have from three to six stratas and are bonded under pressure with artificial resin.

A three year test has proved the practicability of the idea and Hungarian, instead of imported timber is to be used, which is expected to result in the saving of £ 450,000 in currency.

Tradition and Progress in the Production of Railcars

By Prof. Dr. Robert Nejepsa, Dipl. Eng.
Head of the Faculty of Rail Vehicles at the Czech Polytechnical School.

ABOUT 133 years ago in 1825, the building of the first public railway line on the European Continent was started on the soil of the present Czechoslovak Republic. The coach stock of this railway was provided by home workshops which up to then had manufactured road coaches. Twenty years later, in 1845, the first industrial production of coaches was started in the Iron Works in Vitkovice (Vitkovicke zelezarny). More important results, however, were obtained by the Prague factory of F. Ringhoffer, which had manufactured railway wagons since its foundation in 1852 and has continued to do so in the same place up to the present for a full 105 years, now, of course, under the name of the Tatra Smichov Railway Wagon Factory (Vagonka Tatra Smichov).

Steam locomotives have been produced by the CKD factory in Prague since 1900; it has produced diesel-electric locomotives of low outputs since 1930 and both trunk and shunting diesel-electric locomotives of medium and high outputs respectively since 1950. The famous Skoda engineering works in Plzen (now called the Establishment of V. I. Lenin) started to produce steam locomotives in 1920; in the last decade they have changed over to the production of electric locomotives.

The excellent design and painstaking production have enabled Czechoslovak railcars to compete successfully nearly all over the world. Locomotives have been supplied to China, India, Argentina, Brazil, the USSR, Korea, railway wagons in the post-war period to the USSR, the Federal German Republic, France, Holland, Bulgaria, Turkey, Greece, Egypt, etc. The experience based on a century old tradition in the production of railcars as well as the knowledge obtained in supplying both standard and special types of cars all over the world, enabled, after World War II, the production of well appointed passenger coaches, freight wagons and special cars.

Passenger coaches have achieved considerable progress both from the point of view of weight and technical and sanitary-cum standards as well. By the application of welded structures made of pressed sections as well as by the application of new materials, a low weight ration per 1 seat has been achieved both with the international and inland types. The latter types show a tendency towards an arrangement using swivelling seats and folding backs, affording satisfactory comfort also during night journeys. The success of the design of passenger coaches has been manifested also by repeated export orders.

In the field of freight cars there must be mentioned the efficiency of the Czechoslovak industry which has not only been capable of refitting the greatest part of the Czechoslovak rolling stock, but of exporting over 10,000 railway wagons abroad (Federal Germany, France, Holland, Turkey, Sweden, Switzerland, etc.). The last few decades have placed extraordinary demands on railway traffic which have had to be met by the production of special cars, which enable the setting up of heavy, but short trains and the speeding up of wagon circulation by adapting the wagons for rapid unloading of loose substances.

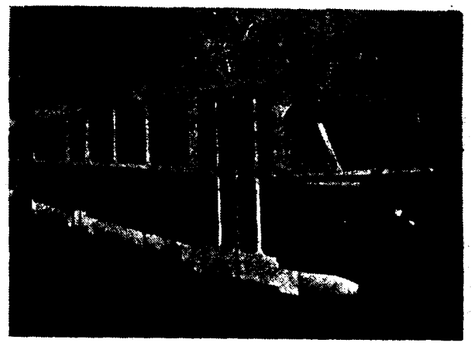
In addition, the Czechoslovak industry supplies all types of single and multiple-purpose railway wagons, such as hopper cars, tippling cars, wagons for use in steel works, mine cars, tank cars and well-wagons.

The well developed production of mobile truck-mounted electric steam power plants is well worth mentioning.

The development of Czechoslovak steam locomotives was marked by the demand to burn low grade quality coal of only 3000 kcal per kg of calorific power. This called for exceptionally large grate and heating surfaces and resulted in the design of a large vertical boiler which had to be mounted above the locomotive frame. Thus also the cylindrical boiler of Czechoslovak locomotives has an elevated position, advantageous both technically due to its flexible entering of curves and aesthetically due to its endowing even a robust construction with the appearance of slender lightness. The technique of the high Czechoslovak locomotives together with consistent architectural care has created a modern engine which has become a hallmark in the world development of steam locomotives. Eight and ten-wheel tenders have been designed to match, showing a continuity with the locomotive cabs and at the same time foring an extraordinarily large space for storing fuel and water, thus increasing considerably the radius of the locomotives.

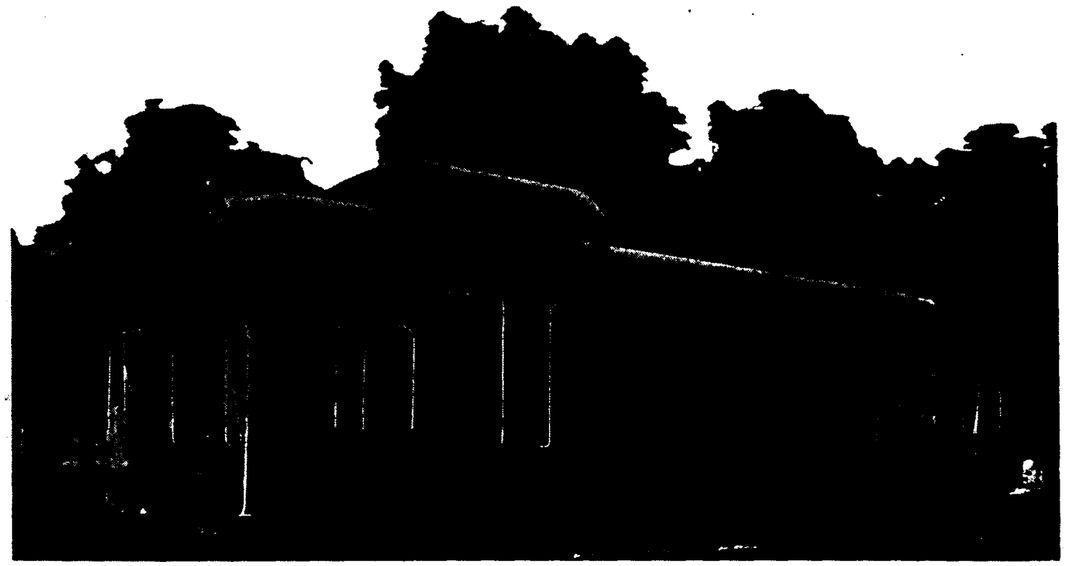
The Czechoslovak tender locomotives have achieved great perfection and their advantages are well known. Now Czechoslovakia has stopped the manufacture of steam locomotives and in its stead continue the production of Diesel, Diesel-Electric and Electric locomotives.

The development of Czechoslovak diesel railcars had its origin in both the advanced railway wagon industry and the long tradition in the production of engines and automobiles. In addition to standard diesel-mechanical and diesel-electric railcars, a Tatra railcar with electro-mechanical transmission was designed before the war with an output enabling a speed of 140 km p. h. as well as a CKD railcar with a Wilson gear box for a speed of 125 km p. h.



Tatra-CKD eight-wheel tram-car, type T II, gauge 1435 and 1000 mm. Weight 17 tons, one hour output 4 × 44 kW, one hour speed 29 km per hr., maximum speed 65 km. per hr.

Following World War II, Czechoslovak industry has supplied over 600 light motor railcars of a uniform four-wheel type, equipped with an air cooled engine with an output of 160 H. P. For medium size traffic purposes a large number of eight-wheel motor railcars has been supplied with an engine of 410 H. P. and electric transmission of an output for 90 km p. h. further an eight-wheel light motor railcar with an air cooled engine with an output of 300 HP and speed of 60 to 80 km p. h. which is followed by a



CKD Diesel-Electric locomotives, series T 434.0, type Bo' Bo' for shunting purposes and light train traction. Weight 62 tons, output 700 HP., speed 60 km per hour.

railcar with an output of 650 to 700 H. P. for speed of 100 to 140 km p. h., affording various combinations with coupled and inserted cars of the train set up for differing traffic purposes.

In the field of motor locomotives the CKD factory produced after the war a Bo' Bo' diesel-electric locomotive for shunting and light traffic purposes over lines with a permissible axle pressure of 15 tons. The locomotive is fitted with an engine of 700 H. P. and is rated for a speed of 60 km per hr. For heavy traffic duties a Co' Co' diesel-electric locomotive was developed with a supercharged engine with an output of 1650 H. P. which attains a speed of 120 km. p. h. over railway lines with a permissible axle pressure of 17 tons.

Especially for the gauge of 760 mm a Bo' Bo' diesel-electric locomotive was developed with an output of 350 H. P., which has been exported abroad in large series.

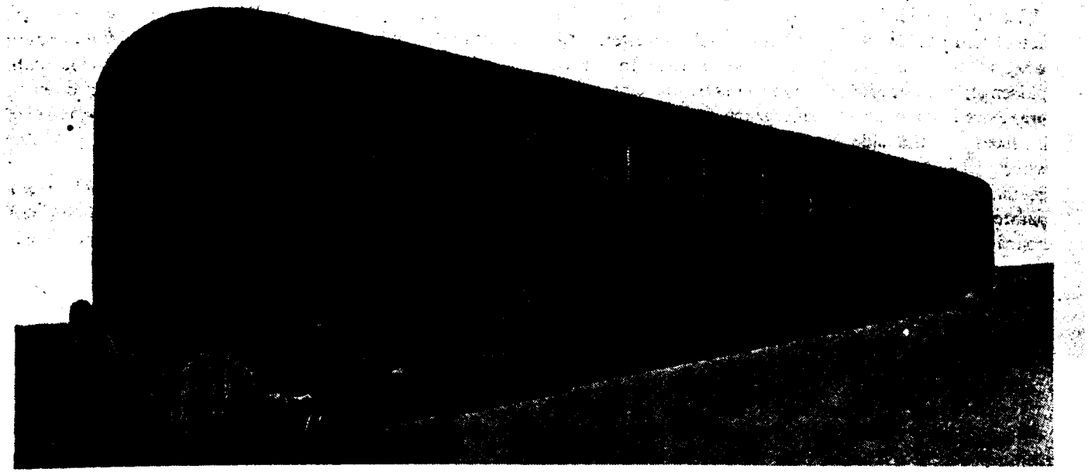
Electric traction was developed on Czechoslovak territory first in municipal transport, as was the case 60 years ago in technically well advanced countries. The development of electrification of the Czechoslovak railways together with development of the production of electric railcars was started only after the war. A direct current system of 3000 V was chosen and the Skoda Works supplied quite a number of locomotives, the first of which were designed in co-operation with foreign industrial concerns. Later on it was possible to dispense with foreign aid. The locomotives are of the Bo' Bo' type, weighing 80 to 84 tons, one hour output 4 × 586 kW, affording a continuous one hour speed of 57 km per hr. and a maximum speed of 120 km per hr., they are of universal type capable of driving both freight and passenger trains.

For the Czechoslovak coal mines and to cover the demand of foreign customers the Skoda Works have developed two types of electric locomotives, the so-called *open pit locomotives*. These locomotives designed for a voltage of 1200 to 1500 V, are of two types: the Bo' Bo', weighing (with additional weight) 100 tons, and the Bo + Bo + Bo, weighing 150 tons. In addition to these open pit locomotives the industry has developed a whole number of industrial locomotives for industrial, mine and forest railway lines, both of steam and motor as well as electric types, of various gauges.

For municipal transport systems both in our country and abroad the Tatra Wagon Factory together with CKD supply modern eight-wheel tramcars using all the advantages of our own experience of sixty years standing as well as results from abroad.

The Czechoslovak industry is studying with great intensity such traction systems on which experts have not yet reached full agreement—as viewed from a world-wide angle. Turbine driven locomotives are one of the examples. The successful design of a turbine driven locomotive makes great demands upon theoretical, constructional and workshop efforts. The Skoda Works intend to develop such a locomotive with an output of 3200 H. P. and—which is rather remarkable—mechanical output transmission. True to their high tradition, by this pioneering work the Skoda Works have again joined the vanguard of progress in the new design of railway traction.

Class Bai Eightwheel Railway Car Type 510



"TATRA" Passenger Coach, of the international 2nd Class type (1950) Weight 34 tons, 80 seats.

Cias Bai eightwheel passenger train car is designed for a maximum speed of 75 miles/hour. It is a light all steel vehicle with two bogies. The interior of the body is divided into two vestibules and two large passenger compartments. In one vestibule the hand brake, W. C. and conductor's room are located, the opposite vestibule includes lavatory and W. C. Side walls and the roof are prolonged over the car heads and make streamlined head extensions. The twin entrance doors, opening outwards, are on both ends of the body. The simple head doors are opening inward. On the heads there are covered gangways.

The underframe is electrically welded of pressed and welded girders, made of steel containing copper. The bogie frame of box shaped cross section is made of steel plates containing copper. Between the yokes and bogie frame there are two double helical springs, and between the body and the frame eight double elliptical laminated springs. The height of the bogie is adjustable by means of inserts between the yokes and axle-boxes. The axle-boxes are provided with roller bearings. Wheels consist of centers and shrunk-on tyres. The draw-gear is of not through-going type, with volute spring, draw hook and screw coupling. Buffers are tubular with equalizer, combined with drawgear. Ram heads of rectangular shape are chamfered and secured against rotation. Buffer shells are welded.

Allmetal car body is electrically welded of steel containing copper. It consists of two side walls, two heads and of roof all welded together and riveted to the underframe. The body frame is composed of posts and horizontal frames to which the sheathing frames are electrically welded. Outside sprayed-on paint of the body is green. The roof frame is composed of rolled steel arches and roof bottom frames to which the covering plates are welded. The floor is of specially corrugated steel plate, containing

copper, welded to the underframe and to the side posts. The corrugated plate is coated with protective paint, then with sound absorbing layer and with rubberoid. Then comes the masonite plate and finally the flooring of pine boards coated with PVC mats. The grooves in the corrugated plate are filled with slag wool or basalt fibres. The floor in W. C. and lavatories is constructed in a similar way but the masonite is covered with galvanised plate and then with glazed ceramic tiles, sloped toward the draining hole.

The compressed air brake is equipped with quick acting triple valve and automatic slack adjuster. All wheels are braked from both sides. In each passenger's compartment two handles of emergency brake are installed. The emergency brake main valve is fixed to the side wall, opposite the handbrake wheel. The handwheel power is transmitted by level gears. The walls are covered inside with treated and painted masonite. The partitions made of block boards are finished in the same way, their lower part up to the roof frame is demountable. Mouldings are of beach or oak wood. The ceilings are vaulted, only W. C. and lavatories the ceiling is flat. The seat frames are of steel tubes, the seats are upholstered and covered with artificial leather.

The luggage nets are made of steel tubes fixed to the ceiling above the seats. Under each window a small table is screwed on. The ventilating slots in the ceiling can be closed by a lever located above the windows. On the roof there are flat exhausters. The vestibules are ventilated through flaps above the doors.

The entrance doors open outwards and are provided with fixed windows, double locks and latches. The head doors opening inward are with fixed windows and standard locks. The doors from vestibules to the conductor's rooms, W. C. and lavatories are without windows, provided with corresponding handles, knobs and fittings. Outside fittings are made of steel and protected with phosphate coating, inside fittings and sheet metal covers are made of polished aluminium alloys.

The frame of passenger compartment windows are metalic, the lower part is fixed, the upper sliding part is operated by a hand cranked mechanism. Conductor's room window upper part is of tilting type. Windows in W. C. and lavatories are fixed, with translucent glass panels and with hit and miss ventilators. The ventilator is provided with an adjustable aluminium grid.

"ISI in the 'India 1958' Exhibition"

'India 1958', the industrial show window of India, has been organized as a national exhibition, the first time by the Union Government ever since the independence, to show to the delegates attending the meetings of International Bank, International Monetary Fund, Rotary International, International Air Transport Association, etc. the industrial progress achieved by India in the last one decade or so. Quite naturally, to portray the part of standards movement in the industrial development and national economy of the country, the ISI has also participated in the exhibition. The exhibition, spread over an area of 120 acres, is by far the biggest ever attempt made by any organisation in India, rather in Asia. The ISI Stall occupies an area of 1350 sq.ft. in M Pavillion (Octagonal Pavillion). The stall brings out the role of standards in the national economy and industrialization; traces the origin and growth of standards movement in India; and outlines the achievement of the ISI in the last one decade in various fields such as engineering, building, textile, chemical, agricultural & food, structural & metals, electrotechnical products, etc.

Admittedly, while the aim of industrialization programme is directed towards the greater production and utilization of country's economic resources, it is vitally important that our products should have stable quality, competitive prices, and good performance, in the interest of home market, consumer satisfaction and foreign exports. This aspect has been brought out in the ISI STALL which depicts ISI's effort in ensuring the quality of goods for home consumption and export markets.

The main emphasis however, is an educating the home consumer, so as to win his confidence in indigenous products, as also to educate and guide him in the recognition and purchase of goods of quality. The stall also bring out the important role played by the ISI for the greater utilization of country's steel resources through its Steel Economy Programme which was launched at the instance of the Planning Commission. Selected specimens of some products, for which Indian Standards have already been formulated or are under active consideration, are also on view in the stall.

Czechoslovak Two-Stroke Diesel Engines of the D 110 Series

THE endeavours towards development in the field of diesel engines are still aimed chiefly towards the designing of light units taking up small space, of relatively high outputs, reliable in operation, requiring only simple servicing and of long operational life. These view-points prevail upon both the general design of the engines and their equipment as well as the detailed constructional design of the engine groups, separate component parts and choice of material. The efforts to simplify the design and reduce the number of component parts become apparent primarily in the case of small engines used by small consumers, since these phenomena reduce the possibility of engine defects, enable easy servicing and maintenance and limit the number of spare parts required.

The above mentioned requirements are best met by the design of the two-stroke, valveless engine, which disposes entirely with the complicated timing mechanism which is generally rather pretentious as far as maintenance is concerned and is the main source of defects. The advantages of this internal combustion system may be increased by application of scavenging of the cylinders through the crank case, which represents today the most simple diesel engine design of all.

Detailed technical-economic analyses carried out in Czechoslovakia and based upon investigations of operational conditions and requirements, statistical data of defects and calculations of manufacturing, operational and maintenance costs, have shown that especially as far as low output are concerned, the simple two stroke engine, both water and air-cooled, has great possibilities in the future, even if at present its research, development and technological mastering is still more exacting than the traditional design of the four-stroke engine with convential timing gear.

The reasons mentioned briefly above have caused the Czechoslovak industry to introduce a new, uniform series of engines of the SKODA and SLAVIA trade-marks, relying upon the manufacturing and development traditions of 50 years standing of the above mentioned factories.

The new standardized series of engines covers a wide range of the most frequently used outputs. These engines, marked "D 110" have a cylinder bore of 110 mm, a stroke of 130 mm, a speed of 1800 or 2200 r. p. m. and their outputs range from 14 to 300 HP. The carefully designed combustion space enables good combustion of fuel in the wide range of loads. The engines are of two-stroke, valveless design produced simultaneously with water and air-cooling. They are listed in the enclosed table, from which the ample scale of outputs in the range of up to 100 HP is apparent.

The single-cylinder engines are provided with scavenging of the cylinders through the crank case and for some types of application they are also designed as horizontal, air-cooled units. Two-cylinder engines are designed with scavenging of the cylinders through the crank case, or, as an alternative, by a volume blower. Water and air-cooling of the engine

Fig. 1. SLAVIA 1 D110 water-cooled, single-cylinder engine.

is applied with units consisting of up to 6 cylinders, while large engines are exclusively water-cooled.

The brief design characteristic of the typical members of the "D 110" series, given below, enables judgement of their universal applicability, simple design, identical design of a great number of component parts and further advantages. The main technical data are listed in the above mentioned table.

All engines are of solid design to withstand heavy duty stationary operation. The main component parts, i. e. the crank-case and cylinders, are, therefore, made of case iron. The rear part of the crank case forms simultaneously the flywheel cover, so that driven machines can be coupled directly to its flange, the complete set thus forming a compact rigid unit. The cylinder heads are of independent design and made of aluminium alloy with good thermal conductivity. The pistons of the engines are cast of special silico-aluminium alloy with low thermal dilation, which are considerably advantageous from the operational point of view. Filtration of oil and fuel is carried out by modern coarse and fine filters which guarantee safety operation, even under difficult conditions. For operation in dusty environments (e. g. in stone quarried or in fields), the engines are fitted with efficient air cleaners with an oil bath which separate the dust from the air and increase considerably the operational life of the engine.

The SLAVIA 1 D 110 single-cylinder engine (Fig. 1) with crank case scavenging is water-cooled. The crank case of the engine is divided in the vertical plane in two halves to enable assembly of the crank mechanism. The crankshaft, mounted in anti-friction roller bearings, is of compound design with the crank pin inserted into split and clamped throws so that it can be easily dismounted. The forged connecting rod is mounted also at both ends in anti-friction roller bearings to ensure easy lubrication and reduction of

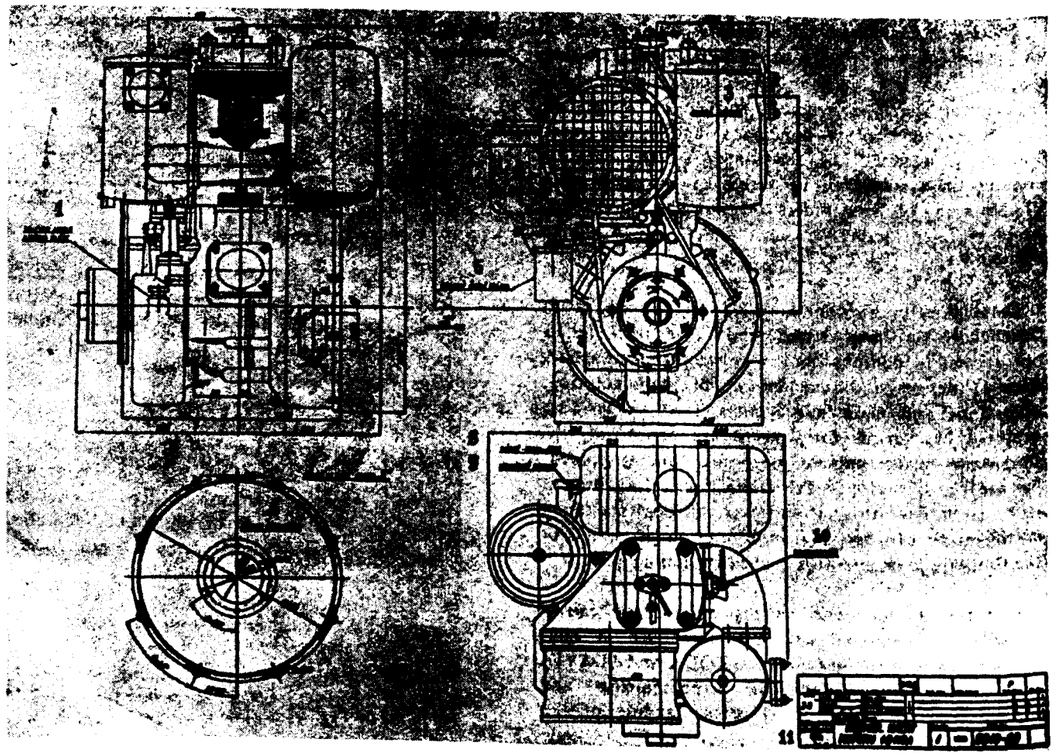


Fig. 2. Dimensional diagram of the SLAVIA 1 D 110A air-cooled engine.

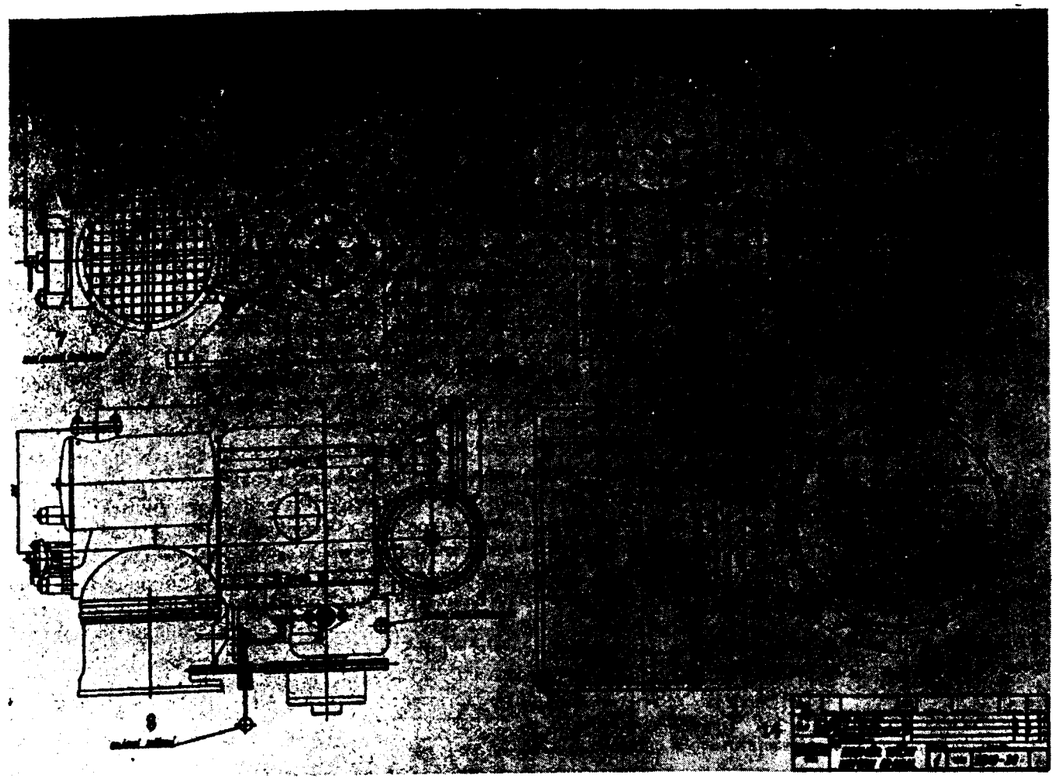


Fig. 3. Dimensional diagram of the SLAVIA 1 D 110 AL air-cooled, horizontal, single-cylinder engine.

mechanical losses. The flywheel of the engine is mounted on the tapered end of the crankshaft. The belt-pulley or coupling of the driven machine can be directly coupled to the flange of the flywheel. The front end of the crankshaft serves all the subsidiary drives. The fuel injection pump is situated on the front cover and controlled by a cam mounted on the crankshaft. The speed governor of the engine is enclosed in the front belt-pulley. The only geared transmission in the engine is the worm drive of the lubrication press, which is double-spaced for lubrication of both the crankshaft and the cylinder. The cylinder head is fitted with a decompression valve to enable hand starting of the engine. For starting at low temperatures the cylinder head is also fitted with a glow plug, which is also fitted to electrically started engines and is employed for pre-heating of the engine.

In addition to the 1 D 110 water-cooled engine the SLAVIA 1 D 110 A single-cylinder engine (Fig. 2) has been designed with air-cooling in which part of the output is consumed for the drive of the cooling fan, as is apparent from the table. To ensure good cooling the cylinder head and cylinder of these engines are webbed and these parts, including the cooling equipment, can be easily replaced, even on the customer's premises, by component parts and equipment for water-cooling, since 90% of all component parts of both engines are identical. The engines are cooled by a fan, driven from the front belt-pulley, and the cooling-air is conducted from the fan through a suitably chosen bonnet.

Another air-cooled single-cylinder engine. The SLAVIA D 110 AL (Fig. 3) with the same output is of horizontal design, 96% of its component parts being identical to the previously mentioned engine. This modification of the engine can meet also the special requirements of such sets where there is not sufficient height for setting up of a vertical engine.

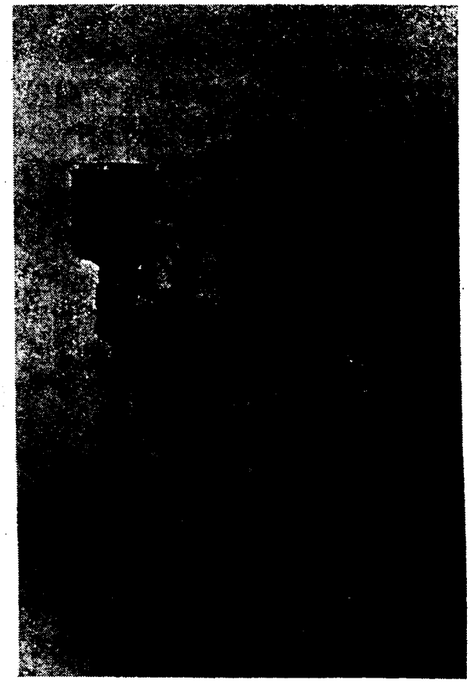


Fig. 4. SKODA 3 D 110 Water-cooled, three-cylinder engine with blower scavenged cylinders.

Of the multiple-cylinder line engine the SKODA 3 D 110 three-cylinder engine (Fig. 4) and the SKODA 4 D 110 four-cylinder engine, belong to the "D 110" series, being water-cooled and employing volume blowers for scavenging of the cylinders. The crank cases of both engines are designed in one part with the crankshaft suspended in slide bearings. The crank case is closed on the bottom by an aluminium sump which is used simultaneously as an oil tank. The crankshaft is forged in one piece with rotary counter-weights, employed for relieving the main bearing, and is provided with a flange for securing the flywheel. To increase the operational life, all crank-shaft pins are surface hardened. The pressed connecting rods are made of two parts with engaging teeth in the dividing joint, which guarantees high rigidity of the big end bearing, security of the connecting rod bolts and enables also the simplest assembly of the piston and connecting rod through the cylinder. All drives of the subsidiary mechanisms of the engine are carried out by gear wheels mounted on the front part of the engine, the drive of the centrifugal water cooling pump and the dynamo (with engines with electric starting) being carried out by means of V-belts. The modern speed governor with hand adjusting is of the hydraulic type and is connected directly to the block fuel injection pump. The force-feed oil lubrication system of the engine is fitted with an oil cooler. Air-cooled three-cylinder engines of the SKODA 3 D 110 A type and four-cylinder engines of the SKODA 4 D 110 A type (Fig. 5) are fitted with an efficient fan to enable good cooling of the engine, a suitably designed bonnet and carefully designed cooling of the rear part of the cylinder to which fresh air is fed through special channels in the cylinder head.

A typical example of engines with V-type designed cylinders is the SKODA 6 D 110 water-cooled six-cylinder engine (Fig. 6). The V-type design enables attaining of a small size and low weight with multiple-cylinder engines. A turbo-compressor, enclosed in the cover of the rear drives and driven by gear wheels over a centrifugal coupling from the rear end of the crankshaft, is used for filling the cylinders with air. The compressor forms an independent unit which can be removed without disassembling the flywheel. The collecting manifold behind the blade diffuser is formed by a centered ring with a constant velocity of the air stream. The right and left hand side halves of the ring form ports which are connected to the manifolds

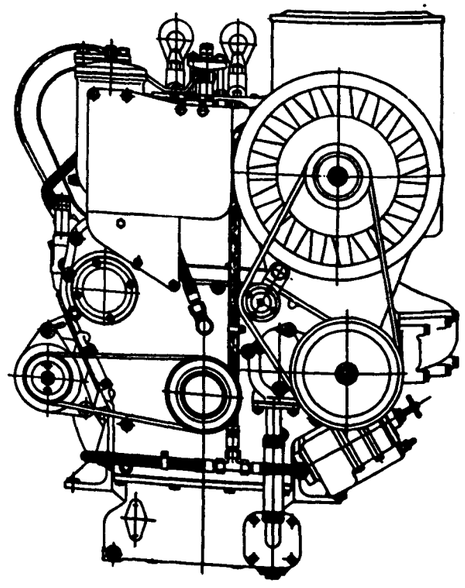


Fig. 5. A front view of a SKODA 4 D 110A air-cooled, four-cylinder engine.

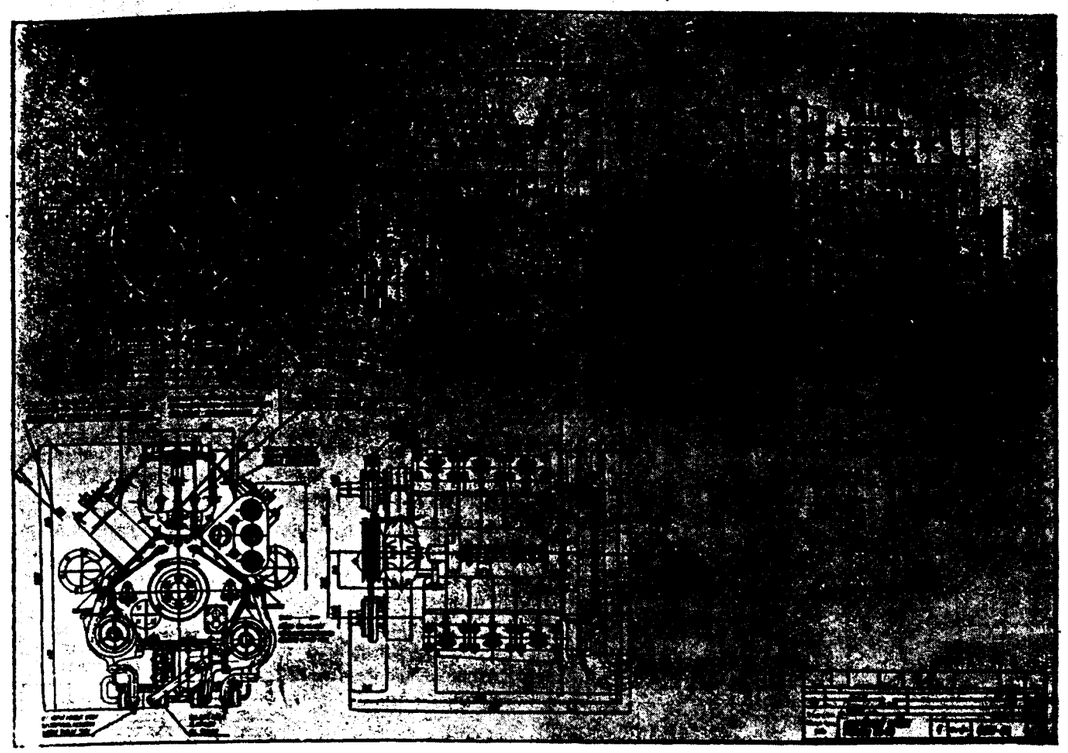


Fig. 6. Dimensional diagram of SKODA 6 D 110 water-cooled six-cylinder engine, with V-type cylinder design.

of the right and left hand side of the crank case through which air is fed to the separate cylinders. The front drives are employed for driving the centrifugal water pumps, the oil pump, the air distributor and the dynamo. The rear drives drive the filling blower, the fuel injection pump, the feed pump and the speedometer. All gear wheels are mounted in anti-friction roller bearings. The engines are adjusted for marine propulsion, since they can be equipped with two centrifugal water pumps (one for cooling the engine and the other for auxiliary pumping operations). After slight adaption (employing intermediate gears) in the timing system and different coupling of the injection pipes the engines can be used for clockwise or anti-clockwise rotation, or after changing the dash-board as right or left hand side engines, which is of great advantage in marine propulsion by more than one unit simultaneously, situated in a common engine room.

Due to their universal design engines of the "D 110" series can be used for widely varied purposes, some of which have already been mentioned. Among these are included primarily the drive of electric generators for lighting residential buildings as well as agricultural units, or for the production of electric power for industrial purposes. Adequate smoothness of the engine run guarantees a supply of good quality electric current without fluctuations. Further they are used to drive compressors, water pumps, building machines such as concrete mixers, excavators, mobile belt conveyors, road rollers, etc. In agriculture these engines are suitable for driving tractors, harvesting combines, threshing machines and other agricultural machines; they can also be used for mine, shunting and passenger train locomotives. In marine propulsion they can be used for passenger and freight ships, tug boats, suction dredgers, etc.

The "D 110" SKODA and SLAVIA engines are at present the only series of two-stroke diesel engines

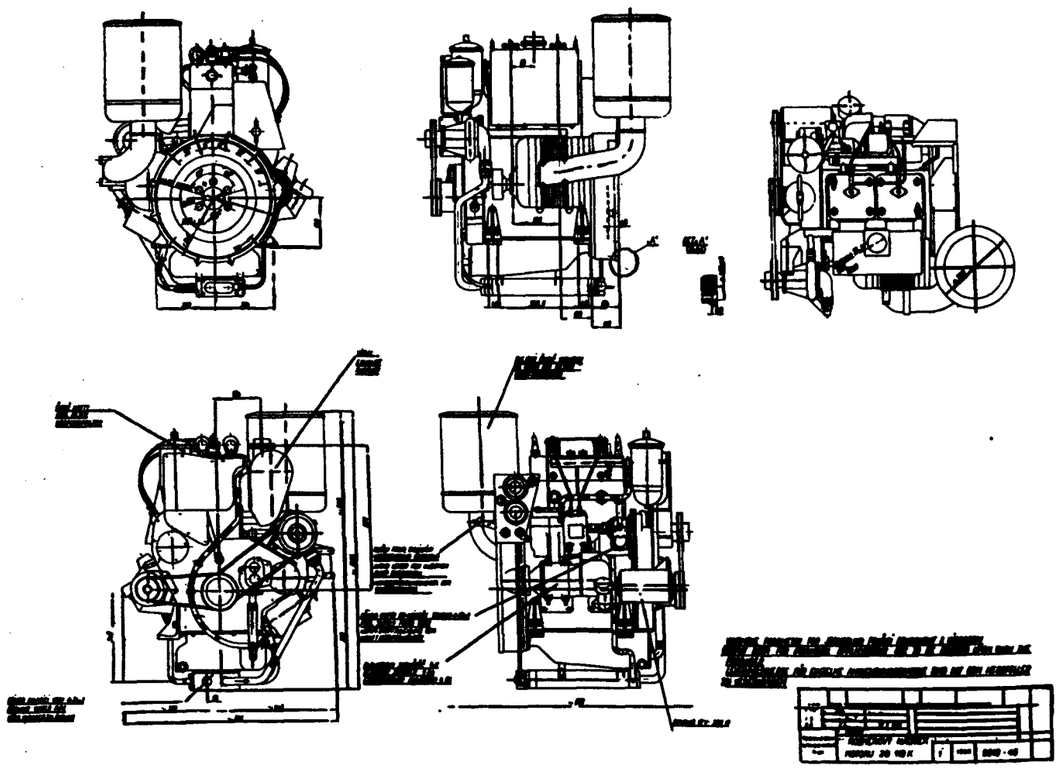


Fig. 7. Dimensional diagram of SKODA 2 D 110 K water-cooled, two-cylinder engine, with blower scavenged cylinders.

in the world designed in such wide range and, in addition, with alternative water and air-cooling, satisfying even the most pretention customers with their wide choice of different designs, simplicity as well as high quality. Thus the Czechoslovak Engineering factories again hold a leading pioneering position in the field of diesel engine in which they developed previously the remarkable TATRA air-cooled, four-stroke engines, well known in many countries abroad for their unique performance.

Czechoslovak Two-stroke Diesel Engines of the "D 110" Series.

Type of Engine.	Number of cylinders	Continuous output HP.	Speed r. p. m.	Mean piston speed m. p. s.
1. 1 D 110	1	14	1500	6.5
		16	1800	7.8
2. 1 D 110 A	1	13	1500	6.5
		15	1800	7.8
3. 1 D 110 AL	1 H	13	1500	6.5
		15	1800	7.8
4. 2 D 110	2	28	1500	6.5
		32	1800	7.8
5. 2 D 110 A	2	26	1500	6.5
		30	1800	7.8
6. 2 D 110 K	2	36	1500	6.5
		45	1800	7.8
		50+	2200	9.55
7. 2 D 110 AK	2	34	1500	6.5
		40	1800	7.8
8. 3 D 110	3	54	1500	6.5
		65	1800	7.8
		75+	2200	9.55
9. 3 D 110 A	3	50	1500	6.5
		60	1800	7.8
10. 4 D 110	4	72	1500	6.5
		86	1800	7.8
		100+	2200	9.55
11. 4 D 110 A	4	68	1500	6.5
		80	1800	7.8
12. 6 D 110	6 V	108	1500	6.5
		130	1800	7.8
		150+	2200	9.55
13. 6 D 110 A	6 V	100	1500	6.5
		120	1800	7.8
14. 8 D 110	8 V	145	1500	6.5
		172	1800	7.8
		200+	2200	9.55
15. 12 D 110	12 V	215	1500	6.5
		260	1800	7.8
		300	2200	9.55

+ continuous outputs for 12 hours of continuous operation with a possibility of 10% overloading for one hour are listed in the table. The outputs marked with a cross are the maximum ones.

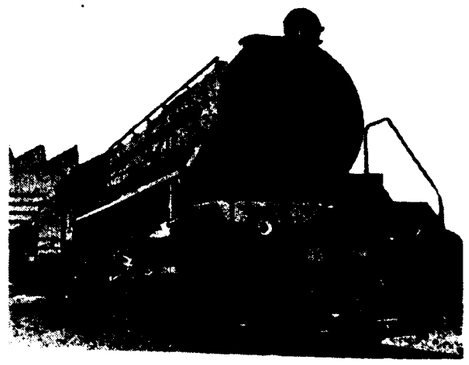
Czechoslovak two-stroke Diesel Engines of the "D 110" Series.

Type of Engine	Mean Useful Pressure.	Weight of Engine.	Specific-Weight of Engine.	Cooling.
	kg/sq. cm.	kgs.	kgs/HP.	
1. 1 D 110	3.41	205	14. 6	By Water.
	3.24		12. 8	
2. 1 D 110 A	3.16	210	16. 2	By Air.
	3.04		14.	
3. 1 D 110 AL	3.16	230	17. 7	By Air.
	3.04		15. 3	
4. 2 D 110	3.41			By Water.
	3.24			
5. 2 D 110 A	3.16			By Air.
	3:04			
6. 2 D 110 K	4.36	400	11. 1	By Water.
	4.36		9. 3	
	4.14		8.	
7. 2 D 110 AK	4.05	400	11. 7	By Air.
	4.05		10.	
8. 3 D 110	4.36	445	8.25	By Water.
	4.36		6.85	
	4.14		5. 9	
9. 3 D 110 A	4.05	470	9. 4	By Air.
	4.05		7.84	
10. 4 D 110	4.36	500	6.95	By Water.
	4.36		5.81	
	4.14		5.	
11. 4 D 110 A	4.05	520	7. 7	By Air.
	4.05		6. 5	
12. 6 D 110	4.36	720	6.66	By Water.
	4.36		5.54	
	4.14		4. 8	
13. 6 D 110 A	4.05			By Air.
	4.05			
14. 8 D 110	4.36			By Water.
	4.36			
	4.14			
15. 12 D 110	4.36			By Water.
	4.36			
	4.14			

Manufacture of One-piece Steel Castings for Railways

By A Special Correspondent

THE methods of casting that General Steel Castings Corporation, Granite City, Illinois, U. S. A. employs in the production of one-piece steel castings are extraordinarily complex and interesting. General Steel, a major producer of steel castings for railways and industry, has pioneered many new processes, and among the most important is the sand core-metal form method of casting the Commonwealth one-piece steel locomotive bed now in use by the Indian Government Railways. In order to outline this procedure and to gain an understanding of how the unique bed is made, let us follow the entire operation from design to delivery in a brief description.



The WG 2–8–2 Indian Government Railways locomotive featuring the one-piece cast steel "Commonwealth" locomotive bed manufactured by General Steel Castings Corporation, Granite City, Illinois, U.S.A.

When designs for a locomotive bed are being prepared by the engineering department of General Steel for the foundry, the manufacturing engineer and the foundry superintendent consider the designs from the standpoint of castability and machinability. So right from the start, the various departments must work closely together, with the understanding of long experience.

The first step in transferring the beds from blue prints to metal is the making of full size layouts. At General Steel these are made on a special cloth-backed paper treated to reduce dimensional variation. As the design of the casting emerges in full size on the layout, the manufacturing engineer and foundry superintendent study it closely to anticipate and prevent manufacturing problems. Since the layout includes the design of the metal form in which the casting will be poured, every aspect of the casting process is drawn in and studied in relation to all other aspects. The gateing system—in a large, intricate casting like this, one of the most important aspects of foundry practice—is planned. It runs approximately two thirds the length of the bed, and each gate must be placed and each gate opening sized so that the entire bed can be poured in one quick operation. The riser system is planned to insure proper solidification of metal in the casting and both open and blind risers are employed.

In a casting over 35 feet long and with metal section varying from 5/8 inch to 3½ inches in the most complex shapes, shrinkage to be calculated becomes a matter of the utmost delicacy. Experience has taught the General Steel foundrymen how to incorporate in their layout the necessary allowances for both rate and extent of shrinkage to insure a sound, dimensionally accurate finished casting.

The layout also includes the addition of the necessary amounts of back-up metal for surfaces to be machined, and the system of chills used in the mold to help control the rate of cooling of the metal.

The metal form itself is designed to reduce the number of cores needed to shape the casting. With over 400 cores used to cast a locomotive bed, it is important to the efficiency of the entire operation that the form follow as closely as possible the shape of the casting.

After the layout drawings have received final approval, with all adjustments made and agreed upon, heavy fibreboard templates are made from them and turned over to the patternmakers for construction of the hundreds of core boxes needed for the cores to shape the casting. Core design also includes placement of steel reinforcing rods, hooks for handling, and vents for gas escape. Dimensional accuracy and precise conformity to layouts are essential here.

A WG 2–8–2 locomotive shown under construction in the Chittaranjan Works with the Commonwealth cast steel locomotive bed being readied for application of the locomotive body. The one-piece unit construction of the bed may be seen which eliminates the need for welded, bolted or riveted connections, and provides trouble-free operation throughout its long life.

The next step after the core boxes are constructed is the making of the cores themselves. In all casting operations, of course, the quality and the formula of the sand mix used are of great importance. But as we have seen with the layout and mold, when dealing with a casting of this size and complexity, the need for precision and control are greatly increased. This is also true of the sand mix. At least six different sand formulas are employed in making cores for different parts of the beds. These formulas have been evolved over many years and continually subjected to test and experimentation to improve them. Each is determined by the specific requirements to be met in its part of the casting. Some cores need a high degree of resistance to penetration and erosion, and special and mixtures are called for. Others, for places in the mold that will fill what are to become box sections in the finished casting, must provide minimum expansion and maximum collapsibility, and may require the addition of cellulose material to the sand formula.

General Steel Technicians are alert to new developments in the use of sand, and in fact have originated many of them. Over the years, resin has replaced oil as a bonding agent in many formulas, volcanic ash has replaced clay for some purposes, and other new ingredients have been added. Zirconium silicate, originally imported from Australia but now produced in Florida, has been found to be a valuable addition to the formulas for some locomotive bed cores. And throughout, quality control must be rigidly maintained. The most precise formula worked out by the most able technician in the best equipped sand lab is of little value unless the sand mill system can reproduce the formula exactly in production quantities as an economical part of the foundry operation.

The three principal methods of core making used at General Steel are the pneumatic hand rammer, the mechanical jolter and the core-blower. All are employed on cores for locomotive beds, depending on the size and shape of the cores to be made. The cores are then washed with various solutions to insure a proper face to form the molten metal, and then baked. Core ovens operate at 425 degrees F. Smaller cores require baking for about four hours, larger cores may take as much as 20 hours in the oven to insure proper strength.

The task of setting the cores in the mold—a crucial operation in General Steel's process of casting locomotive beds—resembles somewhat the assembling of a three dimensional jigsaw puzzle. Eight highly skilled core-setters and their assistants spend a total of about 28 hours in setting the cores, under the close scrutiny of a process checker who is responsible for the dimensional accuracy of the mold. Each core, some weighing hundreds of pounds, some only a few inches in size, is carefully fitted onto its proper place in the form and set. Where the metal is to flow the cores are separated by metal spools or chaplets, the melting point of which is high enough above that of the poured steel to permit the free flowing of the metal, and low enough so that there will be fusion between chaplets and the parent metal after the casting has cooled.

Finally, the mold is ready to be poured. Cover cores are in place, the entire mold securely clamped down to resist any movement or tendency of the cores to float due to the pressure of steel as it rises in the mold. Metal has been prepared in a basic open hearth furnace according to the formula for Commonwealth steel and tapped into the ladle.

The entire mold is poured in one operation which takes only about two minutes. The pouring weight of the Indian Railways W. G. 2—8—2 class locomotive bed is about 72,200 pounds, all of which is poured into a single downgate and distributed in a main runner at the bottom of the mold from which it rises through the different openings between the cores to form the shape of the bed.

This is the "eating" which proves the pudding If all the work that has gone before has been done well and truly, in two minutes of pouring a locomotive bed will be formed in molten steel. If the layout has been right, shrinkage will be allowed for, and metal distribution controlled correctly. If the cores have been made to the proper formula and baked hard enough to present a smooth surface to the metal and not fuse under the 2840 degree F. pouring temperature required for these castings, the metal will fill every open part of the mold evenly and solidly.

After pouring, the casting cools in the mold for 12 hours. It is then pulled from the mold, cooled on the floor for 16 hours and put into the shake-out to remove loose sand. Inner cores are roughed out, the casting received its first cleaning and risers and gates are removed. Cleaning and finishing processes at this stage, in addition to shot blasting in two steps to remove sand and scale, also includes heat treating for normalization at 1650 degrees F., and removal of fins and riser stubs by burning. The casting is ground to the metal line, and a preliminary layout check for dimensional accuracy is made.

After re-blasting with shot, the casting is again checked for dimensional accuracy and layed out for machining.

The major machining operations performed, aside from small miscellaneous operations, are the boring of valves and cylinders and the cutting of pedestal openings. Special machines have been designed by General Steel to perform these operations on castings of this size, and great care is taken to preserve dimensional accuracy through all stages.

Before final inspection is made, cylinders are water tested at two and one half times operating pressure and re-tested after final boring and then sealed. The final inspection takes two trained men eight hours, after which the beds are weighed, painted and crated ready for shipment.

This account of the casting process involved in the production of General Steel locomotive beds makes clear the need for close co-operation and teamwork at each step in the process. No one step is more important or significant to the success of the finished product than any other. There are no rules that can be simply abstracted from this process and set down as a guide to foundrymen. It has taken years of experience and great patience as well as a high order of intelligence and manufacturing skill to bring this process to maturity, to the point where General Steel's castings are in use in 54 countries throughout the world. The only way to learn to cast a locomotive bed in one piece of steel was to have the daring and the persistence to do it—and then do it again, until it became a continuing part of the basic daily production of this unique foundry.

BHILAI STEEL PLANT

Prime Minister Nehru said that the Bhilai steel plant was expected to be completed on scheduled (by the end of the year) but if the schedule was passed, it might be by a month or so—not much.

Mr. Nehru who was replying to a question at his Press conference about a recent communication from the Soviet Premier, Mr. Khrushchev, on the progress of the plant, said certain delays had occurred but Government would keep to the schedule. "We hope we will keep to the schedule. But if it is passed, it may be by a month or so and not much."

The Prime Minister said that the Soviet Ambassador to India, on his return here some weeks ago from the Soviet Union, brought a letter from Mr. Khrushchev to him regarding the Bhilai steel plant. Mr. Khrushchev had expressed the hope that there would be no delay in the plant's completion on time. "We, of course, are very anxious that there should be no delay."

Mr. Nehru said that some delay had occurred because of two or three reasons. One contractor did not come up to expectations and delayed matters. There was some delay at the ports. Then there was the big question of trained personnel for the steel plants. These trained men were needed in thousands for the three new steel plants and one old one whose capacity had been doubled. All this work had absorbed all the welders and other trained people in this work. India was sending a number of people to the Soviet Union for training and technicians were coming here from the Soviet Union.

The Development of Automatic Couplers for Rolling Stock

As manufactured by English Steel Castings Corporation Ltd., Sheffield, England

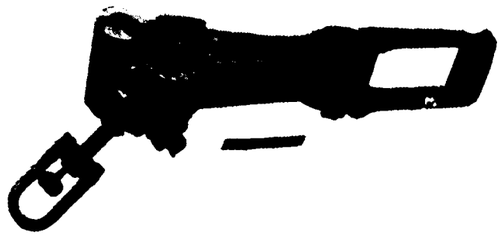
WHILST there are various types of Automatic Couplers in service today, when railway engineers talk about Automatic Couplers they invariably mean the knuckle type of coupler which is in use in the United States of America and a great many other countries in all parts of the world. The knuckle type couplers have proved so successful on railroad operations that where couplers have been adopted as standard that type has been almost universally applied.

The history of automatic couplers dates from 1863 when an American by the name of Miller brought out the first design It consisted of a rigid hook held in place by springs and attached to a long shank. This was improved upon in 1873 when a Major Janney patented another design i. e. the forerunner of the knuckle type coupler, which prevented side engagement, a fault of the Miller coupler, and from this development came the automatic coupler as we know it today.

A. A. R. "F" type Interlocking coupler with M. F. 400–1 rubber draftgear

After Janney's design was put into service, numerous other American engineers started to work individually, with the result that at one time over a hundred different types of coupler, all closely following Janney's idea, were in service on American railroads.

With such a variety of designs, the problem of stocking spares became colossal, and consequently, in 1911, the Convention of the Master Car Builders' Association instructed its Standards Committee to design what was to be known as the Standard M. C. B. Coupler. After considerable experiment this development was finalised in 1918, and the Type "D" Standard Coupler was put into operation on all the A. A. R. (Association of American Railroads) railroads.

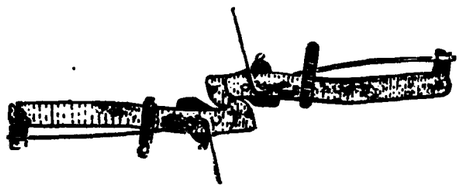


"Standard Alliance" Coupler with clevis transition and vertical plane swivel yoke

As train sizes increased, however, it was found that this, whilst being vastly superior to the previous proprietary designs, still had certain faults, and a further design, A. A. R. Type "E", was devised, which very largely coped with the new requirements. A further modification in the A. A. R. range (Type "F") has since been introduced for particularly arduous conditions and this was approved in 1953. This coupler whilst it is still able to intercouple with the A. A. R. Type "E", cannot be disengaged vertically because of aligning wings which intercouple with others on either side of the coupler head.

Whilst these developments were taking place, various manufacturers were working on lighter models for service in other parts of the world, which did not require the strength of the A. A. R. couplers. Notable amongst these were the "Alliance", the "Sharon", the "XE" and, recently, the "National A. P.", the last and the "Alliance" incorporating all the design features of the A. A. R. Types; namely, strength, ease of operation and safety.

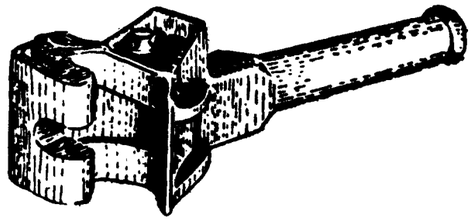
But at the same time as these types were being developed, train weights were also increasing and this necessitated the design of improved draftgear. Changing from the original coil and laminated spring types, these have progressed through friction gears to rubber draftgears. Numerous designs are now giving excellent service, as they provide better riding qualities and protection to underframes, as well as having a long life with need for little attention in service.



Miller Draw Hook—1863

The advantages of automatic couplers over other types include greater strength and safety, maximum life and simplicity of operation with minimum maintenance. Further, it is not necessary for a man to go between the cars to make the coupling between vehicles, and they help to keep wagons or carriages on the lines when they might otherwise be derailed in collision. E. S. C. automatic couplers can be fitted to all types of cars, and can be used to replace old types on existing stock.

Although the history of automatic couplers began in America in the middle of the last century, and



Janney

although English Steel Castings Corporation, Ltd., Sheffield, England, has only been engaged on their manufacture for the past thirty years, the Corporation now claims to have more experience of coupler design and application than any other single organisation and is the biggest manufacturer of these components in the world outside America. Over a quarter of a million E. S. C. automatic couplers are now in service on railway rolling stock in all parts of the world, and the Corporation has proposed designs of standard forms of couplers suitable for use in and for manufacture in India and other countries, particularly in the British Commonwealth.

English Steel Castings Corporation Ltd., Sheffield, are also manufacturers of cast steel bogies and side frames and bolsters for the railway industry, whilst two other wholly owned subsidiary companies of the E. S. C. Group, English Steel Spring Corporation Ltd., and English Steel Forge and Engineering Corporation Ltd., supply, respectively, coil and laminated springs and locomotive frame parts, crank and straight axles.

Hungarian-Iraqi Co-operation

The possibility of closer co-operation between Hungary and Iraq was spoken about by Mr. S. K. Tewfik, managing director of Iraq's railways, during a recent visit to Budapest.

Accompanied by Mr. R. E. Haddid, chief engineer, he visited various railway installations and factories, including the Gyor carriage building works and suggested that Hungarian engineers and technical experts could be of great assistance to Iraq not only in the field of railway transport but also in the field of wagon building and in the construction of housing estates for railway workers.

The Iraqi visitors hoped that it would be possible for their own railway technicians to come to Hungary to study transport problems and said that Hungarian economic experts and engineers would certainly be welcome in Iraq. The changeover from steam locomotion to diesel engines was part of Iraqi long-term policy. In this field Hungary was ahead and could be of great assistance.

Mr. Tewfik declared that the development of close economic relations would be of the greatest benefit to both countries.

* * *

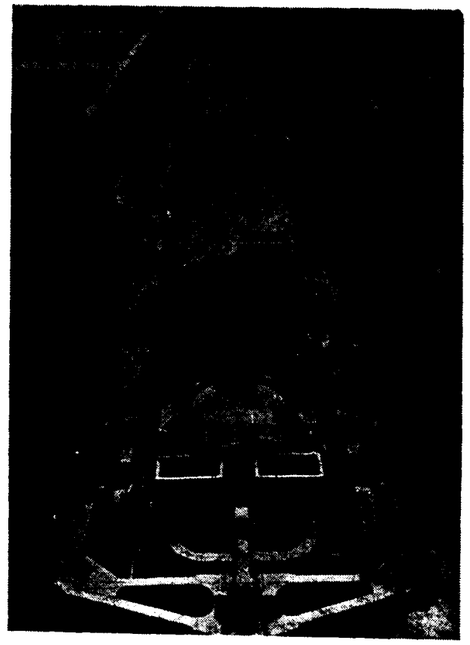
Czechoslovak Engines for Rail Traction Vehicles

By

***Miroslav Zapletal**, Dipl. Eng. and **Jaroslav Trnka**, Dipl. Eng.*

THE importance of oil engines for rail transport has been appreciated already in the thirties although the prices of liquid fuels were relatively high as compared with steam generated energy and presented a serious obstacle for the development of motoring in general. A new impetus was given to this development after World War II when a new price policy combined with an entirely different approach to the energetic aspect of the problem created favourable conditions for the building of railcars and Diesel locomotives. As a result of the new economic policy adopted by the Czechoslovak engineering industry in the post-war years the oil engine industry has been reorganized and numerous old and scattered plants have been abolished to give place to a few specialized plants responsible for the development of oil engines. Engines of the smallest unit range have been derived

12 V 170 DR engine with natural suction and an output of 450 H.P.



12 V 170 DR engine in the railcar bogie.

from automobile engines similarly as in other countries in the world; great popularity have attained especially air-cooled Tatra engines which find extensive use with light branch line railcars. The CKD-Sokolovo Works, Nat. Corp. have been entrusted with the manufacture of special rail engines. In order to satisfy the transport requirements of the early post-war years two units of an entirely new design have been developed for larger motor cars and locomotives at these works, evolved into series and improved in association with the Oil Engine Research Institute so as to meet the highest world standards.

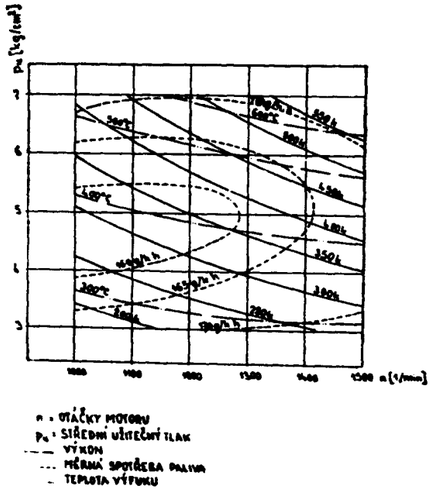
For medium performances oil engines of the "V 170" series have been designed. These engines are modern in design, low in weight per unit of output with cylinders arranged in V. Due to their low space requirements they are built-in to railcar

bogies or employed for the drive of locomotives, being suitable for both electric and hydraulic power transmission. These engines are of various parameters, of the conventional type provided with turbo-blowers, and cover an output range of from 300 to 1000 HP. The extremely smooth operation which is a special feature of these engines, is due to the absence of torsional vibration elements of some importance throughout their whole speed range.

The engines of this series are of the water-cooled four-stroke type with a 170 mm bore and 190 mm stroke. If used for rail traction they develop a speed of up to 1400 r. p. m.

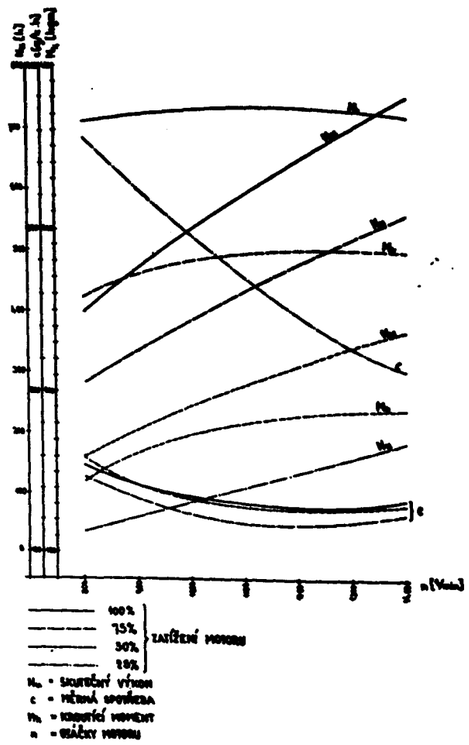
The main part of the engine consists of a thin-walled cast-iron case on which cylinder blocks and liners are mounted. The bottom of the crank-case forms as aluminium sump which is somewhat deeper at the flywheel side where oil accumulates and the oil pump with oil filters is accommodated.

A six-throuw crankshaft of special chrome-nickel alloy steel forging is mounted in the crankcase. The connecting rod and crank pins are surface flame hardened. A two-sectional gear of the timing gear



Characteristic of 12 V 170 DR engine with an output of 450 H.P. at 1400 r.p.m.

n = speed
Pu = mean useful pressure
— output
--- fuel consumption per unit of output
—·· exhaust temperature



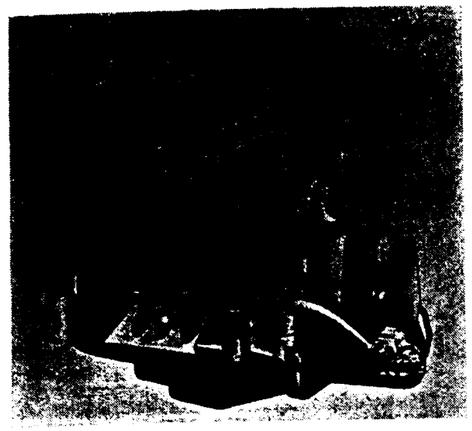
Characteristic of K 12 V 170 DR engine with high-pressure turbo-blower and an output of 750 H.P. at 1400 r.p.m.

——— 100%
— — — 75% engine
---------- 50% load
— . — . 25%

Nu = effective output
c = fuel consumption per unit of output
Mk = torque
n = speed

drive is fitted to the shaft end close to the flywheel. The shaft is mounted in six main bearings and one guide bearing with a steel bushing lined with lead bronze. Both ends of the crankshaft pass into a flange with the flywheel at one end the auxiliary power take off at the other end.

The cylinder heads are made of cast-iron and independent for each cylinder. The timing gear arrangement is of the four valve design with two suction and two exhaust valves which are identical



6 S 310 DR with natural suction and an output of 750 H.P.

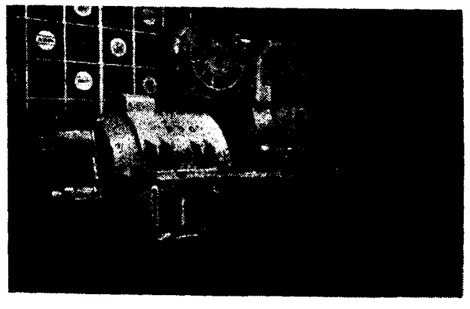
is size and made of fireproof anticorrosion steel. In the centre of the head is a nozzle with eight ports of the opening pressure of which has been set to 220 atm. Located on the top of the head is the respective rocker drive of the valves. The heads of one and the same line are provided with a common aluminium cover.

The piston of the engine is a silicon-aluminium alloy casting with Hesselman type combustion space in the bottom. There are four sealing and two scraped rings on the piston. The crank pin is made of carburized steel and secured by two locking rings. The connection rod consists of the main part to which the auxiliary connecting rod is fitted. Both connecting rods are special steel forgings. Lead bronze bushings are pressed in the connecting rod small end bearing and a tinwalled steel pan lined with lead bronze is in the connecting rod end. The camshaft with the respective valve tappets and rods is mounted between the two lines of cylinders. The block type injection pumps are located on brackets above the flywheel. In the centre between them is the governor of CKD factory own special design. It serves as a hydraulic multiplicator while the travel of the multiplicator piston slide is controlled by a small centrifugal governor. The advantage of this system consists in that the pressure oil for the multiplicator is taken from the lubrication circuit of the engine so that the engine is automatically stopped when the oil pressure drops below 1 atm. The governor can be operated manually, electro-pneumatically or by electric power.

The engine can be started directly by means of generator as is the case with Diesel-electric traction vehicles, or two starter motors with an output of 15 H. P. at a voltage of 24 volts. The engine is provided with a hand—or electric power-operated lubricating pump by means of which the lubricating circuit of the engine is filled before the engine is started.

The basic type of the "V 170" series is the twelve-cylinder engine with natural suction, a permanent output of 450 H. P. at 1400 r. p. m., a fuel cunsumption of 170 grammes/H. P./hr. and lubricating oil consumption of 3 grammes/H. P./hr. The mean effective pressure is 5.61 atm., the compression pressure 43 atm. and the combustion pressure 73 atm. The swept volume of this engine is 51.8 litres at a weight of 2430 kg. This engine is also produced with two turbo-blowers of a low pressure with a permanent output of 650 H. P. at 1400 r. p. m., and a fuel consumption of 165 grammes/H. P./hr. The outputs of 750 H. P. engines equipped with high-pressure turbo-blowers but without intermediate air cooling complies with UIC Standards. The engine is 2900 kilos in weight. For higher outputs intermediate air cooling is required. The eight-cylinder engine with an output of 300 H. P. at 1400 r. p. m. and a weight of 2050 kg has been derived from this basic series; a sixteen-cylinder unit with an output of 1000 H. P. is in the stage of development.

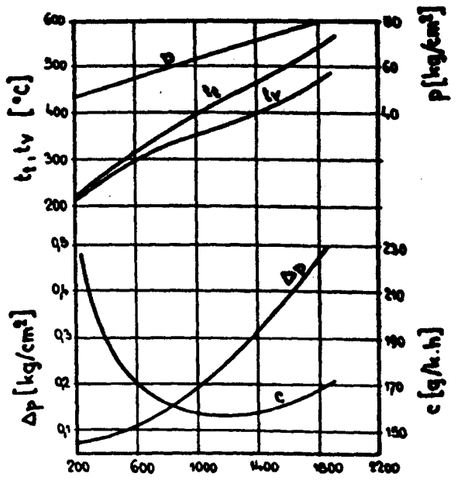
The second series of oil engines has been designed for higher outputs and especially for use with locomotives. For locomotives where the weight of the engine forms an integral part of the useful adhesion weight and where easy accessibility and a long service life of all parts are especially required even at varying loads, engines of a compact design, higher cylinder



K 8 S 310 DR engine with turbo-blower and an output of 1650 HP.

diameters and a lower speed are employed which ensure a higher reliability in heavy duty service as compared with engines of a smaller type.

For this range of application a series of four stroke "310" oil engines has been developed by the CKD Works with direct fuel injection, a bore of 310 mm, stroke of 360 mm and a rated speed of 750 r. p. m. The ratings of these engines are illustrated in the chart. They are produced with natural suction or supercharging by means of exhaust gas turbo-blowers. The engines form an integral Diesel generating set if combined with the d. c. generator of our own manufacture. The whole crankcase is welded from plates and steel castings which have been suitably combined so as to ensure low weight and adequate rigidity. The crankcase bottom forms an oil sump simultaneously and serves for fitting both the generator and the set to the locomotive frame. Provided in the crankcase is also the crankshaft with counterweights which is mounted in three-alloy metal plain bearings. The bearing caps are held by spacer bolts leaning against the top of the crankcase. The connecting rod is an alloy steel die forging. The piston in the bottom (on supercharged engines cooled with sprayed oil from the connecting rod) of which the well-proved Hesselman combustion space is provided, as an eutectic silicon-aluminium alloy. The cylinder liners which have been cast centrifugally from a special alloy, are highly wear resistant. The tangential inlet port of the cast-iron cylinder heads ensures an intensive and controlled air movement in the combustion space at the compression and the working stroke. The cylinder heads are attached to the top of the crankcase by means of five bolts, and provided with two inlet and two outlet valves simultaneously controlled by rocker arms of a special design. All heads are provided with separate covers. The designers have spared no effort to ensure easy access to all parts and prevent, as far as possible, the lubricating oil from being contamined by waste fuel oil from the injection pumps. The camshaft is mounted in plain bearings at the side of the crankcase, and consists of several parts which are connected by flanges, and identical for all cylinders. This arrangement enables the camshaft to be dismounted easily from the flank. Its drive is derived from the crankshaft from the point of torsional vibrations so that smooth operation is ensured. The camshaft drives two governors one of which operates as a safety governor when the speed limit is exceeded, while the second governor is of the functional type and operates as a hydraulic multiplicator the system of which depends on the type and design of the driven machine.



Characteristic of K 8 S 310 DR engine.

c = fuel consumption per unit of output
p = combustion pressure
p = filling pressure
tt = temperature of gases in front of the turbine
tv = exhaust temperature

Ordinary lubricating oil is normally employed for the multiplicator in the governor so that the engine is stopped as soon as the pressure drops, e. g. in the event of a breakdown in the lubrication curcuit. A high-speed centrifugal pump of a special design is carried on the front cover of the engine and ensures an adequate circulation of cooling water at all speeds. The amply proportioned oil cooler overlaps at the oil side and provides a high output with a suitable oil temperature at all operating conditions. Adequate fuel cleanliness is ensured by means of highly efficient filters. Oil passes through a multiple felt filter located at the side of the crankcase, as well as special slot filters in the nozzle holders. For the cleaning of lubricating oil disc type filters is applied from which the deposited impurities can be removed

Diesel locomotive with 6 S 310 DR engine with an output of 750 H.P.

without dismantling the filter and with the engine in operation, or one large felt filter can be employed.

The engine is started either by compressed air supplied to the individual cylinders from a special distributor, or by means of its own generator operating as an electric motor feed from a storage battery according to the general arrangement of the equipment.

Great care has been devoted to the elimination of torsional vibrations by means of a suitable arrangement of the set. In most cases the rigid engine-generator coupling is combined with torsion suppressors having the shape of bifilar rockers. This arrangement has given satisfactory service while the function and service life of suppressors are not inferior to other parts of the engine. Other well-proved combinations provide for the flexible mounting of the generator and engine without an equipment for torsional spectrum adjustment being required.

The new design of the combustion space the shape of the injection cam and a suitable selection of the type of injection pumps and nozzles and their location which are the result of careful research and experimentation, have reduced the fuel consumption to a minimum while ensuring satisfactory combustion and suitable combustion pressures of both conventional and supercharged types of engines.

Due to a suitable combination of engines and the number of cylinders the two types of "V 170" and "310" engines represent a series of up-to-day power units which are used for all traction purposes. They have made advanced designs of all types of traction vehicles possible within an output range of from 300 to 6000 H. P. and provided a basis for the rapid development of motorized rail transport.

CHART I

Types of CKD Rail Traction Engines

Type of Engine	Bore (mm)	Stroke (mm)	Speed (r. p. m.)	Number of Cylinders	Output (H. P.) accord. to UIC	Swept volume (litres)	Weight of engine (kg)
8 V 170 DR					300		2050
K 8 V 170 DR				8	400	34.5	2350
12 V 170 DR					450		2430
K 12 V 170 DR	170	190	1400	12	650	51.8	2900
SK 12 V 170 DR					750		2900
X/ K 16 V 170 DR				16	1000	68.9	3800
6 S 310 DR					750		10500
K 6 S 310 DR				6	1200	163.2	11500
SK 6 S 310 DR	310	360	750		1500		11500
K 8 S 310 DR				8	1650	217.6	17000
SK 8 S 310 DR					2000		17000
X/ K 12 V 310 DR				12	3000	326.5	20000

V = engines with cylinders in V arrangement
S = engines with cylinders in line
K = engines with turbo-blowers
SK = ,, ,, ,, ,,
X/ = in the development stage

The Workshop Organisation in Netherlands

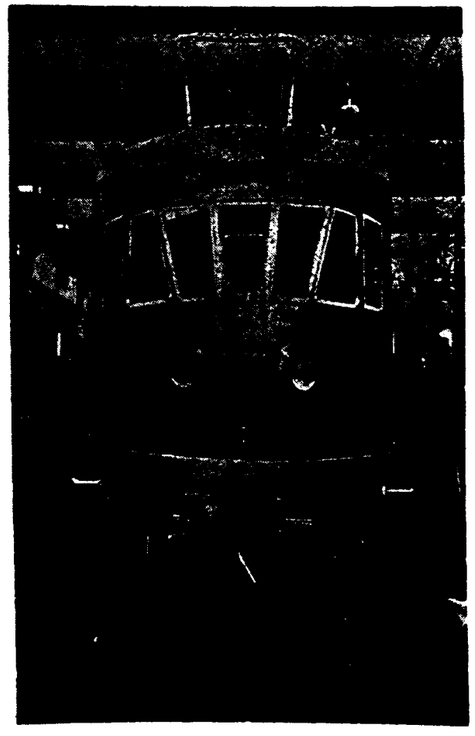
The maintenance of the rolling stock of the Netherlands Railways is to be divided in :

a) daily maintenance
b) periodical (small) maintenance
c) heavy repairs and complete overhauls

The *daily maintenance* is being carried out as soon as the Operating Department does not use the rolling stock. It consists principally of cleaning and putting small failures in order again. This work is done by operating staff. The rolling stock does not enter a shed for this purpose generally.

The *periodical maintenance* is carried out in the line workshops. After a certain period which has been fixed for each type of rolling stock, the train or locomotive comes into the shop where it is affiliated. Besides this time planning, there is also a quality planning. One distinguishes A, B and C maintenance. The B maintenance is more extensive than the A maintenance, the C maintenance is more extensive than the B maintenance. For each type of rolling stock a schedule has been fixed, i. a. A-A-B-A-A-C.

The main workshop at Tilburg



The line workshop Zaanstraat at Amsterdam

There are 7 line workshop. In general, only one type of rolling stock gets its maintenance in a certain shop.

Interior of a line workshop

The organisation is as follows :

Line workshop Maastricht mainly electric locomotives.

Line workshop Leidschendam mainly electric multiple unit stock

Line workshop Watergraafsmeer mainly diesel locomotives

Line workshop Zaanstraat Amsterdam mainly carriages and electric multiple unit stock

Line workshop Eindhoven mainly diesel locomotives

The line workshop at Maastricht

Line workshop Zwolle mainly diesel multiple unit stock and diesel locomotives

Line workshop Utrecht mainly diesel multiple unit stock.

Every year a working schedule is being fixed for these line workshops (the number of locomotives and of coaches, with a maintenance cyclus belonging to it). With the aid of a staff key specially designed, it is possible to calculate the strength of staff required. To this number a surplus is added for control, administration, illness, holidays, etc. The quantity of tools and spares to be used is also fixed beforehand.

The *heavy repairs and complete overhauls* are carried out in the main workshops: at Haarlem for the passenger rolling stock and at Tilburg for all types of locomotives. For this type of maintenance a yearly program is also being made according to the existing strength of staff and the expected use of spares and tools.

The goods rolling stock receives its maintenance in the main workshop at Amersfoort. There are :

a) small repairs, carried out if necessary and requiring between 5 and 50 hour's work ;
b) overhauls once every three years ;
c) complete painting together with the 2nd overhaul ;
d) heavy repairs. The van is also painted then and receives the overhaul, mentioned under b.

Repairs, which require not more than 5 hour's work, are being carried out in a neighbouring depot or line workshop.

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THE INDIAN RAILWAYS WORKSHOP MAGAZINE

Chittaranjan Locomotive Works Supplement

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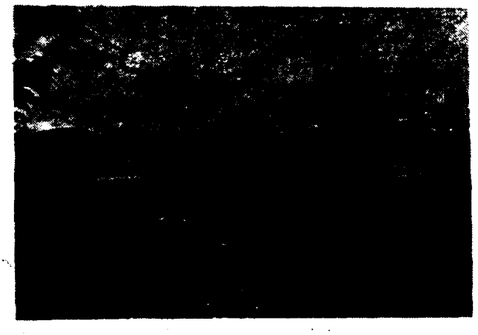
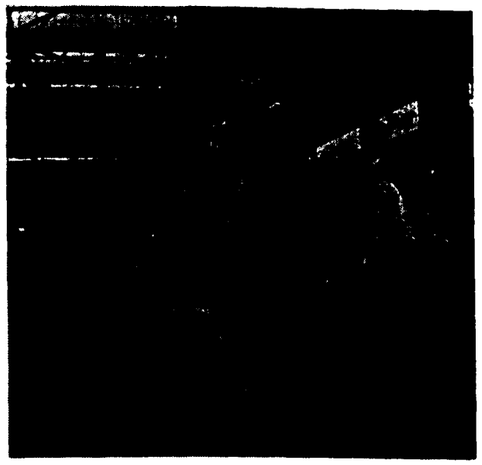
The History behind Chittaranjan Locomotive Works and its Remarkable Progress

NEARLY 5,000 technicians, engineers and mechanics are engaged day in and day out in handling the huge gigantic machines as well as very sensitive precision instruments in this giant engineering unit in the different processes involved in converting the finished steel and steel castings and also in the manufacture of various components and fitting them into a completed locomotive which is coming out of the Assembly Bays at the rate of one every alternate day. 5338 different components go into the production of a locomotive and it is gratifying to note that almost all the components (over 85%) are now being secured from indigenous sources and some of the parts are being manufactured in the shops of the Works itself and thus considerable foreign exchange has been conserved by putting an end to the imports of these items. 70,000 tons of cement, 1,500 tons of wood, 11,000 tons of fabricated steel, 16,000 tons unfabricated steel including reinforcements, 120 miles of pipe line for water supply etc. (estimated to cost Rs. 15 crores—Rs. 6 1/2 crores for the township and Rs. 8 crores for the Workshop) have gone into the production of the Chittaranjan Locomotive Works which has been rightly described as a "poetry in cement and steel". The total strength of the staff number over 8,000 of which 4500 serve in the Workshop and 5,000 houses have been constructed so far. An expansion programme is on hand estimated to cost Rs. 5 crores for getting new machinery for the Workshop and to construct 1,000 more quarters for the staff. The total area acquired is 4,195 acres and the entire building of the



A view of the site before construction started.



Sri P. C. Mukerjee, former General Manager, speaking at the inaugural ceremony. Shrimati Basanti Devi is seated on his left.

township and the Workshop was completed in the record time of three years (1948—50) and named after Deshabandu Chittaranjan, the prince among patriots and production in the factory was inaugurated by Shrimathi Basanthi Devi, the widow of C. R. Das, on the Republic Day in 1950.

It is of particular interest to know that though it was nearly a century since the Railways were first introduced in India and they had been making steady progress covering the entire country, no attention had been paid to the building up of the locomotives to meet the growing needs. Unlike most of the other countries which had developed their own locomotive building industry before the turn of the century, India had been importing practically for all her requirements which was a considerable strain on her foreign exchange. Locomotives were built both at Jamalpur and at Ajmir (a total of 750 locomotives had been turned out for a period of about 55 years) but this was not well-established and was not functioning as an industry at both the places nor was it continued.

After the First World War, the Peninsular Locomotive Company was formed but in the absence of

Visit of the then Railway Minister to Chittaranjan before Construction.

Railway Minister having a bird's eye view of the lay-out of the project from the Mihijam Hill.

protection from the Tariff Board, it went out of business and the Government had to take over their Works which were utilised for manufacture of carriage and wagon underframes for railways. Later on, after the World War II, the Government Railway Workshops at Jamshedpur—the former Peninsular Locomotive Co's Works—were handed over to Tatas. Government entered into an agreement with the Tata Locomotive & Engineering Co. effective for a period of 16 years whereby Government agreed to purchase the locomotives and boilers manufactured by that firm. Subsequently due to consistent pressure of public opinion as reflected in the debates in the legislatures urging the need for Government setting up an entirely separate workshop for the manufacture of locomotives, Government originally decided that the new Workshop could be established near Kancharapura. But subsequently a more ambitious scheme was undertaken to build a model workshop

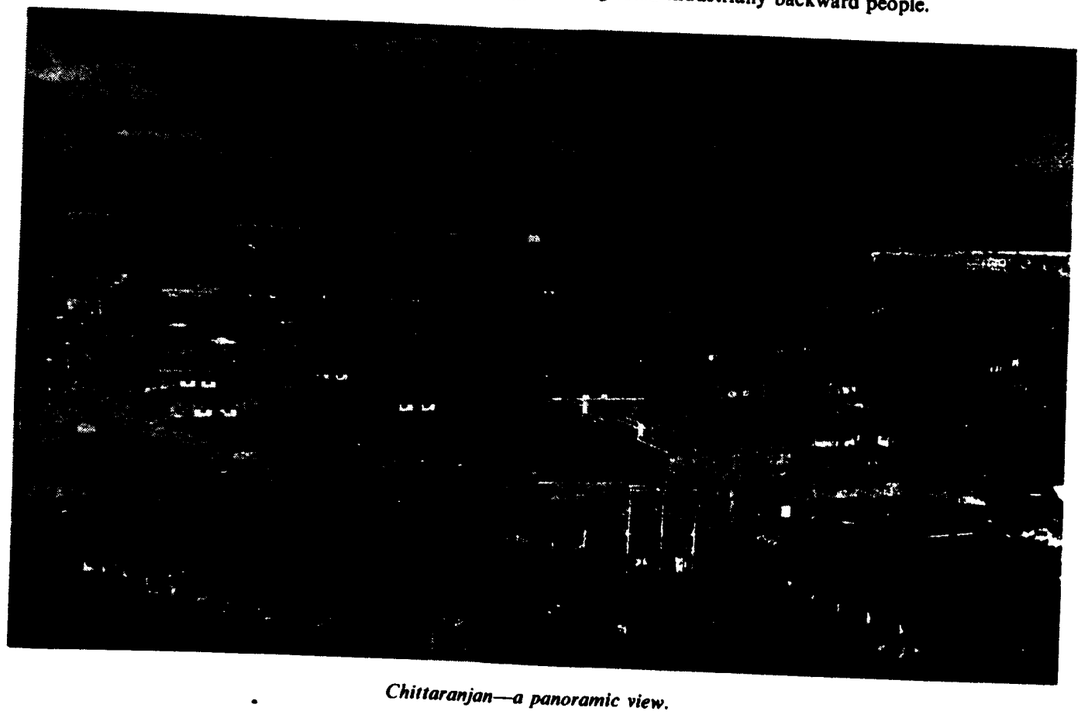
Main structure of the Locomotive Workshop.

and a township in keeping with the ideals of a welfare state to ensure clean and healthy living conditions and reasonable comforts for the staff and thus the Chittaranjan Locomotive Works was born.

The initial plan of the Workshop was to manufacture 120 locomotives and 50 spare boilers per year. From August 1956, the rate of outturn has reached to 14 W. G. locomotives per month which is equivalent to 200 average-size locomotives per year. It is hoped that with the three steel plants at Bhilai, Rourkela and Durgapur going into production and also the Steel Casting Plant to be established in the Workshop also become a *fait accompli*, and all the components obtained from within the country though not entirely from the Workshop itself, Chittaranjan Locomotive Works before long will be turning out completely Swadeshi locomotive to serve the different railways in this vast land. It has been planned to stabilise production at the rate of 14 per month before the end of the Second Five-Year Plan.

The present orders are for the manufacture of 1207 W. G. locomotives, 10 W T Prototype locomotives, 24 XD boilers and 17 W G—W P boilers. The order for the W. G. locomotives is at present under execution in the Works. The manufacture of the 10 W. T. locomotives and 24 X D boilers has been taken up simultaneously. Up till now about 800 locomotives have been turned out of the Assembly Bays of the Chittaranjan Locomotive Works and are serving the different railway systems.

Thus the Chittaranjan Locomotive Works stands as a magnificent symbol of the mighty Industrial Revolution. India is now passing through to build up the economic prosperity of the millions of her long-neglected industrially backward people.



Chittaranjan—a panoramic view.

A critical appraisal of the record of work of the Chittaranjan Locomotive Works

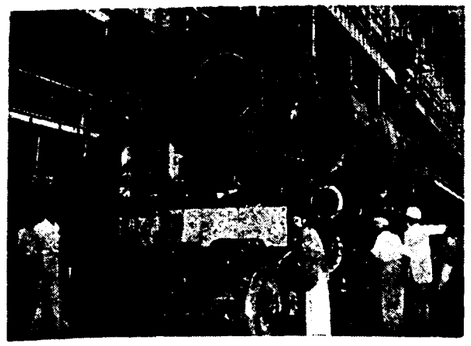
CHITTARANJAN Locomotive Works, the largest engineering unit in the public sector in India which was commissioned into production in January 1950 has been making steady progress since then and the excellent record of achievements under the First Five-Year Plan had inspired and encouraged the men at the helm of affairs to embark upon a still more ambitious programme of expansion under the Second Five-Year Plan. An annual target of 200 locos. has been fixed under the Second Plan. Till the end of the First Plan period, 341 locomotives had been rolled off the Chittaranjan's Assembly Bays. Till the present day over 780 locomotives had been rolled off the Assembly Bays and put on the rails in the different railways all over the country. It is gratifying that the target outturn of 14 locos. has already been achieved. Arrangements are well under way for the manufacture of all the components within the works itself in the different shops and many of the formerly imported items are now being manufactured in the Works itself or within the country anyhow.

Thcugh the progress witnessed during the last few years has been quite satisfactory and gratifying, still certain problems which the Works is faced with deserve special attention and demand early solution. Chittaranjan has provided Government with an opportunity to realise the inherent difficulties and handicaps in the management of huge undertakings. Ownership is an easy thing and a simple affair but enterprise and managerial skill are things which could not be acquired but to be developed and built up steadfastly and assiduously in a sustained and hard way.

The main problem facing Chittaranjan Locomotive Works is the high cost involved in the manufacture of locos. and hence the high selling price. It is stated that at present the selling price of each loco. is about Rs. 4.33 lakhs and experts express the view that unless the price is reduced by 20 per cent at least the economics of production of the giant factory could not be well-established. None-the-less, it is claimed that the cost has progressively come down during the last few years and it is even claimed that the cost of the broad-gauge locomotive manufactured in Chittaranjan is less than the metre-guage loco. manufactured by Telco. But, any comparison with a privately-managed enterprise will hardly serve any purpose from our point of view. When we analyse this point, we should not fail to take note the progressive rise in the manufacturing capacity of the Works and the consequent rise in the rate of production and see whether the so-called reduction in the cost had been to the same degree as it ought to have been. The manufacturing capacity of the Works has risen from less than one loco. per month when it was inaugurated to 14 per month today.

Cylinder Casting.

The Main Generator.



Wheeling the Locomotive.

A view of the Main Assembly Shop.

In this connection, it should not be lost sight of that the social over-head costs necessitated by the expending of large amounts on construction of the township and providing amenities to the staff have been in a large measure responsible for the high cost of production. But this has paid rich dividends since the services of a contented staff and responsible labour was a sine qua non for the progress in any industry and it is a matter of gratification that there has been no labour problem in the Chittaranjan all

these years. It must be particularly noted that the higher productivity of labour was called for to achieve the target since the Works has embarked upon an ambitious programme of expansion under conditions of high cost of materials.

Anyhow, it would be worth reminding ourselves of the views of the Madras industries Minister Mr. R. Venkatraman who has recently returned after a tour of the East. The Madras Minister said that in India, they were spending unjustifiably large amounts on construction of buildings in any industrial undertaking and nearly thirty per cent of the total cost or even more is accounted on this score. They are influenced largely by the way such huge industrial undertakings are being put up in western countries like Britain or America where huge massive structures were probably necessary in view of their climatic conditions. On the other hand, they can usefully copy countries like Japan in this regard where they don't spend more than ten per cent of the capital outlay on buildings.

The problem of tackling leakage of trained technicians is another important problem the Works is faced with. It has been found that the trained technical personnel output for employment in private engineering firms which pay better scales of pay and hold out better prospects. The immediate task facing the Chittaranjan Locomotive Works is to stabilise rather than expand production so that the selling price of each loco. could be reduced to the lowest minimum. Economics wherever possible must be effected by a careful study of the working entire unit and all wastage avoided. The outlay on the expansion programme is estimated at Rs. 2.5 crores for the next three years.

There has been some difficulty in getting adequate quantity of finished steel and steel castings, two essential raw materials necessary for the manufacture of locos. but it is hoped that with the three steel plants at Bhilai, Rurekela and Durghapur going into production and the Steel Castings Plant at Chittaranjan itself becoming a fait accompli, conditions would ease. Regarding the components, it deserves special mention that certain components which were formerly imported from abroad are now being manufactured in the shops of the Chittaranjan Loco-

motive Works itself and the Works seems to be reasonably well-placed in that respect except in the case of roller-bearings which are being imported from the National Bearings Co., Jaipur.

It is hoped that when all the steel plants in the country go into production and all the components are available from within the country itself, it might be quite possible to manufacture the completely SWADESHI locomotive at lesser cost and thus reduce the selling price at least by another lakh of rupees.

DIESEL CARS ON NORTHERN RAILWAY

Shri Shah Nawaz Khan, Deputy Minister, said in the Lok Sabha that 12 Broad Gauge diesel rail cars had been allotted to the Northern Railway and these were expected to be received by them by the end of this month. When received, the Deputy Minister added, it was proposed to operate these rail cars on the following sections over Delhi & Ferozepore Divisions :—

(i) New Delhi - Panipat - Kurukshetra - Narwana - Jind - Rohtak - Delhi - Kishanganj ;

(ii) Delhi - Kishanganj - Rohtak - Jind - Panipat - New Delhi ;

(iii) Jullunder City - Ludhiana - Moga Tehsil - Ferozepore Cantt ;

(iv) Jullunder City - Hoshiarpur - Ludhiana - Lohian Khas.

The Deputy Minister added that diesel cars are already running on the Metre Gauge system of the Northern Railway between Sadar Bazar and Sadulpur Junction, and Delhi Sorai Rohilla and Hissar Junction.

Locomotive Manufacture in Private Sector

THE manufacture of locomotives in both the public and private sectors in this country could now be said to have been fully established. For a long time, serious efforts were made by the Railways in the pre-Independence period, to manufacture locomotives. But, for some reason or other, except for half-hearted attempts and the production of a small number of meter-gauge locomotives in the Ajmer Workshops, the bulk of the requirements had to be imported from abroad. As the work of the Chittaranjan Locomotive workshop in the public sector is examined elsewhere in this supplement, the progress of the industry in the private sector is analysed here. It must be said, however, that between the two producers a good portion of the total requirements of steam locomotives is being provided. Though there are many types which are still being purchased from foreign countries. In fact till recently, large numbers of the types of locomotives p oduced within the country were also being obtained.

It is stated that it has not been found possible to estimate precisely the requirements of the Railways who are the largest users of the steam locomotives in terms of meter-gauge and broad-gauge units. There is a fear that, on account of dieselisation and the increasing use of electric traction, the steam locomotive might become outmoded over a period.

While the possibilities of the increasing use of diesel and eletric locomotives exist, in the near foreseeable future the iron horse will continue to haul the bulk of the passenger and freight traffic. It might be necessary to utilise faster locomotives, diesel and electric, in the congested sections, till such time the track capacity can be considerably augmented. It may also happen that electric traction proves to be relatively less expensive. Steam locomotives should, however, continue to be in great demand. When it has been proved that indigenous locomotives can be produced in adequate numbers and at fairly reasonable prices. Encouragement is needed for further augmenting the facilities for production and achieve self-sufficiency as far as possible.

It took the Tata Locomotive and Engineering Company Limited, over a decade to reach the present stage of manufacture. Somehow, considerable time was lost in planning and constructing the present large workshop. It has been explained that the lack of skilled personnel delays in receipt of plant and machinery and inadequate experience were contributory factors. The various difficulties were, however, got over and the first locomotive manufactured early in 1952. The first order for 50 locomotives of the Y. G. class was completed in November 1958. A rate of output of 50 locomotives and 50 spare boilers was achieved in July 1954 and by this time the Railway Board's stipulation that at least 75 percent of the Telco locomotives should be of indigenous manufacture, excluding castings, instruments, and proprietary items was fulfilled. In fact, it is now claimed that the, indigenous content is as high as 90 per cent and will soon be 100 per cent, except for a few proprietary and patented items. This satisfactory position could be reached as a result of steel castings becoming available from the company's newly installed modern foundry.

STEEL FOUNDRY

This foundry provides high quality castings which were difficult to be obtained from internal source and had to be imported in part at high prices. The company has a link up with a well-known Belgium firm and Indian technicians have been sent to Belgium for further training. The outlay on this foundry alone is stated to be Rs. 3.5 crores. With the balancing of the capacity of the various departments and an assured supply of quality steel castings, it has been possible to step up the rate of output of locomotives to 100 a year recently, thus fulfilling the targets set for the company. With not much additional outlay it may be possible to increase the annual rate further to 120 locomotives. It may be necessary, however, to import some part of the components if there happens to be a short fall in particular directions.

The large-scale production of meter-gauge locomotives in the private sector and of broad-gauge locomotives in the public sector could thus be said to fill an important gap in the industrial structure. Many of the early difficulties in the private sector could no doubt have been avoided. But since recent progress has been reassuring and the foreign exchange saving aspect is very important, there should be proper coordination of the activities of the two sectors and the maximum benefit derived out of the existing facilities.

(Courtesy : "The Hindu Survey of Indian Industry")

Working of State Undertaking—Chittaranjan

THE Chittaranjan Locomotive Works is managed directly by the Ministry of Railways through the Member (Engineering) of the Railway Board. Its organisation and its township have the Railway's atmosphere, and the hard core of its personnel is made up of good railway-men. In the good Railway tradition, its clubs are called Institutes. Chittaranjan is the aristocrat of State enterprises, and like aristocrats it tends to be somewhat exclusive. Luckily, however, it is free from the Railway's latter-day inefficiency. It feels that in commercial and administrative matters it is practically autonomous. Normally the General Manager places his orders for supplies directly on the Director-General of Supply and Disposals. Only for the bigger jobs does he have to go to the Railway Board. The main problem of this first class engineering unit in the public sector, however, is not its internal autonomy; so much as its internal economy. When Chittaranjan was conceived, it was felt that its "social overhead costs", embodied in the township and its amenities, were disproportionately large. They probably were so, and the reduction of their incidence on the price of the locomotive can only be gradual. Chittaranjan's living standards, particularly housing, are higher than those of any other comparable Govenment undertaking and they seem to have paid good dividends in the form of a contended staff and a comparatively responsible labour. Chittaranjan Loco. Works says in fact that it has no labour problem and it recognises no trade union. Anyhow, staff relations have been facilitated by a works committee for the works and a staff council with both works and administrative staff represented on it. Labour relations are sought to be further strengthened by the system of 'payment by results.' All the production shops have been brought within the scope of the system under which each job is progressed from stage to stage to ensure quality.

UNIDIRECTIONAL MOVEMENT OF MATERIALS

Chittaranjan will certainly need both peace and higher productivity on the part of its labour, for it has embarked on an expansion programme under conditions of high cost of materials. It will also need to tackle the leakage of trained technicians into private engineering firms because they pay better. An official admitted that there is more waste of materials in certain sections of Chittaranjan than there is at TELCO, the other locomotive works which is in the private sector. The Chittaranjan works has been laid out in a style permitting unidirectional movement of materials, the most important of which are steel in its cast, forged and rolled conditions, and a large variety of components. The outturn of locos. at the works has steadily increased from less than one a month in 1951 to 14 per month to-day, and the cost has gone down, though not so steadily, from Rs. 7 lakhs in 1951 to Rs. 4.33 lakhs to-day. The next task for Chittaranjan is to stabilise rather than expand the production of locos, and to reduce the cost further. As the new steel plants begin to go into production and when all components can either be made within the works or within the country, it might be possible to reduce the selling price of a Chittaranjan loco. by another lakh of rupees.

The outlay on the expansion programme is estimated at Rs. 2.5 crores and it will take three years to complete. The objects of the programme are to (a) stabilise production at 14 locos per month; (b) attain self-sufficiency in components and fabricating capacity required for this level of production; and (c) to create additional capacity for two more locos. per month, in case it should be needed. There is at present serious shortage of steel castings capacity in the country, and it is imperative that production in a factory like Chittaranjan Loco. Works should not be hampered by over-dependence on outside sources for this work. Besides imported castings, TELCO now supplies castings to Chittaranjan, as do also other private steel casters of the country. The steel castings plant proposed to be installed at Chittaranjan will have a capacity of 500 tons per month. Its installations may have to be arranged on deferred payment terms, and the Railway Ministry should move more quickly over this project. A foundry is not set up in a short time; it takes years to get one made. Texmaco, whose steel casting division is said to be coming up satisfactorily, will be casting a boiler component for Chittaranjan which is now being imported. Also the substitution of welded and fabricated components for imported castings that is being increasingly tried is expected to reduce dependence on imports in this line. TISCO cannot supply Chittaranjan's full needs of wheel tyres and axles, but the Durgapur steel mill will be able to make up the deficiency when it goes into production. Slabs for the main frame, and boiler plates over six feet in length which TISCO cannot at present supply, are now imported, but the new steel mills would supply both. Tubes are at present imported, but early in 1959 it is expected that the Indian Tube Co., will supply all sizes and to the full requirements of Chittaranjan.

MANUFACTURE OF COMPONENTS

Finished steel and steel castings are two of the three major semi-manufacturers that a locomotive works processes into a manufactured loco. The third are components, wherein Chittaranjan seems to be reasonably well placed except for roller bearings. Imported components are now roughly ten per cent by value of the price of a loco. Chittaranjan's brass foundry produces all its brass components, and generally it feels that it can make components more cheaply than the private sector—that its productivity in this line is better. However, roller bearings which are among the more important and expensive components, have still to be imported. The National Bearings Co., of Jaipur is not able to supply to the full extent of Chittaranjan Loco. Work's demands Chittaranjan is in difficulties to obtain bearings from abroad, and the N. B. C. is said to have increased the prices of its products sold to the Chittaranjan Loco. Works. However, Chittaranjan is willing to buy its entire requirements of roller bearings from the N.B.C. on a long term basis if the latter will expand production and supply at economical rates.

(Courtesy: "The Hindu Survey of Indian Industry")

RAILWAY BOOK-STALLS

There is no proposal at present to open departmental book-stalls at railway stations, said Shri Shah Nawaz Khan, Deputy Minister of Railways, in a written reply to a question by Dr. Srimathi Seeta Parmanand in the Rajya Sabha.

The Deputy Minister said that there were 367 stations throughout the country which had book-stalls. Of these Messrs. Wheeler & Co. had book-stalls on 240 stations. There were 101 stations having book-stalls on the Southern Railway; 65 on the Central Railway; 56 on the Western Railway; 51 on the Northern Railway; 30 on the Eastern Railway; 29 on the North-Eastern Railway; 22 on the South-Eastern Railway and 13 on the North-East Frontier Railway.

A description of the different shops in the Chittaranjan Locomotive Works

THE shops are located in three groups - the South consisting of the Pattern Shop, Iron and Brass Foundries, the centre comprising of the Smithy, the Forge, the Heavy Machine and Light Machine shops and the North consisting of the Boiler Assembly, Tender, Erecting Shops. The lay-out has been planned East-West, and in such a way that the raw materials enter the Works at the West end and the finished product comes out at the East end. The entire shops have been equipped with machinery and plant that are of the latest design and of well-known makes.

The first shop, as one enters the Workshop is the Pattern Shop with a covered area of 36,000 sq. feet providing adequate space for pattern storage also. There are thirteen wood-working machines including a universal pattern miller and 67 skilled workmen work here to produce not only all the patterns required for the brass and iron foundries in Chittaranjan but also for the steel castings which are ordered out.

The Brass Foundry with two 400 lbs and two 1,000 lbs. oil fired furnaces and a reverberatory ingotting furnace turns out approximately 50 tons of castings per month. The equipment consists of 4 moulding machines, a shot blasting machine, a core drying oven, an automatic portable sand slinger and a sand-mixing machine. A small field laboratory located in a corner of the shop controls metal mixtures and a separate sand-testing section classifies sand for use in various moulds.

Four 6–7 ton capacity Cupolas, each wiih a monthly capacity of 400 tons are the main features of the Iron Foundry which is equipped with five sand treating mills, two sand slingers, four moulding machines and a shot-blasting machine. The biggest and the most intricate casting done here is the locomotive cylinder.

Forge & Smit y shed also houses the boiler construction section and a small heat treatment section meant exclusively to meet the requirements of the Shops. There are Drop Stamps (I) one 3 ton (II) Two batteries of 20/15 cwts. (III) Hammers - one 3 ton, three 2 ton, one 1 ton, three 15 cwt, Seven 10 cwt.

The Pattern Shop.

The Smithy & Forge Shop.

and five 5 cwt. The average outturn from this shop which employs 86 skilled men is about 325 tons per month. The work of welding is of paramount importance in a Workshop like Chittaranjan where each locomotive turned out carries roughly 7,200 running feet of weld. Spécial welding manipulators for such intricate jobs as the one for the firebox are provided to

The Main Assembly Shop.

ensure down-hand welding to the maximum possible extent.

The machines in the Heavy Machine Shop are so arranged as to follow the sequence of operations of major components like cylinders, drag castings and motion rods etc. The most important of the special duty machines are 4 Hydromatic milling machines used for face and side milling of motion details, a link grinder for grinding the quadrant links and two duplex borers for boring the connecting and coupling rods with trepanning tools. The Machine Shop has also a separate fitting section where the components are assembled into minor assemblies before despatch to the main assembly lines.

164 machines are functioning in the Light Machine Shop which is responsible for the outturn of the largest number smaller components such as bar work items, non-ferrous castings and certain minor ferrous castings. About 260 skilled men are working in the Shop which turns out approximately over one lakh fully machined components.

The Boiler Assembly Shop has a large number of special purpose machines for processing boiler plates. Two Power Drills and two Gap Rivetters are provided for the final drilling and hydraulic rivetting of boilers after assembly. There are five 30 tons and three 20 tons overhead travelling cranes for the internal movement of components in the Boiler Shop.

The Erecting Shop has been provided with cranes at three different levels, complete machinery for the machining of frames, tender plates and allied components. Two of the machines are capable of slotting and milling locomotive frames up to 60 feet in length.

ALLOY & SPECIAL STEELS

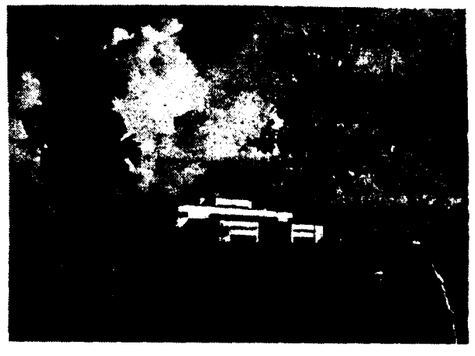
The Session on Alloy and Special Steels held as a part of the fourth Indian Standards Convention was attended to give a lead to the interests concerned although there was no established alloy and special steel indust y in the country at the movement. Shri K. N. P. Rao of the Tata Iron & Steel Co. Ltd., who presided over the Session explained the work on rationalization and standardization of alloy & special steel which has already been initiated by the ISI. The work undertaken by the ISI would set the pace for the development and growth of this industry on right lines. In the discussion that followed the review of the five papers contributed for the purpose, a number of important suggestions were made. It was appreciated that unlike other industrially advanced countries, standardization in India in this field had to be ahead of the industry. This was inevitable for a developing country like ours with a planned national economy.

The discussion at the Session revealed a general approval of the tentative programme drawn up by the ISI in this field. Side by side, emphasis was also laid on the desirability of avoiding wastage in the utilization of steels through intelligent utilization of these steels based on a clear understanding of the important factors connected with the design, particularly taking into account the service conditions, fabrication, treatment, etc., of different products made from such steels. This should result in substantial economy in the use of such steels which are at the moment largely imported. The possibilities of using substitute alloying elements in place of costly conventional alloying elements and also adoption of substitute alloy steels were also brought out in one of the papers contributed for the session.

Attention was also drawn to the classified code for designating different types of alloy and special steels on the preparation of which the ISI is engaged. This should help in easy identification of these steels.

Amenities to the Staff in the Chittaranjan Locomotive Works

WHAT impresses any visitor to this gigantic engineering unit in India more than the mighty machines and in the Workshop and the beautiful Administrative Office buildings is the cluster of neat little houses well-planned and nicely constructed. Already more than 5,000 living quarters for the staff have been constructed and a programme is on hand to build 1,000 more houses. Thus it could be seen that out of the total of nearly 8,000 staff members, 5,000 will have quarters. The least-paid Class IV employee gets a neat two-room house, completely self-contained, separate tap and latrine, electricity etc. for a monthly rental of Rs. 4.50. Probably in no other industrial town the housing problem of its staff has been so admirably and successfully tackled.



One of the Recreation Club for Workers.

For the education of the children of the staff, two schools, one for boys and the other for girls are functioning. Besides these two high schools, the Deshabandu Vidyalaya for Boys and Deshabandu Vidyalaya for girls, there are seven primary schools that are being run by the Administration. It is very gratifying to note that both the high schools have set up and are maintaining a high percentage of passes in the S. S. L. C. examination (roughly round about 90%) during the last eighty years. To these educational institutions have been added four private schools, two convents and three West Bengal Government Basic schools opened last year. The Administration is also providing facilities for the best students to prosecute higher studies as well.

Sewage Disposal Plant.

The Kasturba Gandhi Hospital—A Front View.

Chittaranjan has also provided elaborate and up-to-date medical facilities for the staff. Besides the network of dispensaries in the colonies, a well-equipped 70 bed Central Hospital with the best-equipped radio-

Sri K. Ramachandran, General Manager, Chittaranjan Locomotive Works

logical, pathological, dental, and opthalmic Departments are catering to the needs of the staff and their families. A Chest Clinic and a full-fledged Dental Clinic have also been added to the Hospital last year.

The two Institutes – the Basanthi Institute and the Srilata Institute with their own well-equipped libraries, reading rooms, indoor and outdoor game facilities, swimming pool, spacious auditorium for meetings and cultural activities, meet adequately the recreational needs and requirements of the staff. Added to this, the well-planned and beautifully laid-out 7 public parks in the township.

Chittaranjan has set up a new record of excellent cordial labour-management relationship and there has been practically no labour problem all these years which is at once as gratifying as it is strange at a time when one frequently hears and reads in the newspapers about strikes and lock-outs. In this connection, it will not be out of place to mention though in a casual way the admirable social qualities and genial disposition of Mr. K. Ramachandran, General Manager who has been held in great affection and high esteem by the entire staff.

LADLE REFRACTORIES FOR STEEL PLANTS

The Indian Standards Institution as drafted an Indian Standard Specification for Ladle Refractories for steel plants [Doc : SMDC 18(102)] for eliciting comments before *31st January 1959*.

This draft standard covers the requirements for ladle refractories, used for teeming of steel. Refractories required by steel plants constitute the bulk of production of the refractory industry. The quality of refractory to be used in different units of the steel industry varies depending upon the performance requirements. With a good quality refractory for a particular location, there would be no need for frequent replacement, thus contributing to increased production of steel and cutting down the cost of maintenance. The requirements of refractories for steel plants would greatly increase with the establishment of three more steel plants in the Public Sector and with possible further expansion during the third five-year plan period. In order to meet efficiently the requirements of the industry, a number of Indian Standards are being formulated for refractories for use in the steel industry. The standard for ladle refractories for steel plants forms one of the standards in the series.

Copies of the draft standard are available, free on request, from the offices of the Indian Standards Institution, New Delhi, Bombay, Calcutta, and Madras.

THE TECHNICAL SCHOOL AT CHITTARANJAN

THE Technical School provides for a steady flow of skilled technicians and technically trained supervisory staff for the Chittaranjan Locomotive Works. The services of the Institution are being indented upon by other railways and other Ministries of the Government of India also for the technical training of their apprentices. There are two types of apprentices undergoing training in the school viz., (1) Apprentice Mechanics (2) Trade Apprentices. At present more than 500 apprentices are undergoing training.

Sri P. C. Mukerjee former General Manager, Chittaranjan Locomotive Works welcoming the visitors at the Technical School auditorium

The Technical School along with the Basic Training Workshop and the four hostels has been constructed at a cost of about Rs. 20 lakhs. Besides getting free training and free accommodation in the hostels, the Apprentice Mechanics are paid Rs. 110 and Trade Apprentices Rs. 80 per mensem.

About 450 workers of different trades and categories are also attending evening classes for workmen; the object of these classes is to provide essential technical education to them for their future advancement.

Refresher courses of short duration in advanced techniques of welding, rate-fixing and production methods have also been provided for the benefit of Senior Supervisors and Welding Operators of the Indian Railways.

Diesel Rail Bus for British Railways

THE British Transport Commission has entrusted to Messrs. Waggon-und Maschinenbau GmbH. Donauwoerth, the design and construction of Diesel Rail Buses. The cars which are equipped with only two pairs of wheels are, it is understood, to be put into service in rural and suburban services. The bodies of the cars have been designed in accordance with British Railway requirements and the underframe and power equipment, transmission and brake gear are generally of similar design to cars at present running on the German Federal Railways. The cars will all pass the BR Standard C 1 loading gauge.

In the design of the cars attention has been given to light weight construction principles. Wherever possible standard production components have been used in order to facilitate the supply of replacement parts as necessary.

THE MAIN CHARACTERISTICS AND DIMENSIONS ARE AS FOLLOWS :

			appr.
A) CAR BODY	Length over buffers	45′— 9¼″	13950 mm
	length of car body	41′—10″	12750 mm
	width over body panels	8′— 8⅝″	2650 mm
	inside width of body	8′— 4″	2539 mm
	height from rail to top of roof	11′— 9⅛″	3587 mm
	height of floor above rail	4′— 0″	1220 mm
	interior height, floor to ceiling	7′— 6″	2286 mm
B) BOGIE	Gauge	4′— 8½″	1435 mm
	wheelbase	19′— 8½″	6000 mm
	wheel diameter	3′— 3⅜″	1000 mm
C) POWER UNIT	Diesel underfloor engine (" BUESSING ") 150 HP (150 PS) at 1900 r. p. m.		
	Power transmission : a) ZF electro-magnetic 6-speed gear box		
	b) Final drive and reversing gear (" GMEINDER ")		
D) GENERAL	Max. speed	55 mph	88 km/h
	Tare weight of car (ready for service)	15 tons	15 to
	Power weight ratio	10 HP/ton	10 PS/to
	Seating	56 persons	
	Standing accommodation	40 passengers	
	Compressed air disc brakes ("KNORR "—BSI)		
	Hand brake — lever operated from driver's cab		

BODY

The body contour has been designed to comply with the British Railways C 1 loading gauge. To meet the requirements of the body designed and for absorbing buffer shocks, a through length underframe is provided constructed of longitudinal girders made up from welded flanged plates. The cross beams are of Standard Channels NP 14, the other cross beams being of channels of the NP 10 type. To increase the rigidity, a corrugated plate floor is connected to the underframe. This corrugated plate is welded to the longitudinal and cross beams by means of plug and stitch welding, and design produces a car body of light and modern welded construction. The exterior and roof sheeting are of light metal. The ends are of light gauge steel plate.

A side apron 425 mm. deep is welded to the solebars and provides an extension to the body side panels.

The underframe consists of channel-shaped crossbeams (NP 14 and NP 10) which are welded to the longitudinal girders. Traction stresses produced by

the Power Equipment are transferred into the longitudinal girders by means of parallel and transverse braees consisting of flanged plates. To absorb compression stresses and maintain rigidity, the floor has been constructed of corrugated steel sections attached by welding to the underframe longitudinal and transverse members.

The body framing is formed as a light steel structure fabricated by welding together flanged plate channels. The body side pillars are "Zed" section pressings. The side and roof panals of non-corrosive light metal sheets have been riveted to the body framing. The roof plates have been crimped longitudinally in order to provide maximum rigidity. To achieve a balanced light weight structure the steel has been used for the underframe and body framing members whilst aluminium sheets form the body side panels.

UNDERFRAME

The underframe is a rectangular constructure comprising two longitudinal side girders (or sole-bars) and two headstocks of rolled sections and welded together. In addition longitudinal and transverse members are fitted as necessary to carry the Diesel-mechanical power unit and give ample rigidity to the frame. The axle boxes for roller bearings of the "SKF" type are carried in adjustable guides of the "FERROZELL" type, having a longitudinal clearance of 0,5 mm. and a transverse clearance of 0,5 mm. "FERROZELL" is a wear-resisting synthetic material which does not require lubrication and has been used successfully on the German Federal Railways for a number of years. The axle clearance of 2×0,5 mm. enables—in contrast with a rigid axle — smoother running when negotiating curves.

During trial runs with the cars riding has proved to be very good with an absence of any appreciable oscillation or undue vibration, irrespective of the fact that the wave length of the sine curve is so much shortened by the clearance of the axles. The longitudinal clearance of the axles is kept constant by wedge adjustment, but this adjustment is necessary only after long periods in service due to the use of "FERROZELL" which has high wear-resistant qualities. The light wheel sets with double waved wheel discs and solid axles are carried by 6-plate laminated springs via adjustable

spring screws on the underframe. The wheel diameter of 1000 mm. permits 24 mm. of tyre wear. Each axle has two brake discs of the "BSI" type by which the brake is applied through brake shoes having a lining of synthetic material.

POWER UNIT

The supply of fuel to the diesel engine is pneumatically regulated by a foot-operated valve installed in the driver's cab and by a governor fitted to the engine. In case of failure of the pneumatic throttle motor, the engine can be controlled by a hand lever. A governor of the injection pump ("BOSCH") limits the speed when running idle. A push button fitted on the driver's panel enables the driver to cut out the engine electro-pneumatically. The cooling water of the engine is passed through a cooling unit with hydraulic fan drive of "BEHR" type mounted in the underframe and is automatically kept within a limit of 72/80°C.

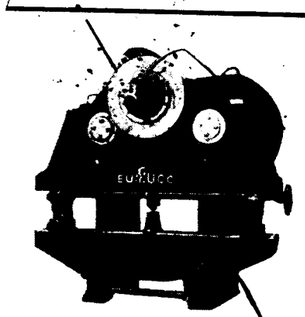
The air intake to the engine is via an exchangeable filter element of the "DELBAG" type fitted in an accessible position in the vestibule. The exhaust gases are carried away by an exhaust pipe rising through the roof of the car, the pipe being insulated against heat and sound.

The engine-driven fluid flywheel operates automatically depending upon the speed of the engine and is locked when either shaft exceeds appr. 800 r. p. m.

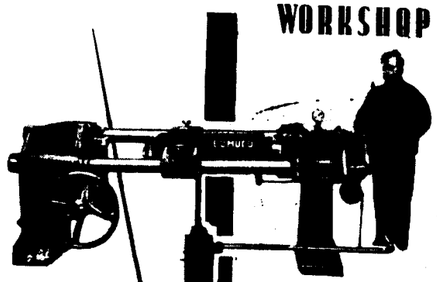
Drive to the 6-speed gear box is by conventional cardan shaft. This gear box is of an electro-mechanical type, the 6-speeds being electrically selected by the driver, drive being by means of electro-magnetic multiple disc clutches. The 6-gear ratio allows full utilization of the engine power curve.

Final drive torque is transmitted to the frame by means of flexibly mounted torque arm. Drive from the gear box to final drive is again by conventional cardan shaft. Forward and reverse gears are mounted in the final drive unit and selection is operated pneumatically by driver controlled valve. In the event of loss of air pressure the design allows for selection by hand, access to this being by means of trap in floor.

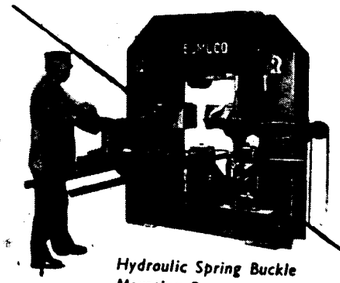
MACHINES FOR RAILWAY WORKSHOP



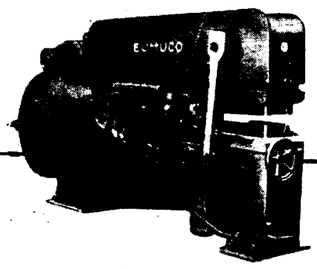
Eccentric Press for Springs



Hydraulic Spring Buckle Pulling-off Press

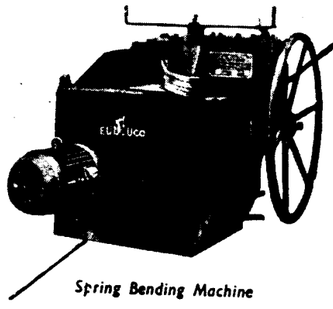


Hydraulic Spring Buckle Mounting Press

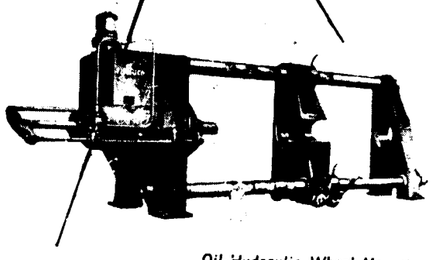


Tube Reducing and Expanding Machine

EUMUCO



Spring Bending Machine



Oil-Hydraulic Wheel-Mounting and Demounting Press

EUMUCO AKTIENGESELLSCHAFT FÜR MASCHINENBAU · LEVERKUSEN I