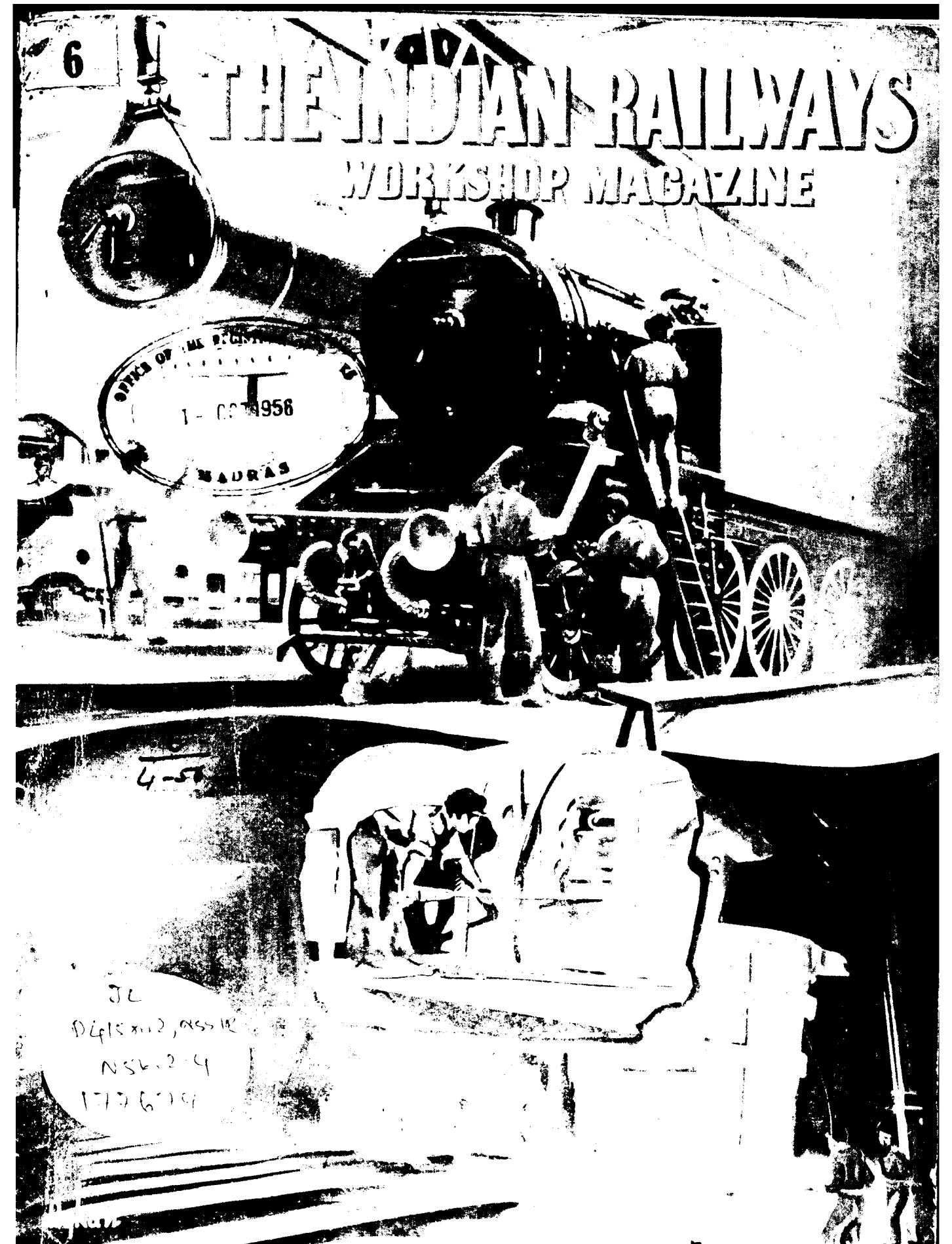
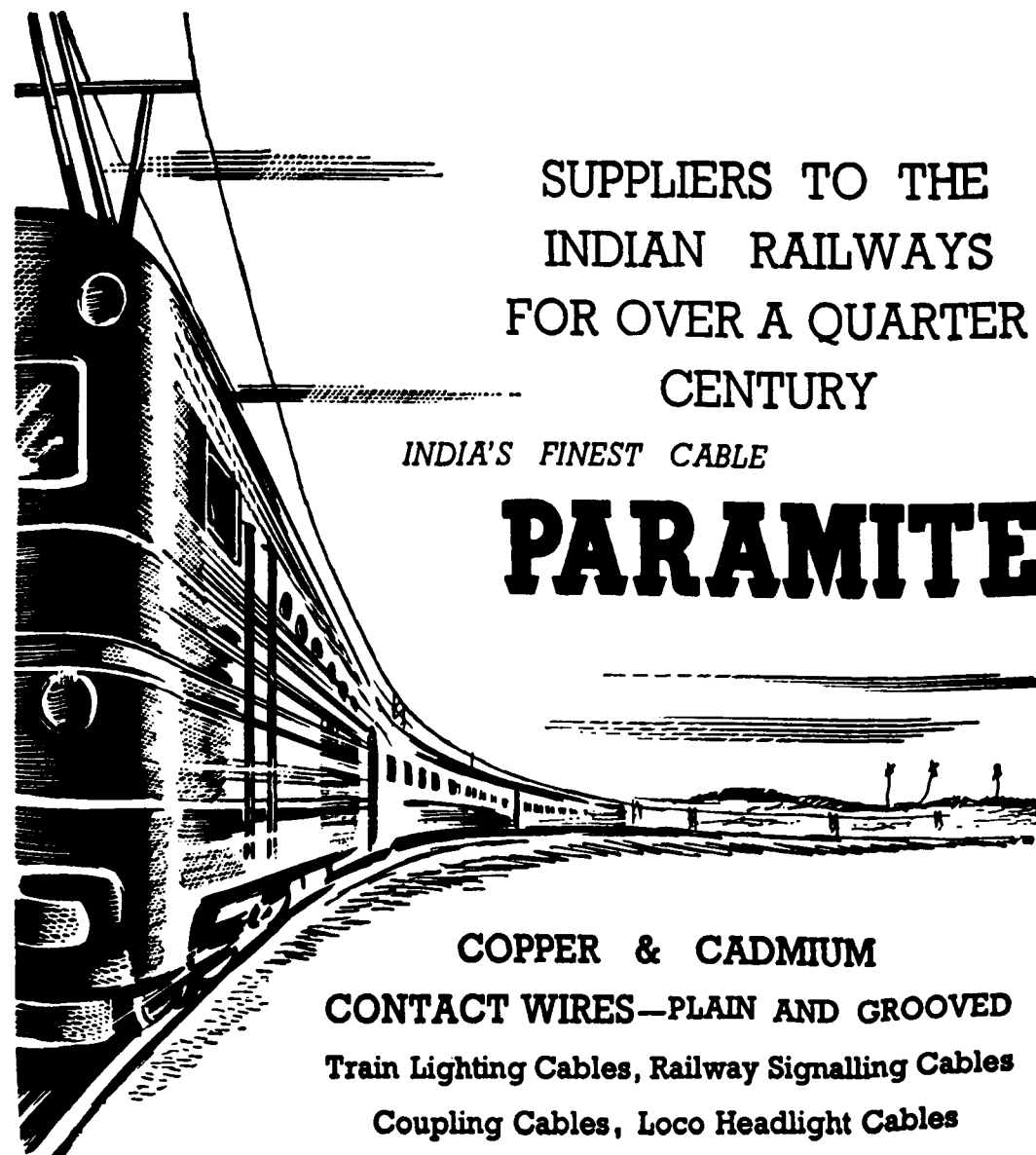






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AN IMPORTANT ANNOUNCEMENT

We have pleasure to inform all our readers and advertisers that we are issuing a special supplement entitled "**LOCOMOTIVE, CARRIAGE AND WAGON**" along with our November **ANNUAL NUMBER**.

THIS Supplement will contain highly technical articles on various stages of construction of Steam, Diesel, Diesel-Electric Locomotives, Carriages and Wagons by eminent engineers of the Indian Railways.

We take this opportunity of requesting all Rolling-stock Manufacturers in India and abroad, who have a large part to play for the success of the Second Five-Year Plan, to extend their full co-operation for the success of this Supplement too which is the first of its kind ever to be published in India.

EDITOR.

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Czechoslovak Railway Engineering

By Our Engineering Correspondent

CZECHOSLOVAKIA can be ranged among the leading countries of the world as regards the scope of its engineering production in relation to the size of its territory and the number of its inhabitants. Under these circumstances it is only natural that the Czechoslovak engineering industry incorporates in its manufacturing schedule also machines intended mostly or exclusively for railways. Nowadays it is more prepared than ever before to satisfy the requirements of railway boards as regards design, material and technology. Due to the fact that the technical development in the world has been continuously followed and that there has been close co-operation with the Czechoslovak Railway Board as well as with foreign railway companies in certain partial sections positive results have been obtained, so that machines and equipment of up-to-date design are manufactured and have proved themselves to be fully satisfactory and reliable in operation.

This line of engineering is backed by a tradition of several decades. As early as the time of former Austria-Hungary the Czechoslovak wagon factories manufacturing railway cars exported the major part of their products to South America, Egypt, Switzerland, Serbia, Russia and other countries. At the same time the first Czechoslovak locomotive works also exported their products, for example, to Italy. Railway safety equipment was also exported to a number of European states even in the last century.

The new development of these branches of production between the two wars gained new markets for Czechoslovakia. Locomotives and wagons of Czechoslovak make were delivered to India, China, Egypt, Burma, Greece, Bulgaria, Rumania, the USSR,

Colombia and South Africa. Wagon wheel-pairs were supplied to India as well as to Egypt and regular supplies of forgings, castings and spare parts were sent to other countries.

The Second World War interrupted the connections between the Czechoslovak industry and the traditional markets for a long time. After the armistice the industry was first faced with the task of modernizing the works and supplying the railways of its own country with the necessary equipment. It was only after several years that orders from foreign countries could be accepted. Since 1948 rail vehicles of Czechoslovak make have been seen in ever increasing numbers among the rolling stock of railway companies in Argentina, Holland, Western Germany, the USSR, Turkey, Poland, Hungary, Switzerland, Korea, Sweden, China and Bulgaria. Modern safety equipment is again being supplied to a number of countries in Central Europe, rails to Argentina and Egypt, steel bridges to Egypt, etc.

The Skoda Works known throughout the world, are the leading engineering works in Czechoslovakia. More than three thousand locomotives of various types have been built by these works. In the past as well as at present many patents in the locomotive line were and are the property of these works and they often choose new methods of solving subsidiary problems. Apart from other auxiliary equipment a new type of mechanical stoker has been developed by them which has also been supplied to foreign countries, and with which locomotives built by all the locomotive factories for the Czechoslovak State Railways have already been equipped for a number of years.

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The locomotive manufacturing works in co-operation with the electrical engineering section of the Skoda Works have already built many hundreds of D.C. electric locomotives for railways at home as well as abroad. The latest Bo' Bo' type of four-axle 80-ton locomotive for 3000 Volts D. C. surpasses, with its relative weight per unit of output and some characteristics in design, all existing locomotives of approximately the same output designed for the same electric current system.

Another Czechoslovak factory manufacturing locomotives, known by the name of CKD, is at present developing a new series of Diesel-electric locomotives in a variety of outputs and gauges, with outputs of from 60 HP. to 1650 HP., which may still be increased. Their successful development is proved by orders from abroad which have already been placed with these works.

A number of Czechoslovak works manufacturing railway cars and linked by the common trade-mark of TATRA manufacture various types of passenger cars, brake vans, trucks and special wagons, not only for service at home, but also for railway companies in India, Turkey, the USSR, Egypt and Korea as well as well proven motor coaches the production of which was started already 30 years ago. In co-operation with the firm of Amler of Switzerland an outstanding measuring car of up-to-date design has been developed and built. It is highly efficient in operation at a speed up to 60 km. per hour. Satisfactory results have been obtained with this car in service on railways in Czechoslovakia and Hungary. Self-propelled trolleys and trailers, which are necessary for the inspection and maintenance of tracks, are also manufactured by one of the TATRA plants.

In Czechoslovakia there are two highly specialized works which supply locomotive

and wagon manufacturing works at home as well as abroad with the necessary equipment and carry out the maintenance of the existing rolling stock. These are: the JURAN works, formerly Friedmann, manufacturing injectors, lubricating and train heating equipment, and the KOVOLIS works, which manufacture air and vacuum train brakes of the Bozic, Matrosov, Kazancev and Knorr types. Last year the International Union of Railways approved for use in international operation the new DAKO type air brake of Czechoslovak design and make, which at present best satisfies the technical conditions of the International Union of Railways and, at the same time, enables the haulage of more heavily loaded trains at higher speeds even on comparatively steep slopes. The products of the JURAN and the KOVOLIS works have been exported in recent years to Poland, the USSR, Argentina, Switzerland, Western Germany, Rumania, Korea, Yugoslavia, Sweden and Hungary.

For the maintenance and building of tracks Czechoslovakia supplies not only rails and switches with auxiliary rail material, but also various machines from rail bending machines, sleeper and rail drills, rail saws, hydraulic jacks to dredgers, Skoda road rollers, compressors/manufactured by ATMOS/, welders and Diesel-electric generating sets/supplied by SKODA-MEZ/. For the construction of tunnels, bridges and other structures concrete mixers, cement injectors, vibrators are manufactured and for the construction of buildings there are also mortar rough-casting machines, cement guns, etc. The manufacturing schedule also incorporates STAVOLOKO-SKODA building locomotives, TATRA tipping trucks and rails for field railways. All these machines facilitate many kinds of work which are still often done manually and thus reduce their cost.

Railway workshop equipment is represented in the Czechoslovak production schedule by many universal and special machine tools

which are known throughout the world under the trade marks of TOS, MAS, Podhajsky, and SKODA. Railway workshops and depots must also be equipped with turn-tables, traversers, rail weight bridges and cranes. All this equipment as well as the steel structures of halls for depots and workshops are manufactured by the Czechoslovak bridge manufacturing works.

Stationary equipment for the electrification of Railways with D. C. current has been manufactured in Czechoslovakia for the last thirty years. It comprises rectifiers of the well proven CKD make, steel masts, erection and wiring material for overhead lines, A.C. switching stations, transformers of SKODA and CKD makes, Metra and Tesla measuring instruments, etc. By mutual co-operation of the TATRA and CKD works mobile transformer stations have been designed provided simultaneously with a maintenance workshop, an office and a room for personnel.

The TESLA works, specialized in telecommunication engineering manufacture, produce special equipment of up-to-date design for railway communication service which fully complies with the requirements of specialists. Such equipment includes the fully automatic railway telephone exchanges for local and long-distance calls. One of the leading features of this system is the possibility of making local and long-distance priority telephone calls and the change-over of all lines with automatic long-distance dialling to semi-automatic operation in case of defects.

Further TESLA equipment includes induction selectors by means of which it is possible to connect up to thirty stations to a two-wire circuit. Each of these stations can call several or each station separately.

By applying induction dispatching again upto 30 stations are connected to one two-wire system. These stations cannot, however, call each other, connection being possible only through the main dispatching station. The latter can be equipped with a loud speaking telephone. In order to improve the service of railways it is possible to supply, for instance, a disposal switch-board for Assistant Station Masters, special telephone sets, etc.

Signalling instruments and equipment for safeguarding the train during travel and for other purposes in connection with railway service are manufactured in a variety of types under the ELEKTROSIGNAL trade-mark. Electrical equipment for the lighting of all kinds of railway cars is manufactured by the VEDKA, SKODA and KRIZIK works in mutual co-operation and has been supplied abroad, for instance, to Poland, Bulgaria, Turkey, Korea and the USSR.

The present development of economic activities in many foreign countries makes claims on their railways which either cannot be realized economically with existing equipment or cannot be realized at all. The necessary development can be ensured only by means of new investments. The Czechoslovak industry is willing to take over a part of the task of providing foreign railways with new technical equipment. Deliveries to foreign countries are carried out by the Czechoslovak works with great care and in strict conformity with the different technical Standard Specifications, the requirements of operation in the tropics as well as other circumstances and requirements of the customer. The products of Czechoslovak make ensure, in international competition, full satisfaction not only of railway experts, but also of a large circle of passengers and shippers.

Motive Power on the Gotthard-line and the new Co Co-Locomotive

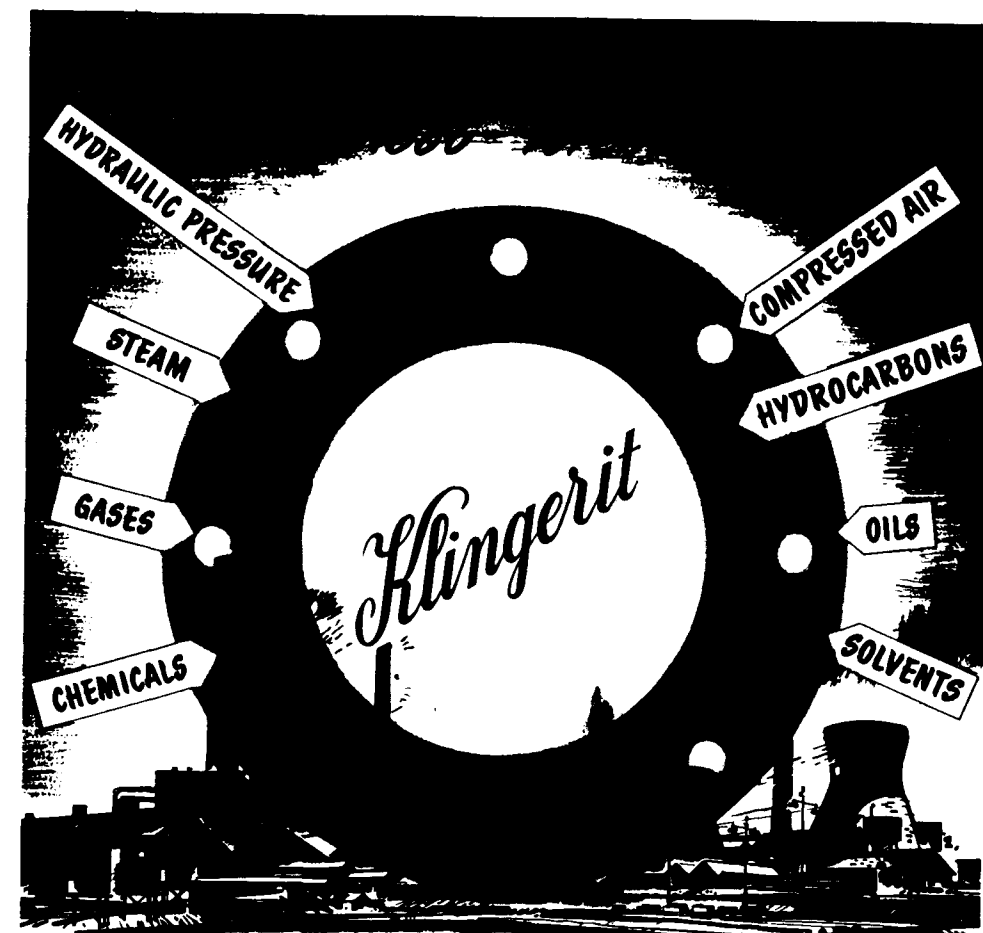
AS recently as 1945 four Ae 4/6 locomotives were put into service on the Gotthard-line and were at that time the newest on that route. In the meantime, however, new developments led to the replacement of this design. With improvements in traction motor design, transformers and other equipment, as well as the application of self-supporting body structures and all welded box structure bogies to the locomotives it has no longer been found necessary to include carrying axles in the design. It has now been realised that leading carrying axles are no longer required for good running stability even at high speeds. Locomotives are now being built to use their full service weight as adhesion weight, with axle loads of 20 tons and developing 1000 HP. per axle. In this way an eight-wheel locomotive with a rating of 4000 HP. need only weigh 80 tons while those on the Gotthard-line with 80 tons adhesion weight have service weights of 105 tons, 111 tons and 123 tons for the Ae 4/6, Be 4/5, and Ae 4/7 respectively. It follows that a modern locomotive with 6 driving axles and 6000 HP. rating will have a weight of 120 tons and one with 8 driving axles and 8000 HP. rating a weight of 160 tons as compared with the 235-244 tons weight of the existing Ae 8/14 machines.

In no instance is it more desirable to reduce the service weight of locomotives than on mountain railways such as the Gotthard-line. It is little wonder therefore that this new technique was also employed on this line of the Swiss Federal Railways.

Serious consideration has been given to the desirability of 4, 6 or 8 axle locomotives but without any carrying axles. The strength of the draw-gear limits the trailing load to 770 tons for one locomotive. When it is required

to pull heavier trains, intermediate assisting locomotives must be employed. To haul 770 tons over the steep gradients of the Gotthard requires, with an axle load of 20 tons, 8 driving axles. Thus a Gotthard locomotive to be of permanent and general use must have 8 driving axles, and this requirement led to the design of the Ae 8/14 series.

Experience has shown that, from an economical point of view, locomotives with 8 driving axles or two multiple-unit controlled locomotives with 4 driving axles each, are not the best solution for the traffic requirements of the Gotthard-line. To avoid the necessity of changing locomotives as the gradient varies and to save time and extra personnel, the same locomotive must haul passenger and goods trains between Erstfeld and Chiasso and in the case of fast services between Zurich or Lucerne and Chiasso. This means that though the trailing load may reach the maximum permissible over steep gradients, an unnecessarily heavy locomotive weight has to be pulled along the intervening sections of the line. In the interest of speedy traffic and smooth operation this disadvantage would have to be accepted if the majority of trains, at least, were to be of maximum weight. This, however, has not been the case. The increased number of trains as well as the employment of new light-weight rolling stock caused the average weight of fast trains on the Gotthard-line to be only 380 tons in 1951. In 1949 only 3.6% of these trains reached a weight of more than 600 tons. A similar situation exists with goods traffic. To accelerate the goods service, additional trains had to be provided thus reducing the average train load. The average weight of goods trains hauled by the existing double-unit



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locomotives with 8 driving axles over the Gotthard in 1951 was 430 tons as compared with a possible maximum of 770 tons. Traction with 8 driving axles therefore leads to poor average utilisation of the traction vehicles.

Locomotives with only 4 driving axles and 80 tons adhesion weight have proved below the standard required for through passenger and goods traffic on the Gotthard-line. On a yearly average about 50%, during peak traffic season 80%, of the fast trains had to be double-headed over the steep gradients. This calls for undesirable service stops and is prejudicial to the efforts made to accelerate traffic.

Since for economical operation locomotives with 4 driving axles have proved too small and those with 8 driving axles too large, the use of locomotives with 6 driving axles appears to be the best solution of the problem. With these considerations in mind the Traction and Workshops Division of the Swiss Federal Railways formulated in 1948 the requirements for such a locomotive as follows :

- (1) The locomotive shall have 6 driving axles built into 2 three-axle bogies or 3 two-axle bogies.
- (2) The axle load shall be 20 tons and the weight of the locomotive, therefore, 120 tons with $\pm 2\%$ tolerance.
- (3) The locomotive shall be required to haul trains of 600 t. over the steep gradients of the Gotthard-line and start from rest with such loads on gradients of 27‰ . On gradients up to 21‰ the trailing load shall be 750 tons.
- (4) The locomotive shall be capable of reaching and maintaining a speed of 75 km/h (47 m.p.h.) on a gradient

of 26⁰/₀₀ with a load of 600 tons and with goods trains under similar conditions a speed of 40-60 km/h (25-37.5 m.p.h.)

- (5) The maximum running speed shall be 125 km/h (78 m.p.h.) with a tractive effort of 8000 kg (8 tons) at this speed.
- (6) The locomotive shall be provided with an electric regenerative brake. This brake shall be capable of braking the locomotive continuously on a falling gradient of 27⁰/₁₀₀ for any speed between 35 km/h (22 m.p.h.) and 75 km/h (47 m.p.h.). The double of this braking effect shall be available for short periods.
- (7) Efforts shall be made so that curves may be negotiated without detriment to the track or the locomotive at the following running speeds :

60 km/h (37.5 m.p.h.) in curves of 175 m
(575 ft.) radius
80 km/h (50 m.p.h.) in curves of 280 m
(920 ft.) radius
100 km/h (62.5 m.p.h.) in curves of 465 m
(1530 ft.) radius
110 km/h (69 m.p.h.) in curves of 580 m
(1900 ft.) radius
125 km/h (78 m.p.h.) in curves of 830 m
(2720 ft.) radius
- (8) The locomotive shall be fitted with a speed-related high performance brake, producing a graduated effect on the brake blocks both during application and release. Besides the automatic brake, a non-automatic brake, acting on both the locomotive and the train, and a shunting-brake acting on the locomotive shall be provided. The brake rods shall be fitted with an automatic adjusting device.

On the bases of these requirements projects have been submitted to the Swiss Federal Railways by the following firms:

**Swiss Locomotive and Machine Works
Winterthur (SLM)**

Brown, Boveri & Co. Ltd., Baden (BBC)

Ateliers de Construction Oerlikon, Zurich
(MFO)

SA des Ateliers de Secheron, Geneva (SAAS)

An order for the construction of two prototype machines was placed in November

1949: for the mechanical part with SLM,
for the main electrical equipment with BBC,
for the electric brake equipment with MFO
and for the electro-pneumatic motor con-
tactors with SAAS.

The development of this new locomotive construction has called for the close co-operation of the interested firms with the Traction and Workshops Division of the Swiss Federal Railways, and though, a big task, it has turned out very satisfactory. The following articles will illustrate how this work of 2½ years duration has been brought to a successful conclusion.

I. MAIN DATA OF LOCOMOTIVE

Gauge	..	..	1435 mm (4 ft. 8½ in.)
Type of current: single-phase 16⅔ cycles	..	..	15000 volts
Length over buffers	..	..	18400 mm (60 ft. 4½ in.)
Total wheel base	..	..	13000 mm (42 ft. 7¾ in.)
Wheel diameter	..	..	1260 mm (4 ft. 2⅝ in.)
			continuous 1-hour rating
Power at driving-motor shafts	..	..	5400 6000 HP
Corresponding travelling speed	..	..	78.5 74 km/h
			49 46 m. p. h.
Corresponding tractive effort at rails, with half-worn tyres	..	..	18000 21200 abt. kg.
			39700 46700 abt. lb.
			continuous
Brief starting tractive effort (average) at rails	..	..	32000 kg.
			70400 lb.
Maximum speed	..	..	125 km/h
			78 m. p. h.
Minimum tractive effort at rails at this speed	..	..	8000 kg.
			17600 lb.

WEIGHTS

Mechanical part, including drive and auxiliary equipment	..	66.1 metric tons
Electrical part	..	55.9 metric tons
Crew, sand, oil and sundries	..	0.5 metric tons
Service weight	..	122.5 metric tons

II. MECHANICAL PART

General construction

The mechanical part consists essentially of two similar three-axle bogies and a self-supporting locomotive body. The body has

to transmit the tractive and buffing forces, since the draw and buffer gear is fitted on its ends. Regarding the question as to whether 2 three-axle or 3 two-axle bogies should be adopted, the Swiss Locomotive and Machine Works, Winterthur, made very thorough theoretical investigations and

calculations. These led the Swiss Federal Railways to prefer the Co-Co type. Besides, it had been found quite feasible to construct bogies with three driving axles and the motors symmetrically fixed in the frame.

BOGIES

Because of the excellent experience made with the novel bogies developed by the Swiss Locomotive and Machine Works during recent years, it was evident that the same principle of construction should be adopted for these new locomotives also. The bogie frame is composed of hollow beams. The elements, formed for the most part of bent plates, are entirely electrically welded and have simple and neat lines. Particular attention was devoted to the design of changes in cross-section and of the head-beam corners, as well as to the inserting of the cross stretchers into the longitudinal beams. Certain parts, such as corner pieces and centre pin bearings are made of cast steel for reasons of shape and cost. The frame is supported on lateral carrying arms on each axle box through two coiled springs. In contrast to former constructions, no arrangements have been made to allow these springs to be removed from below. A friction damper is arranged at the side of each coiled spring to damp the vibrations in it. This damper consists of a simple rod whose upper end is fixed to the bogie frame, whilst the lower end is clamped between two friction discs loaded by spring pressure.

As in all modern locomotives of the Swiss Federal Railways, the axle boxes are guided by means of cylindrical guide pins which are supported in the longitudinal beams of the bogie frame and reach down into the interior of the coiled spring. These guide pins slide in bronze bushes which, enveloped by a silent-block cylinder, are pressed in the carrying arms of the axle boxes. Lubrication is effected by a totally enclosed oil bath. All driving axles run in SKF self-aligning roller bearings.

The locomotive body is supported on each bogie through sliding shoes on two double-leaf springs arranged in the longitudinal direction to the left and right of the middle driving axle, the ends of these springs being connected to each other by cross-beams. The latter pass under the longitudinal beams of the bogie frame, to which they are attached by pendulum links. This type of suspension makes it possible for the locomotive body to swing laterally when subjected to forces acting at right angles to the direction of travel.

Since the space over the middle driving axle is entirely occupied by the traction motor of that axle, a centre pin could not be fitted as in the modern two-axle bogies of the Swiss Locomotive and Machine Works. An imaginary pivot point was therefore created by having the above-mentioned sliding shoes of the locomotive body-support running in an arcuate slideway whose centre of curvature lies in the middle of the bogie frame. This slideway, as well as the sliding shoe fixed in the supporting beam of the body, is of wedge-shaped cross-section. Since the slideway is firmly connected in the horizontal plane to the shackle of the double-leaf spring, these leaf-springs are moved across, together with their suspension device from the locomotive body, when any lateral deflections occur. In order that the bogies may also have an angular displacement in the vertical plane, the above-mentioned slideways are carried on arched bearing plates. The slideways are of bronze, whilst the slide shoes and bearing plates are of case-hardened steel. All supporting elements rest in a dustproof oil bath.

Each bogie has two cross members, one on each side of the middle traction motor, into each of which a centre pin is pressed. These centre pins project downwards and engage in spherical bearings resting in cross members; the latter run under the bogie frame and are connected outside to the

underframe of the locomotive body. The centre pin bearings can move 47 mm. laterally in the body cross member. The bearings can also move in the longitudinal direction a distance of 10.5 mm. towards the outer driving axles and 1.5 mm. towards the bogie centre. This distribution of the longitudinal play guarantees not only the necessary movement of the bogies about their centres but also, that for both driving directions, the bogies always pull and never push.

In order to diminish the nosing angle and the guiding pressure of the leading wheels, the bogies are connected to each other by a novel form of cross-coupling. In this coupling, the rod which was pivotably attached to the bogies in former constructions, has been replaced by a triangular extension to the rear of the bogie frame. This makes it possible to design the cross-coupling also as requisite vertical coupling, which allows a certain compensating of the moments caused by the tractive effort and acting on the frame. The combination consists of a cylindrical part, which is fixed to one of the two bogies, and a cross-shaped stirrup piece which passes round the impact plates in the horizontal and vertical planes and is in its turn bolted to the other bogie frame. Three pairs of springs are arranged crosswise in the interior of the cylindrical part. The middle vertical pair serve to take the load-equalising forces, whilst the other springs, lying to the right and left of this, have to take the transverse forces that occur when running on curves. By means of shims, the springs can be set to the desired initial tension.

The thick full line at the top represents the load reduction of the axle if no vertical coupling is provided, i. e. without any load equalising. The lowest line refers to the "ideal case", i. e. the least possible load reduction of the axles. With the starting tractive effort of 32,000 kg. (70,000 lb.) for instance, the axle load reduction without

vertical coupling would be about 3300 kg. (7200 lb.), and with the "ideal" load equalising about 1300 kg. (2850 lb.). Depending on the characteristic of the spring, its initial tension, or its play in the coupling, a value lying between these limits can be reached. With an initial spring tension of 1000 kg. (2200 lb.) and without backlash (chain-dotted line), the axle load reduction for the same tractive effort will, for example, amounts to about 2100 kg. (4600 lb.). The experience made in service will show whether this improvement, which corresponds to about 7% of the normal axle pressure, makes itself practically perceptible and whether the extra constructional work entailed by such a vertical coupling is worth the trouble.

DRIVES

For transmitting the power of the motors to the driving axles, the spring drive, as formerly developed by Brown, Boveri & Co. and which has proved satisfactory in the Re 4/4 locomotives of the Swiss Federal Railways, has been adopted.

With this driving system it is usual for the large wheel to be carried on a hollow stub shaft. In the present case the bearer for this shaft is at the same time designed as a reinforcing frame for the motor casing; it contains an oil space from which the gear wheel bearing is lubricated by means of a wick. The self-aligning roller bearing as a result always receives fresh oil through this lubrication, which is quite independent from that of the rest of the drive.

The gears have helical teeth; the driving star and the large gear are of special cast steel, which may be case-hardened. The pinions are of chromium-nickel steel. The gear ratio is 1 : 2.216. The gear wheel train is protected by casings with labyrinth packings. All the axle drives are on the same side of the locomotive. This allows the cooling-air ducts of the locomotive to be arranged in a simple manner.

LOCOMOTIVE BODY

As in all recent locomotives of the Swiss Federal Railways, a self-supporting non-warping construction, composed of side walls, underframe and roof, has been adopted for the locomotive body. The whole shell of the body is of steel plate and completely welded. The longitudinals of the underframe consist of 6 mm. bent plates, whilst the thickness of the side walls is 2.5 mm. and that of the side roundings to the roof 3 mm. The buffer beams are also completely welded. In order to render the end walls of the body more resistant, they are made of steel plate 4 mm. thick. As is usual, the cabs are separated from the machine room by partition walls, in each of which a door is provided at the side to give access to the room. It should be noted that the fan sets have been located close to the side walls, so that the cooling-air is drawn in direct from outside through the louvres, arranged between the windows, and through the oil coolers lying directly behind these louvres. A ladder, let into the side walls and interlocked with the pantograph, allows access to the roof.

The machine room has 8 side windows, 6 of which can be swung up on hinges. For inserting and removing the machines and apparatus, the roof is provided with three light-metal covers over the machine room. The end wall of each cab has two front windows and also two smaller corner windows.

The driver's table, apparatus and instruments in the cabs are arranged in the manner usual in locomotives of the Swiss Federal Railways.

BRAKES

In compliance with regulations, the locomotives are equipped with automatic and also with direct-acting compressed air brakes, as well as with a so-called shunting brake.

The "Oerlikon" brake equipment has here for the first time been adopted on a main-line locomotive of the Swiss Federal Railways. This equipment, developed by the Machine-tool Works Oerlikon, allows step by step operation of the brakes when being released, as well as when being applied. It consists of the driver's brake valve type FV3 and the locomotive triple valve type L St 1, which have neither sliding parts nor pistons, and allow pressure losses to be made up whatever position the brakes may be in. The "Oerlikon" triple valve brings together, in one single appliance, the express, passenger-train, goods-train and antislip brakes, thus simplifying the brake arrangement considerably.

Two brake cylinders, fixed to the underframe of the locomotive body, act on each bogie. The brake-rod system of each bogie is divided into two sets. All three axles of each bogie may also have brakes applied to them by hand.

III. ELECTRICAL EQUIPMENT

When laying down the characteristic features of the electrical equipment of the new Gotthard Co Co-locomotive, it was possible to take advantage in a large measure of the experience gained with the Bo Bo-locomotives of classes "Re 4/4" of the Swiss Federal Railways and "Ae 4/4" of the Berne-Lotschberg-Simplon Railway (BLS) built within the last few years. This applied especially to the 4000 HP. Lotschberg-Locomotive, the specified trailing load of which differed from that of the Gotthard locomotive in the ratio of 2 to 3, the maximum speed of 125 km/h being the same in both cases and also the specified practicability of using the locomotive for freight and express passenger trains.

The full utilisation of the adhesion weight on the base of normal starting conditions on the 1 in 37—40 grades with the admissible axle load of 20 tons resulted in a traction motor capacity of 1000 HP. per driving axle.

MACHINE TOOLS FOR

HEAVY ENGINEERING — SHIPYARDS —

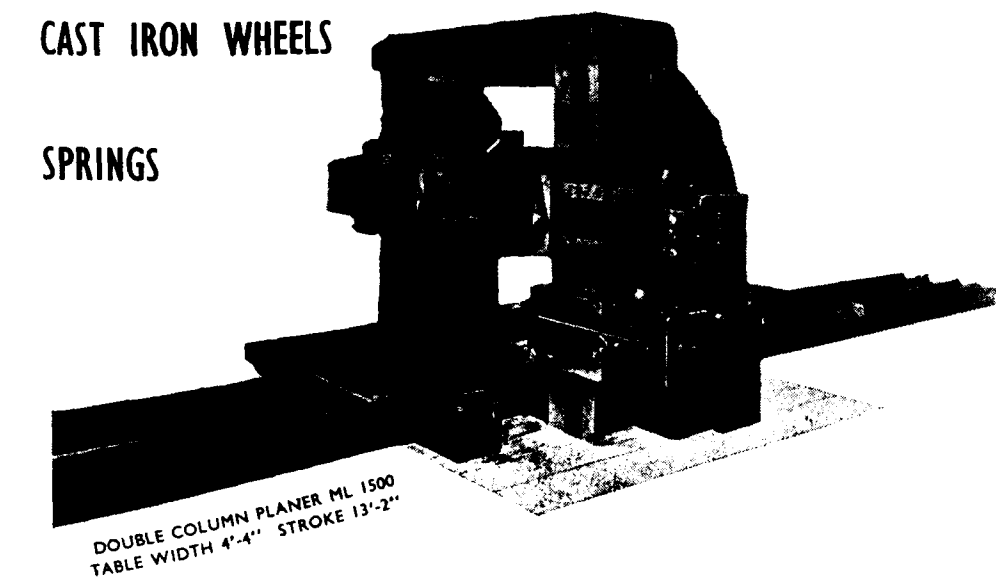
STEEL MILLS—RAILWAY WORKSHOPS.

ROLLS FOR STEEL—

RUBBER — PAPER INDUSTRIES etc.

CAST IRON WHEELS

SPRINGS



- S. EUSTACCHIO - BRESCIA
 - NAVALMECCANICA - NAPOLI
- ITALY—

This allowed of the application of the same driving motor which had been well tried on the "Ae 4/4" BLS locomotive during 8 years of operation.

In the following table the motor capacities

	Referred to one motor					Total tractive effort of locomotive at wheel treads kg.	Running speed km/h.
	HP	mkg.	r.p.m.	V.	Amps.		
1 hour	1000	1010	710	390	2150	21200	74.0
continuous	900	860	750	390	1920	18000	78.5

The maximum tractive effort of 32000 kg. corresponds to an average starting current of about 3200A per motor. The prescriptions of the International Railway Union were specified for temperature rise and dielectric strength test.

TRACTION MOTORS

The 14-pole single-phase traction motor has a frame with the air intake, inspection openings and suspension feet of interesting welded construction which has allowed of reducing the motor weight to a minimum; the end shields are steel castings. The frames of all 6 motors are of the same design and interchangeable, although the central motor is mounted vertically above the axle in the bogie while the two other motors are arranged in an inclined position relative to their axles in order to make the best use of available space.

The motors are built in the bogie in such a way that the air intake connections are all on the same side, against the outer wall of the locomotive, and that the commutators lay on the side of the inspection corridor inside the locomotive. The armature is supported on roller bearings at either end, and mica-silk and glass tissue have been used as insulating materials. Air for the forced-ventilation is drawn in through louvres in the locomotive side wall and forced by a double blower, with

for one hour and continuous operation and the corresponding tractive efforts and speeds are given ; the speeds and efforts are referred to an average driving wheel diameter of 1230 mm. and a gear ratio of 1 : 2.22 Wheel diameter with new tyres is 1260 mm.

common driving motor between them, into the three traction motors of each bogie. The oil coolers for the transformer and the additional equipment for the regenerative braking system are exposed to the air flow.

MAIN APPARATUS AND TRANSFORMER

The locomotive is provided with two electropneumatically actuated current collectors of the standardized Brown Boveri/ Swiss Federal Railways type, only one of which is normally raised for operation.

The oil circuit-breaker which was formerly used as main circuit-breaker, had already been replaced on the "Re 4/4" locomotives by a modern Brown Boveri air-blast circuit-breaker which excludes risks of explosion and fire. The apparatus in the "Re 4/4" class, which was designed for mounting inside the locomotive, has since been developed, so that it may also be mounted on the roof. This design allows the apparatus to be used for motor coaches as well as locomotives and has been specified by the Swiss Federal Railways for all recent locomotives and motor coaches and thus also for the "Ae 6/6" locomotives. With its nominal rating of 400 A at 15000 V and 16 2/3 cycles and a breaking capacity of 150 MVA this circuit-breaker will meet all the requirements of the Swiss Federal Railways' network.

The necessary switchgear for the motor circuit comprises mainly, per group of three motors or per bogie, three single-pole electro-pneumatic contactors built by Secheron at Geneva and an electro-pneumatic reversing and braking change-over switch with 4 positions for motoring and braking, forward and reverse. It is possible to isolate each motor in case of a failure by lifting-off the respective contact-fingers on this switch.

The speed regulation of the locomotive is accomplished in the primary circuit of the transformer by means of the Brown Boveri high-tension control which has been used in various locomotives of the Swiss Federal Railways and of other railway companies in Switzerland and abroad with full success.

This type of control is especially suitable for locomotives of high capacity and with large motor currents, as the current that has to be broken on the primary side is reduced in the inverse ratio of the primary to the secondary voltage. The tap-changer is notable in requiring only three mechanical contactors for breaking the current, none of the other regulating contacts is submitted to any current breaking duty, and their movable parts are built as rollers, so that there is practically no wear in operation.

Thanks to the high-tension control, the amount of apparatus for a mountain locomotive with all six traction motors connected in parallel and with heavy currents is moderate.

The high-tension tap-changer with 27 running positions is virtually a constituent part of the transformer. This latter is of the well-known type with central core and radial laminations as built by Brown Boveri in recent years for over 155 electric locomotives and motor coaches. The laminated iron yoke is mainly composed of the radially-laminated cylindrical main column and of the magnetic return yokes in E-form which are bolted to it. The cylindrical primary and

secondary windings, the control winding and a special winding for the auxiliary circuits are arranged in the space between column and yokes.

The heating equipment is connected to suitable taps on the control winding, the leads from which are connected to the tap-changer of the high-tension control equipment. This apparatus contains in a silumin casine the contact bars and step contacts for voltage regulation ; it is similar in design to that of a battery end-cell switch, and is oil-filled. The step contact rollers are moved by a pair of chains which in turn are driven by gearing from a d. c. pilot motor. Three current breaking contactors, operating in air, that work according to the position of the movable contacts are built on to one side of the tap-changer casing. On the other side there is a case containing the auxiliary contacts, which are cam-shaft operated and serve to ensure the correct sequence of the control operations. The preventive resistance are arranged on the top of the transformer.

Transformer and tap-changer form a unit which may be tested in combination in the test room and subsequently built in the locomotive through an opening in the roof.

The large number of running positions allows of a fine graduation of the tractive effort resulting in a shock-free acceleration of the train good use of the adhesion weight, with correspondingly reduced risk of slipping.

CONTROL EQUIPMENT

A system of mechanically actuated position switches is used to control the tap-changer. This control operates so that when the master controller hand wheel in the driving cab is turned to a given running position, a contact for cutting-in the pilot motor of the tap-changer is closed. As soon as the

tap-changer has reached the running notch selected by the master controller, this contact is broken and the pilot-motor shut down. The interruption is effected through a shaft driven by the tap-changer which connects this apparatus with the control system in the master controller. The same shaft actuates a position indicator in the master controller; in an emergency it may also be used as a mechanical drive for the tap-changer if there is a failure of control current or if the driving motor should fail. In this case a handwheel is put on the end of the shaft projecting from the master controller in the cab which is connected to the mechanical position indicator. After the tap-changer control has been changed over by means of a special lever on the control box of the tap-changer, from motor-to hand-drive, the control system may be operated by hand in the same way as in normal working. There are thus two methods of control for the locomotive, independent of each other, which ensure at any time and practically in any circumstances its readiness for operation, which is especially important on a mountain locomotive. The master controller built in each driver's desk is so arranged that it may be operated from either a sitting or standing position. Besides the handwheel for regulating the speed in 27 notches for motoring (rotation of the handwheel in clockwise direction) and in 10 notches for electrical braking (rotation of hand-wheel counter-clock-wise) the master controller comprises only the position indicator which is operated from the tap-changer and a contact-drum with handle for reversing the direction of running.

REGENERATIVE BRAKING EQUIPMENT

With regard to the long down-hill runs occurring on the Gotthard-line, due con-

sideration was given to the electrical braking of the locomotive weight for increasing safety of operation and saving brake blocks. For reasons of standardisation of material the Oerlikon regenerative braking equipment was specified. In this system one of the traction motors acts as exciter for the 5 others. This electric brake, with its 10 notches, allows of braking the locomotive from a speed of 125 km/h to nearly standstill on all down grades on the Gotthard and on the adjoining flatter-grade sections, two different braking connections being used for covering this range.

AUXILIARIES

No special mention need be made of the train heating, service lighting, various protective relays, control boxes, instruments and switchboards for the auxiliaries, as these items of the electrical equipment, which are largely standardized by the Swiss Federal Railways, are the same as in all the recent locomotives and motor-coaches of this railway system. Certain special features must however be mentioned: the electro-pneumatically actuated anti-slip-brake of Brown Boveri system which on the one hand greatly facilitates starting under adverse adhesion conditions and on the other hand reduces to a minimum the consumption of sand and as a consequence soiling of track and locomotive; the modern indirect lighting of the measuring instruments from inside the driver's desk, the speed indicators with electric remote drive from a transmitter mounted on a driving axle; the perfected safety device of the Maschinenfabrik Oerlikon for one-man drive and the arrangement of the whole driver's cab equipment which was carried out in such a way that the control and operation of the locomotive are rendered as easy as possible for the driver, whether he be sitting or standing.

PACK - LABEL - MARK CAMPAIGN

In the first week of June 1956, the 'P.L.M.' week was observed on the Central Railway with a view to ascertaining the extent to which the Packing, Labelling and Marking of consignments was found defective. At the same time endeavours were also made to educate the staff as to the correct methods to be adopted in this respect in order to ensure effective packing, labelling and marking.

East African Railways "59th" Class Engines

*The locomotives have a total weight in working order of 252 tons
and a tractive effort 83,350 lb. at 85 per cent boiler pressure*

IN 1892 a survey was carried out for a railway to be built between Mombasa and Lake Victoria, but it was not until 1898 that the first section of the line from the coast to Voi was opened to the public and at that time there were 24 locomotives. In 1901, the Uganda Railway, as it was then called, having reached Kisumu, on Lake Victoria, 585 miles from Mombasa, was opened for traffic. The gauge of the railway although originally planned to be 3 ft. 6 in. was actually built as metre gauge, partly as a result of a misunderstanding. The construction of the line because of the terrain through which it traversed, had necessitated extensive earth-works which were equivalent to a 4½-ft. embankment throughout the whole 585 miles.

AMALGAMATION OF RAILWAYS

In 1948 the Kenya and Uganda Railways and the Tanganyika Railways were amalgamated to form part of the East African Railways & Harbours Administration and today there is a total route mileage of 3,100 miles of metre gauge line. The main line of the Kenya and Uganda section Mombasa to Nakuru climbs to over 9,000 ft., Nairobi, the capital, being at an altitude of 5,600 ft., so it is not surprising that 541 miles of this line have gradients of 1 in 66 or steeper.

In 1926 the first Beyer-Garratts were introduced on the railway with an axleload of 10 tons, and they immediately showed their suitability, so that by 1938, 36 locomotives of the Beyer-Garratt type were operating some two-thirds of the traffic on the main line. During, and after the war, further Garratts have been supplied to assist in moving traffic, which had greatly increased

during the war and has continued to do so. With the completion of the delivery of the 34 locomotives which comprise this present order, the railway will have 149 Beyer-Garratts in service.

REALIGNMENT OF TRACK

The original line was laid with 50-lb. rail and today a considerable amount of the total route miles are still of this weight. On the main line improvements have been made to eliminate the momentum gradients and realignment of the track between Nakuru and Mombasa has been carried out. Extensive relaying of the line has also been undertaken with heavier rail of 80 lb. and 95 lb. sections. This, coupled with investigations carried out on rail stresses has resulted in greatly increased axleloads being permitted on the main line.

This increase in axleload opened the way to the employment of even more powerful locomotives, and the "59th" class Beyer-Garratts are the first locomotives to be designed to meet these new conditions, they have a tractive effort of 83,350 lb. on a maximum axleload of 21 tons. They will operate on the 329 mile Mombasa-Nairobi section which carries the greatest density of traffic in East Africa and will be used for hauling loads of 1,200 tons over the 1 in 66 gradients. This load is a 71 per cent increase over the present permitted maximum of 702 tons.

These Beyer-Garratt locomotives which are the most powerful metre-gauge locomotives in the world have been designed to the requirements of Mr. G. Gibson, the

Chief Mechanical Engineer, East African Railways, and built under the supervision and inspection of the Crown Agents for Oversea Government & Administrations. The overall length of the locomotive is 104 ft. 1½ in. and the total weight in working order is 252 tons, including 8,600 gal. of water and 2,700 gal. of oil fuel.

THE BOILER UNIT

Ample steam production is ensured with the boiler which is 7 ft. 6 in. dia. and has a grate area of 72 sq. ft.; the length between the tubeplates is 15 ft. The boiler is of all steel construction, the firebox is of the round top type with radial roof stays, the front three rows being flexible and the inner firebox is of Colville's Double Crown brand plates, while the firebox stays are of Dunic steel. All the stays are riveted over on the fire side.

Although the fire hole door is of the usual type used on oil-fired locomotives, the fire hole in the boiler backplate is large enough to accommodate a mechanical stoker, should the need arise to convert this class to coal burning, provision is also made for fitting five arch tubes if needed to support a brick arch. The firebox backplate has plate gussets, which are also used for staying the smokebox tubeplate, this being of the drumhead type. Cross staying of the outer wrapper plate is provided above the inner firebox.

Dry steam is ensured by using a Melesco steam dryer in the dome and the superheater header in the smokebox combines a multi-valve regulator, the 50 superheater elements are 1½ in. o.d., 9 s.w.g. thick, this equipment being supplied by the Superheater Co. Ltd. The flue tubes are 5½ in. outside dia. and the small tubes of 2 in. dia., all tubes being made of Aquacidox steel. The chimney petticoat can be easily adjusted for height, while four Goodfellow tips are fitted to the blast pipe.

The flame pan is of ample size and is fitted with two burners which are accessible for servicing below the front of the firebox. The oil firing equipment is to the Railways' standard and incorporates a heating coil in the oil tank, and a secondary heater alongside the foundation ring. A thermometer is provided to show the oil tank temperature. Ample washout facilities are provided on the boiler and one Everlasting blow-down valve is fitted on the firebox throat plate and one on the mud collector under the boiler barrel. Alfloc continuous blow-down equipment is fitted.

Three Davies & Metcalfe live steam injectors are fitted, two on the fireman's side of the boiler, and one on the driver's side, each operated by a quick-acting steam valve fitted in front of the cab; the injectors feed into a treble clackbox mounted on the top of the boiler in front of the dome. A steam turret is fitted forward of the cab together with three 3-in. Ross pop safety valves. The boiler is lagged with Fibreglass mattresses supplied by W. Gilmour Smith & Co. Ltd.

ENGINE UNIT

The bar frames of the engine units are 4½ in. thick machined from rolled steel slabs, forming a rigid foundation with the cast steel stretchers. The cylinders are of cast iron, each pair being bolted together on the engine centre-line to form a rigid stay. The cylinders and valve chest have cast iron liners, and the pistons are of cast steel with cast iron peripheries and three narrow rings. Wota N.C. type bypass valves together with anti-vacuum valves are fitted on the cylinders.

The cylinder drain cocks are operated by a steam servo cylinder on each unit. The cylinder and main steam pipes are lagged with Fibreglass. Britimp packing, supplied by the British Metallic Packing Company is used on the piston rods. Cast steel cross-heads of the Laird type with the arms cast

integral are used, the slippers being of cast iron with whitemetal linings.

A Hadfield Precision power reverser is used to operate the reversing gear. This patent reverser with fingertip control has proved itself in over 700 applications to give positive selection and to retain the desired cut-off with complete absence of creep. The valve travel is 6½ in. and the valve liners are 10 in. bore, the Walschaert valve gear being arranged so that the dieblocks for both units are in the lower position of the link for chimney first running.

Case-hardened motion pins of adequate size are used in conjunction with bronze bushes to give generous bearing surfaces. The fixed pins are in bushes of hardened steel. Skefko self-aligning roller bearings are used on the main driving crankpin and for the return crank. The remaining coupling rod bearings are of bronze, whitemetal lined, the bushes being pressed into hardened steel bushes fixed in the rod eyes.

To enable the locomotive to negotiate 350-ft. radius curves without gauge widening the intermediate and driving wheel tyres have thin flanges while all the other wheels have normal tyre profiles. All tyres are Taylor Bros. Empire 70 brand. It is of interest to note that although the locomotive has been designed for metre gauge, provision is made so that if at a later date the gauge of the railway is altered to 3 ft. 6 in., the locomotives can be converted with a minimum of trouble to the new gauge by the fitting of new tyres and with some machining of the wheel centre.

The locomotive is fitted throughout with British Timken roller bearing axleboxes of the cannon type, those of the inner trucks being of a special design to accommodate the bridle bracket and oil baths for the bearing spring shoes and side control spring gear brackets. The couple wheel axlebox guides

are to a special East African Railways' design, which eliminate the normal adjusting wedges. The faces of the guides and axleboxes are fitted with manganese steel liners to give long life and reduce wear.

The outer bogie frames are one piece steel castings made by Beyer, Peacock & Co. Ltd. Laminated springs are used for the suspension and for the side control, in conjunction with two-pin swing links. Compensated springing is divided in two groups on each side of the engine units, one group being the outer, intermediate and driving coupled wheels and the other being the inner coupled wheels and inner truck.

Care has been taken to provide adequate staying of the engine units, cast steel and plate stretchers being used. The pivot centre cast integrally with the frame stretcher is of the patented Beyer Peacock self-adjusting type, which has been successful since its inception, and has proved to be one of the most important items contributing to the success of the Beyer Peacock design of the Garratt locomotive.

LUBRICATION AND ACCESSORIES

Each engine unit is fitted with a 12-feed Silvertown mechanical lubricator for feeding the piston rod glands, steam and exhaust pipe ball joints, cylinders and valves and on each unit an eight-feed lubricator of the same design feeds the pivot centres and slide bars. The horn cheeks are syphon-fed from oil boxes as are also the Walschaert gear, connecting and coupling rod bearings, except those on the driving crank where the Skefko bearing is grease packed. Ajax soft grease lubrication is used for the brake gear and for the pins of swing links on the bogie.

The locomotive is fitted with a steam brake on both units, while a hand brake is fitted in the cab which controls only the rear unit.

For braking of the train a Westinghouse automatic brake is used; twin air compressors being fitted on the left hand side of the smokebox, the steam cylinders of which are lubricated from the cab by a two-feed Wakefield AC type hydrostatic lubricator with a separate condenser, a Gresham & Craven proportional steam brake valve is fitted for use in conjunction with the air brake. Compressed air sanding is provided to the inner and outer coupled wheels of each unit, so that adequate sanding can be provided for running in either direction, this equipment also is supplied by Gresham & Craven Limited.

ABC couplers of the M.C.A.-P.H. type are fitted in conjunction with Spencer Moulton rubber draw gear, provision being made for replacement of this drawgear if required at a later date by the Alliance type of automatic knuckle couplers. The small steam pipes between the boiler and engine units are fitted with Flexstel flexible joints.

The oil fuel tank is of all welded construction and is fitted in the space provided in the rear unit's water tank for a coal bunker should the occasion arise to change over from oil fuel. Space has also been left to accommodate a mechanical stoker complete with conveyor trough if required at a later date.

The two water tanks are of robust design with riveted joints and are secured to the engine units by the Beyer Peacock patented method of flexible fastenings. To provide quick levelling in the tanks when high speed fillings is used on the railway, two large bore equilibrium pipes are fitted. In the curved portion at the outer ends of the tanks, provision is made to carry lifting jacks.

CAB AND FOOTPLATE

In the tropics a large cab of ample size with an insulated double roof and plenty of

ventilation is a necessity, these cabs conform with these requirements and are provided with comfortable seats upholstered with Dunlopillo for the engine crew. A tip-up seat is provided for the inspector. All the controls are conveniently placed, and the regulator is fitted with a handle on each side of the cab. The oil burning controls are suitably positioned in front of the fireman, and provision is made for pre-steaming.

SPEED INDICATOR

A Smith-Stone's electrical speed indicator is fitted, and two Klinger water gauges of the reflex type, which are marked to show the minimum water level on various gradients, an important consideration on a railway with heavy gradients. Electric lighting is provided in the cab and current is produced by a turbo-generator, type LBB, supplied by J. Stone & Co. (Deptford) Limited; the equipment includes a headlight on the front unit, a back-up lights on the rear together with classification lights and the illumination of the valve gears. A useful feature is the provision of plug points to which the lead for an inspection light can be attached.

The locomotives will be painted on their arrival in Kenya in the railway colours of maroon and black with yellow lining and red bufferbeams, and will be numbered 5901 to 5934, inclusive.

The new motive power should prove a welcome addition to that already in service, being economical and reliable in operation. The principal dimensions of the new locomotives are given in the following table :

CYLINDERS (4) dia. and stroke	20½ in. × 28 in.
COUPLED WHEEL dia.	4 ft. 6 in.
BOGIE WHEEL dia.	2 ft. 9 in.
MAXIMUM AXLELOAD	21 tons
LENGTH OVER BUFFERS	104 ft. 1½ in.



Drilling capacity in steel... 1/2 inch.
Spindle speed full load... 490 r.p.m.
Watts input on full load... 570 Watts.
Overall length... 13½ inches.
Nett weight... 17 lbs.

The Wolf range of drills has been found essential in Shipyards, Railway Shops, Bridge Construction and Heavy Structural Engineering Work. There is a good range of WOLF drills for general purposes and for heavy duty. The latter types are all ball-bearing, ranging from ½ to 1½. The Model WD4c (illustrated) has a drilling penetration speed of over 2" per minute in solid steel. The secret is the extraordinary development of the power-to-weight ratio and maintenance of drilling speed and torque.



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UNRIVALLED FOR POWER, PERFORMANCE AND DEPENDABILITY

TOTAL WEIGHT in working order	252 tons.
BOILER PRESSURE	225 lb./sq. in.
HEATING SURFACE:	
TUBES	3,313 sq. ft.
FIREBOX	247 sq. ft.
TOTAL EVAPORATIVE	3,560 sq. ft.
SUPERHEATER (inside)	747 sq. ft.
Total	4,307 sq. ft.
GRATE AREA	72 sq. ft.
TRACTIVE EFFORT at 85 per cent boiler pressure	83,350 lb.
TRACTIVE EFFORT at 75 per cent boiler pressure	73,540 lb.
OIL CAPACITY	2,700 gal.
WATER CAPACITY	8,600 gal.

U. K. FIRM TO SUPPLY CABLES FOR INDIAN RAILWAY ELECTRIFICATION

A contract for the supply and installation of underground power and control cables in connection with the electrification of the Eastern Railway in the Calcutta region has been awarded to a British firm (British Insulated Callender's Cables Ltd.) in conjunction with its associate (Indian Cable Co. Ltd.).

The total value of the contract is in the region of £ 250,000, and is for 245 miles of control cable and 33 kV, 11 kV and 3.3 kV paper-insulated feeder power cables.

Certain sections of the Eastern Railway are being electrified to improve communications in the central and suburban areas of Calcutta. Work on the first stage, covering the main line between Howrah and Burdwan and the branch line to Tarakeswar, has already begun.

Electrical Train Units For The Indian Railways

(Contributed By Breda Ferroviaria)

IN the past few years while competing in the face of the World's most famous industries, BREDA FERROVIARIA has been awarded three tenders for supply of electrical train units to the Indian Railways and delivery of the first electrical train units in the series of 12 for Bombay Suburban Railways, under 1954/55 Programme has already started in March last: BREDA FERROVIARIA is one of the most successful, if not the most ancient Italian firm building railway rolling stock.

Established in 1880 for the construction of steam locomotives, Breda's field very soon spread out covering any type of railway vehicles as designed and achieved for many an Italian and Foreign purchaser. In 1908 the one-thousandth locomotive built by Breda came out and the vehicles running today, i.e. standard coaches, sleeping cars, dining cars, Diesel railcars, electrical railcars, electric trains, luggage vans, wagons and vehicles of any type specially designed, are in the range of several tenths of thousand and are well known the World over.

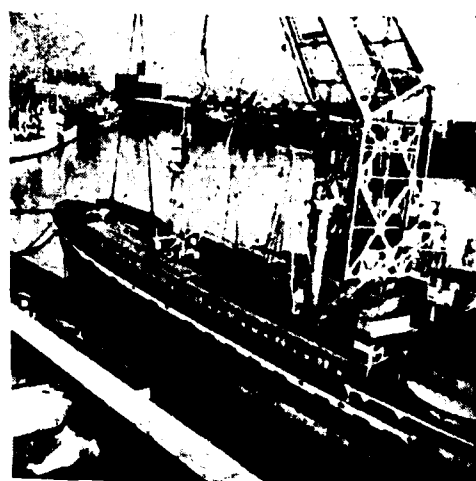


Interior view (third class).

As far back as 1923 studies have been underway for building light-weight railcars powered with diesel engines and these studies materialized in achieving those speedy railcars the various versions of which headed out to conquer the favour of the operating people and of the public through long years of heavy running.

1936 stands for the first articulated electric trains comprising 3 cars each, for speedy connection between Milan and Rome; at that time already these electric trains achieved during experimental running a speed of 203 km/h, while the normal operating speed, on suitable permanent way, was 160 km/h as it still is today.

After World War II Breda participated very efficiently in rebuilding the half destroyed Italian State Railways units. Along with this task although extending over several years, it has nevertheless been possible to



One complete train is loaded for transport in India



Diesel Railcars ALn 880.



The bar in the restaurant car.

design and build some new very interesting vehicle types. Out of these we would mention :

- (a) A substantial series of new very comfortable attractively streamlined Diesel Railcars for the Italian State Railways, 27 meters long, 90 seats, having a flat engine beneath the frame in the centre, 130 km/h speed. These railcars are either intercoupled or running with a trailer of a similar type by means of a special Breda patented device. Such device is composed of a through-foot-board with bellow, built as a recessed passage-way in the platform of the car ; the end doors fit perfectly into the streamlined car ends and open by sliding upwards and recessing into the



One of 16 passenger compartments ten seats each.



Glass wall between passenger compartments and the corridor.

ceiling. The device allows for the coupling to be made within three minutes time and does not change anyhow the streamlined feature of the vehicle.

- (b) Light-weight railcars of various types for private Customers and for foreign Railways ; all fitted with most modern fluorescent lighting and oil burning heating. Gauge is standard or narrow. The railcars are speedy and travellers enjoy particularly provided comfort.
- (c) Numerous coaches of various types for the Italian State Railways used for international traffic and new dining-cars for the Compagnie Internationale des

Wagons Lits. Stainless steel has here been generously used for pantry and kitchen and laminated plastic panels are fitted for attaining a characteristic outfit of the dining place.

- (d) The already well known speedy electric trains ETR 300 for the Italian State Railways, composed of 7 indivisible elements, i. e. 4 passenger coaches, 1 dining and bar car, 1 kitchen and service car, 1 luggage van, a shop and radio-telephone. These most modern electric trains stand out against all the rest of the Italian railway stock production on account of the smartness of design and the pleasing attractiveness of interior outfit; in fact plated glass walls separate the passenger compartments from the corridor; fluorescent type lighting is very generously arranged for; the automatic air conditioning is set by very sensitive thermostats providing for a constant temperature throughout the year round and each compartment looks like a comfortable small parlour with 6 sofa seats and 4 armchairs freely removable. Very practical cabinets in every compartment are closed up by painted panels showing different subjects made by well known artists. These cabinets are to be used for small luggage.



Seven coaches not separables.

Walls in the dining car and in the bar are also enhanced by similar panels. These electric trains fitted with any most advanced comfort have been running on de-luxe tours for the past 3 years from Milan to Rome.

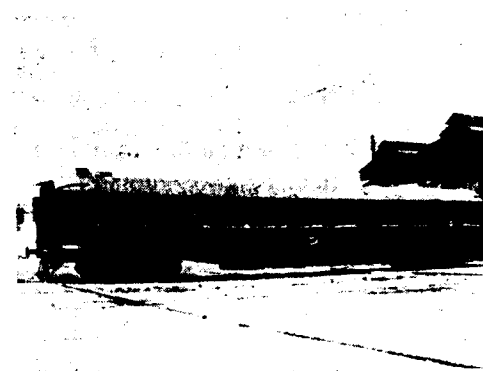
The electric train units for the Indian Railways under construction now with Breda Ferroviaria for the Suburban Railways of Bombay, well deserve to be pointed out among Breda's achievements both for their particular technical characteristics and outfit suitably studied for the environment where these trains are to operate, as well as for the magnitude of the work.

The trains we are describing hereunder are to run on the railway system along the coast of the Indian Ocean connecting Bombay with the nearby places.

Each train is composed of 4 coaches, two of them being motor-coaches and two trailers, offering a totality of 72 Upper Class seats and 515 Lower Class seats. The power unit comprises 8 electric motors located on the four bogies of the two motor-coaches. Motors are series connected two by two, feeding is by 1500 Volt direct current, the total capacity is of 1400 HP allowing for a maximum speed of 65 m.p.h. (105 km/h).



The exchange for measuring the stresses under static tests.

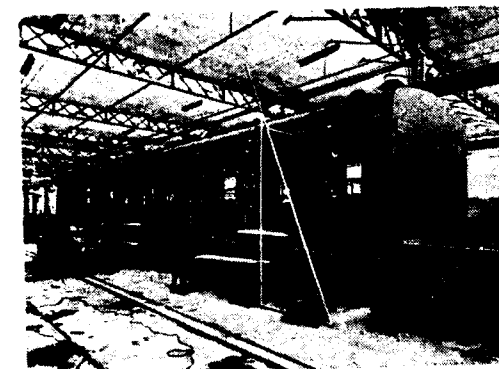


Restaurant car for C. I. W. L.

The coaches of these electric trains look very much like underground railways coaches and in fact they likewise have ample sliding doors (four doors on each side) allowing for top readiness of access and exit of the travellers, access being flush with the station platform; arrangement of the seats is such as to leave ample space for standing people; handgrips are handy. All these features are intended to cope with rush transport of masses of people on runs with many intermediate stops.

Breda Ferroviaria has always given particular care to passengers' comfort and to the good looks of production; this policy has been maintained in designing the trains for the Indian Railways, although they are to operate on short runs only. In view of the hot and moist climate where the trains will run, very special attention has been given to heat insulation of the coaches and an air gap has been devised for the air to circulate between the exterior surface of the coaches and the interior surface of the compartments. Air circulation in these air gaps is enhanced by convection due to temperature difference between outside and inside and between lower and upper parts and it is moreover increased when the train is running by 4 rotating Flettner type ventilators located on the roof facing each platform and taking movement from the wind while likewise running.

AUGUST 1956

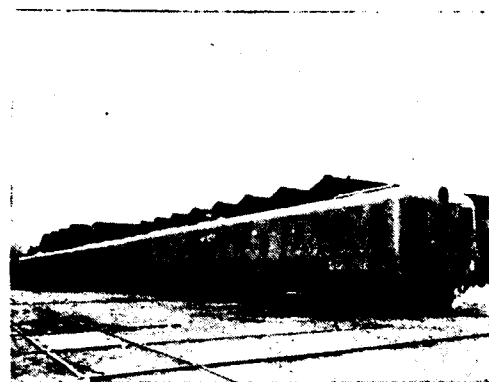


One coach ready for static tests.

Other Flettner ventilators draw out the foul air from inside the compartments through suitable ports with open grids in the ceiling; in addition inside of the coaches the air is moved by an adequate number of electric fans. The side walls of the compartments, i. e. the walls separating the passengers' place from the aforesaid air gap, are made of special panels where the outer face layer is of "rexilon" (resinated wood) while the inside layer towards the gap is of aluminium sheet. Between these two layers there is another layer made of resinated glass wool insulating material (ultralite).

Inside walls of the compartments are matchingly painted with brilliant colours of various blue shades for the Upper Class and green for the Lower Class. Fittings and luggage racks are made of polished anti-corodal and stainless steel skirting gives a particular elegance to the various compartments where the floor is of dark red. The flooring joining the sides, as well as the skirting and the lower parts of the seats are built water-tight, so as to allow for hose washing.

The windows have throughout light alloy framing and likewise of light alloy are the louvres protecting passengers from violent light and strong sun radiations. On the lower part the louvres have an attinic plated glass pane enabling passengers to look



Electro Train for Indian Railways.

out of the window even when the louvres are down.

The Lower Class seats are made of melaminic resin panels, while the Upper Class seats have cushions and backs of foam rubber covered by plastified purple-red cloth.

Electric lighting in opaline round ceiling fittings is of the incandescent type and is such as to give an intensity of light of 4 candles per square foot in the Upper Class and 3 candles per square foot in the Lower Class, both at a height of 33 inches from the floor.

Direct 120 V current for lighting is obtained from two motor generators, one for each motor-coach; each one of these motor generators is feeding all the right hand or left hand bulbs of the train and thus, even in case of failure of one motor generator, the entire train does not remain without light. Some of the ceiling fittings are fed by the batteries, instead of the motor generators and thereby the train can never happen to be completely dark. Lighted head codes at the coach and indicate the route and the number of the train.

A chain alarm signal for passengers is provided; operating is by handles of plastic material; the signal acts on a switch which releases a bell in the cabin and at the same

time an exterior signal is mechanically operated at the end of the coach where the alarm has been released.

Traction equipment on the 12 train units under Item 16 of 1954-55 Purchasing Programme has been supplied by Messrs. English Electric, while on the 12 trains under Item 8 of 1955-56 Programme, the traction equipment has been supplied by Messrs. Ansaldo San Giorgio. Specifications request this equipment to have characteristics enabling to meet the requirements of a very severe service with frequent stops and quick accelerations under worst climatic conditions in the area where the trains are going to run, i. e. by a humidity degree up to 100%. In fact an average acceleration on level is requested of 1.10 m.p.h./sec. up to a speed of 35 m.p.h. and it is furthermore required the train to be started even with half of the power units cut-out on gradients of 2.9 per cent (1:34). Therefore the motors are so designed as not to reach harmful temperatures even under the most heavy operating conditions.

The equipment parts located under the frame are arranged to be water-tight up to a height of 2 ft. and 6 inches above rail so as to enable the train to run even under floods reaching 20 cm. above rail and waves up to 40 cm. due to the train running, i.e. under



Interior lower class coach.

conditions liable to occur during the period of heavy rains.

Braking equipment is of the electropneumatic type.

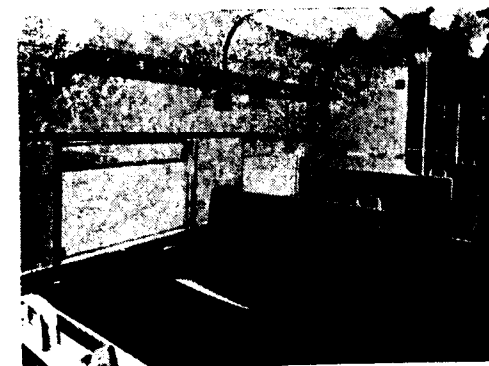
On the driving desk the brake handle can be shifted into five positions: normal running setting, electropneumatic braking, lap position, automatic or pneumatic braking, and emergency braking corresponding to simultaneous acting of electropneumatic braking and pneumatic braking. There is a signal panel available to the driver with a buzzer and tell-tale lamp advising whether electropneumatic braking has been acting according to the driver's request. All electric and pneumatic equipment, both of traction and braking have been installed and grouped for maintenance to be utmost facilitated and for any possible replacement of single parts to be readily made, as well as of complete groups.

On the roof next to the pantograph devices have been fitted for protection of the equipment aboard against overvoltage and lightning.

Bogies are remarkably sturdy and frames and swinging bolster are made of riveted steel sheet. The swinging bolster is divided into two portions, an upper portion with pivot and bearers and a lower portion:



One lower class compartment.



One upper class compartment.

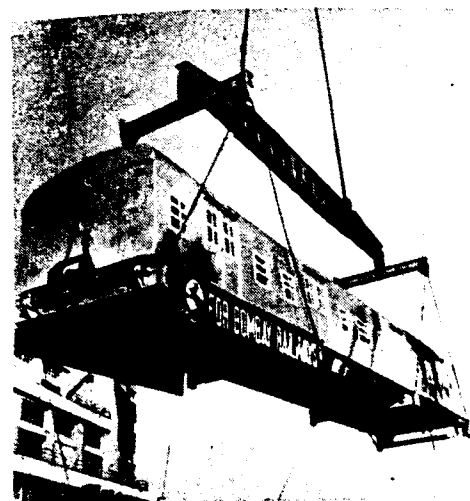
between them there is a spring system consisting of four spring sets with three concentric helical springs.

The swinging bolster is suspended to the frame by means of four sloping links in order to allow for hunting movement of the superstructure. The upper part is guided into the bogie frame by replaceable ferobestos plates secured to the frame and by manganese steel plates secured to the bolster.

Load is taken over by the axleboxes from the bogie frame through four springing sets with links which can suitably be regulated; each set is composed of a leaf spring and two helical springs. The axleboxes are likewise fitted with manganese steel wearing plates sliding against replaceable ferobestos guides secured to the axle guards. Total flexibility of springing is of about 3 mm. per t.

The coaches are intercoupled by Alliance mechanical automatic couplers and bridge mating buffers, whereas on the train ends Majex couplers are fitted with lateral standard buffers.

It certainly has not been an easy task to design and to achieve in just one year and a half a mechanical unit of such magnitude as is a train of entirely new type to be built in series. The more so in considering that requirements of the Specifications had to be met, such as designing and building in using



Loading one coach on board.

English dimensions instead of the metric system and adhering to Indian and English standards. Numerous problems had moreover to be dealt with as arising from contractual clauses.

MACHINE INDUSTRY INVESTMENTS IN HUNGARY

IN the next five years £ 105,000,000* is to be invested in developing the Hungarian machine industry.

This is part of the £ 1,000 millions Five Year Plan (1956-60) proposed by the Hungarian Working People's Party which is now being discussed nationally before being presented to Parliament in a few weeks' time.

About 80 per cent of the investment will go to extending existing plants.

Proposed output in the five years includes :

- 90 motor trains
- 200 motor ships
- 9,000 crawler tractors
- 10,000 universal tractors
- 10,000 corn combines
- 17,000 maize combines

The annual figure for diesel locomotives

* Converted at rate of 33 forints to £ sterling.

By the way Breda Ferroviaria had to amplify and newly equip their facilities for undertaking static tests carried out on a Motor Coach and a Trailer prototype under various vertical loads and horizontal axial load for reproducing stresses as would arise to the superstructure in case of compressure. Incidentally we would point out that just for stress reading of strain gauges fitted on about 300 points of the superstructure under load the electrical circuits connected to the reading exchange required up to 6 kilometers of electric cable.

Only because of Breda Ferroviaria being backed by several tenths of years of experience in the field of vehicle construction has it been possible, within the short time permitted by the contract, to achieve the construction of electrical train units so utterly different as to their constructive and functional characteristics from any other train units normally being built for European Railways.

and diesel tractors is not given, but it is planned that by 1960 the annual output shall reach 380 locos. and 5,700 diesel motored tractors. It is intended that by 1960 diesel motor output, reckoned by horse power, will be seven times what it is at present.

Besides these investments on the production side, £ 300 millions is to be spent in five years on extending transport services.

About 1,500 miles of railway track is to be renewed and a number of single track lines are to be doubled up.

Transport of goods by water is to be raised by nearly 50 per cent and by road 60 per cent. In the five years 17,000 new lorries and 1,100 long distance buses are to be put on the roads. Town transport expansion includes the provision of 140 new trams, 165 trolley buses and 600 motor buses.



INDUSTRIAL PLANTS AND ACCESSORIES



An oil Fired Car bottom furnace.

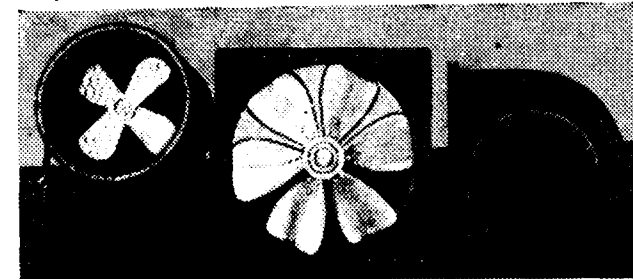
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Profiling Car Wheel Lathe— Model WN-1000

HITACHI SEIKIS CAR WHEEL LATHES which we explain here are our newly designed machines of high productive efficiency. These machines embody many important improvements as the result of our research and experience in our manufacturing of car wheel and driving wheel lathes in the past 20 years. Furthermore, in designing these machines we took into consideration the opinion of the Railway

Ministry which uses a great number of car wheel lathes.

The number of car wheel lathes and driving wheel lathes which we manufactured since 1928 and the place where we delivered them to are as follows. These raised Japanese reputation of fine industrial standard at each destination.

	Period before 1945		Period after 1945	
Overseas	Manchuria		Taiwan	1 set
	Korea	19 sets		
	Formosa			
	North China			
	U. S. S. R.	67 sets		
Domestic	Railway Ministry	54 sets	Railway Ministry	25 sets
	Private Railway Co.	5 sets	Private Railway Co.	4 sets
	Total	145 sets	Total	30 sets

We made a contract with Egyptian Republic Railways for car wheel lathe 1 set, in 1950.

The object of this machines is to return the tread and flanges of wheels of railway passenger and freight cars, front and rear wheels of locomotive and tender either in the shortest time by the effective use of carbide Tipped tools or high speed steel tools, and for such purposes, we adopt the complete profiling mechanism by which the efficiency of the machine is surprisingly double-held. The main characteristics of this machine are as follows :

- (1) By adopting profiling mechanism and hydraulic chuck, the operator can save time and energy, so that one-man control operation is easily effected.

- (2) As all the operational equipments are positioned centrally on this machine, your controlling such as engaging and disengaging of feeds, traverse of tool rests, feed changes, main spindle revolution, etc. are conveniently afforded by your "centralized control".
- (3) It is just required to use only circular roughing tools from roughing to finishing, therefore, the using of forming tools in former times becomes unnecessary.

It is, in another words, summarized from the above three, your actual operating time



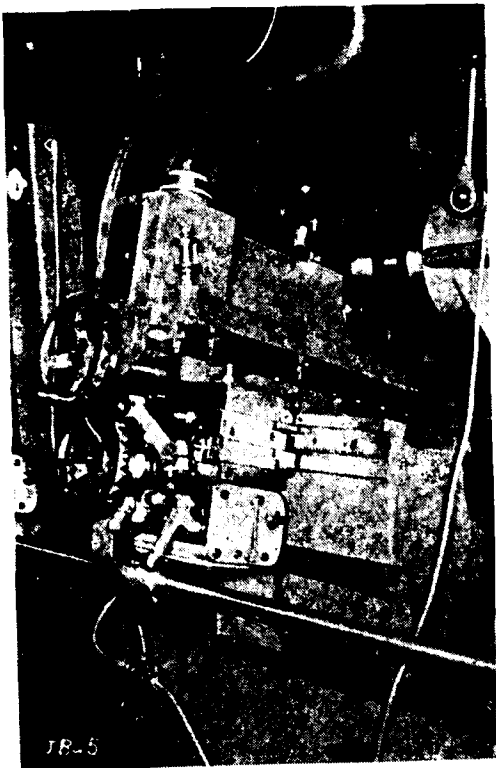
HYDRAULIC CHUCK—MODEL WN-1000
On both the faceplate of either the head-stock side and tail-stock side, there are two hydraulic chuck with hydraulic driving jaws equipped each. Such chucks are controlled by the same mechanical system which is common usable for the tail-stock clamping valve too.

per a pair of wheel, including it's installing and dismantling, is reduced as a half in comparison with the time-honored common car wheel lathes.

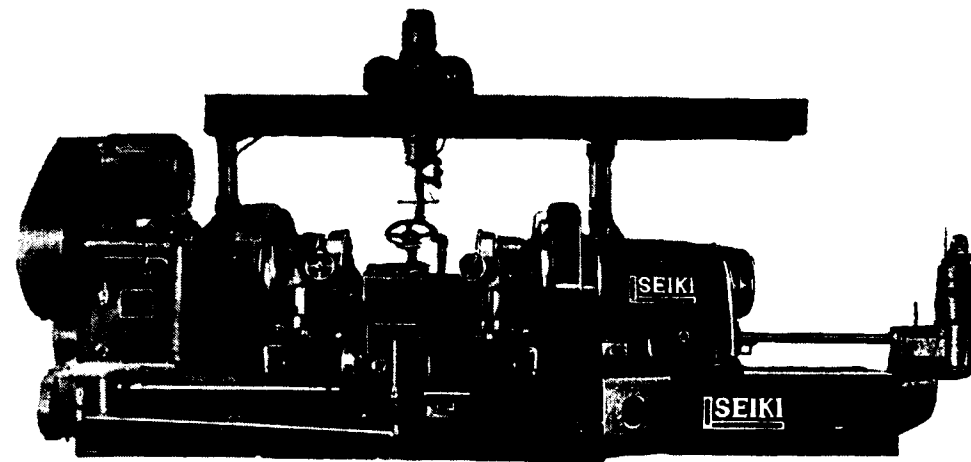
Major Dimension

Swing over bed	..	..	46 ¹ / ₂ "
Wheel Gauge	..	..	3' 6"
Cutting dia. on tread	..	..	30 ² / ₃ —39 ¹ / ₈ "
Dia. of faceplate	..	..	43 ⁵ / ₈
Distance between faceplate	..	..	78 ³ / ₄ —122 ¹ / ₂ "
Number of main spindle speed	..	..	8
Range of main spindle speed, rpm.	..	..	2—30
Feed per one revolution of faceplate	..	..	¹ / ₈ "— ³ / ₂ "
Number of feed	..	..	4

AUGUST 1956



TOOL REST—MODEL JB
For convenient operation, two tool rest which being provided with feed change device are equipped to each saddles. These tool rests are provided with a complete set of returning tools and burnishing rollers. The complete operation for facing at right angle or returning and burnishing at parallel to the journal portion is accomplished by means of power feed and hand feed without re-setting any tools. After returning the journal, smooth and fine surface is obtainable by equalizing the most suitable pressure to burnishing operation with the aid of dial indicator.



PROFILING CAR WHEEL LATHE—MODEL WN-1000

Motors :

Main motor	.. ..	30 KW
Tailstock traverse motor	.. ..	5 KW
Tailstock & chuck fastening motor	.. ..	2 KW
Tool rests traverse motor	.. ..	3 KW
Hoist motor	.. ..	1.5 KW
Oil pump motor	.. ..	0.75 KW
Feed Gear box motor	.. ..	0.75 KW

The range and individual feeds can be altered to suit the customer's requirements.

Regular Accessories :

Motor & its accessories	.. ..	6 sets
Controlling switchboard cabinet for above	.. ..	1 set
Center & driving jaws	.. ..	1 set
Hoist	.. ..	1 set
Tool holders for tread & back gauge	.. ..	2 sets
Test bars & gauge	.. ..	1 set
Foundation bolts & levelling wedges	.. ..	1 set
Spanners & handles for operation	.. ..	1 set

Special accessories :

Disc bite (High speed steel 26 mm. o)

**AXLE JOURNAL RETURNING
AND BURNISHING MACHINE**

Hitachi seiki's Axle Journal Returning and Burnishing Lathe is a single purpose machine designed especially for returning and burnishing the inside and outside axle journals of

wheels of locomotive cars and also for facing the bosses of wheel centres round the axle journals.

The experience and engineering skill acquired through more than 40 years shall offer the advanced simplified designed and

heavy rugged construction and fulfill the following features.

- (a) Weight of machine 19 ton (approx.)
- (b) Satisfactory and continuous lubrication of all moving parts, gears, bearings, etc.
- (c) Power traverse for the motion of

clamping centre sleeve to ensure quick centering of the machine.

- (d) Driving and supporting device to suite all sizes of wheels.

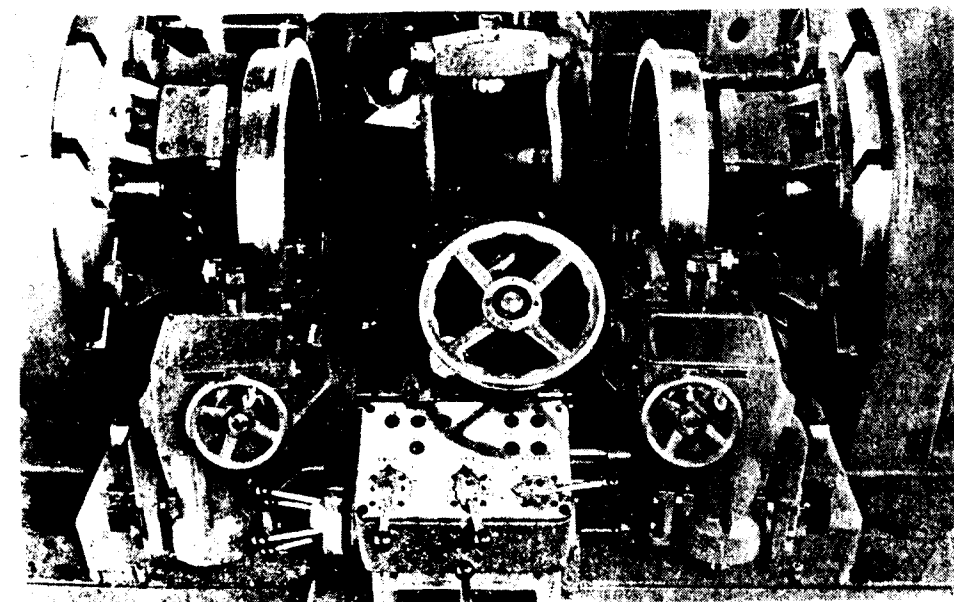
The number of Axle Journal returning and Burnishing Machines which we manufactured and the place where we delivered them to are as follows. These raised Japanese reputation of fine industrial standard at each destination.

	Period before 1945.		Period after 1945.	
Overseas	Manchuria			
	Korea			
	Formosa	4 sets		
	North China			
Domestic	Railway Ministry	14 sets	Railway Ministry	28 sets
	Total	18 sets	Total	28 sets

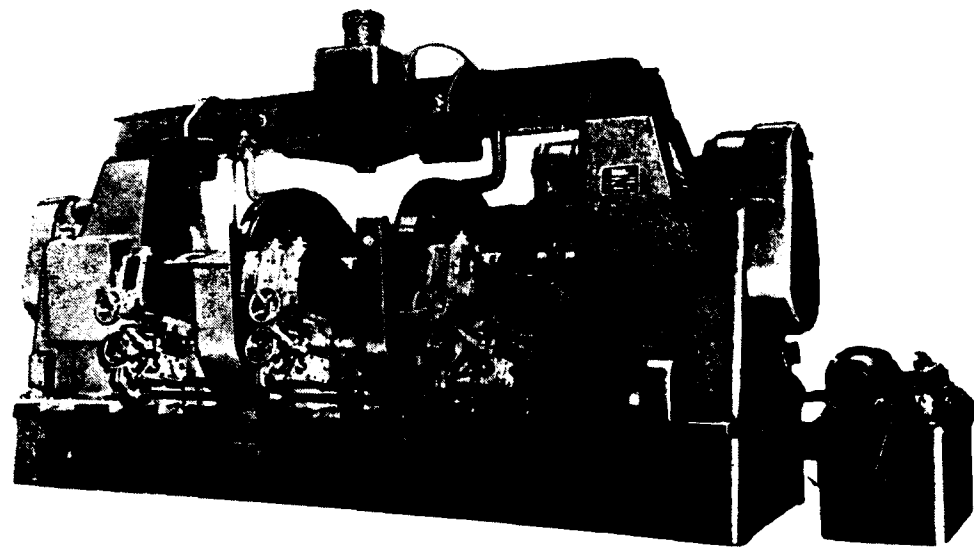
We made a contract with Egyptian Republic Railways for Axle Journal Returning and Burnishing Machine 3 sets in 1950.

This machine is designed especially to burnish the journals by using the rollers, after accurate and efficient returning inside and outside axle journals.

The rotation of flexible rollers are transmitted through speed change gears, running in oil, and pushing the flexible rollers on tread of wheel results the rotation of wheels.



One Man Control Mechanism around Tool rest—MODEL WN-1000



AXLE JOURNAL RETURNING & BURNISHING MACHINE—MODEL JB

Operation of machine

- (1) Starting and stopping of flexible rollers for driving the wheels.
- (2) Speed change and longitudinal and cross feed change.
- (3) Sliding of centre sleeve fitted to both head stock.
- (4) Starting and stopping of hydraulic pump and others.

Main dimension

Center height (on bed)	..	..	31½"
Distance between centres	..	..	68½"—80½"
Dia. of driving wheel will be fixed	..	..	36½"—55½"
Dia. of journal will be turned & burnished	..	..	4½"—7½"
Dia. of face will be turned	..	..	15½"
Number of work speed	..	..	4
Range of work speed, rpm. (on 51½" dia. of driving wheel)	..	..	8—50
Cross feed per one revolution	..	..	¼"—¾"
Number of cross feed	..	..	6
Longitudinal feed per one revolution	..	..	¼"—1½"
Number of longitudinal feed	..	..	6

Motors :

Main motor	..	..	7.5 KW
Oil pump motor	..	..	3.5 KW
Center sleeve sliding motor	..	..	3 KW
"	..	..	0.4 KW
Floor space	..	..	296"X150"

All the operations are controlled at the centre of machine where it is most convenient for the operator.

Regular Accessories

Motor & its accessories	4 sets
Center 90	2 sets
Test bars	1 set
Foundation bolts & levelling wedges	1 set
Spanners & handles for operation	1 set

The KLL Train— A Swedish Light-weight Train

By Erik Aspenberg

Chief Engineer, AB Svenska Järnvägsverkstäderna, Linköping.

THAT railway passenger traffic has suffered severely in competition with other forms of transport, especially the motor car, is generally admitted. The number of passengers has fallen, particularly on short-distance runs and on branch lines in thinly populated regions. Long-distance traffic is the category that has stood up best, and in Sweden it is now the backbone and economic basis of passenger traffic. Long-distance traffic in this context means transport in ordinary passenger trains and expresses over stretches of above 100 kms or so.

However, the problem of maintaining and improving the financial strength of the rail-

ways is one with which railway managements all over the world are struggling. Passengers must be attracted to the railways, and must be provided with fast, comfortable and up-to-date transport at as low price as possible. Efforts are mostly being directed towards developing and improving the long-distance traffic, this being as mentioned above the category that bears the main burden.

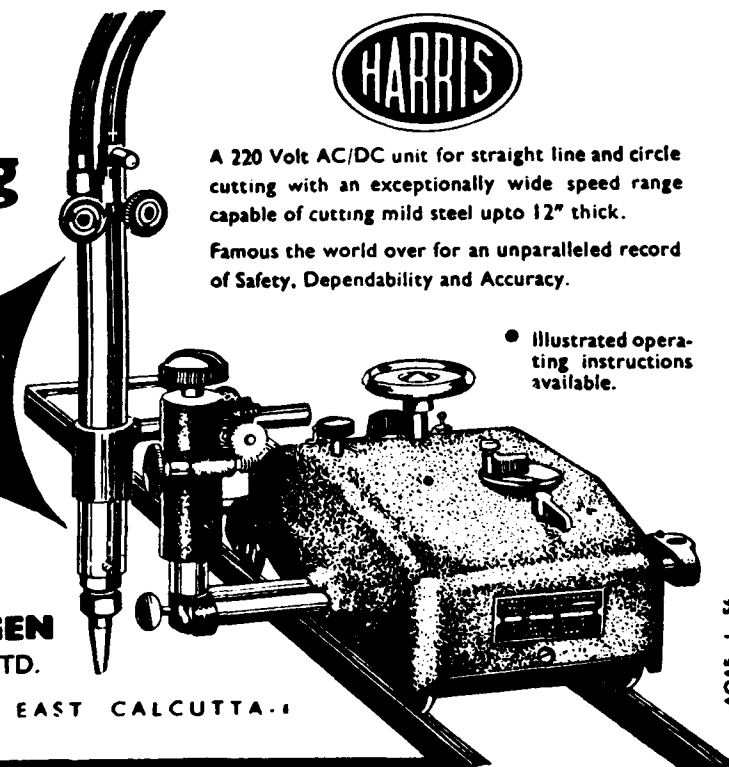
Many ways of meeting the stiffening competition are being tried. Since one undeniable advantage of the car is that the traveller can choose his own time of departure, this competition could, by way of suggestion, be met by supplementing the ordinary main

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express traffic with minor expresses. This would give more departures to choose from. Further, the features which it is desired to make characteristic of rail travel, i. e. speed, comfort and punctuality, can be specially underlined. Efforts are also being made to improve service abroad trains, such as sanitary and sleeping arrangements, the provision of meals, and much more besides.

Whatever approach we employ to increase traffic and ease the financial situation, we find that the rolling stock is of decisive importance. At present, indeed, the rolling stock itself, by its very nature, often sets limits to what is advisable on economic grounds when it is desired to provide a fast modern train of moderate size, which nowadays is becoming more and more common requirement. By reason of main dimensions and technical fittings which have been established practice for many years the rolling stock available is heavy and expensive. The design of other means of transport has been developed to the point where the accepted type of train can scarcely be described as up-to-date in comparison. The objective today is rolling stock which is faster, lighter and more elegant, yet nevertheless low-cost.

The case for a new approach to the design of railway material is further supported by important technical considerations. The vehicles should be adapted to the nature of the load to be carried. Passengers, regarded for the moment as freight, can without hesitation be classed as "bulky goods", which becomes more manifest the more carriage space we give to individual passengers. This naturally focussed attention on the weight of the carriage. At present, the weight per unit of seating is considerably higher than what is required from the point of view of comfortable riding, passenger safety etc. Since such factors place no obstacles in the way of a reduction of vehicle weight, designers should direct their efforts to the creation of substan-

tially lighter rolling stock, since this brings very tangible advantages within reach. The wear on wheels, bearings and other moving parts is reduced. Less material is required in the manufacture of carriages and their capital cost reduced. The locomotive can be lighter and needs less power, so that it too becomes cheaper. The lower axle loading would have beneficial effects on the rate of wear and the extent of maintenance work on the permanent way.

One feature of present-day railway carriages that strikes one as behind the times is the high floor level. On the Swedish State Railways most station platforms are 380 mm. high, reckoned from the top of the rails, and the aim should be a carriage design where no more than one step up is required from these platforms to the floor of the carriage. Moreover, this step should be kept within reasonable bounds. With the present carriages, three good-sized steps must be climbed, which is naturally uncomfortable.

FOREIGN TRIALS

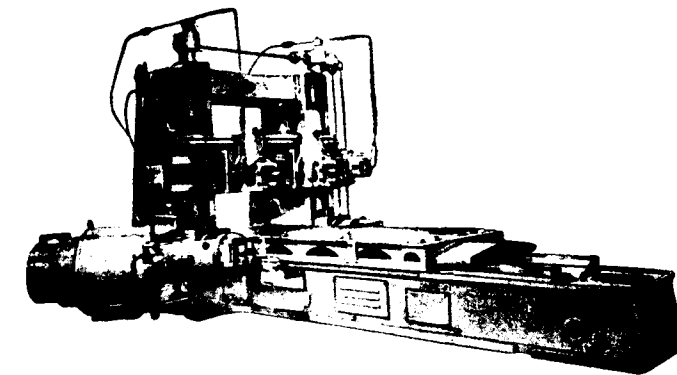
The consideration mentioned above have led to many new rolling-stock designs being tried out in other countries. The "Talgo" train of 1950 in Spain was the first example, followed by the German "Gliedertriebzug" in 1953 and the American modified "Talgo", "Train X" and "Aerotrain". All these designs have light weight, low boarding height and low centre of gravity in common. The carriages have been shortened to make them easier to handle during manufacture and more adaptable in design.

THE SWEDISH KLL TRAIN

Without exception, all the new designs appearing abroad have been in the form of fixed-length trains, which signifies that they consist of several carriages forming an indivisible whole. In several instances, too,

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The three ASJ-built KLL carriages on a trial run in the spring of 1956.

they can only be driven in one direction. These disadvantages limit ease of handling in marshalling yards, and make it impossible to vary the size of a train, its make-up in respect of classes, etc., according to requirements, and it is not so easy to turn the train when it reaches terminals. In Teknisk Tidskrift No. 3, 1952, a proposal was put forward for a train built on the same general lines as the foreign models, but without the above-mentioned drawbacks. The train was conceived primarily for Swedish conditions, and its carriages were *short, low and light*. The initial letters of these words in Swedish, *kort, lag and latt*, gave the design its name, the KLL Train.

The KLL train consists of individual carriages which are coupled together by an automatic central coupling. Each carriage has two axles, or perhaps it is preferable to say four wheels, since the wheels are freely mounted on a fixed supporting axle. Each carriage can be added to or withdrawn from the train at will, and can run in both directions. All carriages have the same main dimensions, and can be built as day carriages and sleeping-cars with optional class, as dining cars or buffet cars, as mail vans or luggage vans, etc. The train will be drawn by a locomotive specially designed for the type.

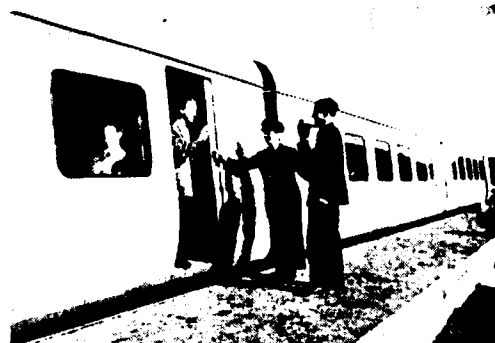
The idea of the KLL train was worked out at AB Svenska Järnvägsverks stadernas factory in Linköping, and when the designs

had been studied for some time the Company decided to build three trial carriages. They were completed in January, 1956, and have been tested on the State Railways in specially arranged trial trains. The carriages were built with the primary object of testing the running gear, consisting of the wheel assemblies and the springing system. These parts were therefore completely finished, with, among other things, a function brake system. The coachwork consists of a supporting framework of steel complete with outer doors, but excluding interior fittings and other interior gear. The carriages were ballasted to their calculated unloaded weight, and one of them, whose riding characteristics have been specially studied, has this ballast as well as additional passenger weight placed at the correct height for the centre of gravity.

Since the carriages are not fitted with the normal draw and buffer devices, a special coupling car is used for trials in which they are drawn by a locomotive of standard type. This car is fitted with both the usual draw and buffer devices and the KLL central coupling. In making up a test train this car is coupled between the KLL carriages and the locomotive.

GENERAL DATA ON THE KLL CARRIAGE

On account of its special low and light design, the data of the KLL carriages differ widely from those of the normal express carriage. The most important data are as follows:—



KLL carriages at a station platform.

	2nd class KLL carriage	2nd class express carriage
Length overall, including couplings and buffers, metres	11.4	23.5
External breadth, metres	3.14	3.14
Height, total, from the top of the rail, metres	3.15	4.07
Height of floor above top of rail, metres	0.57	1.26
Height of C. G. above top of rail, metres, approx.	1.1	1.9
Carriage weight, without passengers, metric tons	9	39
Number of seats of 2nd class, (former 3rd class)	40	78
Carriage weight per unit of seating, kg.	225	500

One of the advantages offered by carriages of this type is the low boarding height. The C. G. is brought low and curve-taking is improved. The weight per unit of seating is about half that of a normal steel carriage. All these features are such as one expects to find in a carriage of up-to-date design.



Two KLL running gears coupled together.

THE CARRIAGE BODY

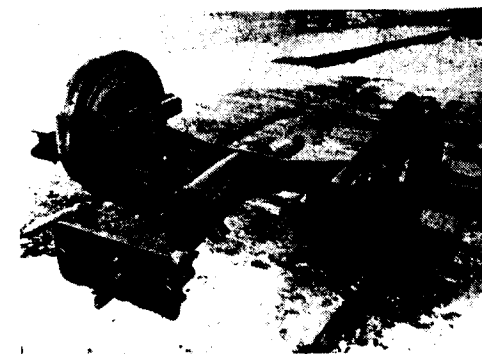
The framework is of steel, and is in its main lines a spot-welded stressed-shell construction. This shell is taken right round the carriage and covers the underside, which is smooth, as well. Along the lower edge and also just below the curve of the roof run strong longitudinal members which together with the stiffened shell give the carriage as a whole a total resistance to compressive forces amounting to 150 metric tons. Towards the ends there are lateral stiffeners which distribute any thrust to the side members.

The three trial carriages are all built alike, and the same carriage framework will be used for every kind of carriage, apart from differences in respect of window size, wall fittings, etc.

Up to the present, the carriage body apart from the actual frame-work has not been made the object of study, since fittings and other equipment are of course individual and do not pose any particularly troublesome design problems. It is of course intended to fit up the carriages with all reasonable amenities in respect of furnishings, heating, ventilation, lighting, sound-proofing, etc.

RUNNING GEAR

The most interesting aspect in the development of this type of carriage is the running gear, i. e. the axles, the wheels, the brake, the springing and the coupling.



KLL running gear with built-in central coupling and braking gear.

In view of the risk of riding-up and de-railing on curves, it is necessary, since the wheelbase is as great as 9.6 metres, to arrange for steering of the wheels. They are mounted on tubular, non-rotating supporting axles. These axles are built integral with the central coupling which is attached to them by a longitudinal central tube. When two carriages are coupled together, and the central couplings with which they are connected fit closely together, the two sets of running gear connected in this way form a bogie in the normal sense. Each end of the carriage rests on its running gear via rubber blocks outside the wheels, and the arrangement is such that each pair of running gears forming a bogie automatically adjusts itself to the curve and gives the carriage a steady motion. The tensile and compressive stresses between the carriage are taken up by a bar, one end of which is centrally attached to the rear of the central coupling, while the other end is fixed to the chassis of the carriage some way inside the running gear. In this way the running gear itself is relieved of tensile and compressive stresses.

The locomotive is coupled in similar fashion to the leading running gear of the first carriage. In the case of a bogie-type locomotive a draw-bar is attached to the bogie frame or to some other point which exhibits the least possible lateral movement during motion along the track. The outer end of the draw-bar is fitted with the KLL central coupling and is coupled to the first carriage. In this way the latter is made to run steadily, and the first pair of wheels follows the curve of the track fairly exactly without lurching.

The last pair of wheels in the train run freely and without steering. No steering is in point of fact required, since the supporting axle is at all times at right angles to the axis of the carriage, and when running in a curve each wheel always has a negative angle of approach with respect to the rail. The supporting axle is held in position by the

rubber blocks on which the carriage rests outside the wheels, these blocks having great restitutive capacity in respect of movements of the axle in the horizontal plane. If found necessary horizontal dampers can be introduced to take care of such oscillatory movements. Further to ensure steady running by the last pair of wheels the brake for this pair is automatically shut off. This is done by a cock mechanically interlocked with the normal stop-cock for the brake pipe, which is always to be found at both ends of the carriage.

The supporting axles have a dropped portion in the centre to give a level floor throughout the carriage. The running diameter of the wheels is 680 mm. and they are mounted in SKF tapered-roller bearings. At the points where the wheels protrude above floor level they are covered by sheet-steel castings.

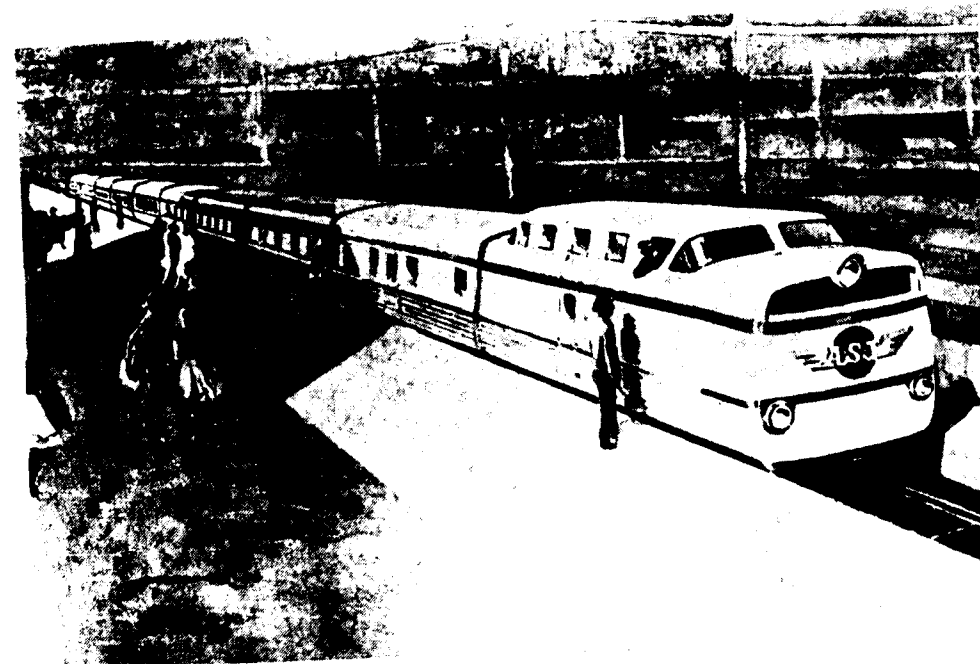
THE BRAKE

The carriages have compressed-air brakes of Knorr's Type KE, a modern standard type which is suitable for all kinds of railway cars. The brake functions as a single-action disc brake with the disc mounted on the inner side of the wheel. When the brake is applied two brake blocks are pressed against one side of the disc, one on either side of the supporting axle. Each brake block has its own brake cylinder. As a result the link system between the cylinder and the block is extremely simple. One pair of wheels on each carriage has a hand brake, and this too acts on the brake disc.

The design of the carriage also permits the fitting of electro-magnetic rail brakes. As yet, however, this step is not envisaged.

SPRINGING

The carriage is sprung with rubber and torsion springs. On that part of the supporting



Front end of KLL express train with locomotive and 10 carriages.

axle which projects beyond the wheel a yoke is mounted, running longitudinally. Two high rubber springs rest on its extremities. Besides their contribution to the springing these rubber springs also have task of absorbing the deflections of the wheels when taking curves and the movements of body laterally with respect to the running gear.

On top of each rubber block rests one end of a beam which thrusts out towards the side of the carriage. At their outer ends these beams are united with a longitudinally placed sleeve which is mounted in rubber in the chassis of the carriage. One end of the torsion spring is secured to this sleeve. Thus the torsion spring runs in the direction of the axis of the carriage, and one end is attached to the chassis. As a consequence of the mounting method used the spring can be made comparatively long, which is advantageous since it means that the stresses in it can be kept down. The outer attachment of the spring to the chassis is adjustable, making it possible to adjust the floor height

as required, allowance being made for the weight of the carriage and for deviations arising during manufacture.

COUPLING

The principle by which the carriages are coupled together by means of couplings mounted on the running gear means that there is no need to have any special coupling fittings on the actual carriage body. This simplifies the design of the chassis to a considerable extent, since the point of attachment of the draw-bar lies some distance inside the running gear, where it is easy to spread out the tensile and compressive forces that arise. As for the coupling itself, it should be pointed out that it must be joined as closely as possible to the coupling device of the next carriage, so as to make the resulting bogie as rigid as possible. This means that the types of coupling at present available must be specially adapted in certain respects to these carriages and must be made with greater accuracy. Furthermore, the coupling has some freedom of

rotation about an axis running lengthwise through the carriage, so as to allow for differences of height among the four wheels forming one coupled pair of running gears.

Associated with the central coupling are the advantages of being able to combine with it the compressed-air couplings and electrical connections between adjacent carriages. These are effected automatically, and no extra lines are required between the carriages.

THE LOCOMOTIVE

Since the carriages are very lightly built the locomotive may also be so. A considerably lower power output is required of it than is the case with the locomotive of a standard train, the number of passengers being equal. As with the carriages, and for the same reasons, it is built so as to bring its C. G. as low as possible. In other respects its design can be conventional, and it can suitably be built on the lines of a bogie locomotive. It has drive on all four axles, and two motors are arranged lengthwise so that each drives its own bogie via universal drive shafts and bevel gears. This arrangement can be employed on both electric locomotives and diesel locomotives. In the case of the latter, the torque is transmitted via a hydraulic transmission.

The locomotive must be furnished with certain auxiliary machines, distinguished by certain new departures in respect of the electrical supply of the train, which it is possible to introduce in cases such as this, where a completely new type of train is being created. Hitherto, railway carriages have had their own generator for lighting, which has been run on 24 volts, DC. Heating equipment has drawn its supply from the locomotive at 100 volts, 16 2/3 c/s. Steam trains have used steam for heating. These arrangements have serious drawbacks. The lighting power supply gives poor efficiency, is heavy and is expensive in initial cost and

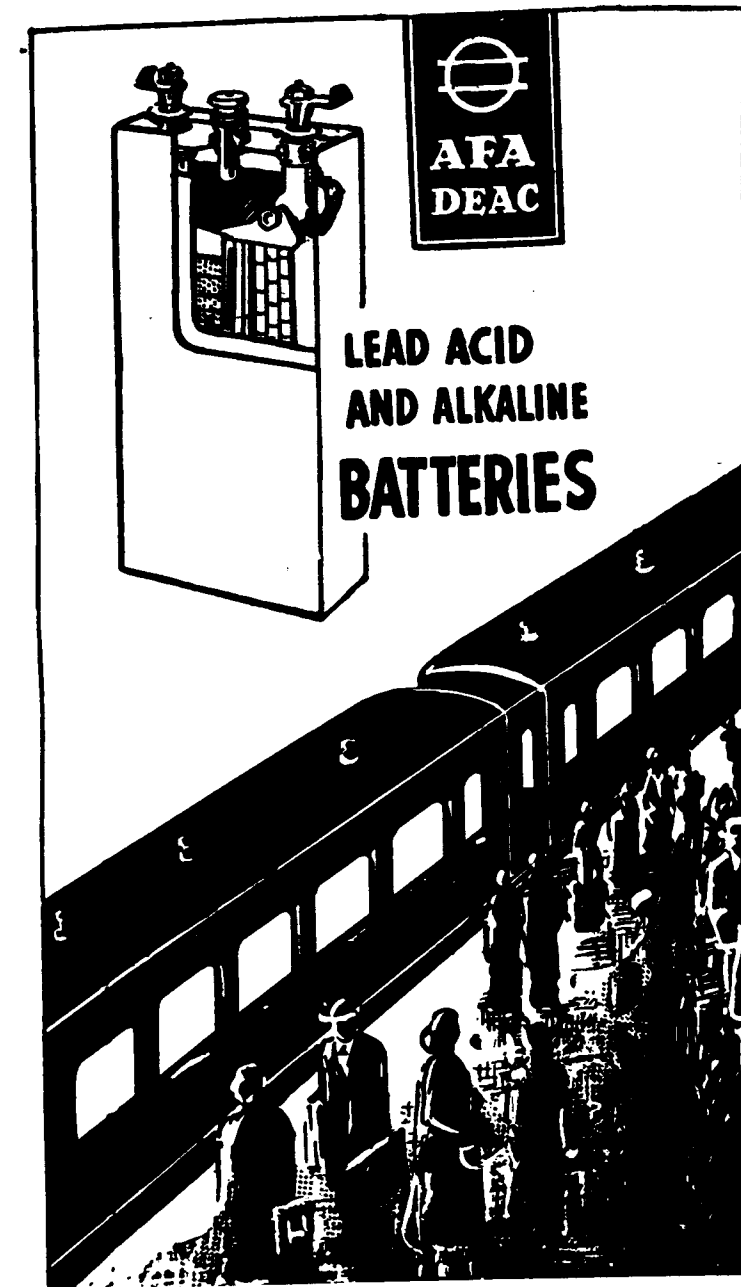
in maintenance. The high-tension electricity supply used for heating demands throughout the use of special constructions to guard against flashover and personal injuries. As a result, this equipment too has to be heavy and expensive. Motors, such as fan motors, which are to be driven by this supply must either be specially designed, or used in conjunction with transformers, and these again are heavy and expensive. The auxiliary equipment of the KLL locomotive can now be made to suit a new type of lighting and heating.

LIGHTING AND HEATING

A motor generator, supplying 380/220 volt three-phase AC at 50 c/s, is carried in the KLL locomotive. Electricity to power the lighting and motors of the train is taken from it. Moreover, each carriage is supplied with a small battery, which is charged by the three-phase supply via a rectifier and used to supply the auxiliary lighting that may sometimes be needed on trains, as when the locomotive is uncoupled for shunting. Since 220 volt AC is available at 50 c/s, material and apparatus employed in installation may be the inexpensive standard equipment, squirrel-cage motors, etc., which is readily available on the market.

The electric KLL train is heated by electricity from the main transformer of the locomotive, and here too a voltage for which standard heater elements and so on are available. For heating also the more suitable voltage would appear to be 220, or possibly 380, so as to permit the use of standard equipment. It goes without saying that the current is employed in heating batteries for heating the train by warm air, and that fixed heaters, in the form of electric radiators, will only be used to a very limited extent.

The diesel-driven KLL train will also have hot-air heating. The heat is produced by



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oil-fired heating units fitted in the carriages. These are made to transfer their heat to heat exchangers from which it passes to air used for ventilation in the normal way.

THE COMPOSITION OF THE
KLL TRAIN

Several sizes of KLL train are planned. Perhaps the most representative has 10 carriages, 265 seats and a total weight including the locomotive of 126 tons. Of the carriages of the train, two are reserved

wholly or in part as restaurant cars, and should it be considered desirable a luggage van can be added immediately after the engine.

Comparing the KLL train with an extant counterpart, the "Goteborgaren" express, running daily between Stockholm and Gothenburg, we get the data given in the table. To a great extent the power output of the KLL locomotive is determined by the drag on a gradient of 1 in 200, 32 %, and the air resistance at 150 k. p. h./ 93.75 m. p. h., 53 %.

EXPRESS TRAINS

Locomotive	"The Gothenburger"	KLL Express
weight	60.8 tons	35 tons
motor capacity	3,300 HP.	1,400 HP.
Number of coaches	5	10
Number of seats	267	265
in first class	96	105
in second class	171	160
Number of seats in the restaurant department	48	46
Total weight with load	251.1 tons	149 tons
Weight of locomotive plus coaches	228.1 ,,	126 ,,
Ratio of pay-load to train weight	0.101	0.183
Max. speed	130 kms./h	150 kms./h
Train weight per seat	857 kgs.	475 kgs.

CLAIMS PREVENTION ORGANISATION

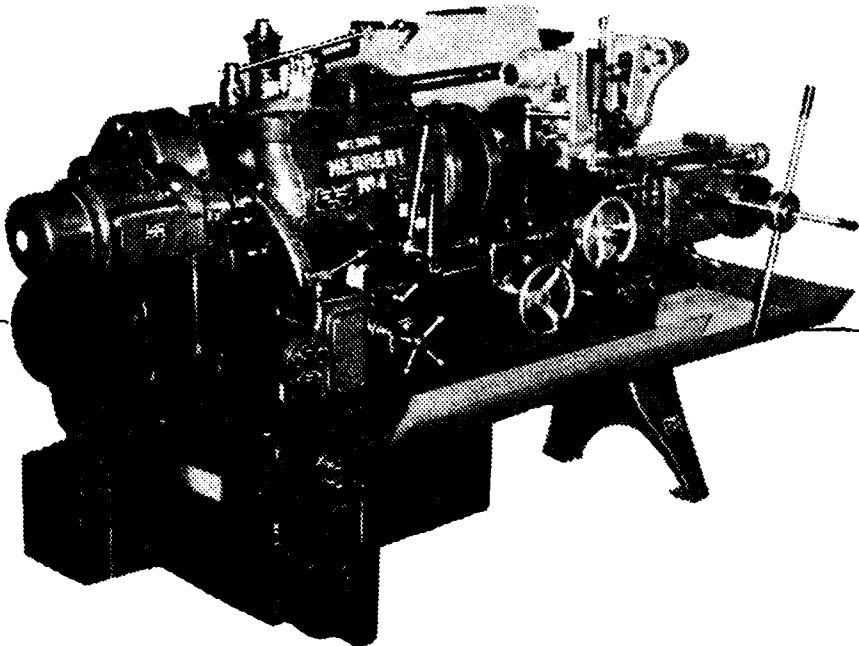
A claims Prevention Organisation under the control of a Senior Officer has been set up on the Central Railway earlier this year. The Organisation has been pursuing measures to ensure the correct packing labelling and marking of goods and parcels which will reduce claims arising from lack of attention to these points. A drive has also been launched

against rough shunting and rough handling of goods and parcels. On the analysis made of the various circumstances leading to losses, damage and delays, preventive measures are adopted to keep down such losses and claims arising therefrom. Several other irregularities leading to claims are also analysed and preventive measures are initiated.

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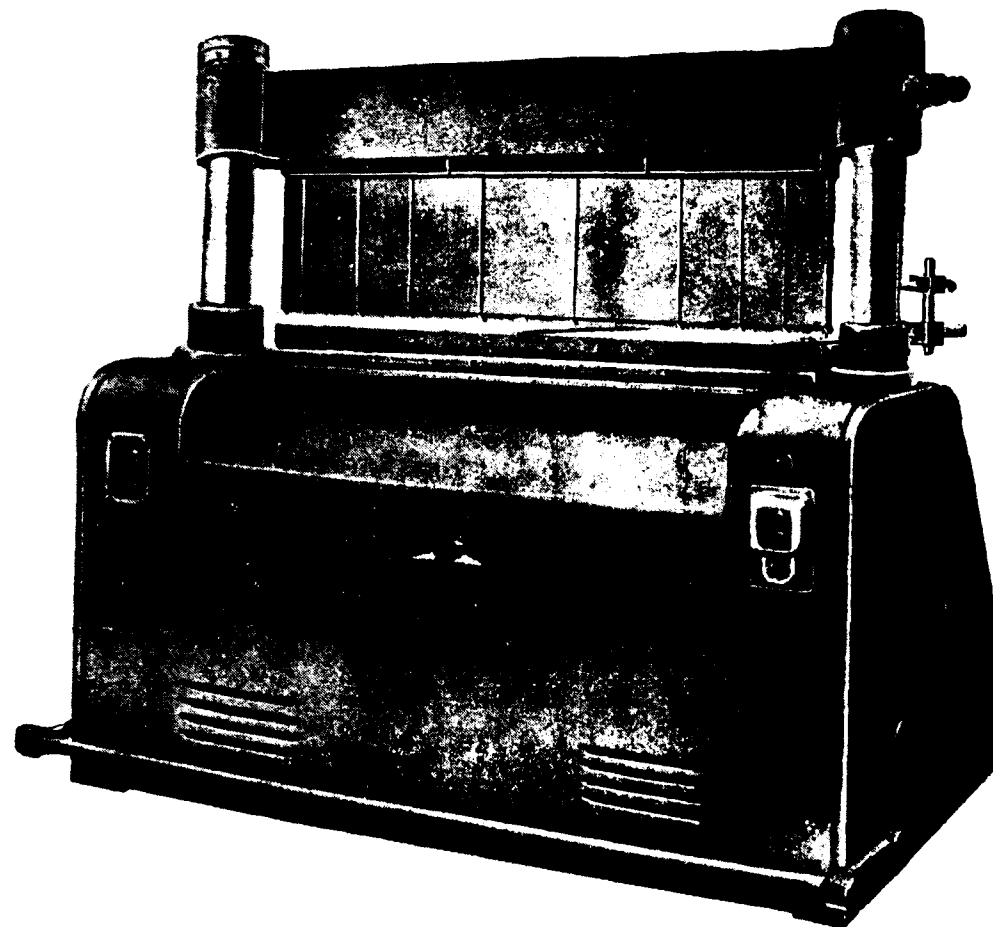
New Besco Production Motorised Swing Beam Box and Pan Press Brake, Model 36.10

PRESSURE EXERTED 10 TONS
BENDING CAPACITY 36 in. LONG

TWO special features that have increased the range of operations performed by folding and bending machines are incorporated in this entirely new press brake. Firstly the top beam is arranged to swing out, thus enabling trunk sections which have been formed round the beam to be withdrawn complete. Also, pan, box and tray work may be performed, by the use of the segmental blade supplied, which can quickly be attached when the ordinary angle bending blade is removed.

The segmental blade consists of detachable fingers which can be assembled at any point along the beam and with them boxes can be formed to a maximum depth of 6 in. These fingers are of various widths, making up the bending length of 36 in. with one 1½ in., one 2 in., one 2½ in., two 3 in., two 4 in., two 5 in., and one 6 in. blades. 14 gauge material is the maximum thickness handled, vee die opening ¾ in. wide; 16 gauge, vee die opening ½ in. wide; 18 gauge, vee die opening ⅜ in. wide.

The top beam, machined from steel plate, is 8 in. deep × 2 in. thick, swings out



New Besco Production Motorised Swing Beam Box and Pan Press Brake, Model 36-10.

in double thrust bearings, and is locked in the operating position by a spring plunger. It is adjustable up to 8 in. high by a side handle, through an enclosed worm and worm-wheel, running in oil, so that blades of various heights can be accommodated, either for production angle bending with the narrow blade which is 2 in. deep, when the beam is in the low position, or for open topped boxes or trays with the 10 in. deep segmental blade. The minimum size of a trunk section formed is 8½ in. × 8½ in. Length of stroke is 1 in. With the stroke up, the maximum distance of the ram to the bed is 12 in., the minimum 4 in.

The main frame is fabricated from steel plate, adequately ribbed and braced, and maintains strict rigidity during operation. In conjunction with the deep bed, the lower frame effectively ties together the side frames. The lower frame also serves as a base for and completely encloses the squirrel cage motor, which is of 1½ h. p. × 1500 r. p. m., situated

between the frames. Drive is through vee ropes to the heavy-speed flywheel mounted on double roller bearings. An indication light shows when the motor is running. The machine is capable of running at 40 continuous strokes per minute.

Through an enclosed worm and worm-wheel gearbox and a bevel drive, a Matrix double-duty combined clutch and brake gives smooth and light control to the crankshaft and top beam couplings, all of which are mounted on replaceable phosphor-bronze bearings. Standard equipment includes, one straight bending blade; one set of finger blades; one bottom die with two grooves; motor and starter; winding handle and gauges. These gauges, one front and one back, have an adjustment of 24 in.

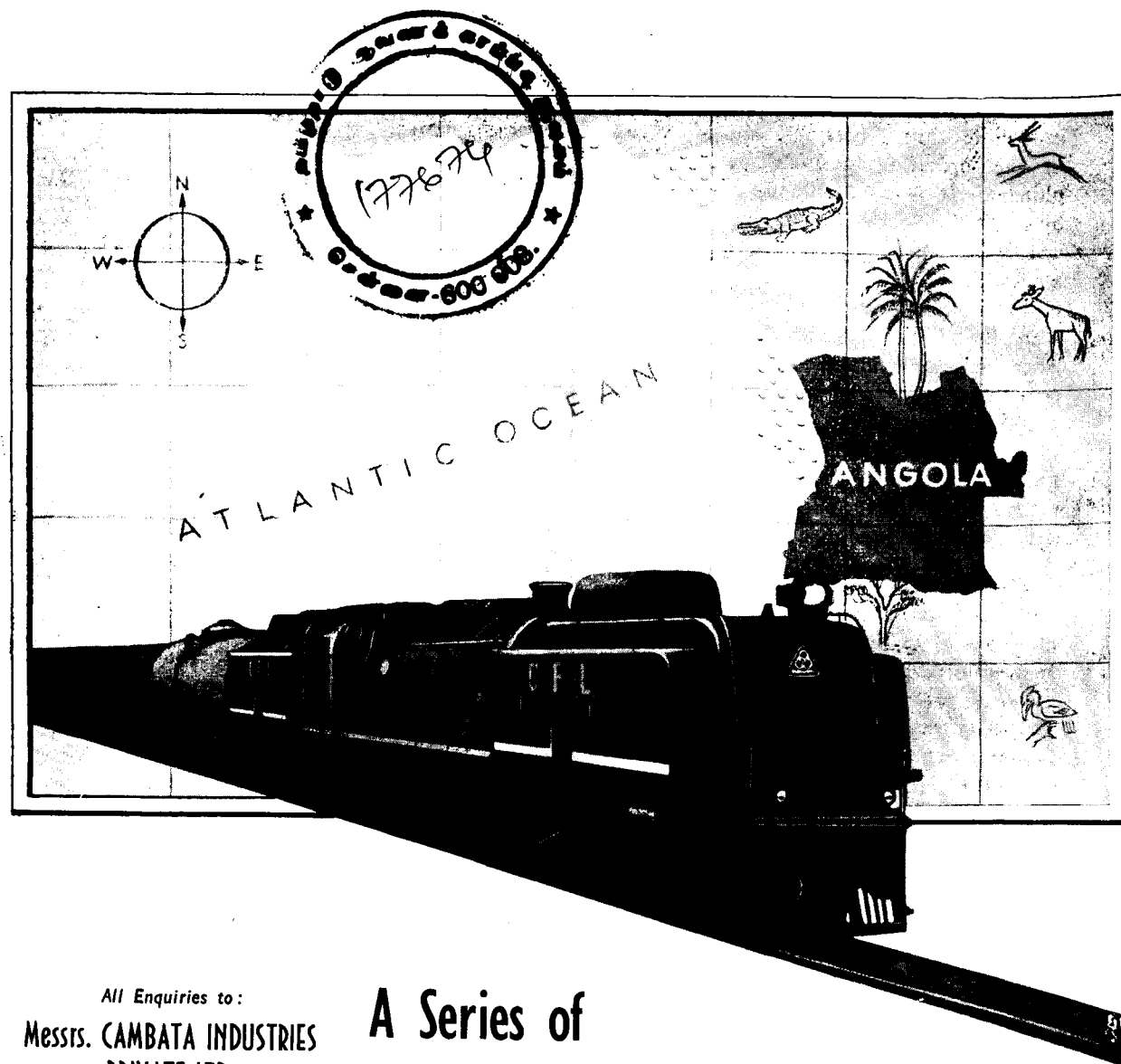
The machine occupies 56 in. × 56 in. of floor space, stands 57 in. high, and weighs 19 cwts. net. (Patent pending). This firm is represented in Madras by Messrs. William Jacks & Co., Ltd.

CONCESSIONAL RETURN TICKETS

During the period from July 15, 1956 to September 15, 1956 (both days inclusive) concessional return tickets for I, II and III class passengers at 1½ single journey fares are being issued both in local and through booking subject to the following conditions: Return tickets will be issued only between stations over 300 miles apart. In the case of stations situated short of 301 miles, when two single journey fares are more than the return fare for 301 miles, return tickets will be issued charging fares for 301 miles. The period of availability of the return tickets will be as given below and it will be reckoned from the midnight of the date of issue:

301	—	500 miles	..	..	20 days
501	—	750 miles	..	..	25 days
750 and above			..	..	30 days

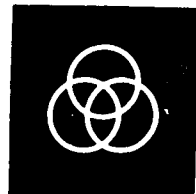
The return tickets will, however, not be available for completion of the return journey after the midnight of September 30, 1956. When advance booking is permissible, the period of availability will be calculated from the midnight of the day on which the outward journey is to be commenced. No break of journey will be permitted on the return journey, but break of journey will be allowed on the outward journey according to the rules in force as for holders of ordinary single journey tickets. Passengers must present the return halves of their return tickets at the booking office at the station of commencement of their return journey and have their tickets dated indicating the date of commencement of the return journey. Passengers holding return halves without being so dated will be treated as travelling without tickets. In the case of children over 3 years and under 12 years of age they will be charged half the concession fare.



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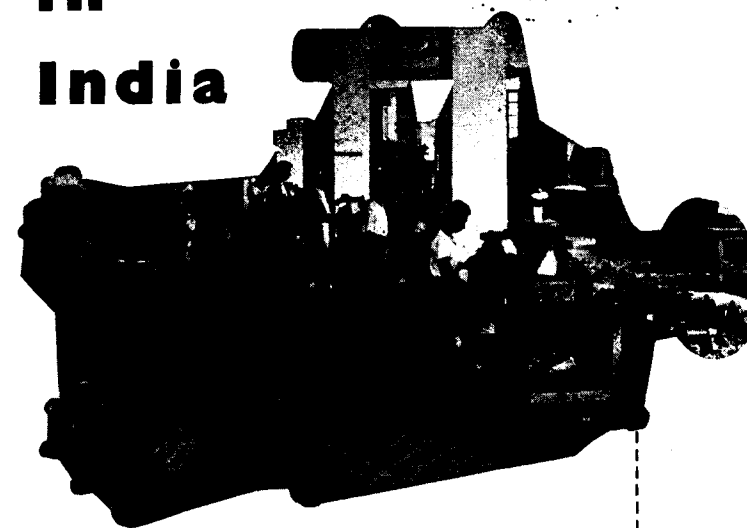


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oil-fired and with a 4-6-2+2-6-4 wheel arrangement were received and delivered to the Luanda Railroad in Portuguese West Africa. The axle load of such an engine is 13 tons, with a cylinder tractive effort of slightly more than 51,000 lbs. and an overall wheel base of about 77' 6". With a wheel diameter of almost 44", this metre-gauge locomotive is rated to run at a top speed of about 32 mph. Its weight in full working order is 165 tons with a maximum adhesion weight of 104 tons. Krupp centre pins are used to couple the frames of the two driving bogies to the boiler frame to give the complete unit excellent riding qualities. All axles rotate in anti-friction bearings.

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HERE'S HOW BICC KEEP AHEAD IN RAILWAY ELECTRIFICATION

Experiments in High-Voltage A.C. Traction

Trials carried out on the Lancaster-Morecambe-Heysham line of British Railways may greatly influence future railway electrification. The overhead system has been converted to 50 cycles single-phase working. For the first time in this country regular services are being operated from a power supply at industrial frequency.

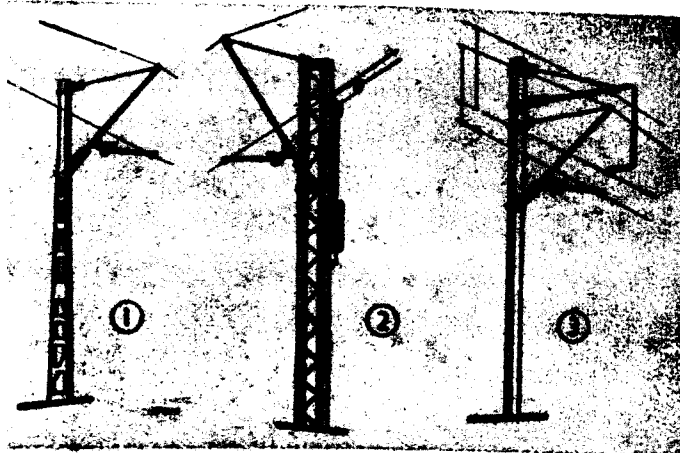
New Overhead Equipment

The early stages of this project included a demonstration of up-to-date overhead equipment. This was designed, supplied and erected by BIC Construction Company, a member of the BICC group. Four thousand feet of the old construction were replaced with light single-track hinged cantilever structures, carried on various types of supports (see below). The equipment is designed for 20,000 volts, although at present operating at 6,600 volts.

By participating in experiments of this nature BICC ensure that their equipment is equal to the changing demands of modern electric traction. The lessons learnt are added to their vast store of experience based on more than 40 years of railway electrification in every continent.

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For further information, please write for Publication No. 12 "High Voltage A.C. Traction Equipment". Two films on BICC electrification schemes are also available on loan to interested organisations.



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