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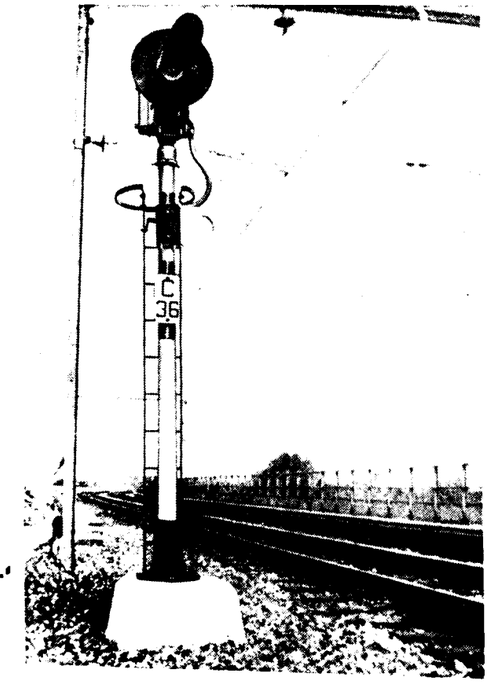
SIGNALLING & TELECOMMUNICATIONS SUPPLEMENT



THE INDIAN RAILWAYS WORKSHOP MAGAZINE

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CONTENTS

ELECTRIC LAMPS

THIS History of Electric Lamps dates back to the time of Alwa Edwin Edison (1879). As a result of his repeated Researches he was able to produce the Incandescent Lamps making use of Carbon Filaments achieving a life of about 500 hours. Ever since that time, the Industry has developed with new improvised Techniques making larger production with increased light out-put, all such lamps giving 1000 hours of burning life.

The principle of Electric Lamp is fairly simple. With the Electric current passing through a metallic wire it results in heating and the matter is raised to incandescence. It is this light out-put which a lamp engineer attempts to conserve to simply increasing the efficiency of the lamps, other qualities being equal. It is therefore apparent that the high melting point of Tungsten (3400 Deg. C) has a very important advantage in the economic production of light. Though Tungsten is ideally suited as a filamentary body, the technique of drawing the material into a thin wire involves the entire engineering skill at command. The Wolfram Ore is crushed and brought to a powder form. This powder is pressed into a small bricket and these brickets are pressed into bars (10 × 20 mm. Square) and from 8 × 24" in length. The strength of the bar is increased by heating it in hydrogen. These bars are further subjected to a treatment known as "Sintering". The sintered bars are further subjected to a process "Swaging" where very rapidly rotating hammers around the axis of the tungsten rod convert tungsten into thick wires. These thick wires are passed through Diamond Dies through special lubrications to various required sizes and these are called drawn tungsten wire. Tungsten while it is yet in powder form it is customary to add certain Oxides so that the growth of the crystals can be controlled to maintain the luminosity. It is at this stage various grades of wire are developed meant for various types of lamps depending upon the efficiency of the lamp required.

Simultaneously the tungsten filaments a special wire was devised so that it could be pinched into a glass

making it vacuum tight. Such an economical alloy is "dumet". This revolutionist in working out the cost of the Lamp production.

It was found that if the filament inside the lamp was subjected to an increased pressure it could be operated to a higher temperature for the same wattage and in consequence the Gas-filled lamps were developed. The straight wire that was used in the vacuum lamp had to be redesigned into a single coil or coiled coil as the case may be to minimise the loss of heat by way of convection when it was surrounded by gas pressure inside the lamp. Needless to mention that the gas must be inert in view of the high temperature of the filament inside the lamp. Hence, normally Argon and Nitrogen are the chief Gases required in this Industry. Sometimes, "Helium" and "Xenon" gases are also used to get higher efficiency lamps in special cases. Each of these inert gases in various proportions at various pressures inside the lamp exhibit special characteristics in luminosity and every Factory has its own special proportions. Inspite of such improvised techniques in Lamp Engineering, it may appear strange that in a 100 W. Incandescent Lamp, the Lamp Engineer has utilised about 12% of the input energy while 88% is converted into heat and removed from the lamp by radiation, by evacuation and by conduction.

PRODUCTION

The first stage during manufacture is Stem Making. The two Electrodes, the evacuating glass tube, the flare and the cane are alligned properly and they pass through a process wherein a vacuum is made at the Dumet. At this stage a small bore is made at the pinch to facilitate evacuation at the Exhaust. These stems are passed on to the Anchroing Machines where a small button is made at the tipe of the cane and the Molybdenum Wire is inserted. It is very interesting that small lengths are cut and at the end of each the pig-tail hooks are made at a fairly fast rate at the automatic machines. These Machines are designed to accommodate from 1 to 23 supports depending upon the type of the lamp. These anchored stems pass on to the Mouting Mill where the filaments are automatically packed up, clamped and mounted. Generally such mouting mill is very costly and hence it is the normal practice to use leg-operated mechanical Clampers engaging more Operators. This is typically suited for our Indian conditions, where unemployment is a problem in our country. Moreover, even for lesser labour we are fortunate to get more intelligent and skilled labour in our country. For this delicate process girls are specially suited.

The mounted stem passes on to the Sealing Machine wherein the Bulbs are sealed to the Flare and the extra cullet is automatically removed and the sealed bulb passes on to the Vacuum Pumps. At this stage of Exhausting, the Lamp passes through a heating temperature and simultaneously suction is going on. In this process all the gases from the glass walls are released and pumped out. After a sufficient high degree of vacuum is attained, the inert gases are filled in and finally the exhaust tube is sealed off automatically. Now the lamp is ready to receive the Brass Caps. This is the finishing stage where the Brass Cap with a thin ribbon of the bakelite cement at the neck will be fitted and subjected to baking. This will result in glass to melt still and finally they are soldered at the eye-let and outside. It is the commercial practice to give a coating of Red Phosphorous on the filament itself before it is sealed. After finishing of the lamp, the lamp is lighted up in very low voltages so that the phosphorous may get pulcerated into small highly reactive particles and as a result electrically charged. In such a condition, the highly reactive phosphorous will absorb the extraneous matter within the lamp. This process being a surface absorption is call as "Absorption". This pressure comes from high vacuum and the process is called "Flash Ageing".

The Day's production undergo systematic check-up at regular intervals at the Photometry. These lamps at present are being designed for the British Standard Specification, the normal average life being 1000 hours. It is important that every process during manufacture must be regorously controlled and inspected. Periodically sub-standards are got from the authorised Testing Laboratories so that the production is standardised for its uniformity and high quality.

PRESSING METAL POWDERS INTO SHEET

A horizontal rolling mill that compacts metal powders directly into sheet and strip, and which can be converted into a vertical 2 high/4 combination mill, has been introduced by Stanat Mfg. Co., Westbury, L. 1. The mill produces ferrous and non-ferrous materials in widths upto 7 inches, and thicknesses ranging from 1/32 to 1/8 inch. They can be used for hot or cold rolling.

CUTTING WITH OXYGEN

By A. L. Chappell,

Export Manager, HANCOCK & Co. (Engineers) LTD.

OXYGEN cutting of steel is very much an accepted technique these days but not so many years ago it was quite another story.

The process was born in the early years of this century and its first recorded use is said to have been by burglars who used it to open a safe in a London post office in 1906.

By the time the first world war had come and gone, hand cutting was established for the rough severing of steel but the industrial possibilities of mechanised oxygen cutting were appreciated by few. The early tendency, resulting partly from metallurgical apprehension and partly from ignorance of the potential accuracy of the oxygen cutting jet, was to use the process for roughing out, leaving generous allowances for subsequent machining.

Hancock & Company (Engineers) Limited pioneered the use of oxygen cutting machines in England. As is always the case with a radically new technique the common reaction was that it was too good to be true. Every machine sold had to be demonstrated first.

In the archives of Hancock & Co. are letters from early users of oxygen cutting machines, which are of historic interest. Engineers speak of jobs which recently meant hours of laborious machining, but which are now being performed in a fraction of the time and at a fraction of the previous cost, by oxygen cutting.

Today the modern oxygen cutting machine is a precision tool in the fullest sense. Strangely enough however the engineering industry as a whole is only now beginning seriously to exploit the accuracy and high productivity potential which has been inherent in the best types of oxygen cutting machine for many years.

It is proposed to give below in a little more detail some fact and figures about (1) accuracy, (2) productivity and (3) the best types of machine.

ACCURACY

The first point to make is that hand cutting and machine cutting have little in common as far as accuracy is concerned. Top class oxygen machine cutting today is concerned with accuracies measured in thousandths of an inch. A modern shipyard using flame planing equipment such as the Hancock Hancoplane shown in Fig. 1 for cutting double bevel and nose preparation on the edges of ship's plates will not expect the edge of the nose to deviate by more than .01" from the straight over distances of 30 or 40 feet. In fact the use of automatic welding

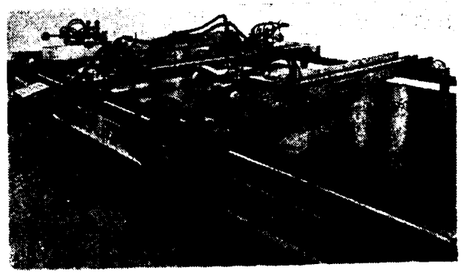

Fig. 1
Hancoplane Flame Planing Machine.

Fig. 2
Multiple cutting on a Hancomatic HM. 4.
The main rails are 60 feet long and shapes up to 10 feet wide can be cut. The machine has two 6-burner carriages and each is equipped with automatic electronic tracing.

techniques often predicates a maximum permissable gap between the edges of two adjoining plates of not more than 1/32". In at least one British shipyard using flame planing to prepare simultaneously all four edges of a plate 30' x 10', the 30' edges are being consistently cut with a maximum deviation from the straight of .060—.080 inches.

In profiling of shapes it is today generally the rule to cut to finished size with no subsequent machining. The actual accuracy achieved depends on the size, shape, and thickness of the work but this would, in virtually all cases be adequate for top quality welding.

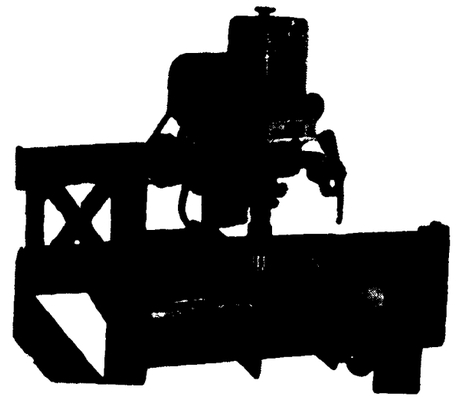

Fig. 3
Close up of Universal Tracer Head, showing hand guided small diameter roller drive in action working from a wooden template. This device is particularly useful for intricate shapes which can not be followed by the larger diameter roller necessary with the magnetic drive.

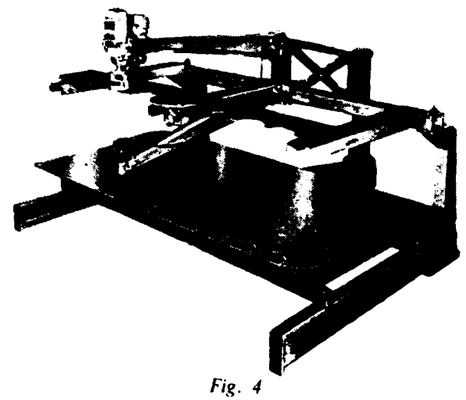

Fig. 4
Hancomaster Machine profiling from a large metal template using magnetic drive. Note the use of the auxiliary arms to support the ends of the large template.

Accuracy is of course a relative and not an absolute factor. High accuracy calls for a good modern machine intelligently supervised, operated with skill and commonsense and well maintained. Where accuracy of a lower order is sufficient it will be economical to employ a cheaper machine and less skilled labour.

PRODUCTIVITY

The possibility of attaining the highest rate of output at the lowest cost depends basically on the design and papabilities of the oxygen cutting machine. This aspect is dealt with in more detail below under the heading "The best types of oxygen cutting machine".

As present the average machine is actually cutting for little more than 20 minutes in the hour. The rest of the time is taken up with plate handling, stopping and starting and setting up. The intelligent use of mechanical handling equipment such as roller conveyors or fork lift trucks alone, can in many cases increase cutting time beyond the 50% mark. Simple jigs and fixtures for positioning can further contribute.

Pre-preparation of templates or drawings, proper supervision of cutting speeds, oxygen pressures, jet size and general procedure will all help towards achieving the right output-accuracy-cost balance. A detailed study of the ramifications of productivity in this field would embrace many aspects of shop and factory organisation which are beyond the scope of this brief survey.

Stack cutting is a method of mass-producing thin profiles by tightly clamping together a number of plates and cutting them as if one solid plate was involved. The technique is quick and economical on suitable jobs; it enables thinner plates than normally possible to be cut, with clean and accurate results. It could be used more extensively.

Multiple cutting by means of a number of individual burners mounted on one machine is a highly popular technique for increasing output. It is as effective as it is spectacular as can be seen in Fig. 2.

In brief productivity calls for the use of the right machine in the right way and in a pattern of intelligently organized production. The machines themselves are considered below in greater detail, and it will be readily appreciated that these modern machines have many features to encourage the fabrication engineer in his efforts to increase production.

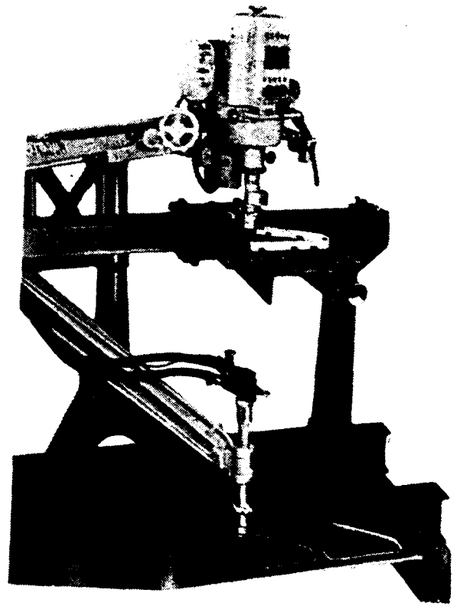

Fig. 5
Hancomaster machine working automatically from aluminium strip template.

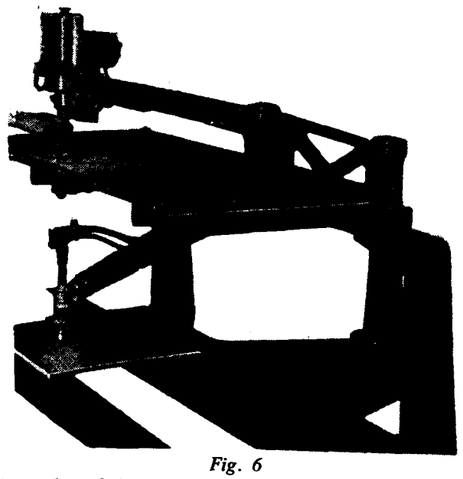

Fig. 6
Hand guided drive tracing direct from a drawing.

THE BEST TYPES OF OXYGEN CUTTING MACHINE

An important factor in good quality oxygen cutting is the maintenance of constant speed. The best oxygen cutting machines do not have speedometers, because their speed once set does not fluctuate. Speedometers are only necessary where speed can fluctuate and are normally found only where speed is controlled by rheostats.

The best type of speed control for most types of profiling machines is undoubtedly mechanical. It is utterly precise in operation and also the most reliable system from a maintenance viewpoint.

Fig. 3 shows a close up of the Universal Tracer Head which is used on Hancock Hancomatic and Hancomaster profiling machines. The handwheel on the right hand side of the Tracer Head is used for setting the speed. The drive, through an infinitely variable gear ensures precise maintenance of the exact speed indicated by the pointer and dial on the front of the Tracer Head. The UT.4 uses a constant speed motor which requires neither commutator nor brushgear when used on A. C. supply.

This Tracer Head can use any one of four different types of drive each interchangeable in a matter of seconds and enabling the machine to work from templates of wood, steel or aluminium strip, or direct from a drawing by hand guiding. (See Figs. 3, 4, 5 & 6). The ability to work from a drawing is particularly valuable where short runs or one-offs are concerned.

THE HANCOMASTER U-ARM MACHINE

The Hancomaster is a comparatively cheap machine which has however many sophisticated features. Amongst these is the grouping of all controls on the upper arm adjacent to the Tracer Head, including remote control of the burner valves and also remote burner height control.

Another outstanding feature is the moveable template carrier shown in Fig. 7. This device enables rapid setting of the template along the same axes as the plate being cut. Its contribution to the rapid production of small profiles can be quite phenomenal.

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 publication in 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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I, S. M. Sivaprakasam hereby declare that the particulars given above are true to the best of my knowledge and belief.

(Sd.) **S. M. Sivaprakasam**
Signature of Publisher.

In the case of one British factory a Hancomaster was recently installed to replace a machine of the type equipped with a radial template arm. The older machine had been used for years to profile standard sets of parts. The cutting time for six sets of parts on the older machine was 25 hours. The new Hancomaster machine in the hands of the same operator was turning out six sets in 10 hours twelve days after it was installed.

It is worth mentioning that the Hancomaster U-3 with a cutting area of 80" × 40", maximum circle 52", offers users a capacity generally obtainable only on the more expensive types of dual carriage machine.

Fig. 7

Moveable template carrier on Hancomaster Machine. Note the facility of setting along the axes of the plate being cut. Rapidity of setting is greatly enhanced by the absence of any radial component in adjustment, which also assists in obtaining maximum number of workpieces per plate with minimum scrap.

Fig. 8

Hancomatic Dual Carriage Machine equipped with solenoid gas control valves and optical tracing device.

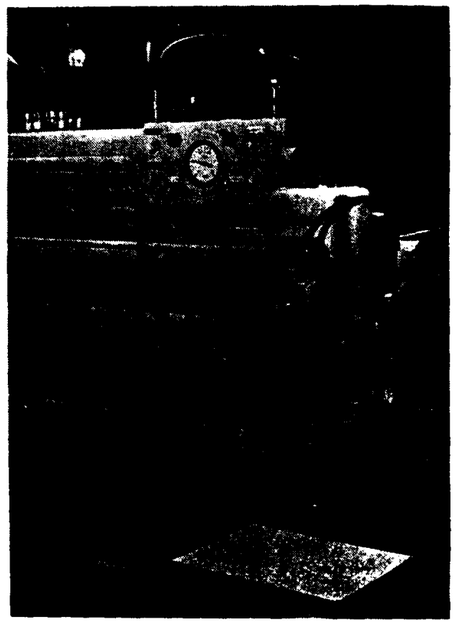


Fig. 9

Close up of controls of Hancomatic Machine and optical tracing device. Switches and warning lights for the solenoid gas control valves can be seen on the control panel. Virtually all controls are electric and are duplicated on a further panel at the burner end of the machine.

HANCOMATIC DUAL CARRIAGE PROFILING MACHINES

This machine illustrated in Fig. 8 & 9 is manufactured in a wide range of sizes shown in the table below:

TYPE		HM1	HM1A	HM2	HM2A	HM2B	HM3	HM4
Cutting Area	Width	40	40	62	62	62	80	120
	Length	40	90	40	90	120	120	120
Largest Circle		40	40	40	60	60	80	120
Thickness of material		UP TO FIFTEEN INCHES						

The length of the cutting area can be extended in multiples of 6 ft., 10 ft. and 13 ft. 3 ins.

In addition to the four standard alternative drives for use in conjunction with the UT. 4 Tracer Head, many Hancomatics are supplied with a fully automatic electronic tracing head which operates from a full size black and white drawing or silhouette. The electronic tracer drives onto a roller geared to the bottom carriage of the machine and there is therefore no physical contact with the drawing.

Hancomatic machines were the first in Britain to be equipped with electrically operated gas control valves. These simple and quick acting valves are capable of feeding up to six burners or of passing the large volumes of gas required to cut steel up to 15" thick. Standard machines are equipped with multiple gas outlet manifolds so that additional burners can be fitted at any time without modification to the machine.

Virtually all controls are electric and grouped on duplicated panels so that the machine can be operated from either the burner or tracer end. These controls include electric switches for the solenoid gas control valves and warning lights are fitted to show when valves are on and passing gas.

The simplicity of the tracing system is a noteworthy feature for a machine of the size and scope of the

Hancomatic; it is characterised by the absence of electronic devices to ensure accurate speed and by the fact that all the alternative drives can be fitted to the Tracer Head without the use of complicated and expensive intermediate gearing units.

For accurate cutting the alignment of the main rails of large dual carriage oxygen cutting machines is vitally important. For this reason the Hancomatic main rails are mounted on robust fabricated stands which tie them rigidly together.

PORTABLE MACHINES

A portable machine is of great value in most fabrication shops for trimming and slitting plates to size for the larger machines or for the simple routine of circle cutting.

The Circaline machine shown in Fig. 10 is a robust machine of this type which is built to the highest precision standards and not down to a price. It is driven by a constant speed motor through an infinitely variable gear and because of its very precise speed control it is frequently adapted to carry certain types of welding head.

The Circaline is also capable of carrying a triple burner flame planing attachment and runs either along a length of special machined track or on a standard 6" rolled joist.

LOOKING FORWARD

Fabrication engineers in many fields are taking increasing advantage of the productivity potential which the best types of oxygen cutting machine have built into them.

In shipbuilding, in the railway workshops, and the heavy electrical industry there is a close liaison between these engineers and manufacturers of oxygen cutting machines.

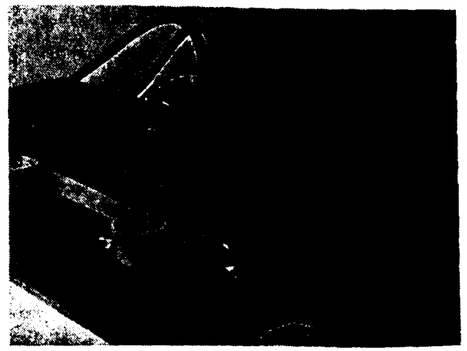


Fig. 10

Circaline Mark III portable machine set up to follow a curved steel strip template located by permanent magnets.

At the present time a period of significant progress lies ahead and this will inevitably see the fullest exploitation of the possibilities of automatic control systems in the heavy fabrication field. But side by side with these new machines and in smaller shops the conventional machines described in this article will continue to make their vital contribution for a good many years to come.

TREATING METAL UNDER HIGH PRESSURE

Soviet physicists have established that the strength and plasticity of metals sharply increase in a liquid at a pressure of 25,000—30,000 atmospheres, "Promyshlenno-Economicheskaya Gazeta" (Industrial and Economics newspaper), writes.

With the pressure removed, the solids regain their original properties. But it has been found experimentally that the plasticity and strength of certain metals, subjected to superhigh pressures, proved much greater even after the removal of the pressure.

Experiments lead one to visualise a probable method of metalworking in a superhigh pressured liquid. The rolling mill will, evidently, be housed in a special liquid filled reservoir. Metal, in addition to being rolled, will be subjected to a pressure of the order of 30,000—40,000 atmospheres to be created by powerful compressors. The metal thus produced will have much greater strength and plasticity than conventionally rolled.

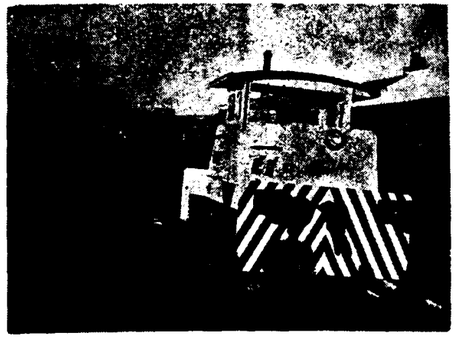
It has been found that high pressure wire drawing obviates that fragility which usually results from ordinary drawing.

The superhigh pressure physics laboratory of the U. S. S. R. Academy of Sciences has devised a number of machines to produce superhigh pressures. More powerful compressors for industrial use are to be developed in the very near future.

"THE YARDMASTER"

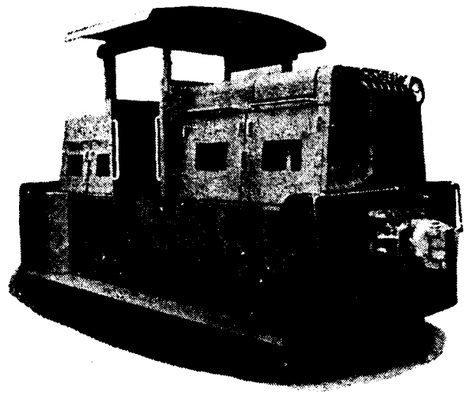
THIS latest "Hunslet" design, the "YARDMASTER", robustly constructed throughout, and with exceptional simplicity of control, presents a "New look" in the field of the light industrial shunting locomotive.

Apart from the usual seated driving positions at both sides of the cab, the locomotive can be handled by finger control from the steps at either side, thus obviating the need for the Driver to climb up and down when performing shunting operations, such as changing points and attending to wagon couplings. During busy periods, the Driver can in fact carry out all his duties at just above rail level, standing on the shunting platforms, and having the controls within easy reach. This "step on step off" feature considerably speeds up shunting and greatly reduces driving fatigue, especially during peak periods. The "YARDMASTER" is of neat and attractive appearance, enhanced by the central position of the cab. Visibility from the cab is excellent, the Driver's field of vision being unobstructed by central supports by the fitting of one-piece windows at the front and rear. The cab can be either of the open type or fully enclosed, and fitted with cab heaters according to site requirements.



Hunslet 71 HP. "Yardmaster" Diesel Hydraulic Locomotive. (4267)

The locomotive is powered by a Gardner 4LW or Dorman 4LB water cooled diesel engine developing 71 B. H. P. at 1,700 r. p. m. The engine is started by means of an electric starter motor mounted on the engine. Transmission from the engine is through Layrub couplings to the "Hunslet" torque converter unit and two speed gearbox. The torque converter is of the simple single stage type. It's use provides an exceptionally smooth start from rest with a tractive effort limited solely be the adhesive weight of the locomotive. Ample tractive effort is also available for acceleration up to full speed in each gear.



Hunslet 71 HP. "Yardmaster" Diesel Hydraulic Locomotive. (4274)

The gearbox is of the constant mesh type, robustly constructed to give long and trouble free service. The gearbox and torque converter unit are manufactured as a single assembly to ensure that perfect alignment is maintained. In view of the fact that the "YARDMASTER" has been designed for exceptional simplicity of control, ease of gear selection has received special attention. The selector lever which can be operated by finger pressure operates a hydraulic control valve which directs oil pressure to the particular gear clutch selected. These clutches are of the multi-plate type having sintered metal face linings for long life. Considerable time has been spent over their development to ensure complete suitability and reliability for locomotive operation. The advantages of this clutch are that due to hydraulic operation it is very light to operate, the time taken in changing gear is negligible. and above all it is unnecessary for the operator to synchronise the shaft speeds as this is performed automatically by the clutch.

The Westinghouse straight air brake and a powerful screw hand brake operate through cast iron brake blocks on all four wheels. The air supply is maintained by a Reavell T. B. C. 12 compressor.

Sanding gear is of the gravity feed type with four sandboxes. This is provided mainly to assist braking as the torque converter enables extremely good adhesion to be obtained even under adverse rail conditions.

The principle dimensions etc., are as follows :—

Rail gauge.	Metre—3′ 6″—4′ 8½″
Diameter of Coupled Wheels.	2′ 9″
Wheelbase.	5′ 5″
Height Overall.	9′ 6½″
Width Overall.	8′ 0″
Length over Buffer Beams.	13′ 3½″
Speed 1st Gear in either direction.	5 m. p. h.
„ 2nd „ „ „	10 „
Fuel Capacity.	75 gallons.
Weight in Working Order.	13 tons or 15 tons.
Maximum Tractive Effort 1st gear (Limited by Adhesion).	8,800 lbs. or 10,200 lbs.
Tractive Effort 1st gear at Maximum Speed.	4,000 „
Tractive Effort 2nd gear at Maximum Speed.	2,000 „
Ratio. Adhesive Weight ÷ Tractive Effort.	3.3 to 1.
Minimum Radius of Curve Engine will traverse with ease.	60 ft.
Weight per yard of lightest rail advisable.	35 lbs.

Print No. 4267 shows a locomotive fitted with a Dorman 4LB diesel engine in service at Yorkshire Imperial Metals, Ltd., Stourton, Leeds. The locomotive illustrated on Print No. 4274 was supplied for service in Southern Rhodesia. This locomotive is powered by a Gardner 6LW diesel engine derated to 71 HP. to suit site conditions.

SHRI KARNAIL SINGH VISITS INTEGRAL COACH FACTORY

Shri Karnail Singh, Member, Engineering, Railway Board, New Delhi, recently inspected the Integral Coach Factory, Perambur. His visit also coincided with the ceremony of the inauguration of the sixth and lost assembly line scheduled to go into production in the Main Assembly Shop on January 9th.

Regretting at the outset that he could not address the gathering in Tamil, Shri Karnail Singh said that the making of Integral Coaches in India was a fine achievement. But, he added, even greater than this achievement was the acquisition of confidence of the workers of I. C. F. that they can "fashion metal sheets into anything that is required." He congratulated all the workers and the officers from whom they had received direction for their fine work at Perambur.

After seeing the fine workshop at Perambur, Shri Karnail Singh said, it was a great pleasure to see the "inner happiness and the brightness so far as the human part of it is concerned." And in so far as the work part is concerned, I can see in the hands and the eyes of the workmen at the machines, the confidence, with which you all are either handling the electrodes or pressing sheets through straightening machines or doing any other type of work.

Earlier Shri K. Sadagopan, Chief Administrative Officer, in his introductory speech said it was a great honour to welcome Shri Karnail Singh whose "dynamic ability, leadership and personality" was reflected in the attainment of the most impressive production record of locomotives at the Chittaranjan Locomotive Works—when Shri Karnail Singh took charge of it.

* * *

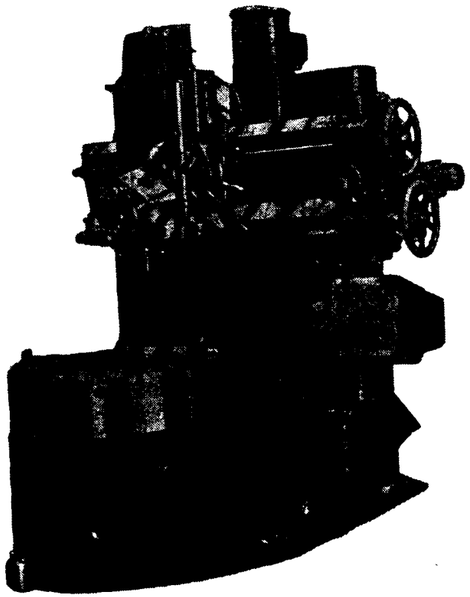
JAPANESE RAIL ENGINES—INDIA PLACES ORDER

The Railway Board have placed an order for 10 broad-gauge electric A. C. type locomotives with a firm of rolling stock manufacturers in Japan.

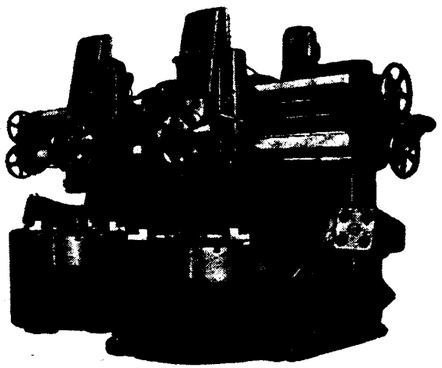
A feature of the contract is that deferred payment terms have been agreed upon by the firm concerned.

The total value of the order is in the neighbourhood of Rs. 98 lakhs.

The Railway Board have also placed an order with another Japanese firm for the supply of spare parts for metre-gauge rail cars, which are already in service.



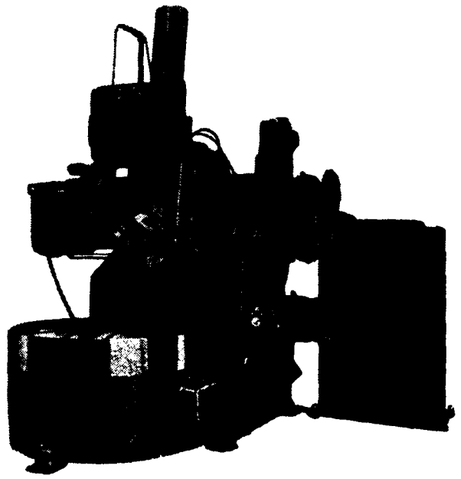
36" Single Series DH Vertical Boring and Turning Mill.



48" Duplex Series DH Vertical Boring and Turning Mill.

of which is available to our customers throughout the world.

India has always been one of the firm's most highly esteemed customers. Conversely the Webster & Bennett Boring and Turning Mill has made a definite contribution to Indian industry, particularly



60" Series DH Vertical Boring and Turning Mill with built-in Electronic Profile Turning Equipment.

to the smooth and efficient running of the Indian Railways. The machine has come to be regarded as a standard tool both in the Production and Maintenance shops of many Railway organisations because it is ideally suited to the machining of Railway Wheels and Tyres, Axle Boxes, and Piston Heads and Rings, all apart from the fact that it is a general purpose machine of a very high order.

The machine is built in 3 standard sizes with a chuck diameter of 36", 48" and 60", and Duplex Mills are available in the 2 smaller sizes. It is of solid build, and consequently the best use of carbide tipped tools may be made resulting in heavy cuts being possible. It should not be forgotten however, that it is equally efficient and economical when employed in machining non-ferrous metals. All the main controls are hydraulically operated giving the operator complete control of his machine whilst calling for the minimum of physical effort on his part.

Various types of attachments can be supplied with the Boring Mill and include Screw Cutting, Taper Turning and Taper Generating Attachments, and two types of Profile Copy Beams.

Electronic Profile Copying Equipment is also available on all sizes of machine. This equipment is not supplied as an attachment but is built into the machine in such a way as to allow the machine to be used as a tracing or a manually controlled tool as required. Machines thus equipped are ideal for the manufacture of tyre moulds, dies or any other components of intricate profile. The accuracy both of form and of repetition of size is of a very high order. Under ideal test conditions repetition of size within .00075" on diameter has been obtained, though this limit is not guaranteed since the nature of the work material, the depth of cut and the likelihood of tool wear have to be taken into account.

In order to produce a good quality, reliable machine-tool at relatively low selling price, the best manufacturing techniques have to be devised. To this end Webster & Bennett have invested in new buildings and many new machine-tools of the latest design. Plans are well up to schedule for yet another capital investment scheme which will raise the current output by 17½% in 1959. This latest increase will mean that between 1946 and 1959 production will have risen by 60%.

Webster & Bennett are thus keeping well abreast of modern trends both of design and production methods and thereby are endeavouring to maintain a policy of rationalised and specialised production which will give quality machine-tools at relatively low prices.

All sales in India are conducted through the agency of Machine Tools (India) Ltd., with offices in Calcutta, Bombay and Bangalore.

HIGH FREQUENCY RESISTANCE WELDING

Applicable to aluminium as well as other metals, a resistance welding process which uses high-frequency power has been developed by New Rochelle Tool Corporation, in the United States, according to Iron Age. The process, known as the Thermatool welding process, utilizes two sliding contracts, one on each side of the seam, which convey H. F. current to the abutting edges. Pressure rolls then force the edges together to complete a forge weld. Tubing passes through the mill in the open-seam condition until it reaches the pressure rolls, where the edges form a triangle upon approaching the pressure rolls. The current contacts are just ahead of the rolls. H. F. current passes through two paths as though they were connected in parallel. Current from one contact flows around the back of the tube to the other contact, which is the route of high inductance, while current from the second contact takes a V-shaped path along the tube edges to the first contact, this being the path of lower inductance. A current frequency of 450,000 cycles/sec. is used. Direct heating is, therefore, confined to the abutting surface areas, which causes the metal on these edges to reach welding temperature before the rolls apply pressure. The edge heating effect of the H. F. current permits the use of lower current than with 60 cycle to achieve the same results. The capacitative action of the H. F. current eliminates the necessity of cleaning to remove the oxide film on the abutting edges of the seam. Aluminium tubing of 1 in. outside diameter, 0.049 in. wall thickness, can be welded at 225 ft./min., and 6 in. outside diameter aluminium tubing of 0.062 in. wall thickness can be welded at 113 ft./min. The process is applicable to strip materials, tapered tubes, and in welding tapered tubes and strip to tube, and similar applications. The metals which can be welded with the same equipment, with no adjustment except heat control, include : copper, galvanized steel, mild rolled steel, etc., as well as aluminium alloys.

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MECHANISM OF PROCESSES OF ELECTROPOLISHING

The process of smoothening the microreliefs of the surface is defined as electrogrinding and is differentiated from electropolishing which is characterized by the formation of bright, reflective surface. The former functions by the difference in the solubility rates at the high and low points of the surface topography, whereas the latter is independent of the initial roughness of the surface and functions primarily through the formation of an oxidized anodic film.

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ALUMINIUM BEARING ALLOY

An aluminium-silver-lead alloy has been found to have excellent anti-friction properties, both in the laboratory and in working practice. Alloys of two different compositions were tested under the severest conditions. The harder alloy can be used to replace bearings made of brass and the softer alloy can be used as a soft bimetal bearing. Both alloys are easily cast, extruded and machined.

The Newall Model 2436 MK. II Production Jig Borer

EXTENSIVELY employed throughout the world in factories associated with production of railway power units, aircraft, automobiles, and in general engineering workshops, the Newall 2436 jig borer has been developed as a dual purpose machine tool. Firstly, its guaranteed high accuracy performance complies with precision requirements of the toolroom and making jigs and fixtures; secondly, design considerations make it possible to maintain toolroom quality when employed in its contemporary role on batch production or prototype work under normal shop working conditions.

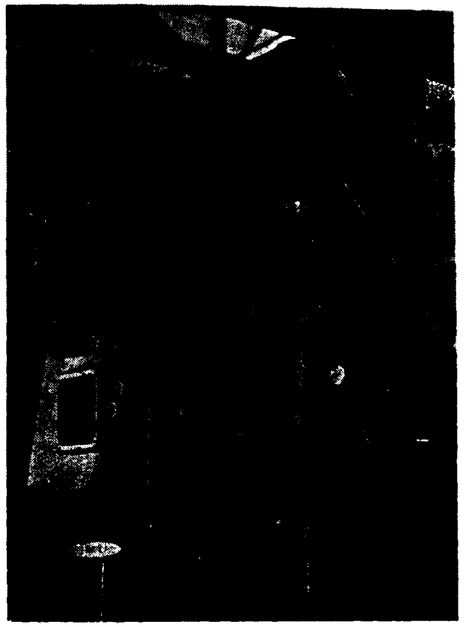
The principle design features which have made this possible are the feed box, generously proportioned to eliminate possibility of spindle deflection; a large diameter quill and spindle assembly to provide tool rigidity under all working conditions; rapid tool changing and positive tool location; centralised and fool proof controls.

Details of the more important structural features are as follows :—

SPINDLE BEARINGS

The demand for high spindle speeds and infinitely variable range of speeds, coupled with maximum rigidity and running accuracy of the spindle, are fully met in the Newall '2436' Jig Borer through the advanced design of the quill and spindle assembly, incorporating rolling bearings lubricated by an oil mist system. Developed after considerable research and practical experiment in close co-operation with S. K. F. of Sweden, the spindle runs in S. K. F. 'ULTRA PRECISION' races of such superlative quality that it is rare for errors of form or dimension in excess of ¼ micron. (.00001") to be found in tracks or rolling members.

A roller bearing is used for journal loads because of its higher rigidity, load-carrying capacity and life over those of a ball bearing, and a parallel roller bearing is employed because it is free from sliding friction on the ends of the rollers, thereby ensuring the highest possible efficiency; the thrust loads are taken by flat thrust ball bearings. Apart from the higher efficiency that results from this design, any wear which may take place in the thrust bearings due to heavy drilling loads has no effect on the radial running accuracy of the journal bearing, as may happen if a single bearing is used to perform both duties.



Close-up of the feed box emphasises sturdy construction and centralisation of controls for spindle speed and movement.

In order to eliminate bearing slackness and increase spindle rigidity pre-loading of bearings is desirable; to accomplish this the S. K. F. double row cylindrical roller bearing employed has a comparatively thin inner race, having a tapered bore and by forcing this up the tapered seating on the spindle any required degree of preload, generally about 0.00008" diametrical interference, can be obtained. Slight preload is applied to the ball thrust bearings to ensure axial rigidity of the spindle.

U. S. LOAN FOR INDIA'S IRON ORE PROJECT

An agreement for a 20 million dollar American loan to India to finance the foreign exchange component of an Indo-Japanese joint project to develop iron ore mines in Orissa was signed in New Delhi.

Under the agreement the U. S. has allocated 20 million dollars from the U. S. President's Asian Economic Development Fund to meet the foreign exchange component of the project. The project is to develop the iron ore mines in the Rourkela area of Orissa, construct a new railway line from Sambalpur to Titlagarh and improve port facilities at Visakhapatnam in order to increase the export of iron ore from India to Japan. When the project is completed it will enable the export of 2,000,000 tons of iron ore from India to Japan.

The loan is repayable in rupees in 31 half-yearly instalments beginning three years after the disbursement of the loan and will carry an interest of 3½ per cent per annum.

The U. S. Congress set up the Asian Economic Development Fund in 1955 with a view to helping projects for economic development in Asia in which more than one country would be interested.

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JOINING NON-FERROUS METALS

Chemical ion exchange between pieces of similar or dissimilar non-ferrous metals is the basis of an entirely new jointing technique by Intertectics Inc., Bedford, Ohio.

The process employs new complex chloride Compounds called InterAct. Under the influence of heat, InterAct reduced the surface oxide layer through reaction and causes the surfaces to flow together by creating an inter-surface eutectic solution. Joining takes place at temperatures below the melting point of either metal, joints in most cases are stronger than the parent metals, electrical, physical and chemical properties remain substantially unchanged in the joint area, and the corrosion resistance of the joints is equal or superior to that of the metals joined.

There are three forms, InterAct-S, composed of the chlorides of zinc, lithium, potassium and sodium, and encased in a tube of extremely pure alloy of zinc and aluminium, which is then drawn down to ⅛ in. diameter 'wire' which is normally sold in 18 in. diameter coils weighing 104 lb. It is for T joints, butt joints and other exposed junctions. The material is also available in powder or granule form. InterAct-E is similar in composition, sold in 10–100 lb. bags, is for broader areas, and InterAct-G, a different composition (aluminium trichloride, zinc chloride and sodium chloride), for foil.

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EFFECT OF SMALL ADDITIONS OF COPPER AND ZINC ON THE MOSAIC STRUCTURE OF ALUMINIUM CRYSTALS

Samples of 99.995% aluminium were alloyed under 10^{-4} – 10^{-5} mm. Hg. pressure with 0.05% Cu and in air with 1.5% Zn. After rolling, monocrystals of the former were grown in vacuo and of the latter in air. X-ray determination of the angle of mosaicity and the size of mosaic blocks gave 32.4′ and 24.3′ angle for pure aluminium treated in vacuum and air; for Al-Cu alloys the average angle was 44.9′ and for Al-Zn alloy it was 45.9′, and the block size for pure aluminium in vacuum was 10^{-2} cm. min., and for Al-Cu alloys 10^{-4} to 5×10^{-5}. Al-Zn alloy blocks measured 10^{-3} to 10^{-4} cm.

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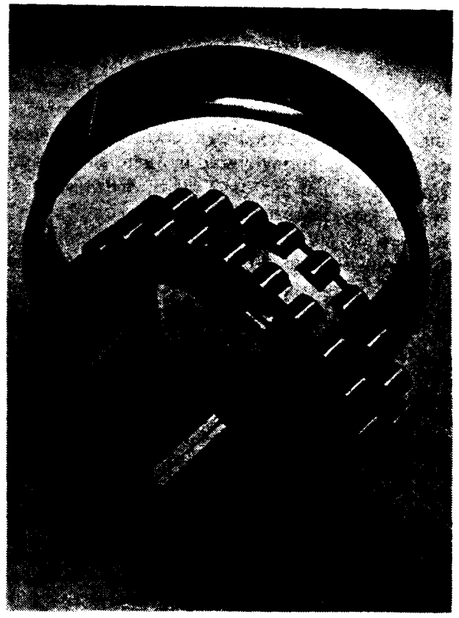
BONDING TIN ALLOYS TO STEEL

The report of last year's work of the Tin Research Institute indicates that all departments were actively engaged in pursuing new ideas and developing fresh applications for tin. A notable achievement was the publication of a method of producing electroplated deposits of tin in a fully bright form.

The Institute's invention of a method of bonding aluminium-tin-bearing alloys to steel has now reached the commercial stage of development and thousands of cars have already been fitted with the new type of bearings. Organotin compounds were investigated for a great variety of purposes during the year and a notable use appears to be developing as a fungicide in agriculture.



S.K.F. Ultra precision, double row cylindrical roller bearings employed in the quill and spindle assembly.

SPINDLE AND QUILL

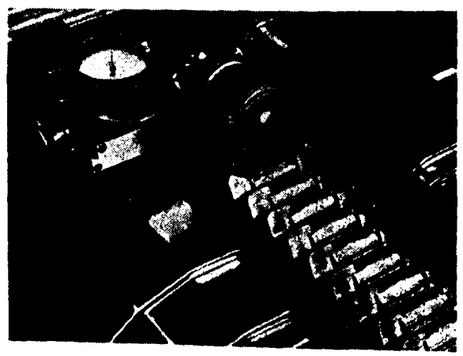
It will be apparent that if the full advantage of the superlative accuracy of these bearings is to be gained, the accuracy of the bearing seatings on the spindle and in the quill must be of the same order, and to this end The Newall Engineering Company has installed special equipment for manufacturing and checking these components. Both spindle and quill are manufactured from Nitralloy steel, hardened, ground and super-finished where necessary; the quill has a main body diameter of 4½" (114 mm.) and the diameter of the spindle in the lower journal bearing is 2⅝" (67 mm.). The spindle nose has a special 10° included angle taper bore and a captive nut, a quarter turn of which serves both to clamp and extract tools.

The quill and spindle of the Newall 2436 jig borer.

Two drive slots of unequal width in the end of the spindle ensure that tools are always inserted in the same rotational position so that accurate repetition of successive bore sizes can be attained. Either a sleeve with No. 4 Morse taper bore may be used or heavy boring and milling equipment may be inserted direct in the spindle nose.

Drive is by steel cored endless Vee belts through a three-speed gear box from a steplessly variable speed D. C. motor giving a constant torque output with a top speed of 3,000 r. p. m. at 4 h. p. Supply for the motor is derived from an A. C./D. C. generating set with static compensation gear to keep speed constant between 'no load' and 'load'. Provision is made for the spindle speed to be reduced almost to zero for setting-up purposes.

Through a gear box four spindle feeds are obtainable up or down of 2, 4, 6 and 8 thousandths of an inch (.05, 0.10, 0.15 and 0.20 mm.) per revolution of the spindle; travel of the quill is 9" (228 mm.) and a limit switch prevents overrun of both up and down movements. Fine and coarse hand feeds are also provided. Electrical rapid traverse



Detail of the measuring system consisting of trays of precision lapped 1" rollers and micro locator. The former provide the main 1" measurings of the measurement system and the latter decimal parts of an inch down to .0001".

of the feed box is at the rate of 50" (1270 mm.) per minute.

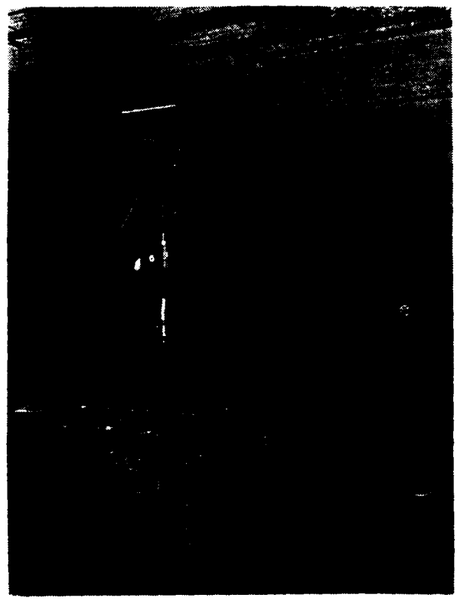
The feed box, manually clamped by a single lever, also incorporates a limit switch in the electrical circuit to prevent overrun.

A depth measuring unit for the accurate control of blind bores, etc., and for use during light milling operations, is built into the feed box.

TABLE

The table has an area of 24" × 36" (610 mm. × 914 mm.) with a longitudinal traverse of 24" (610 mm.) and a cross traverse of 18" (450 mm.), approximately ½" (12.5 mm.) overrun being allowed at each end of both motions. Movement of the work table in each direction for quick setting is by electrical drive, final setting, to size being effected by operation of respective hand wheels. Limit switches prevent the traverses being engaged whilst the table or cross-slide is locked Table positioning is by rollers of special steel hardened, chromium-plated, ground and lapped to 10,000" (25.4 mm.) diameter housed in precision ground channels between the longitudinal slide and the cross slide ways. In conjunction with these the Newall Microlocator is used, this unit consisting of a micrometer graduated by increments of .0001" (.002 mm.), the periodic error of which is within .00003" (.0008 mm.) and a dial indicator adjustably mounted on the machine table. By means of an inverted Vee on the base of its carriage the micrometer is located on the required roller, and as the table is moved by the handwheel the dial indicator spindle contacts the micrometer anvil.

Movement of the table is continued until the indicator hand registers between the two parallel lines on the dial face. It will be seen, therefore, that when setting the table to a new position, the main inch movements are obtained by moving the micrometer to an alternative position along the train of rollers, and intermediate measurements are obtained by means of the micrometer head, the thimble of which is of sufficient diameter to enable tenth of thousandths of an inch to be read directly and with ease. It will be seen also that whilst a bore is being machined at a particular setting the micrometer can be removed from



The Newall 2436 Mk. II Production Jig Boring Machine.

the rollers, set at the correct decimal reading for the next position and placed in the appropriate position on the roller train, effecting a considerable saving of time. With this system of table location the guaranteed limit of error on table settings is .0001" (.002 mm.).

CONTROLS

Special attention has been devoted in the design of the model "2436" Jig Borer to obviate operator fatigues, as a result all controls are centrally located and easily accessible.

Table traverse in both longitudinal and transverse directions is effected by application of push-button controls conveniently mounted on the base unit. Increase and decrease of the spindle speed, which is infinitely variable from 0 to 2,500 r. p. m., is controlled by a rheostat on the front of the base casting. Operation of a single control lever starts, stops and brakes the spindle; in addition, it is employed for releasing the drive clutch to permit rotation of the spindle by hand when setting-up. Positioned beneath the feed box is an octagonal control knob for quick action change of the four spindle feeds.

Selection of coarse and fine hand feeds or power feeds is obtained by operation of a single lever at the left-hand side of the feed box. Both coarse and fine feed handwheels have calibrated rings to indicate amount of quill travel; divisions on the former represent 1/16" and on the latter 1/1000". Machines designated for countries using the metric system are calibrated accordingly.

Rapid electrical traverse of the feed box is actuated by push-button controls.

The electrical control gear is contained in a metal cabinet which may be positioned to suit the convenience of the operator; a techometer indicating spindle speeds is mounted on the face of the cabinet. In addition, a generator set, with automatic compensation to hold the speed constant between 'load' and 'no load' at any speed setting over the working range, is supplied as a separate unit.

LUBRICATION

Lubrication of the table-ways, lead screws and gears connected to the table is effected by a hand pump located at the left hand side of the cross-slide; one depression of the pump lever gives adequate lubrication for a normal day's work. The gearbox and main drive are lubricated automatically by a pump driven from the gearbox and the feed mechanism is oiled from a reservoir in the feed box. Lubrication of the columns ways is by means of oil nipples.

For maximum efficiency an oil mist system is employed for supply of lubricant to the spindle bearings and a unit for this purpose is mounted on a hinged, louvred cover at the rear of the column. This unit consists of an oil lubricator, air filter, and pressure switch which prevents the spindle motor from starting unless the oil mist system is in operation.

The field of application of the Newall 2436 Jig Borer has recently been extended by the provision of milling feeds, steplessly variable in the range ¼" to 15" per minute. With this feature the machine is equipped for shave milling to a high degree of accuracy and surface finish, also for economic stock removal without detriment to machine accuracy.

SPECIFICATION

Capacity

Dimensions of table surface	24" ×36"
Longitudinal traverse of table	24"
Cross traverse of table	18"
Vertical feed motion of quill	9"
Vertical adjustment of quill head on column	14"
Maximum distance, spindle nose to table	32"
Minimum distance, spindle nose to table	9"
Distance from spindle centre to column ways	12⅛"
Distance from spindle centre to column throat	24"
Vertical distance from table to column throat	20½"
Table settings to	0.0001"

SPINDLE *(Double row cylinder roller bearing type)*

Morse taper in spindle sleeve	No. 4
Diameter of spindle in lower bearing	2⅝"
Diameter of quill in head	4½"
Spindle speed range, steplessly variable D. C. Drive through 3-speed gearbox	40 to 2,500 r. p. m.
Spindle speed for setting-up purposes	from 0 r. p. m.
Spindle motor H. P.	1.1 to 4½
Maximum drill diameter from solid, in mild steel	1½"

FEED AND TRAVERSE RATES

Rapid (electric) traverse rate of cross slide and table	90" per minute
Rapid (electric) traverse rate of quill head on column	50" per minute
Spindle feeds (4) in thousandths of an inch (and .001 mm.) per spindle revolution-up and down	2, 4, 6 and 8

GENERAL DIMENSIONS

Height of table surface above floor	33"
Overall height of machine	109"
Floor space required for machine only	95½" × 86½"
Floor space required for control cabinet	40½" × 28"
Nett weight	9500 lbs.

NEW PROCESS FOR POLISHING ALUMINIUM DEVELOPED BY N.M.L.

A new chemical process for polishing aluminium articles has been developed at the National Metallurgical Laboratory, Jamshedpur. This method, it is claimed, will not only cut down the cost of polishing aluminium, but is also expected to yield a degree of brightness not obtainable by mechanical and electro-chemical methods at present in use.

Mechanical polishing is, of course, the simplest and the cheapest method of polishing aluminium. Its major defect, however, lies in the fact that it cannot reach deep recesses of the article to be polished. Moreover, it does not give as high a degree of brightness as yielded by some of the electro-chemical processes. The electro-chemical processes in their turn, however, are handicapped by a high cost of operation which limits their range of application.

The chemical process now developed has been found to be free from these defects. Its extreme simplicity is its major advantage. The simplicity and low cost of this process lends it to easy adoption on a small as well as a large scale with great advantage.

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SANDWICH ROLLING

A new "sandwich" rolling process developed by U.S. Steel Corp. may be an answer to the aircraft and missile industry's weight-strength problems. The process already has demonstrated an ability to produce lightgauge stainless and alloy sheets up to 90 inches wide—nearly twice the width possible with conventional methods.

The new method consists of sandwiching stainless or alloy steel plates between two heavier plates of ordinary carbon steel. The sandwich is closed tight with welded-in-side and end bars. Then, it is heated and rolled to size.

Wheels & Axles for Modern Rolling Stock

By C. F. Ryan, M. B. E., A. M. I. Mech. E., M. I. Loco. E.

AS in so many other spheres of human activity, conditions under which railways have to operate are becoming steadily more arduous. The public is calling for higher standards of speed, punctuality and efficiency while, at the same time, the difficulties of operating railways economically are increasing. The design, manufacture and organization of every item and department must be carefully reviewed to ensure that it is standing up to the requirements of modern operating conditions. The change over from steam to diesel and electric traction is calling for higher standards of accuracy in design and maintenance. In several parts of the world, notably in the U. S. A. and in Switzerland, carriage design has undergone some quite radical changes ; the Integral coach design, developed by the Swiss and now being put into practice at Perambur, is an interesting example of this trend.

Design studies naturally extend to all components and this article sets out to portray the trend so far as wheels and axles are concerned. Although a certain amount of experimental work on radical new designs has been carried out from time to time, it is broadly true to say that the design of the wheel and axle assembly has not altered very radically over the past 50 years and this article will pin point the fact that such improvements as have taken place concern matters of detail rather than fundamental alterations in overall design.

The principal requirements for a wheel set may be set out as follows :

(1) Safety and reliability
(2) Resistance to wear
(3) Minimum weight
(4) Maximum degree of interchangeability.

These requirements are, as so often happens, to some extent conflicting and in each design a measure of compromise will be necessary.

(i) WHEELS

Early wheels for both locomotives and other forms of rolling stock were of the spoked type. These were gradually replaced for many applications by rolled steel disc wheels of the built-up (i. e. centre and tyre) design. More recently the one piece solid wheel has become increasingly popular and is probably the most common wheel in use on the railways of the world today. Both the one piece and the built-up wheel have their place in railway rolling stock design ; individual economic and operating conditions largely determine the choice. In North America a special form of solid wheel, the so called "one-wear" type, has been introduced on a very large scale to replace the chilled cast iron wheel which was formerly the standard for freight cars. This design has an unusually thin tread (thickness 1.1/4") and this is not usually re-turned.

Other interesting wheel designs which have had some application include the resilient wheel which consists basically of a steel tyre separated from the hub by a series of rubber sandwiches, which help to absorb shocks and to reduce any noisy vibrations

Close-up view of the roughing stand in the Wheel Mill at the works of Steel, Peech & Tozer.

developed through wheel rail contact. Wheels with rubber tyres have been tried but these have not been successful except for special applications such as on the Paris Metro where they run on a concrete road bed. In an effort to reduce weight, pressed steel wheels have been used on the Continent and a few wheels with aluminium centres are in service in Switzerland.

Modern operating conditions, particularly high speeds, impose the necessity for very accurate machining of wheels. Not only must the wheels be machined so that the treads and bores are completely concentric but they must also be balanced, statically and dynamically, to fairly fine limits.

Where a particularly high standard of accuracy in the machining of wheel webs is required, such as for diesel locomotive wheels, the webs are profile turned in electronically controlled copy turning machines.

Kinetic energy considerations lead to the desire for the lightest possible design and in this respect solid one piece wheels generally have an advantage over the built-up type.

The pressing of wheels on to axles by hydraulic pressure in a wheel press remains more or less standard practice, although one or two variants are now being introduced. One of these is the S. K. F. oil injection method—an oil way is cut in the wheel bore and oil is fed into this under pressure when it is desired to remove the wheel; the pressure creates an oil film on which the wheel slides. Here again a very high standard of accuracy of wheel boring and of finish on the wheel seat is demanded if the method is to operate satisfactorily. The latest practice in Sweden is to shrink wheels on to the axle in much the same way as tyres are shrunk on to wheel centres; this method would appear to have some advantages but it has not been adopted on a wide scale so far.

Some railways include lightening or sprag holes in the design of their wheels; wheels may have either two or three of these holes, which are normally of approximately 2.1/2" to 3" in diameter. They lighten the wheel quite considerably without seriously affecting the web strength. They are also useful for inserting a sprag in cases where it is more convenient to do this than to apply a hand brake.

The wheelmaker has plenty of opportunity to study the very wide range of wheel designs which have been evolved by railways in different parts of the world. The amount of variation in web design in particular prompts the thought that these designs are not always based so much on fundamental principles as on the various theories of the individual designers.

(ii) TYRES

The general trend over the years 1929—49 has been in favour of the one piece solid wheel. At the works of Steel, Peech & Tozer the change in the pattern of demand has been such that whereas in the early 1930's the requirement for one piece wheels was approximately 10% of the total demand, by the late 1940's this had been reversed to about 90% solid wheels and 10% built-up. Now, however, a hard core of convinced tyre users appears to have been reached and the demand for tyres is remaining fairly constant. Some railways fit new stock with one piece solid wheels with the intention of fitting tyres when the tread portion has worn down to scrapping size; the economics of particular cases should be carefully studied before this practice is adopted, the main factors being availability of suitable machines and local labour costs.

Modern operating conditions are increasingly severe as both loads and speeds build up. Wheel treads must be increasingly resistant to wear, thermal checking, spalling and shelling. A lot of research has taken place, and is continuing, into the most appropriate qualities of steel to be used under these increasingly severe conditions; the steels concerned contain alloying elements in varying proportions and call for special heat treatments. The advantage of the tyre over the solid wheel for these applications is that the special steel is concentrated where it is required, namely in contact with the rail; it is not wasted in the general mass of the wheel.

These special steels are generally higher in tensile strength than the standard types and the necessity for avoiding stress raisers of any kind is correspondingly greater; this puts a premium on a high standard of finish when machining, particular attention being given to adequate radiusing.

Tyres are shrunk on to the wheel-centres and the methods of attaching the tyre to the centre include riveting, the double-snip method (i. e. a snip on each side of the tyre bore) and the use of retaining rings; of these the last-named is the most widely used. It is most important that the radius at the bottom of the slot in the tyre into which the ring fits should be adequately radiused; if it is not the lip of the tyre may crack when it is rolled down. In some cases this lip is peened but rolling gives a more uniform grip.

(iii) AXLES

The biggest development in axle design has been brought about by the advent of the roller bearing axle; this has demanded a very high standard of accurate finish and has led to the development of improved semi-automatic techniques such as copy turning and plunge grinding. Tolerances of as close as 2/10th of a thou. are expected in some instances. Improved surface finishes may be obtained on journals by burnishing. A similar cold rolling operation can be applied to wheel seats; it hardens the surface and thus diminishes the liability to fatigue cracks in this portion of the axle.

As the standard of accuracy increases and the range of tolerances is reduced, more and more axles are being machined all over; here again the copy-turning lathe is an invaluable tool. Another noticeable feature of modern axle design is the elimination of the collar behind the wheel-seat.

In an endeavour to save weight hollow axles have been tried from time to time but they have not been adopted on a wide scale. The advantage of decreased weight does not appear to balance the increased cost.

(iv) WHEEL SETS

As in the case of the individual components so with the finished wheel sets the story is the same—improved accuracy and finish. The modern wheel set will probably have roller bearings and may have traction gear wheels, motor suspension sleeves and/or disc brakes. Cannon boxes, dynamo pulleys and, in the case of spoked wheels, quill drives are alternative features.

As speeds increase accurate balancing becomes increasingly important. British Railways carriage wheels are balanced to within 32 ins./ozs. and other railways have similar standards. Dynamic balancing is achieved by spinning the wheel set in a special machine in which any out of balance forces can be compensated and the amount and position of the necessary compensating weight determined. New and more accurate methods of achieving this result electronically are now being introduced in an attempt to improve the standard of accuracy.

Enough has been said to convince the reader that standards of wheel and axle manufacture are rising; the challenge offered by higher speeds, heavier loads and more intensive utilization is being met.

REMOVING METAL FROM CASTINGS

The removal of excess unwanted metal from certain types of castings is often difficult when the areas where it occurs cannot easily be reached by hand grinding. A new "flame washing" process, which has been developed by British Oxygen Gases, is said not only to provide a cheaper and more efficient method for removing excess metal from steel castings, but also to be fully effective in areas where hand grinding is not easy to apply.

The equipment used for application of the process is simple, being much the same as that for normal oxygen cutting processes, except that a special curved nozzle is used and propane is the fuel gas. It is claimed that it is possible to train skilled oxyacetylene operators to become proficient in the technique after only about a week's training.

One limitation of the process is the fact that its application is generally limited to castings which can be cut safely and readily by normal oxygen cutting methods. Likewise, it is not effective when sand is encountered to any great extent, or for stainless or high alloy steels.

*** *** ***

KRUPP-RENN PROCESS INTRODUCED IN U.S.

The Krupp-Renn process for economical treatment of low-grade iron ores, invented in Germany, is being introduced in the United States by Southwest Engineering Co. of Los Angles.

The reduction process for production of metallic iron from ore can now be applied to Western ores and coals to produce iron pellets at cost as low as $ 16 per ton. The pellets are suitable for direct charging to open-hearth or electric steel-making furnaces.

Tilley's Contribution to Railway Signalling

(By a Technical Correspondent)

THERE are few railwaymen who are not familiar with the name " Tilley ". " Tilley " has become synonymous with the best that there is in portable paraffin pressure lighting particularly on the world's railways. For over a quarter of a century The Tilley Lamp Company in co-operation with railways everywhere have developed a collection of portable lamps specifically for use by railwaymen.

Possibly for best known of this large collection is the Tilley 5,000 candle power Floodlight, Model F. L. 6 which is standard equipment on British Railway Breakdown Wagons and is the first lamp that is rushed up in the event of a night catastrophe or emergency of any serious nature. (See Figures 1 & 2).

Supplementing this lamp is the portable 2,000 candle power Hand Lamp Model A. L. 21, originally designed for tunnel inspection. It has become a " maid-of-all-work " on the railways and is used extensively for close rescue work and track maintenance and inspection. (See Figure 3).

The A. L. 16 is familiar to most railwaymen. It was designed specifically for the illumination of track repair work and removed from its stand it is then know as Model A. L. 15. It is the most versatile of all Hand Lamps. (See Figures 4 & 5).

During recent years, The Tilley Lamp Company has developed, in association with the Railways, a more

Fig. 1. Surrey Railway Accident.

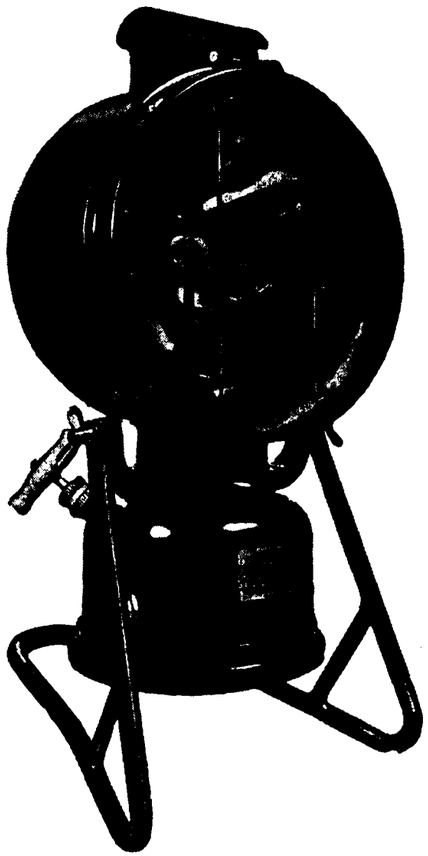
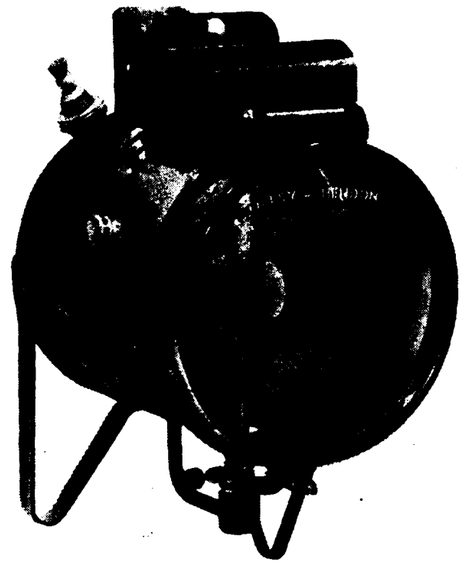


Fig. 2. Tilley Paraffin (Kerosene) Pressure Floodlight Projector Model F.L.6.

powerful form of portable lighting using L. P. Gas.

Their first model met with instant success and is in the form of a 10,000 mean reflected candle power Floodlight, Model B. T. 25. Developed in conjunction with the Floodlight has been an adjustable 16 ft. Tripod Stand enabling the source of light to be lifted well above the working area but giving the user complete control from ground level, including angling of the light and the swivelling of it through 360°. This lamp has already been acclaimed as a worthy



addition to the Tilley Railway range and has been adopted by British Railways, among others. (See Figure 6).

Another addition to the paraffin pressure range is the new Tilley O. H. 57 Overhead Inspection Lamp. This has been designed for the easy inspection of overhead electric wires and signalling apparatus. The user can adjust its floodlight from the horizontal to the perpendicular by adjusting the Reflector to the position he requires. It is equally useful for tunnel inspection. (See Figure 7).

The Tilley Lamp Company has always prided itself on giving the world's railways the lamps that THEY want and today more than ever their slogan that " There is no need to make do, there is a Tilley lamp for every job " is more true than ever.

The true railwayman never stands still but is forever seeking new and improved ways of efficient running to the service of the Public. The Tilley

Fig. 3. Tilley Paraffin (Kerosene) Pressure Hand Lamp Model A.L.21.

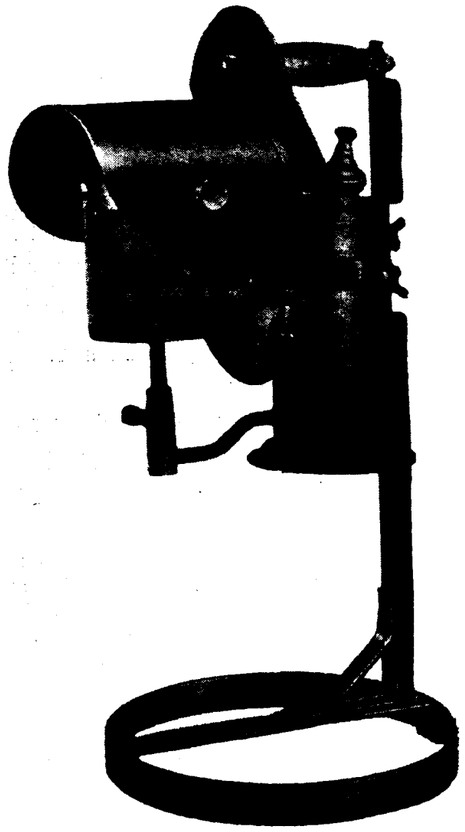


Fig. 4. Tilley Paraffin (Kerosene) Pressure Hand Lamp Model A.L.16.

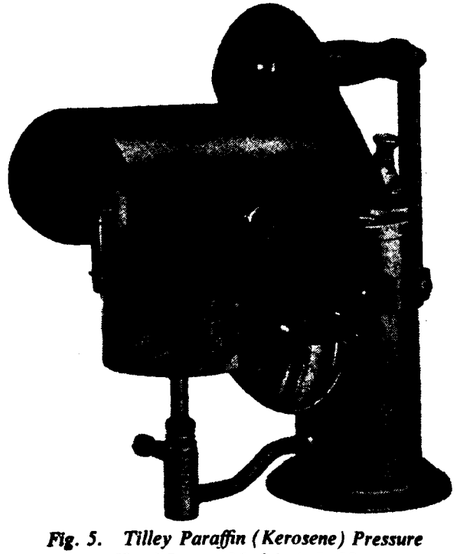


Fig. 5. Tilley Paraffin (Kerosene) Pressure Hand Lamp Model A.L.15.

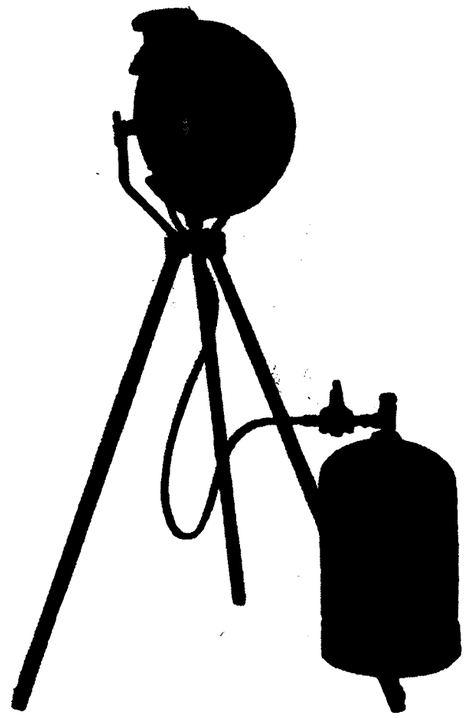


Fig. 6. Tilley Propane – Butane Floodlight Model B.T.25.

Fig. 7. Tilley Paraffin (Kerosene) Pressure Overhead Swivel Lamp Model O.H.57.

Lamp Company likes to feel that in their small way they have made some contribution to this efficiency of which ever member of railways throughout the world is justly proud.

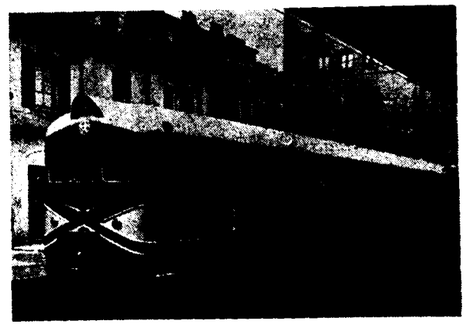
New Fiat Railcar

A NEW Fiat rail car is of a type expressly designed for the Cuban Railways, " Ferrocar riles Consolidados " which comprises three Companies (Compania Ferrocarriles de Cuba, Ferrocarriles del Norte de Cuba and Ferrocarriles de Guantanamo y Occidente).

The " Ferrocarriles Consolidados " operate a standard gauge (4′ 8 1/2″) system of 1165 miles. The main line runs lengthwise of the island of Santa Clara, where it joins the Ferrocarril Occidente (connecting this locality with Havana) and goes on to Santiago de Cuba, touching Camaguey, headquarters of the Company.

The order given to Fiat involves 24 power cars and 19 trailers built in the OM Works in Milan. The power cars, air conditioned, have forward-facing seats with backrests adjustable to 3 positions and also have a bar. The trailers are of three types: one with all-passenger accommodation like the power cars, one with a passenger and a luggage Compartment, and another for luggage only. All the passenger compartments have Carrier Safety air conditioning equipment.

The power cars have each two Fiat 700. G supercharged engines rated at 215 h.p. each at 1450 r.p.m. The transmission is hydraulic. The bogies are of the half-adhesion type with one driven axle and one bearing axle. A public address system enables music or information to be broadcast to passengers. The driver has a radio transmitter-receiver for communication with stations and other trains travelling on the lines.



The rail car, which made a trial run from Milan to Turin, is the first of the batch will be shipped to Cuba. The whole order will be fulfilled, in 3 batches, by the end of next December.

TIN ELECTROPLATING

The Tin Research Institute has published a method of producing electroplated deposits of tin in a fully bright form. The tin deposit obtainable by electroplating has hither-to been matte and chalky in appearance and the new method produces coating which come from the bath with the appearance of having been mechanically polished.

Essentially, the process, which is available without patent restrictions of any kind, requires the addition of a dispersion of wood tar prepared with a selected surface-active agent to an acid stannous sulphate electrolyte. Tests of tin-nickel alloy deposits show that for indoor environments of comparatively mild corrosivity an undercoating is not necessary, and coatings up to 0.0005 in. thick, depending on the environment, give excellent protection.

For out-of-doors use, undercoatings of copper or bronze, preferably polished after plating are desirable, but no advantage accrues from increase of undercoating thickness above 0.0005 in. It is interesting to note that this alloy plate has been adopted by instrument makers when particularly hard-wearing and corrosion-resistant finishes are required.

The Design and Manufacture of Light-Weight Coaches

By Shri K. Swarup
Chief Administrative Officer,
Integral Coach Factory, Perambur, Madras.

INTRODUCTION

IN the earlier years the design of railway rolling stock was inspired by that of the vehicles used for road transport at that period. It was soon found, however, that the railway could cope with heavier loads, and the evolution of railway rolling stock tended towards increased capacity together with the provision of comfort, a factor which upto then had been ignored. The constantly increasing speeds also made greater strength imperative and this desire for improvements led to such an increase in the initial weight, of approximately 220 lbs. per seat, that in many vehicles now in service it has reached more than half a ton, resulting in higher constructional and operating costs.

While the railway enjoyed a monopoly of transport, the results of such heavy loads did not matter, but when more modern road motor transport came into the picture it gave the public the benefit of vehicles, which though of a lower standard of safety and comfort, were much lighter and a better user, so that lower prices could be charged. This new method of transport obliged the railway to revise its policy in the case of passenger services and resulted in the appearance of passenger coaches of light construction. The method of transport which will attract the greatest number of clients, will be that which in each case offers the greatest convenience, speed, safety and economy, and these conditions often run contrary to each other. It is now recognised that the best policy is to reduce the weight of the rolling stock without reducing either its strength or its capacity, not only in the case of passenger coaches but in all railway vehicles to which the technique used in the construction of passenger cars has been applied. It is a question therefore, which affects the whole

Fig. 1

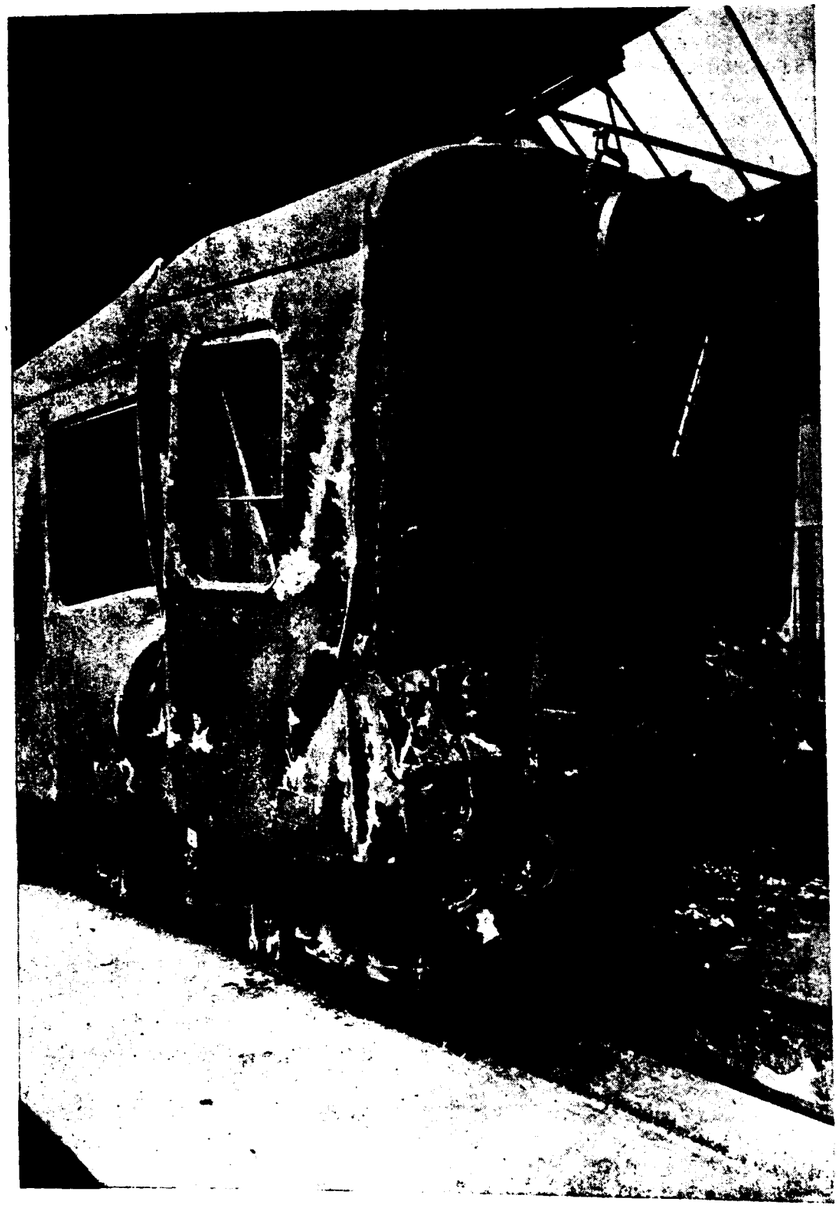


Fig. 2

economy of the railway and consequently its solution is of great interest. Considering all these aspects and the fact that India is short of good coal of high calorific value, the preservation of which is of great national importance, the light-weight construction for passenger coaches has been adopted as the most

suitable for the Indian railways.

PRINCIPLES OF LIGHT-WEIGHT DESIGN

In the past it was generally accepted that heavy vehicles possessed better riding qualities than light ones. Experience has, however, shown that intelligent design leads to improved efficiency in operation. To properly appreciate the basis for light-weight design, it is essential to realise that old-fashioned considerations based on statics do not meet the requirements of modern design. These views had to be replaced by the dynamic conception, which takes into consideration the actual working conditions in service. The 'static' designer considered every detail as a separate unit and not as a part of the complete structure. In case of failure he usually considered any part which failed and strengthened it, which automatically led to increased weight. However, design development proceeded from the static to the dynamic conception rendered necessary by higher and economical outputs, better performance and greater speeds. It is necessary, therefore, to consider all designs from the dynamic point of view and here to deal not with simple forces, as in the case of static considerations, but with the ability to do work. If some section of the dynamically stressed unit fails, then it is upto the designer to appreciate that its ability to do work was insufficient and therefore must be strengthened. The first and foremost, yet simplest, means to achieve this is to ensure that all stresses are adjusted to the given maximum value. Thus the designer will increase the capacity to do work of a low-stressed part by removing redundant material and this will in turn increase the working capacity of the entire structure and its ability to withstand dynamic stresses. As will be appreciated from this, the dynamic considerations force one to keep the use of materials to a minimum, which in turn leads to reduced weight, and this is the basic meaning of light-weight design.

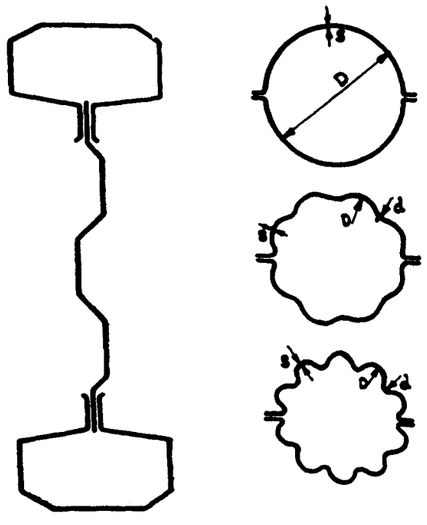


Fig. 3

Light-weight design and improved effectiveness are thus synonymous. If greater effectiveness is required, a reduction in the weight is necessary; if the weight is reduced improved effectiveness will be achieved. The improved effectiveness becomes economically effective in a number of ways, in increased capacity, in reduced operating expenses, in improved service and life. By taking these principles into consideration it has been possible to reduce the weight of our passenger coach from 42.5 to 35.5 tons as follows :—

	Break-up of weights	
	Conventional coach	Integral coach
Bogie frames with Brake rigging and bolster springs and bolsters	7.91	5.3
Wheels & Axles with axle boxes and springs	6.65	5.4
Total weight of bogies	14.56	10.7
Weight of underframe alone	10.55	
Weight of bare shell		11.55
Weight of underframe or Body Shell and Bogies	25.11	22.25
Weight of furnishing including electrical equipment, doors and windows (approx.)	17.39	13.25
Total weight	42.50	35.50

Of still greater importance, however, is the fact that stressed-skin carriages possess very favourable static and dynamic qualities. This applies particularly to the resistance against torsional and bending stresses, which is considerably better than that of the heavy standard carriages. Moreover, the vehicle possesses an extraordinary high compression rigidity,

particularly over the entire length of the passenger compartments. This ensures a greater protection in case of accidents, still further increased by the fact that the sections located at the ends, *i. e.*, lavatories, etc., possess lower compression rigidity than the passenger accommodation. In case of accidents these parts would be destroyed first and thus absorb the collision energy. This is borne out by the behaviour of these light-weight coaches in an accident which took place on the Swiss Federal Railways in October 1943. (Figures 1 and 2).

As already mentioned, the conception of the light-weight design originates in the appreciation of previously unknown physical and technical considerations, particularly in the recognition of the possibilities offered by the use of hollow girders which are far superior to solid girders so far as the utilisation of material is concerned. Typical pioneer designs as originally developed by English aircraft designers are shown in Figure 3.

This shows tubular sections with and without corrugation. The radii of curvature D and *d* and the wall thickness *s* as well as the relation of these to each other are of paramount importance so far as the buckling resistance is concerned. This is increased with an increase of the ratios D : *s* and *d* : *s* respectively. In the present example this increase amounts to 67% when changing from the upper to the lower right-hand section. The left-hand portion of Figure 3 shows an aircraft spar composed of two hollow sections connected by a corrugated shear resisting section. These sections serve to demonstrate the application of stressed-skin construction to single plan structures, the compression and shear resistance of which can be increased very considerably by the provision of suitable corrugations. These experiments prove that the static properties of materials now become of secondary importance, the elastic properties of the material and correct design being of major importance so far as the load-carrying capacity of the structures is concerned. Therefore, it is proper to state that the form-stability is determined by the elasticity of the materials employed. Only when the form-stability exceeds the strain-limit of the material that the latter becomes a further important factor.

Although hollow girders have been known for some time, it was not originally possible to utilise them to the extent now made possible by the use of stressed-skin construction. The hollow girder possesses a high moment of resistance and a high working capacity both in torsion and bending. It is thus eminently suitable for being dynamically stressed in every direction. It is at its best when uniformly thin girder walls are employed.

The very advantageous stressing made possible by the use of hollow girders is indicated by the sections, Figure 4. Either of the two girders made up of the sections shown here is assumed to be stressed by a centrally located load of 3,600 lbs. which can be applied to either side of the major axis. The left-hand composite girder weighs 14.7 lbs. per foot and is subject to a stress of 13,800 lbs./sq. in., while the hollow girder weighs only 6.12 lbs. per foot, the stress being 13,900 lbs./sq. in. This example illustrates the possibilities offered by the use of hollow girders.

Figures 5 and 6 show the typical frame which has been, and still is, widely used for the carriage bodies. This structure consists of horizontal girders, pillars and sole bars which are connected by gussets. This frame is capable of dealing with side forces and torsional stresses if existing partitions provide the necessary rigidity.

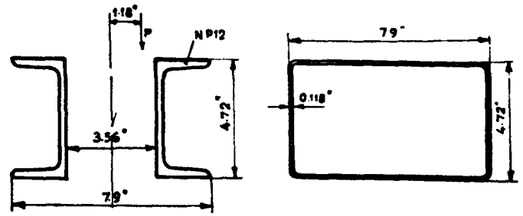


Fig. 4

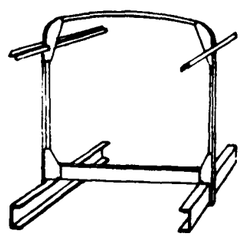


Fig. 5

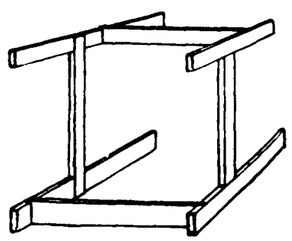


Fig. 6

However, the number and disposition of such frames is limited by the doors, windows, etc. If, however, tubular girders are used, it will not be necessary to arrange for all members of a frame to be in the same plane, since the torsional stiffness of the longitudinal members will be capable of dealing

with the bending moment imposed upon the various girders. The three-dimensional framework (Fig. 6) is superior to the single plane frame not only because of its increased capacity to do work but also because it permits the provision of what may amount to any number of frames. In addition to its torsional rigidity, the hollow girder has the advantage of universal bending rigidity and this permits the use of entirely new design of frames.

The reduction in weight of the light-weight coaches has been achieved by making full use of the stressed-skin construction and by the use of light alloy fittings, etc. The underframe, sidewalls and roof are united into what might be termed as a static tube representing the thin wall hollow girder consisting of steel sheets. Since thin sheets are capable of dealing with compression and shearing stresses only to a very limited extent, the resistance must be increased. This has been achieved by the provision of suitably pressed grooves or welded ribs. The body frame is shown Figure 7, indicating the position of the welded ribs,

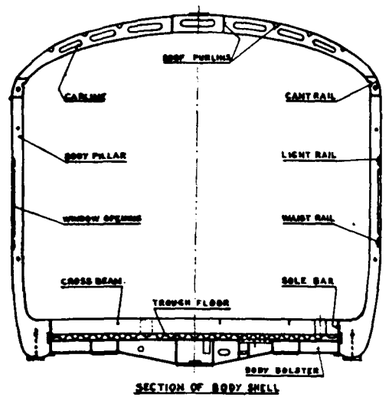


Fig. 7

in the sidewalls and the roof. Corrugated sheets are utilised for the floor and these deal to a large extent with the buffing stresses. The pillars together with the carlines and underframe cross members, form frames which ensure the necessary rigidity to the structure. The end walls are made of steel sheets. These together with the sidewalls, floor and roof form a compression and bending resistant tube. The lavatories and the vestibules are less rigid than the central passenger-carrying part of the vehicle. The above principles have been applied rigidly to the coach being built at Perambur.

DETAILS OF PERAMBUR DESIGN OF LIGHT-WEIGHT COACH

(Fig. 8)

The specification of the Perambur-built coach is :—

Gauge	5′ 6″
Length over Body	70′ 0″
Length over Buffers	73′ 1-13/16″
Buffer centres	6′ 5″
Width over Body	10′ 8″
Drawbar height from Rail level.	3′ 5½″
Buffer height from Rail level	3′ 7½″
Overall height of coach from Rail level	12′ 9″
Floor height from Rail level	4′ 3-5/16″
Distance between bogie centres	48′ 6″
Rigid wheel base of bogie	9′ 6″
Tare weight	35 tons.
Seating capacity	80
No. of lavatories	4
No. of doors aside	4
Passengers per lavatory	20
Passengers per door aside	20
Lighting	I. R. S. Double battery system

SPECIFIED LOADS

(i) Vertical load of 45 tons uniformly distributed over the whole floor area of the Coach and simultaneously horizontal compression load of 100 tons on each buffer. Under this condition, the deflection at the centre of the body shell shall not exceed 3/8″.

(ii) Horizontal compression load of 60 tons at one foot above buffer centre, distributed over the whole width of the end construction.

(iii) Horizontal compression load of 30 tons uniformly distributed over the end construction.

GENERAL CONSTRUCTIONAL DETAILS

The skeleton of the shell is made up of a series of hoops consisting of the floor cross beams, body side pillars and roof carlines as shown in Fig. 7. The sole bars, waist rails, light rails, cant rails and roof purlins are the members that hold the hoops

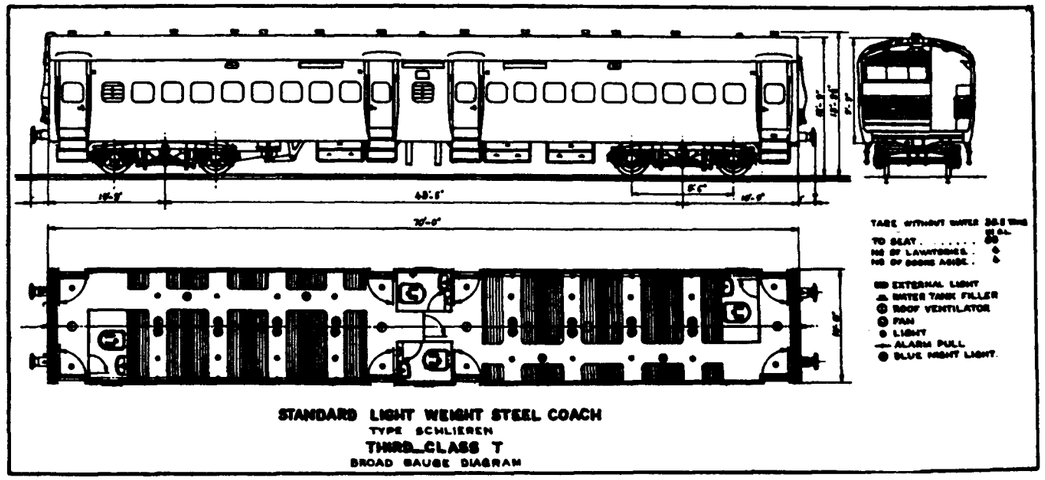


Fig. 8

together in a rigid framework which is then covered over by the roof sheets on top and the panels on the sides and ends.

The cross beams rest on a "trough" floor, so called on account of its section, which has been adopted so as to pack in the limited space the cross-sectional area necessary to keep the stresses occurring within the permissible limits. It offers considerable resistance to crushing loads in the longitudinal directions, although its ability to carry vertical loads is practically negligible. At each end of the trough floor is welded on a specially designed headstock as shown in Fig. 9, which initially receives the draw and buffing loads and then imparts the same to the trough floor. The trough flooring and the sole bars together with the headstocks virtually take the place of the conventional underframe.

To the underside of the trough floor are welded the body bolsters which then rest directly on corresponding units of the bogie trucks as well as all the beams and supports for the vacuum brake equipment, the brake rigging and the electrical apparatus and dynamo.

The ends of the coach are again of special interest, as it is in them that the anti-telescopic structure is incorporated. (Fig. 10). This consists of four vertical stanchions each of box section 10" deep and 4-5/16" wide manufactured from 3/16" thick material. These stanchions are transversely connected by 10" deep Z-sections and are welded to the headstock beams at the bottom and to the roof longitudinals at the top. Thus, any shock received through accident is resisted by these end-stanchions, and if the shock load is high enough it is absorbed by them during their plastic deformation. Further load, if any, is then imparted to the periphery of the shell which may then buckle at the doorways, these being designed as the weakest sections in order to safeguard the compartments.

The thicknesses of steel used for some of the more important members are :—

Sole Bars	3/16"
Headstock Beams (Outer)	3/16"
Trough floor	3/32"
Pillars	3/32"
Carlines	5/64"
Sidewall panels	3/32"
Roof sheeting	1/16"
Headstock beams (Inner)	3/8"
Cant Rail	1/8"

VERTICAL LOADS

	Tons
Weight of body shell (furnished) excluding bogies	24.6
Pay load (Passenger + Luggage + 10% overcrowding)	12.9
Gross weight of the coach excluding bogies	37.5

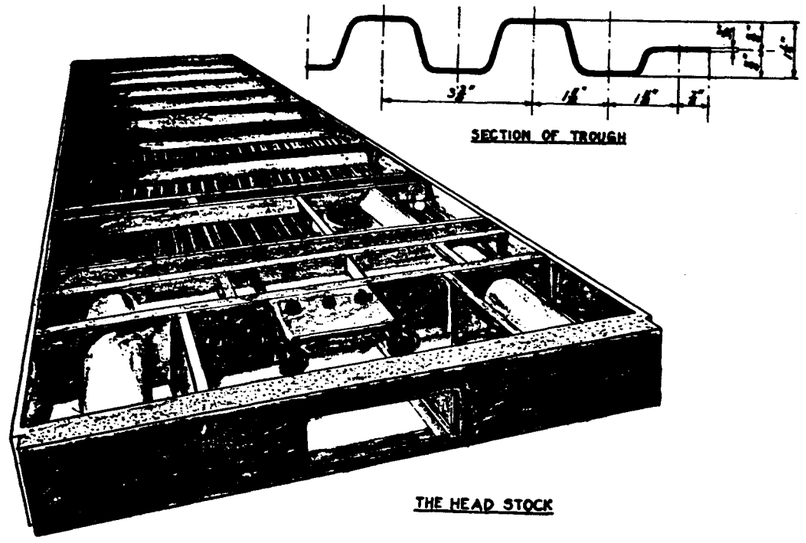


Fig. 9

Gross weight of the coach + 20% shock	45.0

CASE (1)—HORIZONTAL LOAD OF 100 TONS PER BUFFER

As has already been mentioned, the headstocks sole bars and trough floor virtually take the place of the conventional underframe. Thus, the 200 tons on buffers has to be received by these 3 structures between which, however, the trough floor is decidedly the weaker, as may be seen from their respective slenderness ratios (L/K). The case of the trough floor together with the sole bars is, therefore, alone considered here.

Assuming that the load of 200 tons is shared by the trough floor and the sole bars in proportion to their respective cross-sectional areas,

Compressive stress in each of the Sole Bars = Compressive stress in trough floor.

$$= \frac{200}{6.128 + 14.38}$$

= 9.75 tons per sq. inch.

Where 3.064 sq. inches is the area of cross-section of each sole bar and 14.38 sq. inches is the area of cross-section of the trough floor.

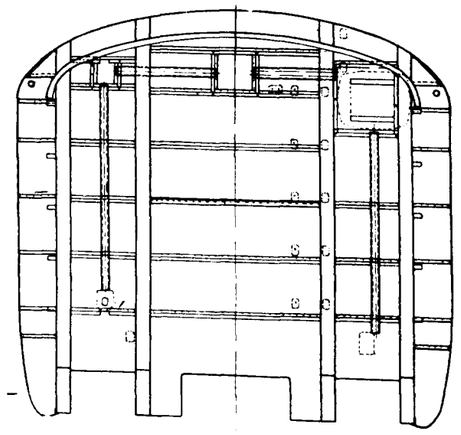


Fig. 10

Calculating the critical stress for buckling according to the formula—

$F = 19.7 - 0.0724 \times L/K$ where L/K is the slenderness ratio.

Critical stress for buckling in side longitudinal

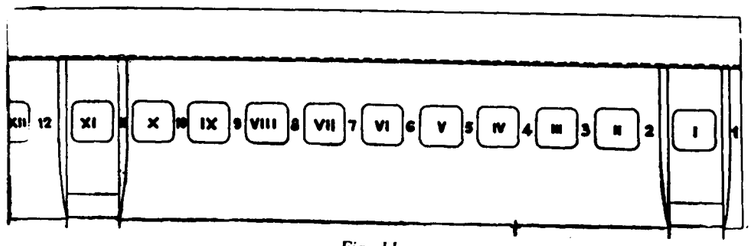


Fig. 11

= 19.2 tons/sq. in. and critical stress for buckling in trough floor = 15.32 tons/sq. in.

∴ Factor of safety against buckling in side longitudinals $= \frac{19.2}{9.75} = 1.97$

and Factor of safety against buckling in trough floor $= \frac{15.32}{9.75} = 1.57$

During actual tests conducted on the coach, where a load of 100 tons was imposed on each buffer, it was found that once the load distributed itself, *i. e.*, in the areas below windows V and VI (Fig. 11) stresses of only 5 to 7 tons per sq. inch. occurred. This is due to the sidewalls also taking a share of the buffer loads. For the same reason at the door openings in the centre of the coach where there is no panel or waist-rail and light rail to convey further the load taken by the sidewall, the load flows back into the trough floor setting up a maximum compressive stress of 10 tons per sq. inch, which it will be noticed is even slightly higher than the calculated value. It should also be remembered that there is a further (+) or (−) inherent stress value already present due to the initial sheet metal operations, welding, etc., which, however, cannot be measured.

CASE (2)—HORIZONTAL LOADS OF 60 TONS AND 30 TONS

The end construction is designed to withstand the shock load of 60 tons applied 12″ above the buffer centres or 30 tons distributed over its entire surface. For purposes of calculation the 30 tons are taken as applied along the horizontal centre line as it simplifies calculation and at the same time is safer to adopt, as it presents a more severe case than if the load is distributed over the entire end wall. In dealing with this case, therefore, the antitelescopic stanchions are considered as beams for which maximum bending moment has been taken as WL/6 being the mean between beams simply supported (B. M. = WL/4) and beams with fixed ends (B. M. = WL/8).

Treated in this manner, it is found that a greater bending stress is reached with the 30 tons applied at the centre than with 60 tons applied 12″ above buffer centres. On the other hand, a greater shear stress is reached with the 60 ton load than with 30 tons.

Thus :

Bending stress with 30 tons applied at centre	9.7 tons/sq. in.
Shear stress with 60 tons applied 12″ above buffer centres	2.4 tons/sq. in.
The factor of safety in each case is approximately	2.

CASE (3)—VERTICAL LOAD OF 45 TONS

(*a*) The vertical load of 45 tons distributed over the whole length of the coach has to be carried by the floor members, but since, as mentioned previously, the trough floor is weak in this direction, the cross beams have been designed to meet this load fully.

In the prototypes and upto the 130th coach manufactured by Schlieren, 45 cross beams of 1/8″ thick steel were used.

Thus :

Load carried by each cross beam = 1 ton.

Maximum bending moment = WL/10 taken as an average between WL/8 and WL/12 due to the uncertainty of the ends support.

$= \frac{1 \times 100.63}{10}$

= 10.063 inch tons.

Maximum bending stress

$= \frac{10.063}{1.33}$

= 7.56 tons./sq. in.

where 1.33 is the 'Z' value of the members.

Also maximum shear stress

$= \frac{0.5}{0.907}$

= 0.55 tons/sq. in.

where 0.907 sq. inch is the area of cross-section of each member.

In the present design of the coach the number of cross beams has been reduced to 23, but the section has been increased to 3/16″ to maintain the same strength.

(*b*) In calculating the strength of the side walls, the structure is treated as a Vierendeel girder bearing the following vertical loads :—

	Tons.
Weight of body shell (furnished)	24.6
Maximum pay load (Passengers + luggage + 10% overcrowding)	12.9
Gross weight of coach	37.5
Gross weight of coach + 20% shock.	45.0

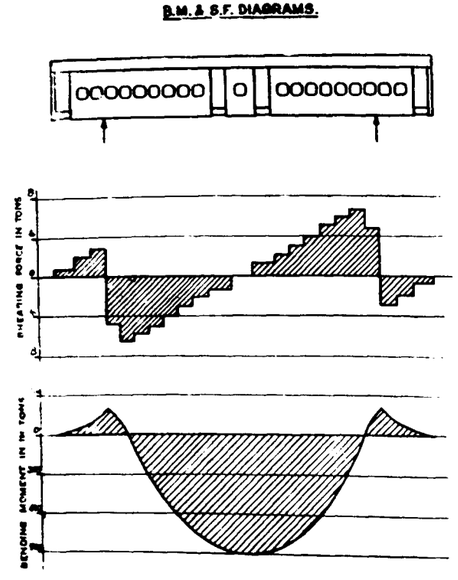


Fig. 11(a)

It is assumed for the purpose of calculation that this load of 45 tons is shared by the sole bars, the side walls and part of the roof upto the first longitudinal rail only. Also initial stresses set up due to sheet metal operations, welding, etc., are not taken into account as being indeterminate.

The side wall section is divided into three parts. The portion extending from the first roof longitudinal to the top of the window openings referred to as the "Top Boom"; the part from below the window openings till and inclusive of the sole bar referred to as the "Lower Boom", and the portion connecting the top and lower booms referred to as "Girder Pillars." (Fig. 12).

In order to ascertain the likely loads that are carried by the upper boom and lower boom, it is assumed that the weight of the body shell (18.7 tons) is distributed over the periphery of the shell, whereas weight of fittings such as brake rigging, battery boxes, decolite flooring, etc. (total 5.9 tons) as also Pay Load (12.9 tons) is carried only by the lower boom.

Divided, thus, in proportion to their respective peripheries,

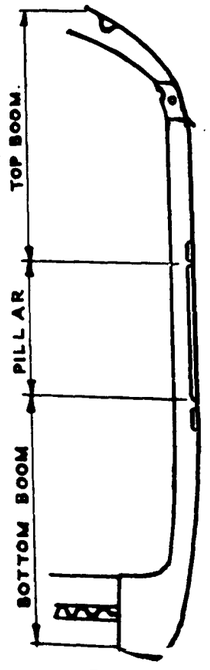


Fig. 12

	Tons
Load carried by upper boom	10.8372
Load carried by lower boom	34.1628
Total	45.0000

Treated to this manner and assuming that the reaction of the Centre Pivot is conveyed only to the pillars on its either side, a shearing force diagram and a bending moment diagram as shown in Fig. 11 (a) are arrived at.

Further calculations reveal that at the following points the maximum direct stresses are reached :—

	Direct stress Tons/sq. in.
Upper boom : At window opening III	0.316 (tensile)
Upper boom : At window opening XI	2.595 (Compr.)
Girder Pillar : At Pillar 12	0.611 (tensile)
Do. 4	1.626 (Compr.)
Lower boom : At window opening XI	2.581 (tensile)
Lower boom : At window opening III	0.238 (Compr.)

It will be found that the maximum tensile stress is reached in the lower boom, as is to be expected (though of a small magnitude) and compressive stress in the upper boom.

For calculating the factor of safety due to compression, the following formula is applied for the panel sheets, with the assumption that the edges are rigidly held all round :

Critical compressive stress for buckling, according to Schaptiz

$$= K. \frac{E}{1-V^2}\left[\frac{S}{b}\right]^2 \text{ tons/sq. in.}$$

Where E = Modulus of Elasticity

Where V = Poisson's Ratio.

S = Thickness of sheet in inches

b = Breadth of sheet in inches

K = Corrective factor depending

on $\frac{\text{length}}{\text{breadth}}$ of sheet

Results from this formula show that the weakest panels lie over window openings XII where—Critical buckling stress = 2.98 tons/sq. in.

But max. compressive stress reached in this area = 1.92 tons/sq. in.

∴ Factor of safety in this panel (least factor of safety) against buckling due to compression = 1.6.

In a similar manner critical shear stress in panels for buckling is calculated but assuming here the worst condition, that is, with the edges of the panel freely supported. This gives the following as the weakest points :—

Position	Factor of safety
Upper boom : At window opening VII	3.8
Girder Pillar * No. 8	7.0
Lower boom : At window opening VII	5.5

In all the above calculations the roof members are not taken into consideration though due to the Monotype of construction a certain amount of load is shared by members of this structure. Actual tests, however, justify neglecting these members for purposes of calculation since the stresses measured were all in the region of 2 tons/sq. in. (tensile) only.

(To be continued)

*Girder Pillars 5, 6 and 7 are additionally strengthened against buckling and therefore their factors of safety have not been computed.

Electric Locomotives from Japan

The first of three electric locomotives for the Indian Railways, ordered in Japan by the Government of India, has been completed and is ready for shipment. The second locomotive is nearing completion and is expected to be ready for shipment while the third will follow shortly thereafter.

The giant 110-ton, 3600 horsepower, 3,000 V. D. C. locomotives are for use on the electrified sections of the Eastern Railways and they are part of a total of 12 ordered by the Indian Railways. Apart from the three ordered in Japan, the remaining nine were ordered with a British firm.

The three ordered in Japan are being supplied by Hitachi Limited, one of Japan's leading manufacturers of electric equipment of all sorts, from power generating installations, rolling stock and communications equipment to industrial machinery of all kinds. This firm has already supplied to the Indian Railways, nearly 200 steam and other locomotives as well as other types of rolling stock.

The three electric locomotives now going to India have been meticulously designed to meet stringent working conditions and to withstand high temperature and humidity conditions. They are built to serve under temperatures of as high as 60 degrees Centigrade and humidity of 100 per cent. Certain features of Japan's Engineering Standards also have been incorporated into the locomotives. Built for use on broad gauge (5 feet 6 inches), these are 64 feet 3 inches over the buffer and stand 12 feet 6 inches high above rail level, while the overall width of the body is 10 feet. The locomotive has a maximum safety speed of 75 miles per hour, while the rated speed is 35.8 m. p. h. (on gradients). It is equipped with six sets of 600 h. p. motors (1,450 V. 330 A. 800 r. p. m.), while the electrification system provides for a nominal voltage of D. C. 3,000 V and rated voltage of D. C. 2,900 V. It has a maximum axle load of 41,070 lbs., while the braking system consists of a combined vacuum and air brake and screw hand brake. The axles and braking system, in accordance with specifications, are not of Japanese make, but were supplied from England. The control equipment is of the non-automatic, non-multiple, indirect control, electro-pneumatic unit switch group system. The control circuit voltage is 110 V. D. C. The locomotive has a 3-axle monoblock cast steel frame swing bolster system bogie with equalising beams, while the body is of the box type with sides streamlined and with cabs at both ends.

FIRST ORDER

Because this is the first time that such locomotives are being supplied to India from Japan, extreme care has been taken in incorporating the best of engineering techniques to ensure complete satisfaction even under the most rigid operating conditions. The locomotive has been subjected to the most rigid factory tests and inspection in the presence of inspecting engineers designated by the Indian Railways.

Furthermore, the locomotive has certain special features such as some safety points. For example, when the pantograph is raised, entrance to the high-tension compartment is automatically shut off. Only when the switch for lowering the pantograph has been put off does the locking equipment open for entrance to the high-tension compartment.

LOWER PRICE OF JAP. LOCOMOTIVES

Although, when the bids were called, the price quoted by the Japanese manufacturers was low, the Indian authorities were understandably hesitant about placing the order with a Japanese firm. Since the Indian authorities had no experience with such equipment from Japan, they were hesitant to take chances, especially since such costly equipment was involved and they were keen that there should be no delay in the electrification project in the Calcutta area. But the order was finally placed. There is a considerable difference in the prices at which the locomotives are being supplied by the Japanese and English firms. The Japanese firm is building them at a cost of £ 42,800 each, while the nine supplied by the British firm are believed to cost £ 67,000 each, a difference of almost £ 25,000 per locomotive. There cannot, however, be any strict comparison as it is stated that the lower price was quoted by the firm "as a kind of an entrance fee", in order to demonstrate that Japanese Engineering Standards are comparable to the world's best, although this meant a sacrifice to the firm. Nevertheless, the saving might be sizable on repeat orders.

Recently, a demonstration of the new locomotive for India as well as one completed for the Thai Government Railways, was given to which a number of diplomats from Asia, Africa and some South American countries along with newspapermen were invited.

SIGNALLING & TELECOMMUNICATIONS SUPPLEMENT

Signalling for New Electrifications

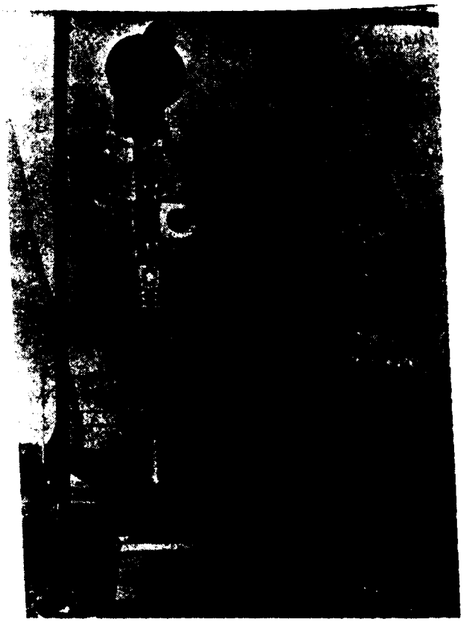
WHEN a railway is electrified, the extent of the signalling work required depends on the previous history of the line. If it is still equipped with semaphore signals, the opportunity is likely to be taken of replacing them with colour-lights. It is possible, on the other hand, that colour-lights will have been installed already while the line was steam-operated, and it then becomes necessary to modify the track-circuits and signalling equipment to immunise them against the effects of the traction current. This work is most likely to be accompanied by a revision of the power supply arrangements, taking advantage of the sources of power available at substations along the line.

Details of the work differ according to the form of electrification adopted for traction. Examples of this are seen in installations on British Railways recently completed by, or now in hand with the Siemens and General Electric Railway Signal Co. Ltd. These fall into four categories as below:

1. Immunisation of signalling on lines converted from steam working to electric traction at 1,500V d. c.
2. Immunisation of signalling on lines now operating at 1,500V d. c. which are to be converted to the high-voltage 50 c/s single-phase system.
3. New signalling on steam-worked lines which are to be converted to the high-voltage 50 c/s, single-phase system.
4. New signalling on lines, now steam-operated, which are to be converted to the 750V d. c. third-rail system.

In category (1) above, the Eastern Region lines from Shenfield to Chelmsford and to Southend-on-Sea were dealt with when the Liverpool Street—Shenfield 1,500V d. c. electrification was extended to those two places. In both cases a power supply at 650V a. c. was taken from the traction substations and distributed to locations and signal boxes by a cable route which also carries the signalling and telecommunications cables. The route is accommodated in ground level concrete troughing where space permits, and otherwise in asbestos cement troughing carried by hangers on concrete posts. At each location the cable is led into the apparatus case through a reinforced-concrete T-piece at ground level, the stem of which fits directly into the base of the case. A termination case, bolted to the side of the apparatus case, contains a 650V/110V transformer, to which the power cable is connected through twin isolating links and two H. R. C. cartridge fuses. Two spare fuses are provided, ready fitted to fuse carriers clipped to the door of the case.

Industrial type power switchboards are provided at signal boxes. Battery chargers, with automatic voltage-regulating characteristics for giving a conti-



S.G.E. searchlight signal on the Shenfield – Chelmsford 1,500V d.c. electrification of British Railways.

Pouring concrete for the fuses of new colour-light signals from a specially-equipped train.

nuous trickle charge to the signal box lever lock and telephone batteries, are mounted on the boards.

Point machines with quick-acting detectors are installed for working certain points on the Shenfield—Chelmsford section which are located too far from signal boxes for convenient manual operation. They take their supply from batteries in lineside cases which also accommodate the trickle-charging equipment. The batteries consist of 88 NIFE 25 a. h. cells contained in insulated crates of 8 cells each.

The lines were already equipped with searchlight signals and d. c. track circuits. It was necessary to convert the latter to a. c., and as double-rail track circuits were required except through points and crossings, both rails being needed for the traction return current, auto-impedance bonds were installed. Single-rail track circuits are capacitor-fed. Existing searchlight signals were modified for operation through transformer-rectifier units housed in the adjacent locations. Certain new searchlight signals with a. c. mechanisms were installed.

Signals within the control limits of stations are operated from manually-operated interlocking frames, to which combined lever locks and circuit controllers were fitted to effect the control of points and signals. These are energised from trickle-charged batteries. At 18 ground frames between Shenfield and Southend, controlling intermediate sidings, station yards, and one level crossing, the existing d. c. lever locks were immunised by operating them through transformer-rectifier units. New relay racks with plug-in relays were installed at signal boxes on both sections.

In due course the lines referred to above, together with the main line from Liverpool Street to Shenfield and beyond, are to be converted for a. c. traction at 50 c/s. The equipment described will therefore be modified for immunity from this frequency. A signalling frequency of 83⅓ c/s has been chosen, and the work includes the provision of new windings for hundreds of relays to adapt them for operation at this frequency, and their protection by resonated filters to oppose the 50 c/s traction current. Some a. c. searchlight signals will be converted to 83⅓ c/s working and d. c. searchlight signals protected from 50 c/s traction currents, while route indicators, banner signals and other auxiliaries will be equipped with protective chokes. The contracts awarded to S. G. E. for this work at Liverpool Street, Fenchurch Street, and from Shenfield to Southend and Chelmsford, also cover cabling for the 83⅓ c/s signalling supply, including specially-screened cable for an independent supply at this frequency to provide additional protection against false operation of relays. The modifications are planned so that the signalling may be converted to 83⅓ c/s while 1,500V d. c. traction remains in use, so that when the changeover of traction system takes place, no further work on the signalling will be necessary and it will therefore be possible to change the form of electric traction on these busy lines virtually overnight.

The Company is also engaged on the installation of colour-light signalling on the Colchester—Clacton—Walton lines of the Eastern Region, where traction at 50 c/s is due to be introduced this year as a pilot scheme for testing new motor coach and locomotive stock. These lines are at present worked by steam locomotives or diesel railcars, and have semaphore signalling. It will be possible to use single-rail d. c. track circuits and signalling apparatus throughout most of this scheme, the apparatus being rendered immune from a. c. by the inclusion of series inductances and similar devices.

The fourth category of signalling for new electrification on which S. G. E. is engaged is that of equipping a main line which is to be converted to 750V d. c. traction with third rail. This work involves the provision of colour-light signalling over 28 miles of the Southern Region, British Railways, main line to the Kent Coast and on the 7½-mile branch line to Sheerness. Relay interlocking control panels will be provided in four signal boxes. Signalling on the Sheerness branch will be remote-controlled by new electronic equipment developed by the G. E. C. Telephone Works, Coventry, to permit a more rapid transmission of control impulses and return indications than is possible with conventional coded impulse systems.

Air Depolarised Primary Cells

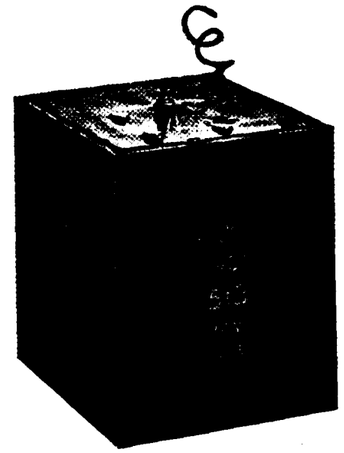
FOR many years Leclanche Wet Cells of conventional types have done useful service, but to keep pace with the forward developments in railway signalling techniques, the need for heavy duty primary cells, having the utmost reliability, has became more and more pressing. Air depolarised primary cells do fill this need. Indeed their value for railway signalling and telecommunication duties has been recognised for many years, and they are now in service all over the world.

However, in this modern era of rising costs, attention has naturally turned to the development of cells which are not only reliable, but which entail the minimum of maintenance work in their duties. This has resulted in the production of a full range of air depolarised cells of the DRY type, the use of which has spread at an astonishing rate during the past decade.

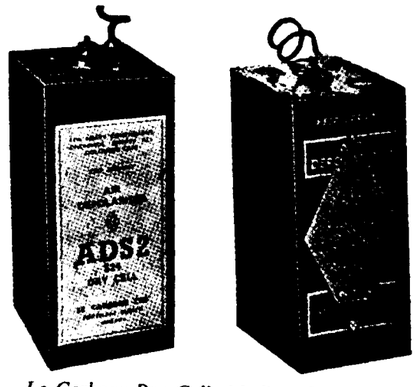
The basic difference between the air depolarised cell and all other types lies in the positive element, consisting as it does of a special porous carbon which actually "breathes" the atmosphere. This porous carbon permits air to circulate within it, so that the oxygen in the atmosphere can be used as a depolariser, thus obviating the need for chemical depolarising agents, which are normally incorporated in the conventional types of cells. The advantage of this system will be obvious, for there is an inexhaustible supply of air, and the life of the cell is therefore governed only by the quantity of zinc available for consumption, and the overall dimensions of the particular cell. It also enables a very steady voltage to be maintained even at current drains well above those possible from ordinary cells of equal size.

As an example, the curve of an ADS2 Dry Cell, measuring 3.5/16" square by 7.1/2" high, discharged on both 10 ohms. and 15 ohms. continuous is shown on page 46. The steady voltage and long life is well illustrated.

Consideration of this point will show why this should be so, for so long as a sufficient internal flow of air can be maintained within the positive element to provide full depolarisation, then the internal resistance remains the same throughout the life of the cell, or at least until the last remnants of the zinc are being consumed.

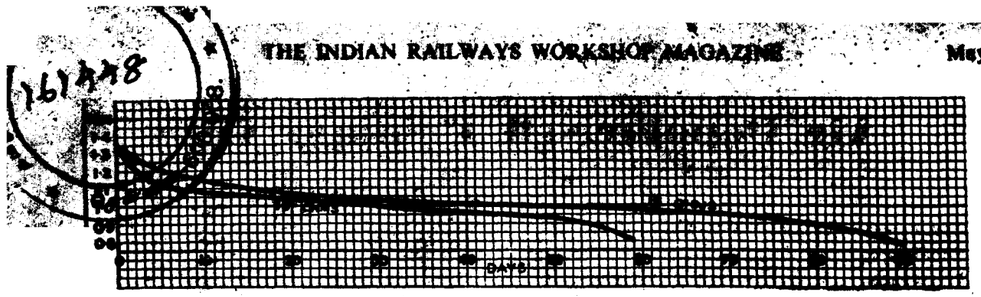


Le Carbone "AD" High Capacity Dry Cell, Type 513



Le Carbone Dry Cells Medium Size Types "AD" 524 and "AD" 526, Carbadia

Another very satisfactory feature of the air depolarised dry cell is its immunity to long periods of storage, because the positive element, consisting of this special porous carbon, contains no depolarising material to deteriorate. This is probably the biggest single factor contributing to the ever increasing use of this type of dry cell, for it enables all users to discard their old-fashioned sacs, porous pots and



"AD" 524 on continuous Discharge through 10 Ohms. and 15 Ohms.

s for the clean and modern air depolarised dry cell, without being concerned with storage problems.

These air depolarised dry cells, which are manufactured to meet the British Standard 1335 : 1946, are guaranteed to give 90% of their rated output after twelve months' storage, and will give a reasonable service life after three years' storage. The full range goes from the small ADS3 size cell (2¾" sq. × 6¾" high), which is admirably suited for telecommunications work, right up to the AD 513 size cell (6¾" sq. × 8¼" high), which has a capacity of 850 watt hours, will discharge at five amps. intermittent and one quarter amp. continuous, and is the most powerful dry cell in the world.

PIPES JOINED WITHOUT THREADS, WELDS

An improved method of joining pipes and tubes, which eliminates threading and pipe fittings, welding or brazing, has been recently developed by an Australian inventor.

The Kempee Combination Tube Jointer, which looks like a standard pipe cutter, joins metal tubing, solid rods, rubber and plastic hoses, ferrules and handles with the aid of sleeves.

The development of the new tool took 32-year old Frank Kemp, the inventor 10 years of research, trial and planning. The inventor found that concentrated pressure on a minute engagement area of metal caused the metal to "flow" or be displaced.

In the application of the principle three high-tensile steel rollers are fitted to the tool. Under pressure, these displace metal in a sleeve, causing it to flow between the sleeve and the section to be joined. Pressure is applied by just turning a threaded plunger.

The joint which can be produced in almost every case in under 5 minutes, is strong, pressure-resistant, and water-tight. There is a saving in labour, time and component costs.

The tool also confers another advantage, which is the freedom from the need to use foreign matters, such as solders, fluxing agents and caulking compounds which sometimes affect the durability of joints.

Metal jointing is only one of the applications of the multipurpose tool. Under the same displacement principle, metal and rubber, metal and plastic, and different types of metals may be joined.

The tool is suitable for use in factories, in the refrigeration industry, railways, water schemes, engineering, plumbing, electrical work, building, farming, and the automotive industry.

The Kempee is available in three models ¾" to 3" outside diameter, 2½" to 5" outside diameter and the Kempee Junior ¼" to 1½" outside diameter.

Licensees for the manufacture and marketing of the tool in Australia and New Zealand are: Alfred Sasshall, Anthon Pty. Ltd., 74, Eagle Street, Brisbane.

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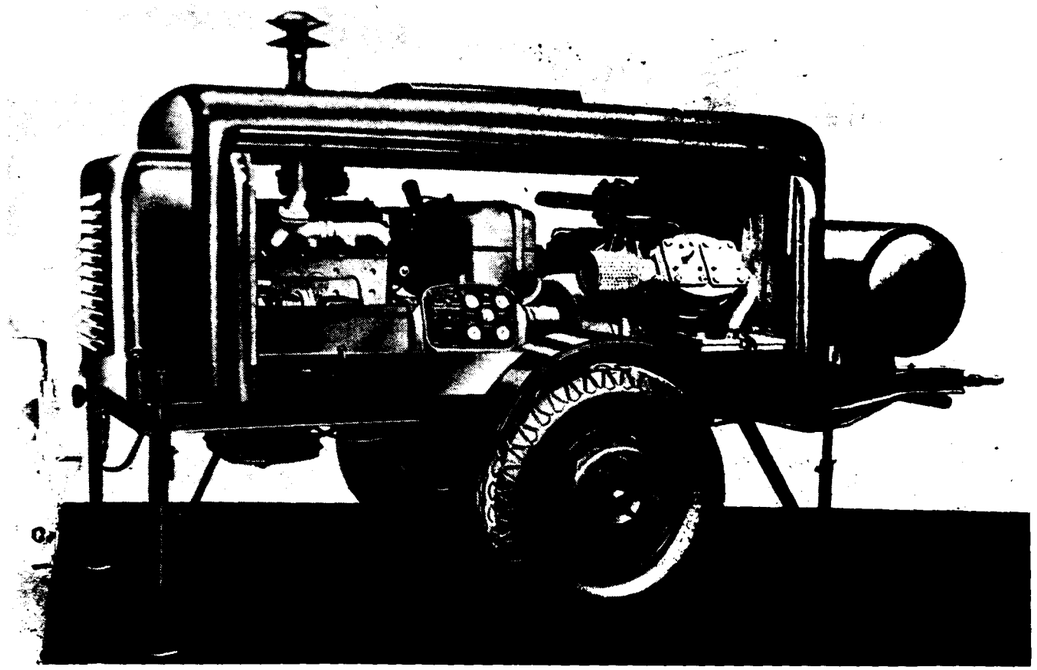

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Speed	960 r.p.m.

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