THE INDIAN RAILWAY

WORKSHOP MAGAZINE

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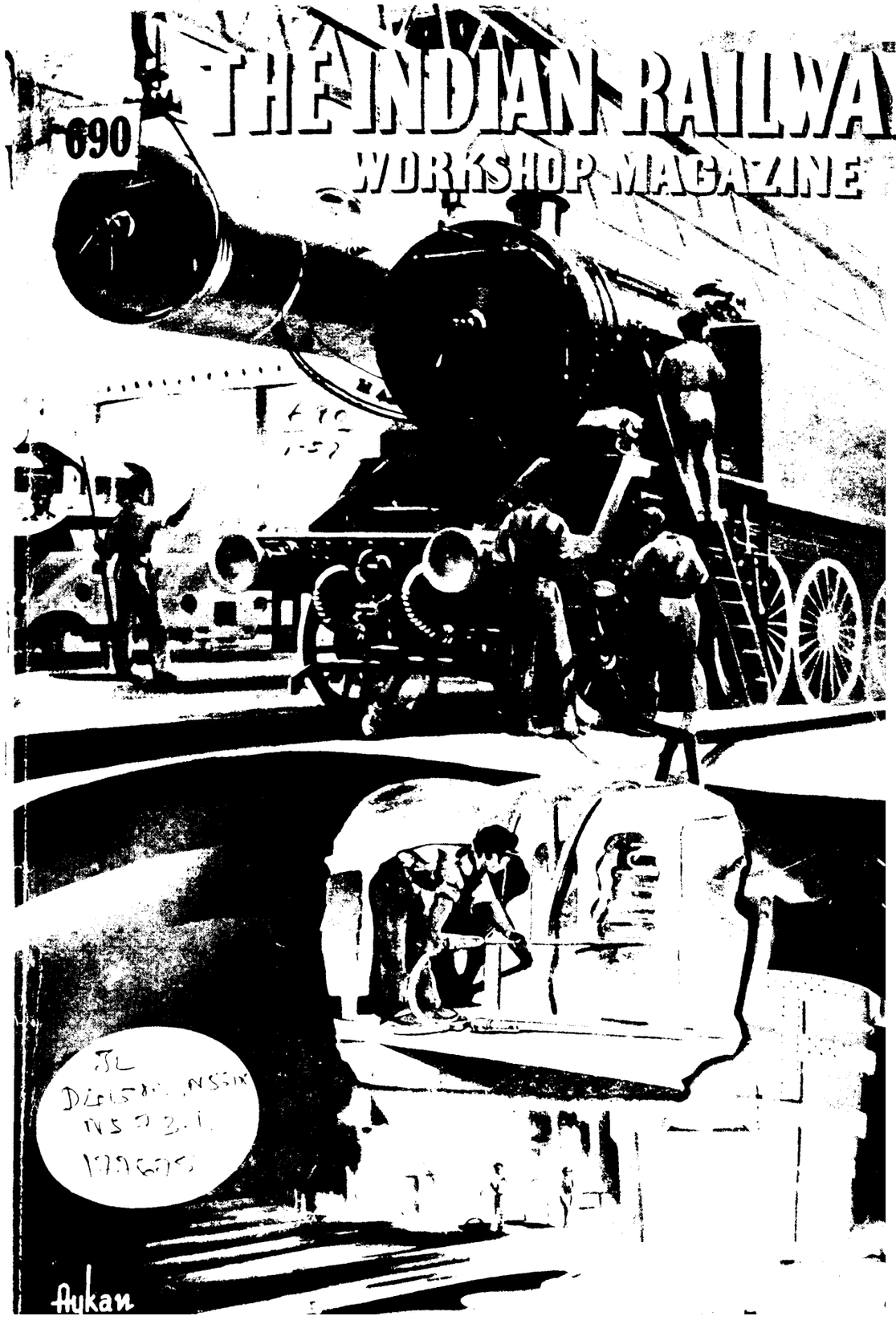


THE INDIAN RAILWAYS WORKSHOP MAGAZINE

LOCO. CARRIAGE & WAGON SUPPLEMENT

Vol. III No. 1 ANNUAL NUMBER Price As. 8/-

CONTENTS

Second Five Year Plan for Workshops on Southern Railway

THE holdings of the Southern Railway, as at the beginning and at the end of the Second Five Year Plan, are shown below :—

BROAD GAUGE

	Beginning of the plan	End of the plan
Locomotives	575	730
Carriages	1,500	2,600
Wagons	14,000	19,000

METRE GAUGE

Locomotives	850	1075
Carriages	2,100	3,300
Wagons	9,200	18,000

Southern Railway has four workshops situated at Perambur, Golden Rock, Hubli and Mysore. All the workshops undertake repairs for locos, carriages and wagons. All the workshops are engaged in building new carriages also.

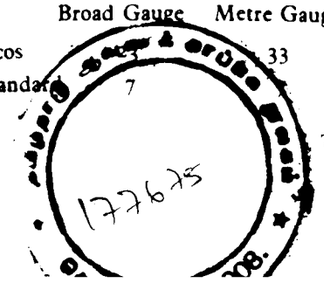
Locomotives are given two kinds of repairs in workshops, viz. periodical overhaul and intermediate overhaul. The periodical overhaul repairs are done approximately after the engines have earned mileages as given below :

Passenger locomotives	1,20,000 miles.
Goods do	1,00,000 ,,

If these mileages are not earned within a period of four years, as the boilers are to be examined at about this period, periodical overhaul repairs are given on a time basis.

The Southern Railway has different classes of locomotives, as per details given below :

	Broad Gauge	Metre Gauge
Earlier Locos		33
I. R. S. Standard	7	



The capacity of Loco workshops has to be increased so that the out-turn per year at the end of the Second Five Year Plan are in accordance with the figures given below :

	Present		Revised	
	POH	IOH	POH	IOH
Perambur Loco Works	96	144	208	208
Golden Rock	144	204	188	188
Hubli	84	150	132	132
Mysore	36	60	48	48

Carriages are given periodical overhaul repairs once between 12 to 18 months. Increased capacities have been planned at the various workshops as given below :

	Present	Revised
Perambur Carriage Works	1100	2700
Golden Rock	1500	3200
Hubli	1560	1680
Mysore	575	680

Wagons are given periodical overhaul repairs once in three years in workshops. The capacity planned for the various workshops at the end of the Second Five Year Plan is as per details given below.

	Present	Revised
Perambur	3036	—) *
Golden Rock	3300	—)
Hubli	3100	3250
Mysore	800	700

* will be dealt with in the New BG & MG wagon repair units.

The expansion proposals for meeting the above demands of increase in workshop capacity would cost approximately 5¼ crores, to be distributed as follows :—

		In crores Rs.
PER (Loco. & Carr. Works)		0.85
UBL	—	1.05
GOC	—	0.25
MYS	—	0.10
Addl. workshops for BG wagon repair		1.50
Addl. machinery	—	1.50
		5.25

Rs. 5¼ crores are proposed to be spent in five years as follows :

1956—57	55 lakhs.
1957—58	130 ,,
1958—59	140 ,,
1959—60	130 ,,
1960—61	70 ,,

In addition, two wagon workshops are proposed to be built.

BG wagon shop	80 lakhs.
MG ,,	60 ,,

For the above additional work, there will be considerable increase in the number of men that will be employed by the Southern Railway. The approximate strength of the skilled categories of Mechanical workshops of the Southern Railway in the Second Five Year Plan are given below.

	Supervisory	Skilled
1956—57	140	1200
1957—58	280	2300
1958—59	430	3600
1959—60	600	5000
1960—61	750	6400

In broad outline, the expansion proposals includes provision of the following items :

(a) Adequate provision of craneage,

(b) A new tender shop of Perambur Loco. Works,

(c) Improved lighting in yards and shops for working night shifts,

& (d) Expansion of wheel and tyre, heat treatment, foundry, saw mill and smithy shops.

At Golden Rock the traverser is to be modified to deal with modern locomotives. Hubli shops are going to be remodelled on modern lines, as the present shop is about 66 years old.

Mysore has a serious disability in that no central stores for feeding the shops exists at present. Iron and brass foundries are planned to be expanded. Perambur Carriage Works is congested hampering movement of stocks inside the works and to and fro stores. Considerable increase in covered accommodation for affording amenities to the workers who now work in the open are contemplated. Higher capacity traversers as also additional lifting capacity in wagon shop are priority items.

At the end of the Second Five Year Plan, the strength of the various workshops will be approximately

Perambur Loco Works	6,000
Perambur Carriage Works	4,300
Golden Rock shop	8,000
Hubli Shops	4,200
Mysore Shops	2,600

New Worksmanagers' offices for both Loco. and Carriage Works are planned. Loco. Works office will house the office of the Chemist & Metallurgist and his laboratory.

Erection of kiln seasoning plant by the side of the Saw Mill at perambur is an additional improvement.

The development of capacity in the workshops is closely inter-related with maintenance, equipment and facilities in running sheds and Carriage & Wagon depots. The ultimate aim is to undertake only periodical

overhaul repairs in workshops and develop large and small maintenance depots, both for Loco. and Carriage & Wagons at suitable points in the Railway system. As it would cost considerable capital expenditure if in sheds facilities for intermediate overhaul repairs to locomotives are now planned and further as it would be uneconomical to do so where expansion of existing workshops would cater for full requirements of undertaking repairs to stock with the Railway on the whole at the end of the Second Five Year Plan, the Southern Railway will continue to give intermediate overhaul repairs in workshops only. The intermediate overhaul repairs are give at mileages slightly above half-way between two consecutive periodical overhaul repairs varying from 50,000 to 60,000 miles.

The Second Five Year Plan includes the following provision:

1.	New Loco. Sheds	73 lakhs
2.	Remodelling of Loco. sheds & yards	8½ ,,
3.	Provision of additional facilities for the loco. sheds.	9 lakhs
4.	Provision of adequate wagon repair facilities	28 ,,

The Carriage maintenance depot at Madras Central is to be expanded as a part of the Madras Central Station remodelling.

Over-head watering arrangements at important stations for refilling of overhead tanks with water at frequent intervals than at present and to cater for additional capacity of water tanks, which have been provided in coaches recently built, provision of one lakh of rupees at each of the stations given below is made.

Coimbatore	Hubli
Calicut	Madura
Guntakal	Shoranur
Bezwada	Arkonam
Vilupuram	Trichinopoly
Dronachellam	Erode
	Rajahmundry.

With the increased trains, provision of additional running rooms and adequate accommodation in existing running rooms as an amenity to the drivers and firemen, who travel long distances from their home stations are necessary. A provision of Rs. 60 lakhs has been made for this purpose, for 14 stations on Southern Railway.

The above scheme has been drawn after taking into account the anticipated improvements in the availability performances of Locos. Carriages and Wagons as it will be noticed from the details given below. The non-availability of locomotives on account of repairs in Mechanical Workshops and running sheds is anywhere in the order of about 20%. The target figure which has been laid down now is 15%. This means that out of 1800 locomotives with the Southern Railway about 125 locomotives will be additionally available for use on line. Similarly for coaching stock, the percentages have been reduced to 7% for passenger coaches and 6% for other coaching vehicles like parcel vans etc. This reduction of about 3% will result in 300 coaches out of 10,000 coaches being made available for service day after day.

Southern Railway will hold at the end of the Second Five Year Plan about 50,000 wagons and the reduction of non-availability from 5% to 3% will release 1,000 additional wagons to be in service daily.

Further, as per procurement programme, at the end of the Second Five Year Plan period, there will be 120 additional BG and MG locomotives, about 5,000 additional BG wagons and 3,000 additional MG wagons. The increase in coaching stock would be

	Broad gauge	Metre Gauge
Passenger coaches	200	400
Other coaches	300	200

Training scheme for staff to the extent of about 50 lakhs has been planned so that staff for workshops, engineering permanent way inspectors and operating staff particularly on signals side are properly trained for efficient discharge of their duties.

The integrated Second Five Year Plan for all the Railways in India has a provision of 1,125 crores of rupees, and Southern Railway's share in this is about 134 crores.

Main items comprising the above are

		All Railway Rs.	Southern Rly. Rs.
1.	Additional rolling stock and locomotives	380 crores	28 crores
2.	Track renewals	100 ,,	18 ,,
3.	Line capacity works	166 ,,	52 ,,
4.	Workshop Plant and Machinery	65 ,,	7·5 ,,
5.	Signalling improvements and replacement	20 ,,	3·5 ,,
6.	Electrification	80 ,,	3·5 ,,
7.	New lines	66 ,,	1·5 ,,
8.	Bridge rehabilitation and new bridges	24 ,,	3 ,,
9.	Staff quarters and staff welfare	50 ,,	7·5 ,,
10.	Rly. users' amenities including expansion of goods sheds	35 ,,	3 ,,
11.	Vizagapatam & other projects	15 ,,	.. ,,
12.	Steel requirements and stores development	40 ,,	1·5 ,,
13.	Safety works	5 ,,	0.5 ,,
14.	Training schools	3 ,,	0.5 ,,

Built-in Tarpaulin Covers Car

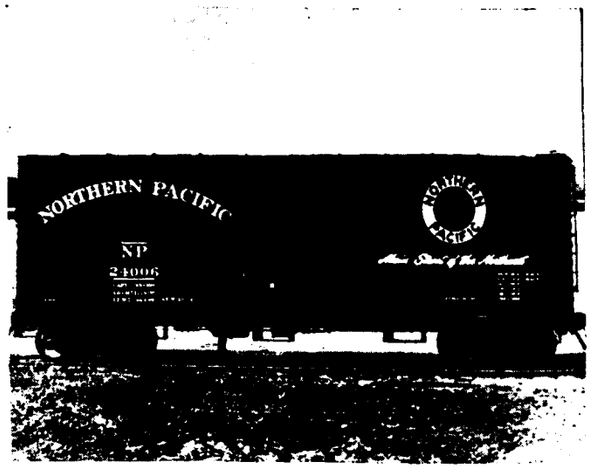
(From our Engineering Correspondent)

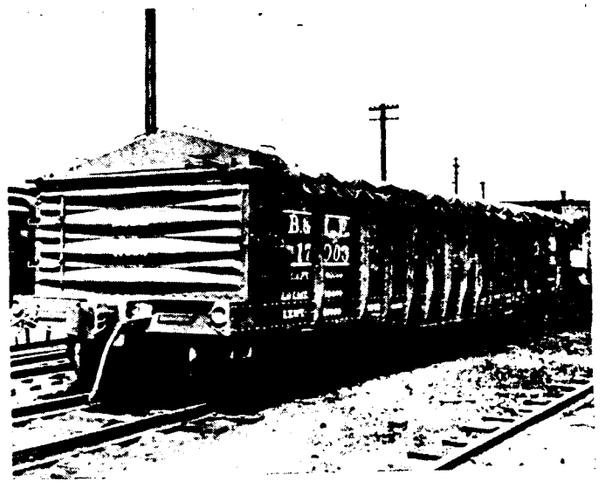
A covered flat car that can be loaded and unloaded with either overhead cranes or fork-lift trucks has been placed in experimental service by the Bessemer & Lake Erie. This car was designed to give complete weather protection to shipments of steel and other products without expensive wrapping and packaging. Built-in blocking, bracing and tie-down apparatus are provided.

The bellows-fold cover can be opened or closed in less than one minute. It is operated by a cable and drum mechanism which is turned by a hand crank at one end of the car. There is also a locking mechanism which secures the cover in the closed position. The tarpaulin material used for the cover is nylon impregnated with neoprene.

Material being loaded on the car is placed against the fixed bulkheads at the ends. Supporting bars, end and side chocks, and load binders can be quickly secured around the load. Wedges are driven between the chocks and the lading to take up any remaining space.

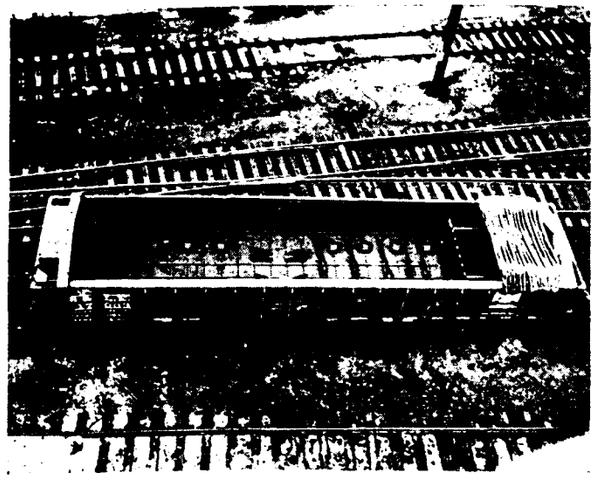
The tarpaulin cover is supported by a frame of bows which extend across the car and are carried on three-wheeled trolleys that

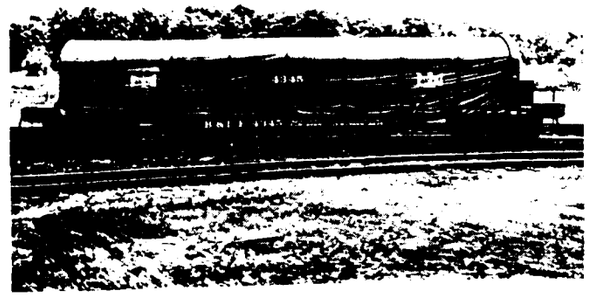




run on tracks along the side sills of the car. These bows are connected with tarpaulin risers which elevate the cover between the bows as the car is uncovered and prevent dragging the tarpaulin over the lading.

The bottom edge of the tarpaulin along each side is guided and secured with a spring loaded guide cable running its full length. An eye, ring or harness snap is attached to each bow to prevent oscillation of this cable while the car is moving. All the gaps and seams in the cover were first cemented and then stitched





together. Where scuffing takes place at the tarpaulin risers and at the permanent end plate, neoprene strips were cemented on to prevent weakning.

The bow nearest the operating mechanism is the only one attached to the power cable and it is secured on both sides of the car. When the cover is being closed, this first bow is pulled by the power cable and succeeding bows are pulled to their proper position by the tarpaulin material as it is stretched into position. When uncovering the car, the first bow moves in against the second and these two against the third. This continues until the entire cover is collapsed and the lading is exposed.

Weatherproofing in the closed position is achieved by designs that seal the two ends and the lower edges of the cover. At the end where the tarpaulin is fixed, it is pulled tight over a weather bulkhead and is lashed with ropes to a bar welded on this bulkhead. These lashings are covered with a bolted weather plate to prevent driving rain from entering around the edge of the cover. The cover moves in against the end where the operating mechanism is located, and here the first movable bow is held in a weather hood. This hood is sealed with tarpaulin material flaps and has a water conducting gutter running around the inside.

The side sill openings are protected by plates edged with the tarpaulin material along the lower edges. There is also a rolled angle running along the top edge of the side sill on each side. All the holes in the universal loading

channels in the floor are sealed by $\frac{1}{8}$-in. plate welded on the bottom.

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NEW DIRECT-TO-METAL FINISH FOR FREIGHT CARS PERMITS ONE-DAY STAY IN PAINT SHOP

Railway freight cars can be painted a lot cheaper by using a new direct-to-metal paint. Known as 89-Line "Dulux" Direct-to-Metal Freight Car paint, it needs no primer, but is applied directly to the sand-blasted or pickled surface, and forms a durable glossy finish with only two coats.

Research men at Du Pont's Fabrics and Finishes Department, where the new paint was developed, estimate considerable savings in time, labor, and materials. Since no primer is needed, material savings should average 20 per cent, and since only two coats are necessary labor costs can be cut one-third. Perhaps even more important, the whole painting process can be completed in one day.

Gloss retention of the new finish is excellent, and durability is expected to at least equal that of conventional three-coat systems.

The new paint can be applied with equipment presently available in car shops. No special equipment is needed.

The new direct-to-metal "Dulux" is currently produced in red, black, green, yellow, orange, and brown.

A light-weight, long-wearing, non-shrinkable tarpaulin material constructed by a patented process involving two notable creations of industrial research — nylon and neoprene — is being manufactured by the Du Pont Company's Fabrics and Finishes Department.

Medium weight "Fairprene" neoprene-coated nylon tarpaulin material has proved to be twice as durable as conventional tarpaulins, and will probably last three times as long, judging by the condition of several tarpaulins after two years of field tests. It is only half as heavy as other types, yet has considerably more tear strength and abrasion resistance.

Since it does not absorb water, the new "Fairprene" material does not become heavy or stiff on exposure to rain or freezing weather. This makes it easy to handle, and the synthetic materials are not affected by the action of rot or mildew even when stored wet.

Lasting adhesion of neoprene to the nylon fabric has been assured by a patented process developed in the Du Pont laboratories at Fairfield, Connecticut.

Reports from industrial and transportation firms' use-tests indicate durability and ease of handling are major advantages of the new tarpaulin, while impermeability and resistance to chemicals, oils, and greases are almost as important.

Greatly improved resistance to tearing and cutting, to abrasion and handling, and to weathering are strong factors in its long service life, and its economy. Its lightness makes it easy to handle, and the fact that it does not shrink means that tarpaulins and covers of the new material can be made snugly, for permanent fit.

ELECTRIC TYRE HEATER SPEEDS TYRE CHANGING WORK

By A. C. Bhattacharya, A. M. I. Prod. E.

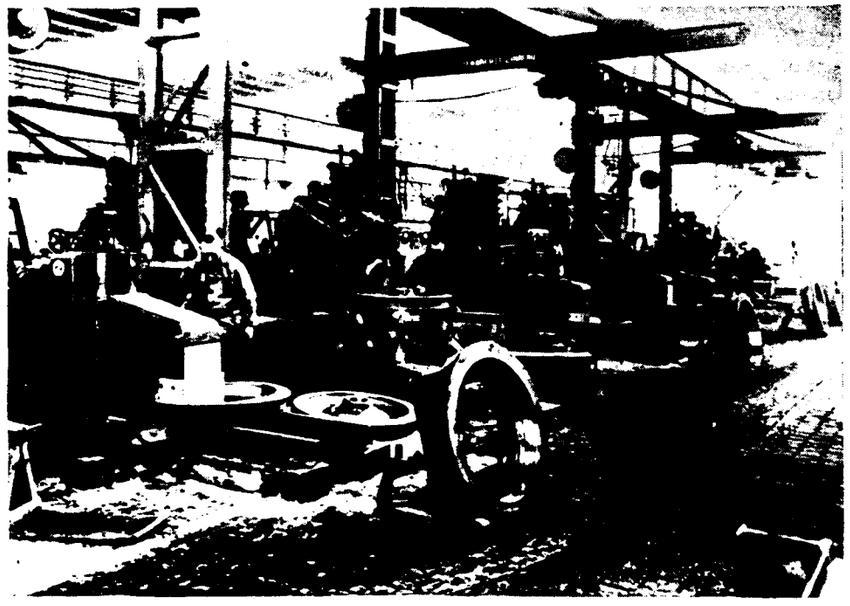
THE present development of traffic regarding rail borne vehicles in having the increased travelling speeds has led to an increase in strain on rolling material. This increase in strain is being met by using high grade raw materials and corresponding designs. In addition, this fact has entailed the application of new working methods or improvement of methods already existing. Greatest care is, for instance, taken to the processing of shrinking bearing surface between tyre and centre disc to ensure a high class of fit. Scaling and other impurities during the heating process has to be avoided. Further, the temperature must be exactly obtained equally over the whole tyre to avoid tension in the same. It is only the better dissipation of heat from tyre to centre, in conjunction with a good shrink fit that the risk of the tyre being loosened by braking loads is considerably reduced.

On the grounds of above considerations, the Electric Tyre Heater has been developed. Its advent has revolutionised tyre fitting practice in Railway Workshops and turned a hitherto objectionable and uncertain method into an organised and reliable process.

ADVANTAGES

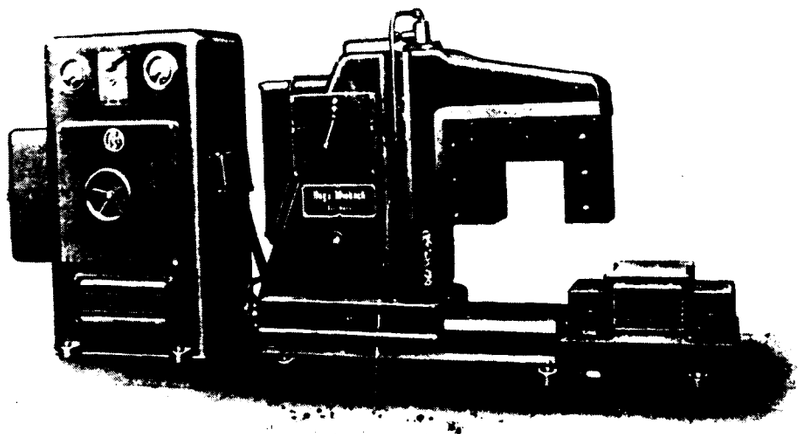
The method of electrically heating the tyre provides the following advantages:

(a) Absence of all factors tending to distort the tyre and decarbunisation due to overheating of the surface by applied frame.



The general arrangement of several tyre heaters in a modern wheel set shop.

Miebach S 90



A modern electric tyre heater showing the heating device and the control panel incorporating the contactors, the step switch, the variable ratio transformer and the measuring & starting elements.

(b) Uniform heating all over with uniform expansion and therefore tight fitting all round upon the wheel centre.

(c) More even stress distribution in the various parts and no permanent deformation.

(d) No soiling of the tyre as well as production of sweating water during heating process.

(e) Absence of all smoke and gas fumes attendant upon the old process.

(f) Economy — the required electrical energy costing less than gas or oil at average prices.

(g) Speed — tyres can be heated for normal expansion in about ten to twenty minutes, which is far quicker than any other means of heating. Thus time is saved and further economy gained.

In electrical tyre heater, the tyres are heated by induction and the heater itself operates according to the transformer principle. The tyre is brought into a single phase core type transformer and acts as a short-circuited secondary winding. Upon passing current through the primary coils, the heavy currents induced in the tyre, heat it to the required temperature.

The greater the amount of energy the shorter the time taken to heat the tyre to any predetermined temperature. It is however inadvisable to attempt extremely short heating periods as the forcing of too great an induced current through the tyre tends to give unequal heating effects, and the process becomes unmanageable. For that reason it is best to set the heater so that heating duration is not less than about ten minutes. This results in more even heating throughout the tyre and more control over expansion.

CAPACITY

For the standard B. G. Wheel sets, the capacity of 100 KVA is considered sufficient and the unit with this capacity can deal with tyres up to 48" size of tyre. For larger sizes of tyres i. e. up to 82", a unit with a capacity of 200 KVA is generally required. It is actually the weight of the tyre that counts since the power input is in a definite relation to the Core Section of the tyre. The tyre when in the heater must be protected from undue circulation of air for better results.

The primary coil of the heater is provided with taps in order to be able to select the desired capacity according to the weight of the tyre to be heated. The duration of the heating period is dependent upon the choice of tapping.

The following tables on the basis of actual tests carried out for heating locomotive bogie and coupled wheels on electrical heater are reproduced below :—

37" inside dia. railway tyre Weight 473 lbs.

Time in Minutes.	*Amps.*	*Volts.*	*KVA.*	*K. W.*	*P. F.*	*Temperature in centigrade (by thermometer).*
0	215	428	92	47.2	.51	20
6.6	200	,,	85.6	46.2	.54	125
12.5	189	,,	81.8	45.2	.55	225
17.9	179	,,	76.6	44.8	.59	300

Power required to heat 37" tyre from 20°C. to 300°C. is 13.6 Kilowatt hours.

55½" inside dia. railway tyre Weight 647 lbs.

0	225	421	94.5	49.2	.51	20
10.7	214	,,	90.1	47.1	.52	125
20.3	201	,,	84.3	46.6	.55	295
33.0	195	421	82	43.5	.56	302

Power required to heat 55½" diameter tyre from 20°C. to 300°C. is 25.5 Kilowatt—hours.

The above figures are for tyres heated in air at an ambient temperature of 20°C. a brick pit or other means of heat conservation not being provided.

The power consumption per tyre necessarily varies with the weight of tyre, the duration of heating periods, and the final temperature. An end temperature of 250°C. gives sufficient expansion for most requirements.

Electrical tyre heater is economical. It gives the appropriate kind of heating, at the right temperature. It can be controlled exactly and easily. With this type of equipment it is possible to get higher production, lower costs and better working conditions.

FORGE FOR PRODUCTION OF RAILWAY WHEELS

A new forge for producing rolled-steel solid wheels and disc centres for railway carriages and wagons has been brought into use at the Trafford Park Steel Works, Manchester, of Messrs. Taylor Brothers and Company, Limited. The plant includes a notable rotary-hearth furnace (believed to be the largest in Europe), an 8,500-ton forging press, two other large presses, and a rolling mill for forming the rims. The block from which a wheel or wheel centre is made is heated in the furnace to forging temperature—the heating and soaking taking about 6¼ hours, equivalent to nearly one revolution of the rotary hearth—and is then passed through the presses and mill in about five minutes, without reheating, emerging as a completed forging ready for machining.

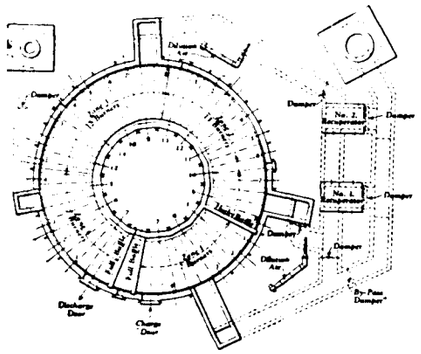
The whole plant is mechanised to an unusually high degree, mechanical handling equipment conveying the steel blocks between the furnace, presses and mill with a minimum of human control. The man-power is only 50 per cent. of that in the old plant, which is to be used for tyre manufacture and produced an average of 40 wheels an hour. In the new plant 11 operators, including furnacemen, produce 60 wheels an hour. This output may be increased when the operation and maintenance of the forge have been perfected.

Fig. 1. Rotary-Hearth Furnace.

With a plant which is so automatic in operation, a few months must elapse before its optimum performance is reached, but then it will undoubtedly justify the investment of over £ 1,000,000 which it represents. It has been financed by the English Steel Corporation—Messrs. Taylor Brothers being one of the E. S. C. group of companies—the money coming wholly from profits. Taylor Brothers, Limited, have been the largest producers of railway wheels in the British Empire for many years, and as the English Steel Corporation have recently also installed new plants in Sheffield for the more efficient production of railway springs and cast-steel bogies and automatic couplers, the new wheel forge is further evidence of the importance attached in the E. S. C. group of companies to the manufacture of railway materials, more than 50 per cent. of the output being exported.

The new plant produces wheels ranging from 24 in. to 50 in. diameter on the tread, at a continuous rate of 60 pieces per hour. In conjunction with Mr. E. Homer Kendall. the American consulting engineer, the layout of the plant and the design of the equipment were completed by Taylor Brothers' engineering department, under the control of Mr. J. H. Ellis, assistant chief engineer in charge of development. The major items of plant comprise the 69-ft. diameter rotary-hearth furnace, illustrated in Figs. 1, 2, 7 and 8 the 8,500-ton forging press, a 1,000-ton punching press, an electrically-driven rolling mill, a 2,000 ton dishing press, and fully-automatic handling plant designed to ensure fast production and an appreciable saving in labour. Separate 6,600-volt incoming supply cables and switchgear have been installed and the plant has self-contained hydraulic, cooling-water and compressed-air services. These, together with the mill motors, generators, oil hydraulic and lubricating equipment, are housed in a separate building. To reduce

Fig. 2.



production delays and maintenance costs to a minimum, attention has been paid to the installation of single-purpose equipment wherever possible. A distinctive feature of the new plant is the extensive use of special manipulating machinery fitted with individual oil hydraulic units. Economies in power have been effected by the use of air-loaded accumulators in conjunction with the main hydraulic plant to regulate the operating pressure in accordance with the section being made. Power-operated controls and automatic equipment are incorporated to eliminate physical fatigue and facilitate the continuous maintenance of high rates of production.

SEQUENCE OF OPERATIONS

The sequence of operations should be read in conjunction with Fig. 9. The two control rooms A and B, shown in this plan, are well placed for observing the operations which they control. The furnace control room A enables the operator to view the charging and discharging gear, and the main control room B, which is placed high up, allows the operators to watch their presses and mill. The blocks of steel from which the wheels are made are cut or broken from an octagonal or octodecagonal cross-section ingot of which the width across the flats varies from 12 1/2 in. to 18 in. The block weight is calculated from the finished wheel weight with allowances for furnace, punching and machining losses. The blocks in the ingot-breaking shop, *a*, are taken by a gravity roller conveyor to the furnace charger *b*. The charger picks them up individually and places them in radial rows on the hearth of the rotary furnace. The blocks pass successively through the preheating, heating and soaking zones in the furnace and are then taken individually by a furnace discharging machine to a transfer car. This car transfers the block through a hydraulic descaling machine to the 8,500-ton hydraulic press.

After slabbing down between flattening tools, from the shape shown in Fig. 3 to that shown in Fig. 4, the bloom is transferred to forging tools mounted on sliding tables on the bed and crosshead of the press. Under increased pressure the slab is forged to finish the hubs, partially form the bore and prepare a rim section suitable for rolling, as shown in Fig. 5. The forging is transferred from

Fig. 3. HOT BLOOM BEFORE SLABBING.

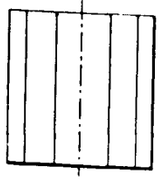


Fig. 4. SLABBING AND DUMPING.

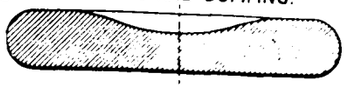


Fig. 5. FORGING.

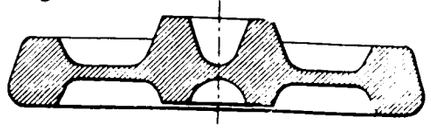
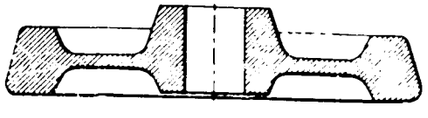


Fig. 6. PUNCHING.



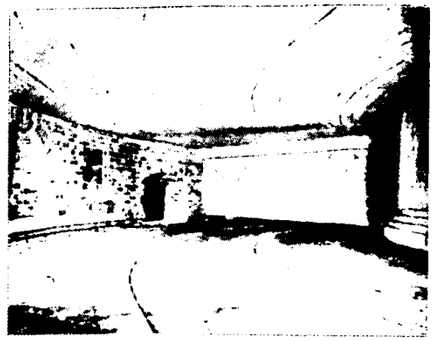


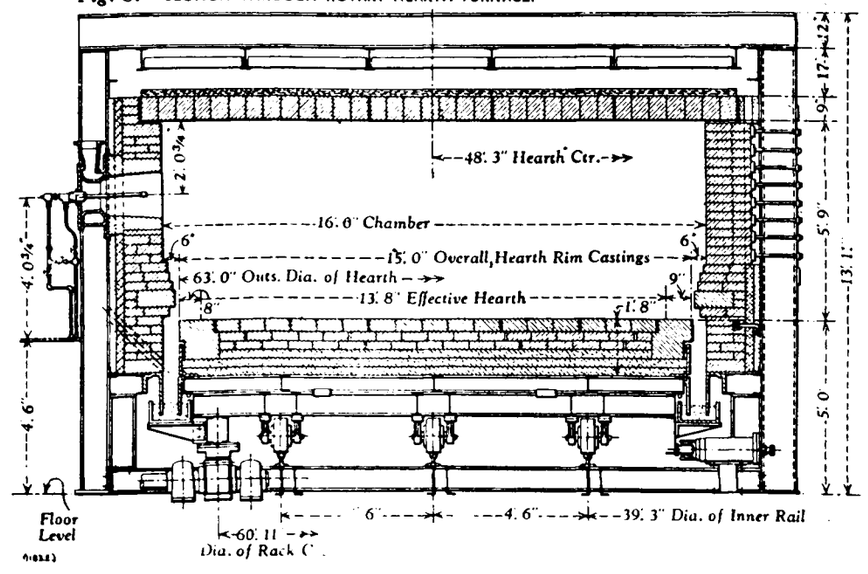
Fig. 7. *Interior of Rotary-Hearth Furnace*

the dies to a live-roller table by an unloading mechanism and is then conveyed to the 1,000-ton punching press, which is of the upstroking type with hub-clamping dies. The punched slug falls through a hole in the lower die to a quenching bin. The punched wheel Fig. 6 then passes, on a roller table, through a tunnel beneath the main control room to a position from which it is loaded into the rolling mill. In the mill the rim section is reduced in volume and rolled to the required contour, with an accompanying increase of wheel diameter. An unloading mechanism takes the rolled wheel from the mill and, by means of a transfer car, the almost completed wheel is carried to the 2,000-ton dishing press. The wheel rim is clamped by dies in the press and pressure applied to the hub and "plate" to produce the correct hub off-set and plate contour. Finally, after dishing, the wheel is stamped with identification numbers and transferred either to a five-station rim-chilling machine or direct to a cooling bed.

FURNACE-CHARGING MACHINE

The furnace-charging machine (*b* in Fig. 9) consists of a cable-driven carriage mounted on a fixed but adjustable bridge. The peel hoisting mechanism and the oil hydraulic equipment for the gripping motion are mounted on the carriage. The peel structure is pivoted at the rear and is fitted with forging manipulator sheaves at the furnace end. Mounted on the peel structure is the peel proper, equipped with tongs which ensure accurate spacing of the blocks on the hearth and permit a straight withdrawal from the

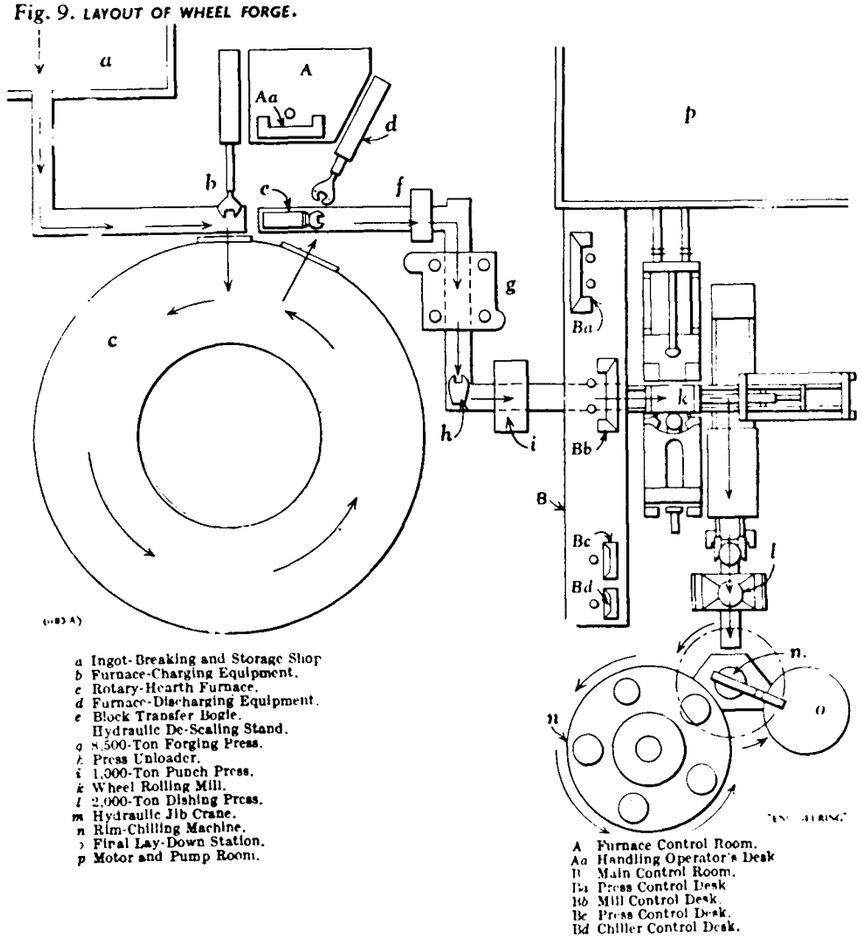
Fig. 8. SECTION THROUGH ROTARY-HEARTH FURNACE.



furnace. Rotation of the peel through an arc of 90 deg. is effected by means of cams and rollers operated by the action of hoisting or lowering the peel structure.

The machine is arranged to complete automatically a cycle of operations initiated by the operator after he has indexed the rotary hearth. With the tong head resting on a centring cam and the block lying on the roller conveyor against the conveyor and the stop, the cycle commences with the lifting of the furnace charging door. The tongs grip the block at a fixed distance from its base. The peel structure is lifted and the tongs rotate 90 deg. to bring the axis of the block into the vertical position and the base of the block to a fixed distance above the furnace-hearth level. The carriage moves to the extreme forward position in order to bring the first block to the innermost position on the hearth. Completion of forward travel actuates first the lowering of the block to the hearth, this motion, in turn, releasing the grips. At the end of the release stroke the carriage returns to its original position and lowers the peel structure until the tong head again rests on the centring cam. The cycle is then repeated and a second bloom is charged. The forward travel of the carriage is sequence-

Fig. 9. LAYOUT OF WHEEL FORGE.



a Ingot-Breaking and Storage Shop
b Furnace-Charging Equipment.
c Rotary-Hearth Furnace.
d Furnace-Discharging Equipment.
e Block Transfer Bogie.
Hydraulic De-Scaling Stand.
g 8,500-Ton Forging Press.
h Press Unloader.
i 1,000-Ton Punch Press.
k Wheel Rolling Mill.
l 2,000-Ton Dishing Press.
m Hydraulic Jib Crane.
n Rim-Chilling Machine.
o Final Lay-Down Station.
p Motor and Pump Room.

A Furnace Control Room.
Aa Handling Operator's Desk
B Main Control Room.
Ba Press Control Desk
Bb Mill Control Desk.
Bc Press Control Desk.
Bd Chiller Control Desk.

controlled from a multiple-cam limit switch of the vernier-setting type. After the seventh or outside bloom has been charged the furnace door is closed and the peel and tong-head cooling sprays are brought into action. The carriage travel control has provision for variable radial spacing of the blocks on the hearth and for charging any number up to a maximum of seven blocks.

ROTARY-HEARTH FURNACE

The furnace, built by the Salem Engineering Company, Limited, Milford, Derby, is the largest of its kind in the country. It has a rated heating capacity of 40 tons of steel an hour at a maximum temperature of 1,280 deg. C. The diameter over the outer buckstays is 69 ft. and the hearth is 15 ft. wide and has a mean diameter of 48 ft. 3 in. The charging and discharging doors are set at an angle of 30 deg., as shown in the plan, Fig. 2, and there are two suspended baffle walls between the doors, built radially across the furnace; one of these is shown in Fig. 7. Small doors in the inner and outer walls between the baffle walls facilitate cleaning of the furnace hearth while the furnace is in operation. The furnace has four firing zones and is fitted with 39 steam atomising burners designed for burning heavy fuel oil. Preheated air for combustion is obtained by using part of the heat contained in the waste gases, two Newton Chambers needle-type metallic recuperators being used as heat exchangers, as shown in Fig. 2. Preheated air is used in the heating zones and atmospheric cold air in the preheating and soaking zones. The hearth, which is of the Salem floating type, is driven at diametrically-opposite points by a 27-h. p., motor coupled through a differential gear and line shafting, all in the furnace foundation. There is a 200-to-1 reduction worm-gear driven by V-ropes at each end of the shafting. A pinion on the worm-gear output extension shaft engages a rack mounted under the rotary-hearth structure, as shown in Fig. 8. The hearth is carried on 108 wheels fitted with taper-roller bearings running on circular rails.

Fifty-three rows of blocks are arranged in the 330 deg. between the charging and discharging doors, giving a maximum of 371 blocks in the furnace. The rows of blocks are carried through the heating and soaking zones of the furnace by progressive indexing of the hearth at a rate corresponding to the output of the plant. At a production rate of 60 pieces per hour the heating time of the blocks is about 6¼ hours. The furnace is equipped with Honeywell Brown "Electronik" temperature controllers and Electroflo fuel/air ratio controls in each zone, and with Electroflo automatic furnace pressure control operating on the recuperator dampers.

The roof, shown in Fig. 8, is of the flat suspended-arch type and is formed of tongued-and-grooved interlocking blocks. The tongues and grooves are tapered in two directions.

Fig. 10. Transferring Block from Furnace to Press.

The larger blocks connect with the supporting structure by means of mild-steel hangers and clips, the hangers having toggle joints which, by a hinge action, give maximum movement in all directions to correct for expansion and contraction. The furnace walls are carried on the sand-seal dipper castings. The inner wall forms a polygon of flat vertical panels and is made of tongued-and-grooved interlocking bricks. A four-piece refractory burner is placed in the centre of each panel. The vertical joints at the junctions of the panels are made of dovetailed blocks which are anchored to the inner buckstays by alloy bolts to prevent outward movement due to expansion. The furnace foundation has been designed as an open pit about 7 ft. deep to ensure adequate ventilation under the hearth and to prevent overheating of the steel structure and wheel bearings. Lubrication of the latter is also facilitated. The inner buckstays are carried on piers. Steel beams span the space between these piers and the outer foundation wall forming the bottom ties of the furnace bindings as well as supporting the track rails.

FURNACE-DISCHARGING MACHINE

The heated blocks are removed from the furnace by a high bridge-type discharging machine of 1-ton capacity. The general design of the machine is similar to that of the charging machine, having a cable-driven carriage in which is mounted a rocking peel structure. The hoisting of the peel of the discharging machine, intended merely to clear the hearth, is effected by eccentrics mounted on extension shafts of a worm reduction gear coupled to a 10-h.p. direct-current motor. The grips are operated by a Vickers-Detroit combination pump, the small-volume portion being used to maintain the grip while the large-volume pump is unloaded to the tank. The grip cylinder is controlled by a solenoid pilot-operated four-way valve. The carriage—a welded box-type structure—forms the oil tanks for the gripping gear. Travel of the carriage to the predetermined billet position is controlled by a multiple-cam limit switch with vernier setting adjustment and "slow down" and "stop" rings for each billet position. The grips, at the withdrawn position, are aligned over a vertical air-operated ram which has a stroke of 30 in. Operation of the elevator ram is interlocked with the discharger carriage in order to prevent the release of the block when the elevator is not at the top of its stroke, though permitting the operator to commence the discharging cycle before the elevator is raised.

To commence the discharge of a row of blocks, the carriage travels to the outermost hearth position with the peel lowered. Completion of the travel initiates the gripping, which is followed by hoisting the peel, withdrawal to the elevator and lowering the peel. If the elevator is raised, the release of the grips and subsequent lowering of the

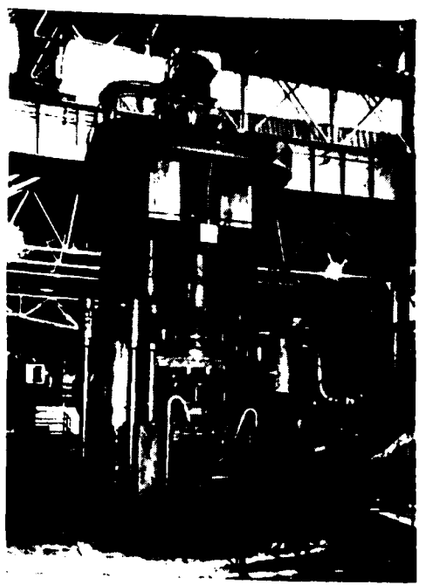


Fig. 11. 8,500-Ton Forging Press.

elevator take place automatically, together with closing of the furnace door. The operator then initiates transfer of the block to the descaler and press, and the discharging machine may be restarted. After the furnace door has been rehoisted, the machine commences its inward travel again and completes its cycle by with drawing and holding a second block over the elevator until the latter is automatically raised, following the return of the transfer car to the furnace. The cycles are repeated until the innermost block in a radial row has been discharged. A system of signal lamps on the control desk shows the operator at a glance how many blocks remain to be charged and discharged at any time. The hearth is not index until a clear space is indicated at the discharging position. Complete sequence controls on each machine automatically reset for the next cycle of operations. A rotating dial mounted outside the control room is geared to the hearth and is used for maintaining a continuous indication of the progress of the blocks through the furnace and of the operation of the hearth-indexing limit switches. Details of the blocks are chalked on this dial.

Fig. 12. Forging Produced in 8,500-Ton Press.

TRANSFER CAR

A tubular fabrication mounted on four flanged wheels forms the body of the transfer car, which is shown in Fig. 10. The front bulk-head of the body carries the grips. The operating cylinder and solenoid valve are mounted in the leading compartment, and the centre compartment forms the oil supply tank. A Vickers-Detroit combination pump and valve unit is flange-mounted on the rear bulkhead. The pump motor, pressure switches and electric junction box, enclosed by a ventilated cover, are mounted on a platform at the rear. The car travels on flat-bottom rails on a fabricated track structure 67 ft. 2 in. long, of which one end is built into the hydraulic descaler. Live rails along one side of the track supply current to the pump motor and the sequence-control circuits. The other side of the track is fitted with angle guides for wire ropes which attach the car to a drawbench-type winch unit mounted at the furnace end of the bridge structure. An electrical contact switch at the furnace end of the track is automatically operated by the transfer car to control the supply of cooling water to the peel of the discharging machine. Similar track switches at the press end of the track are used for slowing down the car prior to it entering the descaler, for operating the descaler control valve and for finally stopping the car when the block is over the 8,500-ton press slabbing die. Similar switches are used at the furnace end of the track for slowing down and stopping the car on its return journey to the furnace and for interlocking duties. Release of the blocks from the car grips, which is followed by the automatic return of the car to the furnace, is under the control of the operator of the 8,500-ton press.

HYDRAULIC DESCALING MACHINE

The hydraulic descaling machine has six Harland-Aldrich No. 2 nozzles, each of 27.2

gallons per minute capacity, mounted in an adjustable header pipe above the block, and six similar nozzles in a fixed header pipe arranged 6 in. below the lower surface of the block. The operating gear is mounted in a box-shaped fabrication, on top of which is fitted the upper-nozzle adjusting gear and a Schneible Multiwash collector with an extractor fan to prevent the steam generated in descaling from obscuring the view of the press operator. The steam is condensed in the collector and the waste water and scale are guided to fall into a scale bin located below floor level, the water draining to the main sump. Canal water is used for descaling, at a pressure of 1,500 lb. per square inch. The water is drawn from the main cooling-water supply pumps by a Berry three-throw pump delivering 34 gallons a minute into a weight-loaded accumulator of 47.7 gallons capacity. Supply to the nozzles is controlled by a Hunt "Quick-as-Wink" air-operated valve and the system is fitted with a priming pipe and non-return valve to maintain water in the nozzle headers and to eliminate hydraulic shock. Descaling is fully automatic, the transfer car turning the water on and off.

8,500-TON PRESS

The block is slabbed down on the forging press (shown in Fig. 11) between flat dies until the required thickness is obtained; a "dumping" effect is also produced, as shown in Fig. 4. It is then gripped in centring arms and transferred to the lower forging die. The upper sliding table is moved to bring the top forging die under the centre-line of the press, and the second forging operation is completed under intensified pressure. Meanwhile, the next block to be forged is placed on the slabbing die, and the lower sliding table is moved back to bring the completed forging over the stripping ram and the following block under the press crosshead. A forging at this stage is shown in Fig. 12. At an intensified pressure of 5,600 lb. per square inch, the maximum load on the press

Fig. 13. Forging in 1,000-Ton Punch Press.

is 8,500 tons. This load can be reduced on smaller forgings by reducing the pressure in the air-loaded accumulators. The press is fitted with four cylinders, having a diameter of $33\frac{3}{8}$ in. and a stroke of 36 in. The "daylight" between the sliding tables is 5 ft. 7 in. and the top and bottom tables have travels of 5 ft. and 9 ft. 6 in., respectively. The columns are 8 ft. centres and have a minimum diameter of 26 in. The press bed is a fabricated structure made from five castings and plates forming triple-web beams arranged diagonally to take a central load. The press crown is also a fabrication, the four corner castings being joined together with vertical plates to form four triple-web beams which transfer the load from the cylinders to the columns.

The crosshead is a one-piece steel casting designed to transmit the load from the four rams, which are located between the columns, to the centre of the crosshead. Built into the crosshead are twin hydraulic cylinders for moving the top sliding table. The lower sliding-table extension on the outgoing side of the press is a fabrication carrying the stripping cylinder. Top-die cooling equipment is built into the moving guards on the lower sliding table. The water sprays are automatically operated by valves actuated by the table movement. Cooling of the lower dies is effected by spray rings attached to the

crosshead and fed through flexible hoses. The spray rings are hinged to facilitate die-changing. Control of these water sprays is by air valves, pedal-operated at the press control desk. The crosshead bushes, which are lined with white metal, and all main glands, are fed with grease from a Trabon automatic system.

The hydraulic intensifier, which has a ratio of 2.87 to 1, gives a pressing stroke of 6 in. The press is equipped with a large pre-fill tank and surge tank. The latter is mounted directly over the pre-fill valves on the press crown to reduce cavitation in the cylinders when lowering the crosshead under pre-filling conditions. All the main hydraulic valves are arranged in the press foundation between the press and the control room. A pressure switch is installed to prevent operation of the intensifier before full accumulator pressure has been developed in the main cylinders. The control gear is electro-hydraulic, using V. S. G. auto-controlled pump and solenoid-operated pilot valves to direct oil to servo cylinders mounted under the main valve spindles. With this system it has been possible to group conveniently all the press controls on a desk. Thus, this stage of forging is placed under the control of one operator who is protected from heat, steam and noise and seated in clean and healthy conditions in the main control room.

On being lifted from the bottom die by the stripping ram, the forging is gripped, lifted further and slewed through 90 deg. by a special machine to bring it directly over the live roller table which runs through the punching press and on to the rolling mill. The press unloader is operated by the punching-press driver, who is seated alongside the 8,500-ton press driver at a common control desk. A double Vickers-Detroit pump driven by a 5-h.p. motor and a single pump driven by a 10-h.p. motor, both of which are mounted, together with the control valves, on a tank in the oil hydraulic room, supply oil to the grip cylinders and to the hoist and slewing cylinders respectively. The roller table, part of which is shown in Fig. 13, is divided into four units each having a separate driving motor. No. 1 section serves as a receiving table from the press unloader. No. 2 section is built into the punching press and mounted on the press column structure. Nos. 3 and 4 tables carry the blank from the punching press under the main control room into position for charging into the mill. Tables 1, 2 and 3 are driven by 10-h.p. alternating-current motors running at 965 r.p.m., giving a surface speed of 192.5 ft. per minute. These tables run continuously. No. 4 table is driven by a 5-h. p. direct-current motor which gives a table speed of 99 ft. per minute. This table is slowed down and stopped by photo-cell equipment to the mill end and is restarted automatically by operation of the mill-loading mechanism.

The punching press is of the upstroking type, equipped with twin 26-in. diameter rams and double-acting pull-back cylinders. The press has a rated capacity of 1,000 tons and a punching stroke of $9\frac{1}{2}$ in. at a speed of 3 in. per second. A 100-ton boss-clamping cylinder is mounted in the press crown around a rigid punch stem. Jack cylinders give an approach speed of 6 in. per second. The forging, on arrival in the punching press, is centred by an adjustable stop

Fig. 14. Main Control Room.

mechanism and lifted off the live rollers by the lower boss-clamping die. Continued upward movement of the crosshead first clamps the boss and presses the hub against the rigid punch. When the punch has completely penetrated the boss, the crosshead is stopped by limit-switch control and the forging is then lowered on to the live rollers. In the meantime the centring stop is removed and the forging is allowed to proceed to the mill. The control gear is similar to that used on the 8,500-ton press.

After the forged wheel has left the punching press, it is passed through a tunnel which is underneath the main control room illustrated in Fig. 14, herewith. Then it is rolled to give it the required rim section, as shown in Fig. 15, and finally it is dished in a press to produce an offset of the hub in relation to the rim, as shown in Fig. 16. If the rim is to be chilled the wheel is passed to a chilling machine, otherwise it is delivered directly to a "lay-down" station. These processes, which are regulated entirely from the main control room, where the operators work in white overalls and comfortable surroundings, are described below, together with the hydraulic and compressed-air plant which makes possible the remote and automatic control which is such a notable feature of the forge.

ROLLING MILL

The mill loading machanism is mounted under the main control room, its main supporting frame being pivoted at the mill end and suspended at the other end from a curved track. This arrangement facilitates the alignment of the machine in relation to the mill rolls. A carriage actuated by a hydraulic cylinder carries a self-centring grip mechanism which is rotated to enable the grips to clear the wheel forging. A separate oil hydraulic unit, located in the motor room, has a Vickers-Detroit double pump for the grip mechanism and a separate pump for operating the twisting and travelling cylinders. All these cylinders are mounted in the movable carriage and fed through flexible hoses. The travel stroke is arranged to take the forging from the end of the roller table to the centre-line of the mill, where the forging is deposited on forks attached to roll carriages. The rolling mill is illustrated in Fig. 18, which also shows the operators at their control desk.

The forged rim is reduced in cross-sectional area in the mill and formed to the required shape, as shown in Fig. 19, by

Fig. 15. ROLLING.

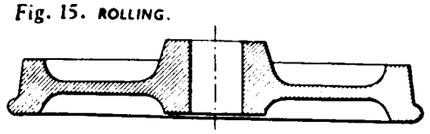
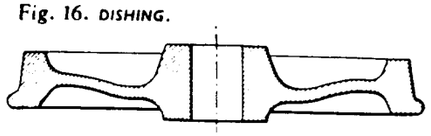


Fig. 16. DISHING.



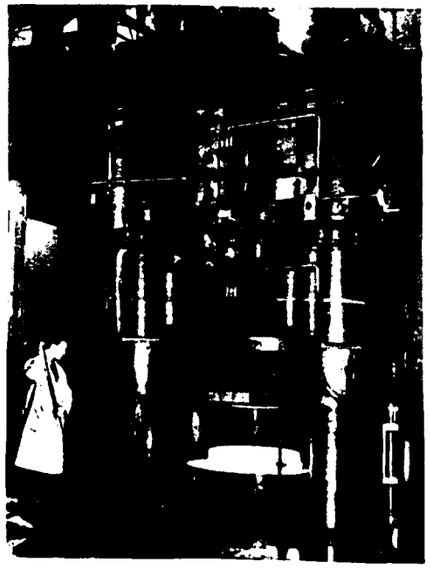


Fig. 17. 2,000-Ton Dishing Press.

driven edging rolls which bear on the front and back faces and on the inside contours of the rim, and by the load on two pressure rolls which bear on the tread and form the flange. The mill, of Taylor-Kendall design, has also a driven main roll mounted in an adjustable carriage and two guide rolls mounted on a separate carriage but sliding on the same ways as the main carriage. The hydraulic pistons for the guide-roll carriages are attached to the main-roll carriage to give movements relative to that carriage. The mounting arrangement of the guide rolls permits their retraction behind the main roll to facilitate loading and unloading of the mill. The arrangement adopted reduces the handling time at the mill and simplifies the handling equipment. Pressure regulation on the carriages during rolling controls the formation of the section and the rate of expansion of the wheel diameter. Indicating equipment is built into the mill to show the inside diameter of the rim, and mill setting scales are mounted on the side of the main stand for rapid setting-up to suit varying rim widths and roll diameters.

Each carriage has a self-contained oil hydraulic unit comprising large-volume low-pressure pumps for rapid-traverse duties and small-volume high-pressure pumps for maintaining pressure during rolling. The pumps, together with the electrically-operated control valves, are mounted on tanks which contain all the system connections. Only the cylinder piping and remote-control drains are located outside the motor room. Cylinder pressures are remotely controlled at the mill desk by adjusting venting valves coupled to Vickers-Detroit "hydro-cushion" relief valves which are mounted on the operating side of the cylinders.

The top and bottom edging rolls are each driven by a 400-h.p. direct-current motor having a speed range of 690 to 860 r.p.m. These motors, during rolling, are coupled in

Fig. 18. Rolling Mill and Control Desk.

series across a 480-volt generator. The motors drive through a primary reduction gear and wobbler shafts which are coupled horizontally to spiral-bevel pinions engaging wheels mounted on the roll shafts. The edging-roll shafts are inclined at 35 deg. to the horizontal plane and are mounted in quill castings which also form the bevel-gear casings. At the roll end of the shafts are four-row Timken "balanced-proportion" roll-neck bearings. Steep-angle taper-roller bearings are mounted in a cartridge behind the bevel gears. The input bevels are mounted in the quills on stub shafts carried in cartridge-mounted taper-roller bearings. The main roll, which is the only other driven roll, is carried on a tapered extension of a vertical shaft mounted on a Timken two-row "balanced-proportion" roll-neck bearing with a double-row taper-roller bearing at its lower end. A single-helical gearwheel is mounted on the roll shaft and engages a pinion on a vertical intermediate shaft which also carries a spiral-bevel wheel. A bevel pinion is mounted horizontally on a shaft coupled to a 150-h.p. mill motor having a speed range of 460 to 1,150 r.p.m. This motor is fed from a separate generator mounted on the main set and has a "shovel" characteristic to prevent it taking load from the edging-roll drive motors and overloading itself. All driven-roll speeds are independ-

ently variable and the overall mill speed is also adjustable to maintain pre-set roll speed ratios, modified to suit the various roll diameters.

The primary gearbox, edging-roll quills and main-roll gearbox are fed with lubricating oil from a De Laval circulating unit made by Denco Engineering Services, Limited, Hereford, and installed in the motor-room basement. The unit is fitted with duplicate gear-type pumps, a motor-driven filter, steam-heating coils and oil cooler. It has automatic control equipment to bring the second pump into operation in the event of loss of pressure and is provided with audible warnings for excessive pressure. The mill-motor controls are interlocked with the lubrication system to prevent the starting of the mill before the lubrication system is operating.

The three roll carriages slide on round ways and are fitted with bronze bushes pressure-fed with grease from a Trabon automatic reversing lubrication system. The bushes are fitted with wiper seals. It is claimed that this method of mounting the carriages facilitates effective lubrication and maintenance of roll alignments, with a consequent improvement in the consistency of product dimensions. Both edging-roll quills are mounted on pivot shafts having an eccentric centre portion for quill adjustment.

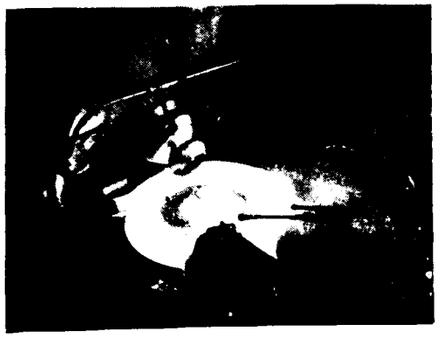


Fig. 19. Rolling the Rim Section on a Wheel.

Rocker bars at the roll end of the quills are connected through adjustable pitman arms to the screw-down crankshafts. The crankshaft for the lower roll is connected through a wormgear to a 5-h.p. mill motor forming a drive for retraction of the roll. The upper quill is similarly connected to a 20-h.p. direct-current mill motor of 450/1,200 r.p.m. This motor is coupled to a Metadyne set having a 35-h.p. driving motor, a 0/17-kW 0/230-volt generator, a 5-kW 250-volt exciter and a 600-watt 150-volt Metadyne exciter. Controls are provided to give "instantaneous" edging, which produces a parallel wheel web, or "continuous" edging to produce a tapered web by the use of an electronic ratio controller coupled to the wheel-growth dial. A separate controller is provided for manual adjustment of the top screw-down motor. Further information on the mill and screw-down drives is being prepared by the Metropolitan-Vickers Electrical Company, Limited.

2,000-TON DISHING PRESS

The wheel, on completion of the rolling, is transferred to a flat-topped car by an unloading mechanism similar in design to the one used for loading the mill. This car, which is cable-driven, takes the rolled wheel over the bottom die of the dishing press shown in Fig. 17. A swinging arm is brought into position by the dishing-press operator, who then returns the car to the mill end of its track. The car, in returning, slides from underneath the wheel, which is restrained by the stops, and the wheel falls on to the die. The lower sliding table of the press is then moved, bringing the die under the crosshead ready for the next forging operation. The dishing operation changes the web of the wheel from a flat disc to a cone shape and sets the boss offsets, as shown in Fig. 16. The press has a two-piece top die mounted in a holder on the crosshead and has a bottom sliding table having a stroke of 6 ft. on which are mounted the bottom dishing die and a stripping stool.

The press has a rated capacity of 2,000 tons at an accumulator pressure of 2,200 lb. per square inch, intensified to 6,000 lb. per square inch on a single ram 31⅝ in. in diameter with a 2 ft. 7 in. stroke. Hydraulic pull-back cylinders are mounted on bolsters fastened to the top of the press columns. The intensifier has a 19½ in. diameter low-pressure moving ram and a 11¾ in. diameter high-pressure stationary ram. The press control system is similar to that used on the 8,500-ton press, except that a pre-fill tank only is provided.

Mounted over the dishing-press table cylinder is a 1-ton hydraulic jib crane with a guided hoist in the form of a box-section column sliding vertically in guides at the end of the jib arm. To the bottom of the column is attached a set of automatic tongs which are adjustable to suit varying wheel diameters. A hydraulic cylinder mounted vertically on the jib mast is coupled to the column by wire ropes and fed with hydraulic oil through a rotary distributor which is mounted on top of the mast. The crane is slewed by a V. S. G. transmission unit driving through a planetary gearbox, the outer case of which is held by a friction brake to prevent damage in the event of fouling the jib arm. The crane is placed in such a way that the automatic tongs may be brought directly over the dishing-press stipping stool, the chiller loading station and a final lay-down station. These three points are at 120-deg. intervals around the 14-ft. diameter circle described by the jib. The slewing controls are arranged to give progressive movements of the jib through 120 deg. in either direction, thus enabling dished wheels to be taken either to the rim-chilling machine and from there to the lay-down station, or directly from the dishing-press to the lay-down station, according to the heat treatment required. Before transfer from the dishing-press stool the wheel is hot-stamped with the cast number of the steel. The stamps are mounted in the jaws of a toggle mechanism operated by an oil hydraulic cylinder, the complete gear being mounted in a carriage slung under the crane structure and traversed by a pneumatic cylinder. Stamping is carried out when the wheel on the dishing-press stripping stool has been moved from under the press crosshead. Gauging of a wheel after dishing is illustrated in Fig. 20, herewith.

RIM-CHILLING MACHINE

The rim-chilling machine has five chilling stations mounted on an electrically-driven turntable 14 ft. in diameter. At each chilling station is placed a set of three tapered rolls, one of which is driven by an electric motor mounted inside the turntable hood. Box-section spray rings are mounted on the roll housing and coupled to a pump located inside the turntable hood through a solenoid-operated valve. This pump, rotating with the table structure, draws water from an annular tank located around the vertical post which carries the weight of the whole machine. At the centre of each chilling station is a set of loading forks under which is mounted a live-roller centre. At the point of intersection of the spray-ring pitch line and the jib-crane radius a fixed cam is arranged to lift the forks above the level of the live rollers in readiness to receive the wheel from the jib crane. After the wheel has been deposited on the forks the main turntable is indexed one-fifth of a revolution, lowering the forks and leaving the wheel on the rotating

Fig. 20. Gauging Wheel after Dishing.

rollers. The water-spray valve of that station is automatically switched on, together with the spray timing device which holds the spray valve open irrespective of further movement of the station.

As the first station is carried away from the loading point the fifth station goes into the loading position and the wheel is lifted from the live rolls by forks, ready for transference by a hydraulic jib crane to the final lay-down position. The water from the spray rings runs down the hood at the main turntable structure into an outer annular tank fitted with overflow pipes which act as a return to the main drainage sumps. The outer casing of the chiller dips into the return water tank, forming a water seal, and the underside of the hood is ventilated by a fan mounted on the centre of the main hood structure. This flow of water is used to assist the flushing of scale from the mill and press foundations. The main turntable drive consists of a 10-h.p. motor with a brake, coupled by means of an extension shaft to a wormgear unit mounted underneath the turntable hood, a pinion on the wormwheel extension shaft meshing with a ring gear fastened to the inside of the rotating hood structure. A set of collector rings mounted on the vertical centre column supplies current to the five roll motors, the spray pump and the spray valves. The timers are located in the main control room on the chiller control desk. The latter also carries the turntable rotation controller and the hydraulic jib-crane controls. The final lay-down station consists of a simple turntable carrying three stacking pegs. The pegs, designed to receive five completed wheels, have their upper ends shaped to suit a set of automatic tongs fitted to the overhead crane used for removal of the completed stacks of wheels to the cooling beds.

MOTOR AND PUMP ROOM

The Main pumps and accumulators for the press hydraulics, which are designed to

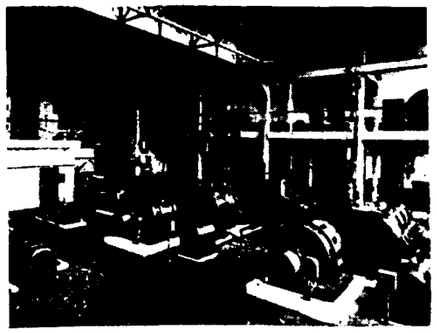


Fig. 21. Motor and Pump Room.

operate up to a maximum working pressure of 2,200 lb. per square inch, are arranged to form two independent systems with separate control gear. The large system comprises five strip-wound air vessels, each with a capacity of 68 cub. ft., and one strip-wound water vessel of a similar capacity. The small system comprises two 68-cub. ft. strip-wound air vessels and one 25-cub. ft. solid forged water vessels. These vessels are shown in Fig. 21, above. The ratio of air to water volume is such that a pressure drop of 10 per cent. is allowed over the normal operating levels. The 68-cub. ft. vessels are made of welded plates covered by four layers of special-section rolled-steel strip. A three-stage Hamworthy air compressor with a capacity of 18 cub. ft. per minute is used for charging the air vessels. The water and air vessels are connected to mercury level-control pots of Vickers-Armstrongs design for control of the pumps and accumulator automatic stop valves. The pumps are unloaded by lifting the suction valves at a predetermined water level. Contacts in the mercury pots shut down the pumps at extra high level to avoid overfilling. Should the pumps fail to meet demands on the system, further contacts are arranged with close the accumulator automatic stop valves, thus isolating the water vessels from the press supply lines.

The large accumulator system is fed by two three-throw Vickers-Armstrongs pumps, each having a capacity of 400 gallons per minute at 2,200 lb. per square inch. The rams are 4⅜ in. in diameter, with a stroke of 21 in., and the crankshaft speed is 110 r. p. m. Each pump is driven through single-reduction double-helical gears by a Metropolitan-Vickers 6,600-volt slip-ring motor of 750 brake horse-power at 740 r. p. m. The small accumulator system is fed by a Davy three-throw pump of 160 gallons per minute capacity at 2,200 lb. per square inch. The pump is driven through a single reduction double-helical gear by a Metropolitan-Vickers 6,600-volt slip-ring motor developing 275 h. p. at 740 r. p. m.

It is possible, by means of the independent accumulator systems, to operate the 8,500 ton press at lower pressures than the punching and dishing presses, and thus to consume less power in the forging of smaller products. The accumulators can be connected together to operate as a combined system by equalising the air pressures and opening a stop valve in the water lines. The pumps and accumulators are housed in the motor room and the valves are arranged under the vessels in a basement which extends into the main pipe subways and the press foundations.

New 2-ft. diameter supply and return culverts have been constructed between the motor room and the Bridgewater Canal, which forms the south-west boundary of the works, and two Gwynnes centrifugal pumps, each with a capacity of 1,000 gallons per minute, are coupled through Auto-Klean strainers to supply cooling water for the rolls, dies, chilling machine, etc. All waste water is returned to a scale sump through open troughs constructed in the plant foundations. The scale is collected in containers which are lifted out of the main return sump and allowed to drain before being emptied into rail wagons. The return water is lifted from the deep sump to an oil-separator chamber by two float-controlled Gwynnes vertical-spindle pumps, and then returns by gravity to the canal.

An Ingersoll Rand 90 h. p. three-cylinder air-cooled compressor equipped with an after-cooler and air receiver supplies compressed to the forge for operating the elevator at the furnace discharger. Compressed air is used for operation of the cooling-water valves and the stamper traverse cylinder, and is also piped to convenient points for general service. The motor room is supplied with clean air through a Visco filter at 30,000 cub. ft. per minute by a fan designed to maintain a positive pressure in the room.

The main 6,600-volt switchgear, the 400-volt switchboard and the rolling-mill control board are mounted on a balcony over the oil hydraulic room. The latter is at motor-room floor level but is enclosed from the main room and houses the tank units carrying the Vickers-Detroit equipment and the oil supply tank for the V. S. G. systems. In the basement beneath the oil hydraulic room is housed the mill lubrication equipment, the mill and press greasing equipment and the V. S. G. oil hydraulic pumps. Care has been taken in preparing the general layout to give ease of access to the extensive pipe and cable runs.

NEW TURBO-DRILL

The Kungur Engineering Works in the Urals is manufacturing drilling machinery to be exported to the People's Democracies, India, Egypt, Syria and other countries. The work has recently commenced the production of the axial-radial T-25 turbo-drill. The machine is noted for its higher life time and high productivity. Its capacity exceeds that of the existing models by 50 per cent.

The New Murex "Dynex" Welding Generator

THE Murex "Dynex" generator which was first briefly announced a short time ago has recently gone into full scale production. One of the most important features of this new generator is that it has been specially designed for welding. In other words it is not just a generator which has been adapted for welding requirements, but it is an equipment which has been designed from the outset to have special advantages for welding purposes.

It is suitable not only for D. C. metal arc welding, but also for other processes such as argon arc welding. Furthermore this new generator has been designed so that it can be supplied as a motor generator equipment and so that it can be incorporated into all Murex engine-driven equipments.

CURRENT ADJUSTMENT

The Murex "Dynex" generator employs a new and unique principle of current control giving infinite current adjustment between maximum and minimum values throughout its entire current range at a practically constant open circuit voltage. This facility provides ideal characteristics for modern electrodes and techniques.

VOLTAGE CHARACTERISTICS

When necessary the open circuit voltage of the "Dynex" generator can also be infinitely varied between maximum and minimum values to meet the needs of special applications. The machine is twice as fast in voltage recovery as a conventional type of equipment owing to the laminated construction and special design of its field components. This results in improved welding facilities, particularly for the welding of special alloys, stainless steel, aluminium and for those application which involve the use of argon or helium gas screens to protect the weld area from contamination by oxygen or other elements.

SERIES RESISTANCES ELIMINATED

Another advantage of the "Dynex" generator is that series resistances have been entirely eliminated and thus a familiar source of trouble in some other types of welding generators has been overcome.

POLARITY CHANGE-OVER SWITCH

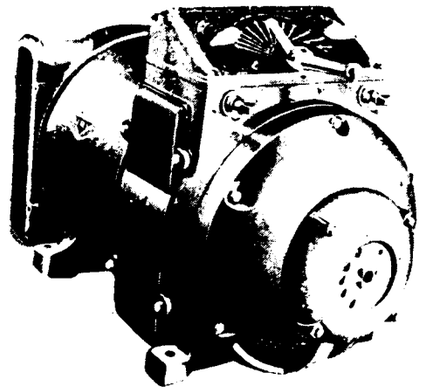
A polarity change-over switch is fitted and thus the necessity of reversing the main welding leads is avoided when a change of polarity is required.

SIMPLE CONTROLS

All the controls of the "Dynex" generator are very simple. The indicator plate is clear and accurately calibrated. This eliminates the need for instruments. In the case of motor generators a simple push button starter is incorporated. This is of the start delta, air brake type with an overload and no-volt release.

CAPACITY

The generator is known as the Type DX002 and has a welding rating of 9-14 KW. Its output is infinitely variable from 20 to 400 amps. and the open circuit voltage may be infinitely varied from 70 to 90 volts approximately. The maximum hand welding current is 300 amps. at 30 volts and the maximum intermittent hand welding current 400 amps. at 35 volts. Where the output of the prime mover permits, currents of up to 450 amps. may be obtained. All the above ratings are to B. S. 638 : 1954.



Murex "Dynex" 300/400 amp. Welding Generator.

DRIVE

The "Dynex" generator can be coupled directly through a flexible coupling to an electric motor, petrol engine or diesel engine. Alternatively it can be arranged for a belt drive.

MOTOR GENERATORS

The "Dynex" motor generator is known as the Type MDX. In this case the generator and A. C. motor are built into a single carcass and the equipment is suitable for connection to any 380-440 volt 3 phase 50 cycle supply. As previously stated a star delta push-button starter is incorporated in the control panel.

OVERLOAD PROTECTION

A thermal type overload protection device is incorporated in the windings of the motor of the motor generator sets. In the event of sustained overloads causing overheating of the motor windings the device will operate and return the starter to the "off" position, thus disconnecting the set from the mains. The equipment cannot be restarted until the temperature of the windings has fallen to normal and the device has reclosed.

CAPACITY

The 200–300 amp. "Dynex" motor generator is known as the Type MDX041 and has an output infinitely variable from 15 to 200 amps. at 25 volts for continuous hand welding and up to 300 amps. at 30 volts for intermittent hand welding (to B. S. 638 : 1954). Open circuit voltage infinitely variable from 70 to 90 volts approximately.

The 300–450 amp. "Dynex" motor generator is known as the Type MDX002 and has an output infinitely variable from 25 to 300 amps. at 30 volts for continuous hand welding and up to 450 amps. at 35 volts for intermittent hand welding. Open circuit voltage infinitely variable from 70 to 90 volts approximately. Complies with B. S. 638 : 1954.

REMOTE CONTROL

When required a portable regulator can be supplied and this will allow current variations to be made up to 200 amps. according to the original setting of the brush shift control of the generator.

A TUBULAR QUIZ

What is Elastic Limit?

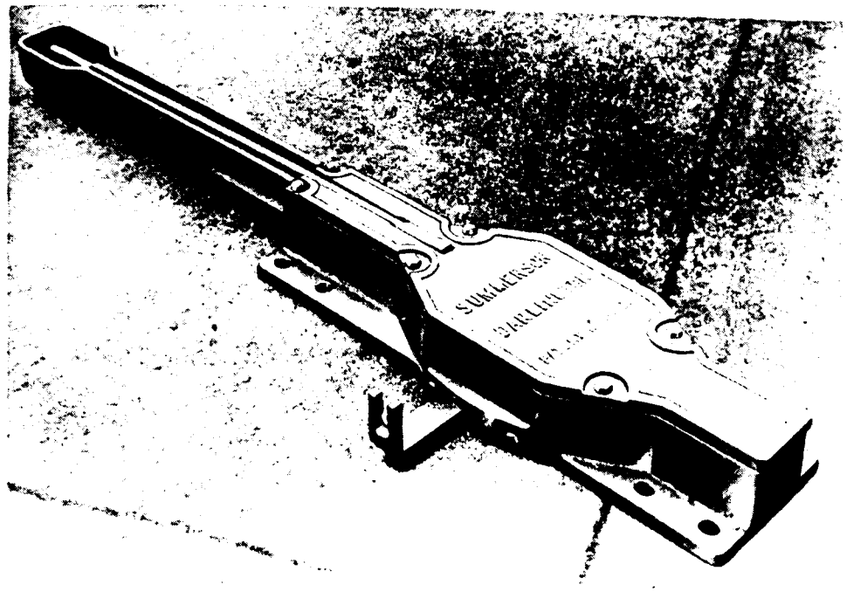
Elastic limit is the highest stress which can be applied to a material without causing it to be permanently deformed when the load is removed.

Summerson All-Steel Lever Boxes

THE name of Thomas Summerson & Sons Ltd., Darlington, England, has been known to the railway engineers of India ever since the introduction of railroads into India, and there is little doubt that much Summerson equipment for the permanent way is to-day operating on Indian Railways. The success of the second Five-Year Plan for the development of India will necessitate assistance from railway engineers of the outside world, which Summersons are ready to give and in fact contracts have already been obtained.

Lever Boxes are an important, indeed vital accessory to the operation of railway switches, and Summersons have designed and produced types of Spring Acting Lever Boxes which are outstanding in performance and of worldwide renown. The Lever Boxes, known as "DAVID", "No. 45 FLUSH TYPE", and "STOWAWAY", have all been produced on the basic principle of *all-steel construction, manufactured to precision limits.*

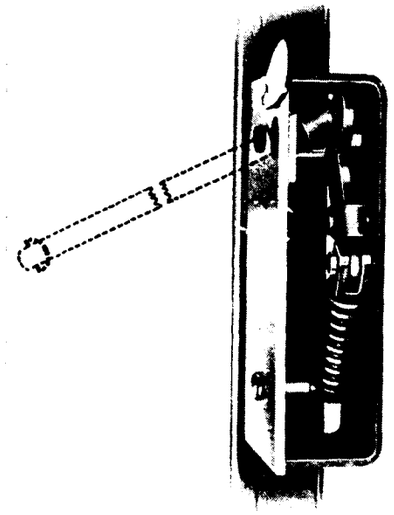
The operating principle of both "DAVID" and "No. 45 FLUSH TYPE" is the toggle spring in combination with a patent Trip Rod arrangement, whereby the handle remains "still" with trailing traffic. These boxes are used with switches made of medium and heavy rail sections, and pressures of 400 lb. can be exerted by the Spring against the switches. For double slips and switches of very heavy section rail it is possible to apply tandem springs and an adjusting mechanism to the "DAVID"-box. Both "DAVID" and "No. 45 FLUSH TYPE" can be supplied for either two-way or one-way operation, and whilst "DAVID" is always supplied with upright handle, the "No. 45 FLUSH TYPE" is eminently suitable for use in paved and concreted areas for both road and rail traffic combined.



"No. 45 Flush Type"

The "STOWAWAY" Spring Lever Box is suitable for use with switches made from rail up to 60 lb. per yard section and has been specially designed for use in colliery workings served by Diesel locomotives and mine cars. It fits snugly to the web of the rail and has a detachable handle so that, with underground conditions, the hazards and resultant injuries to personnel are greatly reduced.

"David"



"Stowaway"

The "all-steel" construction of the three boxes eliminates the possibility of damage to which case iron is liable by the impact of dislodged loads whilst the susceptibility of steel to corrosion through contact with chemicals or the effect of tropical climates is nullified by the anti-rust treatment, which the components undergo before assembly.

The Precision Methods used in the production of the components which go into Summerson Lever Boxes represent a complete departure from custom and the result is a high-class piece of engineering equipment, worthily capable of taking its place in modern railway sidings. The wear and tear with resultant maintenance costs are reduced to a minimum; there is perfect interchangeability of components which simplifies the fitting of spares when this eventually becomes necessary; frictional losses are reduced to a minimum with a corresponding reduction in the effort required from the operator, and this in turn gives maximum pressure against the switches and the certainty of positive results in operation; it is virtually impossible to gag switches and cause derailments.

(Continued on page 32)

THE "ENTERPRISE" CONSTANT-OUTPUT MECHANICAL-DRIVE LOCOMOTIVE

210 Constant Horse-Power Hudswell Clarke Design with Dual-Fluidrive Transmission and Paxman Hi-Dyne Engine

IN order that a Diesel-mechanical locomotive can produce the ideal type of tractive effort curve, such as is produced by an electric-drive locomotive, it must have a gear ratio varying inversely with road speed, while the engine runs at constant speed and constant horse-power.

After considerable research and development the solutions to these problems have been included in the design of the constant-horse-power "Enterprise," the new Hi-Dyne Dual-Fluidrive locomotive built by Hudswell, Clarke and Co., Ltd., Railway Foundry, Leeds, 10.

This new locomotive is an oil-engined machine, type 0–6–0, of 4-ft. 8.5-in. gauge, incorporating a Paxman Hi-Dyne engine, Dual-Fluidrive transmission, and a low-high range final reduction gearbox, incorporating forward and reverse gears. Leading dimensions are: height 11 ft. 6 in.; length between buffer beams 24 ft.; maximum width 8 ft. 6 in.; wheelbase 10 ft.; wheels 4-ft. diameter. The sharpest curve which the loco. will traverse is 150 ft. and the total weight 48.5 tons, in full working order.

Tractive efforts in the low speed range, at 4.54, 8.01 and 14.5 m.p.h. are 14,750, 8,350 and 4,610 lb. respectively, maximum tractive effort being 25,200 lb. at 2.66 m.p.h. For the high speed range, at 9.32, 16.45 and 29.9 m.p.h. the tractive effort values are 7,170, 4,060 and 2,230 lb. respectively, the maximum tractive effort being 11,200 lb. at 5.97 m.p.h. These figures are based on 85% efficiency and the factor of adhesion is given at 4.3:1.

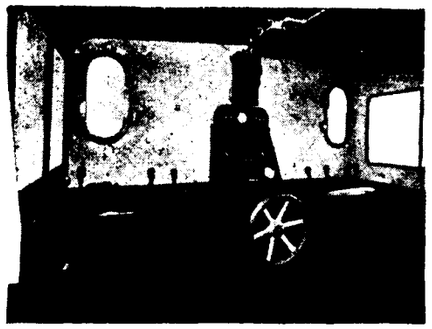
A Paxman six-cylinder 6RPHX-II Hi-Dyne oil engine is employed as the prime mover. It is the usual standard model with Ricardo heads and electric starting, but fitted with a constant-horse-power governor and pressure-charged by means of a Brown Boveri turbo-charger (type VTR 160). Cylinders are in vee formation, of 7-in. bore by 7.75-in. stroke, with a rating for this application of 210 b.h.p. over the whole speed range of 735 to 1,250 r.p.m. The standard Paxman 6RPHX engine, for example, has a normal continuous railway output of 312 b.h.p. at 1,250 r.p.m. which falls to 175 b.h.p. at 700 r.p.m.

TORQUE CHARACTERISTICS

The main characteristic of this Hi-Dyne engine is that the turbocharger and the governor control unit are so arranged that the torque developed by the engine increases with reduction in engine speed over approximately a 2:1 speed ratio, and the maximum horse-power capable of being developed by the engine over this speed range remains substantially constant. Therefore, the engine is able, in conjunction with a suitable change in speed mechanism and fluid-type coupling to produce a smooth, stepless tractive effort/speed relationship closely approaching the ideal.

Cooling of the engine circulating water and lubricating oil is by means of a Serck radiator and fan. The fan drive is by belt from a pulley on the engine transmission shaft to a countershaft and thence by a short belt to the fan. On the countershaft is fitted a small Vulcan-Sinclair scoop-controlled fluid coupling. The main purpose of this coupling is to keep the fan speed more or less constant regardless of the engine speed. This is accomplished by fluid pressure on the scoop, which is fully engaged at low engine speed and automatically withdrawn as the engine speed increases.

With a constant torque engine the dissipation of heat to the radiator decreases with reduction in engine speed and power output, but with a constant horse-power engine the heat rejected to the radiator is substantially constant, therefore, it is necessary to drive the fan at a uniform speed.

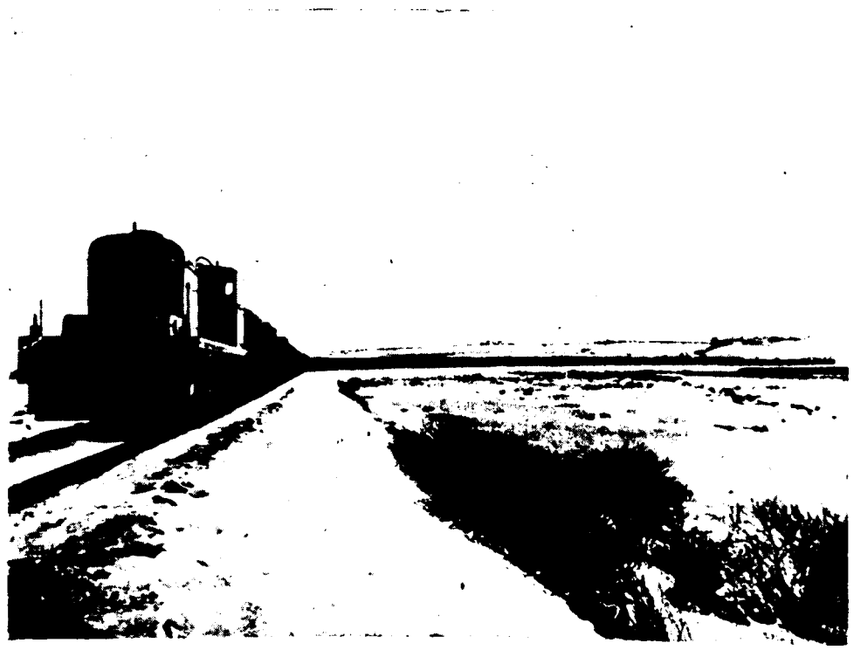


An interior view of the driver's cab, showing the controls and instrument panel.

Torque from the engine is transmitted through a Holset flexible coupling, the Dual-Fluidrive unit comprising, as the name suggests, two fluid couplings, planetary gears

(Continued from page 31)

One of the world's greatest problems of the present era is to overtake the shortage of iron and steel supplies, in which India will shortly be playing an important part, and Summerson All-Steel Lever Boxes can justly claim to also play their part in the conservation of materials by replacing heavy, easily fractured, cast iron structures by a stronger steel construction of approximately half the weight.



The "Enterprise" when working at a C.E.A. power station hauling 75 full coal wagons—1,500 tons—on a 1-in-129 grade and 250-ft. radius curve.

and S. S. S. coupling; a Croft flexible coupling, and a final reduction gearbox incorporating the direction and low-high alternative gears are used.

The final reduction gearbox input is geared down to the parallel bevel pinion shaft which carries the "range" gears for the low and high ratios. The bevel pinion meshes with two bevel wheels, running free on the final reduction pinion shaft. The rail wheel's rotation is determined by which bevel is engaged to the shaft by the sliding dog clutch. In turn the final reduction pinion meshes with its mating wheel on the jackshaft. Actual construction of the final-drive gears and gearbox was by David Brown and Sons (Huddersfield), Ltd.

Underneath the Daul-Fluidrive unit a sump, provided for the working oil, also contains a centrifugal pump, gear driven from the primary shaft, and control valves for filling the couplings either singly or doubly as required. For example, when selecting first gear, oil is pumped from the sump into No. 1 coupling. On selecting second gear the pump fills No. 2 coupling and the quick-emptying valves allow the oil in No. 1 coupling to drain back to the sump. For third gear operation both couplings are filled and the drive is then through both couplings. When the engine, is idling at about 400 r. p. m. the quick-emptying valves are open and at about 500 r. p. m. they begin to close. All change-speed operations are made by the use of compressed air at 50 p.s.i. There is a dial in the driver's cab which indicates when the gear is in forward or reverse, also if in high or low "range" gear.

SCOOP COUPLING COOLING

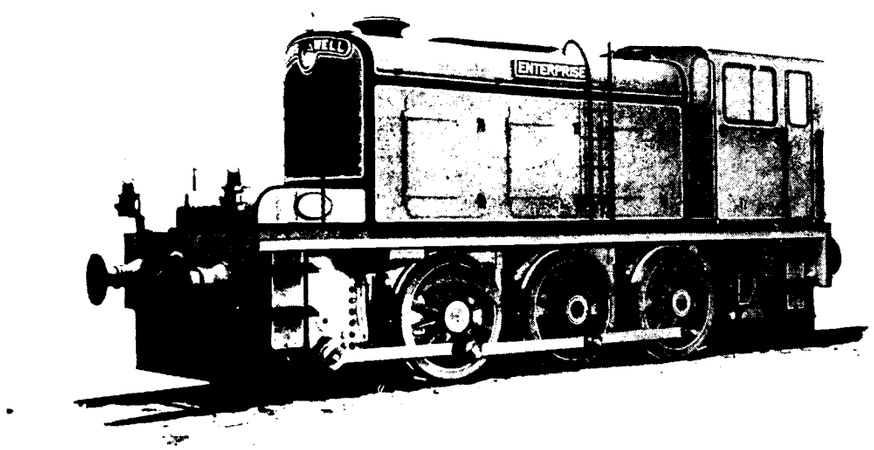
Both couplings are fitted with diaphragm-type quick-emptying valves, which close when the circuit is filled, due to a by-pass allowing oil to seat the valve. Oil used in the couplings is cooled by means of a heat exchanger.

Neutral gear is obtained when both couplings are empty, as when changing the forward-and-reverse direction gear, or when selecting the high or low range gear, both of which are fitted in the final drive gearbox as already mentioned. The impellers of the two fluid couplings, which are driven at engine speed, are connected by a sleeve shaft; the casing, bolted to each impeller, houses the diaphragm-type quick-emptying valves.

The runner of the low-gear coupling drives the shaft terminating in the sun pinion of the planetary gear, the planet carrier of which is connected to the output shaft, giving a reduction of 3.2 in the first gear. The high-gear coupling runner is connected through a hollow shaft to the primary annulus gear giving a reduction of 1.8 in second gear. Incorporated in the planetary train is a second annulus gear which constitutes the reaction member in first and second gear, and this is connected to a sleeve shaft carrying an S. S. S. clutch which prevents the annulus from rotating backwards, but permits it to rotate freely forward when both fluid couplings are filled to give third gear conditions.

This S.S.S. clutch carries a pneumatically-operated sleeve by which it is locked bi-directionally when in first gear to make available the engine braking effect with the fuel control closed and the low-gear coupling filled. The clutch is unlocked when the gear control lever is in the second and third gear positions. The pawls of the S.S.S. clutch are centrifugally tail heavy so that they become operative only at low speeds, just before rotation ceases, hence ratcheting does not occur during normal running. Pneumatic control from the driver's gear-selection lever is provided for the filling valves of the two fluid couplings, and for the control sleeve of the S.S.S. reaction clutch.

Gear changes are made normally with the engine speed control open, and the change in ratio is only evident from the variation in the



A view of the constant-output mechanical-drive Hudswell Clarke locomotive

engine note. To an observer on the footplate this behaviour is not clear but at the same time the maintenance of drawbar pull is most obvious.

PRACTICAL EXPERIENCE

To substantiate this statement we recently travelled on the footplate of this locomotive engaged on shunting duties at a large C. E. A. power station near Leeds. During the period of hauling empty wagons from the coal dump to the weigh-bridge, where each wagon was weighed separately, and back to the marshalling yard, the operation was carried out in second gear. The whole performance was completed with a smooth stepless tractive effort, in a manner much better than the ordinary steam locomotive would perform this duty.

At the marshalling yard we picked up a coal train comprising 53 full wagons and hauled it from the yard up a gradient of 1 in 200 for about half a mile in first gear at about 3 m. p. h. then changed to second gear for the rest of the journey, the change being made in from 1 to 2 sec. So far as variations of load on the locomotive were concerned we did not feel any difference in performance, and no effort was shown by the Paxman engine; the take off, as already mentioned, was exceptionally smooth. One noticeable feature was the absence of wheel slip. During shunting we observed that the driver changed from reverse to forward speeds practically instantaneously; this also applied when changing from forward to reverse. The train load of 53 wagons was a small one for the "Enterprise" but at this particular site, until the new marshalling yard is completed, the handling of 53 wagons is the limit, otherwise the roadway would become jammed with wagons and interrupt working conditions at the coal dump. A total of 117 wagons, each of 20 tons, has been handled by this locomotive; an illustration on page 34 shows the haulage of 75 wagons.

So far as the mechanical construction of the "Enterprise" is concerned, this is of typical Hudswell Clarke design with jackshaft at the front and the power unit between it and the cab. Wheels are larger than usual, a feature which enables a rail clearance of 6 in. to be obtained; that is most desirable for working over steel works' and colliery tracks.

Frames are of open-hearth steel in one plate running the full length of the locomotive and suitably braced and bracketed to form a rigid foundation for the engine and transmission, including the gearbox. Buffer beams are also of open-hearth steel of substantial thickness, firmly stayed back to the frames to withstand heavy shunting duties. Using thick frame plates, buffer beams and an exceptionally thick running plate gives the necessary adhesion weight.

The driver's cab is of all-steel construction with windows to give clear view for driving in either direction. Sliding windows are provided at each side of the cab, and all the driving controls are grouped conveniently, together with instruments and gauges. The controls are arranged for working from either side of the cab. Driving is simple in that there is only an engine speed-control handle and a gear selection lever to look after. The latter is simply a servo handle of short travel, with a simple-back-and-forward movement; it is not necessary to move the speed-control handle during a gear change. Driving is almost foolproof in that whatever methods the driver adopts, the transmission protects itself and the engine from ill effects.

Compressed-air-operated brakes are fitted and operate through rigging to cast-iron brake blocks, one on each coupled wheel tread. For the supply of compressed air a compressor, belt driven from the main engine, is provided. The main fuel storage is mounted under the bonnet and holds 115 gal.; the fuel flows to the injection pump by gravity.

The locomotive's weight (48 tons) is said to be heavy for its power, even allowing for the effect of a constant h. p. engine, but this weight decided upon in case lengthening experience with the engine showed that the constant h.p. setting could be raised to 225, 240 or up to 250 b. h. p. Against the present maximum tractive effort of 25,200 lb.—a figure which is high for a 210 h. p. loco.—the factor of adhesion is 4.3.

With this constant h. p. engine, much running has been undertaken at 800/950 r. p. m., or at 64 to 76% of the governed speed and with no adverse effect on exhaust or water temperatures. The locomotive has also had a run of a mile or so uphill (about 1 in 50) with 250 tons trailing load which was hauled at a steady 11 to 11.5 m. p. h. at 1,000/1,050 r. p. m. in third gear (low range), with complete satisfaction.

The enterprise power unit had run about 3,500 hr. up to the middle of January, 1956, with great success, apart from one or two minor "teething" troubles which can usually be expected with an entirely new venture such as this. The locomotive is now operating at a colliery near Leeds for further trials on a different type of duty from that of a power station.

The next development by Hudswell Clarke is a 500-constant-h. p. locomotive powered by a pressure-charged Paxman 12 YHXL 12-cylinder engine and suitable for hauling trains—either passenger or mixed traffic.

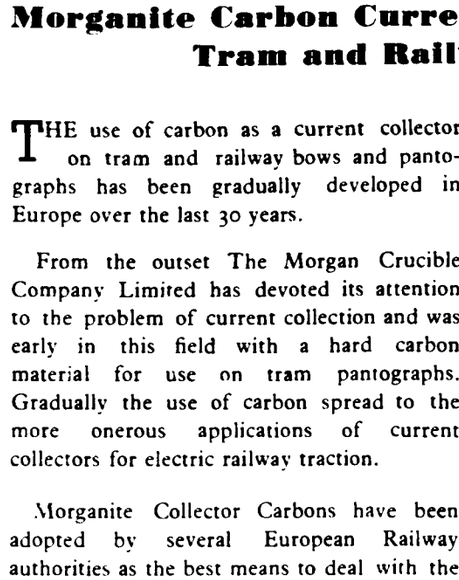
(By Courtesy: The Oil Engine)

Morganite Carbon Current Collectors for Electric Tram and Railway Bows and Pantographs

THE use of carbon as a current collector on tram and railway bows and pantographs has been gradually developed in Europe over the last 30 years.

From the outset The Morgan Crucible Company Limited has devoted its attention to the problem of current collection and was early in this field with a hard carbon material for use on tram pantographs. Gradually the use of carbon spread to the more onerous applications of current collectors for electric railway traction.

Morganite Collector Carbons have been adopted by several European Railway authorities as the best means to deal with the very complex problem of electrical current collection at high speeds from a relatively light, overhead copper wire. Based on their experience during the last thirty years, The Morgan Crucible Co. Ltd., has developed special carbon grades for use on electric tram and railway bows and pantographs.



PC 1
Fig. 1. formerly 562/A

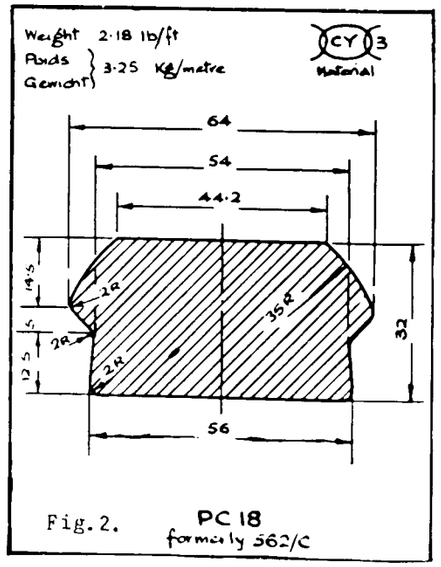
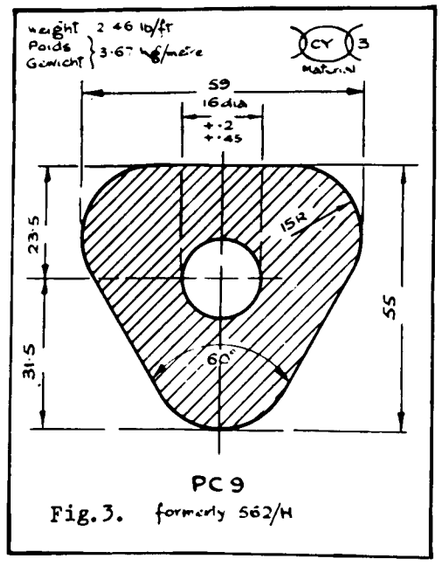


Fig. 2. PC 18
formerly 562/C

ADVANTAGES OF CARBON CURRENT COLLECTORS

(1) A greatly reduced rate of wire wear owing to the smoothness and polish produced by the carbon collector as opposed to the roughness of the metal collectors.

(2) Reduction of radio interference–The earlier applications of carbon collector were intended chiefly as an aid to suppress radio interference, coinciding as it did with the onset and expansion of wireless communication (i. e., the years 1920 and onwards). This advantage is the result of considerable improvement in contact stability between overhead wire and collector. This contact stability arises out of the smoothness and polish developed on the wire with carbon.



PC 9
Fig. 3. formerly 562/H

(3) This polishing of the wire contact surface in turn resulted in longer life of the carbon current collector compared with that of a conventional metal collector.

CARBON SECTIONS AND MATERIALS

Morganite pantograph carbons are available in a variety of sections. Figs. 1 to 4 show some of the standard shapes. It is of interest to note that the large sections are used exclusively for single piece bows whereas smaller sections are used for lining pans. These sections are available in either Hard or Metal Carbon.

The Hard Carbon is known as Link CY3T or CY3WA: (T = wax impregnation; WA = resin impregnation). These impregnations render the carbon impervious to moisture. These materials are available in lengths up to 51.2" (1,300 mm.).

The Metal Carbon is called Link MY7A, MY7B, MY7D: (These materials are hard carbon incorporating A = Copper or B = Babbitt or D = Copper lead). They are available in lengths up to 14" (355 mm.), longer lenghts being made up of short pieces which can, however, be held in a common metal sheath. The number of pieces per sheath, however, not exceed two.

RATE OF CARBON WEAR

The rate of wear of a pantograph carbon is directly dependent on the total current to be collected and the efficiency or stability of the contact between collector and wire.

To quote an instance of a D.C., 1500 volt railways, the carbon—life per pan was about 50,000 miles (80,000 km.) on coach unit trains fitted with Link MY7D and half this value on the locomotives also fitted with Link MY7D. In this case the current loading on the pans of the locomotives is a little more than twice that on the coach units. On the locomotives the Link MY7D material is near the limit of its capacity whereas on the coach units the Link MY7D is well within its limit. A plain carbon under similar conditions on the coach units would give a life of about 40,000 miles (65,000 km.) compared with 50,000 miles (80,000 km.)

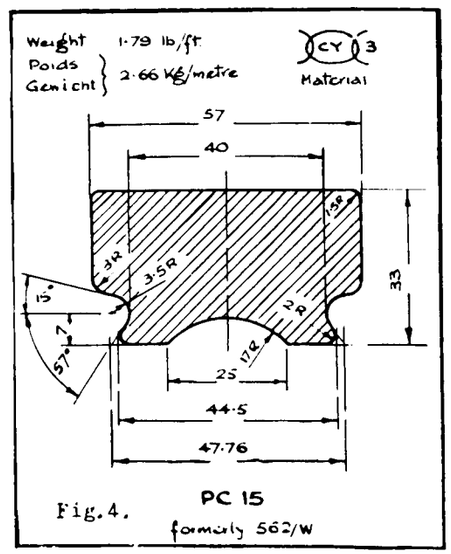


Fig. 4. PC 15
formerly 562/W

with Link MY7D. On the locomotives the current to be collected would be quite beyond the current carrying capacity of a plain carbon.

For maximum life much depends on the distribution of wear over the carbon and on the amount of wire stagger. If the stagger is wide and very even then a wear factor of 70% may be achieved. (Wear factor = volume of carbon worn / total volume of carbon)

A carbon current collector must at all times work within its current—carrying capacity. Greasing or oiling of carbon current collectors should be avoided because such lubricants collect abrasive dust and cause abrasion and rapid wear both of the carbon and the wire. In sandy areas it is of very considerable importance to keep the collector and wire quite clean so that the wire develops a good polish; in fact, in all circumstances, if the wire does not develop a polish then the life of the carbon will be short.

Where a steam train service is inter-running with an electric service "sooting" of the wire may be encountered particularly at

Contact line suspension on the 1,500-Volts Paris—Le Mans line. (French State Railways)

Right: One of the welded and riveted masts supporting the tensioning weights for the contact line.

Below: Detail of the overhead suspension gear.

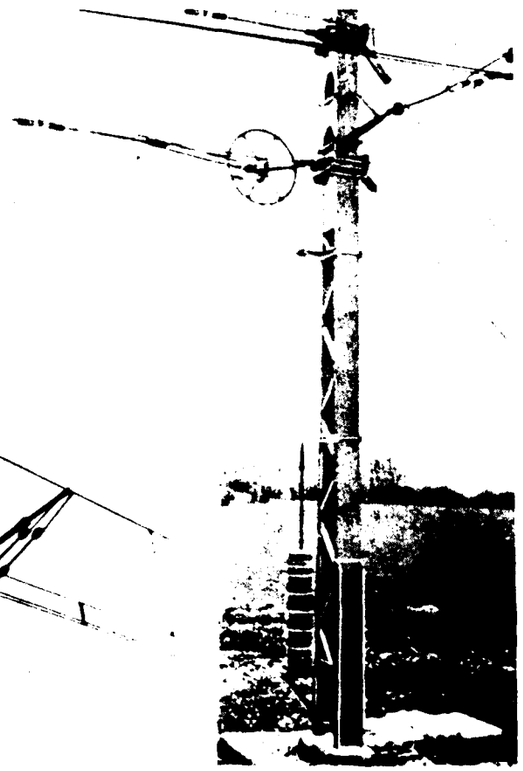
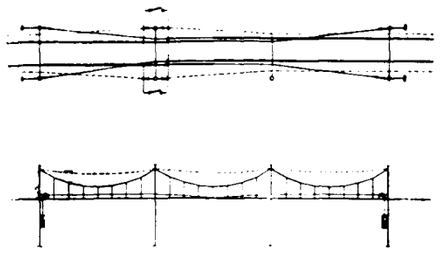


Fig. 5

Illustration of twin wires with locating arms and also section wire tensioning post with tension weight and tension multiplying gear.



Section stressing arrangements of overhead contact wires—Netherlands Railways—showing in the side elevation the small vertical displacement of the wire to facilitate changeover by the pantograph from one section to the next.

In the design of the overhead line the basic principle has always been that it must be possible to collect current at a high speed. This has demanded great accuracy in the horizontal positioning of the trolley wire, an accuracy which, of course, has had to be maintained notwithstanding variations in temperature. It has called for, not only the automatic tensioning of the trolley wires, but also a special construction of the catenary.

The automatic tensioning of the trolley wires is achieved in the following way. The overhead line system is divided into sections each having a length of something like 1,500m (1,641 yards). Where one section passes into the next, the trolley wires are stressed by means of weights, as indicated in Fig. 2. The weights are such that the tensile stress in the trolley wires amounts to about 1 ton per wire.

Two ways of suspending the trolley wires can be considered:

(a) From a catenary an almost horizontal auxiliary cable is suspended which serves to support the trolley wires. This construction has been adopted, for instance, by the French Railways.

(b) To a catenary with a large amount of sag the trolley wires are connected directly by means of hangers. This construction, was adopted by the Netherlands Railways.

It has been found that this simpler construction, provided it is accurately erected, gives very good results, so that it has not been deemed necessary to apply the more complicated construction mentioned under (a). During the years before the war, when the maximum speed of the trains was about 125 km/h, experience showed that this construction gave entire satisfaction. From the results of trial trips made at higher speeds there is every reason to expect that a maximum operating speed of 140km/h can be allowed.

stopping points of the steam locomotive. If the amount of "sooting" is small or the electric service is sufficiently frequent to clean off any soot before it has time to build up, then the effect of such sooting will be negligible. If however the electric service is small in relation to the steam service then the large amount of soot on the wire may cause an increase in the rate of wear of the carbon collector.

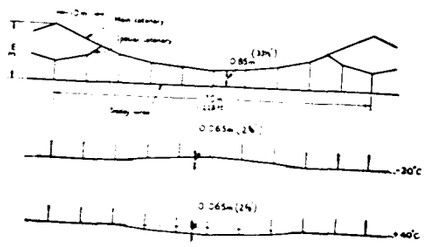
When applying carbon collectors to a railway system which has previously been operating with metal collectors considerable carbon wear is to be expected if few carbon collectors are used, and in such a case only metal-carbon collector material should be used; plain carbon should not be used in this case. If an immediate and complete changeover is made from metal to carbon collectors then plain carbon or metal-carbon may be employed, as may be determined by current loading on the collector. The initial rate of wear will be considerable in this case but will rapidly improve as the wire is smoothed by the carbon. When applying carbon collectors to a line, metal smoothing collectors of cast iron or steel should not be used as a means of smoothing the surface of the wire; they may do considerable damage to the wire and do not assist the running-in of the carbon.

WIRE WEAR

Wire wear when using metal collectors has always been a cause of concern with railway operators. Where carbon has been used as a current collector the rate of wear has been of the order of .005" (.125mm.) per year compared to .020" (.5mm.) for a copper collector.

OVERHEAD WIRE AND EQUIPMENT

Whilst there is very little that the carbon manufacturer can do to influence the design of overhead equipment, the use of carbon is, as already stated, very much dependent on



Side elevation of overhead wires—Netherlands Railways—showing temperature compensating device in the catenary.

The catenary not being stressed automatically like the trolley wires, but being secured at each point of support exhibits a change of length under the influence of variations in temperature. Consequently the sag of the catenary varies as well as the height of each of the suspension points for the trolley wires.

In order to preserve the horizontal position of the trolley wires, measures have to be taken to ensure that all points of suspension move an equal amount in the vertical direction. This can be achieved by the use of a special catenary, which as shown is stretched between two points on the main one. By means of an accurate determination of the length and the sag of this catenary, it can be arranged that, with variations in temperature, all points of suspension of the trolley wires are almost equally displaced in the vertical direction.

Since 1936 the construction of the overhead line has been standardized as much as possible. A few relevant details are given below.

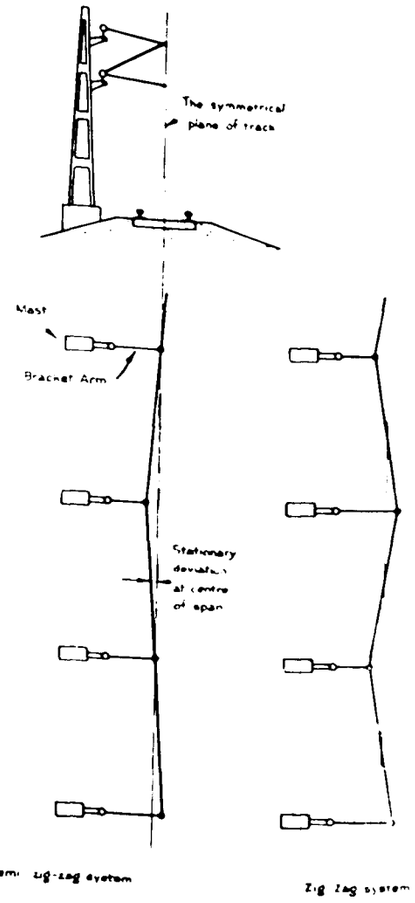
The total copper section per track has been fixed at 500 mm^2. This is necessary in order to avoid too great a drop in voltage. At the same time allowance has had to be made for the fact that too small a copper section might give rise to an excessive resistance which would not be permissible in case of short-circuits. This copper section is distributed as follows:

	mm^2
Two trolley wires at 100 mm^2	200
One catenary at 150 mm^2	150
One supplementary line at 150 mm^2	150
Total	500

the state and type of overhead gear. The average contact wire cross section is 100 sq. mm. With extra high voltage lines 20,000 volts, A. C., the single wire carries all the contact current. At 1,500 volts D. C., twin wires are used, together with D. C. supplementary feeders to reduce voltage drop in the contact wire. The contact wires are suspended from catenary cables and are connected thereto with short dropper wires which are adjusted to maintain the contact wire in a level position.

WIRE STAGGER

In order to maintain control over the height adjustment of the wire, and to give lateral stability to the wire against side winds, the wire is staggered in a zig-zag fashion across the main centre line of the track. This stagger is very beneficial with carbon bows since it tends to equalise the wear of the carbon over the length of the pan.



Plan of the installation of the contact line in accordance with the zig-zag and semi zig-zag principles.

On the Netherlands Railways this stagger amounts to 22" (550 mm.). This has been found to be a very satisfactory value and results in a very good wear factor of the carbon of about 70%. Most of the other railways employ a stagger of only 12" (300 mm.). This causes very rapid wear in the centre section of the carbon and has the objection that it causes steep steps or ridges on the carbon between the centre section and the side sections. As a result of this, the overall life of the carbon is very much reduced, the centre section receiving all the wear and the end sections hardly any.

It has been suggested to several railways that if the stagger on the wire cannot be increased, that the centre line of the 12" (300 mm.) stagger be displaced by 6" (150 mm.), on consecutive line sections on either side of the centre lines of the track. This would give an overall stagger for any two sections of 24" (600 mm.). It would smooth out the carbon wear and improve its life without increasing the mechanical tension or side load on the supporting frames of the overhead gear.

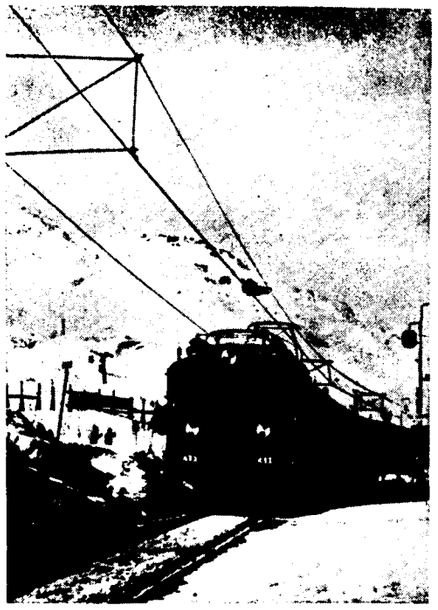
SUMMARY

Carbon-lined pantograph collectors are employed chiefly to reduce wire wear.

They reduce radio interference.

They also increase the collector life and reduce maintenance costs.

Carbon material comprises hard carbon Link CY3T and CY3WA and Link MY7A, MY7B and MY7D metal carbon.



Swedish State Railways Locomotive. Type 1-C-1 (Type "D"). Make. A. S. E. A.

One hour rating 2000 H.P. Total weight 80 tons. Line voltage: 16000. Number of motors: 2, single phase commutator type. Max. speed: 100 km/hr. Fitted with one carbon lined bow to each pantograph. Carbon grades supplied Morganite Carbon Link CY 3T and Link MY 7D.

The current-carrying capacity of metal-carbon is twice that of hard carbon and the material is much more resistant to wear.

For best results with any grade of carbon it is necessary to maintain stable contact under all conditions and to distribute the wear as nearly as possible over all the carbon.

With carbon collectors wear of collector and wire is reduced with increased contact pressure; with metal collectors wear is increased.

(Continued on page 44)

"Richards Borers for Railway Workshops"

FOR many years Richards Machine Tools have proved themselves invaluable in Railway Workshops throughout the world both in the machining of new components and the reconditioning of used parts of fine precision limits.

"Electrabore" Horizontal Boring and Facing Machines, embodying great rigidity of construction and producing work to a high degree of accuracy, are used on a wide variety of work in railway shops.

The adaptability of this type of machine, which in addition to boring and facing, is capable of milling, drilling and tapping, enables several operations to be carried out at one setting, without loss of operational time and with complete accuracy.

Probably one of the most important functions which Richards Horizontal Borers perform in railway workshops, is the machining of locomotive cylinders and in Fig. 1 a No. 5 size machine is shown installed in the British Railway Workshops at Horwich, Lancashire. This machine, which has a 5" diameter traversing spindle and automatic facing head to face up to 54" diameter is engaged in machining a cast steel cylinder

Fig. 1

block for a 2—6—0 No. 4 Freight Tender Locomotive. In this illustration, the machine is facing the end of the steam chest, using a telescopic snout toolholder. The boring bar, which is used for subsequent operations, is supported by the special column at the right and is ready for immediate application when required.

Fig. 2 is a local view of the same machine and in this illustration the machine is facing the end of the cylinder. The table is then indexed 180 degrees and the operations repeated on the opposite end. Due to the Richards Patent Squaring Lock, absolute accuracy is obtained.

(Continued from page 43)

To maintain stable contact it is necessary to maintain uniform pressure between carbon collector and wire providing ample pressure, keeping down collector weight, avoiding windage effects, avoiding mechanical oscillation on the pantograph and maintaining pantograph springs at required tension.

For best results carbon must be used within its current carrying capacity.

Correctly used the carbon current collector is a well established and economic accessory in electric railways with overhead collection.

Carbon is not a magic wand to overcome shortcoming in overhead equipment.

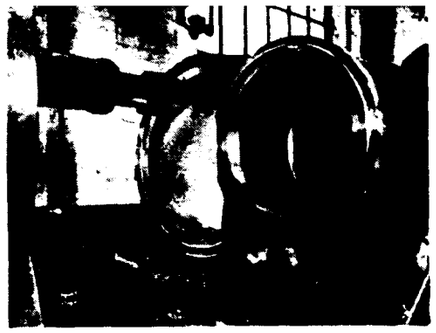


Fig. 2

Fig. 3

Another interesting application of a No. 5 machine with traversing spindle, is shown in Fig. 3. In this case, the machine is shown in operation on a smoke box seating for a British Railways Locomotive. The upright and boring stays on this machine are 4 ft. higher than standard and a special boring head is utilised, mounted on a 6" diameter boring bar.

Richards Vertical Boring and Turning Mills are in popular demand for operating upon railway tyres, wheel centres, etc., and a 4 ft. machine specially arranged for machining tyres is shown in Fig. 4.

This machine has a 4-jaw independent chuck table which runs on a white metal bearing, the spindle being mounted on roller

Fig. 4

bearings. Twelve table speeds are available ranging from 6.16 to 130.35 r.p.m., and the table jaws are provided with special swivel clamps for holding the tyre.

The left-hand head is of the standard swivelling type, which can be swivelled over to any angle up to 30 degrees from the vertical for tapper work, when required. The right-hand six-sided turret head is released, revolved and indexed, then relocked by a single lever, thus greatly facilitating tool positioning.

The mill is illustrated with a tool set-up for the machining of carriage tyres. The left-hand ram has a tool bar for finish boring, whilst the turret head is loaded with tool-bars for carrying out rough boring and rough and finish grooving operations.

Details of the operations carried out by the various tools are shown in Fig. 5.

The "AB" type Patent Axle Box Boring, Facing and Radiusing Machine illustrated in Fig. 6 is specially designed for dealing with

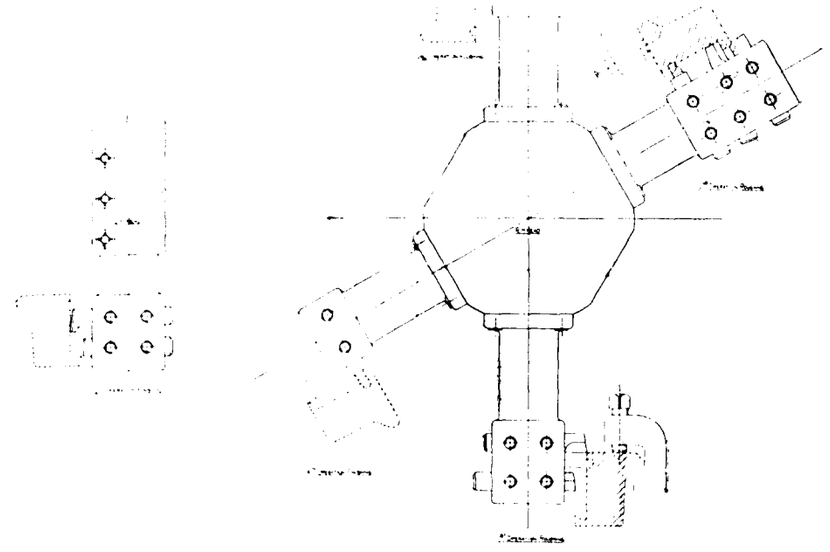


Fig. 5

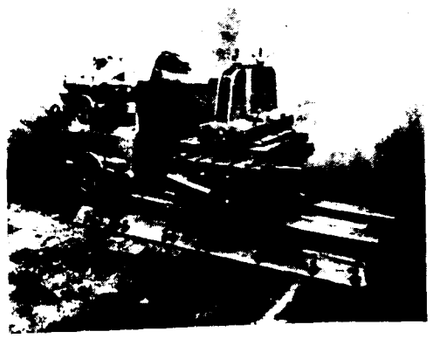


Fig. 6

axle boxes and has been supplied in large numbers to the Railway Workshops of the world and in particular to India.

The machine incorporates an automatic facing head capable of facing up to 24" diameter and a powerful snout bar is provided for the boring and relieving operations

The machine is fitted with a main table, having hand cross movement, and this is mounted on two inclined saddles which provide vertical and horizontal adjustment to accommodate different sizes of axle boxes. On top of the main table a square revolving table is fitted, incorporating Richards Patent Squaring Lock, by means of which the table can be set square to the spindle with absolute accuracy. The axle box is held on the revolving table by a specially designed fixture.

With adjustments provided in the longitudinal, transverse and vertical directions the machine is fully capable of dealing with new and repair boxes of various sizes and furthermore, by simply extending the length of the bed, the machine can be used with equal success on radial axle boxes.

A very valuable feature of the machine however, is that with these various adjustments and the range of speeds and feeds provided, it can be adapted for use on other work should the whole of its time not be occupied on the production of axle boxes.

Arc Welding in the Indian Railways

By S. V. Nadkarni, M.Sc., A.M.I.W. (Lond.)
Chief Welding Technician

J. B. ADVANI-ŒRLIKON ELECTRODES PRIVATE LTD., BOMBAY.

ARC Welding has been universally recognised today as the most efficient means of joining metals. Changing over from riveting to welding was a slow and painful process in every country, but, thanks to persevering research, all the major constructions of today, including bridges, ships, locomotives, boilers and pipelines incorporate the maximum of welded joints, resulting in considerable savings in steel and giving a streamlined finish of the product.

The fact that arc welding is being increasingly used in the Indian Railways speaks highly for their correct outlook and progress in the right direction. The author recently visited the Tata Locomotive & Engineering Co., at Jamshedpur and the Chittaranjan Locomotive works and was delighted to find that fireboxes for the locomotives are now entirely welded to give consistent radiographic quality of welded joints. The electrodes used on these jobs are indigeneously produced. Many other parts previously cast, are now designed for fabrication by welding using standard steel sections, and high quality electrodes now manufactured in India.

The installation of the Integral Coach Factory at Perambur, Madras, signifies a triumph of arc welding. These coaches have been designed to afford maximum of arc welding resulting in considerable lightness combined with streamlined appearance. For the first time, in this case, large-scale use is being made of the so-called "Low-Hydrogen" electrodes which are guaranteed to give extremely ductile and crack resistant weld deposits. Again, these electrodes are made in India. Wagons which were formerly almost wholly riveted are now redesigned for welding. Such welded wagons will definitely be lighter, stronger and more pleasing in appearance.

Adoption of welding in fabrication work calls for the knowledge and study of many factors which have a far-reaching influence on the ultimate quality of the product. Lack of adequate knowledge of these factors may lead to failure and one need only recount the disastrous failures of many welded ships in recent times to bear the statement. For one thing, welding involves the actual fusion of joints. These may result in the embrittlement of the weld metal or the zone of the parent metal next to the weld, depending on the chemical composition of the material. The weld metal on resolidifying is bound to contract and exert a pull on the parts, setting up internal locked-up stresses or causing distortion. Very often, lack of fusion at the roots or the inside corners of the welded joints, or slag inclusions between weld passes, in combination with porosity, can be the starting point of a crack under dynamic loading. These can only be avoided by correct joint design, welding procedures and skill of the welder.

It must be said that the Indian Railways have been very much alive to these problems, judging from the fact that they have set up the Testing and Research Centre at Chittaranjan, where among other things, considerable testing and research is being carried out on the subject of welding. For example, electrodes to be introduced on certain important jobs are thoroughly assessed for their weld metal analysis, physical and mechanical properties and performance characteristics. Any new metals to be welded are examined for their weldability characteristics, and the right type of electrodes are chosen. Special welding procedures are also developed and recommendations passed on to the fabrication shops. Welded jobs are also frequently examined for their soundness by standard non-destructive testing methods such as X-ray radiography, ultrosanic method and so on.

Reclaiming of worn-out parts by hardfacing, that is, by depositing hard surfaces at suitable points with special electrodes, is another important application of arc welding. The railways have already carried out tests of surfacing worn-out rail points and crossings and results have been encouraging. One of these test joints made with indigenous hardfacing electrodes has stood up very well now for over a year.

STEEL ECONOMY PROJECT

While on the subject of welding in the Indian Railways, one cannot but make reference to the Steel Economy Project launched by the Government of India through the Indian Standards Institution during the first five year plan. Among the many steps proposed to be taken to effect economy in "Steel" was the one for the "popularisation of welding". The start in this direction has already been made by the drawing out of standards and handbooks on welding, some of which are now awaiting publication. Next comes the question of introducing low-alloy, high tensile steels which also lead to lighter designs of construction. It is proposed that alloy steels will also be produced in the Government steel plants and one can rightly hope that alloy steels will come increasingly into use in the Indian railways. TISCO have already introduced "TISCOR" low-alloy steel in the market.

When such low-alloy steels are developed, the producer attaches special significance to their weldability characteristics. That is to say, he makes sure that welded joints produced with normally available electrodes are ductile and notch-resistant and no undue hardness with brittleness is produced in the heat-affected zone of the weldment. The Tata Research Laboratories duly published a paper on their findings of the weldability tests on their TISCOR Steel and these were very reassuring.

It is generally recognised that low-hydrogen electrodes are the most suitable for the welding of low-alloy steels, and these should, as far as possible, give the weld metal composition identical with that of the parent metal. Such low-alloy, high-tensile low-hydrogen electrodes with varying alloy compositions and mechanical and physical properties are already being produced in India.

TRAINING OF WELDERS

The ultimate quality of a weld deposit laid with an electrode depends as much on the skill of the welder. Training of welders is a very important job. The Technical school set up by the Railways at Chittaranjan provides among other courses, a graded course in arc welding. The trainees who come out of the school are expected to have acquired sufficient skill in welding to be of use to industry. But their training does not end there. In fact, their real and effective training commences in the welding shop. There it is not merely a question of skill, but of temperament and conscience and physical fitness and a will to learn and adopt new methods. Making consistent radiographic welds, especially, calls for skill combined with sustained concentration and physical fitness.

The above remarks also indicate the necessity of looking upon welders as important members in the welding scheme. Naturally, one expects them to be well looked after. On the other hand, they must continue to be instructed in the newer and wider applications of arc welding. The Indian Standard Institution has rightly planned to publish a welding hand-book for welders. Further, one hopes that we will soon have a national welding society in India which will look after the scientific development of welding and instruction of the welding personnel, and will serve as a platform where experiences and viewpoints will be exchanged, and common problems discussed and thrashed out.

While on the subject of the proposed Indian Welding Society, the author would like to mention that he has in the past stood up on many platforms and asked for initiative from those concerned to set up such an institution in this country. The author has been receiving many letters frequently from welders who are determined to raise their stature, asking that some positive move be taken in this direction. Once this move is taken, there is definite indication that a big response will be forthcoming from the hundreds of welders engaged by the Indian Railways. This is a definite indication that all personnel connected with welding are preparing themselves to meet the challenge of the rapidly expanding Indian Welding Industry. The author anticipates that in the near future the Indian Welding Society will be born and will serve the industry in the same way as the Institute of Welding in United Kingdom and the American Welding Society in the States.

A TUBULAR QUIZ

What is Yield Point?

This is the lowest stress at which a material under load undergoes an increase in length without increase of the applied load. For practical testing purposes it is often taken as the stress at which a visible permanent increase in the distance between gauge points on a test piece can be detected when using dividers.

Progress of Rumanian Rolling Stock Industry

ALTHOUGH in Rumania the rolling stock industry is of long standing, in the period after World War Two it has been greatly developed. This development came as a consequence of the increase in the raw material resources, the strengthening of the heavy industry and the refitting of the works with modern means of production. In this way it became possible for the home industry to cover all the requirements of the domestic network and at the same time to turn out a constantly growing number of locomotives and wagons for export.

As a result of the development of this industrial branch, today our export programme of rolling stock includes serially made products of well studied design, whose efficiency in service has been proved by the excellent results given on the home network. Rumanian made rolling stock offered for exportation includes steam, Diesel and Electric locomotives and common and special type passenger cars and freight trucks.

From among the range of *locomotives for fast trains* we should mention the types ID2 and 2CO locomotives. Both are locomotives with superheated steam and twin cylinders. Their top speed is 110 respectively 100 km/h and they have a high acceleration power. Both types have a pressure of 17-18 tons per axle. On the home network their combined coal and liquid fuel burning device has proved to be very satisfactory. The usual outfit of the locomotives includes Knorr brakes central lubrication, light installation with turbine generator, steam heating, sanding device, etc.

The best known *freight train locomotives* are the two *types IEO and OEO* also superheated steam locomotives with twin cylinders. Type OEO is made also for wide gauge and in this design it has a traction power at hook of nearly 19,000 kg. The top speed of these locomotives is between 65-80 km/h. The strong built of these two types of locomotives makes them very suitable for freight transports over long distances.

Diesel locomotives are built in two similar models. Such is the case of types LD-760 and LMK-2 of which the first one is a forestry work locomotive of 760 mm. gauge, type LMK-2, of 600 mm. gauge is designed to work in mines and on building sites, these two locomotives have certain different characteristics concerning the outer dimensions, power transmission and weight, but both types are equipped with the same engine. That is the well known KD-35, four cylinder, four stroke Diesel engine which has proved its high technical qualities in the thousands of Rumanian tractors of the same mark. These engines develop 35 HP at 1400 r.p.m. The top speed of both locomotives is 12.6 km/h and the maximum tractive power at hook 1400 kg.

The two *electric locomotives with battery, types LAM-2 and LAM-8* are fire damp proof and consequently may be used in any mine. As concerns type LAM-8 we should especially mention its compact design (length 4.3 m, width approx.1 m). The two motors develop a total power of 17 kw. giving the locomotive a maximum tractive power of 1080 kg. Each locomotive is supplied with two interchangeable batteries which can be loaded in turn without need to interrupt the use of the locomotive.

The railway cars and trucks made in the Rumanian P. R. will satisfy all the requirements of a modern railway network. The first and second class passenger cars have as

distinctive feature their very comfortable arrangement. The third class cars have upholstered seats, low pressure steam heating and Dick system electric lighting. This car is made entirely of metal and is mounted on two bogies with 2 Gorlitz axles each, and 3m distance between the axles.

The freight cars are made in covered and open design and as platform trucks. Depending on the serviceable load of 25 or 50 tons they have two or four axies. In the latter case they are fitted with cast steel Diamond bogies. All trucks have compressed air and hand brakes. They moreover correspond to all RIV prescriptions for speeds up to 100 km h.

A special execution and interesting design is that of the 50 tons *self-discharging truck* whose convertible bottom can be used horizontally or inclined in the form of a saddle. This truck is very suitable for the transport of materials loaded in bulk such as : ores, coal, coke, sand, etc. which are easily unloaded by means of trap doors located under the level of the lateral walls. On return trips the truck can be used as a common freight truck with horizontal floor.

Among the special types of railway wagons built in the Rumanian P.R. we should cite in the first place the 50 tons tank cars used chiefly for the transport of petroleum products and which are built in great serials. From among these, very good results were obtained with the self-supported tank-car whose tank is resting directly on two Diamond bogies, without frame. For warning the oil a steam heated serpentine may be fitted inside the tank. These wagons too are in keeping with all international prescriptions of railway traffic.

The process of manufacturing of the rolling stock is submitted to a very exacting control which is carried out in every stage of fabrication and on the finished product.

On the strength of these controls quality certificates are issued and the usual guarantees given. In addition to the usual controls made in the factory, foreign customers can empower the goods control office in Rumanian, which upon request will carry out a very strict control; moreover customers may take over the material.

The export of any kind of rolling stock is handled in the Rumanian P. R. by the "Masinimport" foreign trade state company of Bucharest, Str. M. Eminescu No. 10.

A TUBULAR QUIZ

What is a "Weld decay free" steel ?

When a plain austenitic stainless steel is heated to a temperature of 500 C. to 900 C. and is then subject to certain corrosive substances, it becomes liable to selective attack along its grain boundaries. The metal corrodes rapidly and may even disintegrate into separate crystals, and be reduced to a powder. When such a steel is welded, some part of it near the weld is heated within the dangerous range and if subjected to acid attack will corrode. This is known as "weld decay" and a steel which is free from this phenomenon is called a "Weld Decay Free" steel.

BOREHOLE TURBINE PUMPS

By A Staff Engineer, Jyoti Limited, Baroda

IN India large tracts of land could not be brought under the plough because of the water scarcity. The main difficulty lay with the proper type of pumping machinery for lifting sub-soil water. This underlines the role of borehole turbine pumps in solving the food scarcity problem. After the advent of independence, Central and State Governments sponsored various tubewell schemes under their "Grow More Food" campaigns and brought a sizeable portion of unused land under cultivation. In this development, the contribution of borehole turbine pumps has been no small.

For lifting sub-soil water from underground storage reservoirs and water bearing strata, borehole turbine pumps have hardly any rival. Sub-terranean water, like water underground, forms brookes, rivers, pools or lakes. This water can be reached through borehole pumps and so made available for domestic, Agricultural and industrial uses.

A stage in borehole turbine pump installation. Photograph showing a vertical hollow spindle electric motor being carefully slid over the motor head shaft.

WHAT IS OUTSTANDING ABOUT BOREHOLE TURBINE PUMPS ?

1. These pumps do not require costly masonry wells. By virtue of their small diameter cylindrical construction, they are ideally suited for small diameter, less costly borewells, for which centrifugal pumps are out of consideration.

2. As the pump unit (bowl assembly) remains sub-merged under water, there is no suction problem as in the case of centrifugal pumps. It is convenient to use under fluctuating water level conditions which provide a veritable poser in case of centrifugal pumps.

3. Tubewell installations almost completely seal the wells from the exterior, ensuring freedom from contamination, etc.

4. Normally centrifugal pumps, have suction limits from 15–25 ft. There is no such limit in respect of borehole turbine pumps, which being under water, work against a positive head.

5. In case of borehole turbine pumps, there is no priming problem whatsoever, as the bowl assembly being under water is always maintained primed.

6. In case of borehole pumps, the driving units are usually installed at ground level. Hence, decent pump houses can be erected conveniently to protect the installations from the effects of sand, wind, sun, rain, etc. What is more, there is ease of maintenance and repairs. Again the float, remote and sequence switch controls can also be arranged easily.

CONSTRUCTION & WORKING

A borehole pump is essentially a single or a multi-stage vertical centrifugal pump with its pump element (bowl assembly) submerged under water and driving head usually above the ground level, external to the bowl and column assembly. The flow of water is co-axial along the line shaft vertical axis and the exit is through a discharge elbow, either separate or integral with the discharge head.

Water first enters the strainer or suction pipe into the eye of the first impeller located in the bottom most bowl of the pump unit via lower shell. One bowl and one impeller constitute one stage. The impeller impels water and builds head, whereas the bowl directs water at a desired angle into the eye of the pump impeller. As water passes through the bowl stages, proportionately more head is built.

The shaft through the bowls (impeller shaft) is of stainless steel and with or without key-ways. In the former case, impellers are keyed on the impeller shaft by means of keys and set-screws. In the latter case, impellers are fixed on the shaft by means of taper split bushes, lock-nuts and washers. This is a better arrangement in that it helps maintain the concentricity of the impeller hub with respect to the impeller shaft axis and secondly it results in a stronger shaft with less possibility of strains and warping.

Water is conducted up to the discharge head through the annular space between the column pipe and shaft tube in case of oil lubricated pumps and is delivered through the discharge elbow at the ground surface or is further conducted at a required altitude through the delivery pipe line.

The column assembly is made up of column pipe sections (usually 10′-0″ in length), shaft tubes and line shaft (usually 5′-0″ in length). In the centre of this column

A borehole turbine pump bowl assembly (3 stage pump unit) being lifted in a tackle during installation.

assembly lies a stationary shaft tube assembly comprising shaft tube sections with line shaft bearing at each end. Inside the tube assembly, is a power transmission line shaft assembly usually in sections of 5′-0″ in length. At the top of column assembly and located on the ground level on a concrete foundation is a discharge head. The driving head (which may be a vertical motor, pulley or gear head) is mounted on top of a discharge head. Drive is provided by the head shaft of the driver, as it is connected to the impeller shaft through sections of line shafts joined by threaded couplings.

Lubrication to the line shaft bearing is provided by a solenoid operated lubricator in case of electric motor drives and by means of a drip feed lubricator in case of non-electric drives. The lubricating oil drips through a series of line shaft bearings provided with a recess at the top. This helps gradual filling of oil into the bearing.

Electric motor drive is by far the simplest form of drives and is also the cheapest if the price of electrical energy is reasonable. Under good conditions, steam engines, steam turbines or diesel engines also prove economical as prime-movers. When electrical energy is not available, a belted arrangement with a vertical pulley or gear head is also supplied in place of vertical motor head. In such cases, the pump is usually driven by oil engines and at times by horizontal motors or steam engines.

In case of vertical pulley heads, quarter twist belt drive is resorted to. Gear head drive is at times preferred for the following reasons.

(i) it facilitates horizontal belt drive instead of the cumbersome quarter twist drive.

(ii) speeds permitting, it is suitable for being directly coupled with horizontal or vertical engines or horizontal motors.

(iii) in case of a direct-coupled engine drive, this arrangement is a definite saving on space.

TYPES—OIL LUBRICATED AND WATER LUBRICATED

Borehole pumps are available in two types —oil lubricated and water lubricated. In the former type, shafts are enclosed in tubes and are lubricated by oil fed through a lubricator from the top. In the latter type, there are no tubes and the shaft assembly rotates in water which serves as a lubricant.

In water lubricated pumps, shafts bear against rubber bushes housed in cast iron spiders whereas in oil lubricated pumps shafts run in hard bronze bearings. Consequently the life of oil lubricated pumps is usually more than that of water lubricated pumps. As for power consumption and cost, there is hardly any difference worth consideration.

VULNERABLE POINTS

Being a refined type, a borehole pump usually gives a trouble-free performance when compared with other types working under normal conditions. Nevertheless, this refined construction is not without its weak side — being accompanied by a degree of sensitiveness. This renders the pump vulnerable under certain working conditions.

The borehole pump is susceptible to failure, if

(i) it is made to pump sand

(ii) it is lowered in a crooked well

(iii) it is misaligned while installing or due to any other reasons such as poor manufacture, careless transport, storage, handling and installation.

EFFECT OF SAND

Bronze bearings in the bowl assembly are to an extent directly exposed to any matter passing along the main flow of water. In case of excess amount of sand, bowl bushes will fail to withstand the abrasive action of sand and the wear will commence from the bowl bushes and will gradually spread upwards, impairing the line shaft bearings and the driver bearings. Whereupon, the whole line shaft alignment will gradually get out of order and the pump will be damaged.

CROOKEDNESS

For satisfactory service, a borehole turbine pump requires to be installed in a vertical position with all parts in proper alignment. In case of borehole pumps, the connection from bowl assembly i. e., the pump unit right upto the head shaft is through a series

(Continued on page 56)

The Czechoslovak Railway Wagon Industry

WHEN the scope of production of its engineering industry is considered in terms of its area and population, Czechoslovakia belongs among the leading countries of the world. Under these circumstances it is only natural that Czechoslovakia also manufactures machines intended predominantly or exclusively for railways. A considerable part of these consists of products of the Czechoslovakia railway wagon industry.

This branch of engineering has, in Czechoslovakia, a rich tradition dating back three quarters of a century. Already during the times of the former Austria-Hungary wagons were made on the territory of the present Czechoslovak Republic for Argentina, Brazil, Canada, Egypt, Switzerland, Tunisia, Serbia, Russia, Italy, Turkey, India, Rumania, Greece, etc. And these deliveries were not restricted to the above mentioned countries alone. In Argentina, in Turkey of those days and in Italy vehicles from Bohemia and Moravia were ordered independently for various railway companies of the same country. Vehicles of all kinds were exported but passenger coaches predominated, and among them particularly saloon cars, dining cars, sleepers and hospital cars. Of the goods wagons there were usually special vehicles such as tank wagons, gas wagons, refrigerator vans, wagons for the transport of motor vehicles which were in common use in those days, scale test weight cars and low loading wagons.

The unprecedented development of the railway wagon industry in the period between the two World Wars produced new customers. Czechoslovak wagons found new markets, for example in China and India, with the international company of Wagons-Lits, in Bulgaria, etc. However, the second World War cut the ties between the Czechoslovak industry and its traditional markets for a long time. When the armistice was concluded the factories had first to be

(Continued from page 55)

of line shaft assemblies having bearings at intervals.

Manufacturing, storing and handling defects apart, the most outstanding reasons leading to the disturbance of line shaft alignment are the presence of sand and crookedness of the bore.

In fact, the crookedness of a well can be taken as synonymous with mis-alignment, for the pump cannot hang freely throughout its length without being cramped on any side, if it has been forcibly inserted.

MIS-ALIGNMENT

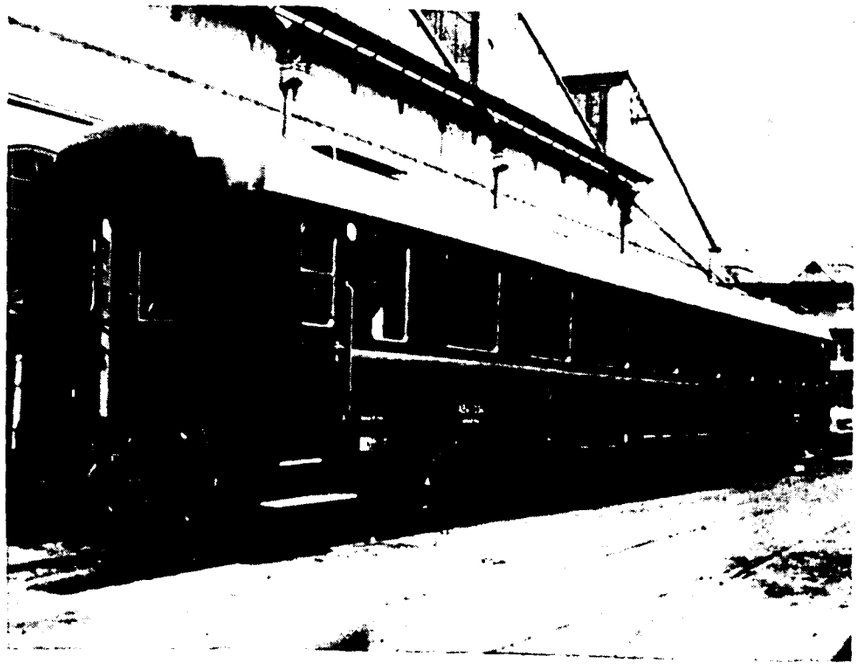
As will be clear from the above discussions, a borehole pump will work satisfactorily only if the line shaft assembly is well aligned.

Mis-alignment of the line shaft assembly and consequently of the whole pump can be due to careless transit, improper storage of components especially line shafts, inadequate mode of shifting, excessive and improper application of pressure to line shafts at the time of installation and such other reasons.

All said, borehole turbine pumps work satisfactorily for a long period when carefully installed in straight vertical bores bearing cold sand free water. In case of tubewells, they have practically no rivals.

rebuilt and modernized where-upon priority had to be given to the task of re-equipping the country's own destroyed railway system. It was only after several years that the first orders from foreign countries could be accepted. Since 1948 railway wagons of Czechoslovak manufacture are again more and more in evidence in the fleets of the foreign railway administration of Holland, Western Germany, the USSR, Turkey, Switzerland, Korea, Sweden, Bulgaria, Egypt, India and Greece. At present railway wagons are produced by a number of Czechoslovak wagon factories united under the common name of Tatra and also by the Brno-Kralovopole Engineering Works. Their manufacturing programme is extraordinarily rich and includes any type of railway vehicle in accordance with the customer's requirements.

Let us now mention a few types of railway vehicles of Czechoslovak design and manufacture. Passenger coaches for express as well as local trains are designed exclusively as well sprung four-axle cars with up-holstered seats, even in the third class, and of a very light self-supporting steel design and an attractive stream-lined shape. All the principles of modern building of railway cars for areas of moderate climates have been applied to them. The latest types are commonly equipped with hot air heating, each car being fitted with equipment for the heating of air by steam as well as by electric resistors. Goods wagons are of a simpler design than passenger coaches but there is a greater variety of their types. A fleet of railway wagons of to-day is no longer complete when it consists only of the basic kinds of wagons, i. e. coal cars, low-wall platform cars, gondola cars and box cars. Apart from these classical cars Czechoslovakia also produces lorry trucks with stanchions for long logs, platform trucks of a particularly sturdy design with four and six axles for heavy and wide objects, low loading wagons and crucible wagons for steel mills. A

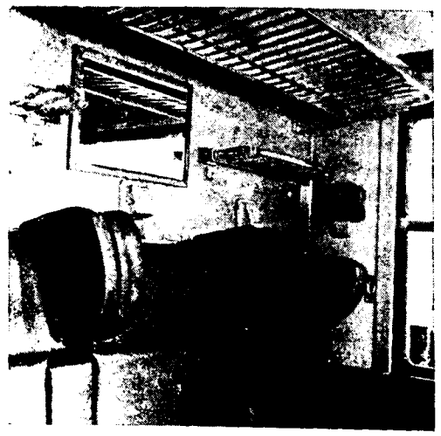


wagon of a carrying capacity of 250 tons has been produced by the Tatra wagon works for the handling of ingots.

Liquid and semi-liquid loads have to be conveyed in special tank wagons. Many of them are, at first glance, quite similar but in reality they differ considerably by their equipment. They are built, according to the load for which they are intended, for a standard pressure or as high pressure units, without any special treatment of the inside of the boiler or with the internal surface zinc plated or rubber lined. They may, if necessary, be equipped with steam heating for the handling of semi-liquid loads to facilitate discharging. The filling and discharging equipment may vary considerably. The simple equipment used for loads involving no hazard, which are emptied by gravity, is replaced by special equipment when unloading under pressure is demanded or when the load is caustic, inflammable or explosive. The tanks may be manufactured of steel, aluminium or stainless steel. For certain liquid loads vessel wagons are demanded with vessels made of earthenware, or barrel wagons with large wooden barrels. Certain tank or barrel wagons must be protected from direct solar radiation by a roof or even by walls and a roof of the design commonly used on box cars. Closely linked with the manufacture of tank wagons for liquids is the manufacture of wagons for gas which are frequently also provided with a great variety of equipment in accordance with their purpose and the customer's specification.

The mechanization of loading and unloading of bulk loads, particularly coal, ores, gravel and earth, leads to the use, on an increasingly large scale, of hopper, side discharge and tipping wagons of large loading areas. Czechoslovakia has developed several types of wagons discharging their load either only to the sides, or to the sides or between the rails, as required. The first of the two basic types utilizes more fully the railway track section given by railway regulations but can be discharged to advantage only from a bridge structure. It is specially well suited for the handling of coal and ores. The other type is highly suitable for the conveyance of gravel to points where the permanent way is being repaired and for the transport of coal to smaller dumps not equipped with a discharge bridge.

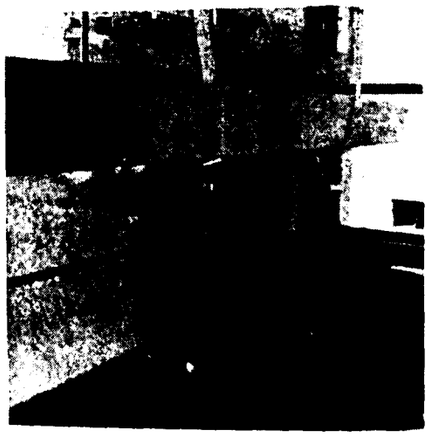
The transport of perishable goods, such as fruit and vegetables, over long distances requires perfect refrigeration. Frequently vehicles cooled with ice are no longer



adequate. Modern refrigerator vans of Czechoslovak design, which are of the bogie type of a large carrying capacity, are fitted with their own refrigerating set and with a room for an attendant. Each car can operate independently. However, when larger quantities are to be hauled, it is much more economical to use a train of eight cars with a special generating set car. In such a case the Diesel-electric sets in the individual cars remain inoperative and the generating set car supplies power to the individual electrically driven refrigerating sets in the cars. If the train stops in a station for any length of time current from the public mains can be used.

The Czechoslovak railway wagon industry also designs, for the use of the railway administrations themselves, the most varied vehicles for operational purposes. Let us mention, as an example, cars for work trains, i.e. living accommodation cars, office cars, workshop cars, kitchen cars, store cars, cultural cars, health cars, overhead line erection cars, broadcasting cars for marshalling yards, scale test weight cars, chemical spraying cars, travelling rectifier stations for electrified lines, etc. This category also includes the group of service and mail vehicles which is very numerous.

Recently a train for the measuring of the permanent way was placed in operation on the Czechoslovak State Railways. It was produced by co-operation of the Tatra wagon works and the Swiss firm of Amsler. The train consists of a motor coach and a measuring carriage. The motor coach accommodates, apart from the driver's posts and the engine room, also a kitchen with a coal fired kitchen stove and a refrigerator, three berth compartments, an office and a wash room. The kitchen stove serves, at the same time, for hot water heating of the motor coach at times when it is not heated by cooling water of the Diesel engine. The berth compartments, which have two berths each, are equipped like standard sleeping car compartments except that they have built-in cupboards in view of their character of long-term living accommodation and are not fitted with wash-basins. The wash-room, which is combined with a toilet, has running hot and cold water and a shower. The office equipped for three engineers who evaluate,



even while the train is in motion, the graphic information obtained of the conditions of the track, is fitted out with office machines, office cupboards and other office furniture designed individually and permitting the limited space available to be carefully utilized. The measuring carriage has two similar berth compartments, a toilet, a wash room, a machine shop with a lathe and a generous set of tools, a conference room and an operational room with instruments and an observation vestibule for the rearward observation of the receding line which has just been measured. The carriage has a special three-axle measuring bogie. Influences of the track acting on it are transmitted by suitable means to measuring instruments and are recorded graphically. The instruments record, apart from the distance covered, the time and the speed, also the gauge and its variations, vertical irregularities, sinking of joints, warpage of individual lengths of rails and a number of other records important for judging the condition of the permanent way. The instruments work with the required accuracy up to a speed of 60 km/37.5 miles per hour.

For the permanent way construction service goods motor trolleys with trailers are built in Czechoslovakia. The motor trolleys have an air cooled engine below the load carrying platform and a small, totally enclosed driver's cabin arranged eccentrically in the L.H. front corner. The major portion of the surface of the motor trolley is thus cleared for the carriage of goods. This facilitates, in particular, the handling of long objects, such as rails and telegraph poles, which extend substantially beyond the loading surface in either direction along the longitudinal centreline of the trolley, and at the same time affords perfect protection to the driver of the trolley from all unfavourable influences of the weather and from accidents which might occur should the load itself loose during travel.

Also included among the traditional products of the Czechoslovak railway wagon factories are tramway cars. The type T II of tramway motor coach satisfies the latest claims of world engineering on city transportation and is a development of the type T I of coach which had already been in production for a number of years. The design with bogies which have tyres spring mounted in relation to the discs ensures the best possible springing and thus also the most silent and soft travel. The high speed electric traction motors are mounted parallel with the center line of the vehicle and their torque is transmitted to the axle by a propeller shaft and gear. The vehicles are built for one direction of travel, the comfortably seated driver controls the travel and the brake by means of pedals, all other controls by hand. The large inside space carries up to approximately 145 sitting and standing passengers. The car is fitted with indirect control which allows several coupled motor coaches to be controlled from a single driver's post. The maximum speed of the coach is 65 km/40 miles/per hour and, in line with the demand for a speed-up in city traffic, the starting acceleration is 1.7 m/sec ^{2}, the braking deceleration 2.5 m/sec^2. The automatic accelerating equipment decelerates the vehicle automatically during braking. A check on the driver is exercised by a "dead man" equipment. The vehicle is designed for gauges from 1 metre /3' 3 3/8"/ to 1435 mm. /4' 8 1/2"/, the housing and certain parts of the bogies remaining unchanged for either gauge.

Our short account of certain interesting rail vehicles of Czechoslovak make is far from exhaustive. Czechoslovak wagons factories are at present manufacturing, for export as well as for the domestic demand, scores of types of vehicles, many which in a number of versions, and their rich experiences and hundreds of thousands of wagons and coaches already built are a guarantee of the customer's satisfaction.

IMPROVING CLASS III PASSENGERS AMENITIES

The Railway Board has set up a committee of three senior engineers to examine the amenities now available to Class III Passengers inside compartments, and to make recommendations in regard to any improvements considered necessary. The committee will, for instance, examine the provision of more convenience to passengers by increasing the capacity of water tankage in third class and by providing automatic water taps. The committee will also examine the feasibility of revising the present design of lavatories, wash basins, water pipes and storage tanks and improving light arrangements in third class carriages. Members of the committee are: Chief Mechanical Engineer, Northern Railway (Chairman); Chief Electrical Engineer, Northern Railway and Chief Design Engineer (C & W), Central Standards Office for Railways.

RAIL RESURFACING

WITH the tremendous expansion of the Indian railways the question of the efficient maintenance of the Permanent Way has come to the fore. It is needless to point out that in order to cope with the already increased and ever increasing traffic it is imperative that the Permanent Way be maintained in a manner that would leave no scope for criticism. To achieve this end sweeping changes in outlook and technique will have to be brought about and recourse must be made to imaginative planning. It is, therefore, heartening to note from results of recent large scale experiments that efforts are being made in the right direction. A certain lack of progressive spirit is often noticed amongst the rank and file of railway engineers but this should not cause undue pessimism and despondency. Tradition dies hard and it is but wise to let it die a natural death. Sudden changes might appear spectacular at the outset, but seldom do they succeed in creating a lasting impression because of their incompatibility with the existing trend of events.

The process of rail resurfacing is of recent origin in India. It is concerned with the reclamation of worn out points and crossings. In industrially advanced countries the process had gained popularity and established a large following much before it was considered seriously in this country. In fact, it was during the second world war, when supplies of steel from foreign countries ebbed to a mere trickle, that experiments were first carried out to ascertain the most effective method of resurfacing points and crossings. The period of preceding experiments shows little activity in this sphere. Electric arc welding was exclusively used in reclaiming whatever small number of crossings came to be treated in the various railway workshops. Points and crossings thus reclaimed did not, however, inspire confidence and the process failed to provide the real answer to the problem. There were repeated failures and the reports received indicated that the deposited metal often chipped off in the form of flakes within a very short period of time. Cracks also showed up and bad patches appeared in plenty impeding the passage of trains from one line to another. In other words electrically welded deposits proved far from satisfactory. To appreciate the reason for the unsatisfactory nature of such deposits it is necessary to look into their inherent characteristics.

Deposits effected by means of electric arc welding consist of a coarse, dendritic cast structure having a very hard zone-martensitic-at the weld junction. The hard zone or the martensite is formed by the rapid quenching of the first layers of weld metal by the mass of rail metal upon which they are deposited. Although additional runs have a normalising effect on previous runs, this hard zone can not be totally eliminated with the result that the extreme hardness and brittleness of the martensitic zone render the built-up section liable to cracking in service.

Another common defect with rails built up by the electric arc process is the presence of slag inclusions, which form weak spots in the deposit and lead to failure under impact.

The greatest disadvantage, apart from structural weakness, from which the electric arc process suffers is that it can be applied to a crossing only after it has been removed from the line or movement of traffic has been temporarily suspended. In most cases the crossings are sent to a central workshop for reclamation involving unnecessary expenditure and inconvenience to the Permanent Way Staff.

The only other alternative in this field is resurfacing by the oxy-acetylene process. It was first practically applied in the U.K. in

1933 and in India in 1942. Since the first demonstration at Dum Dum near Calcutta, by the former East Bengal Railway, it has been, and is being, increasingly made use of by the Indian Railways. A sufficient number of crossings have now been reclaimed to provide reliable data and other information regarding the process. Results obtained so far prove that the process has much to commend it. Its principal features can be summarised as follows :—

(a) The plant consists of a few readily transportable items. It occupies very little space and is suitable for use in restricted positions. No auxiliary plant is required.

(b) The initial cost of the complete outfit is very low; repair and overhead costs are also correspondingly low.

(c) The quality of the deposit has proved to be reliable, not subject to cracking, flaking or extreme hardness and of excellent wearing qualities. There is no detrimental effect on the rail structure.

(d) Resurfacing can be carried out without interruption to traffic.

(e) No grinding or other preparation of the rail surface is necessary and no other finishing beyond hammer smoothing has been applied to crossings resurfaced up to the present.

The process can be satisfactorily applied to the resurfacing of any type of B. S. carbon steel and chromium steel crossings, but it is not suitable for rolled or cast steels embodying more than 1.6 per cent manganese.

A carbon-chromium-manganese welding rod is employed: this provides a deposit very similar in composition to the B. S. carbon steel rails and embodying ductility and toughness with only a moderate harness. Examination of deposits made on crossings in service shows that the harness varies between 290 and 310 Brinell, the surface of the deposit being slightly softer than the core. A valuable characteristic of the deposited metal is that it is capable of being hammer forged while hot, thus enabling the surface to be smoothed or contoured without grinding. The hammering or peening effect is also beneficial in compressing the metal and provides a slightly work hardened and homogenous structure. The rod is deposited in conjunction with an oxy-acetylene flame with a definite excess of acetylene. The excess acetylene flame carburises the base metal surface and thus lowers its melting point. The formation of a carbonaceous self-fluxing film eliminates the formation of surface oxide and permits complete fusion of the deposited metal without measurable depth of penetration, or melting of the base metal. An adequate bond is thus secured at the lowest possible temperature which is probably some 400 C below the melting temperature. This ensures the minimum disturbance of the rail metal. Further, there is extremely little adulteration of the deposited metal with the base metal. Microphotographs taken of sections cut through both rail and deposit indicate a small refinement of structure, or normalising effect, in the rail head, compared with the parts of the rail unaffected by heat. A further benefit derived from the comparatively diffused heat of the oxy-acetylene flame, and therefore the retarded heating and cooling of both rail and deposit, is the elimination of localised hard areas which often result in fatigue flaws.

The growth of rail-resurfacing by the oxy-acetylene process in our country has not been spectacular. From a humble start it has grown steadily and to-day it constitutes an import medium for combating wear on points and crossings. The beginning was made in 1942 when a crossing was resurfaced at Dum Dum. Other demonstrations followed, all showing uniformly good results. But it was not until 1949 that the first railway decided to go ahead with the process on a moderate scale. A batch of six operators underwent

extensive training for a period of eight weeks under the auspices of the then G.I.P. Railway. Other railways soon followed suit and by the beginning of the current year all except the South Eastern Railway have accepted the process as a means of alleviating the acute shortage of points and crossings. Credit is due to Eastern Railway for having started their own training scheme for turning out skilled operators. There are now approximately one hundred trained operators engaged in reclaiming points and crossings throughout India. A steady increase in their number has so far been observed and it seems unlikely that it will ever remain stationary at a certain point for a long time. With the extension of track to new regions and the introduction of faster moving traffic, the demand for skilled operators is bound to grow.

It can easily be appreciated that satisfactory results can only be achieved with the help of properly trained operators. The length of training required by a crossing welder depends to a certain extent on the receptiveness of the welder to new ideas. The technique called for in this work is different from ordinary welding procedure. For this reason, very little advantage has been found in training existing welders and almost equally good results have been obtained by training men having no experience in welding. Men employed on permanent way work are the most suitable as they are more accustomed to working under traffic conditions. It has been observed in this country that men drawn from the "semi-skilled worker" category provide the best human material for this type of work.

The arrangements that have been found most satisfactory upto the present are as follows :—

The men receive three weeks training in the instruction workshop. At the beginning of this period the process is described, and the technique explained and demonstrated; then sweating and depositing practices on small pieces of rail are carried out. During the fourth week the men resurface scrap crossings under conditions similar to those on the track.

Finally a fifth week, under their instructor, is spent on some unimportant crossings in a siding subjected to very infrequent traffic. After this the trainees are handed over to the Railway.

The foregoing explains the training method of operators in India. In foreign countries the same schedule is more or less followed with changes to suit local conditions. It is indeed gratifying that barring only a few, most of the crossing welders in this country display a uniformly high standard of proficiency in their work. Under conditions not always conductive to the development of a healthy mind and body, the Indian welder does turn out results of a very high order. A look into the causes of the few failures that have been reported uptil now, convinces the observer that in almost every case casual disregard of the principles guiding the process has been responsible for the failure. To blame the operator for such failures would be extremely unjust for he is only one of the many who must actively co-operate with one another to produce satisfactory results.

India is a vast subcontinent with an impressive network of railways. As years roll by this network is bound to expand and stretch its tentacles even to the remotest corners of the country. With industrial advancement, the demand for faster trains will increase which will enhance, immeasurably, the responsibility of the Permanent Way Engineer. If he has to maintain his track in first class condition, he must have some means to combat the wear on points and crossings Rail-resurfacing provides him with the necessary means.

It will be presumtuous to infer that the existing processes will not be supplemented in future by better ones. They will be welcomed when they arrive but let the opportunity that is present be availed of fully in the meanwhile.

Automatic Train Control

THE developments in the methods of railway traction resulting in faster and in some cases more intensive train services called for a reliable and technically sound scheme of train control to secure both efficient operation and the highest degree of safety. Thus some means of automatic train control had to be provided to suit the requirements.

The outlines of the two methods given here are based on the methods used previously in signalling but with some modifications towards simplicity of continuous proving and some other modifications resulting from the research and experience. These systems are regarded as a highly satisfactory, safe and efficient apparatus for the equipment of new routes or complete Railway Systems.

A. T.C.

The equipment is based on the principle of using inductive impulses which are transmitted through two independent channels between the track apparatus and moving train equipment. By these simple and technically sound means absolute safety in working is obtained.

BASIC PRINCIPLES OF OPERATION (Figs. 1 and 2)

A constantly energised electro-magnet E1 passes over corresponding relaying inductor U1 as the train passes the signal and induces in it a voltage which in turn gives rise to an alternating current which, if the signal control relay contact S is made, energises the winding of inductor U2 whose induced magnetic field reacts on the electro-magnet E2. If, however, contact S is opened, electro-magnet E2 is unaffected.

E2 being energised, operates the receiving relay R which in turn controls the train

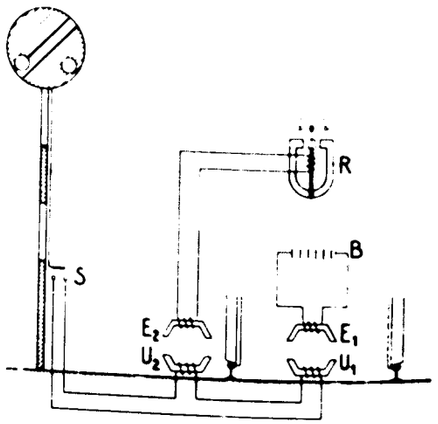


Fig. 1

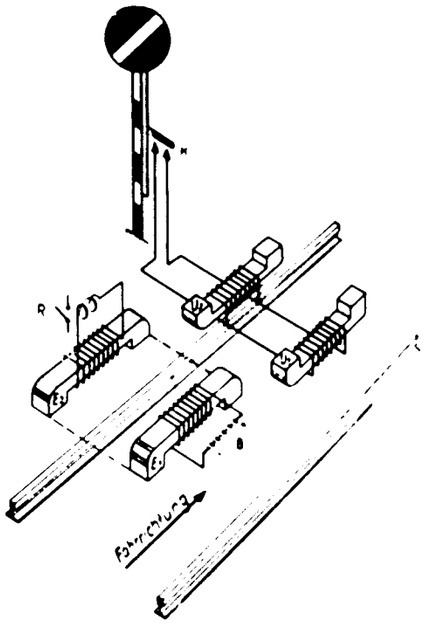


Fig. 2

equipment. This principle of a double transmission of impulses permits a highly sensitive relay to be employed since any extraneous

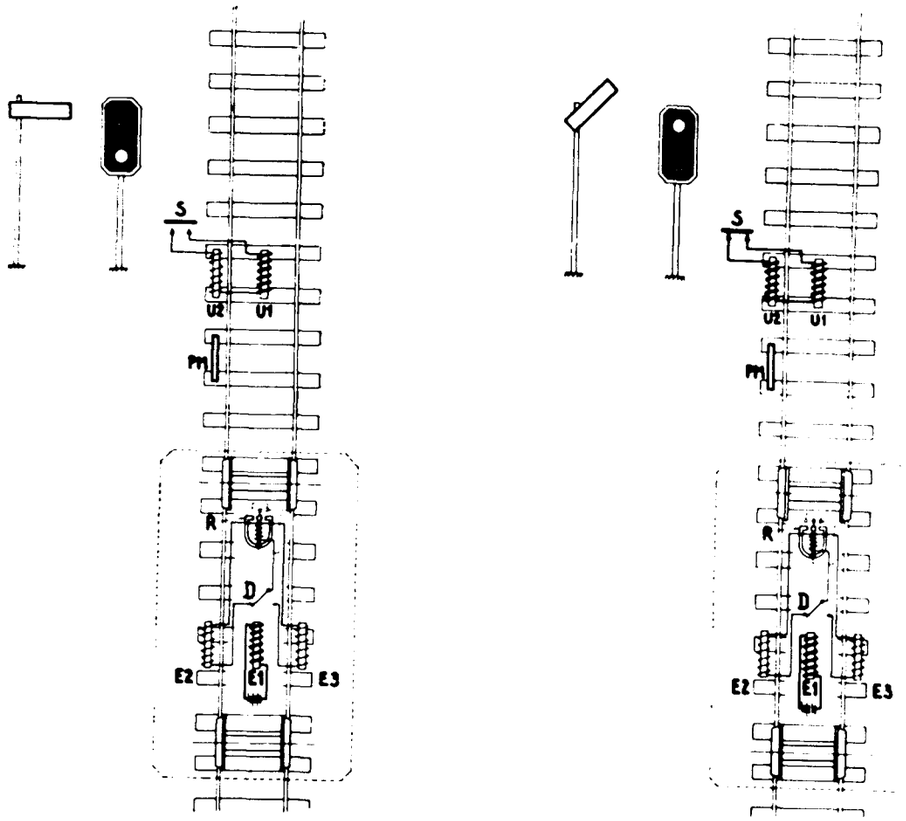


Fig. 3

influence on the inductors or receivers, or the effect of large ferrous masses is eliminated.

OPERATION OF 2-INDICATION SYSTEM (Fig. 3)

S– Signal Relay Contact

U1, U2– Two Intermediate Inductors } Track Equipment

PM– Permanent Magnet

E1– Continuously Energised Inductor.

E2, E3– Receiving Inductors for Two Directions of Running.

D– Directional Switch.

R Receiving Relay.

On the train passing a signal inductor E2 is first acted by permanent magnet PM, this causes receiving relay R to operate (left hand side of Fig. 3). This action corresponds to the STOP indication given by the signal and the operation remains stored in the locomotive apparatus. If however during that short period no further effect reaches inductor E2, the train equipment will at once bring into operation the apparatus corresponding to the stop aspect of the signal.

On the right hand side of Fig. 3 PROCEED indication is shown. After receipt of the impulse from the permanent magnet the exciter inductor E1 induces in the intermediate inductor U1 an alternating current which passes via the S to the other intermediate inductor U2 and a second impulse is thus set up in the receiving inductor E2 which brings into operation relay R. This cancels the stored effect and sets up operations corresponding to "PROCEED".

It can be seen that any defect in the track equipment must operate on the side of safety. The main circuit of the locomotive is continuously proved. Provision is made to put receiving equipment out of action in the event of failure of the receiving apparatus and driver takes over the control of train in the usual manner. Failures however are very seldom experienced.

TRANSMISSION OF 3 OR 4 INDICATIONS (Fig. 4)

The important feature of this system of train control is that it is possible to transmit more than 2 indications by simple additions to already existing 2-indication equipment at a low cost. As a general rule the four following controls are commonly used:— "STOP", "CAUTION", "ATTENTION" and "PROCEED". To provide for 3 or 4 indications the track equipment is supplemented by an additional intermediate inductor U3. As previously described in - indication control the "STOP" indication is produced by the influence of permanent magnet the action of which can be cancelled by inductor U2 or U3 or from both. On the locomotive receiving inductor E3 is used to pick up impulse emitted by the intermediate inductor U3. It is desirable at this stage to provide a visual cab indicator to show the particular signal aspect being received at any given moment.

On Fig. 4 the action of the track apparatus with the signal showing various aspects is illustrated.

Fig. A indicates "STOP" aspect
Fig. B „ "CAUTION" aspect
Fig. C „ "ATTENTION" aspect
Fig. D „ "PROCEED" aspect

The "PROCEED" can only be received if all parts of the track apparatus are intact.

The indications transmitted from the signal location to the locomotive can be adapted to give in addition to visual an audible indica-

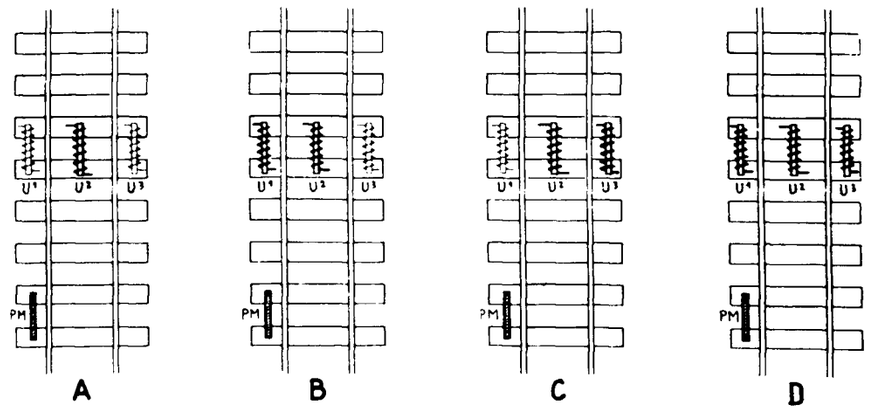


Fig. 4

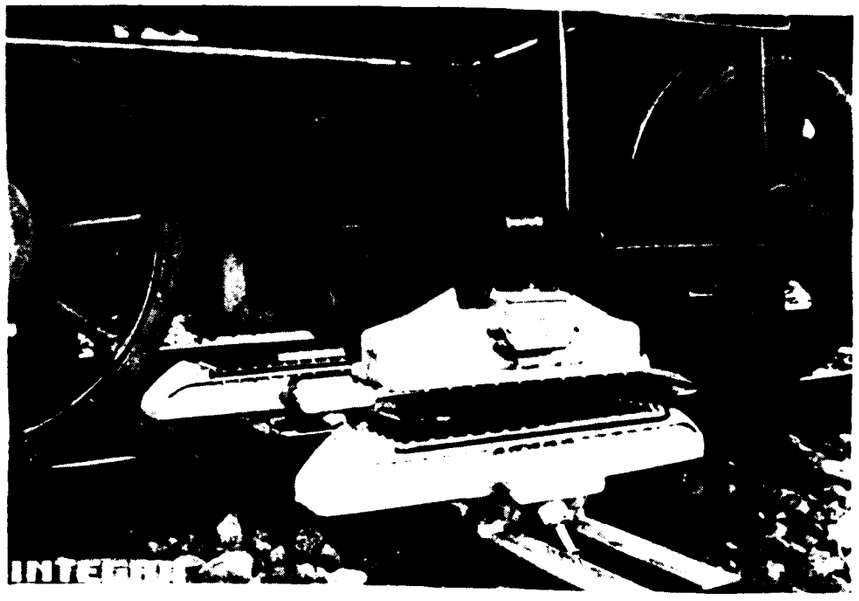


Fig. 5. Position of locomotive receiving inductor over intermediate track inductor.

Fig. 6. Permanent magnet and Intermediate Inductors at an Automatic Signal.

tion and also an automatic speed reducing device together with automatic brakes device to suit particular requirements.

The advantage of the system is that there are no direct contacts between corresponding parts of the apparatus, consequently there is

Fig. 7. Locomotive Apparatus Assembly with cover removed.

no wear or tear. No source of electric power is required for track equipment. Absolute safety in operation is achieved and the method can be applied to any system of traction and type of signals used. The system is independent of type of sleepers used whether concrete, wooden or steel. High economy is obtained due to the low initial cost.

LIGHT A. T. C.

This method is a development of A.T.C. and its principle of operation is as follows:—

2 INDICATIONS (as per Fig. 9)

Signal showing red aspect

When signal shows red aspect, neither of the signal relay contacts Cvl, Cav and Cab will be made. Therefore the electro-magnet EA will not be energised.

The train passing over track permanent magnet AP will receive an impulse, through the impulse receiving relay RR fixed to the bogie of the locomotive. This will automatically operate brake device, but since the relay RR has a few seconds time delay the auto-

Fig. 8. The equipment functions in worst weather conditions.

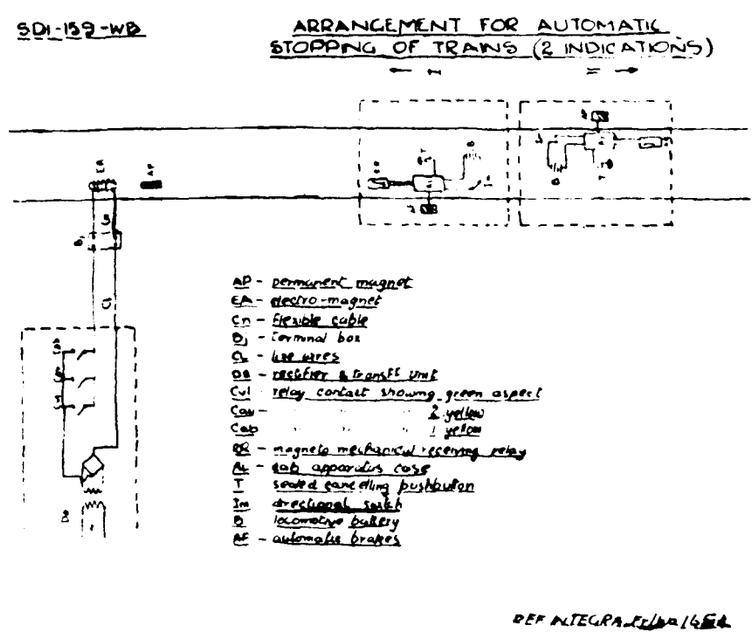


Fig. 9

matic brakes will not be applied instantly. The train next passes over electro-magnet EA which in this case, has no effect on relay RR and thus after the delay time has elapsed, automatic brakes will be applied and train brought to rest. The driver cannot start the train but has to get out of the cab and operate normally sealed push button T, which is situated at the headstock and has to state the reason for overrunning stop signal in a log book provided. In addition a red lamp can be lighted in the cab and also sound warning in the form of a horn can be incorporated.

Signal showing green, yellow or double yellow aspect

When any of the above aspects is displayed one of the contacts Cvl, Cab or Cav will be made thus energising electro-magnet EA. Train after passing over permanent magnet will have its received impulse stored, ready to apply automatic brakes but this time passing over the energised electro-magnet EA, receiving relay RR will have its armature attracted for one second thus cancelling the previously stored impulse to apply automatic brakes and at the same time giving a bell or horn ring in the cab, warning the driver of signals passed. The apparatus is thus brought to normal position until next impulse is received.

4 INDICATIONS (as per Fig. 10)

The track equipment for 4 aspect indications is practically the same as for 2 indications, except the second electro-magnet EA2.

The locomotive or train equipment has an additional impulse receiving relay RR ii and two more cancelling push buttons and also visual cab indicator.

SIGNAL SHOWING RED ASPECT

When red signal aspect is displayed neither of signal relay contacts Cab, Cvl or Cav is made so that both electro-magnets EA1 and EA2 are de-energised. On train passing over permanent magnet AP, impulse receiving

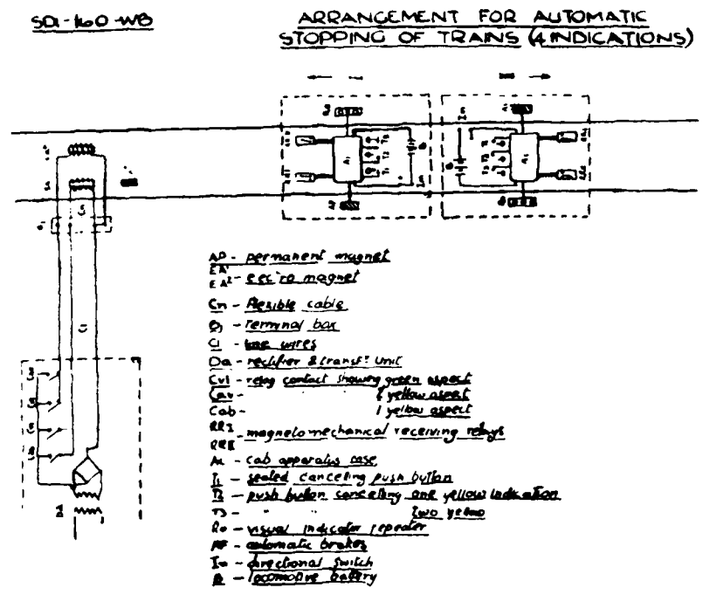
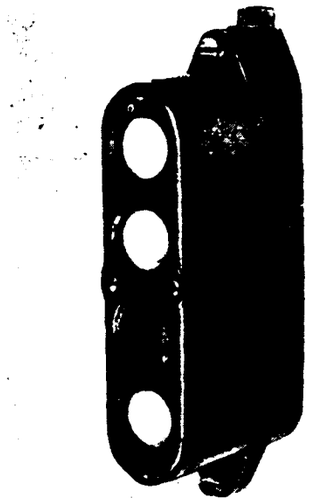


Fig. 10



Visual Cab Indicator.

relay will receive an impulse, which will be stored in cab apparatus for a few seconds before operating automatic brake device Af. On train passing over electro-magnet EA1, which has no effect on relay RR on the locomotive and after time delay has elapsed automatically brakes will be applied and train halted. The driver has to break normally sealed button T1 situated at the headstock of locomotive to be able to start the train. The reason for passing the danger signal has to be put in a log book provided. As soon as the train crosses the danger signal, red light is displayed on visual indicator in the cab and in addition sound warning in the form of a horn can be incorporated.

SIGNAL SHOWING SINGLE YELLOW ASPECT

Signal relay contact Cab will be closed, energising electro-magnet EA1, whose effect on passing train is to cancel the previously stored impulse to apply automatic brakes and light single yellow lamp on visual indicator in the driver's cab, together with horn sound. The visual indication in the cab can then be

(Continued on page 74)

Horizontal Forging Machines with tongs type jaws

By Dipl. Ing. W. Strotmann, Leverkusen

THE Horizontal Forging machines, commonly known as upsetting machines, serve principally for pressing and upsetting and preforming processes. Speedy operation and the fact that it is possible to arrange a number of tools in the machine at one time permits the forming in a number of operations in single heat. The using of split tools, coupled with the possibility of using multi tools have given the forging and upsetting machine a greatly increased field of application in the past decade.

The construction of the horizontal forging machine can be likened to that of a horizontal crank press. The construction with vertical split gripping jaws and a vertical arrangement of tools within upset slide is generally known. There are obvious disadvantages in its construction, i. e. it is difficult often to insert the working dies, the upsetting punches and dies are difficult of access and they are only inserted and adjusted with the aid of a crane or lifting tackle. It was because of these obvious failings that a new construction has been developed during past years. This new construction (fig. 1) is characterised by tongs gripping insuring the easier accessibility of the tools, at the same time providing for the horizontal splitting of gripping jaws.

The moveable gripping jaw of the horizontal forging machine with tongs gripping does not move in a straight line but is pivoted

(Continued from page 73)

cancelled by operating push button T2, bringing apparatus to normal.

SIGNAL SHOWING DOUBLE YELLOW ASPECT

In this case signal relay contact Cav will be made, energising electro-magnet EA2, whose effect on the passing train will be to cancel previously stored impulse to apply automatic brakes by attracting for one second armature of impulse receiving relay EA2 and also to show double yellow aspect on visual cab indicator with horn sound. The visual indication can then be cancelled by operating push button T3, bringing the apparatus to normal.

SIGNAL SHOWING GREEN ASPECT

Signal relay contacts Cv1 will be made, making closed circuit for current to energise both inductors EA1 and EA2. On train passing over those electro-magnets previously stored impulse to apply automatic brakes will be cancelled and green light will be displayed on the visual indicator in the cab and the bell will be sounded.

METHOD OF ATTACHMENT

(a) *Electro-Magnet* can be bolted to the sleepers either inside or outside the rail gauge depending on the position of magneto-mechanical receiving relay on the locomotive.

(b) *Permanent Track Magnet* can be bolted to the sleepers in a similar manner as electro-magnet.

(c) *The Magneto-Mechanical Receiving Relay* is housed in an enclosure and can be bolted to the bogie of the locomotive by means of angle brackets. The cable connections to the cab apparatus are housed in a flexible conduit.

Summing up it can be seen that the two methods ensure complete safety and caretake for overrunning signals at " STOP " causing many fatal disasters on Railways.

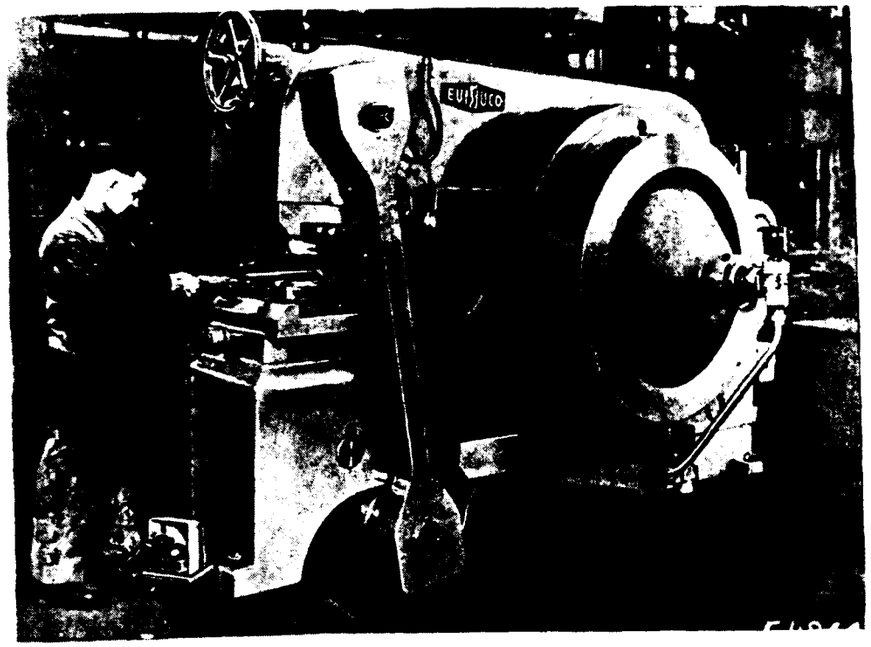


Fig. 1. Horizontal Forging Machine with tongs gripping : Handwheel for the adjustment of gripping power.

in the characteristic tongs yoke, whose pivoting point is in the rear of machine standard. With this wide radius of pivoting the deviation from the parallel within gripping area of work pieces is negligible, practically showing no difference. The tongs gripping is by lateral tie-rods and a toggle.

The total of drive-and lever-shafts are housed in the bed of the machine which is of rigid box type construction. The guides provided with wearing gibs, are carried in the front and rear of machine bed, permitting of long guiding gibs for the upsetting of the slide, which is of a similar cross section. The arrangement of these guides prevents the front guide from projecting into the proper working area, thus obviating the fouling by scale and the possibility of unwanted wear fig.2 .

The gripping jaws of forge steel at the front end of standard and tongs yoke take up the tools. Thus, all operations in the tools are performed between both rigid tie-rods of forged steel exerting the gripping power equivalent to the upsetting force with all machine sizes. The gripping is easily adjusted by hand wheel provided on top end of tongs yoke. The adjustment of gripping is necessary through the transfer of heat to the tools when in continual use, resulting in expansion.

Actuation of gripping drive is by multiple crank gears deviated from a crank shaft. Danger of overloading is obviated by means of a safety pressure rod within multiple crank gears allowing to absorb the entire stroke. In the event of excessive pressure or by wrongly inserting the blanks, or by accumulation of dirt, the toggle system immediately releases the safety pressure rods. This causes the upsetting rams to reverse and the machine returns automatically to the open position, permitting immediate continuation of work without loss of time (fig. 3).

Shop to deal with these new locomotives which were of a longer wheel base.

The Khargpur Loco. Shops, therefore, went in for certain expansions and one of the major expansions completed was that the Erecting Shop. The Khargpur Loco. Shops had also to face the problems of standardizing, manufacturing and stocking of components for the new types of locomotives for the Workshop as well as for the Shed repairs.

During the first Plan Period, the Loco. Shop had to standardise nearly 1,500 W.P. 800 W.G. 700 W.M. and 1,150 X.D. components. The Shop had also to manufacture a large number of jigs, fixtures and special tools to be able to manufacture these components quickly and economically.

CARRIAGE SHOP

Coaches are given periodical overhaul and heavy repairs in this shop. The output is 4 bogie coaches per working day. New coaches are also built here and the capacity is five coaches per month. All types of coaches including air-conditioned coaches are constructed in these Shops. Besides coach-building, reconditioning of coach bodies and underframes is also undertaken in this shop.

The target for the revenue periodical overhaul during the first Five-Year Plan was 2,190 P. O. H. units per year. The target out-turn of capital coaches was 120 units per year.

WAGON SHOP

Wagons are given overhaul once in three years, and the present capacity of this Shop is 35 units per day. Additional facilities have been provided to increase the output to 41 units per day.

SECOND PLAN AND THE SHOPS

During the Second Plan Period, the overall increase in the number of trains to be worked on the South Eastern Railway will be about 100% in addition to 15% extra passenger trains. The increase will mainly be due to the heavy traffic requirements of the giant new steel Plants at Rourkela, Bhilai and Durgapur and the additional demands of the Tata and Burnpur Plants under the Second Five-Year Plan. 190 steam, 120 diesel and 40 electric locomotives, 1,099 passenger coaches, (in terms of four-wheelers) and 24,783 goods wagons (in terms of four-wheelers) will be added to the existing stock of the Railway.

In order to cope with the workshop repairs of the increased holding the annual POH capacity of the shops will be increased from 265 to 324 for steam locos., from 2,190 to 3,200 for coaches, from 10, 183 to 18,883 for wagons. This will involve large scale development of the existing shops at Khargpur at an approximate cost of rupees one crore and the setting up of a new Wagon Repair Shop at an estimated cost of Rs. 2 crores.

The expansion of the Khargpur Workshops will require 2,100 additional staff, besides 2,600 additional men for the proposed new Wagon Shop. Elaborate facilities for the training of new recruits and also for existing employees have been planned.

APPRENTICE TRAINING

Similar to almost all other railway workshops, Khargpur has its own Apprentice Training Scheme—where matriculates are trained to be supervisors and non-matriculates to be skilled workmen. The workshop has also trained engineering graduates who have been appointed by the Railway Board as Officer Apprentices.

TOWNSHIP

The entire Khargpur Workshops are under the direct control of a Chief Administrative Officer (Chief Mechanical Engineer). Khargpur boasts not merely of the largest Railway Workshops in India but a most modern

township too. The population of the railway settlement occupying nearly 4.20 square miles is in the neighbourhood of 70,000. The Khargpur Municipal Colony which is in the periphery of the railway settlement has almost an equal population, out of which a large number belongs to the Railway. The town itself has all modern amenities, market, cinemas etc. There is a first class railway hospital and two railway High Schools, besides clubs, institutes and other recreational facilities. With its wide roads, electrified houses, broad meadows, undulating countrysides and modern sanitary arrangements, Khargpur is one of the picturesque railway settlements in India.

Editorial Notice

The Editor invites contributions from the Engineers and Works Managers of Railway Workshops as well as company-managed Engineering Workshops in the form of original articles, research write-up, production technique etc. relating to Workshop practices in India and abroad. Besides, suggestions for the technical improvement of various aspects of Railway Workshop practice are also invited with suitable write-ups accompanied by photographs wherever possible.

Contributions are accepted on the distinct understanding that they are sent solely to "THE INDIAN RAILWAYS WORKSHOP MAGAZINE". The Editor accepts no responsibility for the views and statements of the contributors.

All contributions intended for publicationin any particular issue should reach the Editor at least 30 days prior to the scheduled date of publication. This Journal is issued quarterly i. e. February, May, August, November.

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Editor.

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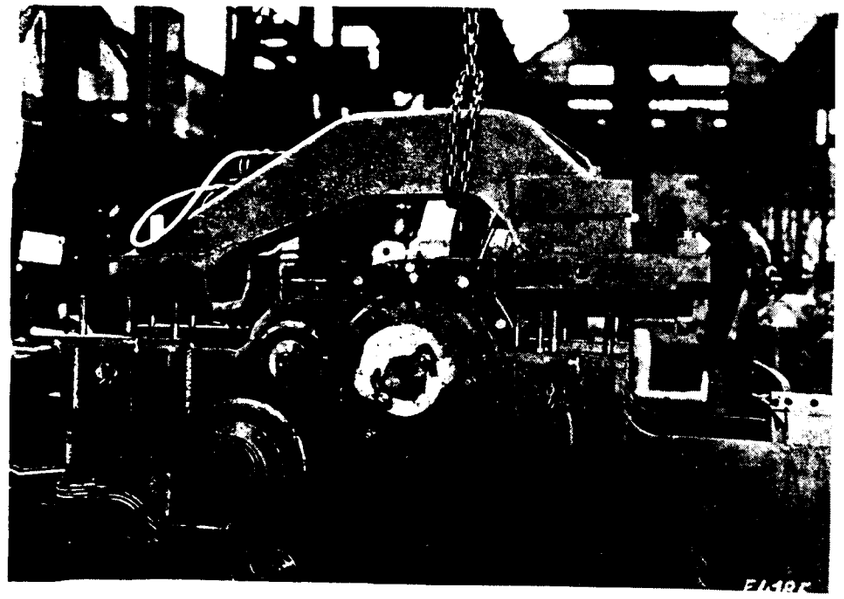


Fig. 2. Upsetting slide and standard.

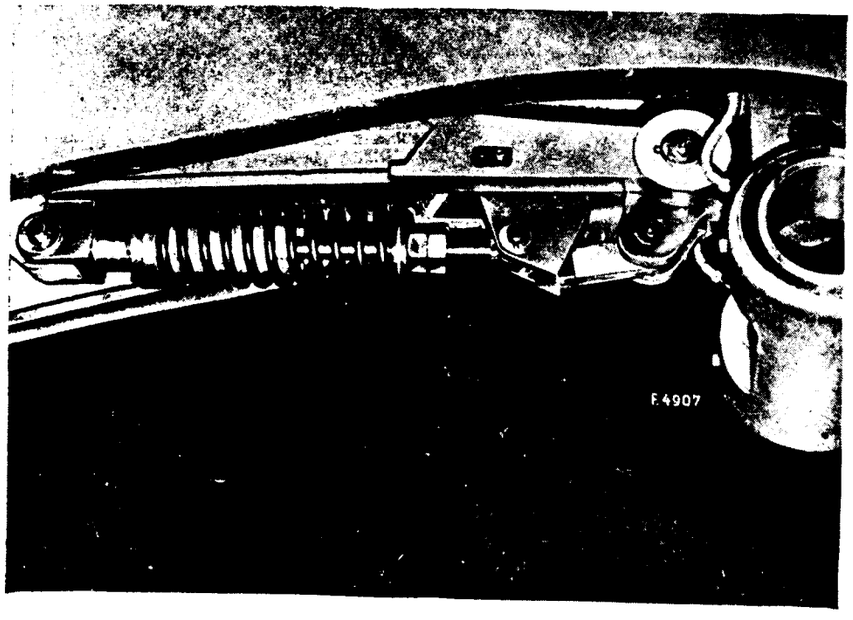


Fig. 3. Safety pressure rod.

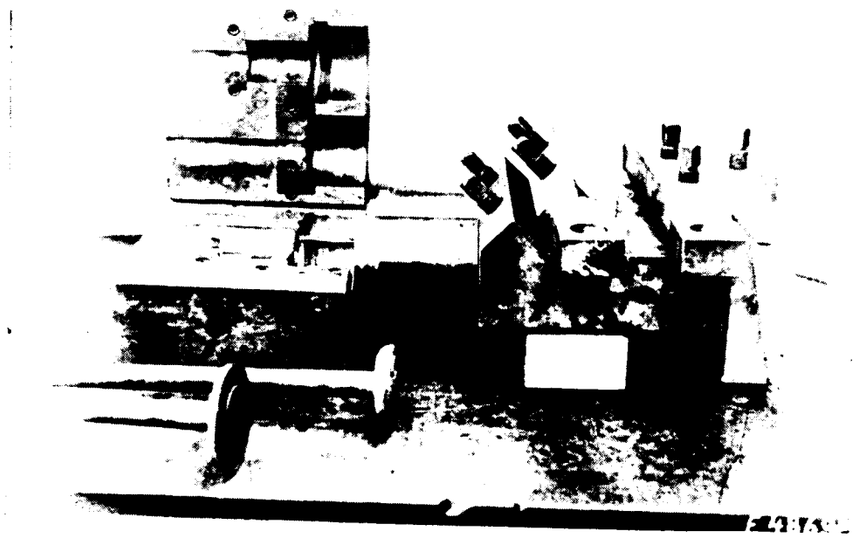


Fig. 4. Tools for the manufacture of flanges.

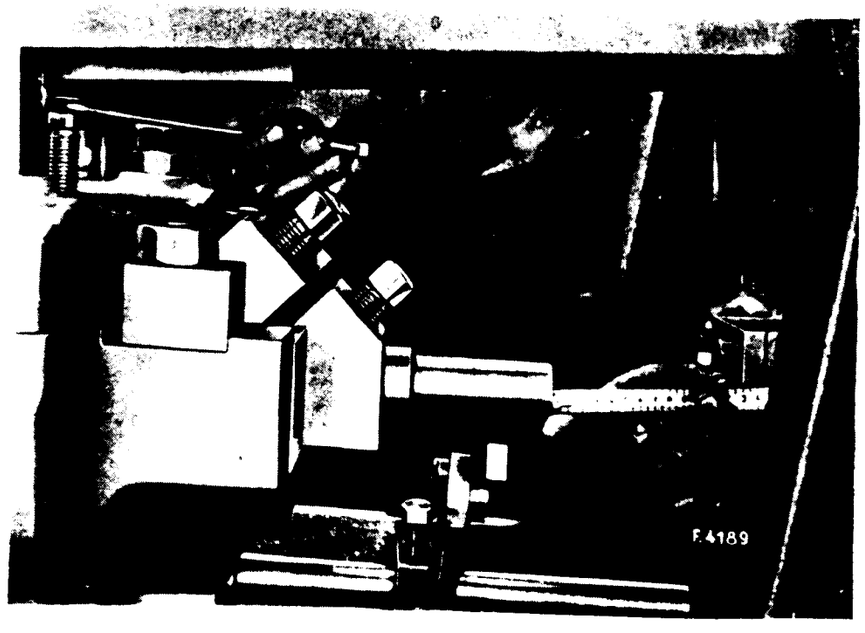


Fig. 5. Setting of tools.

The drive is single by electric motor, V-belts, and flywheel to the countershaft. Operation of the crankshaft is by means of spur gears operated by friction clutch which also serves as a further overloading safety device of upsetting drive. With machine up to 450 tons capacity the clutch in mounted directly on the eccentric shaft. By this means friction is reduced to a minimum and any number of strokes are permissable without danger of the clutch running hot. With all machines, clutch and brake are electro-pneumatically controlled. From the crankshaft the upsetting power is transferred to the slide by means of a pressure rod which is so massively constructed that the momentum has no effect on the guide gibs. To facilitate correct insertion of the work pieces to be effected in the initial operation, an adjustable stop is provided. A central lubricating system provides that all moving parts, bearings and guides, be automatically lubricated.

Operation of the machine is by a foot operated electric switch. The electro-pneumatic control permits by respective adjustment the setting as well as single stroke. When setting—generally applied when inserting the tools—the machine can also be 'inched'. With normal working stroke the machine is automatically disengaged after each stroke. We can also provide for an additional switching to continuous running.

The process is the following: the work piece is placed in the split tool, the gripping jaws opened. By actuation of the foot switch the machine is engaged via electro-pneumatically controlled friction clutch. By the simultaneous release of brake, the gripping jaws are locked via gripping drive, thus clamping the work piece. After the gripping operation and following to shape of tools, the upsetting tools form the work piece. The useful upsetting stroke, i. e. the movement of upsetting slide after the locking of gripping jaws can be fully utilised. Fig. 4 indicates an example of tool construction.

The easy accessibility of the tools required is fully obtained with the horizontal forging and upsetting machine with tongs gripping. Adjustment of the punch holders provided at the front of upsetting slide, is easily carried out by adjustable wedges in upsetting direction (fig. 5). The arrangement of tools is without the slightest difficulty, since the working area of machine is easily accessible from both sides. The change of upsetting punches, too is without any difficulty. The horizontally split gripping tools are easily accessible from three sides, thus insuring the working from the bar as well as from cut off pieces as it is possible with a die forging hammer or on a die forging press. Further, work pieces (bar material as well) can be inserted in longitudinal direction as well as transverse, permitting the upsetting by punches in two directions. The operator clearly follows the operation and the work pieces tumble from the machine but above floor.

The horizontal partition of gripping tools facilitates and quickens the operation without the necessity for the strenuous lifting of workpieces from one die to the other as the movement of horizontal and not in a vertical direction. It is necessary to lift the workpiece only half of the working diameter or half of the upsetting diameter. The end of the barracan advantageously be placed on a support, thus facilitating its lifting.

The free accessibility of horizontally split tools insures the construction of an automatic feeding device without any difficulty, since the workpiece can be shifted from one operation to the next in horizontal direction and across the machine. By the eventual arrangement of an induction system the forging unit can be fully automatic.

Polish Production of Railway Rolling Stock

THE production of railway rolling stock began in Poland when the country was still capitalist, shortly after the end of the first world war and the restoration of Polish independence. Favourable conditions for the development of industry during the early years of the inter-war period led to the establishment of plants of all kinds. It was then that major Polish railway rolling stock works came into being and achieved a remarkable production level within a comparatively short period of time in a number of industrial centres; Upper Silesia, Warsaw, Poznan and other places.

The Lilpop, Rau and Loewenstein, Railway Rolling Stock Works of Warsaw, which prior to the first world war produced only an insignificant number of freight wagons, made remarkable progress during the short inter-war period and reached a high degree of efficiency in the construction of a wide range of passenger and goods cars.

In 1920, a new plant was set up in Chrzanow, Silesia, under the name of Poland's First Locomotive Factory. It soon specialized in the construction of locomotive of all kinds.

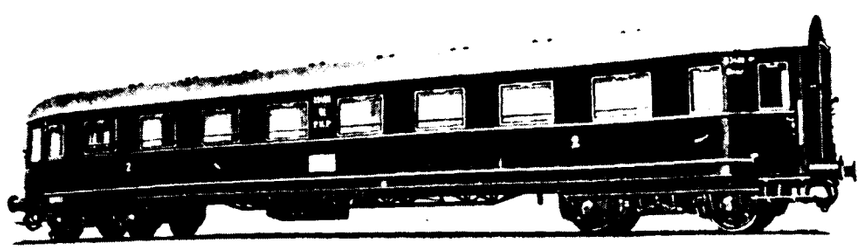
The second locomotive plant, the Warsaw Locomotive Construction Company began to undertake locomotive repair work in 1918 for the Polish State Railways, and from 1923 started the production of locomotive.

In addition to those mentioned, the large scale H. Cegielski Industrial works of Poznan (founded in 1846), began in 1920 following reconstruction after the first world war, to produce first locomotives, then railway passenger and goods cars.

Other railing stock plants include the Ostrowiec Steel Works, the Sanok Wagon Factory, the Ostrow Wielkopolski railway repair shops, and other railway repair shops situated at railway junctions.

All these plants were concerned with meeting home needs, primarily those of the Polish railways. However, with the expansion and improvement of production, they began gradually to win foreign markets in the face of keen competition.

Thus the Polish rolling stock industry began even between the works to export to the Soviet Union, Bulgaria, Latvia, Marocco and China and shortly before the outbreak of



Wagon 2-nd class 50W

the second world war received orders for deliveries of locomotives to Egypt. It also supplied spare parts to India, Yugoslavia, Greece and many other countries.

After the second World War, People's Poland faced in 1945 colossal tasks of reconstruction, and above all that of rehabilitating and extending railway transport—an indispensable condition for the development of the rapid progress of the railway system was brought about by the speedy reconstruction and extension of rolling stock works.

To compare with the unimportant deliveries of a small number of rolling stock units before the second world war, Poland today exports year in and year out hundreds of locomotives of various types, together with similar quantities of passenger wagons and thousands of goods wagons varied as to construction and specifications. Poland has become one of the largest exporters of rolling stock in Europe.

A brief outline of some of the types of railway locomotives and cars constructed for home use by the Polish State Railways will give an idea of the productive potential of this branch of Polish industry.

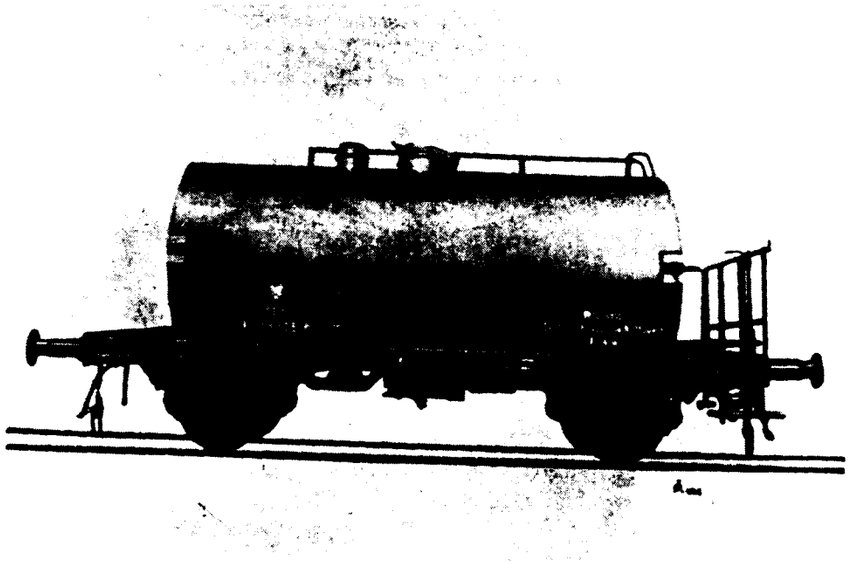
In the class of standard gauge passenger locomotives; attention must be drawn to locomotive 1—4—1, Series Pt-47, built for fast long-distance passenger service. Weight of engine empty 98 tons; 4 axle tender, unladen weight—30 tons fitted with a water tank of 33 cubic meters capacity and a coal box holding 17 tons. Weight per driving axle - 18.3 tons, pressure of truck axle—14/18 tons. This locomotive is capable of hauling 1,600 tons on a level line. Maximum speed —110 km./h. If required the locomotive may be fitted with a mechanical stoker.

This type of locomotive is intended shortly to be brought still further up-to-date by the introduction of the latest technical and constructional improvements.

Locomotive 1—3—1, Series OL-49 is designed for passenger service, employing a smaller number of wagons over shorter distances. Weight of engine empty 75 tons; 4-axle tender, unladen weight 25 tons, fitted with a water tank of approximate 25 cubic meters capacity and a coal box for 12 tons. Maximum speed 100 km./h. Weight per driving axle 17,4 tons per truck axle 15/17 tons. This locomotive is capable hauling 750 tons on a level line.

Passage in Wagon 50W

Standard gauge goods locomotives include, Series Ty-51, 1—5—0 goods locomotive for hauling heavy goods trains at speeds of up to 80 km./h. The locomotive is fitted with a mechanical stoker. Distribution and residue removing bars are operated by means of servomotors. For more efficient and economical operation a steam superheater and a water heater can be included. Weight of engine empty - 97, 4-axle tender unladen weight—32.5 t., fitted with a water tank of 27 cu. m. capacity and a coal box for 20.5 t. Weight



Cistern with two Axles 3R.

per driving axle—19.4 t.; weight per truck axle—15 t. This locomotive is capable of hauling 2.800 t. on a level line.

Standard gauge tender-locomotives include Series Tkt-48, 1—4—1, locomotive, suitable for suburban passenger traffic and adapted for frequent stops and quick pick-up from start. Weight of engine empty—74 t. It is fitted on both sides with water tanks of 10 cu. m. combined capacity and a coal box for 6 t. placed at the rear of the driver's cab. Maximum speed—km. h. Weight per driving axle—16 t.; weight per truck axle 14/16 t. Capable of hauling 1450 t. on a level line.

A wide range of narrow gauge locomotives includes the series Px-48, 0—4—0 narrow gauge locomotive with tender for 750 mm. gauge. Weight of engine empty 20 t., 4-axle tender, unladen weight 8 t. fitted with water tank of 6 cu. m. capacity and a coal box for 4 t. Weight per axle—5.5 t. Maximum speed—35 km./h. This locomotive is capable of hauling 450 t. on a lever line.

Narrow gauge tender locomotives include, the Series TW-35, 0-5-0 locomotive, with superheater, for 785 mm. gauge. Weight of engine empty—31 t. Fitted with two water tanks of a combined capacity of 4 cu.m. and a coal box for 1.6 t. Weight per axle—8 t. This locomotive is capable of hauling 1.200 t. on a lever line. Maximum speed—30 km. h.

Narrow gauge tender locomotive for saturated steam of the "Las" Series 0-3-0, 70 HP, is an industrial locomotive with a good reputation at home and abroad. Gauge—666, 750 or 785 mm. May be pit—or timber heated. Weight of engine empty approx. 9.5 t., water capacity of side-tanks-0. cu.m.; fuel capacity 0.5 t. Weight per axle not more than 4 t. This locomotive is capable of hauling 240 t. on a level line. Maximum speed 20 km. h.

Internal combustion locomotives include WLas—40 narrow gauge locomotive, built for 600 mm. and 750 mm. gauge, designed for factory and building-site interior transport.

Construction of wagons designated for export to the Soviet Union.

It is fitted with a 4-cylinder, high compression, four stroke Diesel engine, developing 40 HP at 1000 r.p.m. Weight of engine empty—6.8 t.; in working order—7 t. Maximum speed—15.9 km./h.; maximum adhesive weight on level line 100 t.

The Polish rolling stock industry also produces a wide range of passenger and freight cars for a variety of purposes and for various gauges. 13 types of standard gauge passenger coaches have been constructed up to the present, i.e., 4 types of 1st, 2nd and 3rd class coaches, 5 types of sleeping cars, 3 types of mail cars and one baggage car. Passenger coaches are also produced for narrow gauge.

Type 2A, series Chuxz standard gauge, 3rd class passenger coach is widely used on Polish inland routes. Along one side are located passenger compartments fitted with sliding doors and facing a corridor, which is separated from the vestibules by two-direction hinge doors. There are 10 passenger compartments with a total of 80 seats, in addition to 9 collapsible bench seats in the corridor. Each compartment is fitted with two 4-seat benches with movable supports, for sleeping. The benches consist of semi-hard seats, fixed soft back supports and semi-soft movable back supports. When the back supports are lifted, 4 persons are able to sleep in each compartment (each wagon has a total of 40 sleeping places). Weight of carriage—approx. 38 t.; length over buffers—24,420 mm.; width of body—2,910 mm.; height of body from rails—3,980 mm.

The LF Series 4-axle luggage van is designed for carrying luggage and packages for passenger service. It has a vestible at each end. A luggage compartment adjoins one of the vestibules. The van, fitted with sliding entrance and exit-doors is 15,900 mm. long. At one end is the conductor's compartment and a lavatory. The conductor's

stand is situated on an elevated platform to enable him to observe signals through windows in the roof superstructure. Weight of carriage—33 t.; length over buffers—22,420 mm.; width of body 2,910 mm.; height body from the rails—4,255 mm.

For goods traffic, Series 14 K two-axle closed trucks are used in Poland and abroad. Gauge—1,435 mm.; may be readjusted for wider gauges. Suitable for trains running at speed of up to 100 km. h. Weight of truck—12.5 t.; loading length—9,270 mm.; width—2700 mm.; floor surface—25 sq. m.; capacity of body—60 cu. m. Wall and roof frames made of laminated steel, all welded. Floor made of planks 40 mm. thick. Roof made of planks 20 mm. thick, lined with zinc-plate sheeting 0.6 mm. thick. The side walls have four vents for ventilation and loading on each side of the truck protected by grates and closed by downward sliding valves.

Among the series of tank cars constructed by the Polish rolling stock industry the most popular is the Series 34W 2-axle tank car 24 cu. m. capacity, for transporting oil and oil products. The all-welded tank, 24 cu. m. capacity, is 6.100 mm. long, 2.300 mm. in diameter and has an inner partition serving as a protection against wave motion in the oil. The tank is made of plates 6 mm. thick and 9 mm. thick at the bottom. Weight of tank car 9.15 t. loading capacity—22 t. length over buffers—8,800 mm., width—2,700 mm., height above rails—3.690 mm. In addition to an air-brake system, the tank car has a hand-brake operated from a platform or from a box of dimensions 700 × 1,100 mm.

All metal automatic tipping goods trucks include Series 15W 1 standard gauge automatic tipping 3-axle car, for transporting sand or similar materials. Weight unladen 18.3 t., volume capacity 24.2 cu. m., loading capacity—48.4 t., carrying capacity—51 t. Length over buffer—6 640 mm., width—3.105 mm.

The types of freight wagons described above do not, of course, cover the entire range produced by the Polish railway rolling stock industry. An idea of the scope of production can be obtained from the fact that during the past 10 years 43 types of freight wagons of varied construction and specifications have been built i. e. 7 types of coal trucks, 4 of closed trucks, 4 of flat cars, 2 of lime-carrying cars, 3 of ice-wagons, 14 of tank cars, and 9 of special and automatic tipping cars.

During the past ten years, production has been started of modern electrically-propelled units, such as 4×400 kw passenger locomotives, 6×250 kw goods locomotives, and a three-unit electric carrier for suburban traffic.

In addition, Polish industry is turning out motor and trailer tram-cars as well as several types of underground electrical locomotives for the mining industry.

Over and above production to meet the home needs of the railway system and industry, the following export of broad, standard, and narrow-gauge locomotives, 5 types of 2-axle coal wagons, 4 types of 2-axle closed trucks and 1 type of 4-axle wagon, 1 type of 2-axle tank-car, 1 type of a mail-car and 2 types of broad-and standard-gauge passenger wagons.

Some of these export lines are delivered in series of several hundred or even several thousand units.

Export deliveries made to the following countries: Albania, Bulgaria, Czechoslovakia, Holland, Rumania, Hungary, and the U. S. S. R. This export range and the number of countries involved do not of course represent all the export possibilities of the Polish rolling stock industry. With a further extension of commercial relations, Polish railway rolling stock shows every likelihood of taking an important place in international trade.

Khargpur Workshops of the South Eastern Railway

AT Khargpur, 72 miles from Calcutta, is located one of the major workshops of the Indian Railways. Here the broad gauge engines, coaches and wagons of the South Eastern Railway are repaired and broad gauge coaches built as well. The shops have on roll over 12,000 workers of all categories. The Workshops consists of three sections—Loco. Shops, Carriage Shops and Wagon Shops.

Prior to 1904-05, when the Khargpur Workshops were built, the work of repairs to the locomotives as well as the coaching and goods stock of both the broad and the narrow gauge systems of the ex-Bengal Nagpur Railway was confined to that Railway's small Workshop at Nagpur. Khargpur Workshops, on coming into existence, took over the entire work of repairs to broad gauge locomotives and rolling stock leaving the repairs to narrow gauge stock to be done in the Railway's Motibagh Workshop at Nagpur.

LOCO. SHOP

In the locomotive workshop, which has a strength of approximately 6,500 workers of all categories, on an average every month, 24 locomotives of various classes are given periodical overhaul. Garratt Locomotives belong the one of these classes. They have a maximum axle load of 20.25 tons. There are four types of Garratts which were obtained at different periods and the latest type ('P' Class), with a wheel arrangement of 4-8-2-2-8-4 and axle load of 17 tons, has been specially designed to negotiate short curves in the Central India Coal-fields area. These Garratt locomotives are intended mainly for carrying coal and iron ore traffic, and have a hauling capacity of 1,800 tons on 1:100 grade.

The engines for the passenger service are of 'WP' class (4-6-2 wheel arrangement) and 'M' class (4-6-2 wheel arrangement). The former has an axle load of 18.5 tons and the latter, a compound engine, 21.5 tons. These two types are capable of hauling passenger trains of 15 bogie coaches approximating to 650 tons.

The main goods traffic is handled by the new postwar type 'WG' locomotives with an axle load of 18.5 tons. These engines are now being built in the Chittaranjan Locomotive Works. In certain graded sections up to 1:100 these engines can haul a maximum load of 1,650 tons.

Locomotives are given periodical overhaul in the Mechanical Workshops on the mileage basis, varying between 1,00,000 and 1,75,000 miles. All engines are pooled and the maximum link mileage for passenger and express trains is in the region of 8,000 miles per month. Locomotives are not brought into the Shop (except for accident and special repairs) between periodical overhauls, as all maintenance repairs are now carried out in the Running Sheds which are equipped with proper facilities, such as Machine Shop, Drop Pits and Electric Hoist, etc.

A striking feature of the Khargpur Shops is the Belt System of Repairs. This system is the only one of its kind in any railway workshop in India. Introduced in 1928, the system has been responsible for reducing the repair-time of a locomotive to only 18 working days from the 16-week systems in 1923.

During the first Five-Year Plan, the Locomotive Workshops at Khargpur had no specific targets to contend with. The main problem was to rehabilitate the stock which was in a very poor state of repair following the ravages of War and the vicissitudes of Partition. During the post-war years, the South Eastern Railway was allotted new types of engines. And it was a problem to find additional accommodation in the Erecting

Expansion Work of this Erecting Shop in Progress at the Khargpur Workshops.