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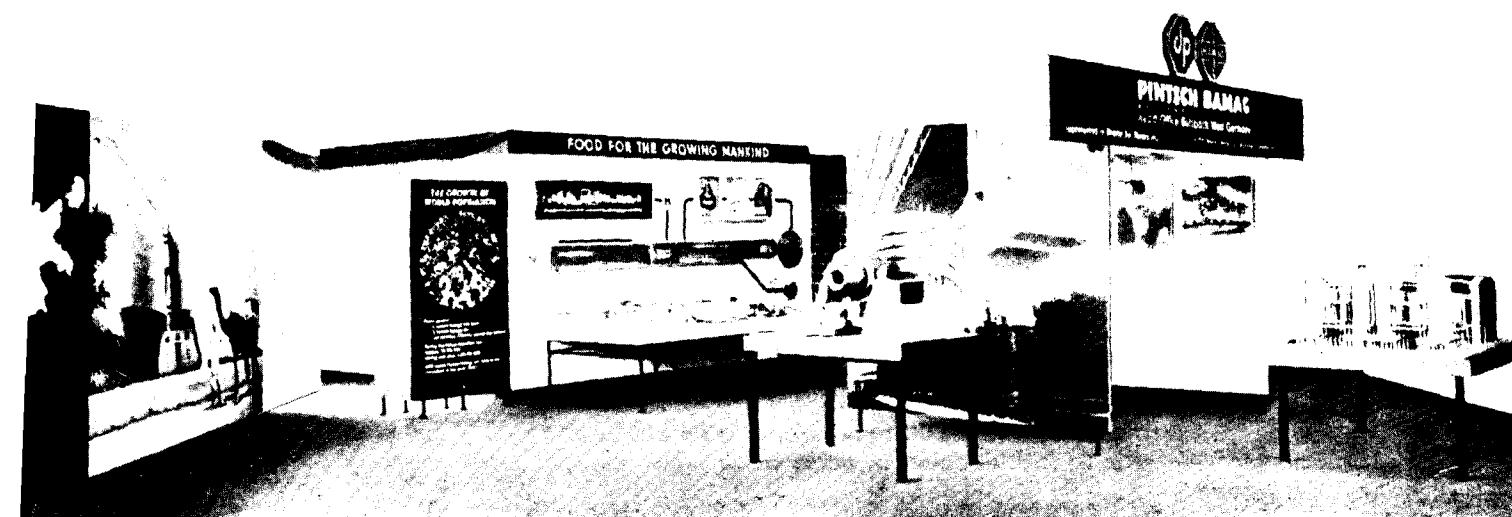
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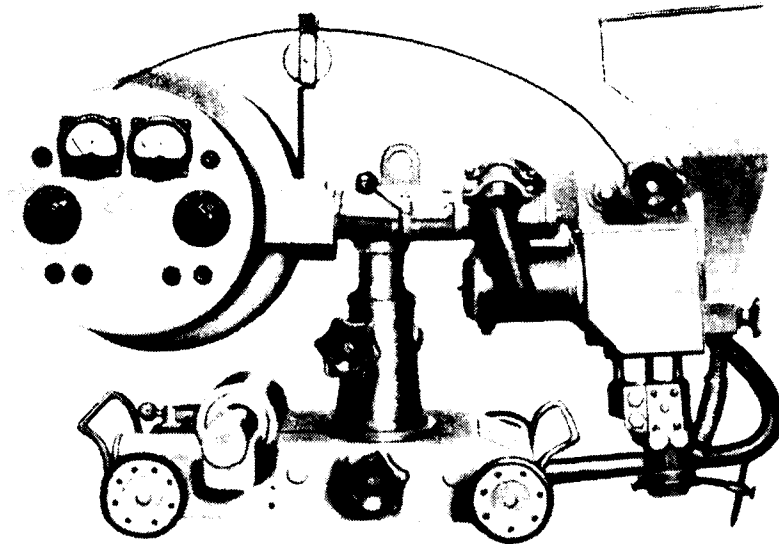
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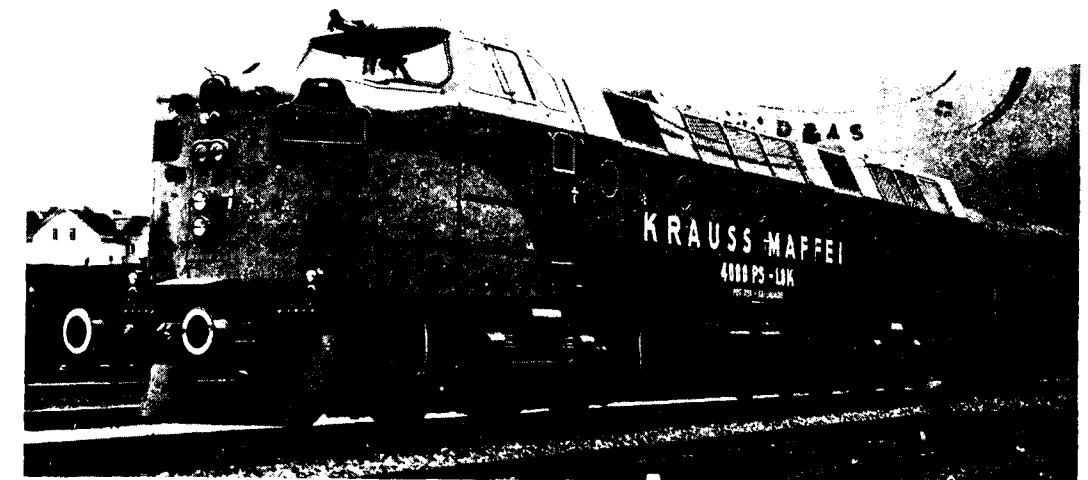
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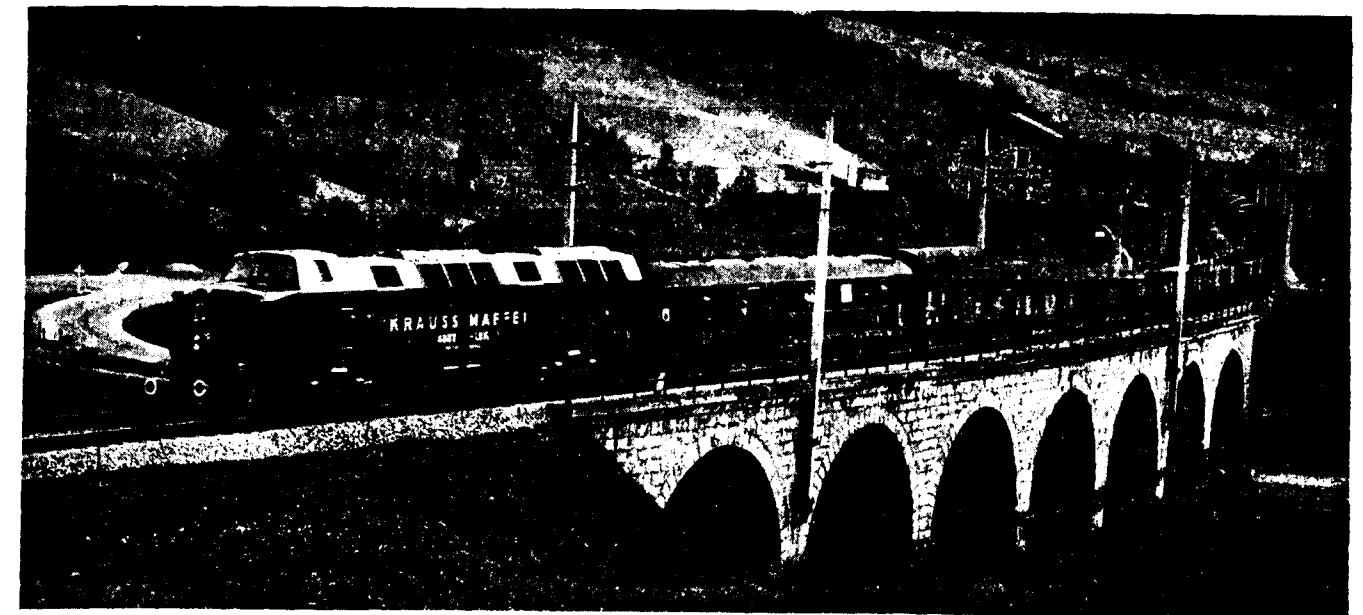
MAYBACH-engined diesel-hydraulic locomotives are assuming world-wide importance

197



4000 b.h.p. diesel locomotives for the U.S.A.

Of the 500 diesel-hydraulic locomotives equipped with high-speed Maybach engines and ranging in power from 650 to 4000 b.h.p., which about a year ago were in course of construction, now the first 4000 b.h.p. units for the Denver Rio Grande and Southern Pacific Railroads have been completed and subjected to successful service trials. With their two 16-cylinder diesel engines they are actually the world's most powerful diesel locomotive units.



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CONTENTS

	PAGE		PAGE
Type 4 MVC New Continuous Butter-Making Machine of Czechoslovak origin	3	New Creation of the Zeiss Works in Jena, German Democratic Republic	66
Rolls-Royce Standardized Diesel-Hydraulic Equipment for Mixed-Duty Locomotives (400-800 h.p.)	7	Coventry Climax—An International Reputation in Three Spheres of Industry	70
Self-supporting Welded Spectacle Plate with a Diaphragm Expansion Joint	11	Testing Instruments for the Textile Industry	73
The Churchill Hard Gear Finishing Machine	16	Controlling Vibration in Structures and Plant	76
Electrolytic Polishing of Aluminium and its Alloys	18	The Nuclear Track Measuring Microscope	81
The Manufacture of Railway Cars in Czechoslovakia	25	Soviet Turbodrills—The best in the World	85
New Types of Welding Machines	30	AB Alpha—Yesterday and Today	88
Seventh European Machine Tool Exhibition in Brussels	34	Mannesmann-Meer AG's contribution to Petroleum Industry	94
Three-Phase Commutator Dynamometer	41	Some Features of OFP 20 Production Gears Hobbing Machine	101
Norton's Range of New Machine Tools	45	SPK 63 Semi-automatic Vertical Lathe with programme Control	107
Large Heat-Treatment Furnace	49	WKV 100 Jig Borer	115
Meritus Barnets' New Type of Spot, Butt and Seam Resistance Welding Machines	51	The Application of Max.-Min. Governors to Rail Traction	122
Greshams' New Range of Transformers	53	Veb Harzer Werke's contribution to the Automobile Ancillary Industry	129
Liquid Solid Separations' New Hydrocyclone	54	4,000 b. h. p. diesel-Hydraulic Locomotives for U.S.A. on test	130
Anchorage and Prestressing Techniques in the production of Prestressed Concrete	55	Third Brno International Trade Fair	136
Strojexport—50 years of manufacture of SKODA Diesel Engines	60	Engineering Notes & News	140
Rise of the Fork Lift Truck	64		

TYPE 4 MVC NEW CONTINUOUS BUTTER-MAKING MACHINE OF CZECHOSLOVAK ORIGIN

By A. Masek Dipl. Eng and Z. Malik,
Czechoslovakia

THE WORLD DEVELOPMENT TRENDS— EVALUATION OF THE MOST IMPORTANT SYSTEMS

THE technical and manufacturing problems occurring in most food industry factories are created by the fact that agricultural products are of a perishable nature, so that they must be processed rapidly. These problems are of considerable urgency especially in dairies where mechanization and particularly automation of all manufacturing processes has not yet been solved satisfactorily.

The construction of a suitable continuous churn is a very important task since the barrel churns fitted with wooden or metal barrels used to a very large extent up to now do not permit continuous operation due to their intermittent operating character.

Dairy construction experts have been working on the design of a continuous churn for 70 years now. The first was built in 1889 by Johansen, a further one by Wahlén and Laval, then others by Salenius, Siedel, Patrik, Fritz, Grischenko and others. All of them have attained only partial results. Their machines produce butter of bad consistence, easily perishable and with an excessive water content. Their universal application in any dairy is further hampered by the fact that these machines can be used economically only for churning of cream with a relatively high fat content.

The entire development of mechanical churning has proved that the difficulty involved in achieving the correct design of a continuous butter-making machine is precise determination of the period required for proper foaming of the entire cream and correct determination of the moment when it is broken up into butter granules and buttermilk. There is, of course, the condition that the cream be properly technologically treated before churning. The preparation and course of churning differ according to the cream composition in different seasons. The most suitable times of the individual operating periods

have been determined only empirically. The consistency of butter from continuous churns is, therefore, much inferior to that from barrel churns, with which the operating periods can be arbitrarily extended, as required.

The continuous churning process eliminates arbitrary extension of the manufacturing stages, the more so the less the possibility of control of the churning elements in operation is considered during the designing stage of the machine.

The unsuitable design of continuous butter-making machines using for their operation the principle of mechanical churning has brought about a new design based upon the theory deriving the change of fraction of the churned concentrated cream from the change of its temperature during processing, without forming first the foam and then the butter granules and buttermilk. Thus a number of continuous butter-making machines has been developed by various manufacturers. These units consist always of several machines and process exclusively cream with a fat content exceeding 80%. The obtained product differs considerably from standard butter, so that it has been evaluated by experts as concentrated milk fat only. The reaction of the consuming public has also not been very favourable.

The results obtained according to this basically differing principle of solution of the continuous production of butter has proved that the method of rapid mechanical churning is the only correct one. For this reason this method has been also chosen as a basis for the design of the new Czechoslovak butter-making machine.

This machine is the result of work based upon thorough investigation of existing designs and a number of tests carried out with a functional and particularly with a pilot plant prototype, during which very valuable facts were obtained. The entire procedure of both the construction and the tests was carried out with very close cooperation of engineering experts and dairy technologists.

ECONOMIC ANALYSIS—RESULTS OF TESTS

The individual operating stages of the machine were first verified empirically by fitting both prototypes with a churning drum made of plexiglass in order to enable continuous control of the duration of the operating processes. The knowledge obtained from the successful results of these tests was checked against the elemental calculations, so that in the construction of the first operating machine both the gained technological experience and the resulting physical and physico-chemical consequences were taken into account.

The pilot plant prototype was tested in one of the biggest Prague dairies in 1956 and 1957. It produced economically more than 15,000 kg. of butter from cream and up to 18°SH of sour cream of a fat content 38 to 42%. From the butter-making machine the butter beam was conveyed by a belt conveyor directly to the forming and packaging machine. Butter was formed and packaged into 1/8 and 1/4 kg. packs which were supplied directly to the shops, or were stored for a short time (a fortnight) at the normal daily temperature. Further these butter packs were stored for a long period (four months) in refrigerating plants at the temperature of -18°C . Due to its excellent flavour, very good consistency equalling easily that of butter made in barrel churns and durability it was preferred by the consuming public to other butter brands of the same quality class.

In the course of anonymous tests of products from various dairies after a fortnight's storage at room temperature and seven months' storage in a refrigerating plant a commission of dairy experts evaluated this butter generally as a product of the first quality class.

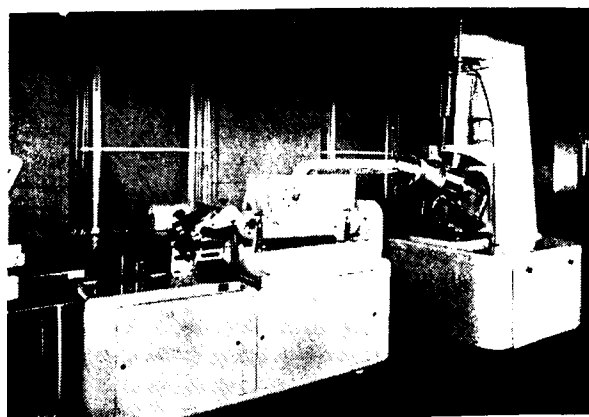


Fig. 1. A General View of the Czechoslovak Type 4 MVC continuous Butter-making Machine.

The results of the tests were influenced by the accomplished very fine dispersion of water in the butter. With regard to continuous production the content of air amounting to 2 to 4% was also very low. The consistency was the same as with butter produced in barrel churns.

Micro-biological tests also showed satisfactory results since the butter was either absolutely free of *Coli-Aerogenes* bacteria or did not contain same even in the first dilution, so that it was approved as microbially sound. After the tests and laboratory investigations had been finished the obtained results were verified by operation of the butter-making machine before an acceptance commission consisting of the foremost Czechoslovak experts from the food industry, health service and engineering industry.

With sweet butter there were no fat losses, since the buttermilk was used for equalizing consumers' milk. In the case of sour butter the buttermilk had the same fat content as that obtained by normal churning of cream containing 40% of fat in kneading churns.

The content of water in the butter is regulated both by the intensity and temperature of the cream fed to the churning drum, and by the dosing device mounted in the machine frame. The central standard specifications for butter have been attained with a tolerance of $\pm 0.5\%$. The design of the machine, which is simple and affords easy control enables the attainment of favourable operating results.

DESCRIPTION

The Czechoslovak type 4 MVC continuous butter-making machine consists of the churning drum, the kneader and the driving equipment (Fig. 1).

The churning drum is mounted in vertical position. It consists of a stator and a rotor (Fig. 2).

The stator is formed by the outside distance rings with inserted discs of annular shape. The distance rings and the discs are air-tightly connected outside the churning drum by means of clamping bolts.

The rotor is of similar design. It is formed by inner distance rings with inserted rotary discs which are fitted on the top surface with 6 to 8 churning bars. The distance rings and the discs mounted on the main shaft are interconnected by a lock nut. The rotor speed is variable within the range of from 900 to

1500 r. p. m. by means of a variable speed regulator. The discs in the drum are mounted in an alternating manner and overlap, so that they are arranged in working couples. The three fundamental conditions of perfect churning, i. e. the number of churning members, their distance and speed, can be varied according to the composition of the cream. Thus economy of churning and good consistency of the butter have been ensured with continuous butter-making machines for the first time.

The surface of the stator discs is diminished in the direction from the top to the bottom. The churning bars mounted on the rotor discs are set in radial and tangential position. They are either of one piece or divided.

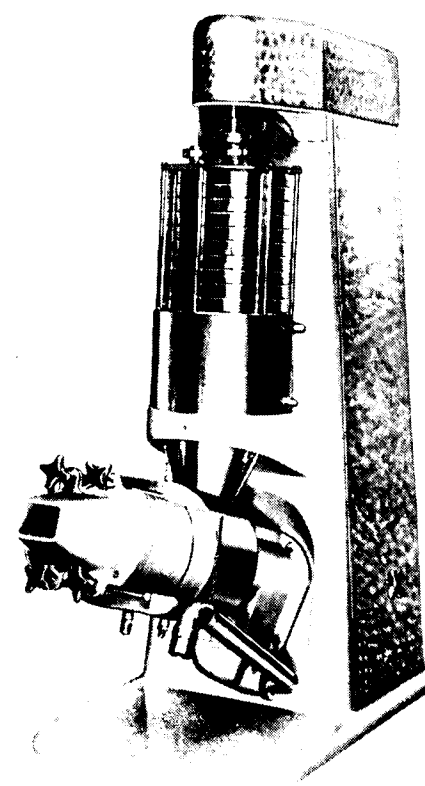


Fig. 2. Stator & Rotor Part of Czechoslovak Type 4 MVC continuous Butter-making Machine. (Churning Drum is mounted Vertically)

Cream flows by gravity on the top surfaces of the stator discs to the top surfaces of the rotor discs. The centrifugal force compels it to flow to their outside edge under continuous, intensive and uniform churning by the bars. At their end the force throws

the cream on the inner wall of the stator distance rings, on which it flows under the turbulent motion to the next, lower stator disc. From the latter it flows again by gravity to the surface of the next rotor disc. The constantly changing direction of the cream flow and its alternating states of rest and intensive stress effect first its uniform foaming, then its breaking and the formation of butter granules which, during the turbulent motion, collect on their surface the remnants of the fine fat globules from the buttermilk.

In principle the churning process in the type 4 MVC butter-making machine is similar to the operation performed in barrel churns, where the state of rest of the cream alternates also with its intensive stress, when it overflows downward under rotation of the barrel. Thus the method of churning of this butter-making machine differs considerably from the operation of the Fritz and Grischenko butter-making machine.

The bottom part of the churning drum is cooled in order to prevent agglomeration of the butter granules into clods. The blades of the blade agitator mounted on the rotor shaft are, therefore, 3 mm distant from the drum wall.

The butter granules and the buttermilk flow from the churn to the collecting sump which is situated in the lowest part of the drum containing counter-current conveying and kneading worms. The butter globules enter the kneading chamber through an orifice. From there they are subsequently fed through three screens into three blending chambers situated in a row. Butter is wiped from the screens by small rotary propellers by which it is again blended. The speed of the shafts carrying the conveying and kneading worms and the small propellers is adjustable.

From the last blending chamber a perfectly kneaded and blended butter beam is extruded which is fed directly into the forming and packaging machine.

The additional water, or water suspension of the cream starter, or the butter ferment culture is fed by the dosing device with an output ranging from 0 to 20 lit. per hr. under a pressure of 0.8 to 1.3 atm. g. into the kneading chamber, where it is finally and uniformly distributed and kneaded into the butter body.

The kneading and blending equipment forms a unit well sealed by four folding clamping bolts.

From the sump the buttermilk flows through a folding pipe into a tank. Its level in the sump as well as in the drum of the conveying worms is thus controllable.

The dosing device mounted on the supporting structure of the butter-making machine is driven from the electric motor of the kneader by means of a gear train.

The electric motor of the churn has an output of 4.4 kW at 1400 r. p. m. The churn shaft is driven from the top over a variable speed regulator and V-belt pulleys, so that the required number of shocks of the bars in the operating couples can be easily adjusted and thus the course of churning as well as the consistency of the produced butter granules affected.

The butter-making machine has a standard output of 400 kg of butter per hr. when churning 800 lit. of cream with a 42% fat content. With a lower fat content of cream and the same quantity the output is reduced in proportion to the lower fat content.

All component parts of the machine coming into contact with cream are made of polished stainless steel with the exception of the kneader castings, which are made of silumine, or another suitable aluminium alloy. The machine covers are made of aluminium.

The electric motor of the churning equipment is fitted with a star-delta contactor combination with a thermal protection.

All electric installations are carried out according to the ESC-UVN standard specifications for moist environments.

The type 4 MVC continuous butter-making machine, which complies with every requirement of modern dairy technology, proves the high standards of the Czechoslovak engineering industry in this field.

MAIN TECHNICAL DATA

Output	400 kg per hr.
Speed of churning equipment	1400 r. p. m.
Speed of kneader worms	38 r. p. m.
Electric motor of churning drum	4.4 kW, 1400 r. p. m.

Electric motor of kneader	2.2 kW, 920 r. p. m.
Applicability: normal and semi-sour cream	Up to 14° SH
Fat content of cream	37 to 42%

THE TECHNICAL DATA ARE NOT OBLIGATORY AND CAN BE CHANGED ACCORDING TO THE LATEST RESULTS OF RESEARCH AND DESIGN WORK

- (1) The Czechoslovak type 4 MVC continuous butter-making machine consists of the churning drum, the kneader and the driving equipment
- (2) The churning drum of the type 4 MVC continuous butter-making machine
- (3) Type 4 MVC continuous butter-making machine
- (4) Type 4 MVC continuous butter-making machine with the type MV 12 butter-packaging machine

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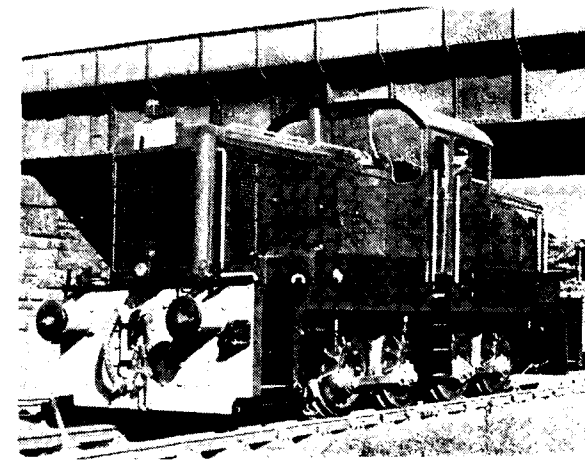
Rolls-Royce Standardized Diesel-Hydraulic Equipment for Mixed-Duty Locomotives (400-800 h.p.)

(By P.R.O.—Rolls-Royce Ltd., U. K.)

1 Introduction

THE versatile transmission system described in this publication is an extension of the Rolls-Royce diesel hydraulic arrangement which has proved itself in service in railcars and shunting locomotives in many countries.

The characteristics of the system make it suitable for locomotives which spend a large part of their working lives on heavy shunting duties, but which are also used for transfer and trip working on main lines.



Yorkshire Engine Company's Taurus locomotive.

2 The differential Principle

The Rolls-Royce Type S differential transmission employs two engines and torque converters. A locomotive may be propelled by No. 1 engine alone, or by both engines. When both engines are driving, they engage opposite sides of the differential. The initial tractive effort is always given by No. 1 engine only.

By comparison with a twin-engine installation without a differential, the Rolls-Royce arrangement gives either:

(a) Higher initial tractive effort and the same top speed

or

(b) Higher top speed and the same initial tractive effort

This publication considers the more common case where the higher initial tractive effort is required.

3 Advantages of Standardized Installation

Many locomotives in the 400-800 h.p. range are powered by single engines. There are, however, a number of arguments in favour of using a twin-engine installation, which may be summarized as follows:

- 1 A railway can be dieselized with one make and type of engine, instead of a variety of engine sizes and powers. Economies will therefore be realized in spares holdings as well as overhaul and maintenance times. It is also worth noting that similar engines with common working parts may also be used in railcar installations.
- 2 The capital cost of a locomotive fitted with this installation compares very favourably with one using any other system.
- 3 The low weight of the power equipment (about five tons per power pack, or 16-18 lb. (7-8 kg. per h.p.) obviates the need to complicate the locomotive structure to save weight.
- 4 Weight can be evenly disposed over the locomotive axles.
- 5 The installation may be mounted in locomotives to run on tracks as narrow as metre-gauge.

- 6 A twin-engine layout allows the use of a central driving cab, giving excellent all round vision.
- 7 Reference to Fig. 1 will show that access for running repairs and cylinder head maintenance is better with engines of the Rolls-Royce type than with a single large engine.
- 8 Maximum availability is assured because when repairs or overhauls are necessary, engines may be detached and re-installed in an operator's local workshop; no heavy lifting tackle is required. There is no need to return the locomotive to the main works.

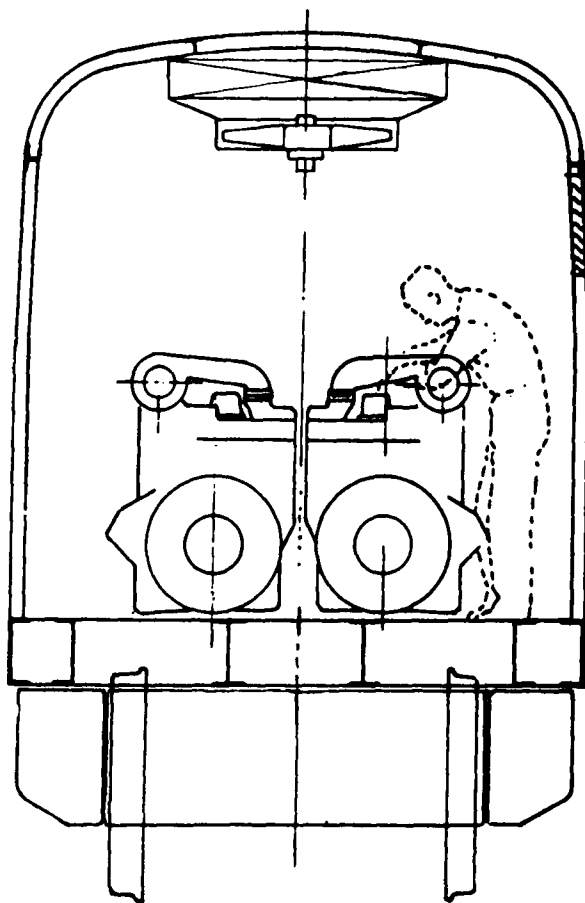
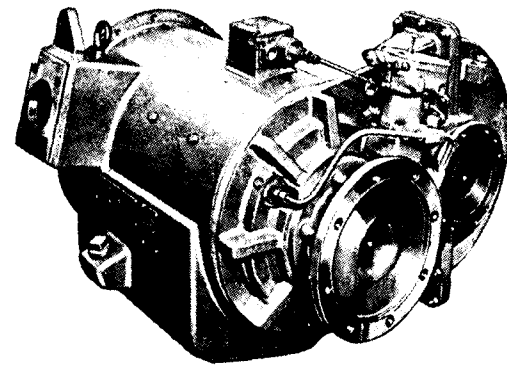


Fig. 1 Access for maintenance is easier with compact engines of the Rolls-Royce type

- 9 Although the equipment is light and relatively inexpensive, the performance of the locomotive is at least as good as that obtainable by other methods of diesel traction. Rolls-Royce diesel engines are conservatively rated to give long life.

- 10 Use of a differential gearbox gives favourable characteristics unobtainable with single-engine installations.



Type CGD. 710 Compounding Differential Gearbox, the heart of the Type S transmission.

4 Composition of Type S Transmission

The installation described in this publication comprises two rationalized diesel engines and three-stage hydrokinetic torque converters, and a compounding differential gearbox; reverse drive is obtained through an axle-mounted final drive gearbox.

5 Installation

The layout of an installation in a typical locomotive is shown in Fig. 2.

The equipment is flexibly installed as two separate units; mounting faces are provided on each.

A cooling system capable of operating in ambient temperatures of 120°F (49°C) may be mounted integrally with each unit.

6 Operation of the type S Transmission

The installation consists of two diesel engines and torque converters, and a compounding differential gearbox.

The drive from No. 1 engine is fed directly to sun bevel wheel A. The drive from No. 2 engine is fed through spur gears in a ratio of 1.875 to 1 to sun bevel wheel B on the opposite side of the differential.

The drive from the differential to the cardan shaft coupling is transmitted by three bevel pinions mounted on a spider.

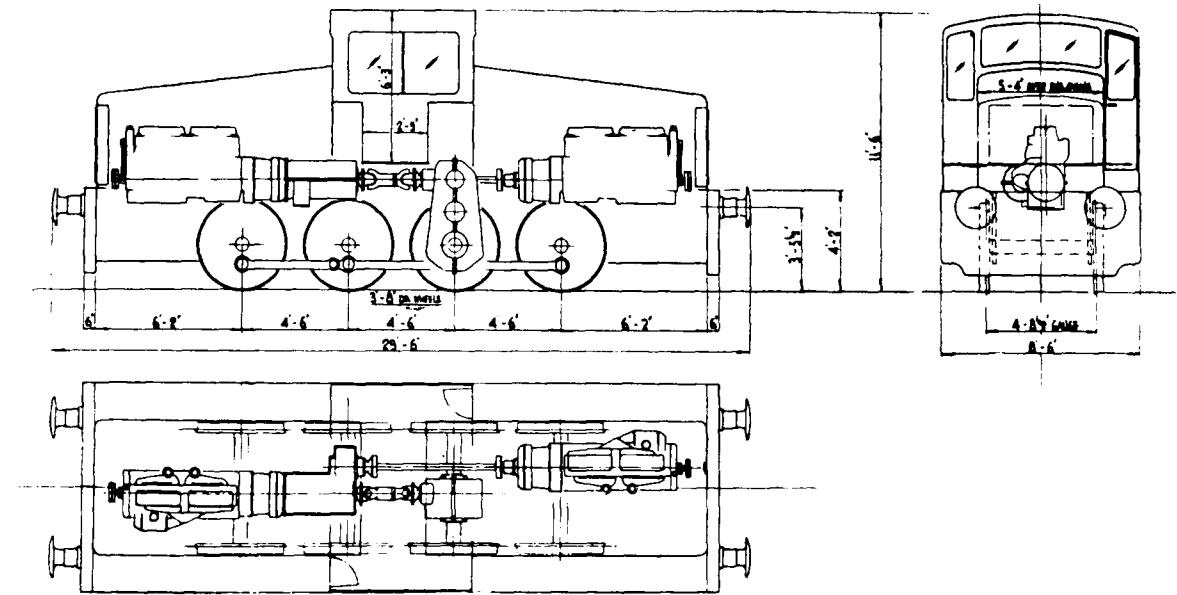
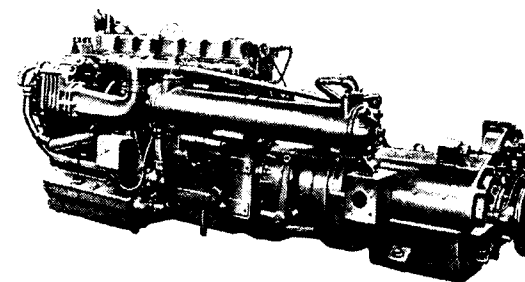


Fig. 2 Typical layout of the Type S transmission

When No. 2 engine is not engaged, sun bevel wheel B is prevented from rotating by a sprag-type free-wheel.

7 From Rest to Full Speed

When the locomotive starts to move, maximum tractive effort is provided by No. 1 engine and torque converter operating alone. In this condition the differential gives a torque multiplication of 2 : 1, so that the overall torque multiplication is in the region of 10 : 1. (The stall torque multiplication of the torque converter is about 5 : 1). The drive from the second engine may be introduced, if desired, when a train has gathered speed. In a typical locomotive this speed could be anywhere between 4 and 14 m.p.h. (6 and 22 k.p.h.).



Rolls-Royce supercharged eight-cylinder engines, as used to power Yorkshire Engine Company's Taurus locomotives. Note the differential gearbox attached to the engine in the second illustration.

The drive from the second engine starts to be effective when the torque applied to sun bevel wheel B is equal to that applied to A. When both engines are running together they are always in balance.

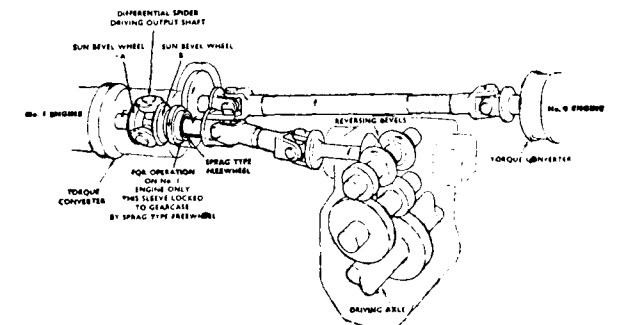


Fig. 3 Arrangement of gears in the Type S transmission

There is no break in torque when the second engine is added or withdrawn. There is no gear changing to be done by the driver.

8 Hump Shunting

During low speed operation, one engine only is working. It can be seen from Fig. 4 that the initial tractive effort given by this engine is unusually high.

9 Summary of Advantages of the Type S Transmission

- 1 At low rail speeds, full tractive effort comes from one engine only.

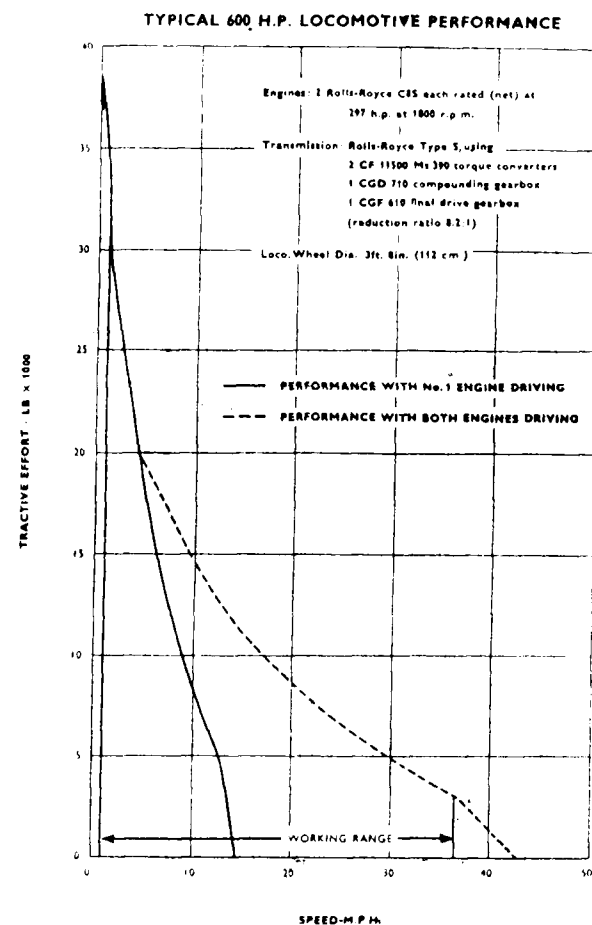


Fig. 4 Typical 600 h.p. locomotive performance

- 2 The 2:1 gear ratio introduced through the differential is ideal when the demand is for maximum tractive effort with a steadily maintained low rail speed.
- 3 The ability to maintain full tractive effort on only one engine nearly halves a locomotive's fuel consumption. This is because the engine is running at a speed at which its specific fuel consumption is lower, whilst the efficiency of its torque converter is higher.
- 4 Continuous working is possible at a very low rail speed.

AMERICAN EQUIPMENT FOR SOVIET TEXTILE MILL

The installation of equipment for a 50,000 spindles textile combine supplied by the American "Intertex" Company is being completed in Kalinin, of the Russian Federation. Equipment for another big textile mill is being installed at Kursk (also in the Russian Federation). The equipment for this plant which will produce terylene fibre has been supplied by the American "Von Kohn International Corporation". At present a number of American companies are negotiating big orders for various Machinery and equipment for the Soviet Union.

- 5 Substantially reduced wear and tear costs result from the use of only one engine when shunting.
- 6 The differential automatically ensures a balance of torque from both engines.

10 Reserving the Direction of Drive.

A means of reversing the drive is built into the final drive gearbox. Two bevel wheels on a cross-shaft are in constant mesh with the input bevel pinion; either wheel may be engaged by a sliding dog-clutch, to give the appropriate direction of drive. Reverse drive cannot be engaged unless the locomotive is at rest.

11 Driving Controls

Apart from the brake, only three driving controls are needed: an engine selector, a regulator, and a reverse lever. The two latter controls operate the engine fuel supply and the final drive reversing mechanism respectively, through air-pressure systems.

The following controls are automatic:

- 1 Engines are governed to prevent stalling on one hand, and overspeeding on the other.
- 2 No manipulation of the regulator is required when the second engine is added or withdrawn.
- 3 It is impossible to change from forward to reverse, or vice versa, unless the regulator is fully closed, the torque converter clutches are disengaged, and the locomotive is at rest.

12 Further Information

Rolls-Royce will be pleased to supply further details of engines and individual parts of the arrangement described in this article.

Self-supporting Welded Spectacle Plate with a Diaphragm Expansion Joint

By Rudolf Kubala

Designer of the MSA Works, Dolní Benešov
Czechoslovakia

PROBLEMS OF WORLD DEVELOPMENT

THE pretentious requirements of world development and the continuous increase of output of heavy industries have put an increased demand on the metallurgical production of crude iron involving the necessity to increase the capacity of its primary production.

Existing blast furnaces were not able to meet the demand of pig iron and, for this reason, new types of blast furnaces of a double capacity have been developed which operate at overpressures increased from the original 0.5 atm. g. to 1.5 — 1.8 atm. g., sometimes even to 2 atm. g. The operation of these blast furnaces at an increased volume presented numerous problems, e. g., transport of gas in mains of a diameter of 3 m or sometimes even larger.

Apart from various problems connected with the design and construction of giant pipe systems, the problem of selecting a suitable and safe seal of the gas pipe had to be solved, too. Requirements on the new seal included: a solid construction transmitting the axial forces of the pipe, without a superfluous internal space which could be clogged by dust deposited from the gas, as the seal was to be mounted also in pipes carrying crude gas. From the point of view of assembly the seal had to be easily accessible, readily controllable even at an overpressure of 1.5 atm. g., and its weight had to be as low as possible.

In original pipes of smaller diameters and low operating pressures blinds are used for seals, sometimes also normal flaps or slides, or turnable spectacle plates with each compression bolt tightened separately and the sealing plate (spectacle plate) turned manually by a rope. Butterfly throttle valves with rubber packings or other seals of a more or less special design were also used for this purpose.

However, for pipes of diameters of 2-3 m operated at a gas working pressure of 1.5 atm. g. the above seals are not suitable any more owing to their tiresome and lengthy manipulation and mainly owing to their unsuitable construction.

DESCRIPTION OF THE ADVANTAGES OF THE SPECTACLE PLATE OF CZECHOSLOVAK DESIGN

Czechoslovak designers have solved the problem of a suitable new seal based on the principle of an open-design spectacle plate. Its parameters are on a world level, and its all-welded self-supporting construction includes a diaphragm expansion joint covered by a Czechoslovak patent (Figs. 1 and 2).

Diaphragm expansion joint 2 of large diameter is mounted in front of the plate body and connected with the latter by means of loose flange 6 and bolts 7 passing through the diaphragm expansion joint and protected by bellows 8. Flanges for the pipe connection are located on both sides of the plate. This design means not only a reduction of the total weight

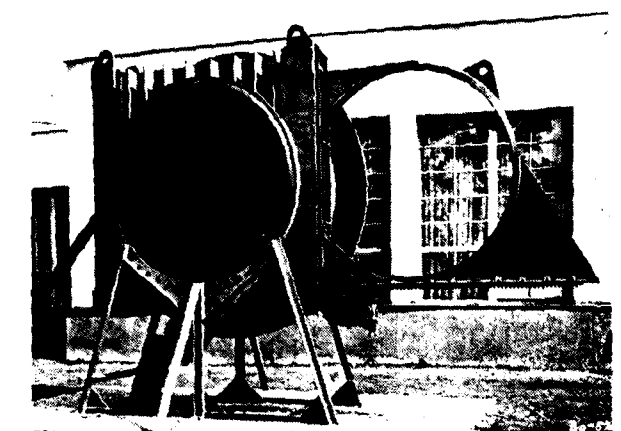


Fig. 1. Self-supporting Welded Spectacle Plate with a Diaphragm Expansion.

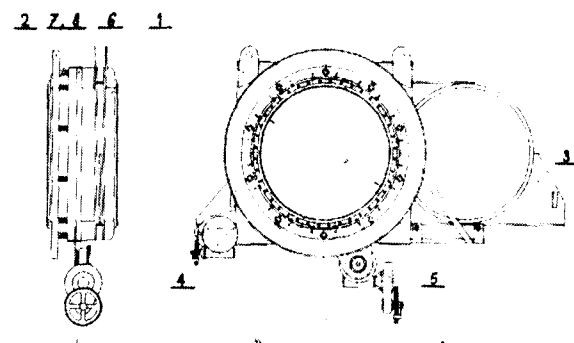


Fig. 2. Description of the Spectacle Plate.

of the plate, but also the possibility to transmit axial forces occurring in the pipe. The rigid supporting columns on both sides of the plate used in other designs for taking up axial forces are not required any more. A free support for taking up the weight of the plate, or possibly a free support in the vicinity of the plate is all that is needed, with no danger of deformation or damage.

The expansion joint of the Czechoslovak spectacle plate is of a large external diameter. It permits advance in axial direction as well as slight shifting in radial direction. Apart from this, it compensates the difference in thermal expansion of the inner and outer component parts of the spectacle plate. Shifting of the movable parts of the body in axial direction (amounting up to 6 cm according to the nominal diameter) gives a sufficient clearance for the sealing plate. Radial shifting may in some cases equalize small overlapping of the opposing sealing surfaces of the spectacle plate.

The expansion joint of a small outer diameter and of a rigid construction represents a shortcoming of spectacle plates of some other designs. A small diameter not exceeding the periphery of the body permits only slight movement in axial direction and none in radial direction. If the spectacle plate is stressed in radial direction, the expansion joint is not sufficiently resilient, it cracks on the periphery or at the point of fastening and gas leaks out. The thus formed crack expands rapidly and a serious threat to the entire metallurgical operation or to the whole work arises. A number of spectacle plates of foreign design is also equipped with an expansion joint of a large outer diameter. However, the joint is connected with the plate body by a movable connection. There-

fore such plates are unable to transmit axial forces. They must have supports of both sides for taking up the forces appearing in the piping and they are not dimensioned for working pressures higher than 0.4 atm. g. Their design requires an additional supporting construction at the bottom of the plate for fixing the clamping mechanism. This is not necessary in Czechoslovak plates. Sealing plate 3 moves on a horizontal path from open to closed position or vice versa, being actuated by controlling mechanism 4 mounted directly on the body of the spectacle plate. The sealing of sealing plate 3 is effected by means of compressing mechanism 5 by which the sealing plate is clamped between the sealing bars of the body and those of the expansion joint. Compressing mechanism 5 is also mounted directly on loose flange 6. The sealing surfaces and sealing plates are made always of metal, ground in the expansion joint body and, in addition, equipped with a labyrinth, an arrangement which guarantees a perfect seal.

In some spectacle plates of foreign make the sealing surfaces of the plate are lined with soft materials, e. g. asbestos strip, or rings of soft sheet metal filled with asbestos, etc.

Plates equipped in this way are perfectly tight, but remain so only for a certain short period of time. Then the asbestos packing is partially destroyed, the plates do not seal, and become a source of continual failures till the packing is completely replaced. These plates must have a special device for tearing off the plate from the sealing surfaces, because, after a long period of clamping, the former sticks firmly to the sealing surfaces of the body and of the expansion joint. However, separation of the sealing plate by the special device results normally in damage to the asbestos seal. Sealing plates of Czechoslovak design have no drawback of this kind, as they are equipped exclusively with metal sealing surfaces with labyrinths, as stated above.

The compression force developed by the clamping mechanism of the new Czechoslovak spectacle plates is transmitted to the movable part of the plate by means of bolts and disc springs. The compression bolts and springs are actuated by means of sprockets with roller chains or internal pinion gear. According to its size, the plate has 12 to 24 clamping points. The advantage of a larger number of points is even distribution of the sealing force along the whole periphery of the sealing ring. A further advantage of this arrangement is reduction of the clamping moment and a lighter construction for mounting the clamping

mechanism. In case of a leakage at any point on the periphery of the sealing ring, the sealing pressure can be increased separately by means of a bolt and disc springs.

A substantially lower number of clamping points, i. e. 3, 4, 8 up to 12, is a disadvantage of plates of foreign make requiring a more robust construction of the whole seal, an increase of the necessary clamping moment, and a robust clamping mechanism.

The newly designed Czechoslovak spectacle plate has an open construction, which means that during manipulation of the opening of the sealing surfaces and transposition of the sealing plate a slot is formed through which gas escapes into the ambient atmosphere. However, the whole process of manipulation of the spectacle plate (opening the sealing surfaces, shifting the sealing plate from one position to another and reclamping the sealing surface), carried out by an electric motor, lasts only about 3.5 minutes, including all idle time, and thus the gas losses incurred have no effect upon plant economy. After closing the pipe with the spectacle plate and after ventilation the gas pipe is definitely gas-free so that maintenance or repair work may be started immediately. In view of the advantage of the possibility to work without any danger of gas poisoning, the loss of gas escaping during manipulation of the spectacle plate is compensated many times.

Spectacle plates made by some foreign manufacturers are of closed construction, i. e. during manipulation of the spectacle plate the chamber of the plate is filled with gas which escapes into the piping. However, with leaking spectacle plates repair workers are exposed to the danger of gas poisoning. Tightness inspections are practically impossible with this type of construction.

Spectacle plates of the new Czechoslovak design may be fitted into piping made of normal material and carrying various non-aggressive gases, e. g. blast furnace gas, coke-oven gas mixed, purified or raw, at a maximum working pressure of 1.5 kg/sq. cm and working temperatures of up to 400°C. The fact that they are able to keep the piping gas-free for an unlimited period of time and without the risk of its being clogged with deposited dust represents a further advantageous property of these spectacle plates. They are mounted as principal seals in the mains of gas piping, main distributors, dust separators and in all gas pipes in general, however, always in open surroundings for the reasons explained above.

They are actuated manually or by electric motor drives. In the case of electrical drives the connections between the individual drives are arranged so as to permit automatic function of the entire manipulating cycle, i. e. opening of the plate body and expansion joint, displacement of the sealing plate and its re-clamping. Electric drives are controlled either from a central board in the control room, or from a control box mounted in the vicinity of the spectacle plate. The sealing plate is equipped with terminal switches in order to prevent its over-shifting.

Compared with similar spectacle plates of foreign make and of the same parameters, the Czechoslovak spectacle plate has, apart from those mentioned above, the following further important advantages.

The new purposeful all-welded design has made possible a weight reduction by about 50%. For instance, the Czechoslovak spectacle plate of a nominal diameter of 2,000 mm and a working pressure of 1.5 kg/sq. cm for blast furnace gas has a total weight of 7,250 kg, whilst a spectacle plate of foreign make has a weight of 13,500 kg, representing a difference in weight of 6,250 kg of cast steel. If we

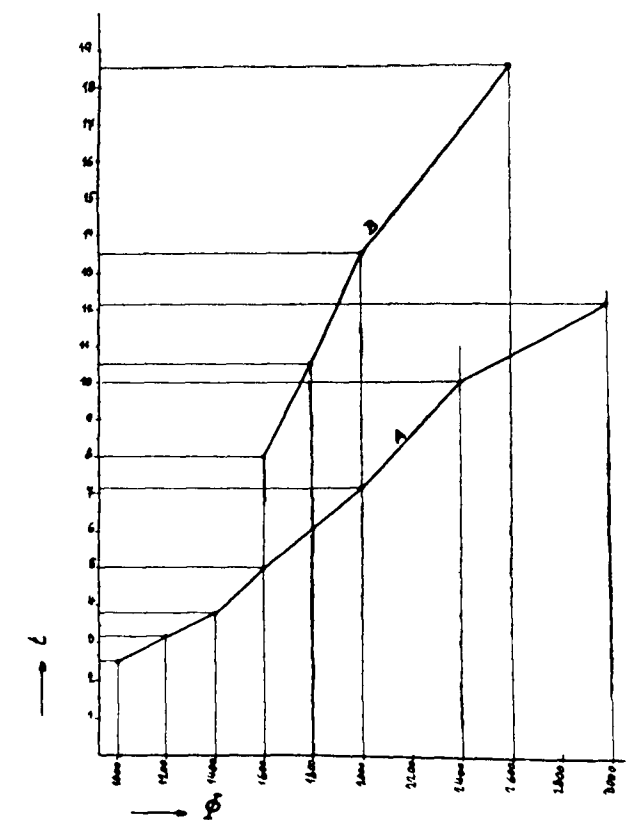


Fig. 3. Efficient comparison of the weights of spectacles plates of the new and old design is shown in the diagram.

consider further that for the 2,000 mm spectacle plate no rigid supporting columns are required, we arrive at a further saving of 8,000 kg of material per each pair of supporting columns. Total savings in materials amount thus to 14,250 kg per one spectacle plate, which is a handsome reduction of investment costs. Another efficient comparison of the weights of spectacle plates of the new and old design is shown in the diagram in Fig. 3.

A further important advantage of the Czechoslovak welded spectacle plates of new design is the fact that they are manufactured of dead material with no internal stresses whatsoever. Consequently, no deformation of the surfaces occurs after machining, in the surfaces of the sealing rings in particular, even after a prolonged period of time. Contrarily, in spectacle plates made of cast steel, in spite of their annealing in the steel works, deformations occur on the machined surfaces after a longer period of time, and these have an adverse effect mainly on the sealing surfaces whose warping is the cause of leakage of the spectacle plate. It is generally known that such deformations appear in heavy castings due to so-called aging. This drawback can be eliminated by aging, i. e. internal quieting, of the castings for about half a year prior to their machining. However, in the accelerated rate of constructions of today it is not feasible to postpone deliveries of spectacle plates because of quieting their castings. Spectacle plates were delivered and made from castings annealed in the steel works, and, in case of deformations occurring at a later date, repairs were made on seals mounted in the piping system. However, such a practice involved increased production and maintenance costs as well as higher investment costs. All these difficulties have been removed and increased costs prevented by solving the problem of the new all-welded design of the spectacle plate. The welded spectacle plates of new design offer the manufacturer and the buyer two further advantages: shortening of the manufacturing cycle and elimination of patterns. The elimination of patterns for steel castings is in itself an important contribution from the point of view of national economy and finance (one set of complete patterns and core boxes for a 2,000 mm. spectacle plate required about 15—20 cu. m. of valuable timber), apart from savings in wages and other production costs. By introducing the production of welded spectacle plates the manufacturing cycle has been reduced to a mere 4 months, i. e. a reduction by 3/4 compared with the 16—18 months required for the production of a cast spectacle plate, including the manufacture of a new pattern and core box.

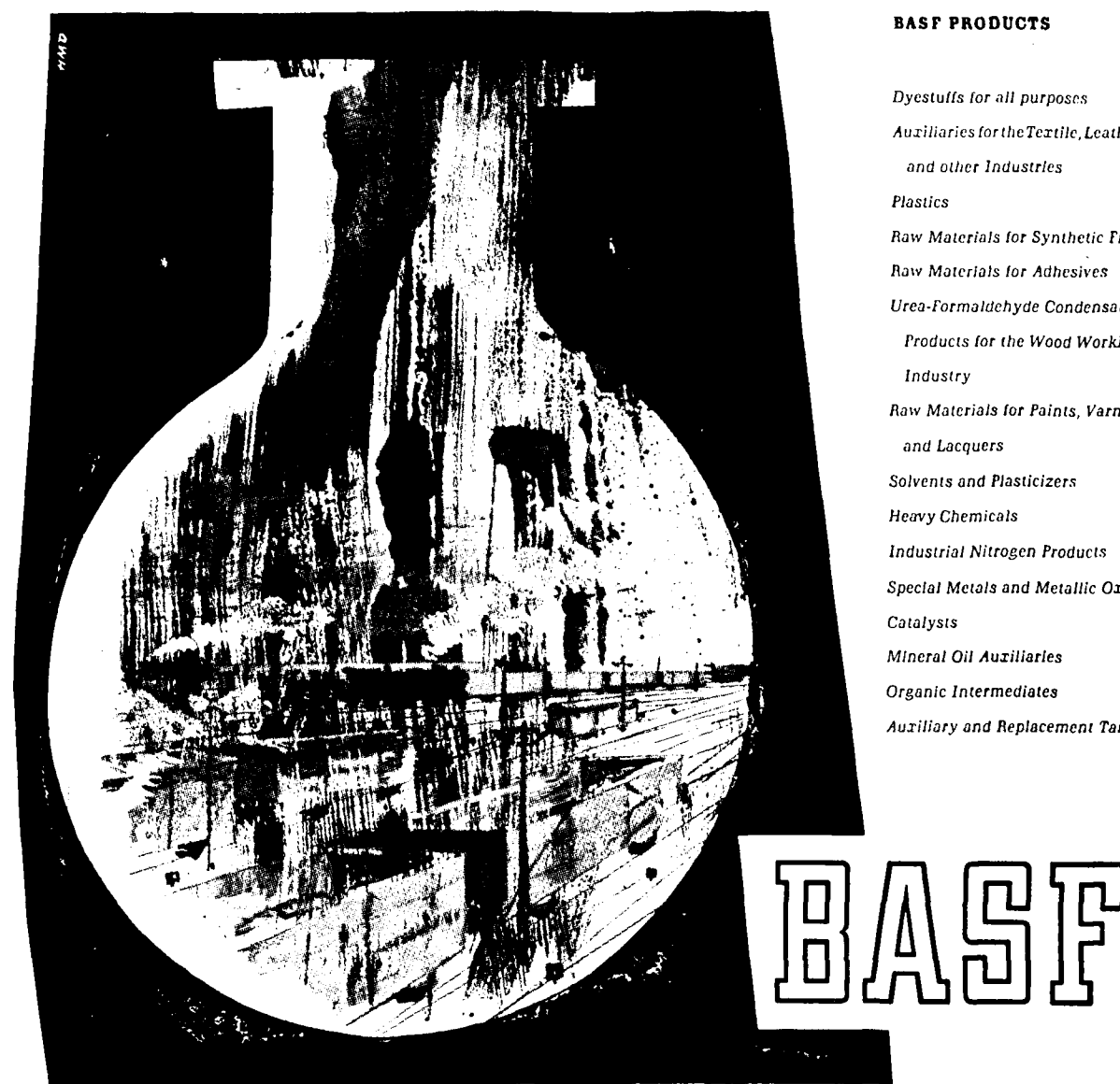
As the Czechoslovak spectacle plate has a "metal-to-metal" seal, all difficulties connected with the provision of spare sealing rings or asbestos strips have been removed.

They require no special maintenance, only the sealing surfaces of the sealing plate must be very carefully greased in order to protect them against climatic conditions.

The Czechoslovak welded spectacle plates of new design comply fully with the present day high requirements of the metallurgical industry. Recently spectacle plates of, for example, a nominal diameter of 3,000 mm. and a working pressure of 650 mm. w. g. for blast furnace gas have been delivered to large metallurgical trusts and put successfully into operation. Spectacle plates of this type have been designed especially for the following conditions: an axial force in the pipe of $\pm 35,000$ kg, a thrust force vertical to the pipe axis in the horizontal plane of $\pm 32,000$ kg, and of bending moment in the horizontal axis of 700,000 kg. m. Similarly a spectacle plate of a nominal diameter of 2,400 mm. for blast furnace gas of a working pressure of 1 kg./sq. cm. and a temperature of 300°C has been designed for an axial force in the axis of the plate amounting to 30,000 kg, a force normal to the axis of the plate of 150,000 kg, a bending moment of 180,000 kg. m. etc. the spectacle plates delivered to the metallurgical industry were within the range of nominal diameters of 1,600 to 3,000 mm.

Main informative dimensions of the welded spectacle plate with a diaphragm expansion joint.

D	L	H	H2
1000	550	1730	820
1200	630	2120	930
1400	710	2460	1050
1600	870	3060	1575
2000	1040	3650	2040
2400	1200	4550	2280
3000	1200	5650	2590



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The Churchill Hard Gear Finishing Machine

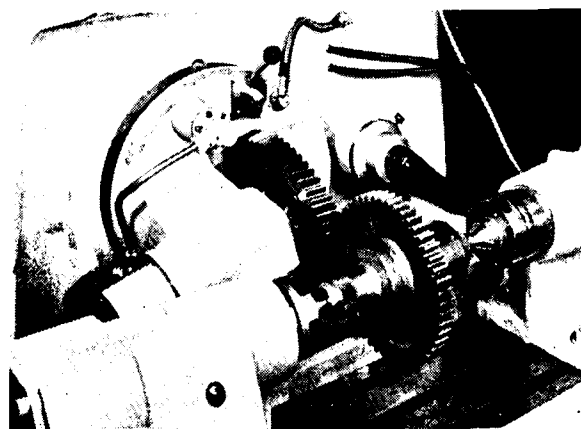
By An Engineering Correspondent

THIS machine has been designed especially to apply the principle of finish honing gears to remove nicks and burrs, and improve the surface finish quality.

After careful study of the application required for a machine of this type, it was decided that it should be arranged with the cutter head at the rear of the work, as this facilitated hand loading and reduced the operating height. It was only possible to design the machine in this manner due to the fact that the pressures required for honing are much less than those needed to finish shave where the "C" frame construction machine offers definite advantages.

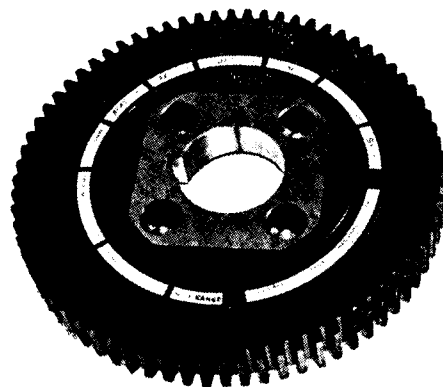
The cutter head is mounted on a cylindrical slide and this can be moved forward as a unit for coarse adjustment. Final application of the hone to the work is through an inner spring loaded cylinder, mounted on ball tracks. This spring loaded slide enables the hone to follow eccentricities in the work, or large nicks and burrs, without breakage, but at the same time the applied pressure reduces these defects to acceptable standards. At the end of cycle the head is retracted hydraulically to facilitate loading.

The knee of the machine is of very simple construction as no up or down feed movement is required, and it is fitted with a conventional table similar to that used on Gear Shaving Machines.



Churchill Hard Gear Finishing Machine.

Table movement is obtained hydraulically and is infinitely variable through a flow control valve.



It should be noted that for the honing operation the table would end its cycle in the centre position, so that when honing pressure is applied there is full face width contact between hone and gear. This is a radical change from the shaving operation where the table always stops at the end of the stroke to give the best loading arrangement.



Churchill Gear Honer.

Spring clamping and hydraulic release of the hone head is incorporated to facilitate the angular setting of the head during set up. It is only necessary to operate the hand valve at the left hand front of the machine to enable the whole head to be easily moved by hand, positive clamping can then be achieved by operating the hand valve in the reverse direction.

The design of the head and tailstocks follows the principle developed on our Gear Shaving Machines and have been proved over a number of years.

The drive to the hone head is through a 1 H. P. 750 R. P. M. motor via a power belt drive to an intermediate pulley and through pulleys and vee belt to

the main spindle. The vee belt pulleys on the intermediate pulley and main spindle can be varied to give speeds of 200, 250, 320, 400 R. P. M.

The electrical controls are arranged in a compartment on the left side of the machine, hydraulics and oil lubrication in a compartment on the right hand side of the machine.

The coolant return has been so arranged that, if desired a clarifier can readily be incorporated in the coolant system.

The honing tool is a comparatively cheap plastic gear, containing an abrasive medium, which is discarded at the end of its life.

COMPUTOR TO WORK ON OIL RESERVOIR STUDIES

An electronic computer is to be used in assisting the British Petroleum Company to calculate the behaviour of natural oil reservoirs as crude oil is produced from them. BP has placed an order with the EMI Electronics Ltd., for a multi-module EMIAC II analogue computer to be installed at a research centre at Sunbury-on-Thames, Middlesex. It is expected that the computer will become operational early in 1962.

This order follows a detailed study by EMI engineers of the possibilities of a new approach to the simulation of the non-linear properties of an oil reservoir. The computer will enable available data regarding flow characteristics of oil reservoirs and the compressibility of the oil and gas mixtures contained in them to be synthesised, thus making it possible to predict optimum operating conditions.

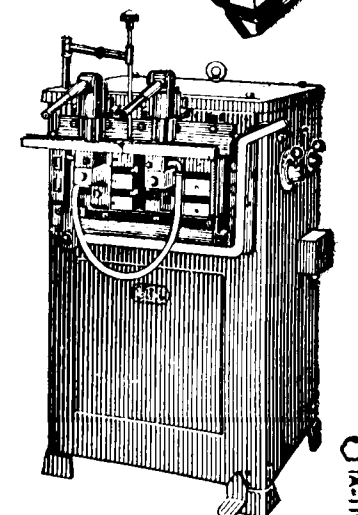
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Electrolytic Polishing of Aluminium and its Alloys

By

B. A. Shenoi, (Miss) K. Vijayalakshmi and
(Miss) K. S. Indira

Central Electrochemical Research Institute, Karaikudi-3

ELECTROPOLISHING which has become an important tool of the metal finisher and metallographer today is a recently discovered phenomenon. The first successful commercial use of electropolishing was in the production of aluminium reflectors by the Aluminium Co., of America's Alzac process with fluoboric acid as the electrolyte. The most of the development work on electropolishing dates from 1935. Jacquet has stated that Nickel, Aluminium, Zinc, Iron, Lead and Tin could be satisfactorily polished in a bath of perchloric acid and glacial acetic acid.

There are many advantages which electropolishing possesses over mechanical polishing. Mechanical polishing in fact is polishing achieved by a series of abrasive operations which bring about the levelling of the surface by viscous flow of the material. The superficial layer of the mechanically polished surface has a structure entirely different from the bulk of the material. In electropolishing levelling of the surface takes place by the selective dissolution of the metal surface itself and the metal mass becomes more homogeneous. Electropolishing is of great value in the preparation of specimens for metallographic examination and for revealing the structure in a distorted condition.

The chief advantage is that once the technique has been evolved the element of skill is unnecessary and polishing is effected in a shorter time. The electropolished surfaces are highly reflecting and the corrosion resistance is improved due to removal of deformed surface zones with their local potential differences and to the presence of a passivating film after treatment.

Theory: A general theory of electropolishing should explain both smoothing and brightening action. Smoothing may be defined as the production of a surface free of large scale impurities and it is controlled by the viscous layer of reaction products around the anode. Brightening may be defined as the production of a lustrous surface free of etch pits and this pheno-

menon is controlled by a thin film on the surface of the anode formed during the process.

Various theories have been put forth to explain the phenomenon in terms of the viscous layer.

Jacquet¹ gave importance to the ohmic resistance of the liquid layer. Later Hickling and Higgins² showed that the current density over an elevation of 0.15 mm. may be about 2.5 times that over a depression. This could explain macropolishing but not micropolishing. Elmore³ expressed a mechanism which explained that under conditions where film dissolution is controlled by diffusion of the metal ions away from the surface, differences in concentration gradients between the anolyte in the valleys and the crests of the surface have a profound influence on the reactive film dissolution at these points.

Then Halfaway^{4,5} put forward a theory of polishing different from that of Elmore. He explained that the dissolution of the metal was not so much controlled by diffusion but by the distribution of the anions over the asperities and depressions on the anode. Edwards⁶ demonstrated experiments and showed that viscosity played an important role and the polishing effect was due to the impoverishment of the anolyte in respect of acceptors. Wagner's mathematical analysis⁷ based on the mechanism of diffusion of the acceptors agreed with Edward's observations.

U. R. Evans⁸ put forward the passivation theory based on the passivation of the depressions on the surface. But practically these regions are also subject to dissolution.

The presence of a thin film⁹ on the surface of the anode detected by the Mercury wet test by Hoar and Farthing¹⁰ explains the difference between etching and brightening. The film follows the contours of the surface and is attacked uniformly by the electrolyte and this causes brightening as Edwards⁶ has shown that uniform metal removal also will bring about polishing (levelling).

According to Doss and his co-workers¹¹ the electropolishing process can be easily understood if the existence of a unimolecular or fine grained polymolecular solid film of a dielectric is postulated.

ELECTROPOLISHING PROCESSES AND TECHNIQUES

A considerable amount of work has been carried out by many authors in investigating the possibilities of electropolishing aluminium. For effective electropolishing the conditions of the surface must be controlled so that the elevations of the anode surface are dissolved at a much faster rate than the depressions. The polishing bath must be suitably designed and the temperature and anode current density must be controlled within suitable limits. The selective attack of the metal occurs in such a manner that the surface becomes smooth and bright. The amount of metal that goes into solution is dependant on the time of treatment, current density, temperature, and also on factors governing the rate of formation and dissolution of the film as well as the diffusion rate.

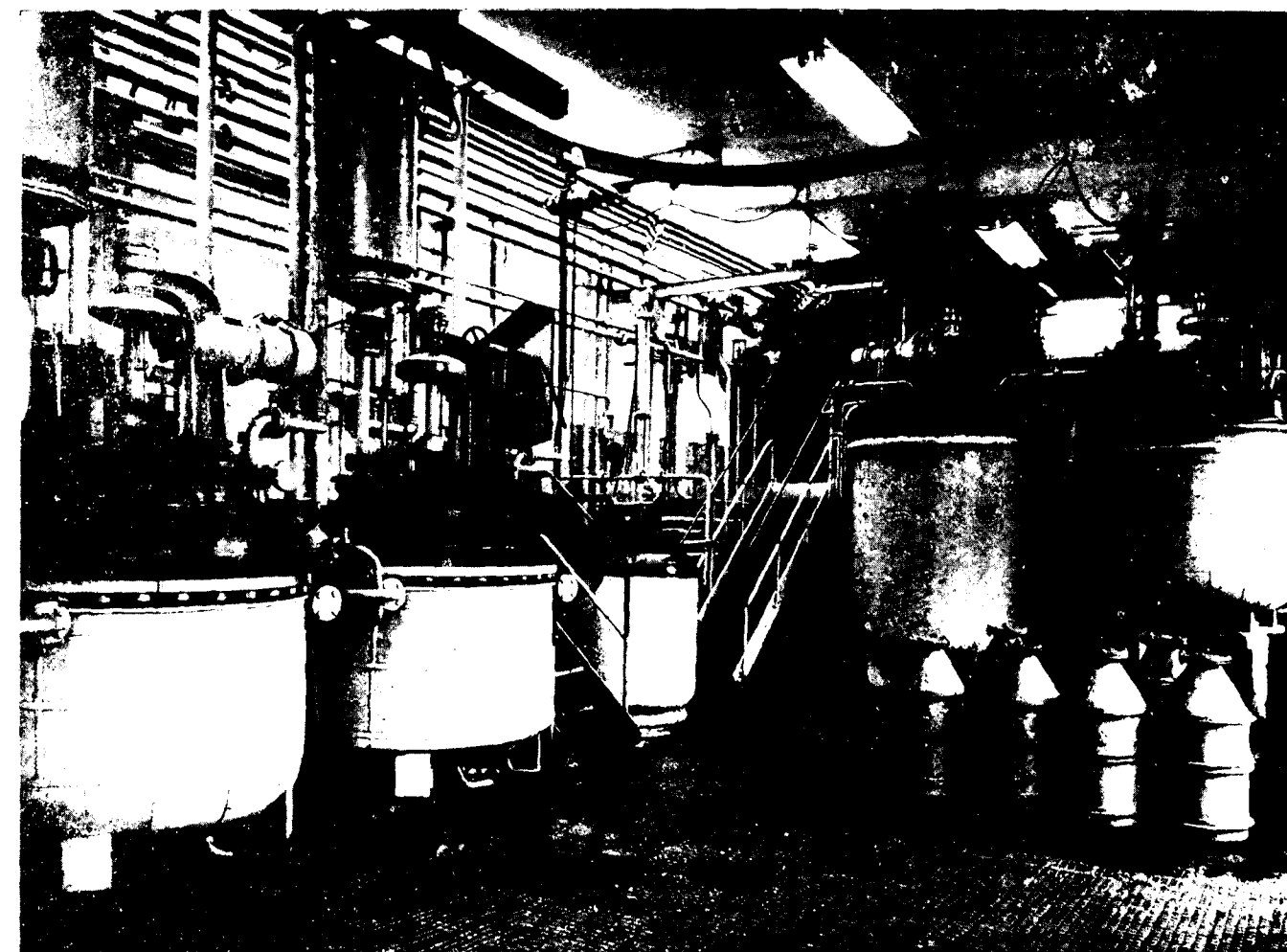
In designing electrolytes one should remember that the polarisation film on the anode surface must be such that all the phases are attacked at the same rate. Otherwise selective attack of one phase or the other will take place with the etching result. Though this is not essential in the case of single phase alloys, it is very important with polyphase systems like carbon steel, low brass and 17 ST. aluminium. Various electrolytes have been used for polishing aluminium electrolytically. The solutions are rather viscous and average conductors of electricity. The electrolyte composition, and conditions of operation are given in the table.

Pretreatment: TREATMENT BEFORE ELECTROPOLISHING

Cleaning is very important for best electropolishing results. Various methods may be employed such as soak cleaning, electrocleaning, solvent degreasing or vapour degreasing. Mostly a combination of these types is used.

No.	Bath composition	Conditions	Remarks
1.	200 c.c. perchloric ¹¹ acid (d = 1.60) 700 c.c. acetic anhydride	c.d. = 0.2 to 0.4 amp/cm ² (according to the composition of the alloy).	Preliminary enrichment of the electrolyte with Al+++ (5 g/litre)
2.	345 ml. perchloric ¹² acid (sp. gr. 1.55) 655 ml. acetic anhydride	t = 25°C V = 15—30 c.d. = 0.8 to 2.5 amp/dm ² Circuit = Potentiometric Cathode = Aluminium	Useful where a smooth strain free surface is required. During polishing the anode should be agitated. The anodic film should be removed by washing with a strong jet of cold water. To increase the viscosity and enhance polishing 5 gm/litre Al should be added to solution before use.
3.	125 c.c. perchloric ¹³ acid (d = 1.6) 875 c.c. acetic anhydride	t = 20—25°C V = 15—25 (for specimen 2 cm ²) T = Several minutes	Cathode is stainless steel 18 : 8
4.	230 c. c. perchloric ¹⁴ acid 770 c. c. acetic acid	t = 5°C V = 15—32 (according to the com- position of the alloy) T = 5 min.	—

No.	Bath composition	Conditions	Remarks
5.	50 ml. perchloric ^{1,6} acid (1.6) 100 ml. glacial acetic acid	V = 35—70 Volts C. D. 10—15 amp/dm ² T = 10—25 sec. temp. below 35°C	Stainless steel or Al cathode is used. Useful for rapid specimen preparation. During polishing the anode is agitated preferably by rotation. Prolonged polishing time causes the solution to heat up and produces etching of the anode. This electrolyte is now explosive but care should be taken when handling perchloric acid.
6.	100 c. c. perchloric acid ^{1,6} 400—500 c. c. ethyl alcohol (or methyl alcohol)	t = 30°C V = 10—15 Volts C. D. 0.15 to 0.20 amps/cm ²	—
7.	200 ml. perchloric acid ^{1,7} (Sp. gr. 1.25) 800 ml. ethyl alcohol	V = 35—70 V C. D. = 100—400 amps/dm ² t = below 35°C Time = 10—25 Sec.	Useful for rapid specimen preparation. The high current densities used lead to "Polish attack" of the anode. Most Aluminium alloys except those containing Si or Mg ₂ Si can be polished satisfactorily for routine examination.
8.	200 c. c. perchloric acid ^{1,8} (d = 1.20) 700 c. c. of ethyl alcohol 100 c. c. butyl cellosolve	V = 40—50 Volts Time = 15—30 secs.	Disa electropol.
9.	70 ml. perchloric acid ^{1,9} (1.61) 1680 ml. methyl alcohol 250 ml. glycerine	V = 70—80 V C. D. 50—150 amp/dm ² Time : 10—20 Sec. Temp. below 35°C	Aluminium cathode is used. Used for polishing Al—Si alloys. Precautions must be taken against sparking and over heating since the solution is inflammable.
10.	200 ml. perchloric acid ^{2,0} (1.48) 1000 ml. ethyl alcohol	V = 20 V C. D. 30 A/cm ² T = 2 min. t = below 35°C	Modification of polish attack method. Larger areas can be polished due to smaller currents passing.
11.	400 ml. orthophosphoric ^{2,1} acid 380 ml. ethyl alcohol 250 ml. distilled water	V = 22—30 V C. D. 35 amp/dm ² T = 4.6 min. t = 42—45°C	Anode rotation is necessary with a small anode. Conditions rather critical varying with the age of the bath ; possible formation of a film of alumina. It should be removed by washing with a strong jet of cold water.



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No.	Bath composition	Conditions	Remarks
12.	By Volume ^{2,2} 53% orthophosphoric acid (d 1.69) 26% water 20% carbitol 1% hydrofluoric acid (48%)	V = 80 initially then 40 when c. d. reaches 0.6 amps/cm ² . If c. d. is too low a thick film of alumina forms. T = 2—3 min.	Large volume of the bath and stirring required.
13.	By volume ^{2,3} 60% orthophosphoric acid (d 1.69) 40% sulphuric acid (d 1.84)	t 70°C C. D. 0.7 amp/cm ²	—
14.	820 ml. orthophosphoric ^{2,4} acid (d. 1.69) 135 ml. sulphuric acid (d 1.84) 160 gm. chromic acid 100 ml. water	Voltage = 10 volts C. D. 12 amp/dm ² T = 5 min. t = 95°C	Solution is stable in operation. The temperature is fairly critical. If it falls below 95°C oxidation occurs.
15.	100 c.c. Nitric acid ^{2,5} 100 c.c. methyl alcohol	V = 4.7 Volts. C. D. 0.1—1 amp/cm ² T = 10 sec. 2 min.	Explosive

The three main industrial polishing processes are (1) The Brytal process, developed by the British Aluminium Co., (2) The Alzak process, developed by the America Aluminium Co., and (3) The Batelle process, developed by the Batelle Memorial Institute.

The Brytal process:—^{2,6} This process involves a two stage anodic treatment. Brightening and Anodising using direct current.

Brightening bath consists of an alkaline electrolyte. As aluminium is amphoteric by nature, it is attacked both by acids and alkalis.

Solution : 150 g sodium carbonate (anhydrous)
50 g trisodium phosphate
1000 ml water.

Cathode : Mild Steel (Cathode area : anode area = 5 : 1)

Voltage : 10 V

Current density : An initial c. d. of 4.3 to 5.4 amp/dm² falling to 2.5—3 A/dm² during polishing.

Time : 8 — 10 min.

Temp : 78 — 82° C (172—180° F)

This treatment produces a very thin transparent film and improves the surface of the metal. The current falls after a short time due to the formation of the anodic film. The pH of the solution must not fall below 10—10.5 and the pH is maintained by adding ammonia or hydroxyl amine. After treatment the articles are removed rapidly and rinsed in cold running water as otherwise the electrolyte would attack the thin film formed during the brightening process.

As the film is not self-protecting, the anodising treatment is carried out to stabilise the film.

Anodising treatment :

Solution : 250 gms of sodium bisulphite
1000 ml water.

Cathode : Stainless steel.

Voltage : 12 V

Current density : 0.65 — 0.87 A/dm²

Time : 20—30 min.

Temp : 20°C

The article after this treatment is washed in cold water and sealed in distilled water heated to 80°C, for 15 minutes. The film can be made transparent by immersing the article in 10% H₂SO₄ at room temperature. Then it is washed in cold water and dried.

The Alzac process :^{2,7}

The electrolyte in the polishing treatment consists of fluoborates :

Solution : 25 g fluoboric acid
1000 ml. water.

Voltage : 10—25 V

Cathode : Al or Cu

C. D. 2.6 A/dm²

Time : 5—10 min.

Temp : 30°C

Batelle Process :^{2,8,2,9}

The electrolyte consists of orthophosphoric acid and sulphuric acid :

Solution : 400 ml H₂SO₄
600 ml orthophosphoric acid
10 ml glycerine

Cathode : Stainless steel.

Voltage : 5—15 Volts.

C. D. 11—16 amp/dm²

Time : 15 min.

Temp : 60°C

The electrolyte in the polishing treatment consists of fluoborates :

Solution : 25 g fluoboric acid
1000 ml. water.

Voltage : 10—25 V

Cathode : Al or Cu

C. D. 2.6 A/dm²

Time : 5—10 min.

Temp : 30°C

The surface is removed from the electrolyte after treatment and the polarised film covering the surface is removed by immersing it in a hot alkaline solution.

Anodising treatment :

Solution : 70 ml H₂SO₄
930 ml water.

Cathode : Stainless steel.

Voltage : 20 V

C. D. 1.3 A/dm²

Time : 10—20 min.

Temp : 20°C

After anodising, the film is sealed by immersion in water at 80—100°C for 10 min.

After polishing treatment, the article is rinsed in cold water and anodised in a 10% solution of sulphuric acid. The surface is sealed by immersion in hot water.

APPLICATIONS

Electropolished and anodised aluminium reflectors are widely used for search lights aircraft, landing lights, cinema projectors etc., where high reflectivity and resistance to corrosion are required. Reflectors for radiant heaters employing electricity, gas and oil can make use of this (E.P) material which is particularly effective in maintaining its high initial reflectivity to infrared radiation.

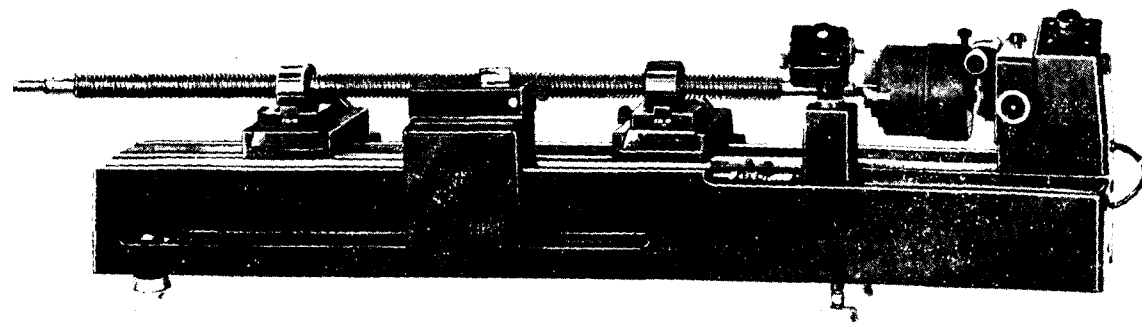
Bright anodic finishes are applied to such varied items as decorative trim for refrigerators, household equipment, motor cars, costume jewellery, military buttons, and badges, watch, bracelets, clock cases, pencils, and a variety of silver items. Electropolished aluminium mostly finds its application in decorative anodising. The possibility of dyeing the anodic film to give a variety of brilliant colours is the main advantage and in particular an orange yellow dye bath can give a finish resembling that of gold.

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The Manufacture of Railway Cars in Czechoslovakia

By **Jaromir Vojtech**, Dipl. Eng.
Research Institute of Railway Cars, Praha

SINCE the territory of Czechoslovakia was among the first on the European continent to witness the introduction of railways, the building of railway cars was also started very soon, so that now this industrial branch has a tradition of more than one hundred years' standing. It is quite obvious that during such a long time the manufacturing programme has been constantly extended, until nearly all types of cars, from the simple ones to the most complicated models have been included, both for inland railways and for numerous customers all over the world.

The contemporary railway car production in Czechoslovakia has been concentrated in the Association of National Corporations, the Czechoslovak Tatra Railway Car Building Works. This association incorporates specialized factories and a research institute. Its manufacturing programme is in line with the main trends of the modern technical development of railways, i.e. electrification and motorization of traction, improvements of the quality of passenger traffic and mechanization of transloading operations in the goods service.

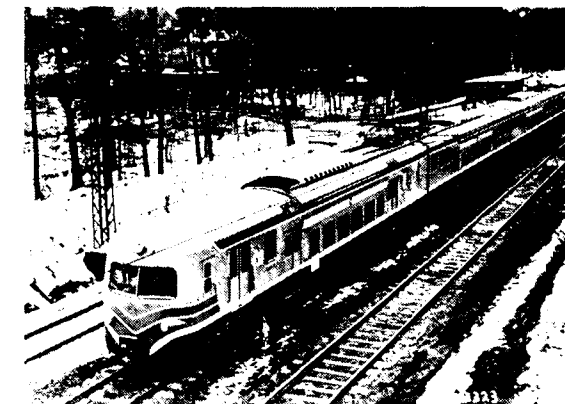
The most important new products which can successfully compete with foreign ones and in many aspects even surpass them, include railway cars of new types which will economize operation and speed up wagon circulation. Among freight wagons they include types for multiple-purpose application of the Zsa and Vsa series which are completely new features of their kind and quite unique on all world markets. The passenger coaches are of excellent design, very spacious and comfortable, affording smooth travel, with excellent ventilation and lighting. Some of these coaches were exhibited at the International Trade Fair in Brno, 1960.

Among these new types of products are first of all the four-car electric motor units of the EM 475 series intended for high speed passenger traffic on electrified lines in the areas of large industrial centres.

All cars of the unit are motor railcars (each with one driving bogie), two cars (a half of the unit) always forming a technical entity. The control is situated at

the end of the unit only, which thus forms the smallest train. A train can, however, be formed of up to three units, i.e. consisting of twelve cars controlled from the first railcar.

In order to speed up boarding and leaving of the cars by passengers and thus increase the travelling speed to 60 km. per hr. even when stopping at every railway station the entrance has been situated in the



Electric motor unit for suburban traffic.

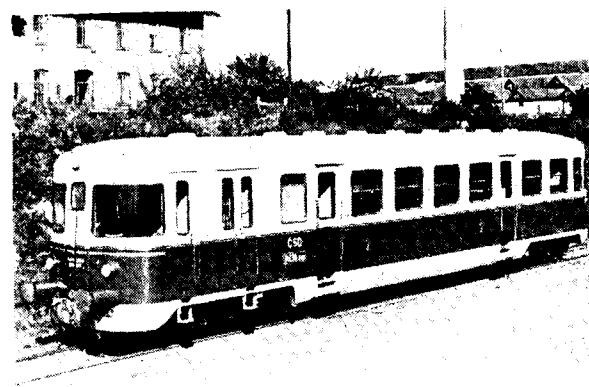
low part of the coach between the bogies, the floor of which is almost on the level of medium-high platforms, so that footboards have been eliminated. The sliding entrance door is remote controlled.

All coaches of the unit have been uniformly furnished as 2nd class coaches with lightly upholstered seats arranged crosswise on both sides on the central corridor with longitudinal luggage racks. The windows are of semi-sash design with a fixed lower half. Over-pressure air-conditioning ensures a fifteen-fold change of air in winter and a thirty-fold change in summer; the respective machinery equipment is mounted over one entrance space. Electric resistance heating has been used as well as fluorescent tube lighting.

The electric unit has been designed for 3,000 V, d. c., but within certain limits it can be operated also on 1500 V. The output of the motors is 1,520 kW, maximum speed 100 km. per hr., starting acceleration

0.7 m. per sq. sec. The electric apparatus are mounted in the railcar box over the driving bogie, the resistors being situated in the roof. The total length of the unit is 93.6 m. and its weight is approximately 180 tons. It contains 302 seats and can accommodate 380 standing passengers.

In comparison with steam traction the electric units have improved the speed, cleanliness and economy of railway traffic. Considerable saving of time and power, as well as increase in railway line capacity have been achieved. As compared with trains driven by an electric locomotive electric units enable quick adaptation of the train size according to the number of passengers,



Railcar for local and district traffic.

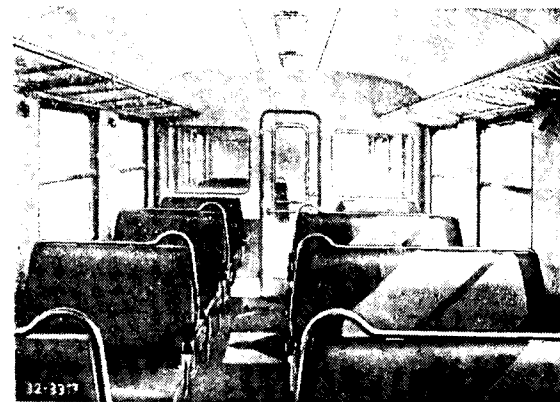
while maintaining the relative performance and the advantageous interval between the individual trains.

From the described type units for long distance lines and units for alternative and direct current can be derived, as required.

The eight-wheel railcars of the M 230 series, designed in accordance with the ample operating experience obtained with the previous types of four- and eight-wheel types, are intended for motorization of traffic on short and medium distances.

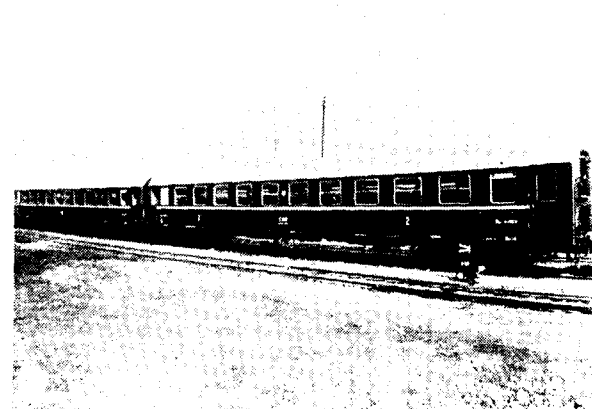
They are driven by a twelve-cylinder Tatra diesel engine cooled by air, which with a supercharger has an output of almost 300 HP and enables traction of a load of 100 tons even up a considerable gradient. It is fitted with a hydraulic or mechanical gear box. The control equipment enables the setting up of trains of railcars and coaches controlled from one operating post. The speed has been limited to 70 km. per hr. with due regard to traffic conditions of local railway lines.

The railcar is provided with two 2nd class passenger compartments, one in the middle part and the other over the bogie; over the other bogie is a luggage compartment, while between the compartment there are the entrance platforms. On either side of the



Inside of the railcar for local and district traffic.

middle corridor there can be either two and two, or three and two lightly upholstered seats; the luggage racks are arranged longitudinally. Hot air crude oil heating and fluorescent tube lighting have been applied. Large windows mounted also in the car ends, new materials used for wall lining and sound insulation contribute to comfortable travelling.



Passenger coach for inland traffic.

The railcar length over the buffers is 18.5 m, its weight is approximately 31 tons and it is equipped with 56 or 48 seats according to the above mentioned arrangement.

Passenger coaches of the Balm series are supplied with railcars quite similar in arrangement and appearance. All three compartments, however, are intended for

passengers, so that the coaches have 78 or 68 2nd class seats and weigh 23 tons.

As compared with steam traction the described railcars and respective passenger coaches have enabled speeding up and improvement of railway traffic as well as a considerable saving of fuel. They can successfully replace railcars of older types, especially diesel-electric ones, due to their economy and increased comfort.

The manufacture of more efficient and better equipped railcars and respective passenger coaches for high-speed long distance lines is in the preparatory stage.

According to experience gained with considerably relieved and well equipped passenger coaches of a different kind, but of the same type series, the manufacture of which was started ten years ago in large numbers, the Czechoslovak industry has developed an analogous, but improved type series, of which *passenger coaches with big compartments* and *cafeteria coaches*, both of 2nd class type are being or will be manufactured.



Inside of the passenger coach for inland traffic.

The first ones are intended for inland traffic and their internal part is divided into two big identical compartments, in which on either side of the corridor upholstered twin seats are mounted with simple luggage racks suspended above the seats. The windows, the bottom part of which is fixed, are fitted with a sash top part. Natural ventilation has been applied, as well as low pressure steam and electric resistance heating. Either an incandescent lamp or fluorescent tube lighting system can be chosen. The coaches are fitted with wireless equipment. At the end of each coach there are two cloakrooms in addition to a lavatory and a compartment for the guard. The coach length over the buffers is 23.5 m; it weighs 34 tons and has a total of 80 seats.

The cafeteria cars intended for long distance trains are provided along their whole length with a side corridor from which both the four normal eight-seat small compartments can be entered, as well as the dining room, kitchen and cafeteria. Their equipment and storage space as well as tanks enable hot meals and iced drinks to be served. The windows as well as the ventilation, heating and lighting systems are the same as those in the above mentioned coaches.

The length of the coach is 23.5 m; it weighs 40 tons and has 32 upholstered seats in the compartments and 17 in the dining room.

Both coaches can travel at a speed of 150 km. per hr. when equipped with the normal DAKO brake and at a speed of 160 km. per hr. when equipped with a fast train one. They are fitted with bogies of well proved type. This type of bogie has successfully passed speed tests up to 330 km. per hr. on French railway lines.



Dining room of the cafeteria coach.

As compared with previous coaches of the same type the described types afford better comfort and require considerably less maintenance work. The cafeteria coaches enable refreshments to be served to a great number of passengers during travel so that there is no need for expensive dining cars on some trains.

Simultaneously a prototype of a passenger coach is being tested which is provided with further improvements and which is intended for international railway lines in Western and Eastern Europe. It is fitted with more comfortable compartments, with double windows in the bottom half, force feed ventilation, hot air heating and new bogies with the DAKO brake affording a speed up to 160 km. per hr.



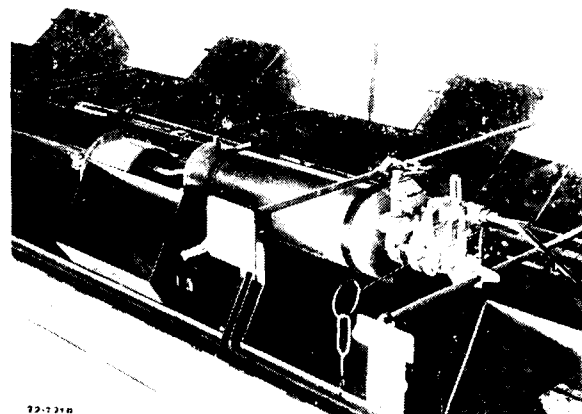
Multiple-purpose wagon for loose and piece goods.

The required mechanization of loading and unloading operations in goods traffic has enforced the construction of a number of new freight cars, mostly of the eight-wheel type. In order to prevent their economical construction from being adversely affected by their complicated equipment, they are being built for multiple-purpose application, running without load having thus been limited.

The multiple-purpose, eight-wheel box car of the Zsa series for loose and piece goods is one of the new and successful types.

The supporting structure of the floor accommodates directly 12 discharge hoppers covered by removable flaps. Should, for example, grain be transported and unloaded by means of the discharge hoppers, the flaps are inserted into the door holes in oblique position with respect to the fronts, so that the car is prepared for quick unloading which then takes less than 20 minutes. The roof of the car incorporates three charging holes for the loading of same, in addition to normal holes in

the walls. Piece goods are loaded through sliding doors, two of which are arranged in each side wall. Large pieces and vehicles can be loaded through the front door, which is arranged at one end only with cars fitted with a brakeman's cabin, otherwise at both ends. The walls are made either of wood or of water-resistant plywood.



The DAKO brake mounted on the bogie of a freight car.

The box car is 16.5 m. long with a loading length of 14.44 m, a loading surface of 39.5 sq. m. and a loading space of 87.3 cu.m. It weighs 25 tons and has a load bearing capacity of 54 tons.

The application of these cars will increase the productivity of freight traffic, in addition to eliminating fatiguing work (speeding up of wagon circulation and thus reduction in numbers); it will also clear the railway lines and stations (higher capacity at reduced wagon length).

Other types, for instance, with a roof which can be opened and for transport of cement in bulk, are in the development stage.

It would be impossible to achieve the greatly needed increase of speed of railway traffic without a better railway brake. Also in this field the Czechoslovak industry has got a product which is equal to several existing systems, or in some respect is even superior.

It is the automatic compressed air *DAKO brake* which meets all the conditions stipulated by the UIC regulations for a modern railway brake. It is distinguished for its high-speed and reliable function, simplicity and low weight. Its standard design has already been approved for international traffic. "The fast train" design for especially fast trains (with an automatic

regulator increasing the braking effect at speeds exceeding 85 km. per hr. and with automatic anti-slip equipment) has passed international tests under the most adverse conditions with the same success.

This brake will be subsequently fitted to all new railway cars.

The documentation for the new conceptions of railway cars and for improvements of the design of exist-

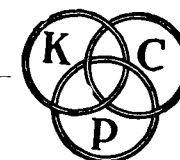
ing ones is supplied to the Czechoslovak industry by our own research institutes that have been developed in the last ten years according to the most modern of our own and foreign methods. It is also equipped with testing devices for verify new products and ensuring that they meet the specified requirements of resistance against forces and impacts, smoothness of travel and correct function of the equipment. It is thus fully prepared to supply modern railway cars of progressive technical standards.

PERKINS ENGINES TO BE MADE IN ARGENTINA

A large-scale scheme to manufacture Perkins engines in Argentina is announced by the British diesel engine group. Production is expected to reach an annual figure of about 12,000 units for vehicles, combine harvesters, tractors, industrial and marine applications in four years.

being provided from Argentine sources, Perkins are also making a financial contribution. The British company will provide technical know-how, including a residential technical adviser and technicians, with facilities for Argentine personnel to receive training in the U.K. At present nearly 25,000 Perkins engines are operating in Latin America, including 11,000 in Argentina.

Although the bulk of the capital for the project is



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NEW TYPES OF WELDING MACHINES

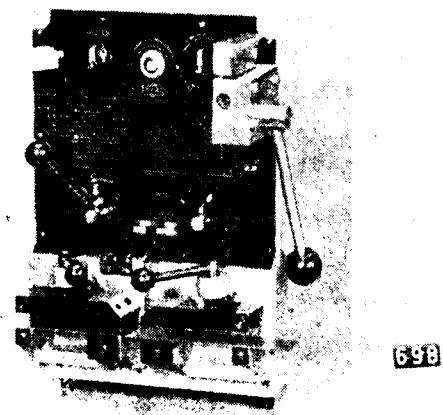
By A Technical Correspondent

ELECTRIC FLASH BUTT WELDING MACHINE FOR BAND SAWS IDEAL TYPE BAS 3

MESSRS. Elektro-Apparate-Bau GmbH, Lippstadt (Western Germany) have developed a new electric flash welding machine for joining metal and wood cutting band saws of a width of 15 to 60 mm.

It is distinguished from the well-known upset-welding Units for band saws by the fact that the ends of the band are welded by the flash welding process (slow flashing of the ends of the band and joining by sudden upsetting). The operation is controlled by means of a motor driven cam disk. This makes it possible to obtain always uniform welds of maximum quality with small welding burr even in case of constant operation.

As the machine is particularly designed for series welding, it has been given a sturdy construction. All mechanical and electrical parts are amply dimensioned.



Electric Bandsaw Butt Welder IDEAL type BS 1.

The clamping jaws are watercooled and have exchangeable bearing surfaces of special hard copper. The stationary jaw can be adjusted and tilted horizontally and vertically. The movable jaw runs on a special

guide of hardened steel, which is easily accessible from outside. The eccentric pressure devices are subdivided in the form of lamellas, so that narrow and wide bands are always pressed on to the contact plate with uniform firmness. The pressure members can be detached with one single movement in order to clean the jaws. The control levers as well as the indicating and checking units are clearly arranged.

After the switching-on the welding process takes place fully automatically. By actuating the welding lever for a short period of time, the movable jaw returns to its starting position.

For the purpose of annealing the welded saws the machine can optionally be equipped with a hand-operated annealing device or with an automatic annealing control. The annealing devices are connected to the welding machine by means of a multiple socket.

The annealing temperature, the soaking time, and the cooling rate can be separately adjusted through the automatic annealing control, thus enabling the annealing and cooling action to be carried out automatically. Soaking time, annealing temperature, and cooling rate are infinitely variable through a wide range.

NEW MACHINES FOR WELDING THE BLADES OF SEPARATING AND BLOCK-BAND SAWS

For butt-welding of the saw blades of separating and block-band saws Elektro-Apparate-Bau GmbH. has developed two new welding machines for band widths of 40 to 110 mm. (1½" to 4¼") and 50 to 160 mm. (2" to 6¼"). These resistance butt-welding machines permit the convenient and rapid clamping of the ends of the saw band by eccentric levers and the simple and accurate setting of heading paths and jaw separations. Once set, the welding machine operates automatically. The welding time as such is one second and is followed by some minutes of annealing time, dependent on the material being worked. Since, unlike soldering, the conditioning and after treatment times are very short, considerable savings in working time result from the use of such a welding machine. The only accessories required are a clipper for the straight and rectangular cutting of the saw band ends

and a grinding machine for removing the welding burr.

Compared to the formerly customary soldering, the butt-welding of saw blades saves much time and material. Tests revealed that the flexibility and breaking strength of the weld are superior to the characteristics obtained by soldering. Also, in practical service, it was found that the weld is more durable than a soldered place. Another advantage of saw welding lies in the fact that the joint can be worked at more easily and accurately so that a perfect chatterfree run of the saw blade is attained.

ELECTRICAL BRAZING MACHINE

For a number of years, Elektro-Apparate-Bau GmbH. fabricate electrical brazing machines for tipping tool holders with cutting metal and for welding and brazing high-speed steel on them. These brazing machines of the type ranges WS and H are connected to AC or two phases of three-phase power lines. Since one phase wire remains open in this application, the current surge is considerable in the case of higher power levels.

As an advanced development the new electric brazing machine, type DW, is marketed which equally operates on the principle of resistance heating and soldering, but is connected to all three phases of a three-phase system so that they share the load uniformly and, being distributed over all three-phases, the current surge in the power line, thus, is far lower.

The transformer of the machine changes the three-phase power line voltage into the required low voltage. Each phase circuit of the transformer can be controlled by a five-step switch. The energization is effected by means of an auxiliary switch through a contactor.

The machine is equipped with three water-cooled gripping jaws. One of them is fixed, the two others are supported in a movable manner on a steel slide ball guide. The copper electrodes send their currents through the tool holder and secure uniform and quick heating. This is a great advantage over the previous method.

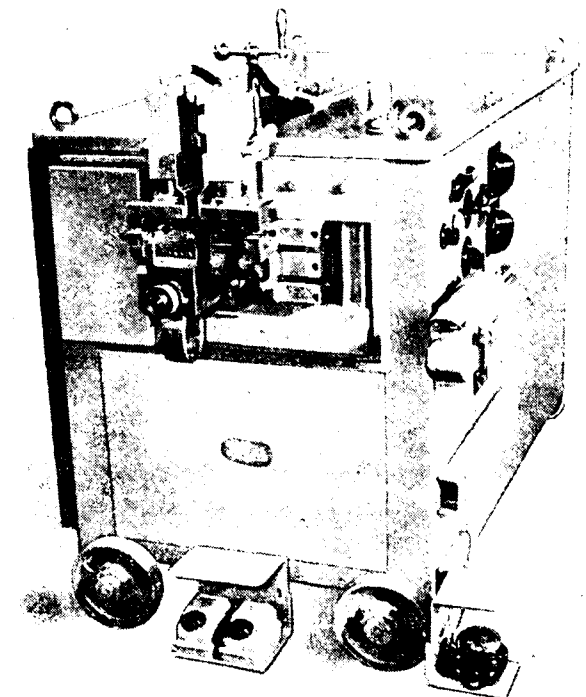
The tool holder lies in an adjustable table between these electrodes. In the clamping process a variable spring load presses the two movable jaws against the steel holder. It is also possible to clamp the steel holder onto one of the gripping jaws and lay only two

electrodes against it. The clamping pattern will depend on the shape of the cutting-metal tip or the tool holder. All types of tool holder can be easily and simply clamped in position and heated up. The machine can withstand continuous duty. It is a standing model, and is covered up with an enclosure of heavy-gauge sheet metal.

Since its power demand is relatively low, even small and medium-size enterprises can set up this machine without changing their power supply system.

IDEAL AUTO ELECTRIC FLASH BUTT WELDER FOR WIRES MODEL AS 4 D

The IDEAL automatic electric Flash Butt Welding Machine model AS 4 D is designed to weld especially high carbon steel wire from 5 to 15 mm. resp. o. 2086 to o. 59055 in. of dia. as easily and as perfectly as possible. The carbon content may amount upto



Electric Flash Butt Welding Machines IDEAL Type AS 4.

0.9%. Due to the flash welding procedure the entire cross-section of the wire to be welded is uniformly heated to welding temperature. The upsetting process is then effected in a sudden upset by pressing the parts together, while at the same time the weld current is

cut off. This method results in a narrow zone of heat and an extremely strong welded joint free from oxides and slag. The polished joint shows no change of the essential grainstructure of the welded metal with regard to the remaining wire.

The wire ends need not be cut rectangularly, they may be cut roughly by a shear or similar as the entire cross-section is melted. When welding unaligned wires, the elevation of the moving jaw may be adjusted 5 mms. either way should it be required, for exact alignment.

The operation of the welder is restricted to that of push-buttons: one for starting the weld process, a second for returning the movable jaw into its initial position. Since the action is motor driven and entirely automatic, control of the welding operation is not dependent upon the skill of the operator but is a built-in function of the machine. The automatic control guarantees a constant high quality of the welded joints.

The welder is provided with an eccentric rapid action clamping device. The clamps are equipped with interchangeable insets of hard copper. An equal clamping pressure is produced by plate-shaped springs. The jaws run on high-precision ball bearing guides, which are covered to prevent globules from entering.

For annealing the welded wire is released and reclamped into blocks of the jaws farther apart. The welder is equipped with an infinitely variable anneal device to adjust the anneal temperature according to all particular requirements. By simple turning of a knob the anneal current may be amended respectively reduced. A switch enables the operator to select preliminarily a certain anneal temperature, which is switched on automatically after the weld process is finished. Finally the heat of the welded joint may be cooled according to requirements: alloyed metals take longer than mere steel.

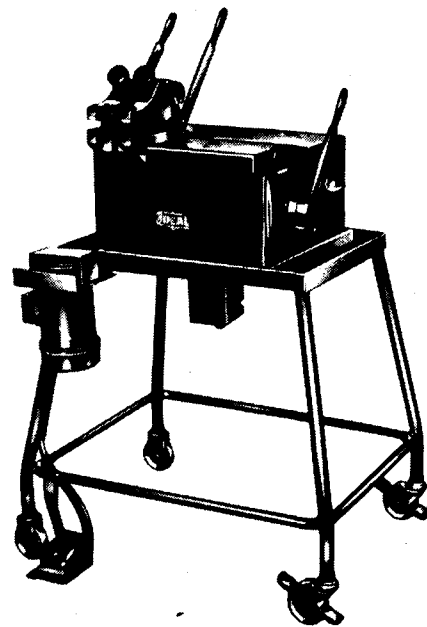
Upon request, the welder will be equipped with wheels to make it mobile. A work-bench may be mounted at the side of the machine to hold a vise, a metal-cutting saw, and a grinding motor with flexible shaft to remove the welding burrs.

WIRE BUTT WELDING MACHINE IDEAL TYPE DS 13 P

Description of the machine:

The sturdy clamping jaws are placed on top in front of the machine. The wire ends are clamped by means of pneumatic pistons. The jaws are equipped with interchangeable hard copper inserts, which are provided

for cooling by water circulation. On request, the inserts can be worked out according to the shape of the pieces to be welded.

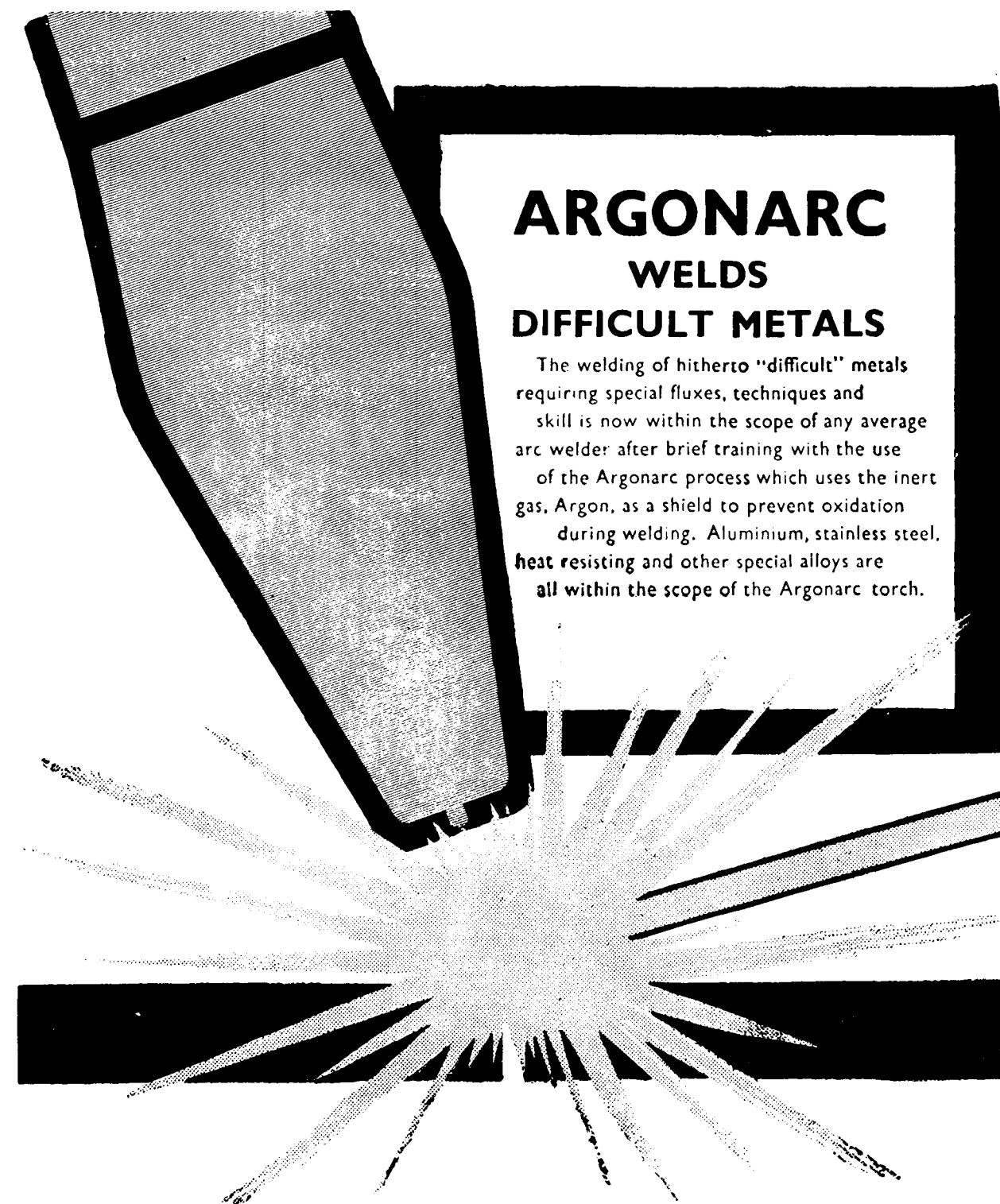


Electric Wire Butt Welding Machines IDEAL type DS 13.

The upset pressure can be regulated steplessly by the incorporated pressure valve. The automatic disconnection of current can be set dependent to the upset way respectively to the time control. The current is regulated by a 5-step-switch, the machine switched on by a sturdy contactor.

The welder is operated by two foot switches, which serve to operate both the clamps separately. After the wire has been clamped the weld procedure is performed automatically. In order to gain an extremely high output the foot switches may be united that a single pressure is sufficient to effect the automatic welding.

electric capacity 8 kVA
welding capacity in iron wire 2 to 6 mm. dia.
welding capacity in 2 mm. dia. wire approx. 1000
pcs./h.
in 6 mm. dia. wire approx. 600
pcs./h.
if the pieces to be welded are delivered suitably.
Pneumatic pressure of condensed air min. 6 atu,
max. 10 atu.



ARGONARC WELDS DIFFICULT METALS

The welding of hitherto "difficult" metals requiring special fluxes, techniques and skill is now within the scope of any average arc welder after brief training with the use of the Argonarc process which uses the inert gas, Argon, as a shield to prevent oxidation during welding. Aluminium, stainless steel, heat resisting and other special alloys are all within the scope of the Argonarc torch.

Now, for the first time in India, Indian Oxygen is manufacturing ARGON—the gas that makes possible the welding of difficult metals.

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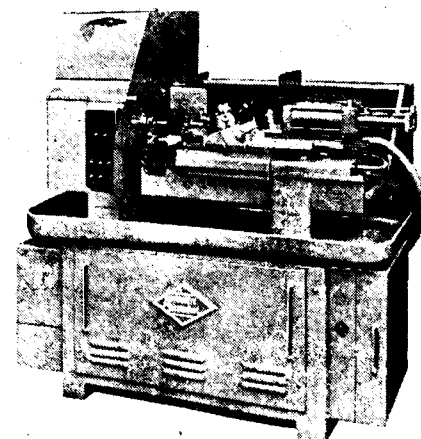
(1) ACCURATOOL AUTOMATIC CAPSTAN LATHE

THE Accuratool Automatic combines simplicity with rapid and consistent production and enables one operator to tend a whole battery of machines. Setting is simple, the requisite feed and speed values and the slide movements being selected by plug-in connections on the electrical control panel.

The set-up can be quickly changed from continuous cycle for bar work to single cycle for chuck work. Movements can be programmed to take place simultaneously, in sequence, or in overlapping sequence.

Collet opening and closing, turret slide movement, cross slide movement, turret slide feed, motor speed change, reverse and stop are automatically controlled and a spindle brake if required.

The Accuratool Automatic is provided with 6-station turret. The collets are of the dead length type, opening and closing being automatically controlled. The control panel, which is conveniently placed, is provided with two sets of electrical sockets, one set connected to the power and the other set to solenoids controlling the machine movements, any of which



Accuratool Automatic Capstan Lathe.

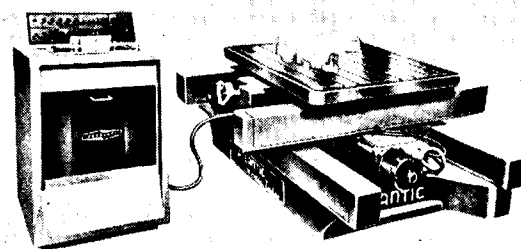
can be actuated by plugging in the appropriate connection. On completion of each movement signals transfer the power to the next step. By linking the sockets movements can be kept in operation as long as necessary. Time delays can be introduced on any step to provide tool dwell and any necessary corrections can be made to the setting after the machine has been run.

The Accuratool Automatic has a bar capacity of 13/16" (21 mm), centre height being 5 1/4" (132.2 mm). The spindle bore is 27/32" (21.5 mm) and the turret slide stroke is 3" (76.2 mm). There are 16 spindle speeds in 4 overlapping ranges, 37 to 3000 r. p. m. and the 2-speed motor is 1 1/2-3/4 HP. The machine is equipped with Puckert Air-operated bar feed.

(2) ATLANTIC CO-ORDINATE TABLE

Designed for mounting on the bed of a radial drill the Atlantic Co-ordinate Table is controlled by Ferranti Electronic Numerical Positioning equipment, the 'instructions' being quickly recorded on easily stored punched tape. Thus the cost of jigs is avoided and the first batch of components can be put into production without delay. Any number of positions can be recorded.

Accuracy of positioning is independent of the leadscrews. The measuring system utilises diffraction gratings which provide accuracy of positioning



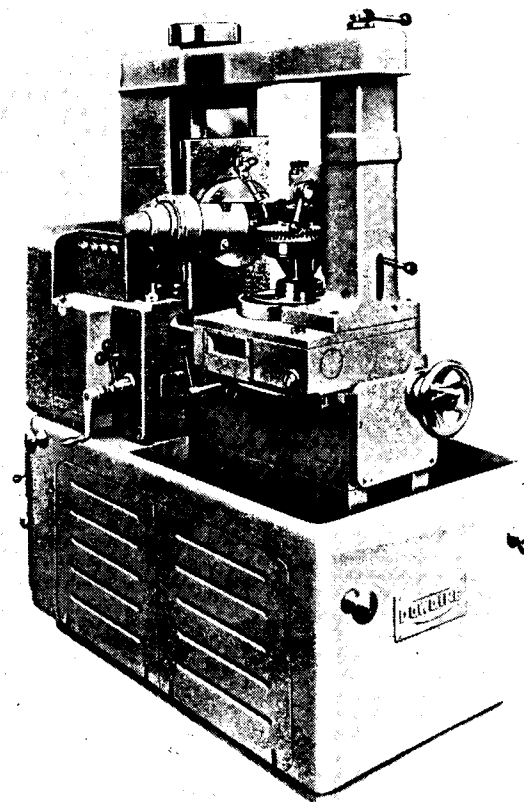
Atlantic Co-ordinate Table.

within $\pm 0.0002"$ per ft. (0.016 mm per metre) and settings can be repeated within $\pm 0.00025"$ (0.01 mm). Modifications to any drilling layout can be easily made.

Hand setting by means of decade dials is provided for single workpieces also. Traverse is simultaneous along both X and Y axes of the table at 60" (1525 mm) per minute. The leadscrews and nuts are of the re-circulating ball type as are the table slideways also. Table size is 36" $\times$ 30" (914 $\times$ 762 mm) and drilling area 30" $\times$ 24" (762 $\times$ 610 mm).

(3) DOWDING V.10 GEAR HOBBER

The new Dowding Universal Hobbing Machine Model V.10 has many unique features. With built-in differential it is versatile. Spur gears and spirals can be generated—sprockets, splines, serrations—and worm wheels can be produced by the plunge cut method. With tangential feed available as additional equipment, worms and high angle worm wheels can be generated also.



Dowding V.10 Gear Hobber.

It is simple to operate, all control levers and push buttons being easily reached from the one position. Either roughing or finishing feeds can be engaged by simple movement of a lever. Climb or orthodox hobbing can be used equally effectively.

Indexing and differential gearing are housed in a large, accessible compartment at the back of the machine and feed and hob speed gears are unusually accessible also. When not in use, all change gears are housed in a special storage compartment permitting easy selection.

The hob head can be swivelled through 60° to left or right and the hob can be shifted through 1 1/2" (38 mm.) axially so that its entire width can be utilised. The hob slide is provided with power return traverse.

The capacity of the V.10 is 10" (254 mm) diameter, 8" (203 mm) face width and 7 DP. (3.63 mod). There are 8 hob speeds 55 to 500 r. p. m. and the main motor is 3 HP.

(4) DOWDING H.7 GEAR HOBBER

The Dowding Horizontal Universal Hobber Model H.7 is designed especially for the production of long splines—straight or helical, parallel or tapered—and serrations. Spur gears, spirals up to 60° right-hand or left, and chain sprockets can be produced, besides gears integral with long shafts and in between flanges or bearings.

The H.7 is fully universal with built-in differential gearing. It is powerful and rigid and its smooth vibrationless running permits climb as well as orthodox hobbing.

The horizontal arrangement of the work spindle, which is bored 3" (76 mm) right through, and the long hobbing traverse, permit splines up to 19" (483 mm) long to be produced at a single setting and greater lengths can be hobbled by moving the work axially.

A knee saddle and former can be fitted for taper hobbing and this attachment, which can be readily disconnected for normal hobbing, also permits gears to be generated between flanges or bearings.

The built-in differential gearing ensures maximum lead accuracy and permits the feed and indexing gears to be changed without affecting the set-up for the spiral lead of mating gears.

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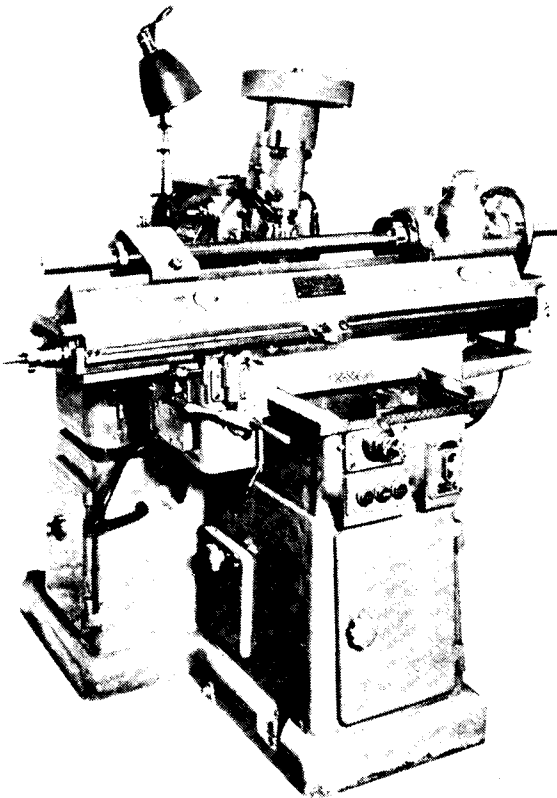
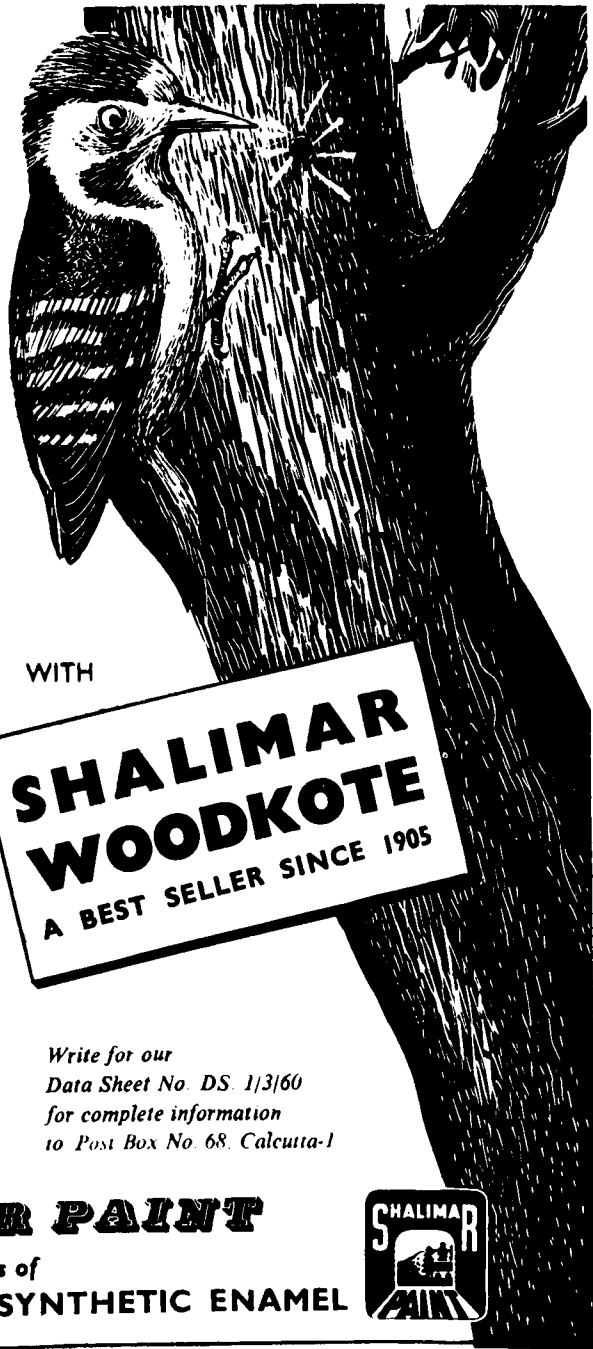
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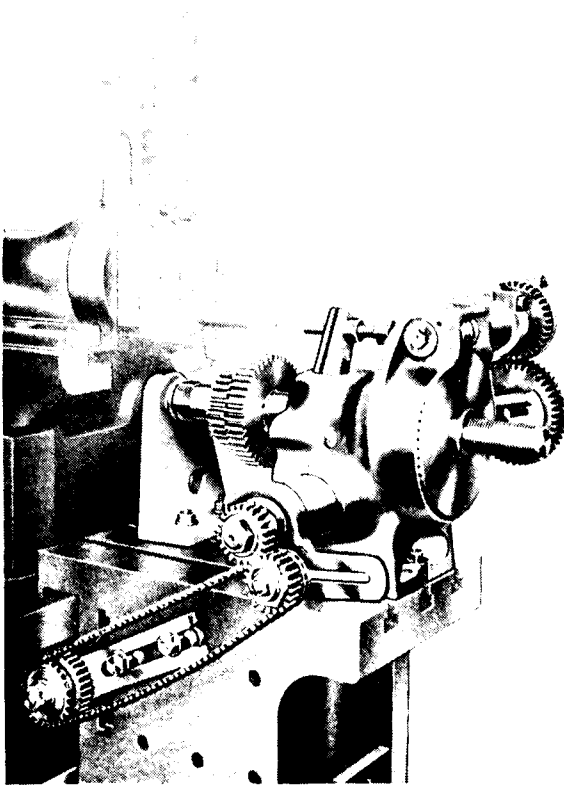
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Dowding H.7 Gear Hobber.



Matterson Gear Cutting Spur Attachments.

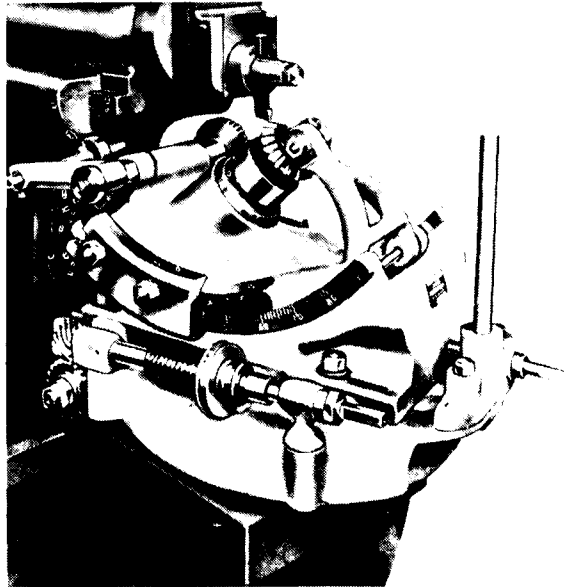
Optional equipment includes alternative heavy duty or high angle hob heads which are interchangeable.

Maximum gear diameter is 7" (178 mm), hobbing traverse 19" (483 mm.) and maximum pitch 8 DP. (3.25 mod.). The work is spindle bored 3" (76 mm.). The main motor is 3 HP.

(5) MATTERSON GEAR CUTTING ATTACHMENTS

Matterson Gear Cutting Attachments fitted to the table of a shaping machine enable accurate gears to be cut in any workshop quickly, easily and economically with simple V-type tools. There are two models—one for spur gears and the other for bevels. Either model cuts gears up to 12" (305 mm.) diameter and 4 DP. (6.3 mod.) and there is also a 6" (152 mm.) bevel model.

The attachments can be quickly fitted to the shaping machine and removed in a few moments for normal shaping work. The spur gear model can be used as



Matterson Gear Cutting Bevel Attachments.

an efficient dividing head on a milling machine, or for spiral milling.

(6) R-G HIGH SPEED HYDRAULIC PRESSES

British R-G High Speed Hydraulic Press 5 ton Model is a new hydraulic press especially developed to speed up blanking and piercing; forming and bending, clipping, marking and assembly operations.

The unique accumulator system provides rapid ram advance with instantaneous speed reduction and the application of full pressure immediately the load is applied. The double acting cylinder and ram provide positive 2 ton power return. The 5 ton model can be supplied for bench mounting or with pedestal for floor mounting and, if required, for foot operation also. It is entirely self-contained, all operating mechanism, pipe work and control rods being enclosed within the robust fabricated frame.

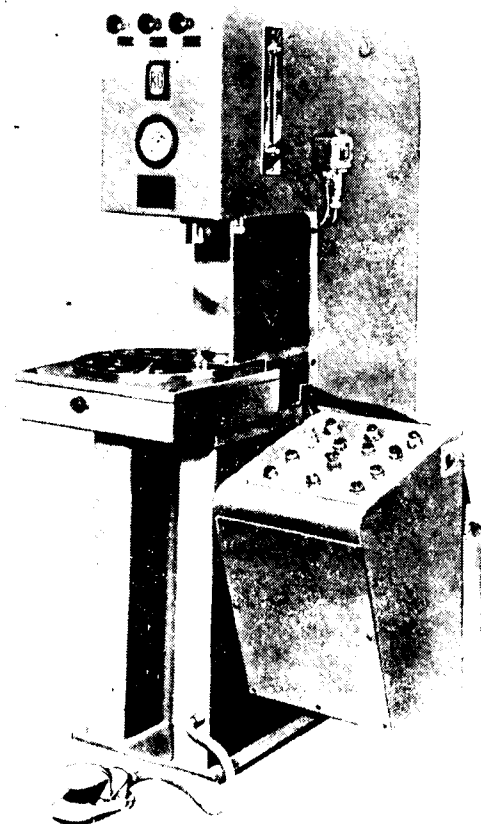
Working pressure and slow ram advance for setting are controlled by a conveniently placed regulator, a pressure gauge and isolating valve being provided. Pressure can be maintained for normal periods, and the time can be extended with simple special equipment. The ram is prevented from rotating by a spring loaded

plunger and the stroke is readily adjustable. High ram speeds—1000"/min. approach, 35"/min. pressing and 650"/min. return—permit the press to be operated rapidly. Both the table and the ram nose are designed to accept most existing tooling. A perspex guard is available.

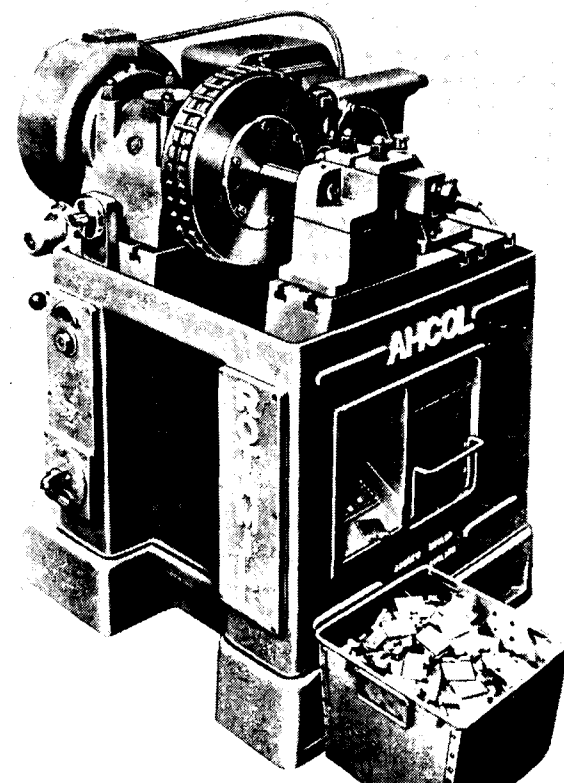
Maximum ram stroke is 4" (102 mm.), throat depth 7" (177 mm) and height, table to ram 12" (304 mm). A 10-ton model is being shown with 4 or 8 station automatic rotary indexing table.

(7) ROTAMILL SEMI-AUTOMATIC ROTARY MILLING MACHINE

The Rotamill Semi-automatic Rotary Milling machine is designed for rapid, continuous production of simple milling jobs such as slots, flats, faces, etc. It is simple, the work being inserted into fixtures round a continuously rotating drum, clamping and unclamping being normally performed automatically. For shorter runs and awkwardly shaped parts the machine can be set for normal speeds while cutting, with fast traverse between stations.



R-G High Speed Hydraulic Presses.



Rotamill Semi-Automatic Rotary Milling Machine.

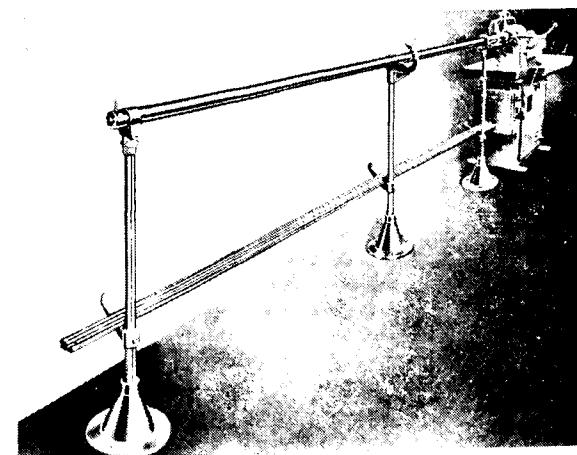
The ROTAMILL has been developed for high rates of stock removal. The cutters can be adjusted endwise and the workhead can be adjusted towards or away from the cutters by means of a leadscrew with a collar graduated in .001" or .02 mm.

There are 4 cutter speeds, standard speeds being 132, 211, 330 and 580 r.p.m. with each of which 14 alternative rates of feed can be obtained. A separately motorised coolant pump, which can be easily removed for cleaning, draws its supply from a tank in the base of the machine.

The work drum diameter is 12" (304 mm.), maximum cutter width, ganged, 6" (152 mm.), and the maximum cutter diameter 6" (152 mm.). The motor is 5 HP.

(8) PUCKERT AIR-OPERATED BAR FEED

Puckert Air operated Bar Feed dispenses with the need for feed fingers, sleeves, etc. on capstans and single-spindle autos. It can be used for feeding bar to saws and other machines also. Bar of any section—round, square, hexagonal—can be fed right up to the bar end and its self-centring action obviates marking the surface. The bar is fully enclosed, safe and quiet. Reloading is the work of a moment.



Puckert Air-operated Bar Feed

Puckert air operated Bar Feed comprises an air cylinder in an outer tube carried on three stanchions, each with a heavy cast iron base. The air cylinder, containing the piston and feed plunger, is connected to the supply line, pressure on the plunger being controlled by a lever-operated valve. The valve contains a whistle which warns the operator on reaching

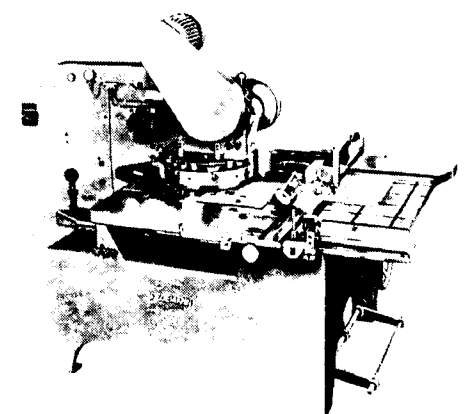
the end of the bar. Automatic knock-off is available if required. The bar is centred by a cone formed in the hardened end of the feed plunger, permitting bar of any size to be fed.

Puckert Bar feeds are available in 14 sizes up to 2" (51 mm.) bar capacity in standard lengths of 10 ft. Special lengths can be supplied if required.

(9) WIEDEMANN TURRET PUNCH PRESS
MODEL RA. 41 P

British Wiedemann Turret Punch Press Model RA. 41P is a power operated press especially suitable for piercing work on the longer runs. It has been developed for maximum production with minimum handling of the work. The apertures to be pierced are located from a master template by means of a pantograph table with depressible stylus which can be operated exceedingly rapidly. The templates themselves can be made on the same machine. All template holes, irrespective of their size or shape in the finished work, are pierced $\frac{1}{8}$ " (6 mm.) diameter, since only the stylus enters the template.

Template and blank are clamped in position with their datum edges against stops. As the stylus moves over the template the blank moves under the punch,



Wiedemann Turret Punch Press Model RA.41P.

Each time the stylus enters a template hole and is fully depressed, the press trips.

Coloured code lines painted on the template link all similar work apertures and by following the routes so formed, turret and work movements are reduced to a minimum. Flags of the same colour on the turret

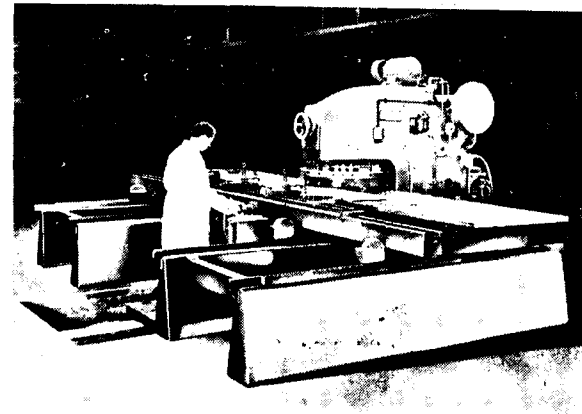
indicate the appropriate punch. Up to 3" (76 mm.) diameter can be punched in .074" 28 ton tensile mild steel plate.

The RA. 41P has a throat depth of 28" (711 mm.) and a table size of 24" x 24" (610 x 610 mm). It is also available with 40" x 28" (1016 x 711 mm.) table. There are 20 turret stations. Pressure capacity is 30,000 lbs. (13,650 kg.) and the maximum punch diameter is 3 1/8" (79 mm.). A 1 HP. motor is fitted.

(10) WIEDEMANN TURRET PUNCH PRESS MODEL R. 61

British Wiedemann Turret Punch Press Model R. 61 is a heavy duty press designed for rapid, accurate and economical piercing of blanks up to 100 x 60" (2540 x 1524 mm.), with minimum handling of the material. No marking out is necessary, all apertures being located by co-ordinate settings, read at a glance from direct measuring counters. Rotation of the turret, which is by power, is controlled from the operating position and the press cannot be tripped between stations.

The blank is clamped with its front edge in contact with location pads and its right hand edge against a stop. It is positioned relative to the punch by means of two handwheels, one controlling in-out and the other lengthwise dimensions. The exact dimension from each datum edge to the punch centreline can be



Wiedemann Turret Punch Press Model R. 61.

clearly seen on the two direct reading counters, one over each handwheel.

A co-ordinate chart at the front of the table indicates the settings for each successive aperture and the turret position also. When the press is tripped the chart moves on to show the next settings. Alternatively, for short runs, settings can be made direct from the drawing. Large diameter anti-friction balls inserted in the table surface permit easy manipulation of the work.

The pressure capacity is 80,000 lbs. (36,500 kg). Up to 6" (152 mm.) diameter can be pierced in 1/8" (3 mm.) 28 ton tensile mild steel plate. Throat depth is 33" (838 mm.) and there are 26 turret stations and 2 motors; main 3 HP. turret 1/2 HP.

"WALK-UP" BANK WINDOW COUNTER

The 49th National Business Efficiency Exhibition which opens in London on October 3, promises to be the most outstanding display of its kind yet staged in the U. K. Assembled under one roof at the same time will be a comprehensive array of the latest equipment designed for coping with office routine.

Participating in this 200,000 sq. ft. exhibition will be 154 firms representing in all the major proportion of an industry, which exports to three-quarters of the countries of the world.

One firm who last year introduced a "drive-up" bank window counter, will be showing a "walk-up"

bank window counter, which is described as a possible answer to the problems of the customer with a small cheque to cash, who has to wait while other customers transact more lengthy business. The window counters which are supplied as single units are made of stainless steel and bullet-resisting window glass. A specially designed two way communication system, by means of two microphones provides for clear conversation between teller and customer.

The window counter can be fitted with a television camera, so that if a signature needs verifying all the teller has to do is hold it to the camera and a picture of the cheque immediately appears on a screen in the required department, where it can be easily checked.

THREE-PHASE COMMUTATOR DYNAMOMETER

By Ing. Václav Mares, MEZ, Vsetín
Czechoslovakia

INTRODUCTION

THE devices used in foreign countries for the measurement of the power of internal combustion engines are hydraulic, electromagnetic, eddy current/ and d. c. dynamometers. In Czechoslovakia the development has followed a track of its own and the devices manufactured and used there for the same purpose are three-phase shunt-wound stator-fed commutator dynamometers /henceforth referred to as commutator dynamometers/.

Intensive development work, 30 years of manufacturing experience and the latest knowledge, particularly in the field of special rotor windings and compensation of commutator machines enable the Czechoslovak industry to build commutator dynamometers of a sturdy design, a high output and a wide range of speed variation.

Type KS commutator dynamometers are manufactured as reversing units for either direction of rotation and with two bare shaft extensions affording the possibility of simultaneous measurement at one end of the dynamometer and preparation of the next machine to be tested at the other end.

BRIEF DESCRIPTION OF TYPE KS 56B-4 DYNAMOMETER WITH ACCESSORIES

Fig. 1 shows a type KS 56B-4 commutator dynamometer, 380 volts, 280/150/30 kW, 2800/1500/300 r.p.m., 50 cycles.

The diagrammatic arrangement of the dynamometer is shown in Fig. 2. Stator 1 is mounted with a rotary movement in bearings 2. On the horizontal axis of the dynamometer are mounted on one side of the stator an arm acting upon automatic balance 4 which is calibrated in kgm, on the other side counterweight 5 by which the dynamometer is set to zero.

The stator and end shields of the dynamometer, the part marked (1) are of a heavy, welded design mounted as one unit in ball bearings in pedestals with a swinging movement. On the front part of the stator

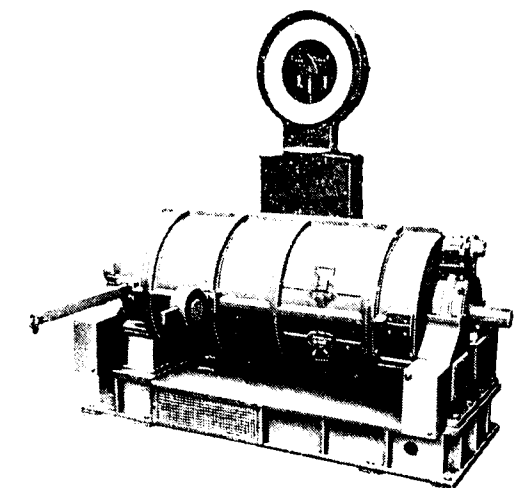


Fig. 1. Commutator-Dynamometer of Czechoslovak manufacture.

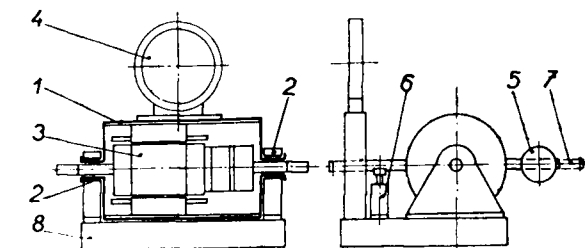


Fig. 2. Brief description of Type KS-56 B-4 Dynamometer

machined surfaces are arranged to which calibrating arms 7 and commutator covers are attached, which, when removed, afford easy access to the current collecting assembly. Sight glasses in the commutator covers permit checking of the commutation during operation. The rotor (3). To the particularly sturdy shaft slotted dynamo sheet punchings are pressed. In the slots a four times-parallel Latour winding is accommodated, with a damper winding for the improvement of the commutation.

The commutator is cylindrical, double. The careful and accurate manufacture of the commutator and its artificial ageing and the perfect balancing of rotating parts ensure mechanically smooth operation of the rotor and commutator, a lasting cylindrical shape of the surface of the commutator under all operating

conditions (temperature rise, speed—checked oscillographically by a capacity pick-up) and thus also a satisfactory commutation from the mechanical as well as from the point of view of reliability in operation.

The accessories of the dynamometer comprise :

- (1) A type 21R double induction regulator (Fig. 3) for the control of the speed and setting of the load.
- (2) A type TK compensating transformer (Fig. 3) windings 5, 6 and 10) for the improvement of the operating properties of the dynamometer.
- (3) A switchboard in which the switch gear and protective devices are accommodated.
- (4) A control desk with controlling and checking instruments.

PROPERTIES OF DYNAMOMETER

The precision of measurement is given by the precision with which the length of the arm and the force is determined (total approx. 0.5%), the precision of reading, the precision of measurement of the speed and the difference between the torque on the dynamo-

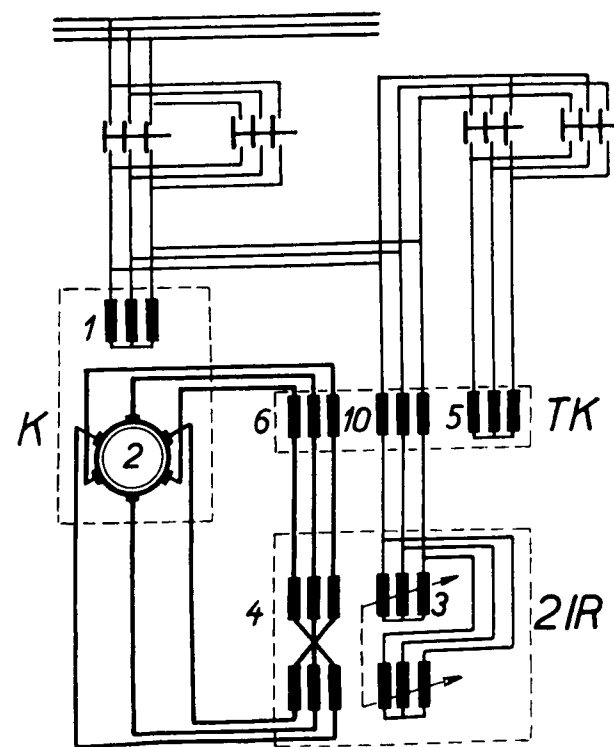


Fig. 3. A type 21R Double induction Regulator.

meter coupling and the real torque which acts upon the arm of the dynamometer stator.

The dynamometer is designed as shown in Fig. 2 so that the torques caused by the friction in the engine bearings and of the carbon brushes on the commutator and partly by windage are transmitted to the stator and measured. Unmeasurable torques caused by the friction of the rotor and coupling with air are taken into account by the so-called correction torque M_{kor} which is determined when the dynamometer is calibrated and is reduced to a minimum by the design, arrangement of ventilation and workmanship of the rotor.

When the speed is measured with a precision of 0.5 to 1% the precision with which the mechanical output on the commutator dynamometer shaft is determined will be, in accordance with the above, 0.6 to 1.5%.

The starting of the dynamometer is effected by direct connection to the mains with the regulator set for the minimum (starting) speed. The regulator is locked in this position. When the dynamometer is switched off the regulator returns automatically to the starting speed position.

The dynamometer can also be started by the engine to be tested and then connected to the mains. If so, a special equipment is required which sets the regulator automatically to the position corresponding to the actual speed of the dynamometer to avoid the occurrence of a momentary overload as the dynamometer is connected to the line.

Internal combustion engines can be started by the dynamometer when it is set for generator operation because the torque required is approximately 0.3 to 0.5 times the normal torque and the starting period is very short so that the temperature rise of the machine due to incorrect compensation is not dangerous for the dynamometer.

The speed is controlled or the desired load set infinitely variably by variation of the voltage supplied to the carbon brushes of the commutator by turning of the rotor of the double induction regulator. This is done either by means of a hand wheel or by a servomotor. The operator sets the required loads in accordance with the speed indicator reading by depressing a push button. He need not observe anything else on the dynamometer or its accessories and may devote his undivided attention to the machine under test.

Commutator dynamometers have a wide control range of 5 : 1 to 30 : 1 as shown in the table of normally manufactured dynamometers at the end of this article.

The dynamometer proper is a rotary machine. Its accessories are non-rotary machines and can be set up separate from the operating space of the dynamometer.

The floor space required and the first cost as well as maintenance costs are lower than those of a d.c. motor with a Ward-Leonard set.

EFFICIENCY AND POWER FACTOR

The overall efficiency of a commutator dynamometer including the accessories for its control and compensation is approximately 75% in the case of lower outputs (approx. 20 kW) and reaches as much as 88% in the case of the highest outputs at maximum speeds.

The curves of the overall efficiency and the overall power factor of a type KS 56B-4 dynamometer when loaded by a constant torque M_n and 0.5 M_n , plotted against the speed, are shown in Figs. 4 and 5 for motor operation (curves 1.1 and 1.2) and for generator operation (curves 2.1 and 2.2). The overall efficiency of commutator dynamometers is the highest of all kinds of electric dynamometers with a possibility of motor and generator operation with power regeneration in a wide speed range.

The overall efficiency and power factor at minimum speed are low because the losses and magnetic energy are approximately constant within the entire speed control range when the dynamometer is loaded by a

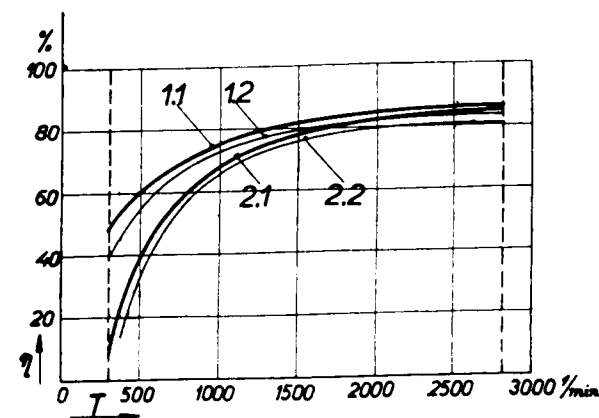


Fig. 4. Overall-Efficiency of type KS-56 B-4 Dynamometer.

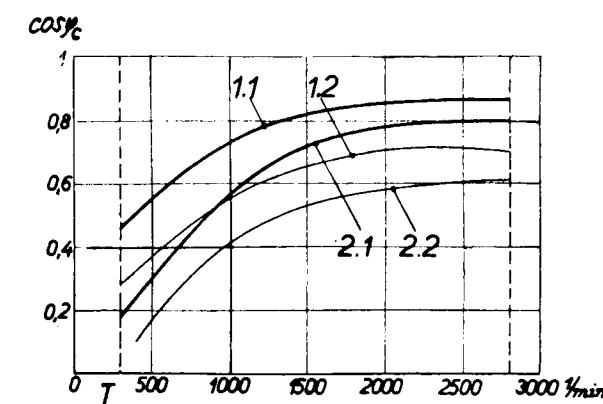


Fig. 5. Overall Power Factor curve in type KS-56 B-4 Dynamometer

constant torque, while the output decreases with the speed.

ECONOMY OF MEASUREMENT OF POWER OF INTERNAL COMBUSTION ENGINES BY COMMUTATOR DYNAMOMETER

The first cost of a commutator dynamometer is several times as high as that of a hydraulic or electromagnetic one which, however, cannot operate as motors and have characteristics which are unfavourable for certain cases at low speeds.

The higher first cost is made up for in a short time by the regenerated electric power.

Below an example is given of the calculation of the period in which the first cost of a type KS 56B-4 commutator including its accessories and a 100 kVA capacitor battery for power factor correction is made up for when Diesel engines of an output of 250 HP at

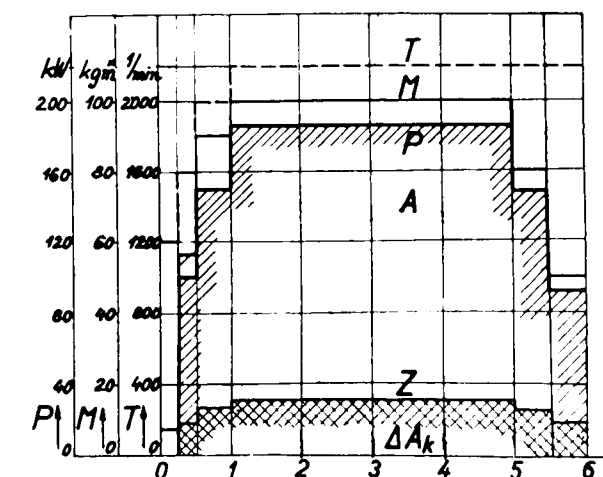


Fig. 6. Curve of the loading of the Engine during one test cycle.

2200 r.p.m. are tested. The curve of the loading of the engine during one test cycle is shown in Fig. 6. The energy measured in one test cycle is 960 kWh. The energy necessary to cover the losses of the dynamometer and accessories amounts to $\Delta A_k = 175$ kWh so that the energy fed back into the mains in the course of one cycle is $A_k = 785$ kWh. The average efficiency is 82%. With a yearly production of 600 Diesel engines and their testing by one commutator dynamometer in two shifts and when testing is carried out at one end of the dynamometer while another engine is being prepared at the other the total amount of energy gained is $600 \times 785 = 472\,000$ kWh.

ADVANTAGES OF COMMUTATOR DYNAMOMETER

- 1. Easy control
- 2. High precision of measurement

- 3. Possibility of motor and generator operation without special equipment
- 4. High economy of measurement of power—highest of all kinds of dynamometers with speed control and regeneration of measured power
- 5. Low operating costs because the dynamometer proper is a rotary machine, the control and compensating equipment are non-rotary machines and require practically no maintenance
- 6. Reliability in operation
- 7. Speed control and regeneration of electric power is effected without change of system of power.

NORMALLY MANUFACTURED COMMUTATOR DYNAMOMETERS

KS 26-4		KS 37A-4		KS 56-4		KS 56B-4		KS 71A-4 ^{xx}	
kW	r. p. m.	kW	r. p. m.	kW	r. p. m.	kW	r. p. m.	kW	r. p. m.
10	3000	33.6	2800	160	2800	280	2800	480	2400
5	1500	18	1500	86	1500	150	1500	300	1500
0.33	100	6	500	34	600	60	600	100	500
				20 ^x	350	30 ^x	300		

The outputs are indicated for generator operation. For motor operation they are 10% lower.

^x 30-minute rating

^{xx} Type KS 71A-4 as prototype in production

GLASS-FIBRE HELMET FOR WELDERS

A glass-fibre helmet for welders which can be used in all types of industries including heavy and nuclear engineering and in shipyard work, has been developed by a firm in North East England. Although larger than the average helmet it is much lighter. Claimed to be virtually indestructible, it does not twist, warp or melt under intense heat. The glass is held by an attachment which also helps to prevent the glass itself being broken.

The new helmet was designed by the firm after developing a successful glass fibre hand guard for welders at a local shipyard.

The manufacturers have made special sink units for nuclear energy establishments, and have also specialised in glass fibre fittings for hospitals and ships.

NORTON'S Range of New Machine Tools

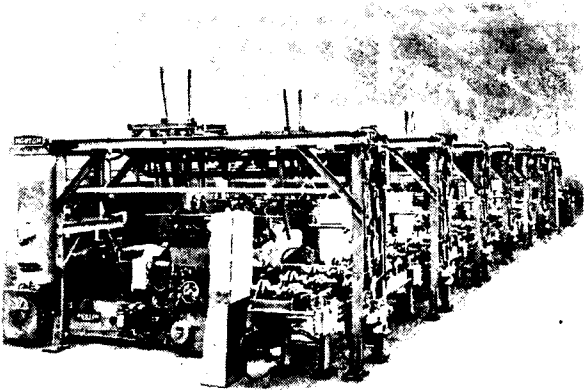
By A Special Technical Correspondent

TYPE CC-8 CRANK-O-MATIC CRANKPIN GRINDING MACHINE

THIS machine, to be shown for the first time in any domestic exposition will be arranged to grind the six crankpin diameters of an automotive type crankshaft. It will be set up as part of a production line together with a Type CM-2 Multi-Wheel grinder and a No. 31 CRANK-O-LAP lapping machine.

Several features insure consistent duplication of ground crankpin surfaces within close tolerances for roundness, diameter, shoulder width, and fillet radii. "STRADDLE BEARING" mounting of the grinding wheel spindle eliminates spindle deflection under load. A torque equalizing work drive rotates the two work heads with exactly equal torque preventing twist in the shaft that can cause out-of-tolerance grinding results.

Perhaps the most significant feature contributing to high quality in the finished work is the continuous path truing of wheel face and radii. The exceptionally accurate radius and blend produces stronger crankshafts. Results from machines already installed on production lines have proved the effectiveness of this truing device design.



Type CC 8 CRANK-O-MATIC Crankpin Grinding Machine

A version of this machine is designed for fully automatic operation and is called the No. 2 Unitized Crank Pin Grinding Machine. For this application, the machine is arranged to grind a single pin on a fully automatic cycle. No operator attention is required, whatsoever, for loading, unloading or checking the crankshafts as they are ground.

During the grinding cycle, the wheel advances to the work in five definite steps. Rapid traverse brings the wheel to the work, the feed shifts to shoulder grinding feed, then slows down for grinding the diameter. The wheel dwells to round up the diameter and then the wheel advances slowly to achieve the final size. Automatic gaging provides a signal to retract the wheel. Automatic truing of the full grinding face including corner radii is accomplished with no slow down in production.

The Exposition CC-8 CRANK-O-MATIC crankpin grinding machine will be shown with the following optional features:

- A. Automatic table indexing. This feature permits one operator to run two machines. After the pin is ground, the sliding table will automatically index to grinding position for the next pin. All the operator need do is index the crankshaft radially, actuate the spark splitter and pull the cycle control lever.
- B. Automatic Spark Splitter. In order to "clean" both side walls of the pin, it is necessary that the side walls of the shaft be located precisely in relation to the sides of the grinding wheel. This is conventionally done by watching the sparks as the wheel starts the grind on the shoulder and equalizing the sparks as the shoulder grinding part of the cycle proceeds. Norton has developed an Automatic Spark Splitter that establishes the endwise location automatically. This has several advantages:

- 1. The walls are sure to be cleaned.

2. There are no ridges in the walls as a result of moving the workpiece after the grind has begun.
3. The operator is freed to run a second machine.
4. Because the sides of the wheel are worn evenly, the wheel does not have to be dressed as frequently and the amount of abrasive material that must be removed from the wheel is reduced.
5. The manual spark splitting operation requires considerable skill whereas the automatic device requires no operator skill at all.

C. Side Wheel Truing Device. Bar type with two heads for truing both sides of the wheel simultaneously. Arrangement is used with power feed (oil motor operated) for turning the feed screw. (Before a crank wheel can be used, this side wheel truing operation must be completed to eliminate side runout from the wheel and to establish the specified width.)

D. Automatic Wheel Wear Compensation.

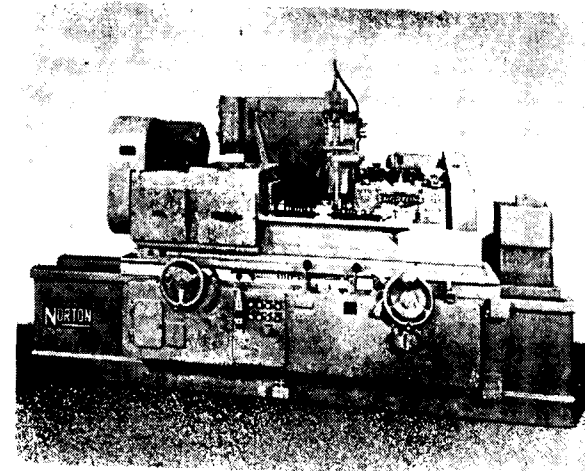
E. Automatic Diamond Turner for crank wheel truing device. This conserves the diamond and promotes truing accuracy by even wear on the diamond.

F. Automatic Constant Peripheral Wheelspeed. Maintains a constant speed of the wheel in terms of surface feet per minute and in this way helps to stabilize the grinding cycle. No operator attention is necessary for changing wheel speeds. No changes in cycle elements during the life of the grinding wheel insures consistently accurate results.

G. Adjustable Controlled Truing. After a pre-selected number of grinds the truing operation is initiated automatically.

NO. 3 CAM-O-MATIC CAM GRINDING MACHINE

This machine has been extremely popular with both domestic and foreign users. The Exposition machine



No. 3 CAM-O-MATIC
Cam Grinding Machine

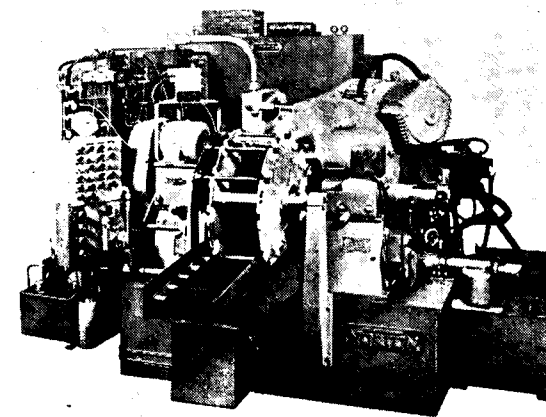
will be grinding cam lobes on an automotive camshaft in a finishing operation. Cam action will be illuminated and seen through a Plexiglass panel on the workhead, replacing the standard cover. The electrical panel will be shown in the same manner.

The cycle is automatic after initiation. Each cam on the shaft is ground automatically without operator attention. Accuracy of cam shape is held within a very few ten-thousandths of an inch. A new selective truing cycle is included for the first time with this machine. The cycle permits truing after each shaft or after any pre-determined number of shafts. Finish will be 10-12 microinches.

Cam grinding is one of the most highly technical grinding fields. Because of the varying relationship between the wheel and the work during the grinding of a cam, conditions must be nearly theoretically perfect. Design and manufacture of master cams which generate the correct shape in the finished cam requires vast know-how and experience. The basic No. 3 CAM-O-MATIC cam grinder has been developed over many years. Like the Volkswagen, it may look the same on the outside but significant changes and engineering improvements are made as they prove desirable.

CP-1 PLUNGE-O-MATIC PLUNGE GRINDING MACHINE

This machine represents a building block approach to high production automatic plunge grinding, designed from the beginning with the idea of incorporating a semi-standard turret type automatic loader. In the past, machines for plunge grinding have been designed



CP-1 PLUNGE-O-MATIC
Plunge Grinding Machine

primarily for manual loading. Limited clearances in front of the grinding wheel, especially restricted swing, complicated the designs of automatic loaders. These complications led to completely special loaders and high selling prices.

With the 15 h. p. Type CP-1 PLUNGE-O-MATIC it is possible to change over to other plunge grinding work with less expense than previously possible. Because of the building block design, it is possible to:

1. Use the same loader, with modifications, for a wide variety of parts.
2. Reposition the wheel slide on the rear base for angular or straight work.
3. Reposition the pedestals on the front base to accept any length part up to 30".
4. Reposition the front base in relation to the rear base for grinding near the head or foot stock.

Because the CP-1 machine has been designed specifically for plunge grinding, no extraneous mechanisms have been included. There is no hydraulic table traverse; in fact there is no sliding or swivel table. Taper corrections are made by adjusting the truing device.

The bases serve simply as supporting members and contain no mechanism. Every mechanism and all piping is readily accessible. The new feed, a refinement of the Norton Type CTU wheel feed, has several new features:

1. The feed screw is designed to be in tension during the feeding cycle rather than in compression, reducing forces that could cause error.
2. The rapid traverse cylinder is located at the front of the feed screw which creates a closed loop of forces in a small area. This is called a short reaction couple. By doing this, the designers have to a great extent eliminated the forces from the base. This in turn minimizes the possibilities of deflections from forces or variations due to heat changes over the course of a day's operation.
3. The distance from the centerline of the feed screw to the plane of the ways has been shortened to reduce the force couple from grinding pressure. There is less chance for the casting connecting the full nut to the wheelslide to deflect.
4. To improve the force conditions, the plane of the wheel slide ways is closer to the centerline of the wheel spindle. This is desirable to bring the ways as close to the line of force of the grinding wheel as possible.
5. The CP-1 feed is all power, even for setting-up. There is no need to turn hand-wheels.

Automatic Wheel Contact Accelerator

Eliminates "grinding air" and shortens the cycle time.

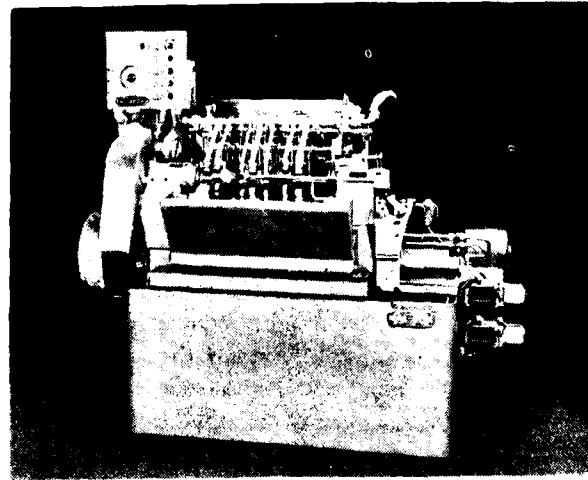
Automatic Wheel wear Compensator

This unit automatically compensates for reduction in grinding wheel diameter after each truing cycle. The unit is built into the new feed system.

Constant Peripheral Wheel Speed

The speed of the wheel face is maintained at a constant rate even as the diameter is reduced. The variable speed wheel drive motor is controlled automatically by the action of the diamond carrying ram of the truing device. As the diamond advances to true the wheel a rheostat is automatically actuated to increase the wheel spindle r.p.m.

The speed at which the truing diamond traverses to dress an angled wheel is the same on each side of the



Norton No. 31 CRANK-O-LAP
Crankshaft Lapping Machine

No. 31 CRANK-O-LAP CRANK LAPPING MACHINE

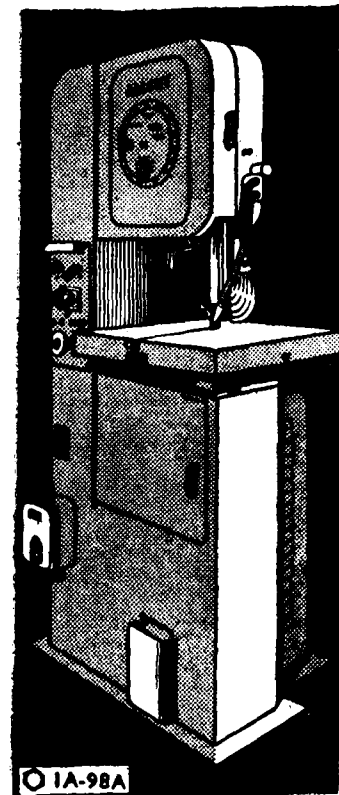
This machine is being shown for the first time. It is designed to lap the main bearings, pin diameters and the seal diameter of automotive and other crankshafts to improve surface finish and in this way increase bearing life.

Surface roughness is reduced to about one third in the average application. A 30 r.m.s. ground finish is readily lapped to about 10 r.m.s. with the coated abrasive strips which do the actual finishing.

The No. 31 CRANK-O-LAP is a high production machine, designed for automatic operation. It will be exhibited in an automatic transfer production line together with a CM-2 MULTIWHEEL grinder and a CC-8 Crankpin grinder.

Features of this machine include easy loading with a swing frame mechanism, single cycle lever control, simple, rugged hydraulic lapping arms, and rugged construction of head and footstocks to permit reciprocation during the cycle.

wheel and the same in both directions. The angle of the "vertical" slide can be adjusted to suit the conditions of the job. The constant speed of the diamond improves the finish obtainable on the work.



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LARGE HEAT-TREATMENT FURNACE

Installation at Tennent Roll Foundry



NEW furnace recently installed at the Coatbridge foundry of R. B. Tennent, Ltd., was designed by John Mathison, Ltd., of Guisborough, and it presents several very interesting points of design.

This particular furnace is of the portable cover type, clean gas fired, suitable for clean town gas, clean producer gas, clean propane or butane gas, or a mixed gas of coke oven and blast furnace gas. In every case it is preferable that it is clean.

The internal dimensions of this furnace are 30 ft. long x 12 ft. wide x 7 ft. 9 in. high inside the cover, and the maximum weight of load imposed upon the hearth is 100 tons. The uniformity of temperature distribution actually taken on the load during the soaking period is $\pm 3^\circ\text{C}$ up to a maximum of $\pm 5^\circ\text{C}$. The temperature range is from 0-1100°C.

The initial installation is used exclusively to do the very exacting heat treatments necessary for high class rolls. The metallurgical requirements on these rolls are such as to demand programme control of the temperature, which involves an extremely slow rise in temperature from cold with accurately controlled intermediate soaking periods, carefully regulated rise in temperature through the critical ranges, followed by equalizing treatments, then a more rapid rise in temperature up to the desired final temperature; the heating, soaking, subsequent more rapid rise in temperature, together with the final soaking period, being predetermined and provided for by means of a suitable cam operating in conjunction with the programme controller.

The temperature uniformity obtained is such as to ensure that the final product is consistently good, and the longest possible life is obtainable from the resultant rolls under the arduous production conditions in the mills for which they are prepared.

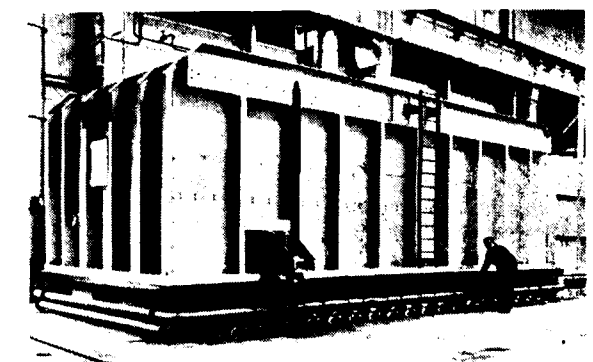
The furnace is designed so as to impart heat both under and over, as well as along, either side of the charge being treated, the combustion arrangements being such as to ensure that there is no flame impingement whatsoever.

The gas burners are claimed to be of unique design, the latest development being one in which the preheated air and gas are intimately mixed in a venturi throat at a high velocity, and from there reduced in velocity into a special high alumina refractory burner quarl.

The vertical flame which imparts the heat to either side of the charge is developed in rectangular slots along the hearth. The flame length can be varied from 6 inches up to 10 feet. It can be arranged to be non-luminous, semi-luminous or highly-luminous. The horizontal flames are directed through restricted orifice burner quarls.

A multiplicity of such burners are disposed along either side of the heating chamber, each burner being equipped with its own gas and air control valve with suitable indicators to permit of these being set for any particular range of treatments.

The hearth is designed so as to make full use of the sensible heat in the products of combustion. The whole of this refractory hearth is heated uniformly above and below, and its thickness is fixed so as to give a very steady temperature gradient with no sudden temperature drop at any point. The cover is of massive construction, meeting the needs of heavy steelworks' practice, the lining being of high temperature refractory insulating materials.



Cover Type Heat Treatment Furnace

A multiplicity of neatly inserted counterflow recuperators are used for preheating the air for combustion and ensuring sound fuel economics. The products of combustion are exhausted from the waste gas flues under the refractory base to waste gas stacks which link up with the outside of the building. The pressure of the atmosphere in the furnace is controlled by means of an automatic atmosphere pressure regulator, which operates directly on the waste gas damper.

Automatic pyrometric temperature control gear is fitted, the burners being grouped in three zones, each zone having its own recording controller, and these recording controllers being regulated by means of a master programme controller. Each zone is regulated from its own master valves, both air and gas. A by-pass arrangement for air and gas is also fitted so as to maintain the flame from the minimum to the maximum rate of fuel consumption. Safety gas shut-off devices are fitted so as to shut off the gas supply automatically in case of gas failure or air failure—or electric or mechanical failure, which might result in air failure.

When treating one high quality steel roll from cold up to 1050°C, the fuel consumption over the various time/temperature cycles proved far more economical than anything envisaged hitherto, either in bogie heat

treatment furnaces or in cover furnaces. The weight of roll was 64 tons and over the full heat treatment cycle, both raising and soaking, the average gas consumption was below 5,000 ft.³ of town gas per hour, the average hourly cost of fuel being 28s. During the final equalizing treatment at 320°C, the fuel consumption was below 200 ft.³ of town gas per hour.

The temperature distribution during the soaking period also exceeded in accuracy anything either promised or envisaged. Six points, three on the top and three on the bottom of the roll, with the thermocouples actually touching the roll, were held consistently to within $\pm 3^\circ\text{C}$. In certain treatments, points top and bottom and end to end were within $\pm 1\frac{1}{2}^\circ\text{C}$. The tests were taken over the complete heat treatment cycle and at temperatures of 650°C, 750°C, 800°C and 1020°C.

The gas consumptions were carefully recorded and tabulated from the beginning to the end of the treatment of this very special roll. The temperatures, also on six points, were carefully measured and recorded, and it would appear that this design of furnace has provided a thermal machine for roll heat treatment, or any other critical heat treatment, which will prove a great asset to the heavy steel industry.

Fire Fighting Equipment at Cologne Exhibition

The Joint Fire Research Organisation in Great Britain, now the largest of its kind in the world, took a prominent part in the recent International Exhibition of Fire Fighting Apparatus and Safety Equipment in Cologne. The main British contribution was centred round a working model showing how the provision of roof 'vents' or openings in single storey industrial buildings may help to remove smoke and hot gases and restrict the spread of a fire. Coloured liquids were used in the model to stimulate the flow of hot gases, and the effect of opening roof vents in each of the three bays of the model on both large and small fires was demonstrated.

Also on the British stand were a number of static exhibits portraying other aspects of fire research:—

Automatic detection of fires in buildings; this showed a heat-sensitive system and how its performance is related to the characteristics of the building

in which it is installed.

Fire resistance of prestressed concrete beams; how beams can be designed to meet the fire-resistance requirements for various types of building.

Statistical analysis of fires caused by electricity; showing how the occurrence of electrical fires has risen with the consumption of electrical energy, and the distribution of the hazard between appliances of various kinds, (cookers, space heaters, etc.) and electrical installations.

Saving of life in burning oil tankers; one of the problems recently dealt with by the organisation was a method of enabling lifeboats to pass safely through a sea of flames surrounding a burning oil tanker. Adequate protection from fire can be achieved by using a tightly fitting canopy wetted with water.

Meritus Barnets' New Type of Spot, Butt and Seam Resistance Welding Machines

RANGE OF MACHINES

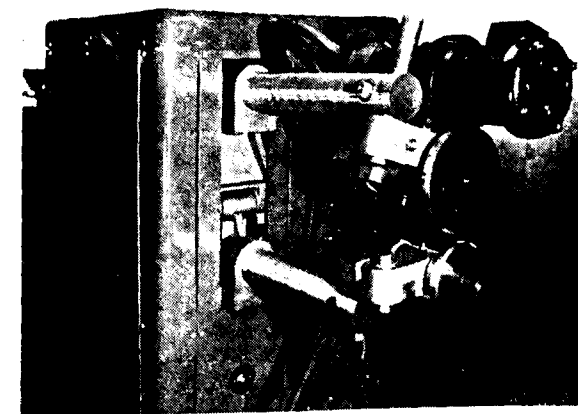
'MERITUS' manufacture a complete range of standard type Resistance Welding Machines from 3 kVA up to 60 kVA. The smallest machine is capable of spot welding down to 2×1 mm. steel wire and the largest up to 2×6 mm. steel plate, or 2×1.5 mm. aluminium sheet.

Pedestal type machines can be supplied either foot pedal or pneumatically operated, depending upon the purpose for which the machine is required. Where strict control of spot weld quality is essential it is general practice to specify pneumatically operated machines with the 'weld' and 'forge' cycles automatically interlocked. The simpler types of spot welded assemblies can be welded satisfactorily on foot pedal operated machines.

'MERITUS' pneumatically operated machines can be used for repeat or 'stitch' welding when fast production is required.

CONTROLS

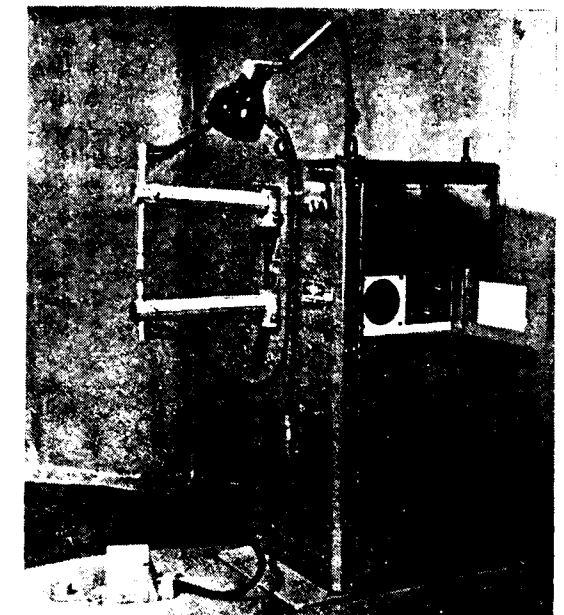
All 'MERITUS' Spot Welders, both foot pedal and pneumatically operated, are fitted with electronic weld timers to give close and accurate control of the welding cycle.



Meritus 'Autoforge' Machine Fitted with Seam Welding Head.

WELDING ARM LENGTHS

'MERITUS' Pedestal Spot Welders are fitted with telescopic welding arms or stakes, normally adjustable between 15 cm. to 60 cm. working length, this increases the maximum welding capacity of any particular size of machine. Longer arms can be supplied when required.



Model A.S.40 A.z Autoforge Spot/Stitch/Seam Welder.

SEAM WELDING

A special Seam Welding Head has been designed to fit 'MERITUS' Standard Spot Welding Machines and which converts them into Seam Welders suitable for both longitudinal and circumferential seam welding of mild and stainless steels up to a maximum of 2×1.5 mm. This enables the machines to be used for either spot or seam welding.

A Synchronous Electronic Timer and Ignitron Contactor fitted with manual heat control is supplied with machines intended for seam welding.

WIRE WELDING

The 'MERITUS' range of Bench Type, Stand Mounted, Foot Pedal Operated Machines have been specially designed for use in the Wire Goods Industry, for spot welding such articles as lamp shade frames, bird cages, display stands, machine guards, racks and trays, and wire goods of all types. These machines are also suitable for spot welding small and medium sized assemblies in steel sheet up to a maximum thickness of 2×1.5 mm.

WIRE BUTT WELDING

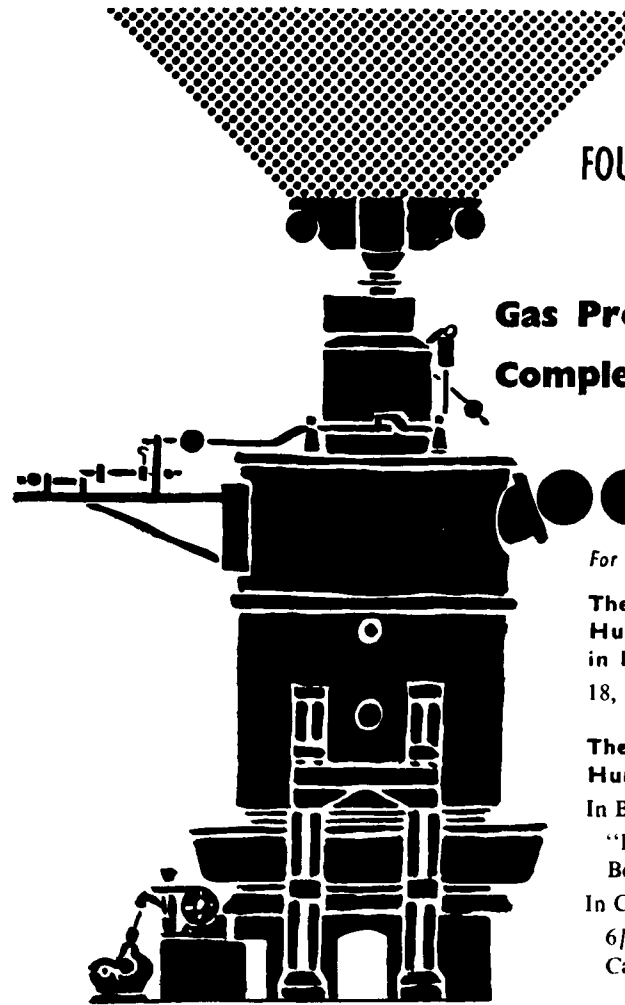
Two types of Wire Butt Welding Machines are manufactured at present by 'MERITUS'. One operated by hand and one by foot pedal. Both machines have a welding range from 1.5 mm. up to 7.5 mm. steel wire.

The Pedal Operated Machines is designed for fast production; the complete welding cycle, including clamping the workpieces, is carried out by one stroke of the foot pedal. This single action operation considerably speeds up production.

The Hand Operated Machine is suitable for use where speed is not so important.

'MERITUS' also manufacture a special Butt Welding Attachments for use on 'MERITUS' Spot Welding Machines.

Full details of all 'MERITUS' Resistance Welding Machines and accessories can be obtained on application to the Company at the above address.



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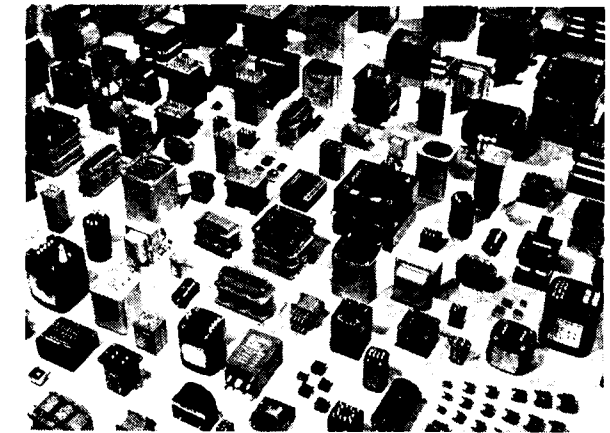
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GRESHAMS' New Range of Transformers

 GRESHAM Transformers Ltd., who are the largest independent manufacturers of transformers in Great Britain, supply transformers varying in size from a few milli V.A. to 5,000 K.V.A.

The Small Transformers Division, which is situated at Hanworth Trading Estate, Feltham, Middlesex, is concerned with transformers for electronic and light engineering applications. Having gained Full Joint Inter Services Type Approval to Humidity Class H.1 of RCS. 214 for all the ranges listed in RCL. 215 and 216, Gresham are specified by the Admiralty, Ministry of Aviation and the leading Radar and Electronic Companies.



A range of Gresham Transformers

Research and development is continually proceeding in the field of lighter and smaller transformers without impairing the humidity requirements specified by RCS. 214. As a result of these developments, a lead has been established in resin cast transformers for use with airborne and other associated equipments.

Resin, of course, is an excellent insulator, and permits internal clearances to be greatly reduced when applied under carefully controlled conditions. This characteristic enables very high voltage transformers to be greatly reduced in size when compared with their

conventional counterparts. Unfortunately, resin possesses lower thermal conductivity, characteristics than oil, but, where temperature rise is likely to cause concern, Gresham utilise the extensive research carried out on heat sinks and general heat dissipation problems.

We shall be pleased to furnish more detailed information about any of our products if readers so desire.

Long-life Fume Extraction Fan

A fume extractor fan which is claimed to have a life several times that of conventional metal fans, has been developed by a U.K. firm.

It has also been specially designed to blend with contemporary architecture of new hospitals, universities and Industrial premises where low silhouette, modernistic lines are essential—an advantage over ducting discharge connections and weather cowls associated with industrial skylines. The range covers six sizes—from 10 ins. to 25 ins. diameter.

The fans are made in P. V. C. (polyvinylchloride). The use of metal has been restricted to stainless steel holding down bolts. A feature of the design is a

special ventilation device which ensures that the motor does not overheat during warm weather.

Installation is simple since the connection at the base of the fan can be supplied to suit the customer's ducting. It also has low power consumption and is resistant to chemical fumes, corrosive gases and bad weather.

The company's developments, which are attracting increasing interest from overseas countries include a range of tanks for use with most commercial acids and alkalis. They are constructed of mild steel lined with polypropylene, combining strength with acid resistance.

Liquid Solid Separations' NEW HYDROCYCLONE

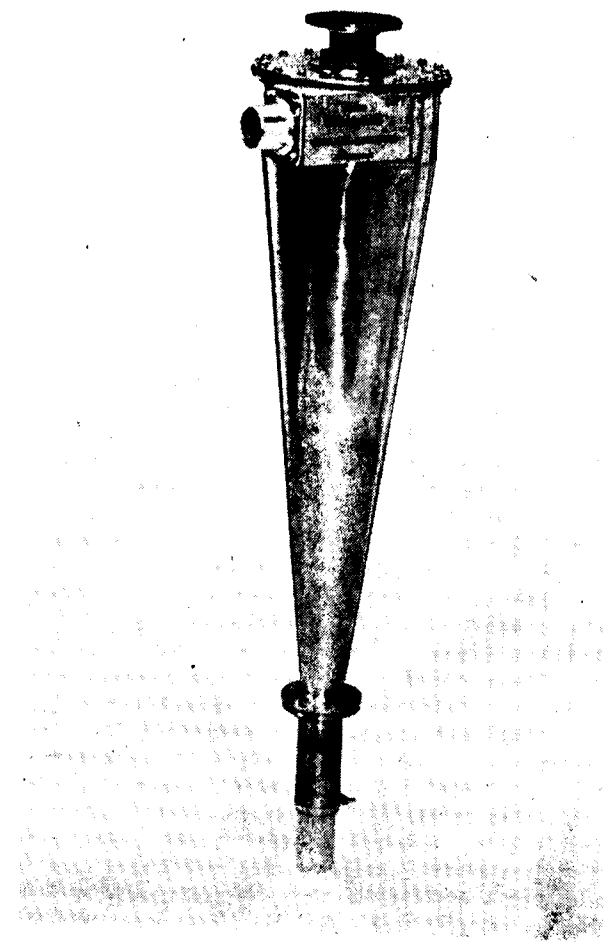
IN order to meet a demand in a variety of industries for a speedy and accurate method of separating or classifying solids suspended in a liquid, a new device known as the Hydrocyclone has been produced. This is a wet centrifuge in the form of a cylindro-conical vessel into which the liquid to be processed is injected under pressure. The rapid rotary motion which is imparted to the liquid produces a very high centrifugal force, frequently of 15,000 G or more, which forms two distinct vortices. The outer vortex carries the heavier solids to a nozzle in the apex of the instrument from which they are discharged together with some liquid. The lighter solids are entrained in the inner vortex to an axial overflow at the opposite end.

Owing to the very strong shearing forces also produced, the Hydrocyclone is effective even with pulps of high solid concentration or plasticity. Its ability to distinguish between granular particles and those which settle by means of flocculation or other form of aggregation, makes it particularly useful for cleaning such difficult materials as fibrous pulps.

The Hydrocyclone is of simple construction and consists of a body, normally of cast aluminium or fabricated mild steel with a lining of special abrasion resistant rubber. The upper part contains the vortex finder and overflow and an easily removable nozzle of solid rubber is fitted to the apex. To provide maximum protection against abrasion, which is intensified as the diameter lessens, the walls of the nozzle increase in thickness towards the orifice. In the smaller sized units the rubber body lining is replaceable.

Under normal conditions the diameter of the Hydrocyclone selected for a particular application is dictated by the fineness of separation required, the smaller the diameter the finer the separation and this can be controlled by varying the diameter of the three orifices the smaller the diameter of the feed inlet and of the overflow or vortex finder, the finer the separation achieved. The apex nozzle controls the proportion of feed volume rejected as underflow and consequently determines its solid concentration. The fineness of separation can also be increased by recycloning the overflow and the sharpness, that is to say the efficiency of separation, by recycloning the underflow. Two other factors which affect the size of separation are pressure, the increase of which usually produces finer separation and feed dilution. Some separations are however possible with pressure drops as low as 2 p.s.i. often obtainable by gravity.

The Hydrocyclone is produced in models with capacities ranging from 4 to 1200 gallons per minute. For fine separations at higher capacities batteries of Hydro-



300 mm. dia. Hydrocyclone.
Liquid Solid Separations Ltd.

cyclones of 15 or 30 mm. diameter can be installed. In suitable cases separations down to 5 microns are possible.

This compact and efficient unit is being used extensively in laboratory research and among its many potential applications in various industries the following can be mentioned: degritting of cutting, grinding and honing fluids and of rolling mill cooling water, dewatering of slurry, desliming of sand as well as degassing deflocculation and general classification and washing operations.

The instrument described is manufactured by Liquid-Solid Separations Limited, 2 Anderson Street, London, S. W. 3, England.

Anchorage and Prestressing Techniques in the Production of Prestressed Concrete

EXCELLENT physical properties of prestressed concrete and successful development of its technology have fostered its world-wide and made it become often the only possible solution of the long span and high strength structures as well as of structures from which long life and durability in exceedingly hard ambient conditions are required. Graceful simplicity and slenderness of shape possible in hitherto unheard-of spans and ideal prerequisites for prefabrication created by this structural system—all these advantages predestine prestressed concrete to become first rate building material of the future.

Economy of prestressed concrete construction, however, is influenced to a very large extent by the mastering of the rudiments of its technology, the type of work aids and particularly the type of anchoring elements and prestressing machinery. On the basis of our own experience and research as well as on the basis of a careful study and analysis of progressive methods of prestressing as reported in world technical literature a new type of anchors and prestressing jack was developed in the Czechoslovak Socialist Republic, satisfying the most exacting requirements.

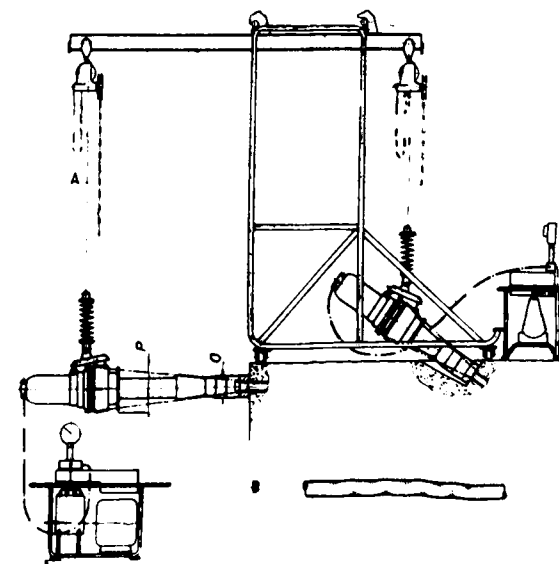


Fig. 1. A General plan of the prestressing post during the execution of a prestressed concrete structure by the cantilever method/correlling/and by stressing from the upper face.

ANCHORS

Reinforcement intended for prestressing passes through the structural elements in tendons consisting of 8 to 24 dia. 7 mm or 5 to 48 dia. 4.5 to 5 mm wires. These tendons are fitted, prior to the beginning of the placing of concrete, into thin-walled pipes or convoluted, spirally wound and locked strip steel tubing. In other cases the tendons are laid into open ducts, left out on the outer face of structural elements, after the hardening of concrete. Tendons are also inserted into ducts created in the precast structural elements in the process of its prefabrication by means of bars of inflatable tubes, which are taken out after the concrete of the element has set. In all cases of post-tensioning the reinforcing tendons must be secured, after having been tensioned, by means of metallic conical anchors.

The anchors consist of a bearing plate provided with a conical hole and a hardened steel cone the surface of which is made rough by means of small,

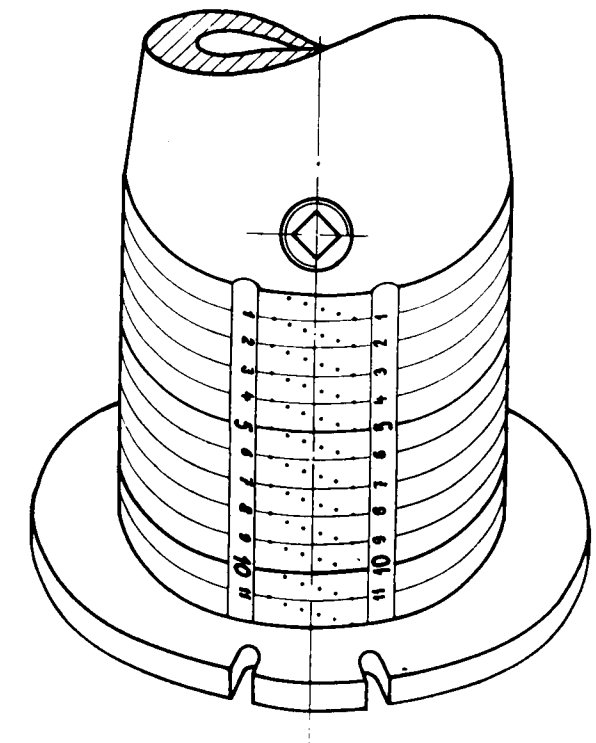


Fig. 2. Vernier scale of the cylinder

peripheral grooves. The bearing plate acts simultaneously as a transferring element, transferring the pressure from the anchor on to the concrete.

Conical steel anchors are very inexpensive, perfectly safe and very easy to handle. For these reason they have superseded all other types of anchorages formerly used for the securing of prestressed reinforcement. They are made of standard type, non-alloy steel and are applied to the tendons either prior to the beginning of the placing of concrete or immediately before the beginning of prestressing. Their use does not require any adjustment of ends of tendon ducts, nor does it impose any requirements on the tendons themselves as far as their length, alignment or cleanliness of surface of their individual wires are concerned. Another advantage of this type of anchors is the possibility of their utilization for the securing of tendons containing any number of wires. Their size and weight advantageous owing to low investment costs are proportionate to the prestressing force of the tendon, depending on the specific pressure applied by the anchor on concrete. It is possible, therefore, to use anchors of the same size and weight for the securing of a short tendon as well as of tendons several hundred metres long with the same degree of safety and reliability. Due to their low price it is advantageous almost in any case to use them on both ends of the prestressed structure, tensioning the tendons from both sides, which considerably reduces losses due to friction. All anchorage units for anchoring forces of from 8 to 100 tons per one tendon are currently manufactured, often in large series.

So far more than 2 million anchors of this type have been successfully utilized in Czechoslovakia.

The fitting of anchors is very simple. The bearing plate is slipped on the end of the cable protruding from the structural element, the wires are distributed roughly uniformly along the perimeter of the conical hole and secured by the cone stopper which is inserted in between them and secured in position by a mild tap of a hammer. This procedure is all that is necessary to make the tendon ready for prestressing.

TYPE A12 AUTOMATIC PRESTRESSING JACK

The type A12 automatic prestressing jack consists of the jack proper and a motor-driven hydraulic pump mutually interconnected with a single flexible hose. The hose provides the prestressing jack proper with

hydraulic pressure needed for the execution of all operations involved in the process of prestressing and anchoring. The pressure gauge built into the pump mechanism cuts off automatically the supply of pressure oil the moment the prestressing force has



Fig. 3. Clamping of the Wires in the clamping jaws.

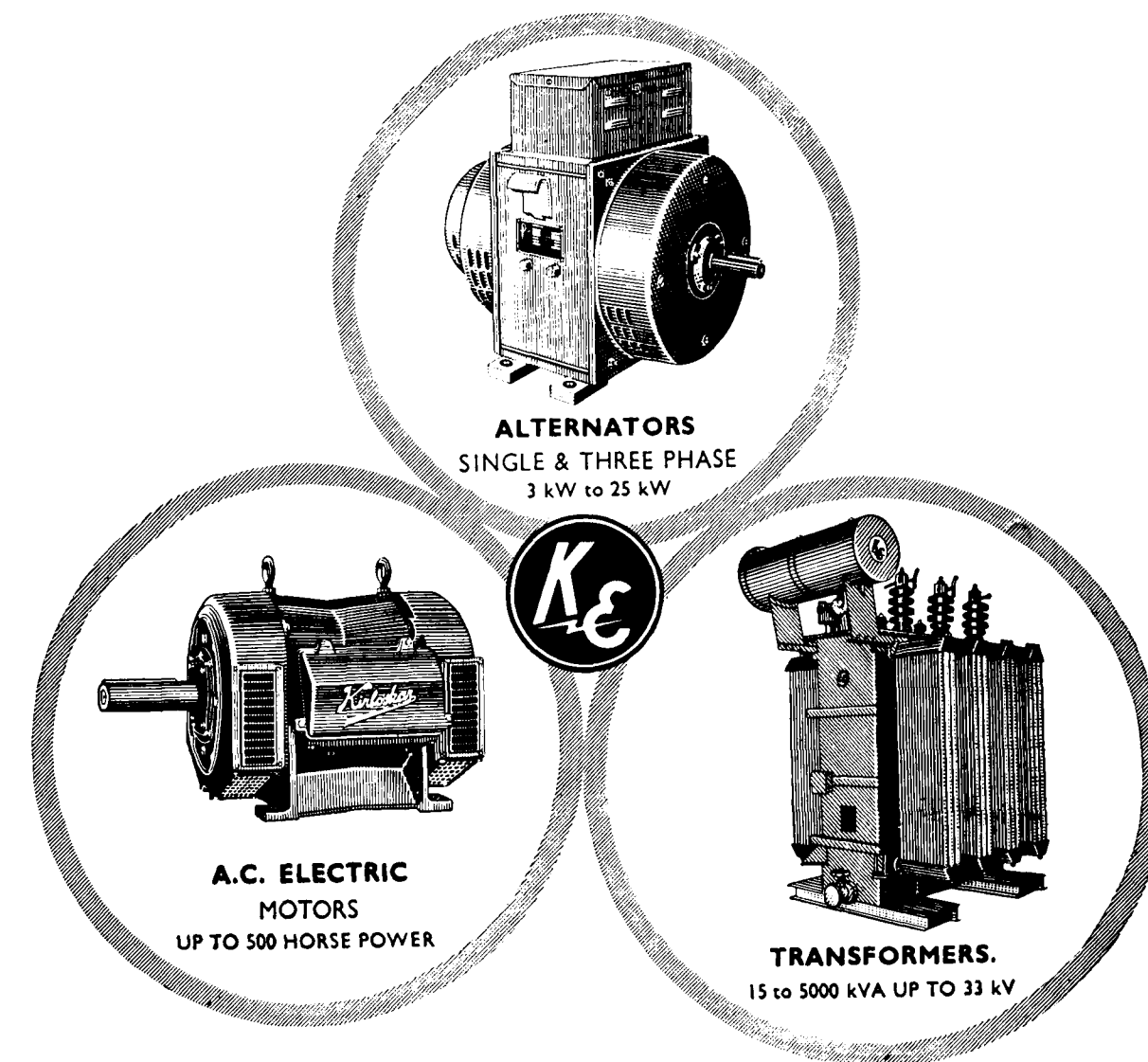
attained the required value. The jack, being suspended above its centre of gravity on a suspension spring, can be always automatically aligned with the axis of the tendon under prestressing.

CLAMPING JAWS

One of the most important functional parts of the prestressing jack are the clamping jaws which clamp the wires of the tendon during the whole prestressing cycle. The jaws are uniformly distributed around the circumference of the jack cylinder, each jaw being capable of accommodating one to four wires. Their design guarantees all wires being clamped simultaneously and with perfect uniformity of pressure.

The jack can be aligned precisely with the axes of the tendon immediately prior to the clamping of the wires in the clamping jaws. This circumstance has a considerable influence on the uniformity of stressing of all wires of the tendon, particularly if the length of the latter is small. The jaws clamp automatically all wires the moment the motor of the pump is put into operation. Also the release of the jaws on termination of the prestressing cycle or whenever it is necessary to readjust the position of the jack, is carried out automatically and with utmost reliability. For this reason the automatic prestressing jack is particularly suitable for the continuous and speedy prestressing of tendons however long they may be.

The notches of the jaws are pressed into the wires solely by means of in-pressing, without



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causing the slightest manual shifting of the wires within the anchor, and always in a way ensuring the staggering pattern of the notches in the clamped wire (see Fig. 1-B). This "soft" clamping ensures that the wires, which are under the highest stress directly within the clamping jaws, where the stipulated prestressing force is increased by the friction of the wires within the anchor and along the guiding surfaces of the prestressing mechanism, would fail only when ultimate strength has been reached.

Another advantage of this "soft" clamping of wires is the fact that the jaws are practically unwearable and that even wires polluted with grease, rust or even a layer of hardened concrete can be clamped without fear and with perfect reliability.

INSERTION OF WIRES INTO THE CLAMPING JAWS

When the hydraulic circuit of the prestressing jack is not under pressure, the clamping jaws are always open and ready for insertion of the necessary number of wires (see Fig. 3).

The wires are secured against spontaneous falling-out by means of a hook (see Fig. 3, left hand), the positioning of which is, together with the insertion of the prestressing jack on to the tendon, the only manual operation required in the whole of the prestressing cycle. All other operations of the whole cycle are executed by the pressure oil.

The pushing of a push-button of the pump motor brings the pressure to the pressing rollers, by means of which the prestressing jack moves along the cylinder. A ring which bears on the rear faces of the clamping jaws presses the latter into wedge-shaped

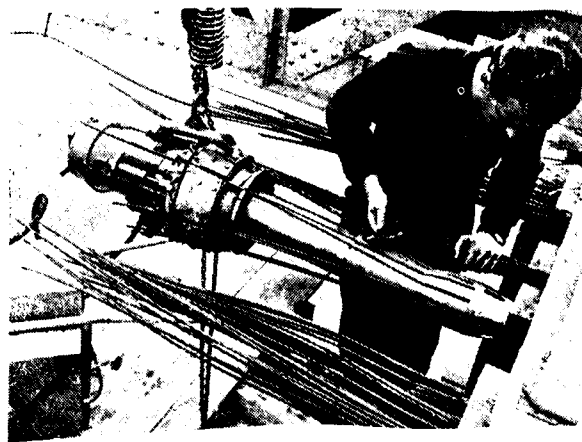


Fig. 4. Pressing-in of the cone anchor after the completion of the prestressing stroke.

grooves in the cylinder, thus clamping the wires inserted into the jaws. The pressure oil enters simultaneously (mildly throttled) into the main cylinder of the jack, thus executing the stressing stroke. While performing this operation, the jack bears on the anchor by means of a separate ring which prevents the jack from wearing out through direct contact with the hard anchor. The cone is pressed into the conical hole in the bearing plate, the tendon having been stressed, by means of letting the pressure oil flow from the main cylinder into the pressing-in hydraulic system situated within the piston of the jack. This operation is carried out as a part of the operating cycle of the pump by means of releasing a valve in the front part of the jack (see Fig. 2).

After the cone has been pressed-in, the clamping jaws of the jack automatically open, releasing the wires which spontaneously fall out on disengaging the securing hooks (see Fig. 3). At the same time the piston is automatically pushed into the cylinder of the jack. The prestressing cycle is terminated by retracting the prestressing jack from the stressed cable.

The servicing of the automatic prestressing jack is very simple and quick. The jack operates in difficult site conditions, in dusty or humid atmosphere without any failure and guarantees perfectly uniform stressing of all the wires in the tendon. The only tool needed in the operation of the jack is one square wrench needed for the release of the valves. All motion operations of the jack concerned with the prestressing and anchoring are fully automatic, this being achieved by means of a really simple hydraulic system with a minimum number of packing sleeves.

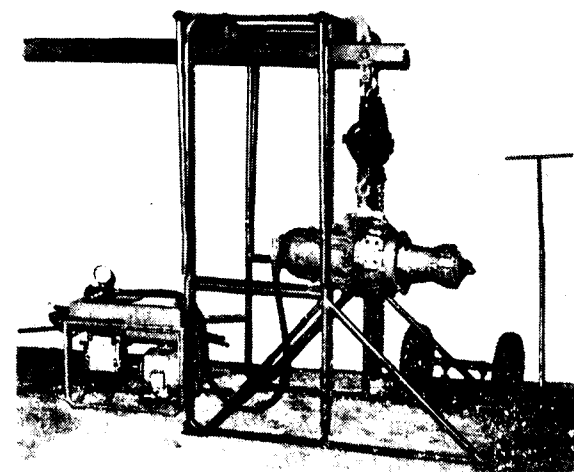


Fig. 5. General plan of the prestressing post using the type M 100 prestressing jack for pressure of up to 100 tons.

The piston of the jack, which protrudes from the cylinder during the stressing operation, is provided along the whole length of its stroke with a transversely grooved centimeter scale with the respective figures (see Fig. 2) which serves as a simple means of control of the elongation of the stressed wires. The readings can be made with an accuracy of 0.5 mm, the scale being interpolated with a slanting vernier scale with divisions of 2 mm.

SCOPE OF APPLICATION

For the stressing jobs within the range of from 8 to 100 tons carried out on the tendons consisting of 6 to 48 wires of 4—8 mm in diameter two sizes of the described prestressing jack are used, which are functionally entirely identical. The motor driven pump is the same in both cases, its weight including the pressure oil contents of 20 litres being 55 kg.

The smaller size D 100 jack can be used for the stressing pressures of up to 50 tons and for tendons consisting of no more than 24 wires. The weight of the jack is 130 kg, the speed of the stressing stroke being 8 cm per min., that of the return stroke 14 cm per min. and 10 cm per min. The length of the working stroke is 37 cm; the stroke can be repeated continuously any number of times to stress gradually even the longest tendons. The minimum length of the jack is 1,000 mm.

OPERATION AND OUTPUT

The automatic prestressing jack is operated by one man only. The output of the jack can be best illustrated by the following figures:

1. The whole prestressing cycle from the insertion of the jack on to the tendon to its removal from the stressed tendon consisting of 12 dia. 7 mm wires 45 m long takes 9 min. 30 sec.
2. The tendon 180 m long consisting of 12 dia. 7 mm wires considerably sagging due to their length was stressed in eight strokes of the jack, the whole operation taking 1 hour 10 min. Operation of the jack on sites, stressing of large structures from their front or from above as well as transverse stressing of tendons can be considerably facilitated by a mobile handling frame (see Fig. 1A), which has proved very well on our sites. The frame can be disassembled into two-dimensional parts, its total weight being 45 kg. The jack is provided with a removable



Fig. 6. Anchors for tendons for various prestressing forces ranging from 8 to 100 tons.

two-wheel tyre undercarriage on which it can be easily transported about the site. Mounted on this undercarriage and fastened to it properly the jack can be also stored and safely transported from site to site.

The use of reliable steel anchors considerably simplifies the technology of prestressed concrete on the site as well as in the manufacture of precast concrete units. The assembly of the moulds and the adjustment of the prestressing reinforcement prior to concreting are easy and quick operations.

The stressing of tendons by means of the A 12 automatic prestressing jack ensures a high productivity of work and perfect transfer of the prestressing force. The description shows clearly that the type A 12 prestressing jack, with its advantages, particularly its easy handling and speedy operation, is a truly revolutionary achievement in the field of the technology of prestressed concrete; its use contributing in no small measure to considerable reduction of costs and improvement of quality of the prestressed concrete construction.

Strojexport—50 Years of Manufacture of ŠKODA Diesel Engines

*History, present state and prospects of
development of Czechoslovak diesel engines*

By A Special Correspondent

MORE than sixty years ago Rudolph Diesel designed the first ignition constant-pressure combustion engine and thus opened new prospects of development of internal combustion engines. They are now one of the most often used power units due to their simplicity and universal applicability. Due to their economic importance they have also been systematically developed, growing into an important branch of the engineering of the industrially well developed countries and becoming a no less important item on the world markets.

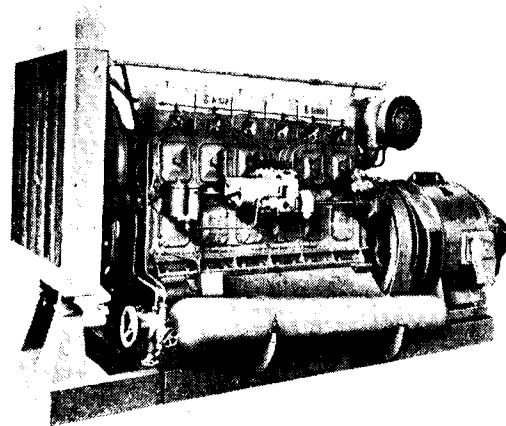
The history of manufacture of oil engines in Czechoslovakia is connected directly with the origin of their design. Their industrial production was started as long ago as 1910, when a mechanical workshop was added to the foundry of the Czechoslovak Oil Engine Works in Prague-Smichov of today. In this workshop, in addition to the manufacture of steam engines, compressors, air pumps and road rollers, the manufacture of oil engines has also developed. Simultaneously the development of the manufacture of the diesel engines in the second big Prague factory—CKD Sokolovo—of today, has been started.

In the period between the two World Wars the Czechoslovak manufacturers attained remarkable technical and business results on the world market. Tumultuous development in this field occurred, however, only after 1945 when the manufacture of oil engines was reorganized and based firmly upon extensive planned development and research. The manufacture of oil engines in Czechoslovakia became primarily an export branch, as is proved by the fact that more than 70% of the manufactured oil engines and oil engine sets were exported in 1959 and the limit of 1 million HP attained. The Czechoslovak industry manufacturing oil engines thus became the 4th biggest exporter of diesel engines in the world.

The association of factories manufacturing diesel

engines Skoda has at present a very wide manufacturing and export programme comprising both small units up to an output of 150 HP and medium high—and low-speed units, as well as big engines. The common features of these machines are their up-to-day design, simple servicing and maintenance, efficiency and operability under the heaviest operating and climatic conditions.

The important milestone in the manufacture of small Skoda diesel engines were the years 1935—36 when the production of the Skoda S 110 four-stroke engine of



A Model of Skoda Diesel Engine.

the works' own design was started. These engines were of very suitable and modern design, so that after the designing carried out after World War II they are still important and considerably exported types in the production programme of the Czechoslovak Oil Engine Works. In their endeavour to keep abreast of the foremost world manufacturers of these engines Czechoslovak designers started from the S 110 series to develop typified stationary and marine units of a low output. The two-stroke operating method was applied as the most suitable solution to obtain a high specific output, low weight and simple design simultaneously with high operating reliability and low maintenance

requirements. Thus the Skoda D 110 series of universal two-stroke engines was developed in which the possibility of typification and the section-type principle are used to the full. These engines can be of both water cooled or air cooled design. Type D 110 engines have attained the highest world standard with their conception, design, technical and weight parameters and unpretentious servicing and maintenance. The results obtained in the development of air cooled multiple-cylinder, two-stroke engines represent a special technical success of the Czechoslovak engineering industry.

In the thirties the design development of our own type of a large high-speed Skoda engine for railcars was also started. Thus in 1931 the type R 215 vertical six-cylinder in-line diesel engine was produced fitted, in addition to an efficient oil system governor, also with a safety governor as a precaution against runaway speed of the engine. From this type was derived the high-speed six-cylinder engine, type 6 R 230, with an output of 400 HP at 1000 r.p.m., used in the years 1933—1935 for the "Blue Arrow" railcars. These machines are still in reliable service on the Czechoslovak railways.

After World War II this well proved diesel engine was redesigned and made suitable for stationary purposes. As an eight-cylinder engine of an output of 500 HP at 900 r.p.m. it was supplied in large numbers for use with earth drilling sets.

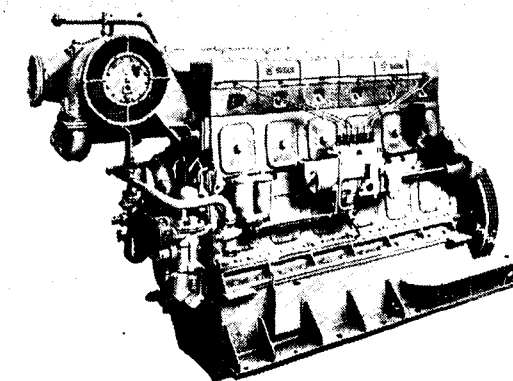
In 1935 the production of one of the most important types of the Skoda S 160 diesel engines with direct fuel injection into the cylinder was started. This engine series was also gradually modernized according to operating experience and results of development work, an output of 30 HP per cylinder at 1000 r.p.m. being achieved, which is a specific output higher by 50% as compared with the original design.

The manufacture of low speed diesel engines of medium outputs was started in Czechoslovakia in 1927—28. During the years 1935—1937 design work on the extensive SL 160, SL 275 and SL 350 series was started, which have been constantly improved in an endeavour for systematic development, and belong in the current programme of the Czechoslovak oil engine industry among the most frequently manufactured and exported types. As far as their outputs are concerned they cover a very important section of the world markets and form the main items of supply of the Czechoslovak oil engine industry for the purpose of shipping and power requirements. In co-operation

with the First Brno Engineering Works low-pressure super-charging has been successfully coped with and an entire typified series of superchargers developed.

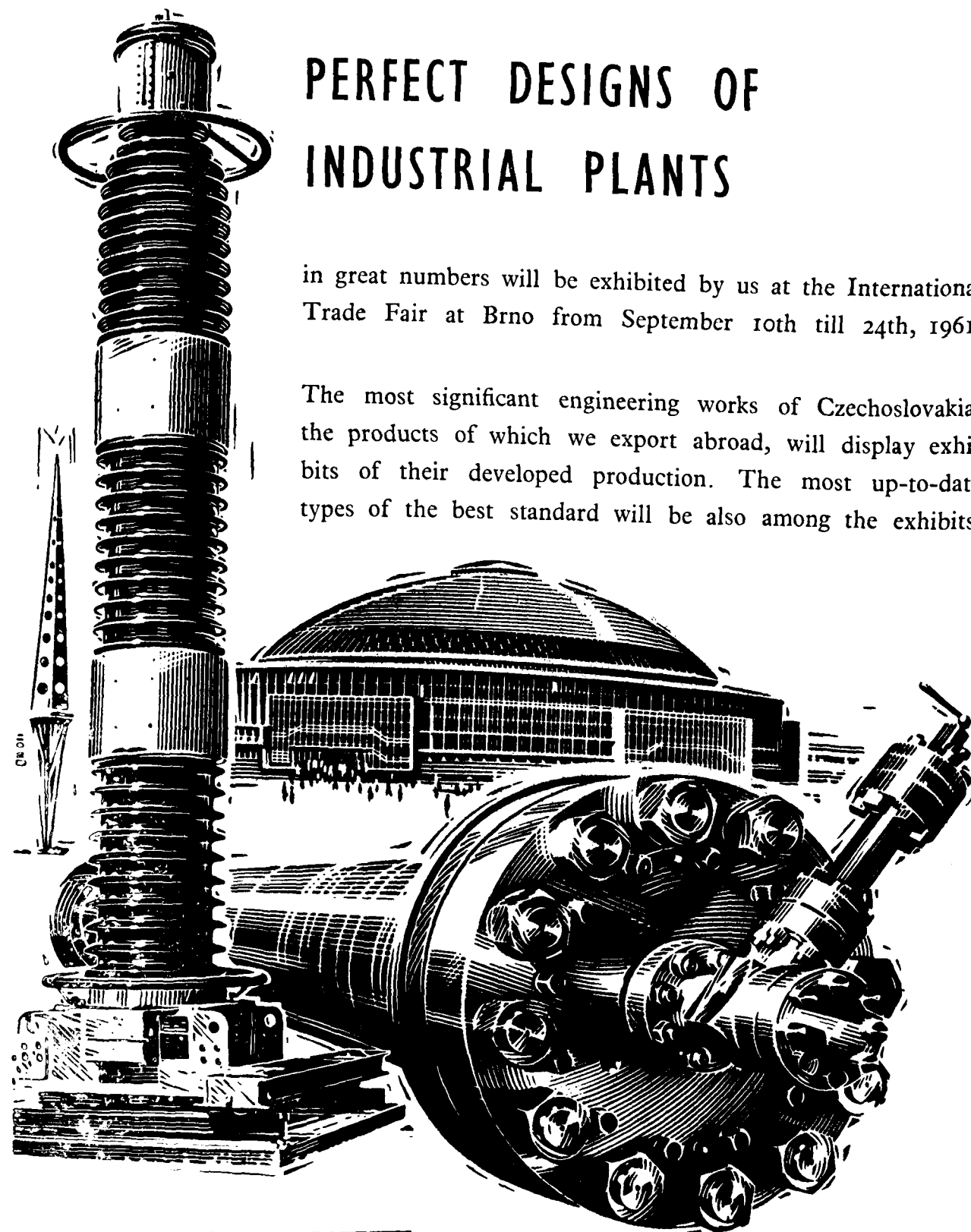
Considerable attention has been paid to the overall modernizing of the SL 160 series, particularly from the view-point of increasing the operating reliability upto 1000 r.p.m., improving the economic manufacturing and fuel consumption indices and creating conditions for supercharging. Introduction of this constructional work into the manufacturing programme and the 40% increase of output of the six-cylinder type by super-charging secured already in 1958 an increase of the technical standard of these engines. First of all was the reduction of their specific weight by 30 to 50%. An important step in modernization of the manufacturing programme of this output was the development of the new typified series of the D 160 two-stroke diesel engines. This series is to be gradually fitted with superchargers in order to increase its output by 30 to 50% and to replace the existing R 140 and SL 160 series.

In the case of the SL 275 and SL 350 series fundamental redesign and modernization have been started, incorporating several view points, viz. increased universal applicability, improved torque spectrum with eight-cylinder units, adaptation of the design for



A View of the World-famous Skoda Diesel Engine.

medium—and high-pressure supercharging complying with the requirement of Lloyd Registers and buyers, and reduction of weight per rating unit. With the SL 275 series, in addition to other improvements, the speed will be increased from 500 r.p.m. to at least 600 r.p.m. In both series the introduction of nine-cylinder units is a new feature. Full attention is paid to the finishing stages of these units both from the theoretical viewpoint of the reliable torque spectrum



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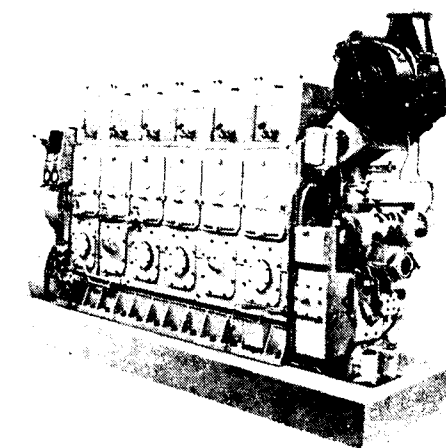
63

and from the technological point of view of the manufacture of the crankshaft with an uneven number of throws. After finishing this reconstruction the output limit of the Czechoslovak marine and industrial diesel engines will have to be shifted to the zone of 2000 HP.

The design of the big Skoda diesel engines was made clear in 1930—33, when two series of the Skoda S 390 and S 425 four-stroke diesel engines fitted with a mechanical type of governor, a cast iron crank case and direct fuel injection into the cylinder through a partly opened nozzle of own production were manufactured. Just before 1935 the design of the well known S 525 engine was prepared. Its development, however, was accomplished only after the war and the first unit of six-cylinder design of an output of 1500 HP, was supplied in 1947. It was manufactured up to 1951 and intended for the drive of big electric generators and irrigation pump sets. It proved well in operation and attained remarkable efficiency—up to 30,000 operating hours up to the first overhaul. Simultaneously further consequent development of the well-proved diesel engines SL 525 was started. This development work will shift at the end of 1961 the output limit of the Czechoslovak diesel engines up to the zone of 4000 HP.

In addition to the oil engines which have been manufactured in large numbers, development work of considerable importance has been carried out also with some important testing units. Some results of the design work of Czechoslovak Skoda diesel engines have assisted not only in the creation of the good reputation of these machines on many world markets, but also in the solution of important questions pertaining to the manufacture and design of diesel engines all over the world. This work concerns new types of combustion chamber and open spaces, rely upon original theoretic studies and enable the operation of Skoda diesel engines in a very wide field of climatic conditions, while maintaining high economy and operating reli-

ability. Then there is a number of problems in the field of dynamics, elasticity and strength of the piston machines which have enabled not only solving by an original method of the complicated questions of the crank mechanism of high-speed piston engines with a large number of cylinders according to a highly pretentious experimental technique, but produced also an original design which has found application also in related branches. Last but not least there is also the solution of questions of the modern measuring technique enabling deep insight into problems of the combustion process, scavenging, mixture forming, etc. and enabling attainment of the peak technical parameters in engine development.



Another Model of Skoda Diesel Engine.

The mastering of these problems has required fully developed co-operation of all research, designing and technological components of this huge field of the Czechoslovak engineering industry which has been unified in the Czechoslovak Oil Engine Works in Prague. This newly Organized trust of factories with its own research institute can fully guarantee that Czechoslovak Skoda diesel engines will maintain their excellent position based upon a tradition of fifty years' standing.

100,000 KW THERMAL POWER TURBINE BEING ASSEMBLED

The Urals Turbine Motor Works began assembling parts of the Soviet Union's biggest thermal power turbine of 100,000 kilowatts. Besides generating electric power, this unit will be able to provide with heat a town of more than 100,000 people. The turbine is intended for one of the residential areas of Moscow.

At the same time the works' designers have begun work on blue-prints for a 250,000 kilowatt thermal power turbine. This unit will be able to provide heat to a town of up to a quarter of a million people.

RISE OF THE FORK LIFT TRUCK

By Ray G. Cook

LANSING BAGNALL LTD.

IN the last 15 years the cry to industry has been for a greater and quicker production, while at the same time industry has been faced with the problems of ever-diminishing space. It is in these conditions that the fork lift truck has made its name.

It is essentially a modern truck, and in its comparatively short existence it has completely changed handling methods in industrial and commercial organisations.

Fork lift trucks are made in an enormously large range of shapes and sizes, with lifting capacities of anything between half a ton and 50 tons. Generally these trucks can be divided into two basic types — those powered by an internal combustion engine and those propelled by battery electric power. Each of these types can then be sub-divided down into many different classes. There are pedestrian controlled fork lift trucks, seated rider operated models and those operated by a standing rider; and these operators can be side or front facing. But they all have one thing in common, namely, to do away with manual lifting, and to work in narrow aisles at high yet safe speeds. Although there are so many capacities of fork trucks almost 80 per cent of them in this country have a maximum load of two tons.

IMPORTANT FEATURES

Fork trucks have to be extremely manoeuvrable, and another important feature is that due to their infinitely variable speed control they are able to "inch" forward or backward when working in confined aisles. The reduction of aisle widths has been one way in which industry has been able to utilise to maximum existing floor storage space.

This has led to yet another development — the fork reach truck, which will work in aisles of six feet. This type of truck carries its load within its wheelbase, and many organisations have found that by using this model they have been able to increase their storage space by as much as 30 per cent. Present trends indicate that the rate of lift speeds are increasing on

reach trucks to make them an even more economic proposition.

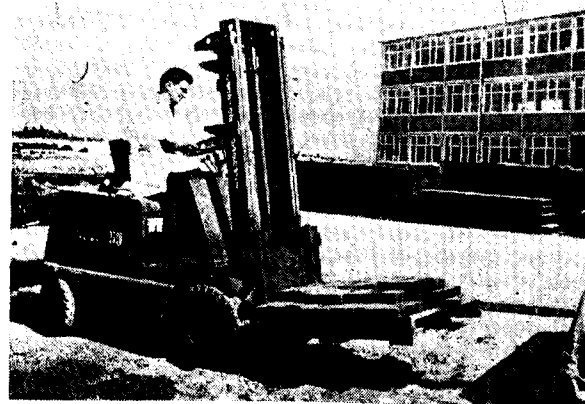
AN ECONOMICAL PROPOSITION

With present day floor rental at between £ 2. 10s. 0d and £3 per square foot a reach truck will recover its original cost in saved space within 18 months to two years.

Another development from the basic fork truck has been the designing of a model for use in deep-freeze cold stores. Here the basic requirement was that the truck had to be operated under both continuous and intermittent temperatures down to minus 20° F.

To do this a battery electric truck has been equipped with special oils and lubricants, whilst batteries, hydraulics, switchgear, insulation and operator comfort have all received special attention. This truck was the result of months of research and development and prolonged working tests and trials in special experimental refrigeration establishments.

The latest innovation is the triple lift system, which, when combined with the reach truck chassis not only saves useful floor area but utilises headroom. Instead of stacking to a height of only 14 ft., 20 ft. can be



The dual purpose Rapide 3000 at work on uneven ground in a steel yard.

managed quite easily, yet the truck, in its collapsed position, can still pass through normal doorway heights.

Basically, the handling of loaded pallets was the fork truck's function although other loads which could not be handled before are now handled with various attachments, e. g. paper reels can be handled by the hydraulically operated rotating roll clamp attachment; carpets can be handled by boom attachments; cartons can be handled by hydraulically operated carton clamps.

The use of these and many attachments eliminates the need for pallets and reduces overall heights of stacks, besides saving on expenditure. The forks are part of the basic equipment, but these varied attachments are gradually taking their place.

RESPECTIVE MERITS

In this article it is only possible to give a few brief glimpses of the scope of materials handling with fork trucks. Each branch of the industry has many facets and problems. One such problem is the choice between battery electric and internal combustion engine powered vehicles. Obviously these cannot be dealt with fully. However, in a brief outline of their respective merits, it can be said that most of the fork lift trucks produced in this country are battery electric powered. One of the great advantages of this form of propulsion is its economical running. After an eight hour shift the batteries are re-charged at a cost of only a few pence, and due to the reduced number of moving parts (in comparison with I. C.) maintenance costs are greatly reduced. The disadvantage met with internal combustion engine powered vehicles is that their exhaust gases contain carbon monoxide. This

eliminates their use inside factories and warehouses, and also near foodstuffs or easily contaminable commodities such as tobacco. The battery electric vehicle is ideally suited to this type of work and can be used inside or outside.

Until a year ago the great advantage the internal combustion engine models, powered by petrol, diesel or L. P. gas, had over battery electric models was their greater speed. They normally travel at up to 13 m.p.h. while the battery electric models were only capable of around six miles an hour.

HIGH SPEED MODEL

But now one British firm has produced a battery electric fork truck which is also capable of working at up to 13 m. p. h. This high speed model has all the other advantages of battery electric propulsion in its economy and fumeless operation, and so has revolutionised the materials handling industry. There is no doubt at all, however, that whatever type of truck is used, benefits accrue in large measure.

The list of users of fork lift trucks is staggering. It includes such industries as brick making, bottling, chemical, canning, cosmetics, confectionery, paper, pharmaceutical, food, timber, tobacco, milk and motor car manufacturers. Indeed, the list is so great that it is impossible to include all its branches.

This then is the fork truck. Capable of handling any commodity, capable of stacking to heights of over 20 ft. and with lift speeds varying between 25 and 80 ft. per minute according to its particular application. Capable of saving space, reducing manual strain to nil, and of reducing costs yet at the same time increasing efficiency and output.

Computer Excels Engineers in Designing Chemical Plant

An electronic computer has designed a chemical plant for the Shell Oil Company in the United States more rapidly and efficiently than a team of experienced engineers, the company reports. The plant will produce ethylene oxide, a chemical used in making antifreeze for automobile engines.

The plant, which is now being built in Emeryville, California, will cost about \$ 500,000 less than a design made by engineers and will cut production costs of ethylene oxide by five to ten per cent, it is expected.

To enable the computer to produce its design, it

was given the basic chemicals and the chemical reactions needed, plus such variables as cost, temperature and pressure requirements, safety factors, and air pollution limits. The machine then ran through 16,000 possible factory designs and selected the design that would produce the largest amount of antifreeze at the lowest cost. This procedure was completed in 16 hours.

On the other hand, a team of engineers worked for a year to prepare three alternate designs for the plant. But their best design was not as good as the one made by the computer, the company says.

New Creation of the Zeiss Works in Jena, German Democratic Republic

By A Special Technical Correspondent

STEREOMETROGRAPH (Fig. 1)

THE Stereometrograph is a new creation of the Zeiss-works in Jena. It serves for the stereoscopic evaluation of air-photographs, particularly at medium and larger scales. According to the instrument's purpose, the mass production of maps, only single-model evaluations are possible. In order to keep the price moderate devices for opto-mechanical aerotriangulation have been dispensed with.

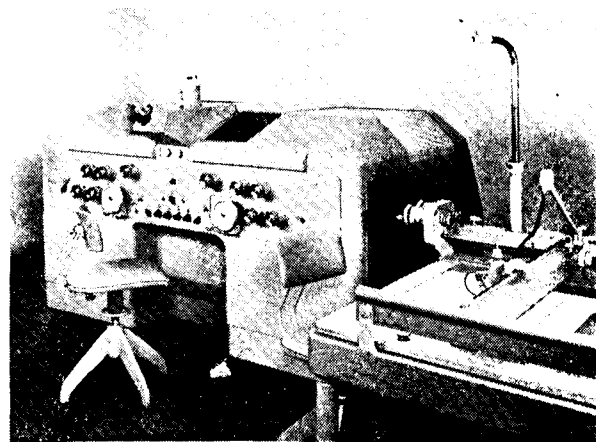


Fig. 1. Stereometrograph.

The Stereometrograph is a stereoscopic mapping instrument with purely mechanical projection and frontal viewing of the picture.

Fig. 2 shows a schematic diagram of the instrument. As compared with similar instruments of other make its apparent characteristics are:

The self-contained shape providing protection against dust and injuries.

A neat and convenient grouping of all manipulative elements on a front-plate within easy reach of the operator.

Rectangular guidance of the image-carriages, spring-balanced precision-guides made of one

single piece each, common guides for both x and b_x as well as for z and b_z movements.

Extraordinarily rigid construction ensuring high precision.

The relative orientation of the images is made an easy operation by the b_y and b_z adjustment-facilities.

Synchro-transmitters effect the transmission of movements from the hand-wheels to the measuring spindles and co-ordinate motions of the drawing table. By this arrangement a high transmission-accuracy as well as a free-choice in placing the drawing-table are ensured.

The electro-mechanical recording and computing instrument Coordimeter can be connected to the instrument.

Stepless setting of the calibrated focal lengths within the range from 95 mm. to 215 mm., photographs up to the size of 23×23 mm. can be evaluated and the projection range lies between $z = 125$ and 310 mm.

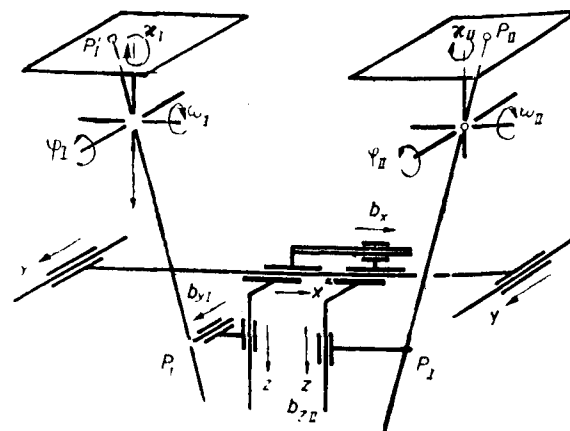


Fig. 2. Stereometrograph.

When plotting with a calibrated focal length different from that of the aerial survey camera

used for taking the photograms, same are automatically decentered by a special device (affinitive plotting). This facilitates the evaluation of photograms taken with super wide-angle lenses.

- Transmitted—and incident-light illumination of the drawing-table for tracing on transparent and non-transparent material.

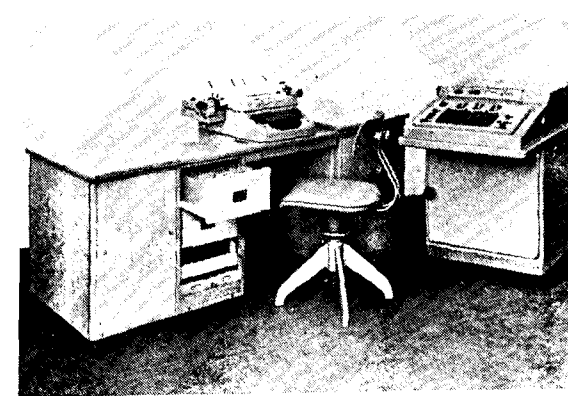


Fig. 3. Coordimeter.

COORDIMETER

The Coordimeter (Fig. 3) a new development of the Zeiss-works in Jena, is a sequence-controlled automatic recording and computing unit for photogrammetric evaluating instruments.

Fig. 4 gives a schematic representation of the machine which can be connected to the stereoscopic plotters Stereoplanigraph, Stereometrograph, Stereoaugraph, and to the Coordinatograph. The Coordimeter serves for the digital indication, recording, and arithmetic data processing of the measuring values. Results may be obtained as text in clear or on punched tape. Direct connection to tape punchers is possible. Seven fixed programmes permit of the following calculating operations:

- Recording of machine coordinates
- Coordinate transformations
- Area calculations
- Calculation of the relative and absolute orientation corrections.

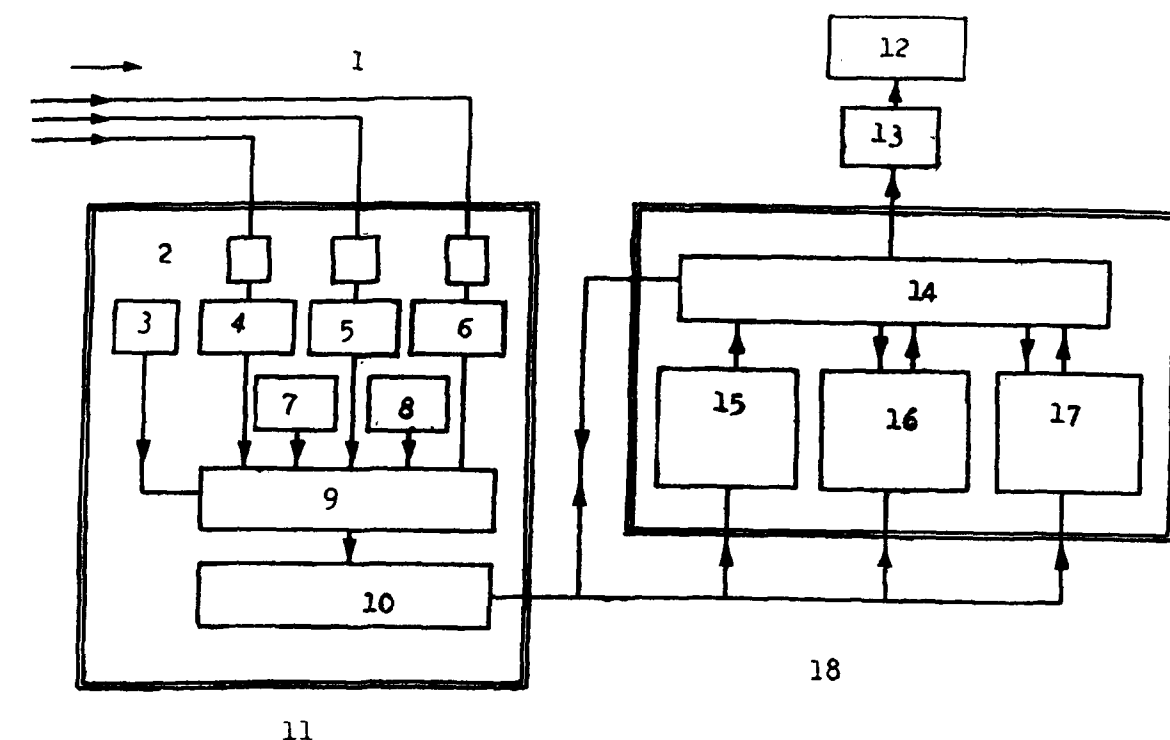
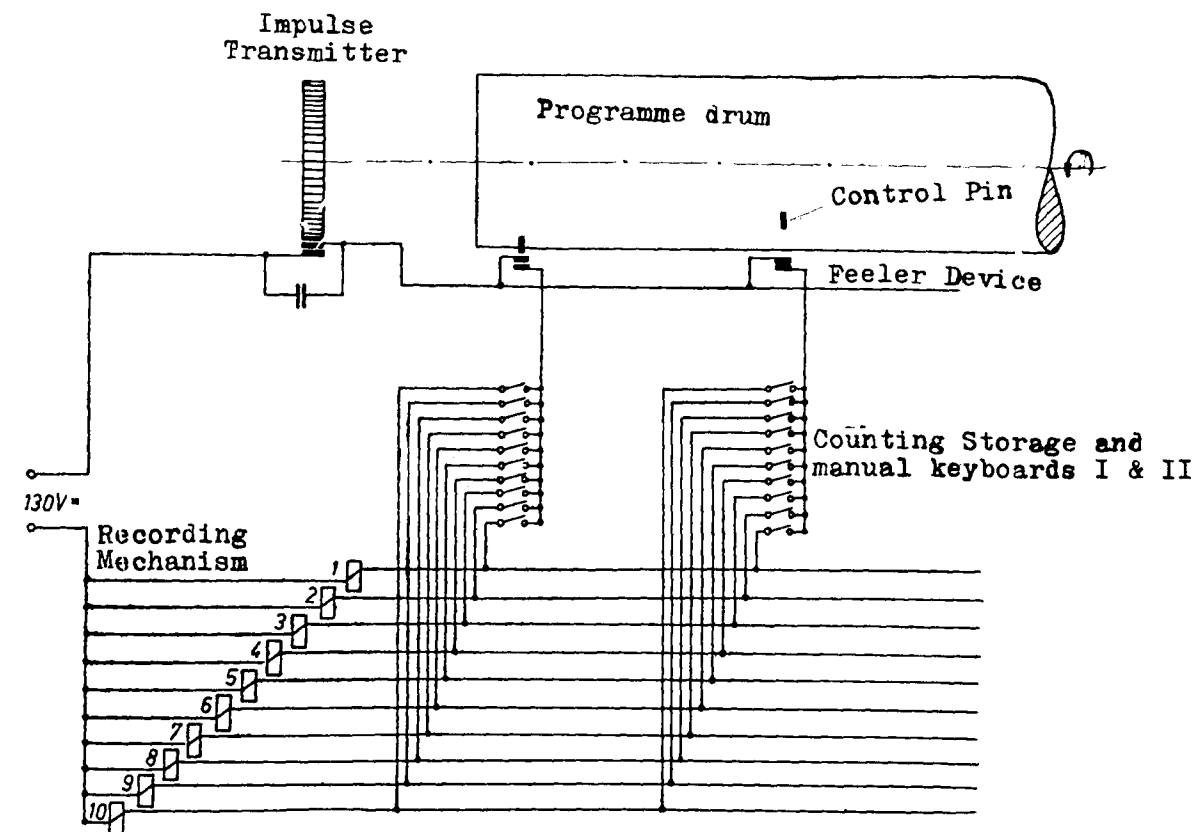


Fig. 4.

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|------------------------------|-----------------------|--|
| 1. Connection to the Plotter | 7. Keyboard H. II | 13. Converter |
| 2. Synchro-recorder | 8. Keyboard H. I | 14. Recording Mechanism with Control bar |
| 3. Point Counter | 9. Storage Drum | 15. Constant Drum |
| 4. Z-Counter | 10. Programme Control | 16. Computing Unit |
| 5. X-Counter | 11. Control Desk | 17. Storage Mechanism |
| 6. Y-Counter | 12. Tape Punch | 18. Computer |



CIRCUIT DIAGRAM OF THE COORDIMETER

Fig. 5. Coordimeter

For operations like coordinate transformations and area calculations the Coordimeter can also be used as independent calculating machine. In this case input of the original values is manually effected on the key board. With the unit connected to a plotter, the measuring values are automatically fed in by means of mechanical transmission counters. Synchro-transmitters transfer the rotations of the measuring spindle to the counting mechanisms. After a brief adjustment of the recording disks, the measuring values are stored through the closing of a contact, called up in the proper time sequence by an electro-mechanical sequence control (Fig. 5), recorded by an electrical type-writer and, if need be, further processed. The calculating unit works electro-mechanically, therefore, the calculating speed is comparatively low but absolutely sufficient for these purposes. A single recording

of machine coordinates takes 6 seconds, coordinate transformations for one point take about 50—60 seconds inclusive of input or setting, respectively.

Apart from the variable original values up to 6 constant ones can be set and processed. Changing the programme is effected by exchanging one control bar in the electrical type-writer and one programme cylinder in the control unit.

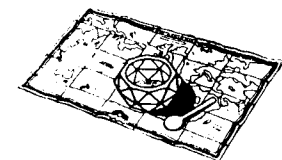
As compared with similar other recording units our make claims to include the data processing according to fixed programmes shaped to special requirements. Individual wishes as to modifications of the programmes or the sequence of words on the punched tapes can be easily complied with.

TAKING OIL-VELLS SIX MILES DOWN

Trials are now nearing completion of equipment for taking Soviet oil-wells 6½ miles down into the bowels of the earth—the deepest holes ever yet drilled.

Director N. Timofeyev of the Soviet Drilling Research Institute says that the light alloy pipes developed for the project are only a third of the weight of steel, yet have a considerable reserve of strength and are more heat resistant. A new heat-resistant cement has also been developed.

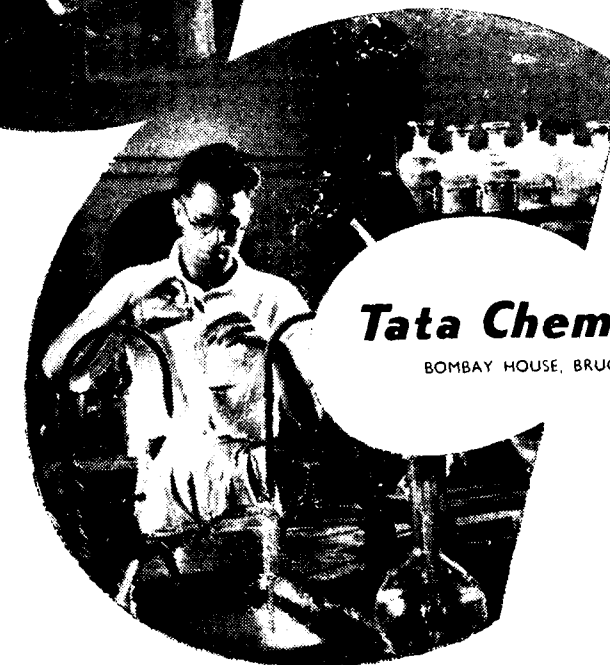
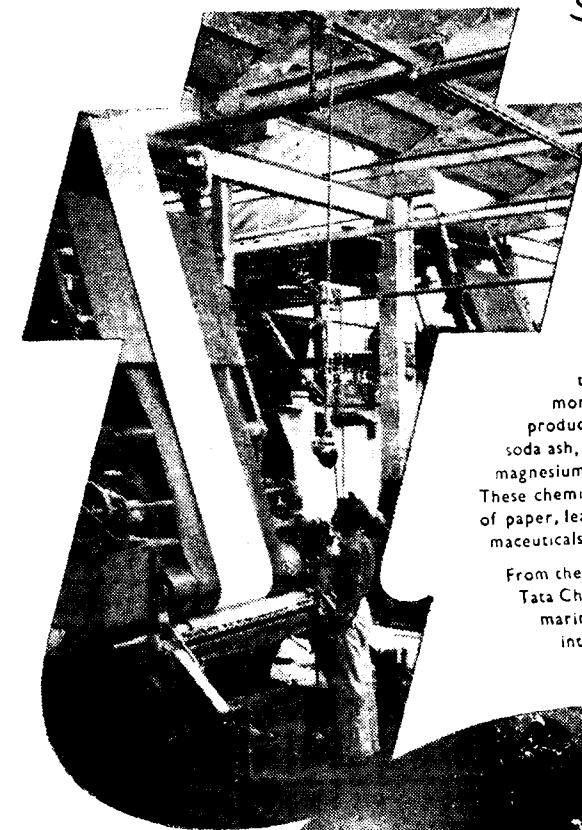
Imagine a world without salt!



Can you imagine how poor the world would be without salt? Your food would lose its savour; there would be no paper to write on; no leather for shoes; no glass to replace the broken window panes; no medicine for the ailing.

In olden days man used common salt as an article of currency and commerce, but the scientists of today have turned it to richer and more varied uses. Out of it they produce such basic heavy chemicals as soda ash, caustic soda, bicarbonate of soda, magnesium chloride and bleaching powder. These chemicals are used in the manufacture of paper, leather, glass, soap, textiles, pharmaceuticals, and other useful commodities.

From the boundless sea as its ore mine, Tata Chemicals recover salt and other marine products to convert them into alkalis and heavy chemicals so essential to Indian industry.



Tata Chemicals Ltd

BOMBAY HOUSE, BRUCE STREET, BOMBAY 1,

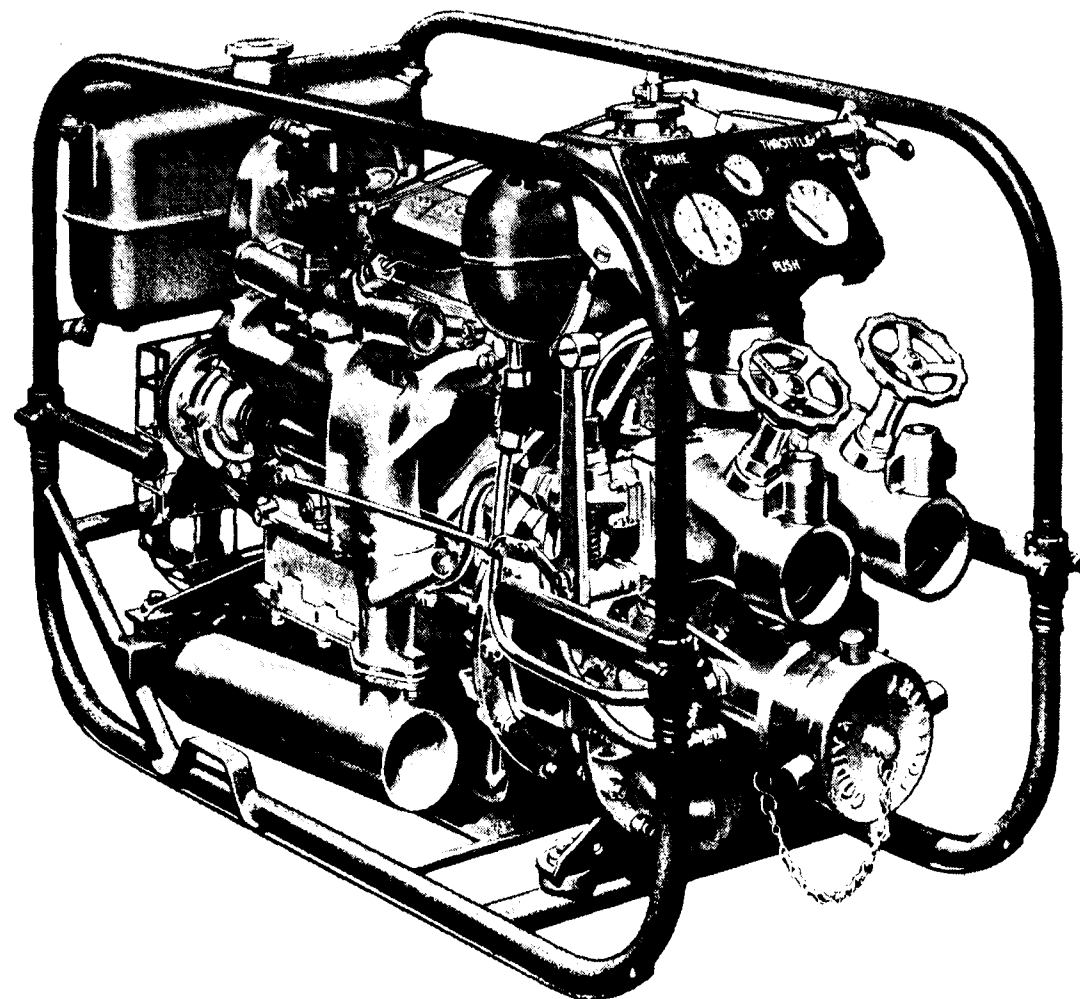
COVENTRY CLIMAX—An International Reputation in Three Spheres of Industry

By A Special Technical Correspondent

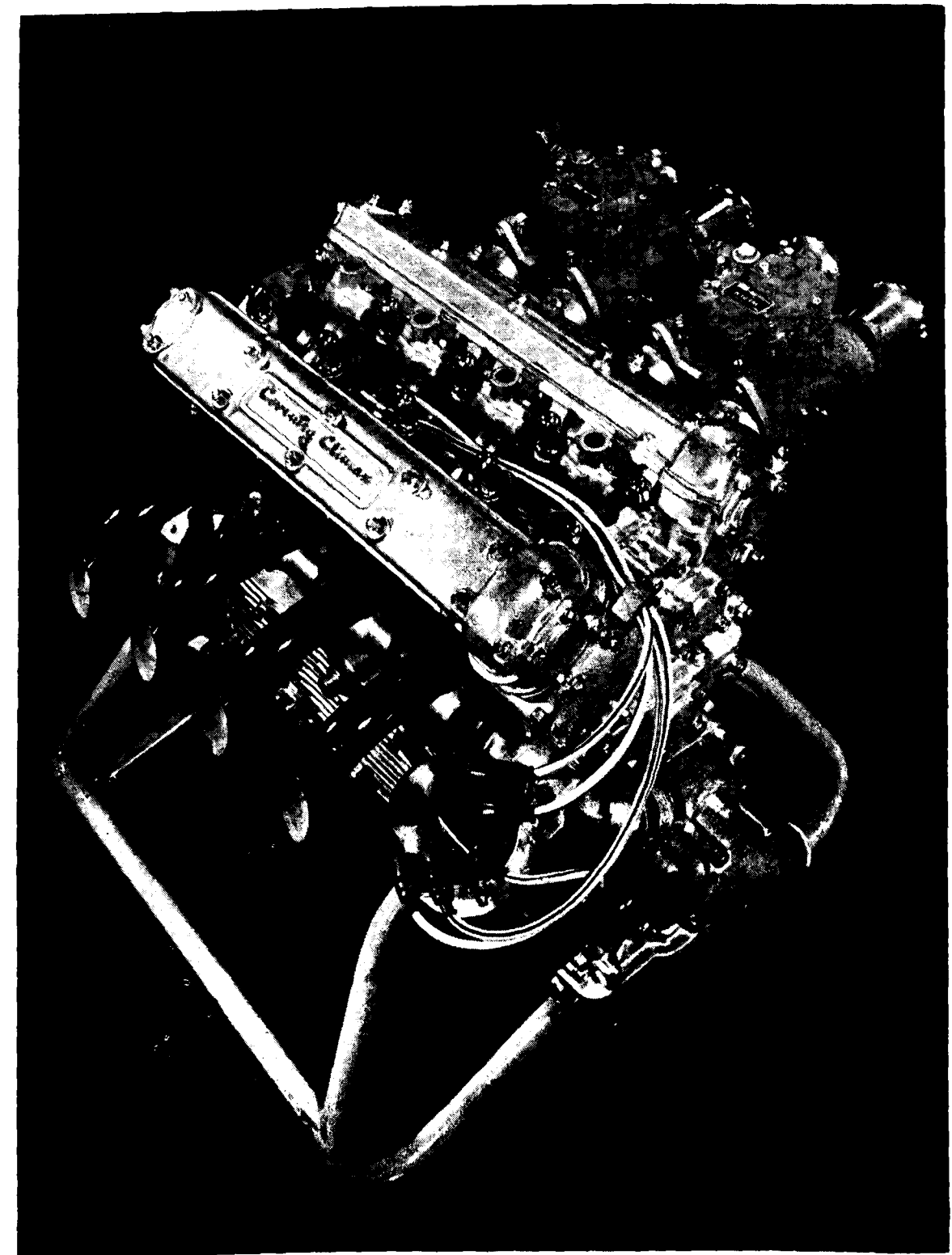
MOST firms are proud if they build up an international reputation for a single product. Coventry Climax Engines Ltd. of Coventry, England, can therefore have justifiable pride in the fact that its name is internationally known in three separate areas of industrial endeavour. The Company's 'Godiva' portable and trailer fire pumps have been standardised on by British and foreign Governments for nearly 25 years for Civil Defence and

fire fighting purposes; Coventry Climax fork lift trucks—the first to be produced in Britain—have speeded up materials handling ever since, particularly in British Commonwealth and European markets; and the Coventry Climax car racing engine has powered British cars to world racing championship successes for the last two years in succession.

Coventry Climax products are backed by nearly



The Coventry Climax F.W.P. Fire Pump which is used by all Fire services in Great Britain. Engines based on the design of the engine powering this pump were successful in powering many sports cars to racing successes.



The Coventry Climax F.P.F. 2½ litre racing engine which powered British cars to the World Motor Racing Championship in 1959 and 1960.

60 years of engineering experience. It was in 1903 the Mr. H. Pelham Lee founded the Company, setting up a small factory in Coventry for the production of petrol engines for motor cars. These engines became extremely popular and, during the next 30 years, Coventry Climax engines were incorporated in many well-known makes of British cars.

The good quality of the engines he manufactured made Mr. Lee look round for fresh applications for his well proven units. In 1937 he decided to commence manufacture of trailer fire pumps incorporating Coventry Climax petrol engines. These pumps proved to be exceedingly compact and mobile units and resulted in Coventry Climax obtaining a large order from the British Government, who adopted the pump as standard equipment for the British Army and Air Force. Tens of thousands of these pumps were supplied to the British Fire Service and to Army and Air Force units during World War II.

After the end of the war, the world potential for mechanical handling equipment led Coventry Climax to be the first British Company to commence manufacture of fork lift trucks—once again incorporating the well-known Coventry Climax engine. In 1946 British Government requirements resulted in exhaustive Government testing of British and foreign fork lift trucks which were then available and, in the face of considerable competition, Coventry Climax once again proved the quality of their engineering by obtaining a large British Government contract for fork lift trucks. This resulted in the British Government standardising on Coventry Climax fork trucks from 1946 up to the present day.

Coventry Climax trucks are now a familiar feature of the industrial scene in Britain and in many countries throughout the world, and they have been standardised on by innumerable large organisations whose names are a household word. The Ford Motor Company are typical of leading users who continue to specify Coventry Climax fork trucks for many of their mechanical handling requirements in England and in other overseas factories.

In 1950 Coventry Climax commenced the manufacture of a range of fire pumps, resulting from a British Government specification covering their requirements under the new Civil Defence scheme. This specification called for a lightweight portable pump, capable of a high performance but light

enough to be carried by two men. Coventry Climax met the Government requirement by producing the F.W.P. pump, which weighed only 365 lb. fully fuelled (166 kg.), but was capable of pumping a minimum of 300 g.p.m. (1350 litres per minute) at 100 p.s.i. (7 atmospheres). Once again, in the face of considerable competition, this new 'Godiva' pump gained the approval of the British Government and the F.W.P. became the standard unit for fire fighting under the British Civil Defence scheme. Fire Services all over Britain soon adopted the new pump and today the F.W.P. is standard equipment for Fire Services in Britain and in many other countries.

In recent years Coventry Climax have developed an even lighter form of portable pump, resulting in the new F.W.M.P. pump which has recently been introduced and which is believed to be the most powerful portable fire pump in existence for its size and weight. This pump delivers a minimum of 250 g.p.m. (1125 litres per minute at a pressure of 100 p.s.i. (7 atmospheres). It weighs only 220 lb. dry (100 kg.) and its size is only 30" x 20" x 23" (76 cm. x 51 cm. x 60 cm.).

Meanwhile the F.W.P. pump has attracted the interest of concerns engaged in racing car manufacture. The F.W. engine which powered this pump combined high power with light weight and compact proportions, which made it a unit of considerable potential for the motor racing track. Coventry Climax responded to this interest by developing this single overhead camshaft F.W. engine into an engine known as the F.W.A., which had an increased capacity of 1100 cc. The new engine was successful in its first race in 1954 and in 1955 Coventry Climax produced a number of F.W.A. engines which gained successes in practically all the Sports Car events for which they were entered.

Later Coventry Climax produced a 2½ litre twin overhead camshaft engine which ultimately led them to supremacy in world Grand Prix motor racing events. This engine (the F.P.F. model) developed 239 b.h.p. at 6750 r.p.m. and, fitted to the Cooper racing car, won the World Motor Racing Championship for Great Britain in 1959 and again in 1960. The 1960 season was one of unbelievable success for the Coventry Climax power unit—for this F.P.F. engine won every Grand Prix race for which it was entered during the year.

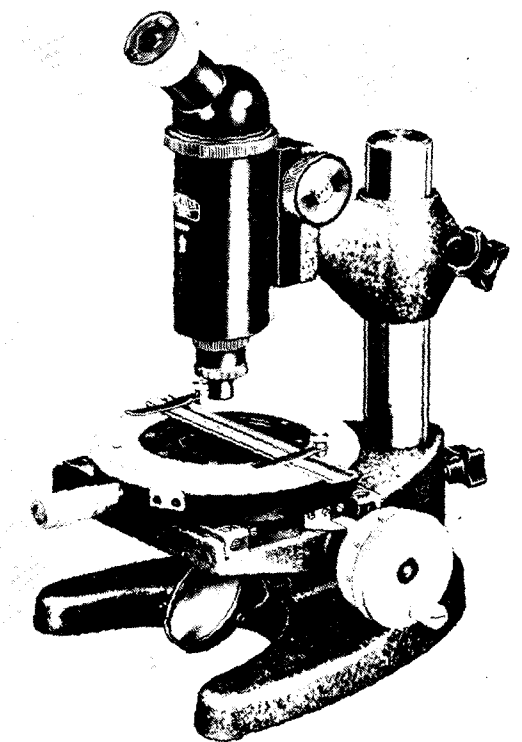
TESTING INSTRUMENTS FOR THE TEXTILE INDUSTRY

Literary Department — Veb Carl Zeiss, Jena, G.D.R.

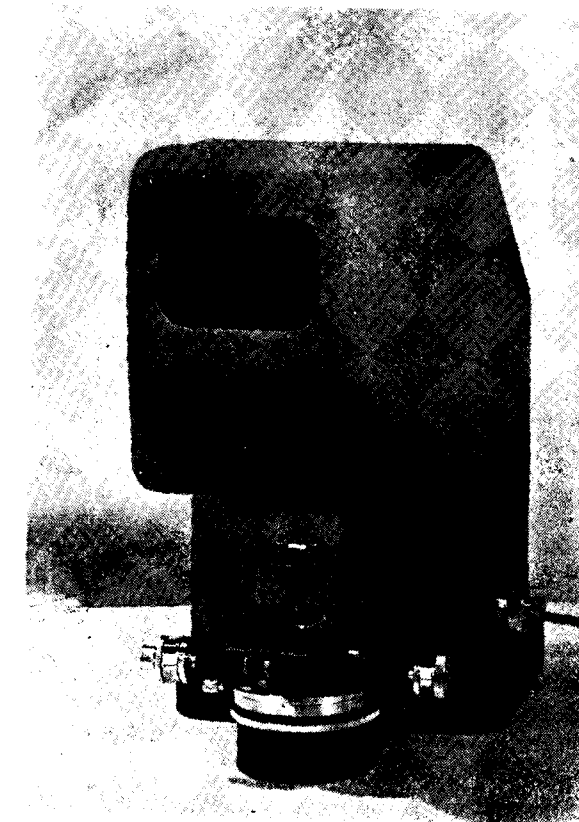
FOR material inspection and quality control of finishing processes in the textile industry, the following instruments are of particular importance: some special types of microscopes, optical measuring instruments and technical precision measuring instruments. Below we list those which can be applied to particular advantage.

With the projection microscope "Lanameter", diameters of animal, vegetable and synthetic fibres of any kind can be measured and in suitable preparations fibre sections evaluated as to their shape and size. For measuring the degree of fineness of wool, as well as of other fibres or, in microscopic work for fibre technicians, the Zeiss-Jena Lanameter in its new and improved design has become indispensable and enjoys general preference. Salient points of the new Lanameter are: the fixed ground glass plate with graticule at eye-level, low-positioned specimen stage situated in

the observer's field of vision, special object traverser with adjustable locks for systematic exploration of the specimens, displacement of slide and rotation of the fibre in its measuring position by the same left-hand pinion head, thus leaving the right hand free for focus-



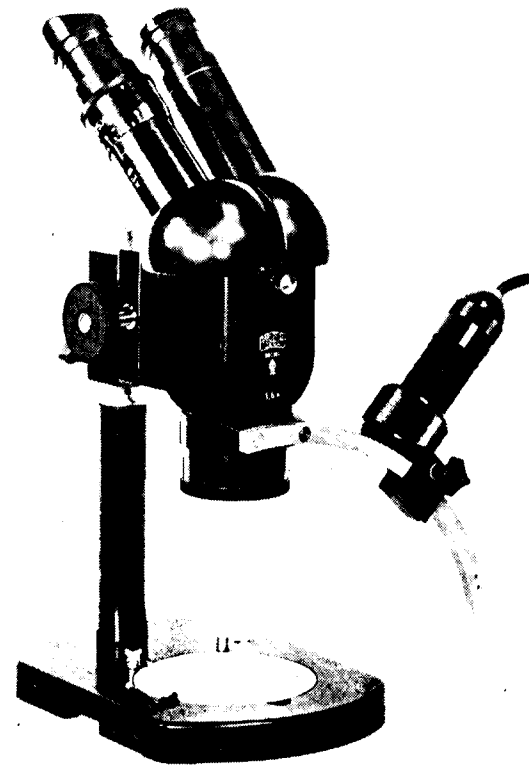
Measuring Microscope



Lanameter

ing and writing, attachable light shield for work in non-darkened rooms. The new Lanameter in a metal casing with fixed projection screen, with upright microscope together with rotary and adjustable specimen stage, with illumination equipment and the cylindrical light hood can be placed on to any normal working table.

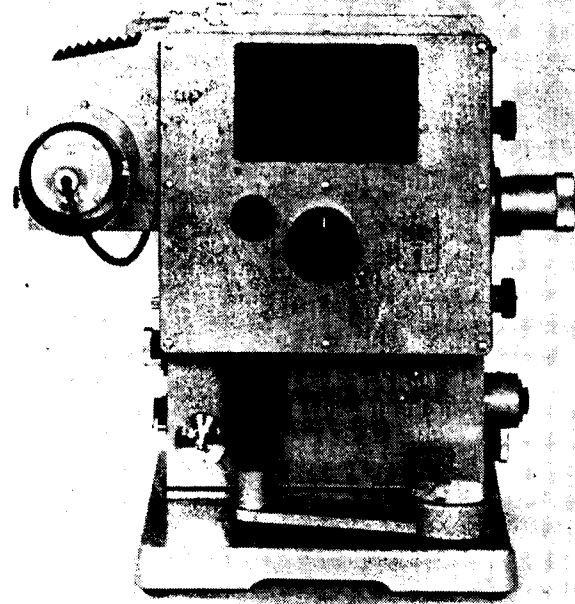
By means of the measuring graduations arranged crosswise on the projection screen, and with the standard magnification of 500:1 object particles of 2 to 200 μ diameter can be measured.



Stereo-Microscope SM XX

For stereo-microscopic research work and investigations of all kinds in workshops and laboratories of the textile industry, the *Stereo-Microscope SM XX* of *VEB CARL ZEISS JENA* is universally used. The optical equipment of this instrument provides natural images of large, even fields of vision up to 44 mm. diameter in excellent relief with the result that even after prolonged work the eyes do not become strained. The 100 mm. working distance remains unchanged for all magnifications from 4 to 110 times, which can be very simply adjusted by turning a control knob without any complicated and time wasting interchanging of paired objectives. The eyepiece tubes of the inclined binocular body can be adjusted to observers' interocular distance, which always remains convergent. The exit pupil of the inclined binocular tube is so computed that spectacle wear can carry out observations comfortably without having to remove the spectacles. While the Stereo-Microscope SM XX is primarily used for observations in incident light, it can also be easily supplemented for investigation of specimens in transmitted light of for both methods of illumination.

As a microscope for the inspection of fabrics in the textile industry the *Measuring Microscope* with horizontal measuring stage adjustment is used in work-



Leukometer

shops and testrooms. The horse-shoe shaped base of the microscope can also be placed directly on to the area to be tested, after removing the stage support and the stage as well as the hinged mirror.

The *Zeiss Leukometer* is used for testing cellulose specimens, for the quantitative control of bleaching or washing processes in the staple fibre and textile industry. By means of this instrument differences in reflection which can no longer be reliably determined with a visual photometer can be exactly measured. This is of particular importance where slight differences in reflection of materials which may still be classified as "white" are to be understood. The photoelectric arrangement of the Leukometer permits even an inexperienced observer to read the overall reflection from the specimen on the measuring drum only a few seconds after insertion of the specimen, the measured result being independent of the structure and orientation of the specimen surface. By measuring with coloured filters the subjective estimation of non-neutral specimens can also be measured with the Leukometer. The light intensity reflected from all sides of the specimen is compared with a light beam of variable but measured intensity from the same light source. Two photoelectric cells serve as radiation receivers, the

current in the compensating circuit operating a single filament electrometer used as a suppressed zero instrument. Some of the special advantages of this instrument are the following: percentage reflection value

immediately readable on the graduated drum, graduation of the measuring drum 0.1%, reproducibility up to $\pm 0.01\%$, horizontal position of specimen when measuring over various spectral ranges.

New College of Engineering and Technology in Delhi

The College of Engineering & Technology, opened in New Delhi on August 17, is one of the major Indian training establishments being assisted by British aid under the Technical Co-operation Scheme of the Colombo Plan.

The United Kingdom Government will provide 10 or more professors and two workshop supervisors for a period of five years.

Equipment is being provided to the extent of £ 250,000, supply being organized by co-operation between the Federation of British Industries and four professional institutions in the United Kingdom (the Institutions, respectively, of Civil, Mechanical, Electrical, and Chemical Engineers). The Government of India is providing the bulk of the teaching staff, items of equipment locally available, and the funds for the building of the college.

At present the college, situated on a 230-acre site, plans to provide instruction at the undergraduate and postgraduate level in electrical, mechanical, civil, and chemical engineering and in textile technology. New branches of study will be developed as facilities become available.

The project has been described as an "outstanding example of partnership in the educational field" between the Indian Government, the British Government, and representatives of British industry and engineering institutions. In the words of a former U. K. High Commissioner, the college is "one more expression of the British nation's warm esteem for India... one more act of co-operation between India and Britain".

GREAT FUTURE FORESEEN

The foundation-stone of the college was laid by

H. R. H. the Duke of Edinburgh during his visit to India in 1959. Speaking on that occasion, the Duke foresaw a great future for the college in improving living standards in India: "There is a wealth of knowledge in the world ready and waiting to be put to practical use, and the only people who can do that are engineers and technologists".

Under the Colombo Plan — which, in the last analysis, is concerned with raising living standards — Britain has assisted with a number of projects in India, including institutions concerned with technical education.

Most of India's national laboratories — for example, the National Metallurgical Laboratory at Jamshedpur, the Central Food Technological Research Institute at Mysore, and the Central Water & Power Research Station at Poona — have had equipment from the United Kingdom, and staff have been trained there under the Colombo Plan. Equipment and experts have also been supplied to the Central Fuel Research Institute, the Indian School of Mines, and the Central Mining Research Station — all situated at Dhanbad, Bihar.

Another institution to benefit under the Colombo Plan is the Indian Institute of Technology at Kharagpur, West Bengal. Some of its Indian staff have received advanced training in Britain, and British guest professors have been provided to serve there. The institute has also received British equipment supplied under the Colombo Plan.

Equipment from the United Kingdom has been supplied to other specialist institutions in India, such as the Vallabhbhai Patel Chest Institute, Delhi, and the Potato Research Institute, Simla.

* * *

Controlling Vibration in Structures and Plant

By F. E. Jones, F. R. I. B. A.

AT the beginning of the century machinery was associated mainly with industry but today we are coming to depend on it a great deal in personal and social activities as well. One result of this multiplication of machines in the factory, the hotel, the cinema, the farm, the shop and the home has been to stimulate the development of techniques for suppressing noise and vibration. This is not merely because noise and vibration are unpleasant and a nuisance but because, if unchecked, they can result in damage to the structure of buildings and be detrimental to the machines themselves.

As the following notes, describing some recent installations, show, very effective techniques have been developed in recent years for mounting all sizes and types of machines and even for mounting whole sections of buildings to isolate them from the surrounding structure. The two main methods of achieving this isolation are either by the use of mats or by means of unit mountings and in all cases one is impressed by the neat and tidy appearance of the job. Rubber is used in both types of mounting and is, in fact, the key material in the science of noise and vibration suppression.

Individual consideration of each problem by an expert in the subject is necessary if the most suitable method is to be selected and applied, since the employment of a suitable vibration absorber is not the complete answer to a vibration problem. The mats or mountings must be correctly arranged if they are to do their work effectively and their indiscriminate use beneath a machine or its foundation can sometimes result in amplification of the trouble rather than a cure.

RUBBER MATS

In Fig. 1 a diesel alternator set and foundations are shown mounted on Dunlop are anti-vibration mountings. These are placed at the bottom and all sides and isolate the concrete foundation to which the machine is anchored, prevent the transmission of

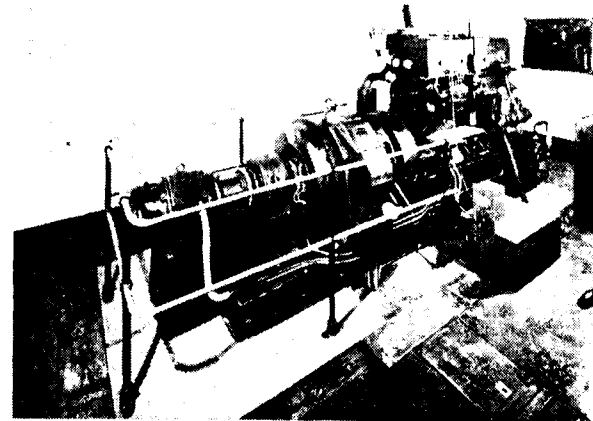


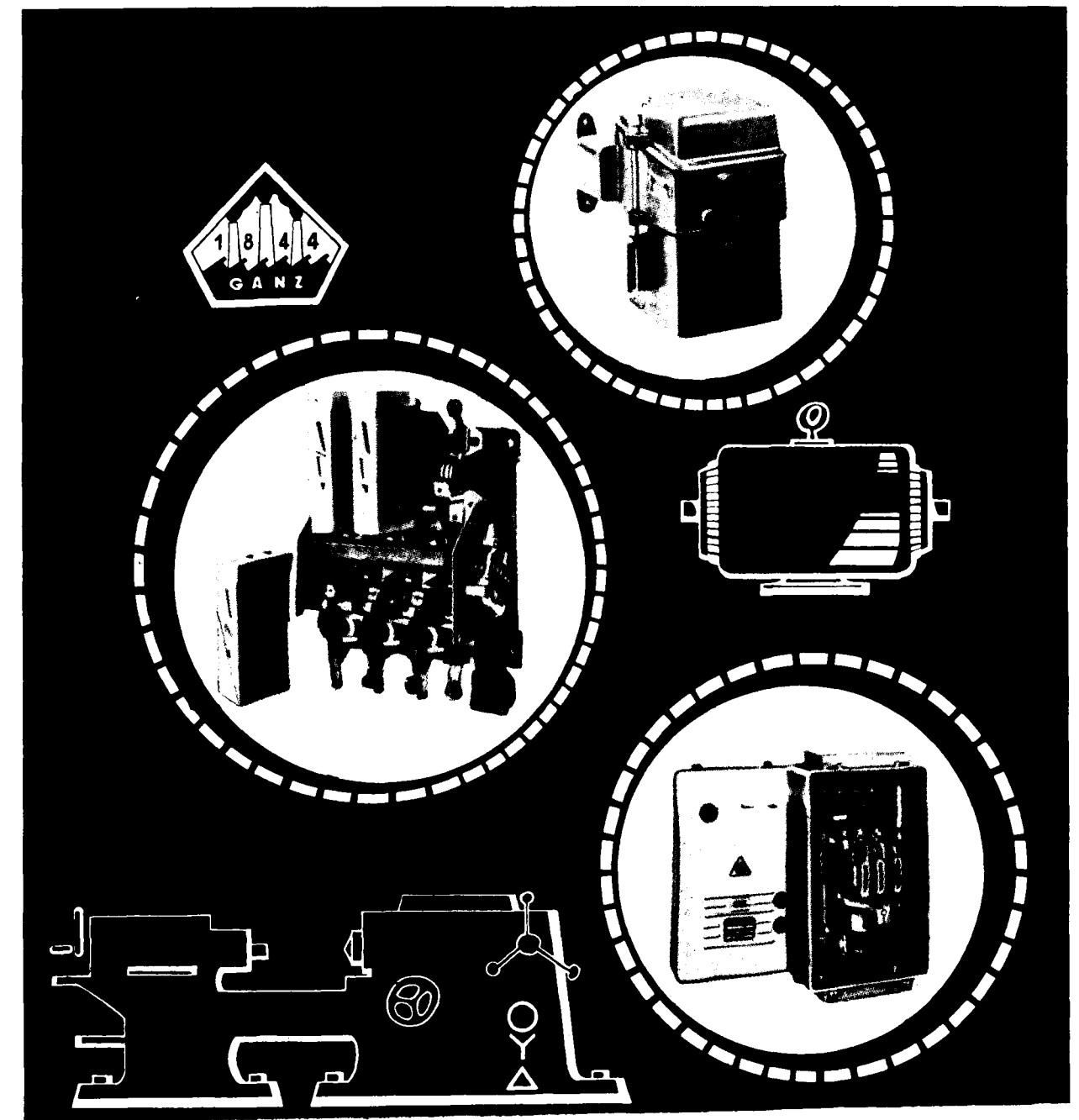
Fig. 1. Diesel/alternator set and foundations mounted on Dunlop are anti-vibration mountings.

vibrations to other parts of the building and safeguard the life of the machine. It is essential that the prepared pit should be proof against the entry of underground waters, or from oil, dirt or water from above. It is the builders' responsibility to prevent the ingress of water from below; water from above can be kept out by placing a cover at floor level which is designed to bridge the gap and yet avoid structural continuity between the floor and the isolated concrete foundation block.

The rubber mats are given lasting resilience by moulding them with studs on both faces. These studs are staggered to prevent the transmission of the load directly from the stud on one side to that on the other. The load is resisted by the 'beam' effect created by the length of rubber between the studs, and this rubber 'beam' is therefore subjected primarily to shear and not compression forces.

RUBBER UNIT MOUNTINGS

Rubber can be used on its own in the form of buffers or pads, or in conjunction with metal as anti-vibration units. These are spaced at intervals beneath the load as required for any particular conditions. They can be employed as follows:—



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- (1) To reduce the intensity of vibration and confine it at its source by "floating" a floor to carry machinery.
- (2) As for (1) above, but by mounting the machinery itself.
- (3) To isolate a machine of a sensitive type which would otherwise be affected by vibrations from outside.
- (4) As for (3), but by isolating a whole section of a building structure.

FLOATING THE FLOOR

An interesting example of this type of construction has been reported from Holland. The Dutch Metal Institute procured a 100-ton Amsler pulsator in order to create and analyse fatigue effects in large metal structures and units. However, before this machine could be installed, the brick foundations had to be tested to find whether they could withstand the recurrent heavy shocks and absorb sufficient vibration to avoid damages to the building and annoyance to others. Tests were therefore carried out by the Institute T. N. O. for Mechanical Constructions in co-operation with the rubber factory of Ruma, Ltd., of Hoogeveen. The results of these tests showed that the problem could only be solved by isolating the machine from its surroundings by mounting it on a concrete plinth on flexible rubber mountings. The concrete plinth was supported on eight specially made rubber mountings and results were completely satisfactory. Even at the highest number of revolutions and at the maximum loading on troublesome vibrations were transmitted to the surroundings.

These principles are often applied to such installations as, for example, the floor of a cinema projection room before the machinery is mounted upon it. Other leisure activities may be conducted on the floating floor itself, which is suitable for gymnasium, for badminton or squash racket courts, roller-skating rinks and dance floors. As well as controlling and localizing the vibration and preventing nuisance, the rubber gives resilience to the floor of obvious value where physical activities are held. A notable instance of a floating floor is in the Hall in Gry's Inn, London, recently completed by Horace W. Cullum & Co., Ltd.

DIRECT MOUNTING

In a block of luxury flats in Kensington, London, it

was found that the air extract fans were transmitting vibrations through the trunking system and to distant parts of the building. This undesirable situation was affecting the letting value of some of the flats and a firm of rubber specialists, A. V. A., Ltd., was called in to attend to the problem. By mounting the fans on rubber vibration absorbers the trouble was satisfactorily eliminated.

In many multi-storey buildings, the lift installations present a similar sort of problem, which has for many years been solved by mounting lift machinery on rubber mountings. In one system a rubber pad with a number of holes pierced through the thickness is used. The holes allow the rubber pad to flex and respond to the variable forces imposed upon it under load. However, sound proofing is playing a bigger part in the keen competition that exists amongst lift engineers today, and one firm has called in the services of Metalastik, Ltd., and mounted their machinery on Cushyfoot mountings. This firm, Marryatt & Scott, has just completed four major schemes in the London area alone in the past few months. Fig. 2 shows a lift motor room in the top floor of Transport House, London, where there was, until recently, a considerable noise problem due to its proximity to a conference room. It was found to be imperative to silence the lift motor room, and this was done by mounting the motor and its equipment, and the generator set, on rubber mountings so reducing considerably structural and airborne vibrations. This, together with some surface treatment of the walls and ceiling, and the installation of inner doors to the room, has completely eliminated what was previously a high level of unwanted sound. As can be seen the connections are by means of flexible couplings as otherwise vibration would be conducted through the pipes.

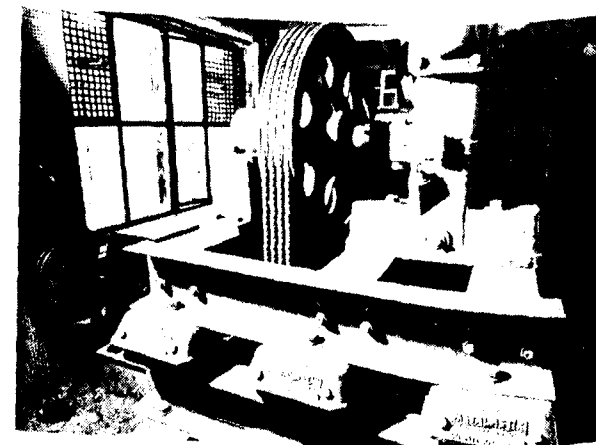


Fig. 2. Lift motor and equipment on Metalastik rubber mountings in Transport House, London.

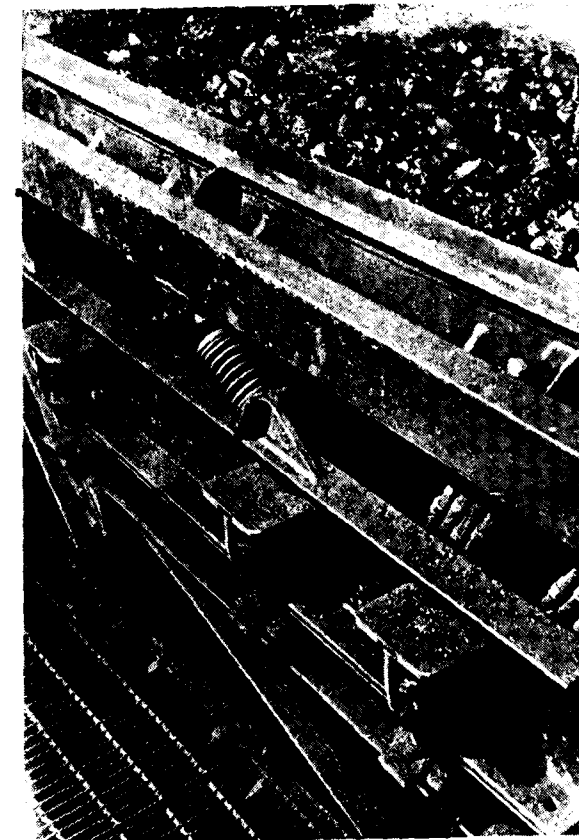


Fig. 3. BTR vibro-insulator on coal-washing plant at Chislet Colliery, Kent.

[Courtesy of the National Coal Board]

Fig. 3 shows vibro-insulators as designed by BTR for the National Coal Board. These deal effectively with the continuous vibrations and irregular shocks to which coal-washing machinery is subjected. The reduction in wear and tear of the machinery is remarkable and the cost of this treatment is amply justified.

Similarly with the 70-ton coal hopper illustrated in Fig. 4. It will be noted that replacement is easy and the rubber which is concealed by the metal pads of the mounting is protected from any injurious agencies. It is of interest to note how in this and all the photographs the mounting units are small and neat, particularly when it is remembered that some of them take loads of up to 12 tons each.

ISOLATING SENSITIVE EQUIPMENT

It is often necessary to prevent vibration reaching mechanical equipment of a delicate type, especially

when precision is of the maximum importance, and balances and recording instruments are often mounted individually, or positioned on a floating floor. An example of this comes from Holland where a whole floor is raised and mounted on rubber and the sensitive machinery isolated upon it. The Luchtarktering and K. L. M. called in the Institute T. N. O. to ensure that buildings where delicate precision work, such as the enlarging of aerial photographs were carried out, were entirely free from outside vibrations. To support the floor and to keep it free from contact with the enclosing walls, 172 rubber mountings were used having a diameter of 29 cm. and a height of 34 cm. fitted with vulcanized end-plates provided with cams. A concrete slab of slightly less area than the room was laid upon the floor. In rectangular holes in this loose slab rubber mountings were placed to rest on the structural floor beneath. The tops of the rubber mountings projected several cm. above the surface of the free-standing slab. Rectangular metal covers were placed over the rubber mountings, being centred by means of the cams on the end-plates. By

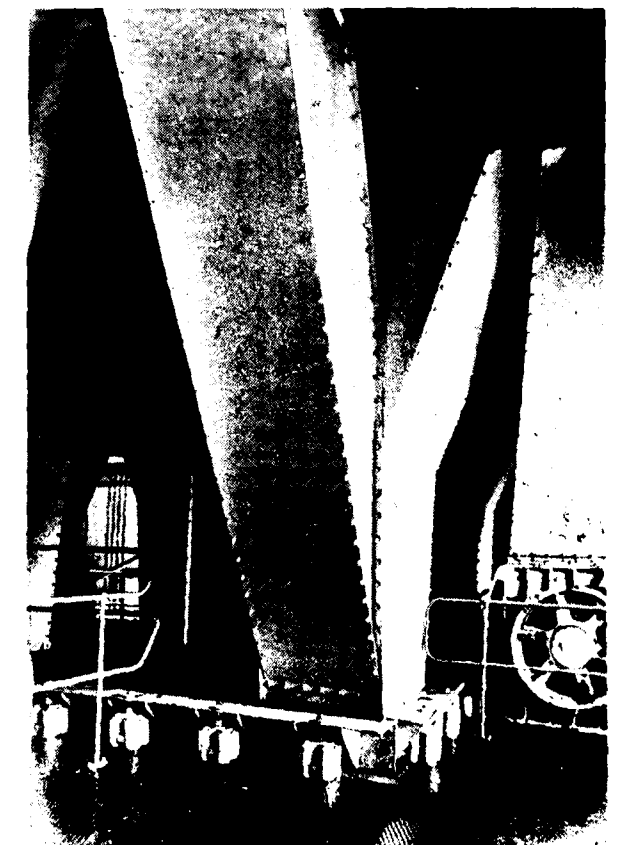


Fig. 4. 70-ton coal hopper (Babcock & Wilcox) mounted on BTR vibro-insulator at Donington generating station.

means of screw-threaded bolts passing through the deck plates and into the metal fittings in the slab, the slab was lifted up until it was supported entirely by the rubber springs without direct contact with either the structural floor or walls. Readers will possibly recall that a floor of a somewhat similar type was developed and constructed by the Building Research Station in 1938.

ISOLATING A STRUCTURAL CELL

The previous example showed how vibrations could be prevented from upsetting the performance of delicate machinery by floating the floor on rubber. In this example the problem was to ensure that conditions were ideal for testing sound equipment. This meant the exclusion of all external vibrations either structure-borne or air-borne, by isolating the whole room from its surroundings. Fig. 5 shows an anechoic chamber for Dawes Instruments, Ltd., in their factory at Brentford, Middlesex. The chamber is approximately 12 ft. $\times$ 12 ft. $\times$ 12 ft. high externally and is made of heavy brick walls resting on a thick concrete slab. The inside is lined with large wedges of glass-silk and the acoustical interior is designed to provide condition where a sound can be generated in circumstances similar to free space. The large mass of the structure is intended to keep unwanted sound out and the wedges to achieve free space conditions. However, the ground vibrations and structure-borne vibrations in this building, so close to a busy arterial road, made the problem complex, and Metalastik, Ltd., assisted in obtaining a completely satisfactory result by mounting the whole chamber on Cushyfoot mountings. The chamber stands in the heart of a busy factory and yet the inside condition are so near the ideal as to enable expensive and extremely sensitive instruments to be tested with extreme accuracy. The chamber weighs some 50 tons and yet it can be "rocked" with very slight hand movement from outside. As a matter of interest it is screened to eliminate all electrical interference, too.

The method of construction is interesting. The eight Cushyfoot mountings were placed on the factory floor on the outline of the proposed chamber. These

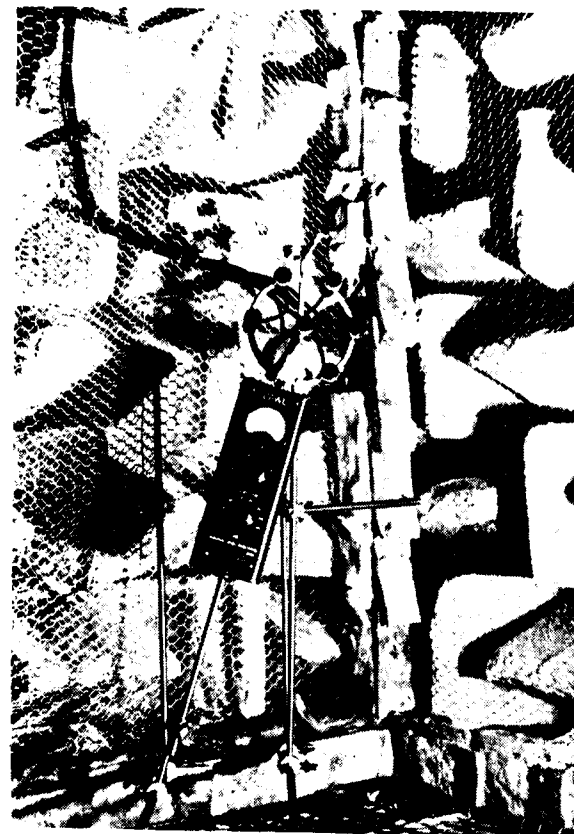


Fig. 5. High fidelity equipment in an anechoic chamber at the factory of Dawes Instruments Ltd. The whole chamber is floated on rubber.

were shuttered round, and sand packed around them and over the whole area up to the top of the mountings. Kraft paper was then laid on top, and the 12-in. thick concrete slab was cast upon it. The brick walls were built on the concrete slab, after which the shuttering was removed from around the mountings, the sand raked out. The mountings then took up the full weight of the structure.

The help given in the preparation of this article by the various manufacturers of mountings and the concerns that granted facilities for the taking of photographs is much appreciated. A further article on the subject is being planned and the author would be interested to hear of any interesting recent installations which might be discussed.

THE NUCLEAR TRACK MEASURING MICROSCOPE

By A Special Nuclear Scientist

PHOTOGRAPHIC emulsions have gained greatly in importance for research on atomic nuclei since the discovery of the π -meson in such an emulsion. In order to be able to identify a particle by the track it leaves in the photographic emulsion and to determine its energy, very accurate measurements are required, especially for particles of high energy. For the identification of particles one of the following combinations of two measurements were hitherto usually made:

1. Range—Grain density (gap density).
2. Range—Multiple scattering.
3. Range—Track curvature.
4. Grain density—Multiple scattering.

For high-energy particles, scatter measurements are of utmost importance. Such measurements can only be carried out satisfactorily with microscopes specially equipped for this purpose, as the upper energy limit accessible to measurement largely depends on the quality of the measuring microscope. With a first-class instrument, 10^{10} to 10^{11} eV should be obtained. The linear deviations of a particle track from a straight line are then approx. 0.1 μ or less, so that in the measuring microscope a measuring accuracy of several hundredths of microns must be guaranteed.

The nuclear Track Measuring Microscope made by VEB Carl Zeiss JENA is a scatter measuring microscope of top performance. In its design particular attention was paid to reduce to a minimum, all errors having a detrimental effect on the scatter measurements. In addition, special attention was devoted to imparting greatest possible operating comfort, since the measurements to be carried out on individual tracks are rather time-consuming and also because rather extensive material usually has to be evaluated. Provision has been made for means permitting exacting depth, angle and gap measurements.

Clever arrangement of the working and measuring elements greatly facilitates operation thus increasing the working speed. Quite stringent demands are

placed on such a measuring microscope, especially with regard to the accuracy of the stage and objective adjustment. Irregular deviations from the linear movement (minute curvature or so-called "noise") should be kept as low as possible. This stage noise depends on the cell-lengths and, for the Jena instruments ranges from 0.005 to 0.02 μ . The noise of the objective movement is of the same order. Both movements can be checked at any time by means of a built-in interferometric checking device, part of which is integral with the instrument.

The microscope rests on a separate desk which accommodates all accessories including the magnetic tape recorder and the electrical control panel.

Figure 1 illustrates the microscope as seen from the right hand side. In front, the pinion head controlling the movement in y-direction will be seen; above which the microphone, as well as the binocular viewing attachment and the adjustable head rest are fitted. On the right hand side of the instrument there is, at the top, the looking knob for the head rests, a pinion head for angle measurements and one for height adjustment. Behind these is the oil pump which regulates the supply of immersion oil. At the bottom of the microscope there is, at the front, a switch to couple the metal stage-top magnetically, at will, either for a rotating movement or lateral

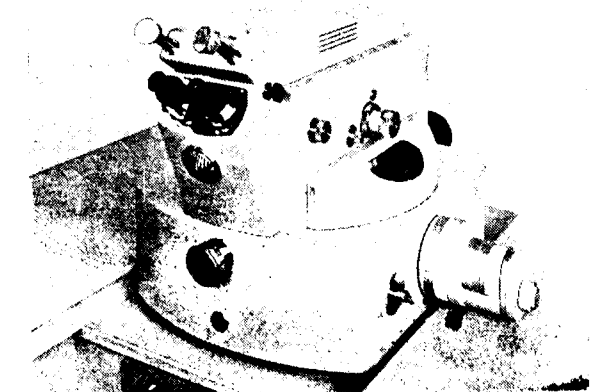


Fig. 1: right-hand side of the instrument.

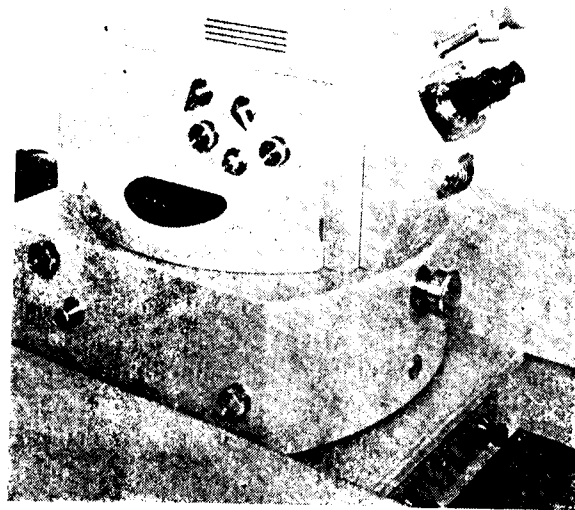


Fig 2: left-hand side of the instrument.

movement in the x-direction. Behind it the pinion head for the x-movement is provided with an adjusting device permitting the setting of various cell-lengths ranging from 50 to 500 μ .

Figure 2 illustrates the left-hand-side of the microscope and the layout of the pinion heads, viz.: the switch for the magnetic tape system, the switch for switching from object to scale illuminations, the pinion head for measuring deviations in the y-directions (sagitta), a control head for focusing purposes and one for gap-measurements. On the lower part of the stand are the pinion heads for stage rotation as well as for the condenser movement and a lever for interposing an auxiliary lens into the illuminating path, thus permitting full coverage both of the visual field of the measuring objective as well as of that of the finder objective.

Figure 3 shows the back of the instrument. On top is the lamp for interference fringe observations and below, the main lamp for object observation.

Figure 4 shows the microscope on its work-desk.

The lens systems for nuclear track measurements must have the greatest possible aperture combined with a large working distance. As a measuring system a monochromatic objective HI x50/1.32 is supplied having a working distance of 0.6 mm. In addition, a special type lens system can be supplied for larger layer thicknesses; viz.: an achromatic system HI x50/1.00 with a working distance of 1.9 mm. A

viewfinder system of x15/0.30 which would be supplied together with it has a working distance of 5.0 mm.

In scatter measurement, the track is aligned parallel to the lateral (x-direction). The nuclear track plate is, in this case, fixed on a metal plate. As required, this can be magnetically coupled either for a rotating movement centred on the optical axis or for lateral movement. In principle, the microscope ensures separation of the measuring procedure from the reading procedure, i. e., the latter can only be read after switching on the scale illumination. The measured values appear in the same binocular tube.

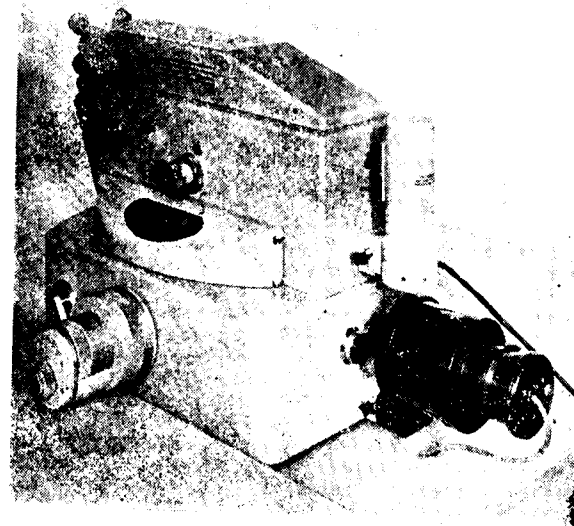


Fig. 3: The Nuclear Track Measuring Microscope; back of the instrument.

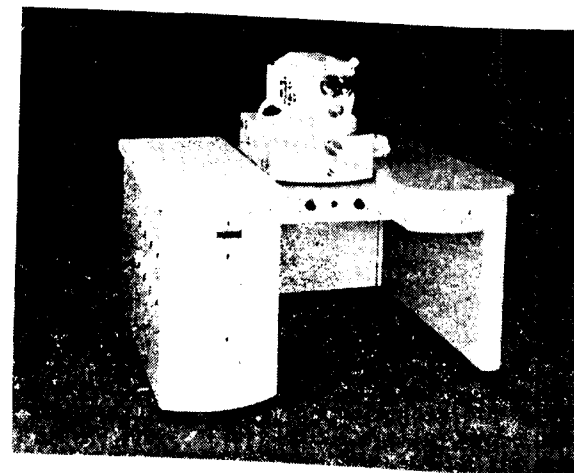


Fig. 4: The Nuclear Track Measuring Microscope on its work-desk.

India makes them...

...these coated rods of metal, so indispensable in the fabrication of ships and locomotives, penstocks and blast furnaces, trucks and railway coaches, pipelines and structurals, that form the very foundation of our Second Five Year Plan. Ranking with Power and Fuel in importance, they are a vital tool for industry. In metal fabrication...

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At once this eliminates any possible subjective errors. After switching for dial observation, three scales can be read in the field of vision, namely, one for the adjustment of the objective (i.e. a depth adjustment, z-direction), another on the right being the scale for scatter measurement, the measuring interval on both scales amounting to 0.1 μ . Yet, since 1/5 of an interval can be estimated with certainty, a reading accuracy of 0.02 μ is achieved. The scale for angle-measurements in the lower part of the visual field has scale intervals of 0.1°, but 0.01° can be conveniently read with the aid of a vernier. After switching on the magnetic recorder, the measured values are spoken on to the tape through the microphone and thus immediately recorded. In this manner, the operator need never, during an entire measuring series, take his eyes away from the microscope, i. e. he need not re-accommodate or adapt his eyes for reading or writing of the measurements. The efficiency of the instrument can be best illustrated by means of an example. The measuring of a meson of an energy of 10^{10} eV was made within one hour with an accuracy of 3%. It is planned to provide a partly automatic measuring system and evaluation of the results.

TECHNICAL DATA OF THE MICROSCOPE

1. Plate Sizes

Any plate not exceeding 195 mm diagonally can be measured free from dead spots. Larger plates are either cut up or can only be partially measured. An absolute limit exists only for the width of the plate. It is 300 mm.

2. Stage Movement (x-direction)

Range of adjustment 55 mm, scale values 2 μ .

Adjustment is either continuously variable or in steps of 50, 100, 250 or 500 μ .

Total deviation from linearity $\angle \pm 0.3 \mu$.

Noise for 100 μ cell-length $\angle 0.01 \mu$.

Noise for 1000 μ cell-length $\angle 0.02 \mu$.

3. Objective Movement (z-direction)

Range of adjustment 3.2 mm, scale value 0.1 μ , reading accuracy 0.02 μ .

Total deviation from the linearity $\angle \pm 0.15 \mu$

Noise of 50 μ cell-length 0.01 μ .

4. Temperature Noise

Due to the good thermal insulation of the entire instrument the thermal "noise" lies below the measuring accuracy. A measuring error caused by local temperature changes does not, therefore, occur under normal working conditions.

5. Device for Scatter Measurements (y-direction)

Measuring range $\pm 77 \mu$, scale value 0.1 μ , reading accuracy 0.02 μ .

6. Device for Angle Measurements

Measuring range 360°, scale reading to 0.1°; estimation to 0.02°.

7. Lens Systems

Apochromat x 15/0.30 working distance 5.0 mm.

Monochromat HI x50/1.32 working distance 0.6 mm.

Achromat HI x50/1.00 working distance 1.9 mm.

8. Magnifying Range

With finder objective 160 to 250 times.

With measuring objective 800 to 1250 times.

9. Electrical Data

Mains supply 220 V. A. C.

Lamps used: For object illumination 12 V/100 W. Bulb 6 V/15W for scale illumination. Sodium spectral lamp for the interference attachment.

SOVIET TURBODRILLS — THE BEST IN THE WORLD

Publicity Officer, "Machinoexport" Moscow

WHEN at Thirties it became clear that all the resources of rotary drilling had been used and the further improvement and reduction of price of the rotary drilling process were impossible, the Soviet engineers designed and developed a new type of motor for drilling bit — the turbodrills.

The extensive application of turbine drilling in the Soviet Union facilitated to increase considerably well sinking rates which, in turn, contributed to the rapid development of new oil-fields.

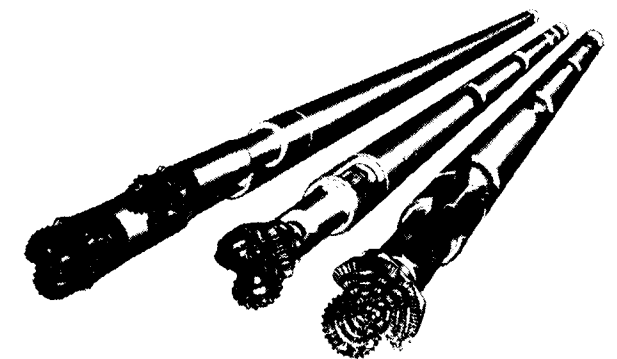
The following are the main advantages of the turbine drilling, compared with the rotary method: lower power consumption per metre of drilling; higher penetration and overall drilling rates; possibility of drilling considerably deeper wells; reduced weight of the drill pipe string by virtue of thinner wall of drill pipes used in the turbine drilling; and, finally, reduced cost of the drilling process itself. All these factors make turbine drilling the most progressive method.

In rotary drilling, a string of drill pipes rotated by a driving machine located on the surface transmits rotation to the drilling bit. As a result, the well sinking rate depends, to a considerable extent, on the depth of the well. As the depth of drilling increases, the speed of the rotary table has to be reduced; it is accompanied by lowering the penetration rate and the efficiency of the rotary drilling.

A long drill-pipe string, sometimes several kilometres long, sustains, during the rotation, undesirable friction created by the hole walls as well as by the drilling fluid, filling the hole. In deep wells, the torque necessary to overcome this resistance becomes a multiple of the torque required for rotating the drilling bit and crushing the rock. According to this the possibility of increasing the rate of rotary drilling in deep wells by raising the p. m. of the bit is limited because of the moment of undue resistance overloading the rotating pipe string.

In turbine drilling, no power is spent to overcome such undue friction forces caused by the hole walls and drilling fluids as the drill pipe string does not rotate.

It is rather difficult to ensure both safety and high drilling rates in deep rotary drilling. It is practically impossible to calculate the maximum torque in the pipes, which may be developed by friction and inertia forces. Such condition may lead to breakage of the drill pipes. For this reason, safe operation in deep rotary drilling can be achieved by reducing penetration rates, as a rule.



A Model of Soviet Turbo-Drill.

The maximum pipe torque in turbine drilling is exactly determined by the turbine characteristics (brake torque magnitude) and depends neither on the depth of the well, nor on the bit speed, bit pressure, and nature of the rocks being passed. It should be emphasized that the motor-to-bit power factor is considerably higher and power consumption per metre of penetration in turbine drilling is accordingly lower than in the rotary method.

As for the design, the turbodrill is virtually a submerged hydraulic motor. The main working parts of the turbodrill turbine are: a stationary guiding wheel (stator), where the fluid acquires the necessary velocity and direction, and a rotating impeller, or rotor wheel. The latter receives power from the fluid, flowing at the attained velocity and directed by the stator, to transmit it on to the shaft. The turbine is of a multi-stage design, comprising from 100 to 120 stages, to produce the required power output at a speed suitable for drilling. All the stages of the turbine are of identical design. The power and torque on the shaft increase from stage to stage in direct proportion with the stage number. The impeller vanes are of the same shape as the stator

vanes, but are directed opposite to the latter. This feature keeps down to minimum the wear of the vanes.

The volume of fluid pumped through the turbines per second is of great importance for the performance of the turbodrill turbine. The pressure head in the turbine varies as the square, and the power developed as the cube of the fluid flow. This means that the power output of the turbine increases eight times if the fluid flow is doubled.

The hydraulic efficiency factor of the modern turbodrill turbines varies between 50 and 70 per cent.

The turbine characteristics depend, to a large extent, on the number of stages. With the existing types, the number of stages varies from 100 to 120. Under normal drilling conditions this ensures bit speeds ranging from 400 to 700 r. p. m., the power at the bit being anything between 100 and 250 H. P.

The turbine shaft bearings consist of rubber bushings working in the drilling fluid without special lubrication. They are well adapted for operation under heavy dynamic loads and a contaminated medium like the drilling fluid.

The T12M turbodrills are now produced by Soviet industry in the following sizes: 9", 8", and 7½" and 6½".

Such a turbodrill weighs anything from 1,068 to 2,365 kg, with 168 to 260 mm outer diameter and 8,500 to 8,947 mm overall length.

Sectional (tandem) turbodrills TC, comprising two or more turbodrill units built as separate sections connected in series to give a single unit, are particularly effective in drilling in soft or medium-hard formations requiring an increased torque one the turbine shaft. They are also used for drilling extra deep wells. The arrangement of such units permits the number of turbine stages to be increased and, accordingly, the torque to be developed. It also gives a better ratio between torque and rotation speed.

Sectional turbodrills are more versatile in their application. For instance, the bottom section of the TS4—9" turbodrill can, if necessary, be used as a separate turbodrill unit. This requires only transferring the sub-connecting the turbodrill with the drill pipe string, from the turbodrill top section to the bottom section.

The following models of sectional turbodrills are manufactured now in the Soviet Union: TS4—9", TS4—8", TS4—7½", TS4—6½", TS4—5" and TS4—4". All of them operate on drilling fluids with a specific gravity of 1.2 per cu. cm.

A new highly efficient tool, the KTD 3 turbine core drill, with detachable core barrel, is used for drilling prospecting wells, where coring is required to receive samples (cores).

The penetration rates of the turbine core drill are nearly the same as with usual turbodrills equipped with solid bits. The application of turbine core drills in exploratory drilling permits the rate of coring to be increased three to four times over on the average, compared with the rotary method. Another remarkable feature is that core extraction is effected without decreasing the penetration rate or pump output. Rock samples can be taken out of the well as soon as the core barrel becomes filled, without raising the drill pipe string. The result is that the overall efficiency of the drilling process considerably increases. The turbine core drill differs from the standard turbodrill in that it has a hollow shaft, inside which the core barrel is located.

Turbine drilling finds a particularly wide application in drilling inclined wells. It has the following advantages over the rotary drilling:

inclined wells can be drilled at the same rates as vertical ones;

normal size drilling bits can be used until they become fully worn;

there is no danger of breakage in drill pipes;

the rated well curvature as well as the required azimuth can be obtained irrespective of geological conditions.

This feature is a result of the permanent action of the deflecting force and the possibility of increasing it by proper selection of deflecting loads. In this way wells with a smooth and straight axis are produced.

The development of directional drilling has contributed to wide application of cluster well drilling, in which well mouths are concentrated in single drilling site while well bottoms are distributed in accordance with the geological operating schedule.

No changes are necessary in the design of existing drilling machines for the application of turbodrills. Some of the rig mechanisms will, in addition, operate under reduced loads than in the case of rotary drilling. For instance, the winch which in rotary rigs often transmits rotation to the rotary table, does not participate in the drilling process in the case of turbine drilling. Thanks to this the service life of the winch, its drive and reduction gear is accordingly longer. Moreover, in the case of turbine drilling the life of drill pipes increases about 10 to 15 times over. Thin-walled pipes can be used for turbodrilling, because of the minor loads to be carried by a pipe string. This creates more favourable operating conditions for the hoisting equipment used for handling in or out drill pipes. Each well to be drilled requires only three or four turbodrills assigned in the following way: one turbodrill in operation, one being repaired, and one or two on hand, for replacement.

The service life of principal turbodrill parts (body, shaft and others) varies from 200 to 400 hours of drilling. It depends on service conditions, the quality of the drilling fluid actuating the turbodrill, were of the rubber bearings, and timely replacement of them.

Maintenance shops may be set up in oil-fields for the inspection, adjustment, and timely repair of turbodrills. One shop of such type, provided with a stock of 50 or 60 turbodrills and operating on a shift basis, is capable of servicing up to 10 or 15 simultaneously drilled wells. A repair shop can perform disassembly and re-assembly, replacement of worn parts, and other maintenance operations. No complex equipment is required in such shops, and their equipment usually includes only a hoist for disassembly of turbodrills, a press for extracting the shaft from the

turbodrill body, an electric motor wrench for unscrewing subs or nipples, and a special bench for testing and running-in reconditioned turbodrills.

Turbine drilling performance depends on the speed and axial load of the bit, the flow rate and quality of the drilling fluid pumped onto the well. An adequate choice of the above factors is essential to both the speed and quality of the drilling process. At present the Soviet Union has a great number of highly skilled specialists in the field of turbine drilling, who transfer their rich experience in the operation of turbodrills to oilmen of many foreign countries.

It will be remembered that licenses on the manufacture and sale of Soviet-designed turbodrills have been purchased by the Dresser Industries of the USA, and the Haniel & Lueg Co. and the Salzgitter G. m. b. H. in the German Federal Republic. In March—May 1957, a group of Soviet engineers visited the German Federal Republic to carry out a turbine drilling trial and to help the Haniel & Lueg Co. and Salzgitter G. m. b. H. with starting turbodrills manufacture. From the outset, the tests demonstrated excellent results as to penetration rate and proved that the cost per metre of well depth is considerably less than with the rotary drilling.

Soviet turbodrills are now being exported to France, Italy, Japan, India, Egypt, Argentina and many other countries.

Export of turbodrills and technical assistance in their maintenance are carried out by V/O "Machinexport", Moscow, G-200. Cable Address: Machinexport Moscow. Telex 170. Telephone 44-45-13.

MACHINE ANALYSES STEEL BY ELECTRONICS

Detailed analysis of steel which at one time occupied four metallurgists for about an hour can now be carried out in four minutes by a new electronic spectrograph—the first of its kind in Britain.

The machine was recently installed at Richard Thomas & Baldwins' Redbourn laboratory.

In operation, a small piece of steel is placed in position at one end of the £12,000 machine. The steel is subjected to a spark in an atmosphere of argon gas and the light is transmitted to a prism which breaks

it up into different colours, each representing various elements in the steel.

The intensity of each colour is measured and transmitted electronically to a typewriter which records it automatically and types out a detailed analysis of the steel under examination.

Capable of coping with 1,500 samples a week, it is estimated that the spectrograph will be invaluable with the advent of the new rotor furnace at Redbourn, which is now nearing completion.

AB ALPHA — Yesterday and Today

By A. RAMNEBY, AB Alpha, Sundbyberg

AB ALPHA is one of the oldest members of the Ericsson group. Founded in Sundbyberg on the outskirts of Stockholm in 1888 by the well-known industrial pioneer, Max Sievert, it was incorporated into the Ericsson group in 1929. A short account of the growth and activities of AB ALPHA is given in this article. (Editor)

MATERIAL TESTING MACHINES

WE may take as our starting point for this resume the time around the turn of the century. It was then that ALPHA began to design and construct materials testing machines, the products which first carried the name ALPHA across almost the entire world.

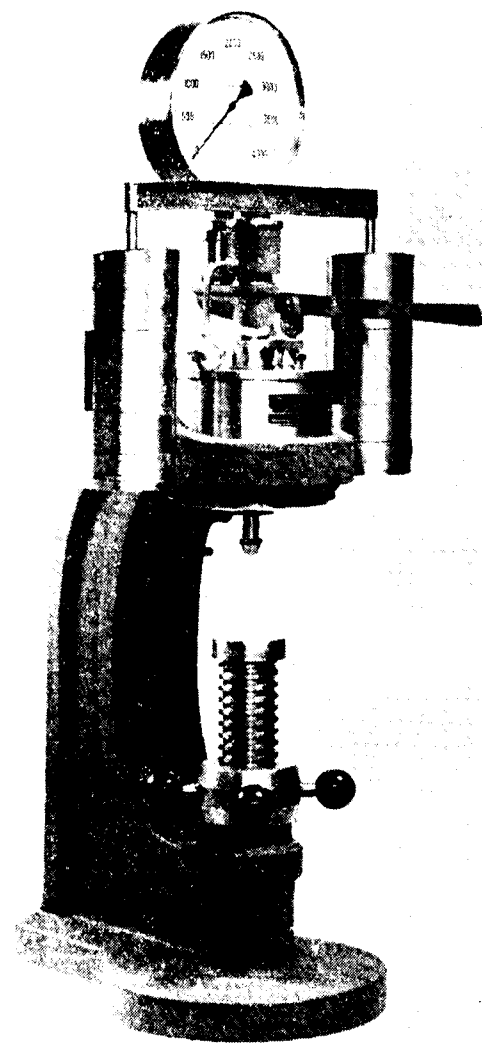


Fig. 1 ALPHA Original Brinell Press—The first presses were marketed in 1905.

The Original Brinell Press (fig. 1) for testing the hardness of metals by the method invented at the end of the 19th century by the Swedish metallurgist, Dr. J. A. Brinell, was brought out by AB ALPHA in 1905. The high quality, unfailing precision and reliability of this press made it a great success.

Inspired by the reception given to the Brinell press, ALPHA's technicians went ahead with their work on materials testing. After some years of intensive research ALPHA brought out a whole series of machines for the most common methods of materials testing, such as tensile, impact, bending and compression tests. This group of products was later followed, in 1918, by a special type of instrument, the ALPHA Carbometer (fig. 2) for electromagnetic determination of the carbon content in steel melts.

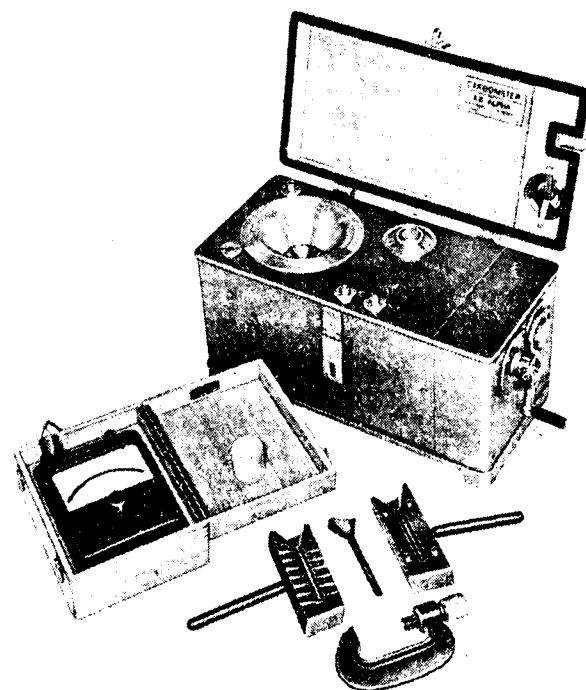


Fig. 2 ALPHA Carbometer.

Another hardness testing machine, the ALPHA Durometer, for Rockwell tests, was added during the 1920's. Though the models of today are practically identical to the original design, these machines are still in good demand.



Fig. 3. ALPHA's new Sematic Durometer

At the end of this year ALPHA will be introducing a new Durometer—the SEMATIC (fig. 3)—for use in Rockwell, Vickers and Brinell tests. The aim of the designers of this machine was especially to simplify the manual work involved and to eliminate all influence by the human factor on the test result.

With SEMATIC, which is equipped with an electric motor, every test is performed under exactly identical conditions. The electric motor makes the machine extremely easy to handle. The specimen is placed in position, a button is pressed, and the result read off—a hardness test with SEMATIC is simplicity itself.

A special SEMATIC finesse is the new dial of patented Swedish design with automatic zeroing of the pointer. Zeroing takes place simultaneously with the application of the minor load. Reading is facilitated by the large diameter of the dial and by its distinct graduations in yellow and green on a black background.

The SEMATIC weight system, which is entirely enclosed within the frame, comprises nine different loads. The choice of load is the work of a moment—by turning the milled weight-selector knob on which each

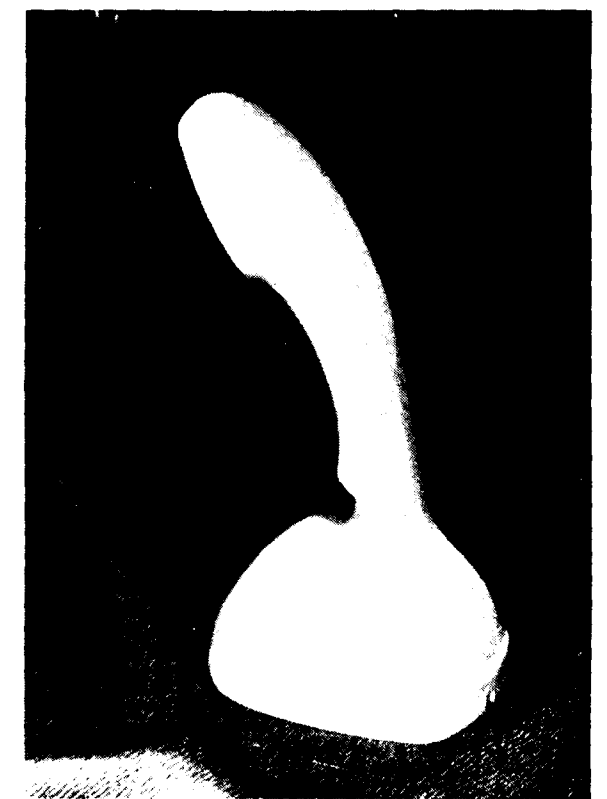


Fig. 4. The plastic housing of the Ericofon is an ALPHA product

load is distinctly marked. Loading time is simply and quickly set with a knob graduated from 0 up to 30 seconds.

A few other practical SEMATIC features are the telescoping sleeve around the table screw, the built-in non-dazzle spotlighting, and the new, robust clamping device permitting unobstructed observation, which enables the operator to position the impression exactly at the desired point.

The mechanism is well protected against dust and damage, being completely enclosed within the frame, which greatly prolongs the life of the machine.

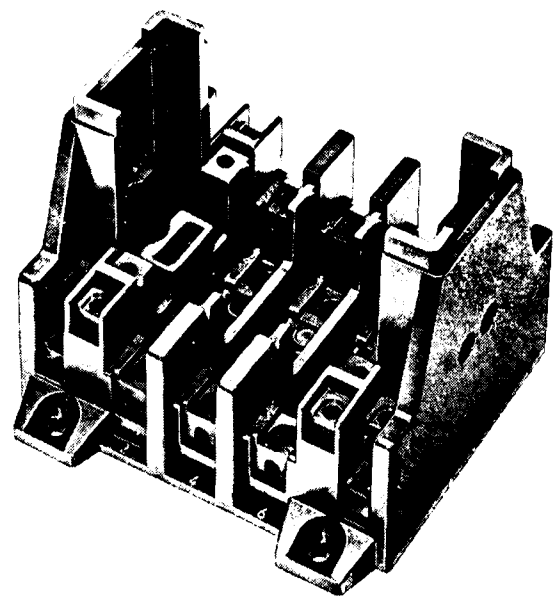


Fig. 5. Plastic housing for contactor.

PLASTIC PRODUCTS

In the early 1920's ALPHA branched out into an entirely new line of production—the moulding of plastic products. From its outset this production was directed to industrial applications, especially to the high quality requirements of the electromechanical industry. ALPHA produces, for example, a large part of the plastic mouldings for LM Ericsson's telephone equipment. The Plastics Section has been successively expanded to cater for the growing demand for plastic products. The moulding shop, with some one-hundred modern presses, most of which were designed and constructed by ALPHA itself, is one of the largest in Scandinavia.

The production of plastics is not based on a standardized programme, but every product is made to the customer's specifications. The product range has thus become very extensive, including thermosetting and thermoplastic products of the most varying forms and dimensions.

The moulding shop has a special section for gramophone records, comprising all the most common types of record, including stereophonic. They are made in hydraulic presses (fig. 6)—again designed and constructed by ALPHA. These presses can be set either for semi-automatic or full-automatic operation

and are equipped with a patented hydraulic reducing valve (fig. 7) with which the press tonnage can be easily adjusted for 17, 25 or 30 cm records. The reducing valve also enables the press tonnage to be adjusted to the special characteristics of the material in use on any occasion. This pressure regulating valve, which has a large field of applications in different hydraulic systems, is also sold separately and has met with a considerable demand especially on the European market.

The ALPHA gramophone record press was originally made for the company's own production of records, the first machines having been installed during the thirties. Since then these presses have met with interest on the part of gramophone record manufacturers in different parts of the world. Particularly since the advent of stereo records this interest has grown very considerably, stimulated by the fact that

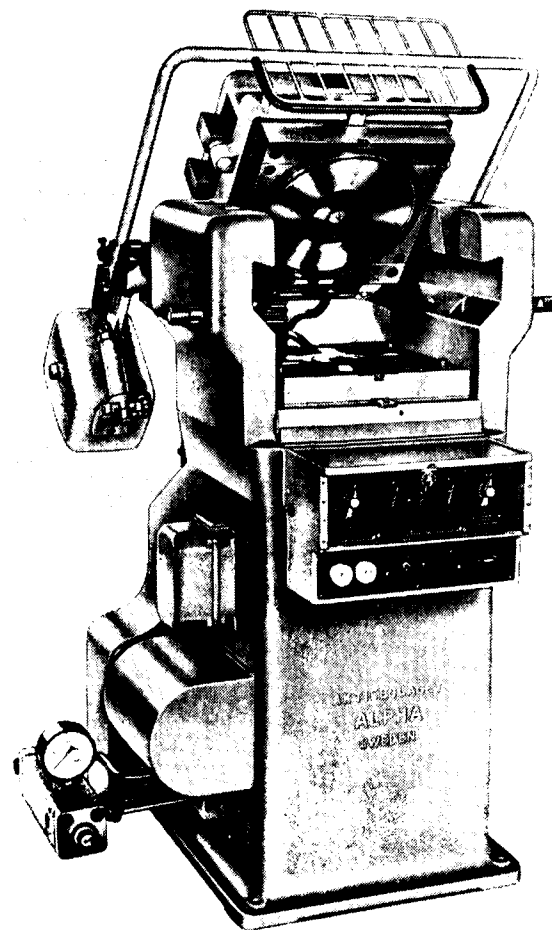


Fig. 6. ALPHA gramophone record press.

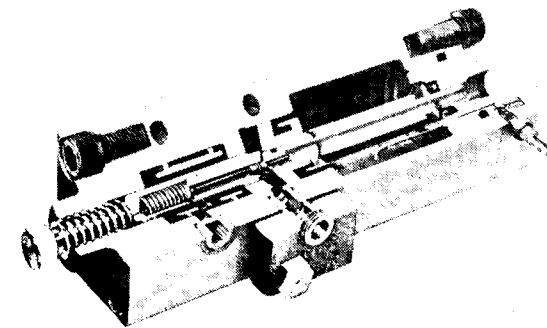


Fig. 7. ALPHA hydraulic reducing valve.

ALPHA's type of press was designed specifically with these records in mind. Several of the larger and smaller European record producers now employ ALPHA presses, and some units have also gone to overseas markets such as the U. S. A. and Japan.

ALPHA's well equipped materials and test moulding laboratory continuously follows the developments in the field of plastics. A machine shop with comprehensive modern machinery and a highly skilled labour force answers for the advanced forms of moulds required by ALPHA's special line of production.

ELECTRICAL INSTALLATION MATERIALS

For nearly 30 years ALPHA has been producing a wide range of electrical installation materials for telecommunication purposes. Some of these products are briefly presented below.

The PELLO switch for alternating current was introduced in Sweden a few years ago. What strikes one in the new PELLO switch is its sober design, which is particularly accentuated by the small, finely formed push-buttons. These are made of *polyamide* and are internally shaped as a resilient tongue which forms the primary organ for the entire mechanism. When the button is pushed, the tongue (spring) directly actuates a self-locking rocker. The entire secret in this design lies in the very simple and dependable mechanism: silver contacts ensure satisfactory operation of the PELLO switch even under such exacting conditions as exist in fluorescent lighting installations with a power factor between 0.6 and 0.3.

ALPHA's wall sockets are all too well known to require further mention in this connection. The demand for them is constantly increasing.

Another group of products which have found wide usage owing to their solid workmanship and attractive design are ALPHA's plug and socket units. These units solve many connecting problems, especially in radio and tele-communication engineering, in a simple and effective manner. They are made in two series, the L and M series. Designed to the standards of the Swedish Electrotechnical Commission, they have bases of black woodflour-filled phenolic. The L series is also made in a non-tracking design with alkyd base. Both types, L and M, are made for cord grip and panel mounting.

During the past two years ALPHA has been making a special type of connector, a concentric 24-pole bayonet plug and socket (fig. 10) for telecommunica-

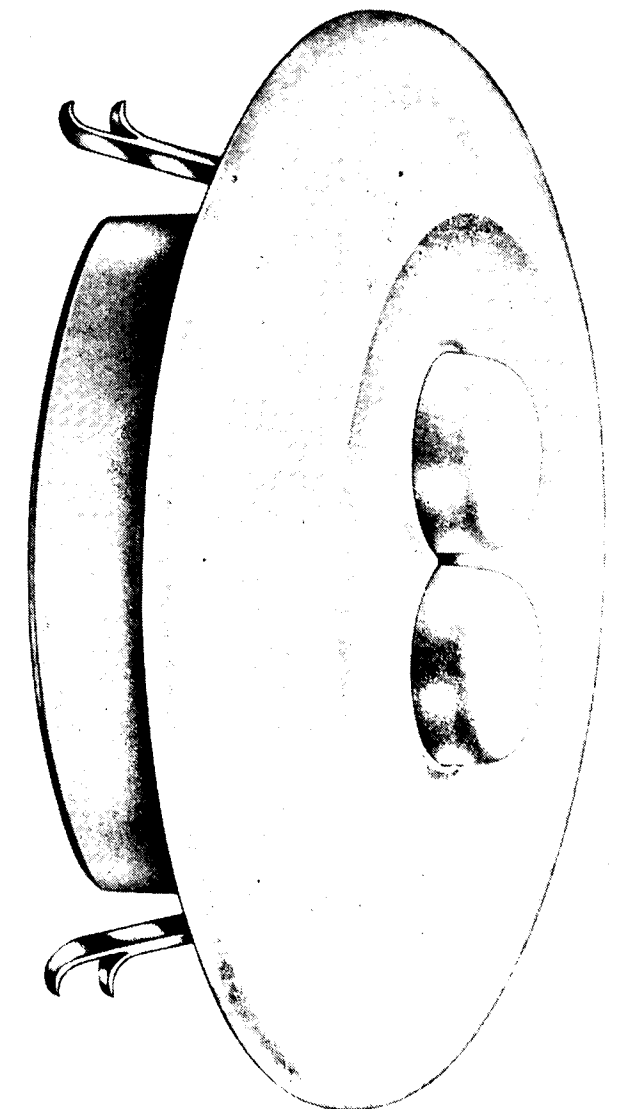


Fig. 8. ALPHA'S new PELLO switch for a.c.

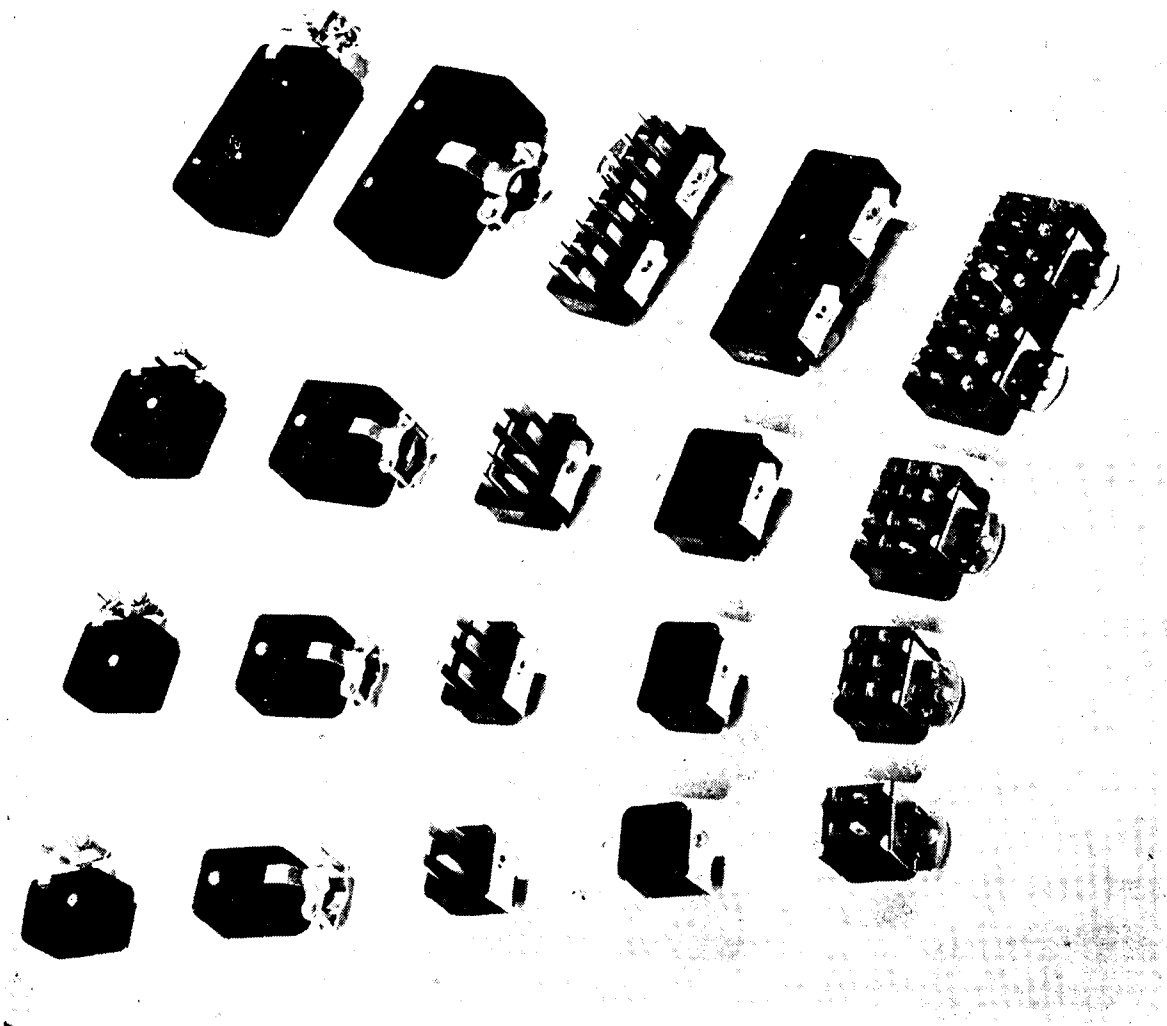


Fig. 9. Some of the plug and socket units made by ALPHA



Fig. 10. Protecting Cap type 3 H.660

tion purposes and for cord grip and panel mounting. The male and female members are identical. They have spring-loaded, gilded pins protected by a strong steel cylinder with bayonet holder. The two members



Fig. 10. Connecting Unit type 1 H.660 for cable fitting

are fitted together in a moment and provide a perfect, hermetically sealed and waterproof connection even after lengthy immersion in water. This plug and socket has so far been supplied only to the Swedish

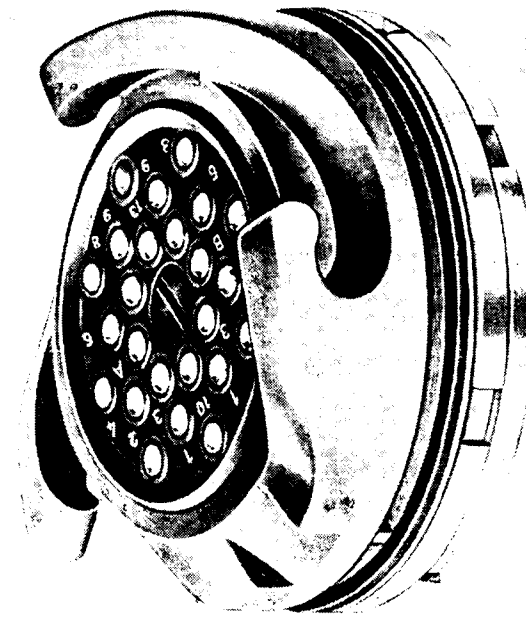


Fig. 10. Connecting Unit Type 2 H.660 for panel fitting

Defence Forces, but when production has come into full swing it will be introduced on the general market as well. Wherever quick and reliable connections are

required in, for example, telephone circuits, this plug and socket meets a long felt need. It is extremely useful for military purposes, in emergency situations, on ships, at building sites, etc.

RESULT PRESSES

This year has seen the appearance of two new production lines. At the beginning of the year ALPHA took over from AB RESULT the manufacture of hydraulic presses for the production of various powder metallurgy products, such as sintered carbides, explosives and uranium dioxide etc. At the same time ALPHA took over the manufacture of the automatic RESULT scales for composition weighing of all kinds of materials in powder form.

As will be apparent, ALPHA's production covers a fairly wide range and the marketing of its products calls for an extensive and active sales organization. The company has its own representatives in most European countries, in the U. S. A. and other overseas markets. ALPHA's products are also sold through the worldwide sales organization of L M Ericsson.

£ 1 MILLION ORDER FOR INDONESIA

Heavy Plant and Motor and Control Gear Divisions of Associated Electrical Industries Ltd. have just received orders valued at £ 1 m. for the supply of equipment for three new cotton spinning factories to be built in Indonesia. An order received from Platt Bros. (Sales) Ltd. of Oldham, the main contractors for the new factories, covers the supply of diesel-generating equipment, lighting, switchgear, transformers, power and lighting cabling, diesel-house cranes and gantries, fuel-oil storage tanks, and various diesel-engine auxiliaries. Other orders, received from the manufacturers of mill machinery, are for several hundred contactor control panels, contactor starters, and small industrial drive motors rated between 1 h.p. and 5 h.p.

The electrical power for each factory will be supplied by four 1070-kW, 3300-volt, 3-phase, 50-c/s generators each driven at 428 r.p.m. by a Mirreles KSS6 turbo-charged diesel engine. An auxiliary Paxman/AEI diesel-generating set rated 165 kW, 380 volts, 3 phase, 50 c/s, will supply power for the factory lighting

equipment and essential auxiliaries. The high-tension switchgear for the generators, the lighting set switchgear, seven transformer-feeders, and one of the seven transformers—which supplies power for the outside lighting—will be installed with the generating sets in the power house. Underground armoured cable of 3.3 kV from the power house will supply the six remaining transformers arranged in two groups of three outside the factory building. The output of each transformer will then be fed, through 380-volt underground armoured cable, to adjacent switch-rooms housing the main distribution boards. Splitter boards mounted around the inside of the factory and near to their respective loads, will be fed from the switch-rooms via PVC insulated cabling laid in shallow troughs.

These factories, in which AEI equipment both large and small plays an important part, will be situated in East, Central, and West Java and were ordered by the Ministry of Peoples' Industries on behalf of the Government of Indonesia.

MANNESMANN-MEER AG, CONTRIBUTION TO PETROLEUM INDUSTRY

By A Special Technical Correspondent

*Gas-Engine Driven Compressor as portable unit
for rapid use on petroleum or natural gas fields*

SINCE the conveyance of petroleum is often coupled with the occurrence of natural gas at the same time, units for exploitation of the latter are also part of the technical equipment on petroleum fields nowadays. Mannesmann-Meer AG, Monchengladbach (West Germany), has developed a portable design of their gas-engine driven compressor for this purpose. The entire unit is skid-mounted (fig. 1) and fitted with all the auxiliary equipment required for operation, e.g. air-charged gas coolers, circulating water-coolers and oil coolers, separators, starting fuel-gas compressors, etc. The gas-engine driven

compressor is to a certain extent a self-driven machine, as it can be driven with the same gas which it has to compress. It consists of a machine, i.e. the compressor, and the prime mover, i.e. a gas engine, combined in one single unit (cf. fig. 2).

Horizontal compressor cylinders are attached on one side of a vertical gas engine with two rows of cylinders in V-arrangement; the motor and compressor sections have a common driving mechanism. As on any engine of V-design, the connecting rods of two opposed motor cylinders act onto a common crankpin, on

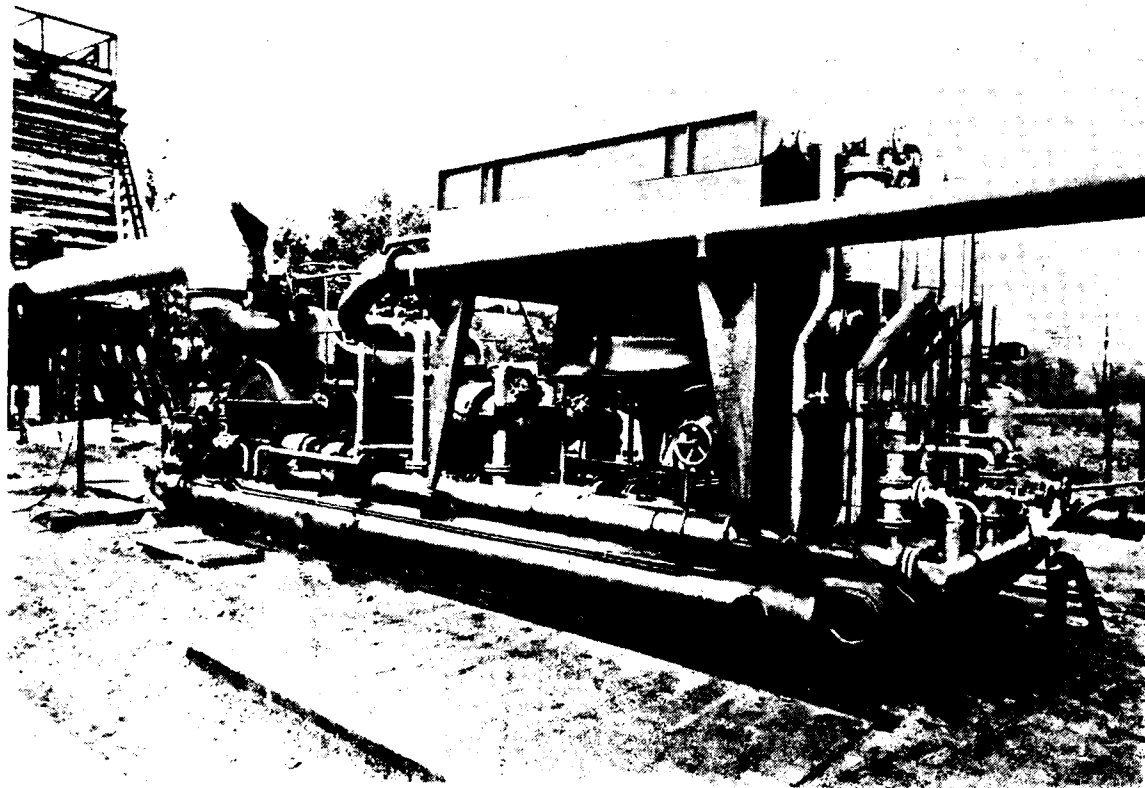


Fig. 1. Skid-mounted gas-engine driven compressor with complete equipment, designed as an independent portable compressor station for rapid installation in petroleum or natural-gas fields.
(Works Photo: Mannesmann-Meer AG)

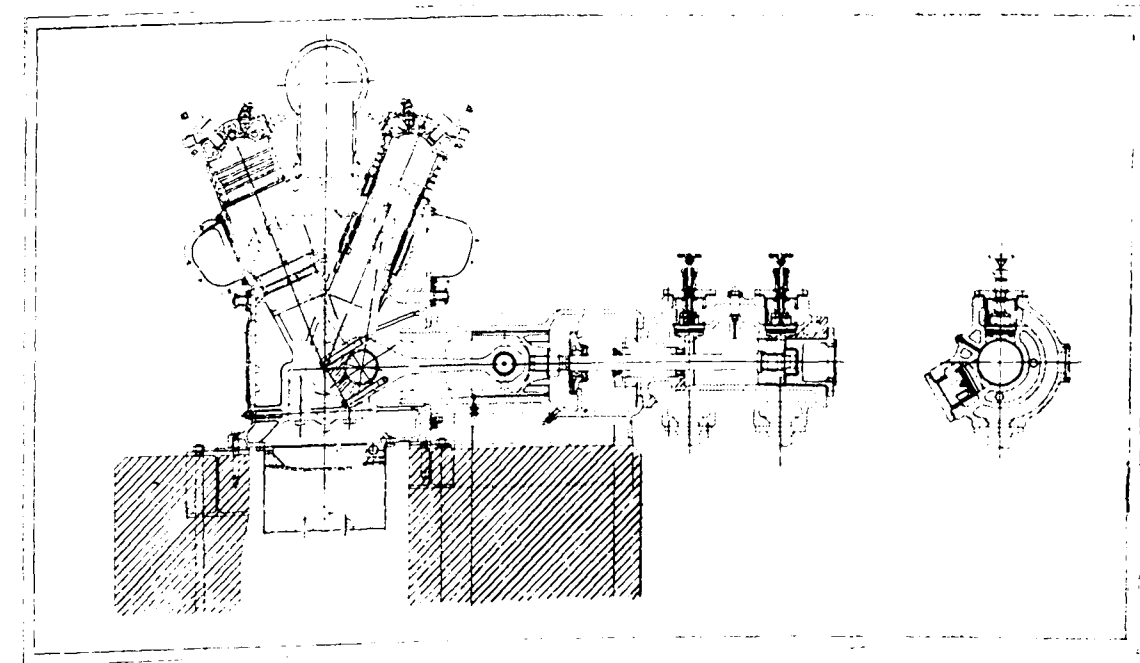


Fig. 2. Basic design of a gas-engine driven compressor in the form of a 12-cylinder motor of V-arrangement with hung-on compressor cylinders.

(Works drawing: Mannesmann-Meer AG)



Fig. 3. Nozzle non-return valves in the assembly stage.
(Works Photo: Mannesmann-Meer AG)

which the compressor connecting rod is also situated, if a compressor cylinder is provided in the same vertical plane. Power is transmitted from the connecting rod via a crosshead onto the piston rod in the compressor cylinder. This transmission of power, effected by the most direct way, results in considerably higher mechanical efficiency than in the case of separate motor and compressor. The construction costs are lower due to the omission of a second crank housing with crankshaft, bearings and lubricating system, and the compound unit is lighter and smaller than two corresponding single machines (motor and compressor) would be.

The gas-engine driven compressor has a very wide

range of application, especially wherever relatively cheap gas is available and has to be compressed. This compressor can be said to operate independently, since it requires no separate energy, and it is this very requirement that is found, among others, on the petroleum or natural gas fields. The operating costs are only one third to one half of those incurred for electrically driven compressors. Operating as a two-stroke engine with reverse scavenging, the gas-engine section is constructed with six, eight and twelve cylinders with a capacity range of 300—600 PS and is designed selectively with electric ignition, as an ignition-ray engine or as a dual-fuel engine. A further operational advantage of the gas-engine driven compressor is the infinite and thus economical adjustment

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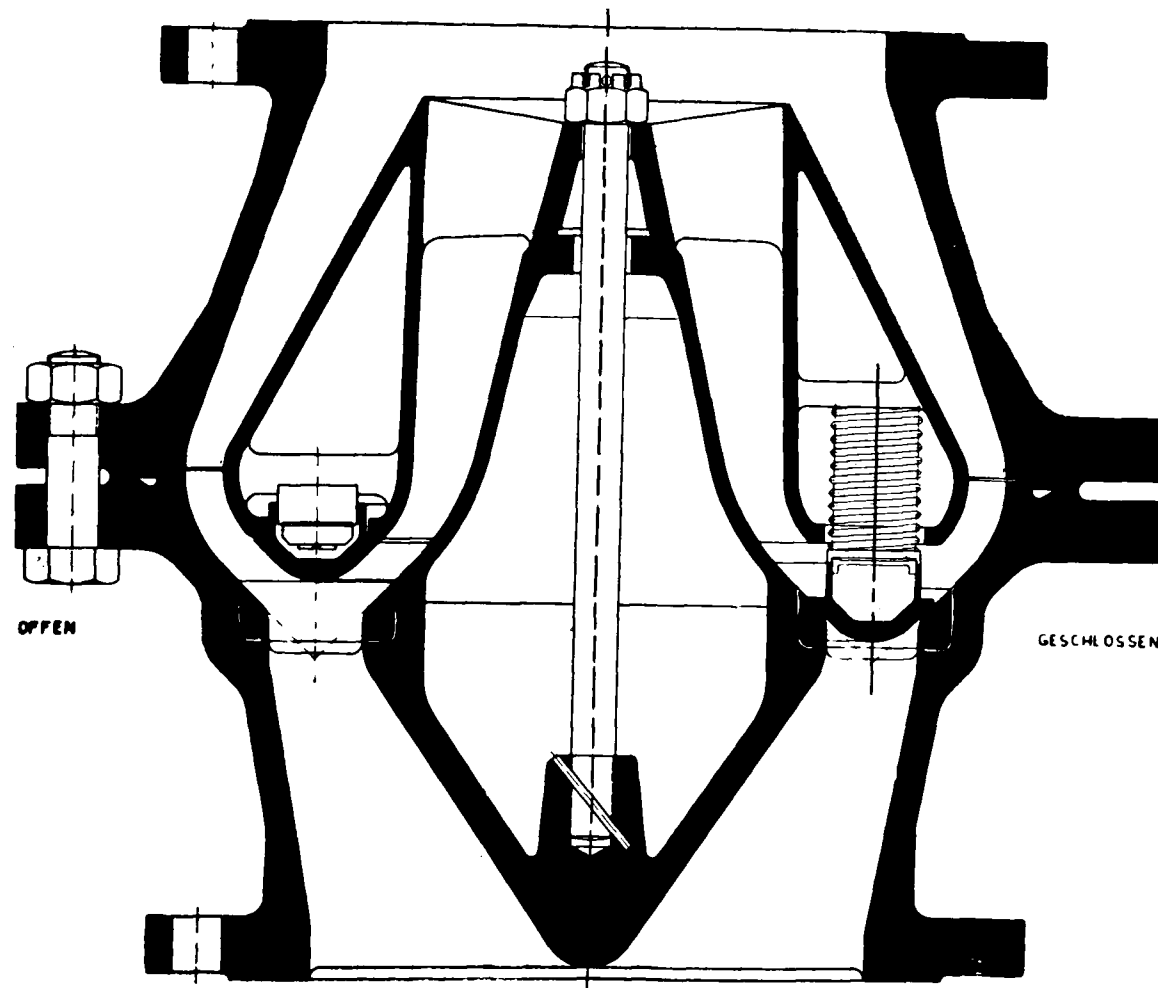


Fig. 4. Section through a nozzle non-return valve.
(Works drawing, Mannesmann-Meer AG)

of the compressor delivery rate to the respective requirement by means of manual or automatic speed control within a range of 100 to 50% and sometimes lower.

NOZZLE NON-RETURN VALVES FOR USE IN THE PETROLEUM FIELD

The nozzle non-return valves made by Mannesmann-Meer AG, Monchengladbach (West Germany), represent a valuable contribution to conveying methods in the petroleum field. These valves can be used not only for petroleum but also for gasoline, benzene and indeed for every kind of fluid and gaseous medium, and are installed behind pumps and turbo-machines in cases where there is an increase in gas or air pressure. They are equipped with completely enclosed housings (fig. 3), are manufactured from various materials and the flanges are designed in dimensions in accordance with DIN, ASA or BSI standards, as required.

The fluid passing through these valves (fig. 4) is subjected to only very slight deviations. The increased

flow velocity in the valve clearance is re-converted to pressure in the subsequent nozzle-shaped enlarged portion of the discharge section with almost negligible loss and consequently the valve has a low flow resistance. The light-weight valve disc (ring) is moved reliably and frictionlessly by 3 to 6 guides (depending on valve size), the closing action being effected by cylindrical helical springs. The completely frictionless guidance of the disc, the small mass of moving parts and the extremely short closing distance (valve-disc stroke) ensure rapid, secure and smooth sealing when the flow is reversed. This explains the high degree of operational efficiency and long service life of the valves. Since they possess no parts which slide against one another, the valve discs cannot jam due to sedimentation or incrustation.

COMPLETE PLANTS FOR THE MASS PRODUCTION OF TUBES

Even before completion of the metallurgical and rolling mill plant in Rourkela steel processing was



Fig. 5. Prime Minister Nehru in front of the tube welding machine on the occasion of the inauguration at Rourkela.
(Photo: Mannesmann-Meer AG)

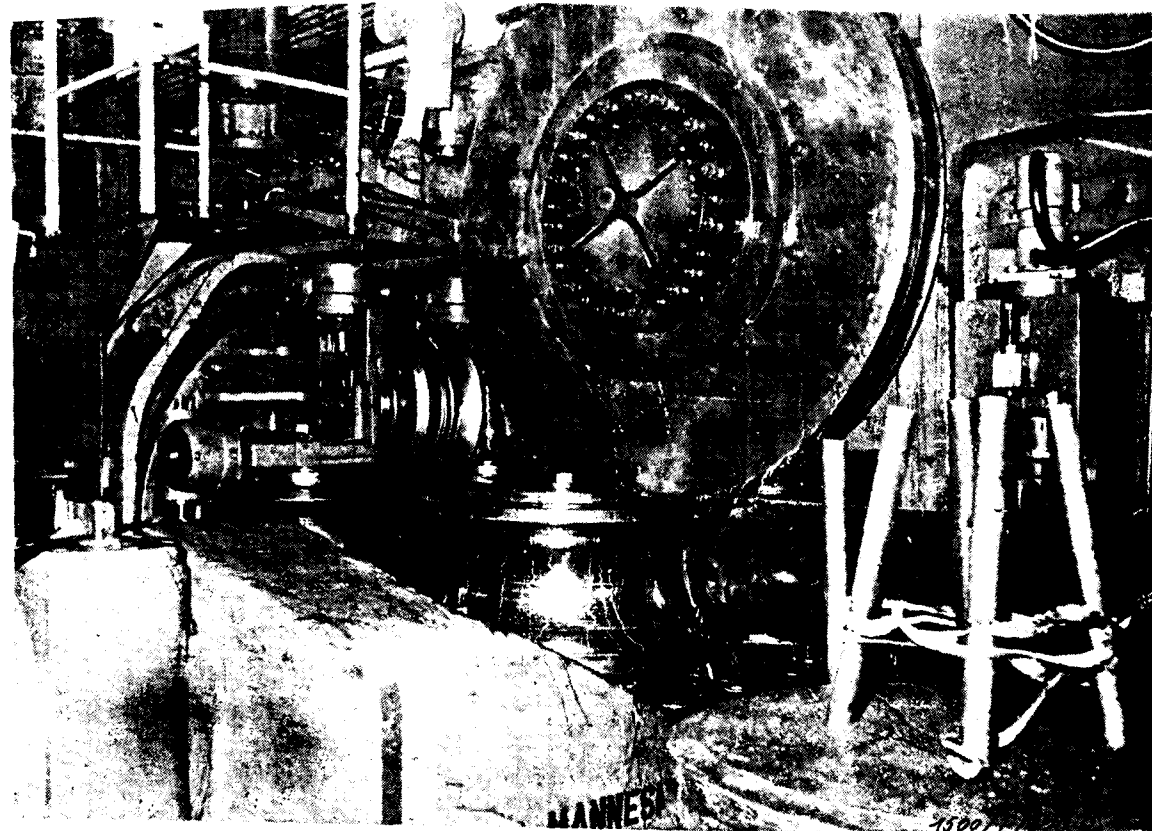


Fig. 6. The tube welding table. (Photo: Mannesmann-Meer AG)

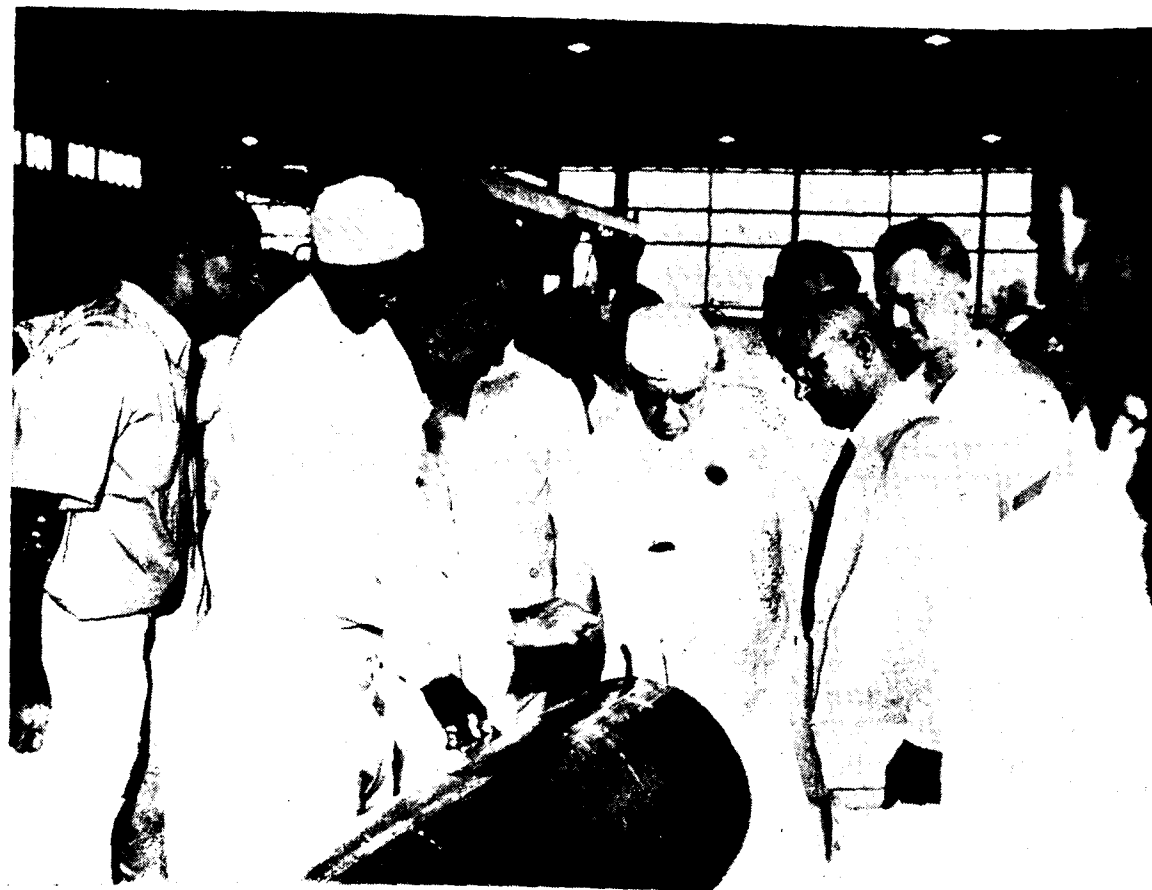


Fig. 7. Prime Minister Nehru inspecting an API pipe. (Photo: Mannesmann-Meer AG)

started there at the beginning of 1961, when the large diameter tube welding mill, erected as a turn-key job by Mannesmann-Meer AG, Monchengladbach (West Germany), was commissioned. The electrical installation of the plant was ready for operation just 15 months after the order for the mill was placed by the state-controlled company, Hindustan Steel Ltd. India is now in a position to make a considerable portion of the tubes for her comprehensive pipe-line projects herself. The supplies for the 1140 km long Assam—Barauni petroleum pipe line, which is already under construction, will result in more foreign exchange being saved than was needed for the erection of the new production plant.

With its fully mechanised and partly automatic equipment the large diameter tube welding mill in Rourkela can manufacture steel tubes from 8½" to 20" (219—508 mm.) outer diameter either continuously from wide strip (620—1600 mm.) or from heavy plate

material, the latter being mainly used for tube wall thicknesses over 10 mm. The tube welding line comprises the following individual units; coil unwinder, strip leveller, strip end shear, edge trimmer for longitudinal trimming on both sides, steel shot blaster with eight whirling blaster turbines and final cleaning by means of strippers and multiple jets, ultrasonic testing device, 8-stand forming mill for pre-rounding and final rounding of the strip or plate, welding table, controlled from the operating desk, with oil-cooled rotary welding transformer and both internal and external flash trimmer, cooling way with induction heating, 4-stand sizing mill for cold reduction and sizing, travelling cut off device and a 7-roller cold straightening machine (for tubes not already straightened in the sizing mill). The tubes are raised by automatic equipment and then deposited on travelling skids, which convey them to a second hall, where they pass through the cut off and chamfering machines, internal-pressure testing presses and the weld seam testing device (Magnaflux).



Fig. 8. The tube testing press. (Photo: Mannesmann-Meer AG)

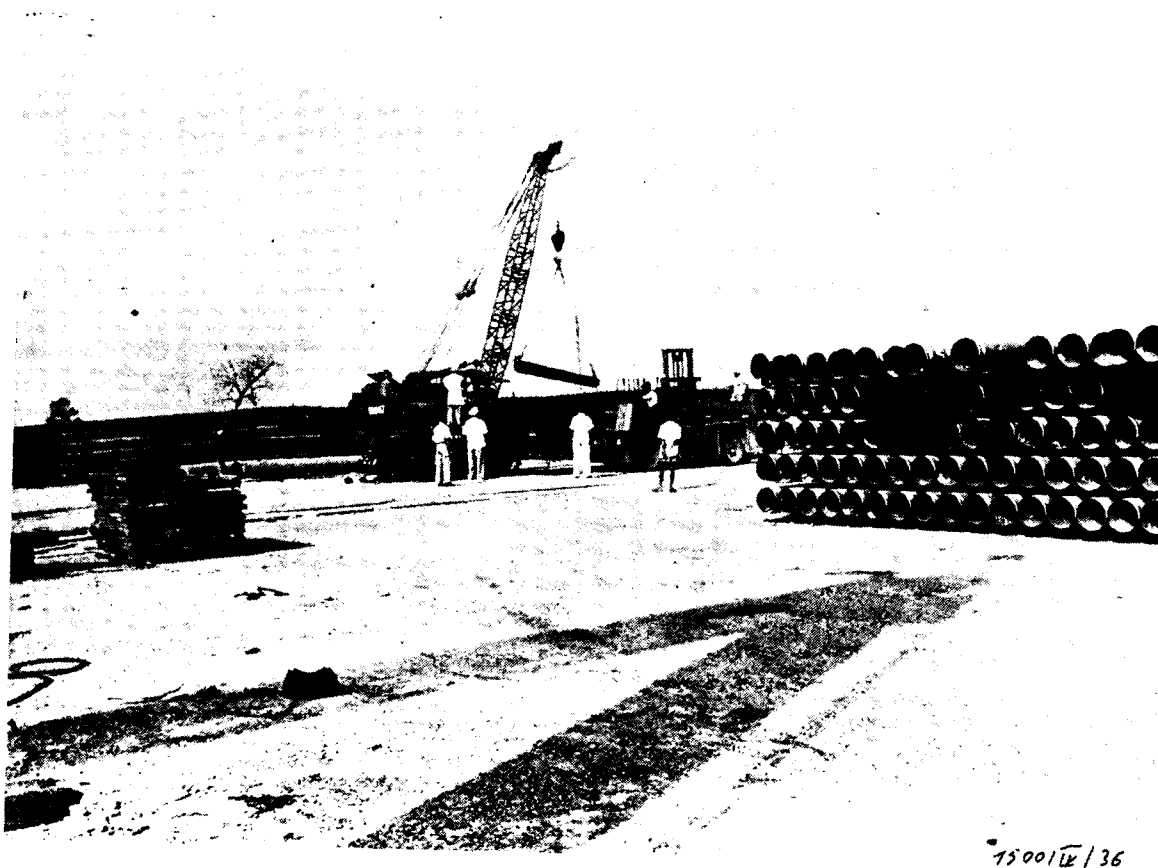


Fig. 9. Loading of tubes for the Assam - Barauni petroleum pipe line.
(Photo: Mannesmann-Meer AG)

The operating speed of all the individual machines in the plant is adapted to the welding speed, in order to obtain continuity during tube production. The welding plant itself is guaranteed for speeds of 8.5 to 22.5 m/min., depending on the tube dimension. These minimum values can be increased considerably in continuous operation. Taking the guaranteed minimum values as a basis, the plant can manufacture 40 to 110 tubes per hour in lengths of 12 m, which in the case of double-shift operation corresponds to an annual production of 200,000 to 380 000 tons.

The recent petroleum discoveries in the Indian Union make it appear certain that the production of this plant will be absorbed by the petroleum industry for years to come.

Mannesmann-Meer AG. also builds stretchreducing mills to supplement tube manufacturing plants. These mills are used for the manufacture of small or medium diameter tubes from large, thick-walled welded or seamless tubes, which are heated to rolling temperature and then passed through the numerous stands of a stretchreducing mill, where they are considerably reduced in diameter and wall thickness. With this

method the length of the finished tubes is greatly increased in comparison to that of the initial tubes and, at the same time, the tube quality is highly improved by hot rolling, as all internal stresses are removed and the structure of the material becomes fine and even. A stretchreducing mill of this type would, for example, enable the dimension range of the large diameter tube mill at Rourkela to be expanded from the previous 8 $\frac{1}{2}$ "—20" down to approximately 2 $\frac{3}{4}$ ". It would then also be possible to manufacture casings and tubings, which are required for working the oil fields, in addition to the previously manufactured line pipes in the dimension range of 8 $\frac{1}{2}$ "—20". Furthermore, the plant could then also be used for making boiler pipes, structural tubes as well as gas and water pipes down to about 2 $\frac{3}{4}$ " in diameter.

In the meantime Mannesmann-Meer AG is also building 2 tube welding mills for private companies in India. These mills are for the manufacture of small diameter gas and water pipes ($\frac{1}{2}$ "—3"). One of them is for Zenith Steel Pipes Ltd. near Bombay, and the other for Bombay Steel Tubes Ltd. in Ahmedabad. Both these plants will have an annual capacity of about 25,000 tons each in double-shift operation.

Some Features of OFP 20 Production Gears Hobbing Machine

By Bohumir Navara

Chief Design Engineer of the TOS Works
Čelakovice, Czechoslovakia

THE OFP 20 gear hobbing machine (Fig. 1), is one of the members of the newly developed range of OFP production gear hobbing machines. It incorporates a number of features which are the prerequisites of an economical production of precision gears and parts manufactured by the hobbing method.

The principal features of all good machine tools are high rigidity according to the "tool-workpiece" system and sufficient dynamic rigidity, determined by the limit conditions for development of self-excited vibration. In testing the OFP 20 machine, steel gears of a maximum diameter and module No. were cut at full loading of the electric motor, however, the limit

conditions were not reached. These good results on a machine of a somewhat unusual open-frame design are due to its well thought out construction, backed by the latest achievements in the field of machine tools and machining technology.

The cutting spindle and bearing supporting the hob arbor (Fig. 2) run without any play in antifriction double-row bearings and the axial forces are taken up by precision thrust bearings. The kinetic layout of the spindle drive has been designed as simply as possible and its last member is formed by the multi-worm gearing including a duplex worm by means of which elimination of detrimental backlash is possible. Similarly, the spindle of the clamping table is mounted

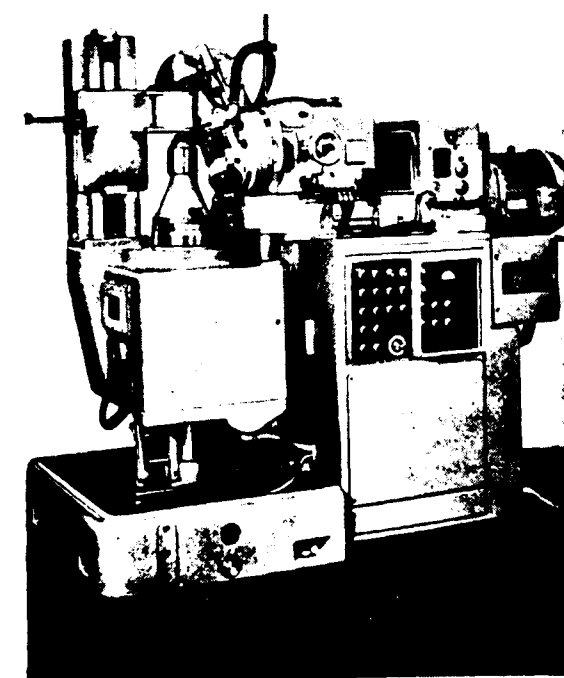


Fig. 1

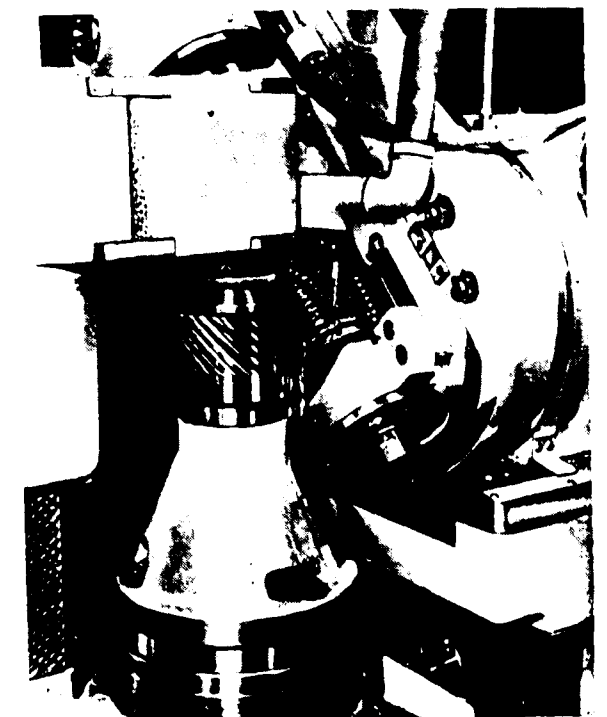


Fig. 2

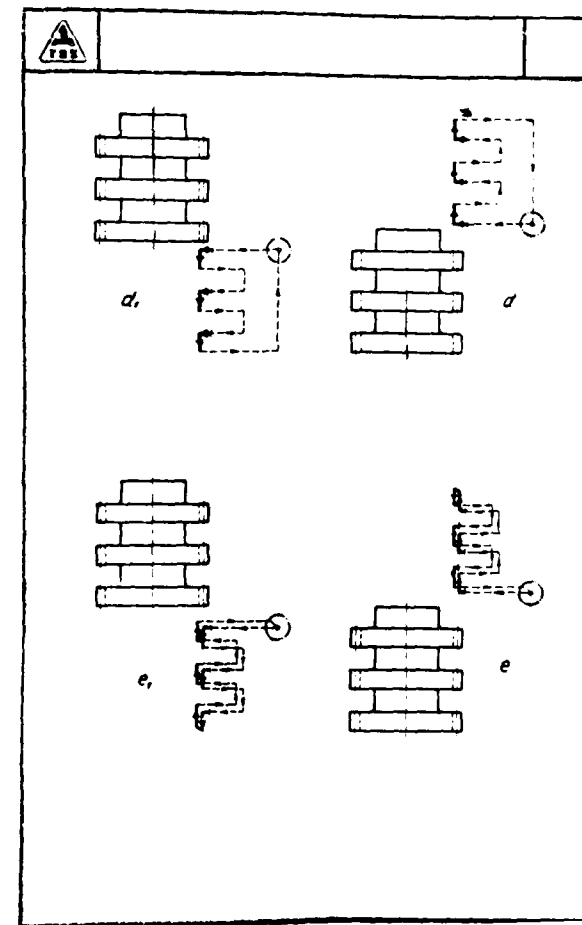
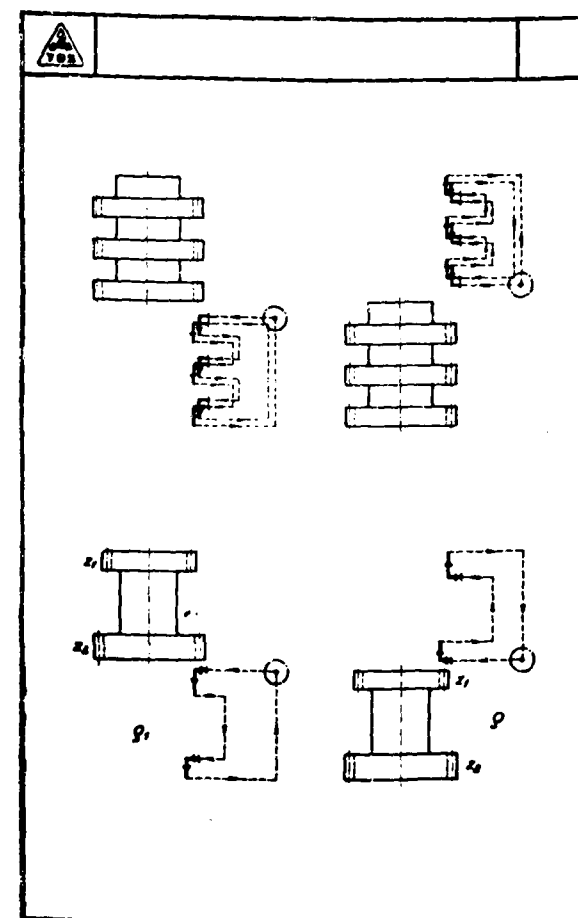
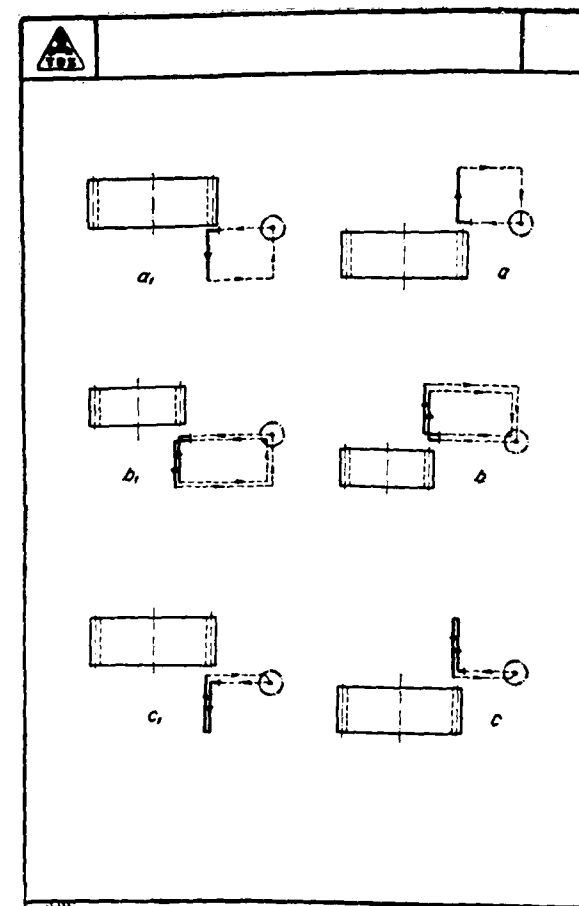
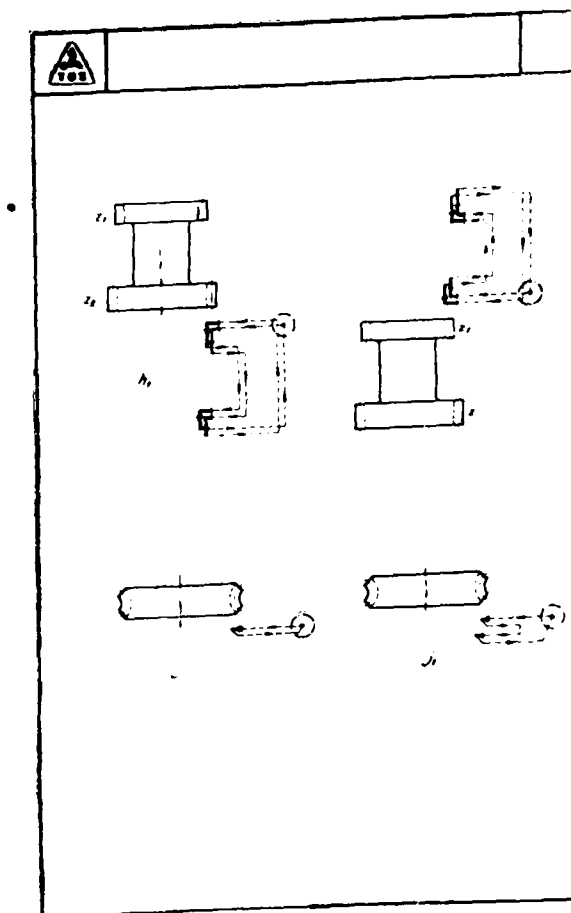


Fig. 3. Diagrammatic layout of automatic work cycles which can be set-up on the machine (horizontal movements are performed by tool, vertical movements by workpiece)

- a —one cutting pass taken by conventional hobbing method
- a₁ —one cutting pass taken by climb hobbing method
- b —two cutting passes taken by conventional hobbing method
- b₁ —two cutting passes taken by climb hobbing method
- c —two cutting passes taken by conventional and climb hobbing methods
- c₁ —two cutting passes taken by climb and conventional hobbing methods
- d —one interrupted cutting pass taken by conventional hobbing method
- d₁ —one interrupted cutting pass taken by climb hobbing method
- e —two interrupted cutting passes taken by conventional and climb milling methods
- e₁ —two interrupted cutting passes taken by climb and conventional hobbing methods
- f —two interrupted cutting passes taken by conventional hobbing method
- f₁ —two interrupted cutting passes taken by climb hobbing method
- g —indexing ratio changed automatically and one cutting pass taken by conventional hobbing method
- g₁ —indexing ratio changed automatically and one cutting pass taken by climb hobbing method



- h —indexing ratio changed automatically and two cutting passes taken by conventional hobbing method
- h₁ —indexing ratio changed automatically and two cutting passes are taken by climb hobbing method
- j —cutting a worm gear in one pass by tangential method
- j₁ —cutting a worm gear in two passes by tangential method

on prestressed bearings of NN-K series.

The duplex indexing worm allows the backlash in the indexing gear transmission to be entirely eliminated which, together with rigid axial mounting of the worm, is a prerequisite of high torsional rigidity of the workpiece driving mechanism.

The radial traverse of the hob slide and the axial traverse of the clamping table are independent of each other and infinitely variable. It follows that for every technological task the optimum cutting conditions in relation to the output, tool life and required finish, can be preselected. The diagram of the feed drive shows that there is a small number of members and that the drive is effected by hydro-motors.

The stop system allows programming of the relative position of the tool and workpiece at the preselected speeds, the feed rates as well as programming of the number of cutting passes by which the gearing is to be completed, rough-cutting and then finish-cutting, climb hobbing or conventional hobbing.

The tool speed on a standard machine is changed in steps according to the geometrical progression. However, the machine can be arranged also for an infinitely variable spindle speed. Control and operation of the machine are effected electrohydraulically and the control system allows a wide variety of automatic work cycles (Fig. 3a–3f). The traverse to close limits in radial direction has been made possible by steady stops. When several cutting passes are to be taken or when the cutting of gears of the same module and pitch but of a different tooth number is involved, the end gauges of various lengths are automatically inserted between the above mentioned stops. Starting and stopping of the axial traverses are controlled by the stops provided on the control drum Fig. 4, the set-up of which is very simple. The positions of the clamping table are signalled by the lighting up of bulbs.

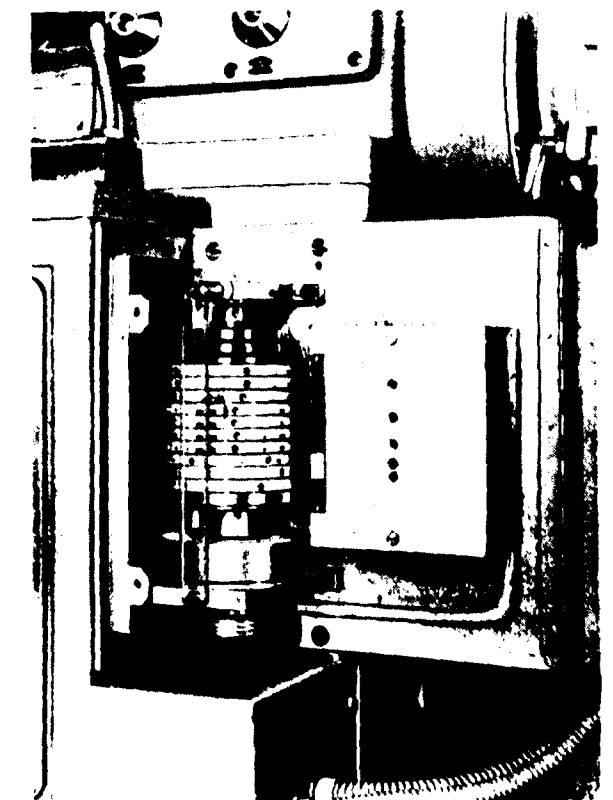


Fig. 4

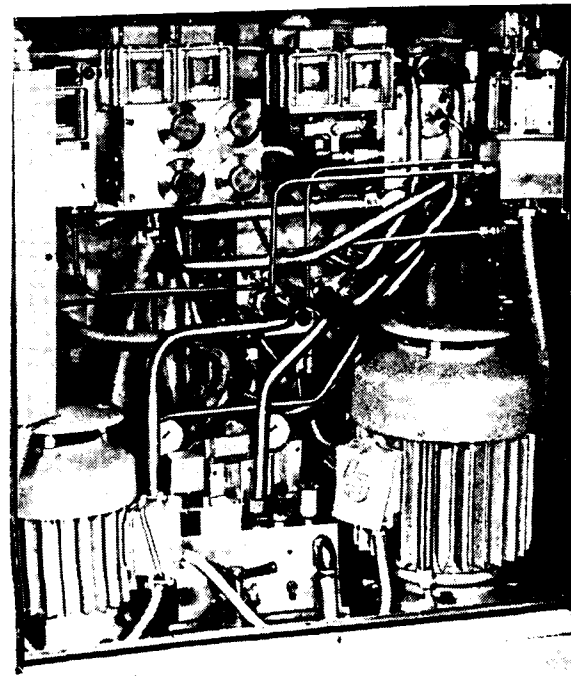


Fig. 5

The stops for a repeat cut and the attachment for automatic changing of the indexing gear transmission can be mounted on a machine of standard execution.

The hydraulic control elements and pressure oil supply units are located in a separate cabinet (Fig. 5). This arrangement makes possible easy observing of the complete hydraulics and leaking oil is centrally retained and delivered into a tank which forms a part of the cabinet. Easy access to the hydraulics for repair work, is made possible by the removable covers.

To reduce the costs of expensive hobs uniform wear of the hob over its total length is essential. This condition is met by the shifting hob-slide, which can be mounted on the OFP 20 gear hobbing machine. The number of axial shiftings of the hob in steps is determined for a certain module in relation to the tooth number, the pitch of the generated gear, as well as the pressure angle and length of the hob. The shiftings take place automatically after the predetermined number of gear blanks has been cut. When all the shiftings (steps) are completed, the hob returns to its starting position and hob-shifting in steps either starts again or the machine stops and a signal light warns the operator that a blunt tool must be replaced.

On the model OFP 20 cutting-down of machining times, especially important in cutting large-pitch gears or when using large-diameter hobs, is made possible by gradual cutting in radial direction to the required depth and thereafter by axial movement of the work-piece. An adjustable time relay ensures complete table indexing which takes place after the required cutting depth has been reached.

To allow feeding out of the hob from the gear blank, it is possible to change automatically the size of the axial travel.

The electrical instruments are grouped in a common cabinet (Fig. 6). The control elements for the setting are conveniently and purposefully situated on a panel close to the operator's post. (Fig. 7). The elements for the programming of automatic work cycles are situated under a locked cover to avoid an accidental or intentional change in the programmed functions.

Removal of the chips from the workpiece and tool involves considerable difficulty on the majority of machine tools. On the OFP gear hobbing machines, the chips are washed away by a flow of coolant in such

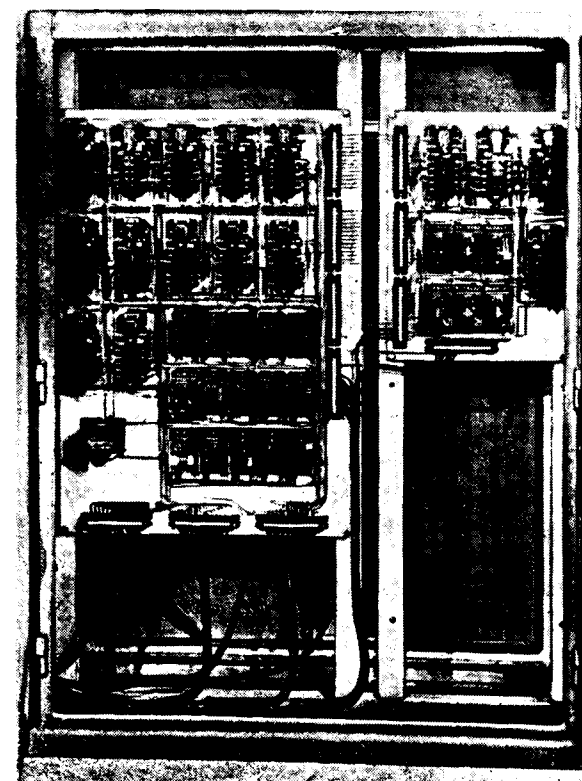


Fig. 6

a way that the flow of coolant directed to the tool is automatically discontinued after the cutting has been completed and the flow is re-directed in special nozzles. By means of a directed, heavy flow of coolant, the chips are reliably washed away into a chip reservoir. There are two chip reservoirs (Fig. 8), rotating round

a vertical axis. One of them receives the chips, while from the other, swivelled clear of the coolant splash guard, there drips the coolant, and the respective chip basket can be cleared at any time. Substituting of an empty reservoir for a full one can be carried out by simple swivelling even while the machine is running.

When the machine is placed in an automatic gear production line, a chip conveyor can be easily connected.

One of the prerequisites of a good-quality surface finish of the machined parts is purity of the coolant and removal of chips sticking to the hob. Apart from the usual filtration by means of sieves and sedimentation, the OFP gear hobbers may be equipped with filter washers provided with permanent magnets for the separation of micro-chips which cannot be separated by sedimentation. Chips adhering to the hobs are removed by rapidly rotating metallic brushes.

On modern machine tools incorporating higher degree of automation, provision should be made for automatic loading. The OFP gear hobbers fully meet this requirement. Their control and general design allow easy instalment of loading equipments of different systems for both large-batch and mass production.

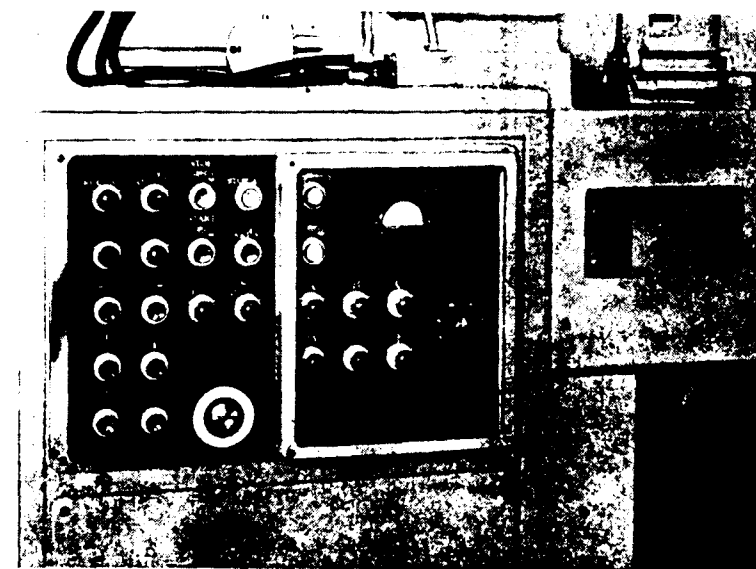


Fig. 7

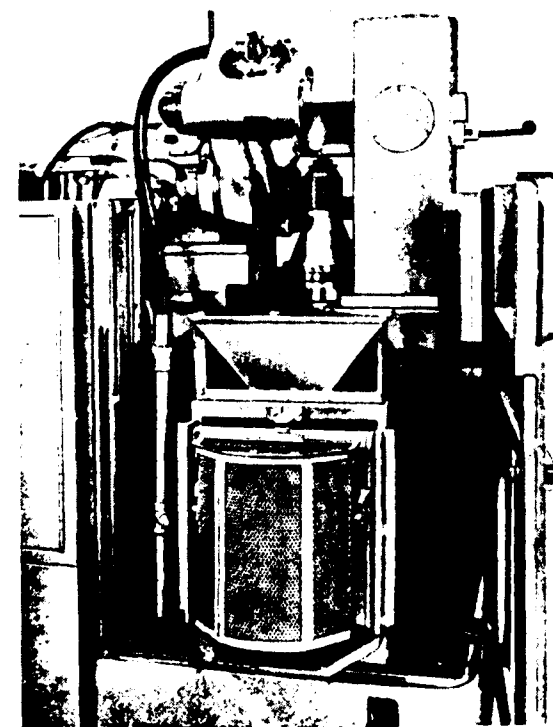


Fig. 8

MAIN TECHNICAL DATA OF THE OFP 20 GEAR HOBGING MACHINE

Maximum module	No. 4	
Maximum diameter/maximum width of gear with straight teeth	mm	200/200
Maximum diameter/maximum width of gear with teeth inclined at 45 deg	mm	160/140
Maximum/minimum distance—centre-line of hob to centre-line of workpiece	mm	205/ 30
Vertical adjustment of clamping table	mm	210
Maximum diameter/max length of hob	mm	135/140
Axial adjustment of hob	mm	50
Diameter of clamping table	mm	250

Bore of clamping table spindle	mm	80	Rapid feed of hob slide	mm/min.	320
Depth of bore, measured from clamping surface of table	mm	700	Feeds of clamping table, infinitely variable	mm/min.	0.62-200
Maximum clamping length of workpiece	mm	1,200	Rapid feed of clamping table	mm/min.	500
Diameter of indexing worm	mm	270	Taper in working spindle	Morse No.	5
Diameter of hob arbor	mm	22-27-32-40	Output of main motor	kW	9
Hob speed	r.p.m.	63-400	Total installed output	kW	13.4
Feeds of hob slide, infinitely variable	mm/min.	0.4-100	Weight of machine with standard equipment	kg	4650
			Weight of switchgear cabinet	kg	520

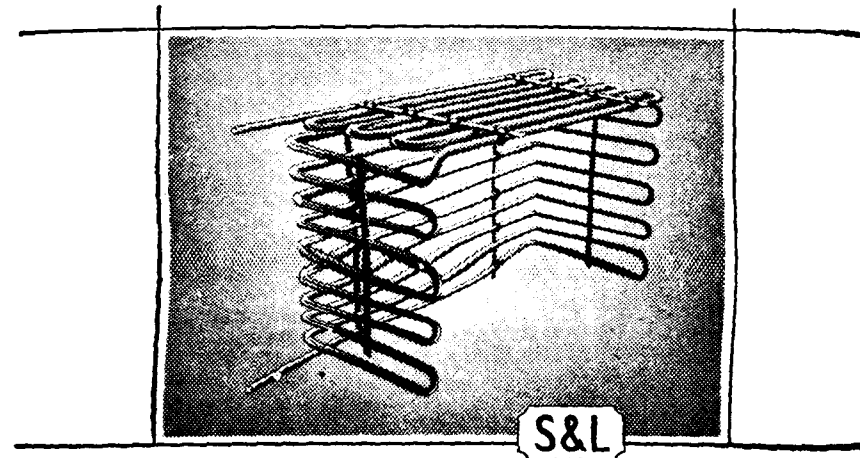
WORK BEGINS ON NEW £ 55,000,000 U. K. NUCLEAR POWER STATION

Work has commenced on the £ 55,000,000 nuclear power station at Sizewell, Suffolk (England). It is being built by the English Electric, Babcock & Wilcox and Taylor Woodrow atomic power group, and is the largest nuclear power station under construction anywhere in the world.

The station will have an output of 650 megawatts, and is due for completion in 1966. It will be the seventh civil nuclear power station to be built in the

United Kingdom, and will bring Britain's nuclear power station electricity output to 3,000 megawatts—more than 10 per cent of the country's generating capacity.

The Sizewell station will have two gas-cooled, graphite-moderated natural uranium fuelled reactor furnaces. Power generated by the station is expected to cost about £ 110 per kilowatt, compared with £ 160 per kilowatt from the plant at Berkeley, Gloucestershire, which is due to go into operation later this year.



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SPK 63 Semi-automatic Vertical Lathe with Programme Control

By Frantisek Borecky

Designer of Research Institute of Machine Tools and Machining in Praha

THE production of shaft—and flange-shaped parts involves considerable production costs in view of its technological intricacy. Therefore automation of these operations is of extraordinary importance for all engineering works.

The Czechoslovak machine tool industry has produced successfully for several years now the SP25 and SP31 semi-automatic copylathes. These machines are arranged for turning operations in horizontal plane and are, therefore, mainly intended for efficient production of shaft-shaped workpieces.

The new SPK 63 semi-automatic machine is designed for high-efficient machining of heavy and bulky components of flange shape which from the technological standpoint are more difficult to machine, than shaft-shaped components. The machine has a vertical turning axis. Its main advantages are the following:

- large stock removal and thus also high machine efficiency are made possible by simultaneous machining by means of three separate carriages the working movements of which are included in one automatic working cycle;
- high precision work is enabled by the frame-system rigidity of the portal arrangement of the carriage guides;
- its vertical execution requires only a small floor space and facilitates chip transport, work-piece clamping and setting-up of the machine.

Fig. 1 shows a general view of the machine and Fig. 2 shows diagrammatically the layout of the carriages.

The main spindle drive is arranged for an automatic changeover of the required spindle speed while the machine is loaded. The kinetic system of the spindle drive consists of two pole-changing electric motors,

one differential planetary gearing, a hydraulically-operated duplex friction clutch and a corresponding number of hardened and ground gears. This arrangement, free of friction transmission elements, is featured by high efficiency of the transmission and easy pro-

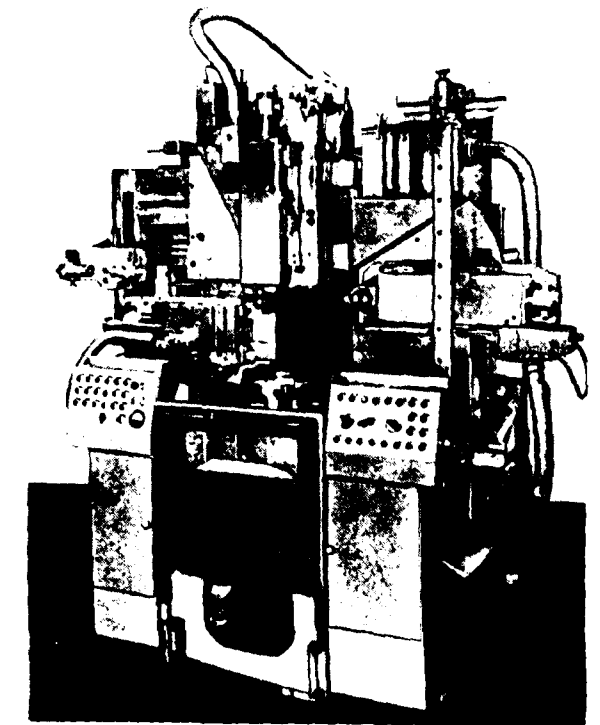


Fig. 1. General view of machine.

gramming of the speed change while the cycle is in progress. The output of the main drive is from 22 to 30 kW. There are 8 steps of the automatically changed speeds, in a total ratio of 1:5. The whole speed range is divided into 7 speed batches, preselected by hand so that the individual speed steps, changed automatically during the working cycle, are grouped as follows:

1st batch : 22.4 — 31 — 36 — 45 — 56 — 77 — 90 — 112

2nd batch :	28 — 39 — 45 — 56 — 71 — 100 — 112 — 140
3rd batch :	45 — 62 — 71 — 90 — 112 — 155 — 180 — 224
4th batch :	56 — 78 — 90 — 112 — 140 — 200 — 224 — 280
5th batch :	71 — 100 — 112 — 140 — 180 — 224 — 280 — 355
6th batch :	112 — 154 — 180 — 224 — 280 — 390 — 450 — 560
7th batch :	140 — 190 — 224 — 280 — 355 — 480 — 560 — 710

The machine can be delivered with a lower speed, namely in a ratio of 1 : 1.58, so that the total range is from 14 to 450 r.p.m. The individual speed steps are proportionally lower.

The selected speed steps allow the most economical cutting speeds to be employed and the available high output of the electric motors permits extreme utilization of all sorts of cutting tools.

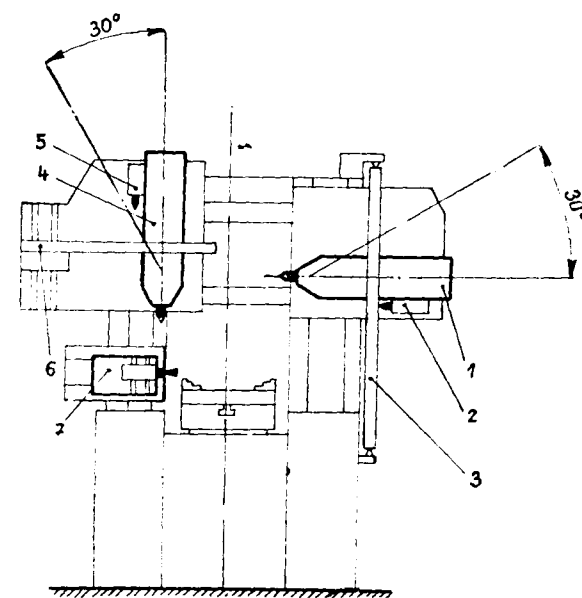


Fig. 2. Diagram illustrating arrangement of carriages. The figures in the diagram following indicate:

- 1 — right-hand copying carriage (first)
- 2 — copying tracer of first carriage
- 3 — copying template of first carriage
- 4 — left-hand copying carriage (second)
- 5 — copying tracer of second carriage
- 6 — copying template of second carriage
- 7 — recessing carriage (third)

Fig. 3 shows a diagram of the drive and Fig. 4 the layout of the transmission ratios.

The main spindle is mounted directly in the rigid basic frame of the machine. The upper end of the spindle is supported on NNK precision double-row roller bearings. The lower end runs in a prestressed bearing. The axial spindle play is taken up by a thrust ball bearing. The mounting of the main spindle

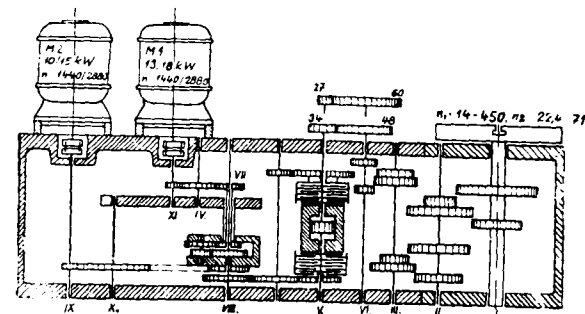


Fig. 3. Diagrammatical layout of main spindle drive.

guarantees high working accuracy even in the case of heavy loading.

CARRIAGES

The carriages guide the tools in a predetermined direction to form the geometrical shape of the work-piece, during which the directions and feed rates are changed according to a programme.

The resultant shape of the finished part is determined by the template shape or the rectangular cycle. The roughing cut is done by the equipment for multi-pass machining which is provided on these carriages and which works automatically according to a cycle and which can be programmed in any sequence.

To allow the carriages to meet these requirements to the highest possible extent and within the shortest possible time, they are purposefully designed as follows:

- (a) the carriage guides and bodies and the parts belonging to the direct hydraulic drive are of rigid construction;
- (b) the carriages are equipped with a hydraulic copying system which works within accuracy limits of 0.015 to 0.028 mm. and is featured

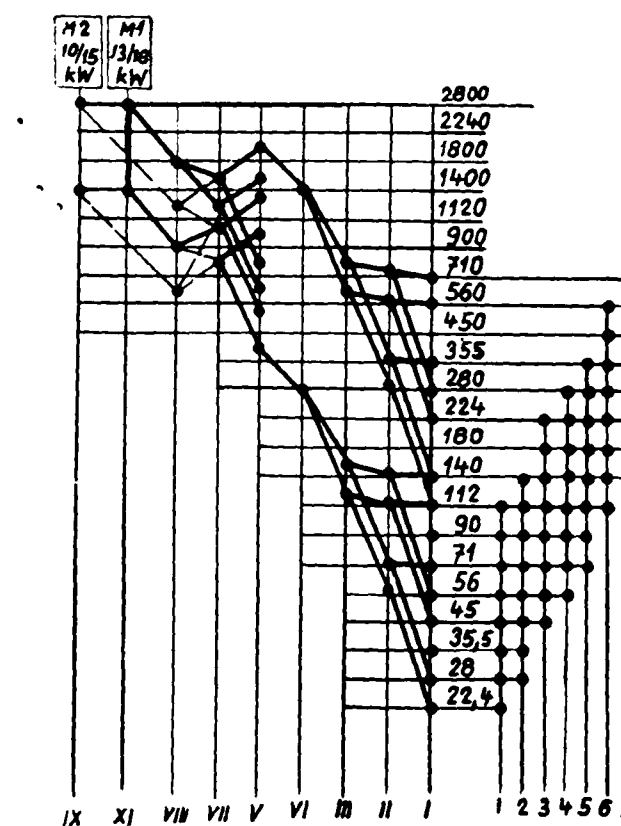


Fig. 4. Layout of transmission ratios — speed batches and individual speeds of drive to main spindle

- IX shaft of motor 2
- XI shaft of motor 1
- VIII driving shaft of planetary gearing
- VII protruding shaft of planetary gearing
- V clutch shaft — change gear 34
- VI change gear 48
- I spindle
- 1 - 7 speed steps

by high stability, allowing large stock removal;

- (c) all functional and setting elements are simply and conveniently arranged;
- (d) the possibility of multi-pass machining is provided even in a rectangular cycle;
- (e) three cutting feeds and a rapid feed for each carriage are included in the working cycle.

WORKING SCOPE OF CARRIAGES

A. 1st carriage (right-hand, copying).

- (a) Profile turning towards the clamping plate

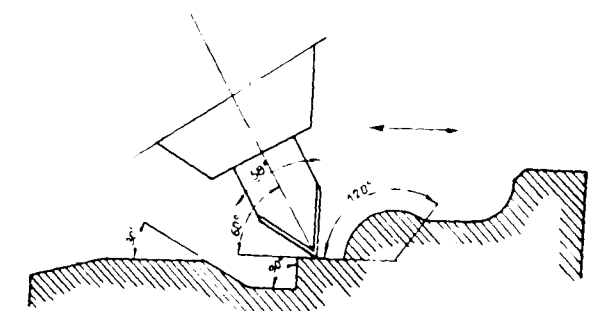


Fig. 5. Copying possibilities of 1st carriage in inclined position.

- (b) Multi-pass roughing of cylindrical shapes towards the clamping plate
- (c) External and internal copy-turning of profile surfaces and turning of recesses by external copying
- (d) Automatic approach in cross direction to a dead stop in preparation for the boring of holes
- (e) three cutting feeds and a rapid feed for each of the carriages, included in a cycle, through the electric control cylinder, which gives an impulse for changing the rate of feed and rapid feed. Simultaneously, the preselected speeds of the main spindle can be changed automatically. While the working cycle of the carriage is in progress or after its completion, the control cylinder initiates further functions of the second or third carriages, or provides an impulse for stopping the machine.

Fig. 5 shows the shape possibilities for work-pieces machined with the 1st carriage in inclined position.

B. Second carriage (left-hand, copying)

This carriage works as a copying or cross carriage and the following operations can be carried out with it:

- (a) copy-turning of face surfaces
- (b) copy-turning of side surfaces
- (c) internal turning, recessing, chamfering and similar operations in a rectangular cycle, with the copying system disengaged.

In the case of rectangular working cycle, the workpiece shapes are obtained by means of dead stops or electrical stops.

Fig. 6 shows shape possibilities for workpieces faced with this carriage.

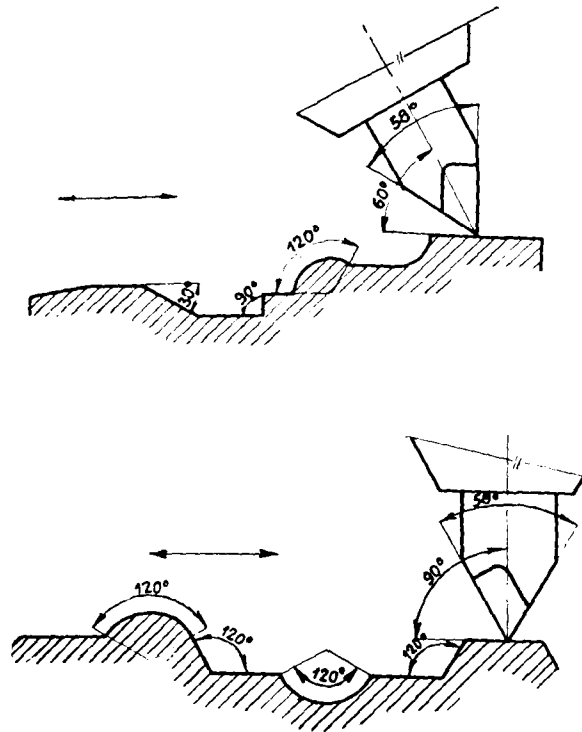


Fig. 6. Copying possibilities of 2nd carriage in its different positions.

Fig. 7 shows an example of internal turning.

C. Third carriage (recessing)

- Turning of external and internal recesses.
- Longitudinal and transverse turning against a dead or electrical stop.
- Turning with the help of a mechanical copying equipment to provide both external and internal corner recesses, or also profile recesses and profile surfaces.

Figs. 8 and 9 show typical application of 3rd carriage.

CONTROL SYSTEM OF AUTOMATIC WORKING CYCLE

The machine control system is based on the electrical programme mechanism which enables quick and easy

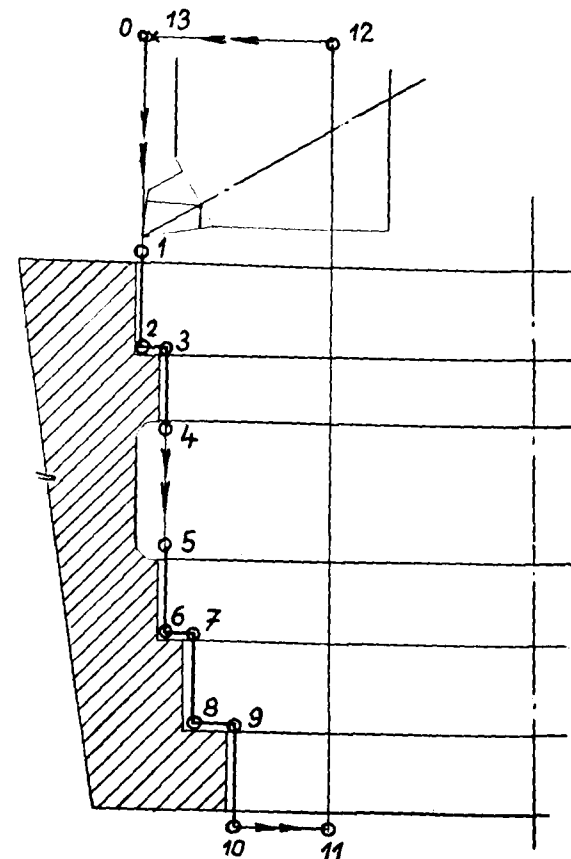


Fig. 7. Possibilities of internal turning by 2nd carriage in cross-wise cycle (cycle may be composed of 11 to 12 movements following each other in any sequence)

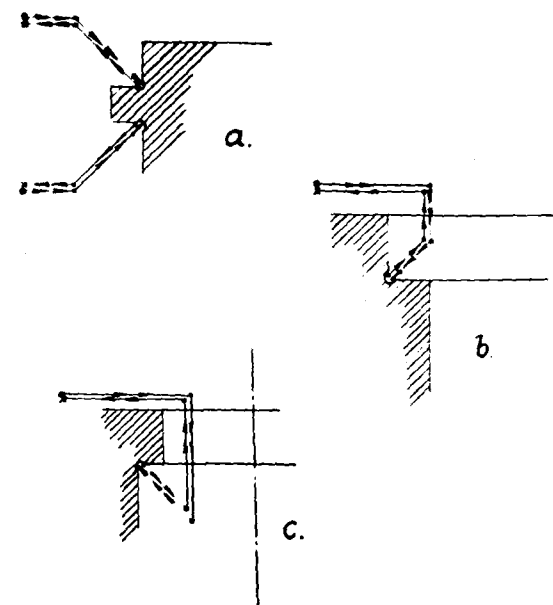


Fig. 8. Example of copy-turning of recesses by 3rd carriage from a mechanical template:
a - external turning
b - internal turning
c - internal turning of a hole

An automatic working cycle for the following functions can be set by means of the programming mechanism:

- changing working spindle speeds over 8 steps, in a total ratio of 1:5, automatic speed change taking place while cutting is in progress;

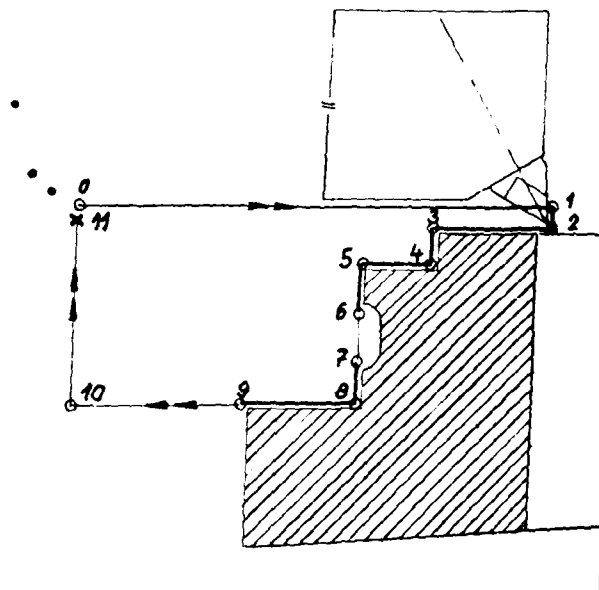


Fig. 9. Possibilities of surface machining by 3rd carriage in cross-wise (rectangular) cycle. The cycle may consist of 9 movements, following each other in any desirable sequence.

preselection of automatic functions in a certain sequence required by the technological analysis of the working operations included in the cycle.

Programme setting is done by simple screwing of the contact pins in the command card, which is delivered to the operator by the technological department. This card has marked holes for taking the contact pins and is fixed on the programme selector. The chuck work necessitates a wide scope of technological possibilities in regard to the individual work phases. For this reason, all three carriages are equipped with separate programme mechanism, the commands of which can be combined into a common cycle. As such, the workpiece is machined at one setting in as many as 30 to 36 operations.

Fig. 10 — a close-up view of the programme selector of the second and third carriages.

During the automatic working cycle the carriage movements are initiated by the contact cylinders, composed of dividing rings the increments of which are given in millimetres and correspond to the respective position of the carriage. Each ring represents one working phase of the cycle and by mere rotating of the ring according to a numbered scale, it can be determined in what position of the carriage the starting of the next working phase has to take place.

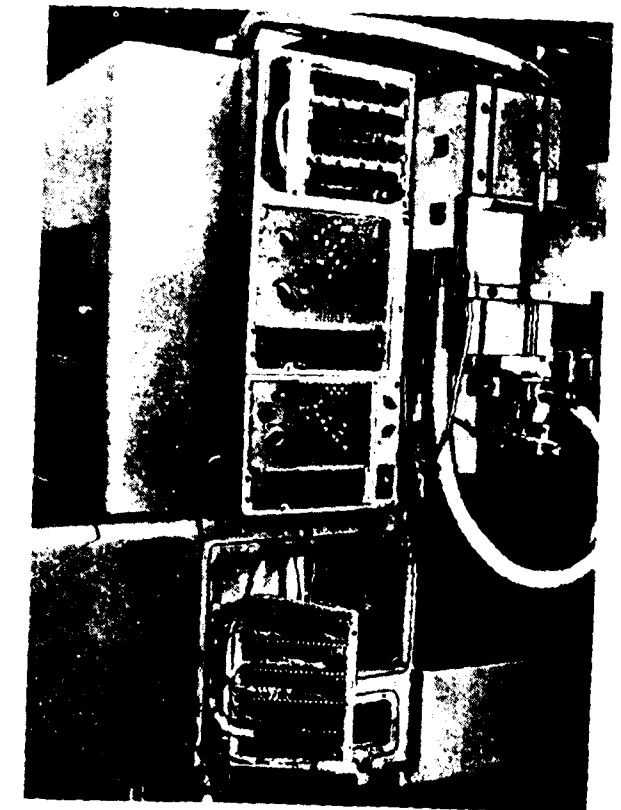


Fig. 10. Close-up view of programme selectors with punched cards for left-hand copying and recessing carriages.

- changing rates of three cutting feeds with all three carriages, independently of each other;
- controlling direction of cutting feeds and rapid feed;
- automatic setting of cutting depth and up to five times repeated roughing pass for stock removal before copy-turning;
- starting recessing carriage the working programme of which is controlled electro-hydraulically;

- (f) starting left-hand, right-hand or recessing carriages in any sequence.

Fig. 14 shows the punched card of the programme selector of the first carriage.

The time required for setting up the machine largely effects suitability of the machine for small-batch and medium-batch production. For this reason, the machine is provided with panel desks for remote hand control of the machine functions while setting-up by means of the push-buttons or change-over switches.

Fig. 11 shows a panel desk for hand control of the second and third carriages.

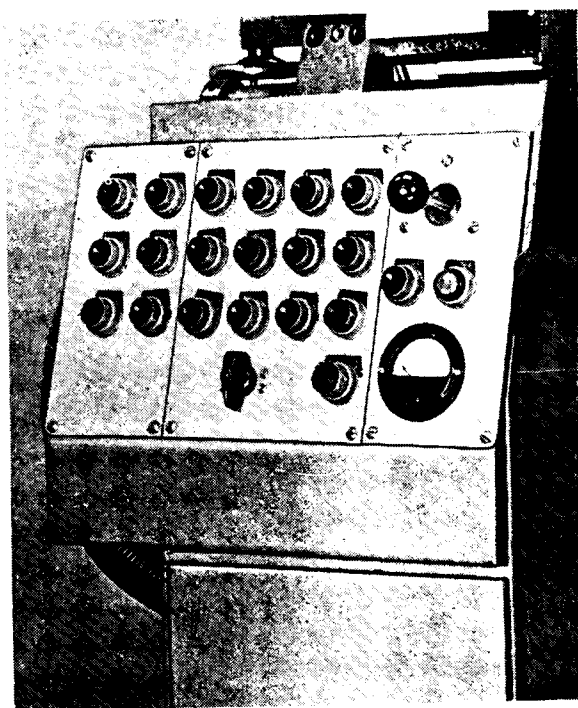


Fig. 11. Close-up view of left-hand panel desk for hand control of left-hand copying and recessing carriages.

The setting of the SPK 63 machine is limited to the following functions, requiring but little time:

- preparation of programme by screwing-in contact pins;
- setting of speed and feed ranges;
- clamping and alignment of three cutting tools and templates at maximum;

- (d) setting of contact rings and depth of pass for individual roughing operations;

- (e) setting of stops for rectangular cycle.

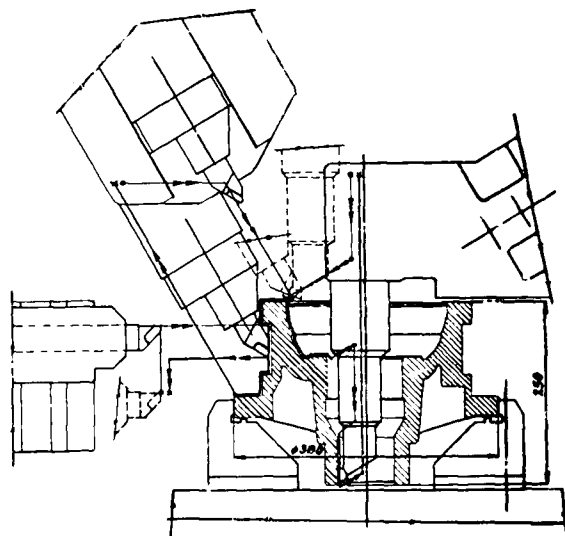


Fig. 12. Method of machining of a wheel hub. Time required for setting - tpz = 150', production time = 6.8'

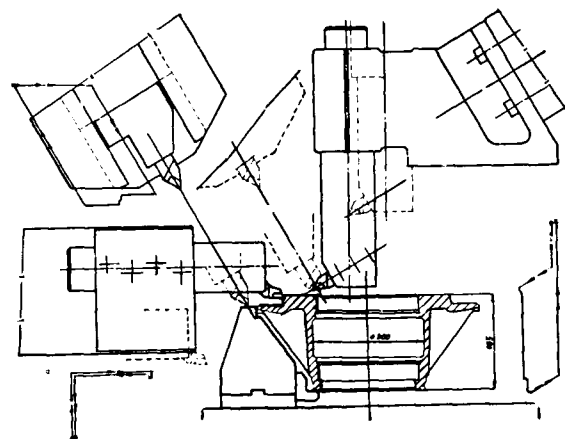


Fig. 13. Method of machining of one half of differential. Time required for setting — tpz = 180', production time = 7'

CLAMPING OF WORKPIECES

The workpiece to be machined is clamped either directly on the clamping plate or in a holding fixture, secured to the clamping plate. Apart from this, the machine is equipped with a hydraulic clamping attachment by means of which the part is clamped in a chuck, or the respective clamping medium must be adapted for connection to this attachment. The

clamping force can be adjusted by regulation of the oil pressure. The latter being of the order of 25 atm., the set clamping force on the chuck jaws is 26,000 kg. Clamping and releasing of the workpieces are controlled by push-buttons.

To avoid injuries caused by a released workpiece, the spindle speeds are interlocked with the clamping equipment. This locking arrangement also prevents the clamping equipment from being operated while the machine is running.

COOLING

The basic body of the machine houses a coolant tank and a coolant pump with the appertaining distribution system connected to the recessing carriage on which the high-speed steel tools are to be employed. The cooling equipment is delivered as a special accessory

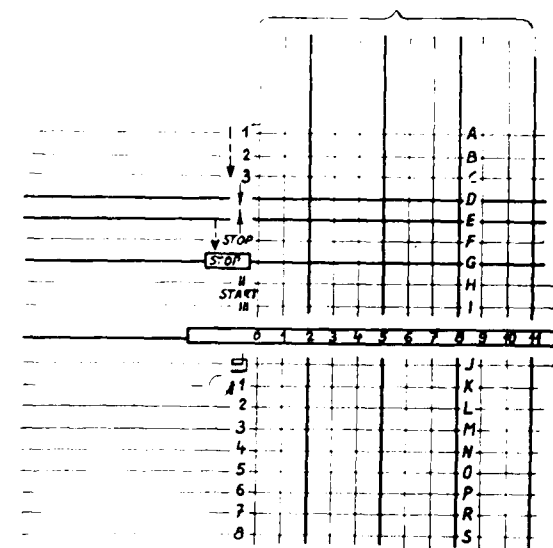


Fig. 14. Command card of right-hand copying carriage on SPK 63 model

1 - feed	A
2 - feed	B
3 - feed	C
rapid feed down	D
rapid feed up	E
Stopping of cycle of 1st carriage	F
Stopping of machine	G
Starting of 2nd carriage	H
Starting of recessing carriage	I
Light signalling in regard to progress of working cycle	0 12
Repeat machining passes	J
1. - 8. Spindle speeds	K S
	individual stages of working cycle

ECONOMY

From the economical standpoint, when considering the machine utilization it should be stressed that in setting the machine work cycle only with the help of stops and in applying hand operation by means of the push-buttons, the machine run is quite economical and is highly efficient for production runs starting from 5 pieces. When the machine is set up for a run on a fully automatic cycle, it is utilized with economy for production runs starting from 20 to 30 pieces.

As compared with the average obtained on conventional universal machine tools, the time savings are of the order of 60 to 90 per cent, and the labour productivity is increased to 150 to 730 per cent.

Figs. 12 and 13 show examples of machined workpieces. Fig. 15 shows machining of a flange by all three carriages.

MAIN TECHNICAL DATA OF THE SPK 63 SEMI-AUTOMATIC VERTICAL LATHE

Max. turning diameter	mm	630
Max. turning length	mm	250

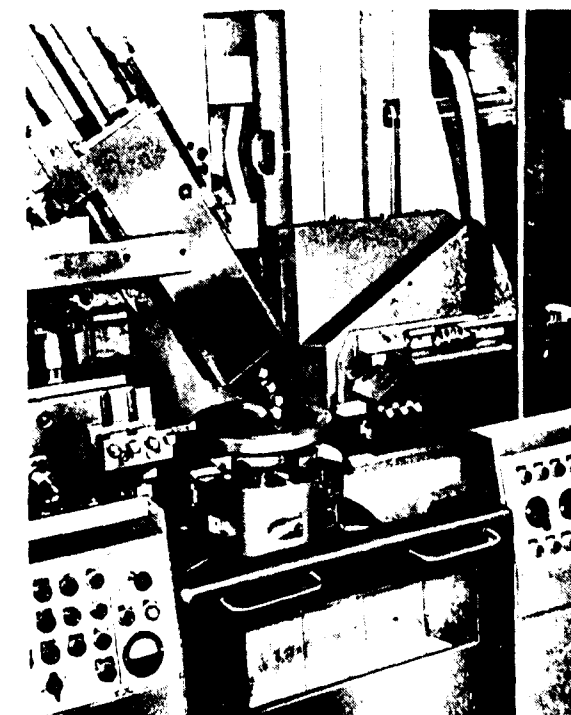


Fig. 15. Close-up view of method of machining on a flange by means of three carriages simultaneously.

Taper in spindle	Morse No.	6
Max. torque on spindle	kgm	560
Spindle bore	mm	50
Diameter of clamping plate	mm	580
Chucks (diameters according to choice)	mm	315,500
Clamping force on chuck jaws	kg	26,000
Max. pressure on tools	kg	2,400
Cross-section of tools	mm	32 × 50

FIRST COPYING CARRIAGE (RIGHT-HAND)

Stroke of slide	mm	670
Copying stroke, measured in plane perpendicular to machine axis :		
(a) carriage in perpendicular position to machine axis	mm	315
(b) carriage in inclined position as measured to machine axis	mm	270

SECOND COPYING CARRIAGE (LEFT-HAND)

Vertical adjustment of slide	mm	420
Horizontal adjustment of cross slide	mm	100
Horizontal stroke of cross slide	mm	390
Copying stroke :		
(a) carriage in vertical position	mm	315
(b) carriage in inclined position	mm	270

THIRD CARRIAGE-RECESSING

Vertical stroke of carriage	mm	260
Horizontal stroke of carriage	mm	300
Adjustment of horizontal carriage	mm	100
Maximum depth of outside copying	mm	50

SPINDLE SPEEDS

Number of speed steps		16
Number of automatically-changed speed steps		8
Number of speed batches		7
Range of speeds—standard	r.p.m.	22.4–710
Range of speeds—low	r.p.m.	14–450
Range of outputs	kW	22–30

FEEDS

Range of feeds	mm/min.	7.1–1,000
Ratio of automatically-changed feeds.		1 : 10
Rapid feed towards workpiece	mm/min.	2:
Rapid feed away from workpiece	mm/min.	2.2
Number of automatically-changed feeds (for each carriage)		3

DRIVING ELECTRIC MOTORS :

For spindle drive :			
output 1 ×	kW	10/15	
1 ×	kW	13/18	
speed	r.p.m.	1,440/2,880	
For drive of hydraulic pump for 1st carriage :			
output	kW	1.5	
speed	r.p.m.	1,440	
For drive of hydraulic pump for 2nd carriage :			
output	kW	1.5	
speed	r.p.m.	1,440	
For drive of hydraulic pump for 3rd carriage :			
output	kW	1.5	
speed	r.p.m.	1,440	
For drive of hydraulic pump for clamping :			
output	kW	0.8	
speed	r.p.m.	1,440	
For drive of lubrication pump			
output	kW	0.180	
speed	r.p.m.	1,440	
For drive of slide of 2nd carriage :			
output	kW	0.6	
speed	r.p.m.	1,440	
For coolant pump :			
output	kW	0.3	
speed	r.p.m.	2,880	
Height of machine	mm	3,100	
Width of machine	mm	2,700	
Length of machine	mm	2,800	
Net weight of machine	kg	11,000	

WKV 100 JIG BORER

By Miloslav Šubrt

Design Engineer of the MAS KOVOSVIT Works,
at Sezimovo Ústí, Czechoslovakia

THE jig borers continue to find ever-larger fields of application in all branches of engineering production. The tremendous development of the engineering industry in this century is featured not only by increased productivity, but also by increased demands on the quality and precision of the products. Despite the fact that the production of other machine tools, such as centre lathes, milling machines, drilling machines etc., is rather old, the first jig borers were manufactured as late as the beginning of the 20th century. Until then, precision drilling operations were a monopoly of specialist—toolmakers and were effected on a centre lathe with the aid of special adaptations and fixtures. The development of these machines is, with due regard to the short time referred to above, by no means backward, on the contrary, it can be said that these machines demonstrate the high standard of present engineering and measuring technique.

Their popularity is proved by the fact that the demand for them continues to grow and that the number of their manufacturers in the world is increasing. The application of jig borers is today limited not only to work in toolroom, the production of fixtures and in singlepiece production but jig borers are now employed for short as well as long production runs, whereby outlay connected with the production and storing of costly jigs and fixtures are avoided. Therefore, manufacturers today endeavour to increase the output of these machines, to simplify their operation, and also to make some of their functions partially automatic. Automation is directed mainly to the measuring and setting of co-ordinates. All the equipments hitherto developed are very costly, which reduces in turn their economical reason to a considerable extent.

On principle, the demands laid on the jig borers may be summarised in the following points :

- (1) Precision
- (2) Output

- (3) Simple operation
- (4) Large application

The Czechoslovak double-column jig borer type WKV 100 (Fig. 1) is intended not only for the drilling and boring, but it allows also all milling operations to be performed to the closest tolerances. On top of this it may be employed for the precision marking-off and inspection of parts. All the operations can be effected within the accuracy limits of an order of 1 micron of a millimetre.

Furthermore, a great advantage of this machine is that it permits both the male and female threads (metric and Whitworth) to be cut without the use of any special accessories.

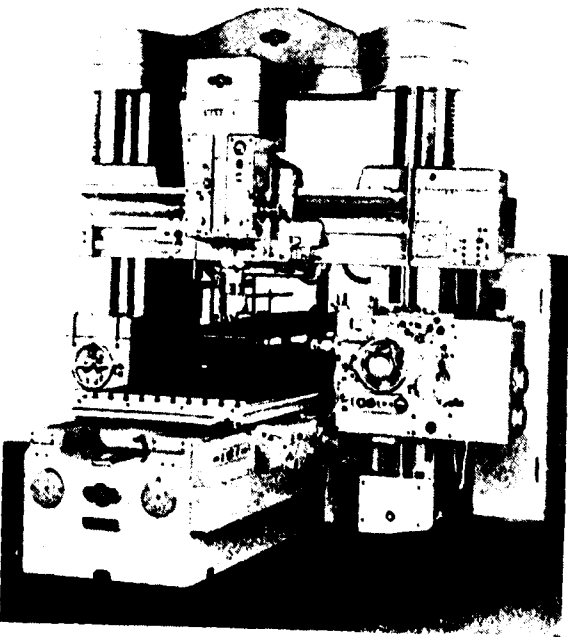


Fig. 1. General view of machine

The machine (Fig. 1) consists of the bed, on the guideways of which moves the work table, supported on antifriction bearings. The working area of table is provided with clamping slots. Two columns, connected at the top by a steady cross beam, are secured to the bed. This whole arrangement ensures the rigid frame of the machine. The moving cross rail, carrying the vertical headstock, is guided on the columns. In addition, the right-hand column carries the horizontal headstock and the left-hand column the rest.

The work table is supported on rollers and actuated through hydraulic equipment. The pump and distribution system are situated at the rear end of the bed (Fig. 2) and are easily accessible. The table feeds are infinitely variable from 20 to 350 mm/min.

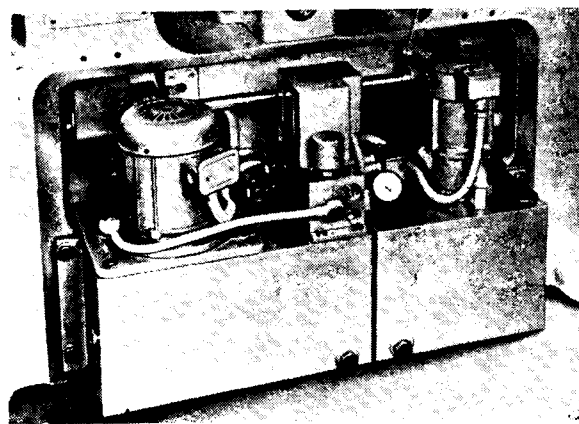


Fig. 2. Hydraulic equipment and cooling.

For rapid table traversing the rapid feed is provided. Fine hand feed, intended mainly for final setting to the required position, is available within a range of approx. 100 mm.

The steady cross beam houses the drive to the lifting screws intended for vertical adjustment of the moving cross rail. The latter is relieved during the elevation through the action of the hydraulic system is such a way as to minimize the wear of the lifting screws and nuts. After the adjustment has been completed, the cross rail is automatically locked on the columns.

The vertical headstock is adjustable in a horizontal plane on the moving cross rail. The feed mechanism is situated in a box at the right-hand end of the moving cross rail (Fig. 3). The feeds intended for milling are controlled by push-buttons, while the rapid feed is controlled by a lever. There are available 4 steps of feed rates to either side of 25, 50, 75, 150 mm/min. and

1 rapid feed of 1,500 mm/min. The drive consists of a 4-speed electric motor, worm gearing and differential gearing. The system allows also fine hand setting, required for final setting of the vertical headstock.

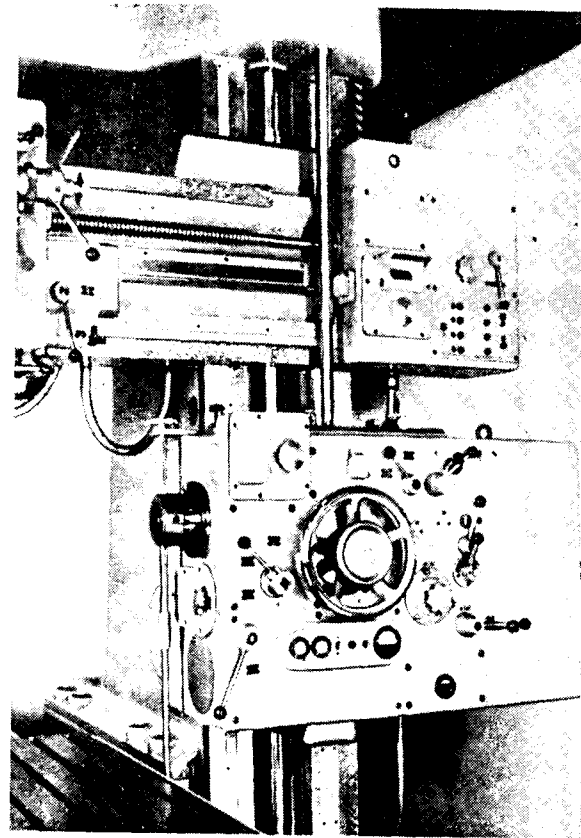


Fig. 3. Horizontal headstock and feed gearbox of cross rail.

The vertical headstock (Fig. 4) is equipped with an individual electric motor of 4 kW output and contains the transmission and feed mechanism, spindle with quill, attachment for measuring the length of spindle out-feeding with automatic stopping of power feed and attachment for thread cutting, i.e. attachment affording a feed to the spindle which corresponds to the lead of the thread concerned. The transmission mechanism allows 23 steps of speeds from 12.5 to 2,000 r.p.m. to be obtained. The feed mechanism allows 8 steps of feed 0.025 to 0.63 mm/rev. to be obtained. The spindle runs in antifriction bearings (Fig. 5), which are specially manufactured for this purpose. The spindle end is provided with an internal taper (15 : 100) and a chucking head for fixing the adapters with tools. The tools are inserted in the adapters which are provided with metric or Morse taper. The tools are held in the adaptor taper either only by friction force, or

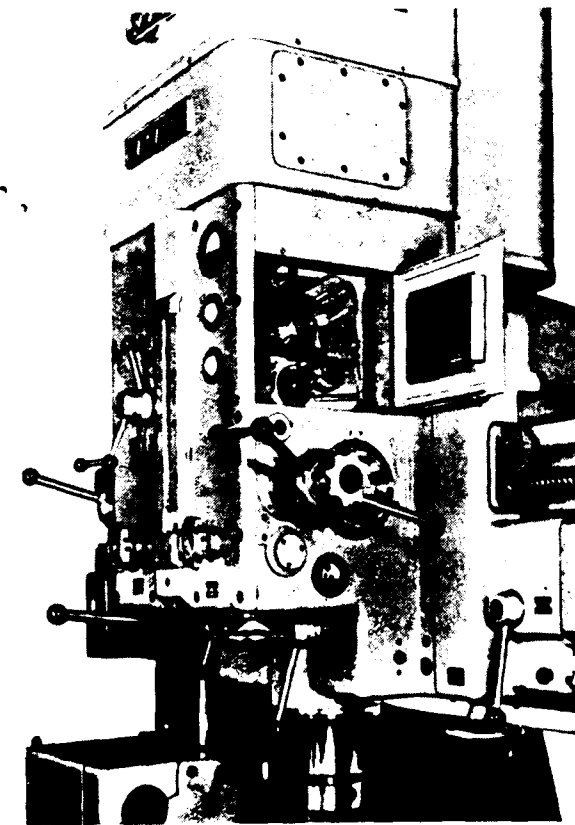


Fig. 4. Vertical headstock (change gears for thread cutting).

they are secured in the adaptors by a screw. After loading the adaptor with tool into the spindle, the adaptor is locked by the chucking head, by means of a hand lever.

The spindle is balanced by a counterweight, which simultaneously balances the whole headstock on the guides of the moving cross rail.

The speed regulation is provided with preselection which allows any further speed to be preselect while machine is running. For measuring the length of spindle out-feeding, there are available the scales on the control levers and also the attachment with adjustable stop, which automatically stops the power feed when the pre-set length of spindle out-feeding is reached.

The thread cutting attachment consists of the transmission mechanism with change gears. The latter are placed in the gear quadrant (similarly as with centre lathe), and by their different set-ups the feeds per spindle revolution, to correspond to the required thread lead, are obtained. (Fig. 4—opened cover). Both metric and Whitworth threads can be cut. In thread cutting of special advantage is the automatic

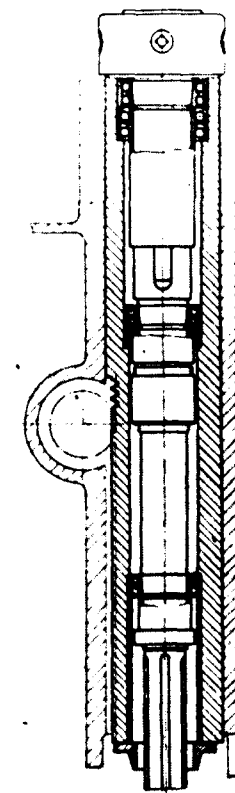


Fig. 5. Spindle mounting.

stopping of the feed after the required depth has been reached. After the threading tool has been driven home and the feed has again been started, the tool always runs accurately against the thread. Thereby damage to the tool is eliminated.

Thread cutting is diagrammatically shown in Figs. 6 and 7.

The horizontal headstock (Fig. 3) has a similar assembly as the vertical headstock. The drilling output, range of speeds and feeds are the same. It is also arranged for thread cutting. It is arranged for hydraulic speed and feed change, as well as for their preselection. Its weight is balanced by a counterweight, housed inside the column. Adjustable stops are provided (Fig. 8), intended for the automatic stopping of the power feed. The dial indicators can be inserted in the stops and thus the length of the spindle out-feeding can be measured.

The horizontal headstock considerably increases the machine application and productivity. When parts, provided with holes or surfaces perpendicular to each other, are to be machined, lengthy and difficult aligning is eliminated and the machining can be completed

at one setting. The rest situated on the left-hand column serves to support the long boring bars.

The machine lubrication is solved in such a way as to avoid the wear of parts and as to ensure reliable operation of the machine.

The transmission gearings are thoroughly lubricated either by circulating lubrication (provided with a separate pump) or with an oil bath. The other working spots on the machine, as well as the guideways, are lubricated centrally from several points.

The machine is equipped also with a coolant pump. The coolant is supplied through pipes and directed to the tools. The tank with pump is situated on the side of the hydraulic equipment (Fig. 2).

MEASURING EQUIPMENT

The optical projection measuring equipment serves for the measuring and setting of co-ordinates. The basic part of the equipment is the precision rule from high-quality steel, with super-finished surface, provided with millimetre scale. The image of the gauge

marks is magnified 32 times by a system of lenses and projected on a screen, provided with a mark. When the final setting is established the gauge mark has to be within the frame of the above mentioned mark. The dividing drum with nonius allows setting to a tolerance of 0.001 mm. The great magnification and projection make possible effortless precision measuring. The equipment is not exposed to any wear and is protected against any damage from outside. On principle, the equipment is the same for all three coordinates. Outside arrangement for the table coordinate is given in Fig. 9. The rules situated on the machine surface are intended for coarse measuring.

The electrical equipment is housed in a separate box (Fig. 10). Both drilling motors when stopped are braked by direct current.

The machine is lighted by a fluorescent lamp, situated in the bottom part of the moving cross rail. All places serviced during the measuring process also illuminated.

Returning to the previously stated viewpoints, they may be summarized as follows:

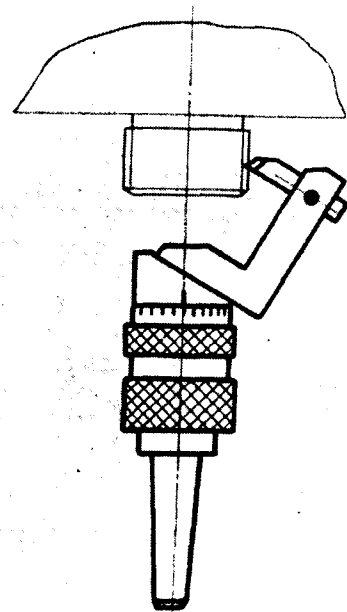


Fig. 6. Cutting of female thread.

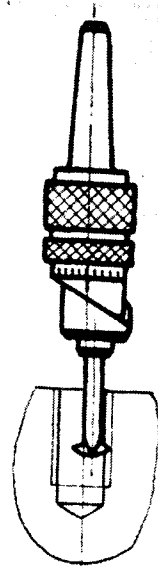


Fig. 7. Cutting of male thread.



Fig. 8. Attachment for measuring length of out-feeding of horizontal headstock quill.

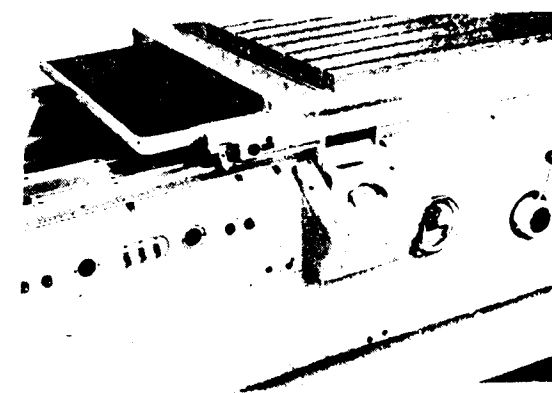


Fig. 9. Arrangement of measuring equipment on bed.

the Jig borer model WKV 100 meets all the requirements claimed for machines of this class.

- (1) It is precise—guaranteed precision of setting within 0.005 mm.
- (2) It has a high output (drilling output of 4 kW and large range of speeds and feeds)

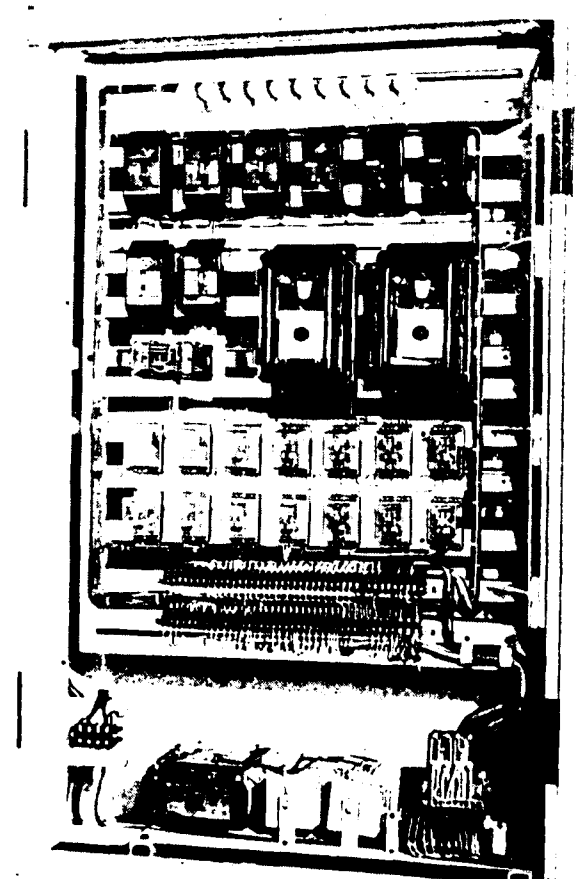


Fig. 10. Electrical equipment.

- (3) Operation does not call for physical effort. The operating elements are easily accessible and are mostly arranged so that the machine can be serviced from either side of the bed.
- (4) Application is increased by the horizontal headstock and rest as well as by the thread cutting attachment.

Technical data:

Clearance between columns	mm	1,600
Height of table clamping surface	mm	913

Table:

Table size (width × length)	mm	1,000 × 1,600
Table adjustment	mm	1,400
Feeds—ininitely variable, hydraulic	mm/min.	20 to 300

Rapid feed (forwards and rearwards) mm/min. 2,000 to 2,500

Moving cross rail :

Cross rail adjustment mm 740

Vertical headstock :

Dia. of spindle quill mm 120

Stroke of spindle quill mm 300

Spindle speed : number of steps 23
range r.p.m. 12.5 to 2,000

Drilling feed to spindle number of steps 8
range mm/rev. 0.025 to 0.63

Milling feed : number of steps 4
range mm/min. 25, 50, 75, 150

Rapid feed mm/min. 1,500

Tool taper special 15 : 100

Sort of cut threads M, W

Adjustment on cross rail mm 1,000

Input of motor kW 4

Horizontal headstock :

Dia. spindle quill mm 120

Stroke of spindle quill mm 300

Spindle speed : number of steps 23
range r.p.m. 12.5 to 2,000

Drilling feed to spindle : number of steps 8
range mm/rev. 0.25 to 0.63

Milling feed : number of steps 3
range mm/min. 50, 71, 120

Rapid feed mm/min. 1,000

Tool taper special 15 : 100

Input of motor kW 4

Adjustment on column mm 700

Rest :

Adjustment on column (only by hand) mm 700

Permissible loading of table kg 2,000

Max. dimensions of machine (width $\times$ length $\times$ height) mm 3,145 $\times$ 4,145 $\times$ 3,298

Net weight of machine approx. kg. 19,000

ELEVATOR FOR UNLOADING FROZEN BLOCKS OF FISH

An elevator, designed and manufactured by a London firm, will help to speed up the unloading of frozen blocks of fish and ice from the cold-storage hold of the 'Lord Nelson', the first distant-water trawler specially designed to freeze half her catch at sea. Built into the cold-store hold is an insulated trunk extending into the superstructure of the vessel. This houses the Webb Continuous Swing-Tray Elevator which is used to unload the frozen fish-blocks when the ship docks.

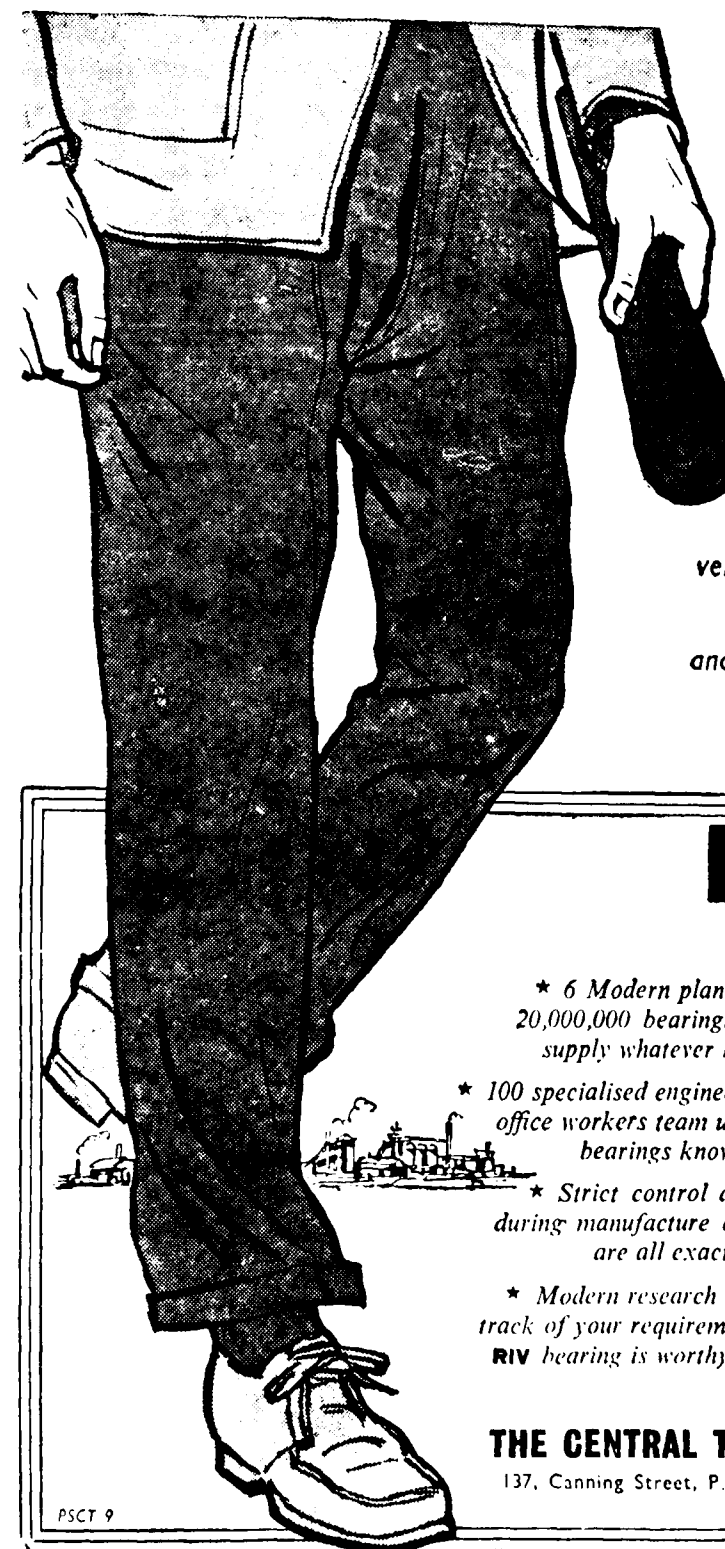
The elevator compensates automatically for any heeling movement of the ship. It can be loaded at an upper or a lower position, depending on the level of fish left in the hold. Charging and discharging is effected automatically by means of a special finger-tray device. Another safety feature is a cut-out which stops the elevator if a block of ice is badly misaligned in one of the trays. Unloading speed depends on the number of swing-trays on the elevator in use. Using 12 trays, more than 80 stones of fish a minute can be unloaded.

At the top of the elevator, the blocks slide out through a watertight steel door in the bridge front, about 5 ft. above the upper deck, and onto the quay-side through chutes over the side of the ship.

* * *

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The Application of Max.-Min. Governors to Rail Traction

By D. F. Cardy

INTRODUCTION

IN general, these notes apply to mechanical and some particular types of hydraulic drive locomotives.

Two main problems exist, the first being a question of engine torque control as opposed to speed control. The second is the problem of sharing the load equally between engines and/or locomotives, should more than one engine be operating at any one time, that is ensuring that each engine exerts an equal proportion of the total tractive effort.

ENGINE TORQUE CONTROL

The advantages of this system are as follows:—

1. Accurate indication of engine load.
2. Accurate control of tractive effort and hence acceleration.
3. Control is possible over wheel slip.

Hydraulic drive locomotives can be subdivided in three main types:—

- A. Pure torque converter drive (Makedro).
- B. Hydraulic coupling (s) and gearbox (Powerflo).
- C. Combination of torque converter (s) and hydraulic coupling (s) (Voith).

In types B and C, whenever the hydraulic coupling is in operation, the engine is directly coupled to the driving wheels via a gearbox, and, therefore, engine speed is directly related to track speed.

This is also the case for the so called mechanical drive locomotives using a gearbox with either a fluid coupling or a plate clutch.

For purposes of this discussion, therefore, it is intended to couple hydraulic locomotives types B and C with mechanical drive locomotives, and it is only these types of locomotive which can benefit from the use of a max.-min. governor.

Typical engine load-speed governor characteristics with 10% Droop are shown in Fig. 1. A given track speed can be superimposed on these characteristics by taking account of the appropriate gear ratio. It will now be seen that in order to place a given amount of load on the engine, and hence obtain the

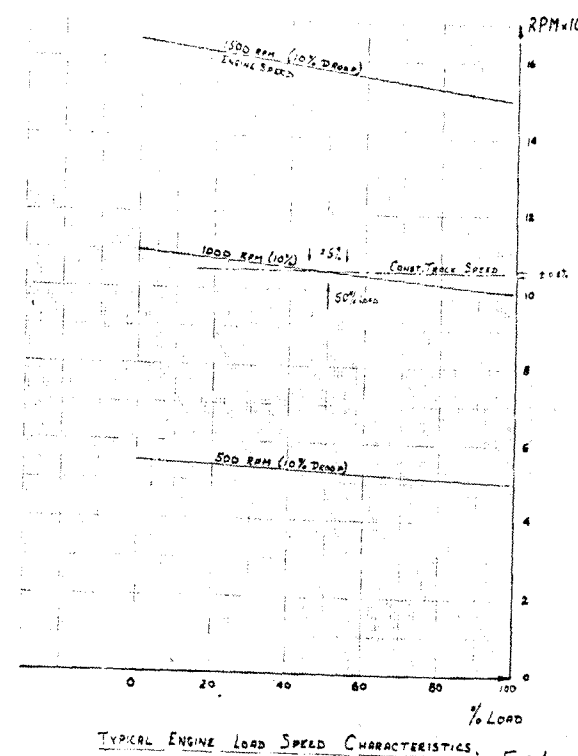


Fig. 1

required tractive effort, the control speed selector must be very closely matched to the track speed as shown. For a load of 50% full load to an accuracy of $\pm 5\%$, the control speed must be matched to the engine speed to an accuracy of $\pm 0.5\%$. Also, as the locomotive accelerates, the setting of the control speed selector must be continually altered in order to maintain the required tractive effort.

It is, therefore, apparent that the driver's control lever bears little relation to the load or torque on the engine. Thus he has little knowledge of the engine

load and has only a small amount of control upon the acceleration of the locomotive as a whole.

- In order to control engine load or torque, all that is necessary is to couple the driver's control handle directly, to the engine fuel rack and to provide a device which overrides the driver's control should over or underspeeding occur. The device is called a max.-min. governor.

It could be argued that ultimately it is the speed of the locomotive which has to be controlled, and that, therefore, a speed control governor is the obvious choice. However, the driver does not have as much direct control of the locomotive as he would have using torque control. It is possible to control wheel slip at starting with torque control, and it must be stressed that the controlled quantity is tractive effort and hence acceleration.

LOAD SHARING

In order to obtain accurate load sharing, when using speed governors, it is essential that the droop characteristics of each governor-engine system are matched at all engine speeds. This is extremely difficult because of manufacturing tolerances on springs and other governor and engine components.

The obvious and most simple method of load sharing is to position each fuel bar so that each engine is developing an equal proportion of its full load torque. This can simply be done with actuators fed from a common control air supply, regulated by the control lever.

It is now apparent that direct positioning of the fuel bar gives both torque control and automatic load sharing.

THE ARDLEIGH 900 SERIES MAX.-MIN. GOVERNOR

This governor combines the over and underspeeding device necessary for torque control as discussed above, with the actuator necessary to move the fuel bar if the engine is remotely situated from the control cab. The resulting configuration gives governor control of engine speed at the minimum and maximum speeds with independent torque control whenever the engine is running at a speed between the two limiting speeds. The work output of the governor is 15 ft. lb. and the unit is completely self-contained.

Fig. 2 shows the torque speed characteristics obtained with the system and the region of torque control is apparent as the system of straight lines. Control is by either pneumatic or manual means. The layout of the governor is also shown and the numbered positions on the torque speed characteristics correspond with the appropriate drawings 1 to 7 which follow. The position A is represented in the schematic diagram.

With no air pressure supplied to the actuator it is in its upper position and, as shown in positions 1 and 2, only the centre spring is in operation. Positions 1 and 2 represent the No Load Torque and Full Load Torque conditions respectively when the engine is running under minimum speed control. The governor is, in fact, behaving exactly as an ordinary proportional (droop) governor with lever feedback.

If now air is supplied to the actuator, so that its piston is moved to half stroke, the pivot point of the feedback lever is lowered. With Full Load Torque applied, the engine is still under minimum

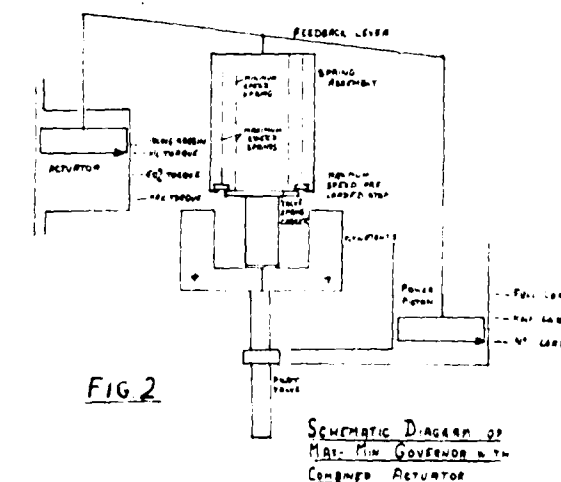
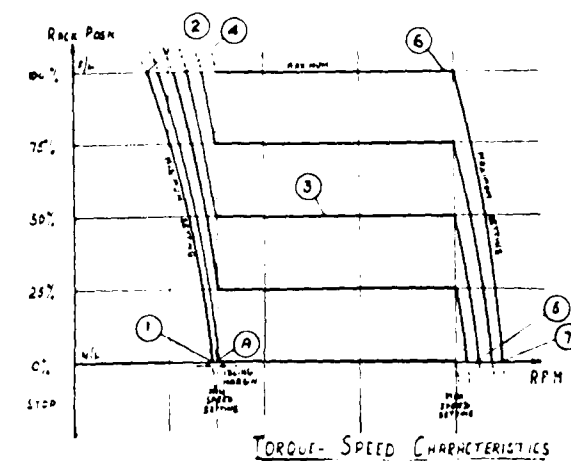
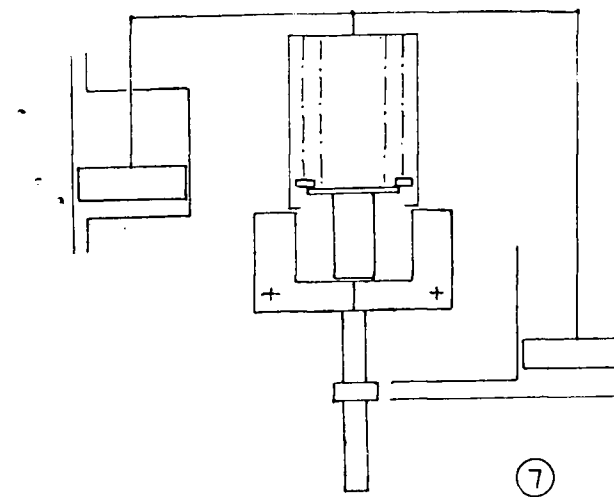
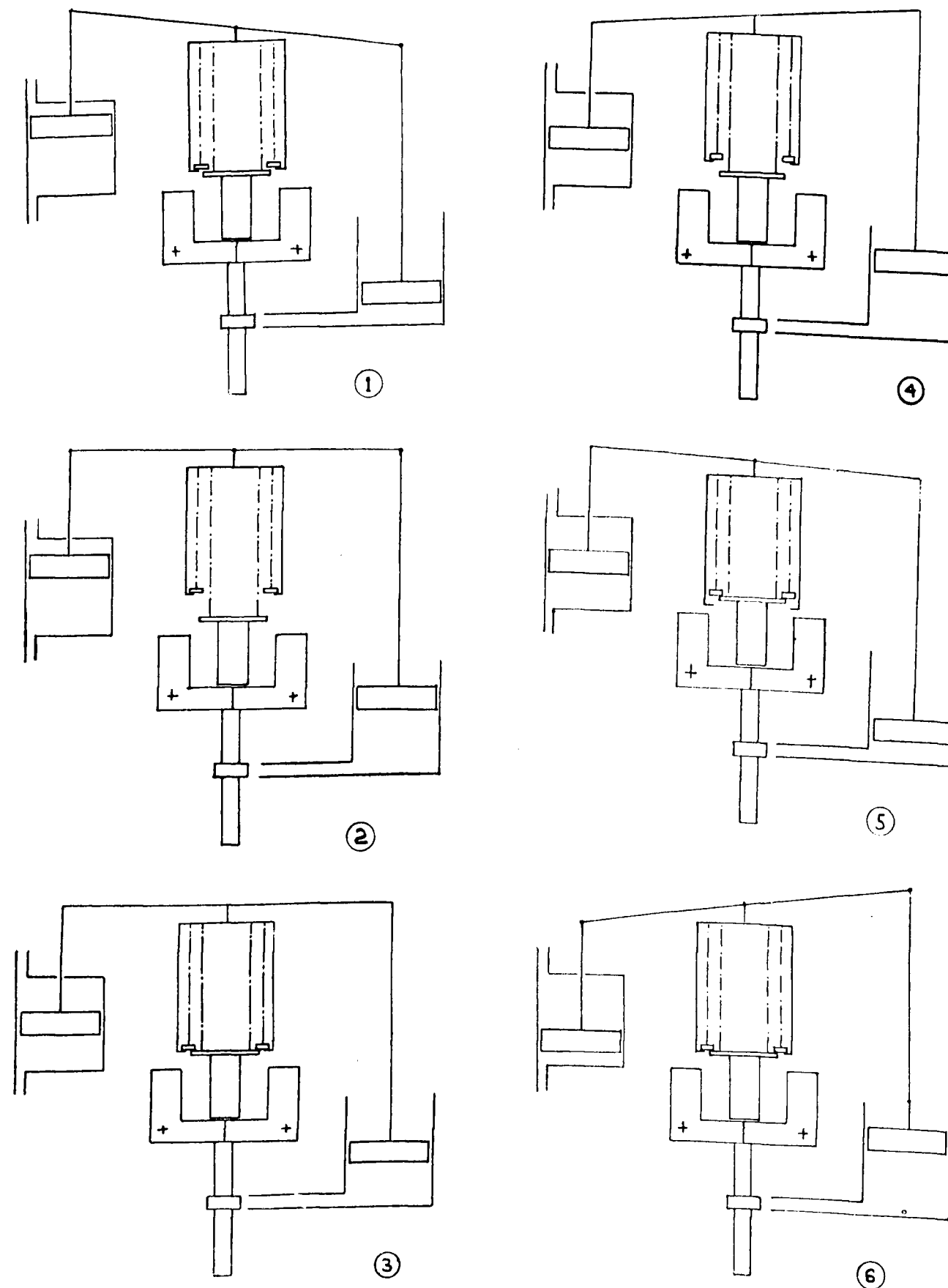


FIG. 2





governor the actuator piston is of annular form around the spring assembly.

A design is available using manual control instead of an air control pneumatic input. A further manual control model of 8 ft. 1b. work capacity, based on the 700 Series governor, is shortly to become available.

Examination of Max-Min. Characteristics

VOITH TYPE DRIVES (USING ONE OR MORE FLUID COUPLINGS)

In these types of drive, top gear is obtained through a fluid coupling which gives higher efficiency than a torque converter. Top gear characteristics are, therefore, similar to those of a mechanical drive locomotive.

Fig. 3. shows the tractive effort-track speed characteristics, and it will be seen that using a speed governor there is no control over top gear torque other than the control obtained by matching track and engine speeds. This has been dealt with under torque control.

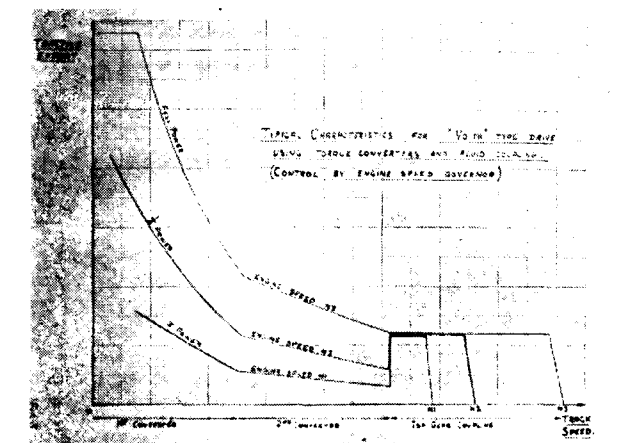


Fig. 3.

Thus, although the change in tractive effort as top gear is reached is smooth at maximum engine power, the change is not smooth at lower power output and the engine always develops maximum torque in top gear.

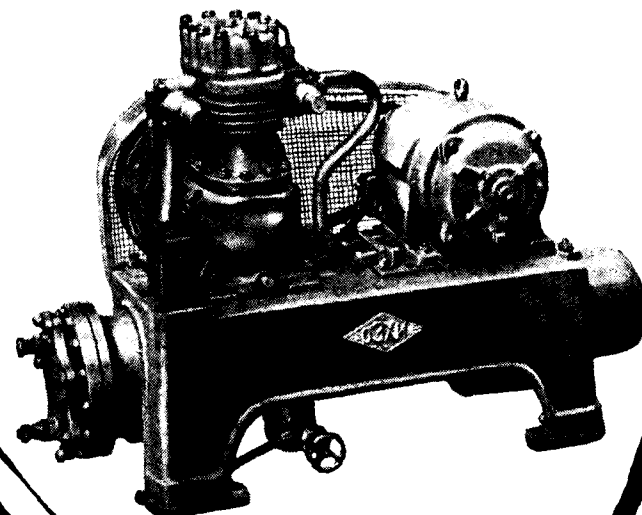
If a max-min. governor is fitted, the torque converter characteristics are unaffected whilst direct control is obtained over top gear torque giving smooth transition

speed control as shown in position 4. If now the torque on the engine is reduced the speed rises because the power piston, in moving downwards, compresses the minimum speed spring. At half load the pilot valve spring carrier contacts the maximum speed spring stop and the power piston cannot decrease the torque setting any further until the flyweight speed has risen sufficiently to overcome the maximum speed spring force. The engine speed can, therefore, rise moving along as shown in position 3. If the engine speed rises to the maximum limit, the maximum speed spring stop is lifted from its seat and the power piston moves to the No Load position 5.

With the actuator piston moved downwards full stroke, the governor position is shown in 6 and 7 at Full Load and No Load torques respectively. The governor in this condition is again operating as an ordinary proportional governor, but at the maximum speed. It will, therefore, be seen that for various actuator air pressures, a family of characteristics are obtained as shown in Fig. 2.

In order to cope with the variation in No Load Idling conditions, experienced during starting and warming up, the governor is set with a small gap between the pilot valve spring carrier and the maximum speed spring stop, as shown in position 1. This ensures that at minimum, i. e. idling speed, the power piston can move below the No Load position without causing the engine speed to rise to the maximum limit. This gap, referred to as the Idling Margin, is closed by a small initial actuator movement and then engine torque control commences.

It should be noted that in the design of the



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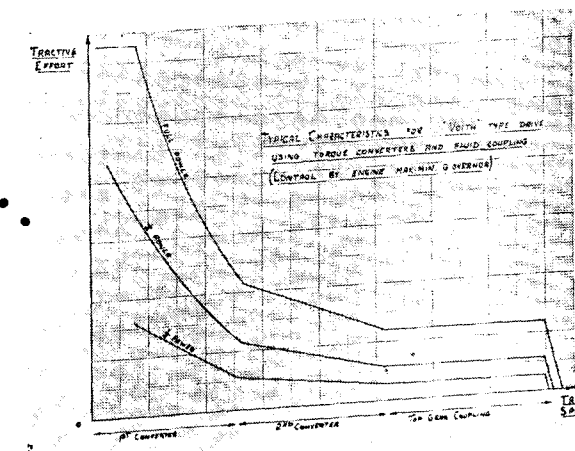


Fig. 4.

into top gear as shown in Fig. 4. Torque converter characteristics are unaffected because the normal engine speed control method is virtually a method of torque control due to the propeller law characteristics of a torque converter.

This application has already been used with complete success.

MECHANICAL DRIVES

The characteristics of a mechanical drive locomotive using a speed governor are shown in Fig. 5. Normally gear changing is carried out by the driver. There is no control over tractive effort.

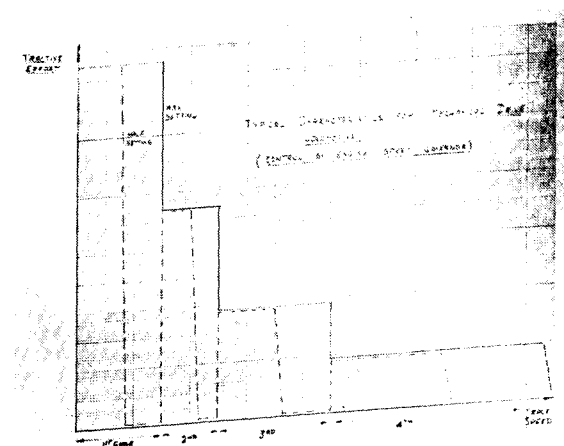


Fig. 5.

If a max-min. governor is fitted, the characteristics available are shown in Fig. 6., and it will be seen that complete control over tractive effort is obtained.

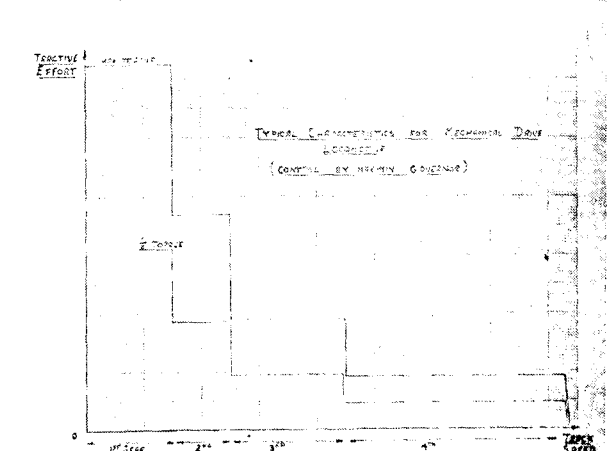


Fig. 6.

GEAR CHANGING

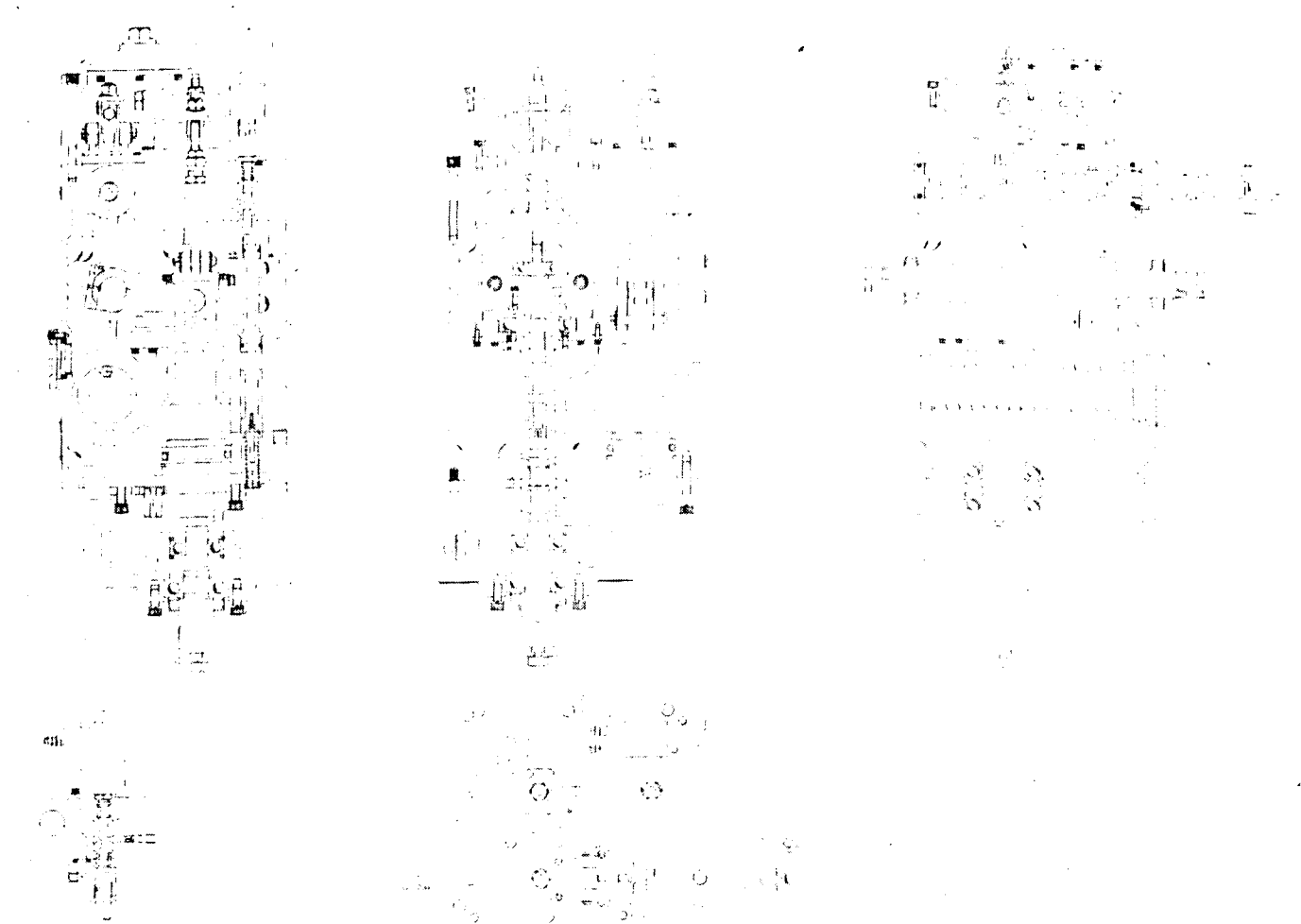
The one problem introduced when using max-min. governors is that of engine speed control during gear changing operations. This can be overcome by matching the minimum-maximum speed ratio of the governor to the ratio change in the gear box. Usually a ratio of 2 to 1 is chosen so that this gives a gear box with ratios in geometrical progression, (i. e. 1, 2, 4, 8 etc. to 1) depending on the number of gear steps and the maximum track speed required.

Thus, when the maximum track speed is obtained in one gear, declutching and moving the control handle back to minimum torque position will automatically give the correct engine speed for smooth clutch takeover in the next highest gear.

When changing to a lower gear, the control handle will not need moving because the engine speed will rise automatically to the maximum as soon as declutching takes place due to the release of load from the engine. The one exception to this rule would be when the torque control handle was in the minimum position, but this would hardly be likely. In any case, a small movement towards the maximum torque position will give the necessary engine speed rise.

Thus, when changing to a higher gear, it is necessary to move the torque control handle to minimum position during clutching operations. When changing down it is not necessary to move the control handle unless it is in the minimum position.

If automatic gear changing is fitted to the locomotive, then all that is necessary is a dumping valve in



Assembly of Type 901/IG Max.-Min. Governor

the air line to the governor which opens when changing up is occurring, thus no movement of the control handle would be necessary.

If a Wilson type epicyclic gear box is used, then no movement of the control handle is necessary during any gear change, whether up or down.

Railcars, which employ mechanical drives, use pump mounted max-min. governors.

POWERFLO DRIVES

In these types of drive where a separate fluid coupling is used to engage each gear, then, provided there is no break in tractive effort, i. e. one coupling is filling whilst the other is emptying, no movement of the control handle is necessary. If, however, there is a break in tractive effort, similar to that during declutching of mechanical drives, then the arguments given under Mechanical Drives still apply if undue engine speed fluctuation is to be avoided.

WORK ON INDIAN DAMS BY BRITISH FIRM

The Indian branch of the British firm of Cementation Co. Ltd. has just been awarded a contract valued at £270,000 by the Tata Hydro-Electric Power supply Co. Ltd. for the strengthening of the Shirawta Dam, near Bombay. Two-and-a-half years ago, the Tata Power Co. entrusted Cementation with a contract valued at approximately £100,000 for the grouting of the Walwhan Dam, which, like the Shirawta Dam, forms part of the Tata hydro-electric project system. This was followed last year by a contract for the strengthening of the Walwhan Dam by means of high tensile cables and the grouting of the Shirawta Dam, valued in all at £400,000. The present contract is for the application to the Shirawta Dam of strengthening works similar to those recently completed on the Walwhan Dam. Work will commence immediately and is expected to be completed by mid-1963.

VEB HARZER WERKE'S CONTRIBUTION TO THE AUTOMOBILE ANCILLARY INDUSTRY

By A Special Technical Writer

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All parts for the above mentioned products are made of special cast iron by the centrifugal casting process. The production programme ranges from 20 up to 550 mm raw-part diameter and from about 1—1000 mg raw-part weight. It is recommended that special enquiries be made for other dimensions and weights.

The important advantages of the centrifugal casting method over the static casting consist in that, in the centrifugal casting, the congelation runs off under the operation of centrifugal forces which are many times more than the force of gravity, and that in consequence of the controlled heat elimination, the congelation itself is simultaneously controlled.

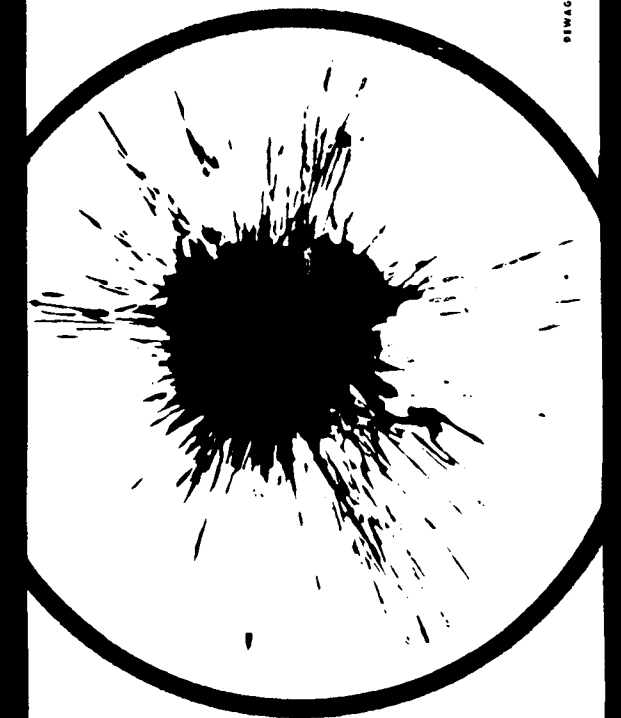
These two peculiarities assure that the centrifugally cast raw-parts exhibit a close-grained structure that is not interrupted by blowholes, gas bubbles or non-metallic factors, and that the castings possess a very uniform hardness.

For the series production, a low nickel-chrome-alloy cast iron is smelted, the properties of which are set out in technical delivery conditions. The synchronisations between chemical analysis of iron, casting temperature and mold temperature concerning individual raw-part groups guarantee, with regard to wearing quality, a structure with high stability and good functional properties.

The material employed is, moreover, well suited to undergo a large number of heat treatment operations through which the gray cast iron acquires the physical and technological properties necessary to meet the special demands made on it.

The machining of the centrifugally cast raw-parts is carried out in special mechanical workshops.

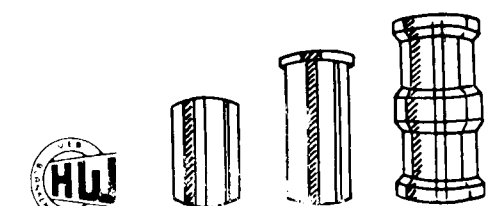
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4,000 b.h.p. diesel-hydraulic Locomotives for U.S.A. on test

By A Technical Correspondent in West Germany

THE six diesel-hydraulic locomotives built by Krauss-Maffei, Munich, for the Southern Pacific and Denver & Rio Grande Western Railroads are distinguished not only by being probably the first European locomotive exports to the U.S.A. this century, but also in being substantially the most powerful single-unit diesel locomotives of any kind in the world, with 21 per cent more output than the largest European unit and 48 per cent more than the largest North American diesel locomotive-unit.

Such increases can be obtained only by the extension of the well-established use of quick-running engines of light weight and of proved design, allied to hydraulic transmission, and both contained in a mechanical portion in which the principles of structural engineering are applied in accordance with modern knowledge. The general-purpose characteristics inherent in such locomotives are well shown in these six locomotives for the U.S.A., which are intended principally for heavy slow-speed drag-freight work up 2.4/2.5 and even 3.0 per cent gradients, and yet have a top speed of 112 km. p.h. (70 m.p.h.) with good traction performance and riding at this speed.



Fig. 1. The most powerful single-unit diesel locomotive of the world, type ML 4000. Six of these locomotives are now being delivered by Krauss-Maffei to the Southern Pacific and the Denver & Rio Grande Western railroads of U.S.A. (Prior to shipment the European draw and buffing gears are substituted by American type central couplers)

With the nominal axle load, for North America, of 25,000 kg. (55,000 lb.) and a total weight of 150,000 kg. (330,700 lb.), with full supplies, the starting tractive effort is about 45,000 kg. (99,200 lb.); since it is the intention to accelerate the service across the Rocky

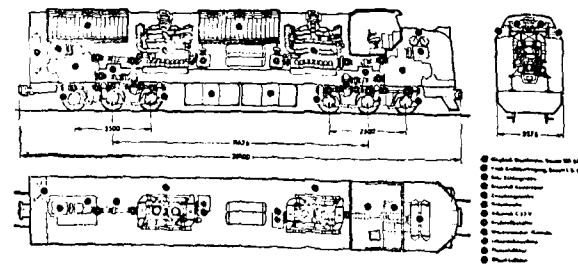


Fig. 2. Arrangement and longitudinal section of diesel-hydraulic 4,000 b.h.p. locomotive, type ML 4000, equipped with 2 Maybach MD 870 16-cylinder engines.

Mountains and the Sierra Nevada, a speed of 25 km. p.h. (15.5 m.p.h.) up the gradient has been envisaged, the corresponding tractive effort being 25,000 kg. (55,000 lb.), enough for the haulage up any length of 2.4 per cent gradient of a trailing load of 2,800 short tons at that speed, by three locomotives coupled in multiple-unit.

In actual service on the D.R.G.W. three of these units are to be run in multiple, giving a U.I.C. engine output of 12,000 b.h.p. on a weight of 450 tonnes, and will replace seven diesel-electric units of 1,500/1,900 b. h. p. apiece and weighing about 725 tonnes total. On such gradients as 1.5 to 3.0 per cent this reduction in locomotive weight, while still giving ample adhesion, increases line capacity appreciably, for not only can trailing loads be stepped up but the speed uphill can also be increased.

General layout of these C-C locomotives is shown in Fig. 2, and little more need be said here about the locomotive portion. Power is provided by two Maybach engines, each with a U.I.C. rating of 2,000 b.h.p. at 1,500 r.p.m. Each engine is located on the frame above the inner end of one bogie, with the driven Voith triple-converter transmission on the frame above

the outer end of the bogie. Thus the main-frame members are subject to very little bending stress from the power-group weights. The welded underframes have fully withstood the AAR end-load requirements, including the compressive test of 1,000,000 lb. (454,000 kg.). Below the underframe are the main fuel tanks aggregating 12,400 litres (2,730 imp. gal./3280 U.S.A. gal.) capacity. No train heating equipment is installed, because of the proposals to use the locomotives in heavy freight work.

From the output shaft of each transmission a cardan shaft leads to a distributor box, and thence further cardans lead to the three axles of each bogie. The locomotive has the feature of dynamic braking applied to the hydraulic transmission; each transmission group has an additional fluid coupling for braking only, the heat generated in the oil by the retarding force being dissipated in the large transmission heat-exchangers, the water circulating through these being itself cooled inside radiator banks having roof-mounted fans. Normal braking is on the American Westinghouse air system.

The pivotless bogie is on the same principle as those of earlier Krauss-Maffei 2,700/3,000 b. h. p. diesel-hydraulic locomotives, which were developments of the initial widely-used two-axle type. SKF roller-bearing axle boxes are used. Wheel diameter is 1,016 mm. (40 in.), and so the specific load per wheel is equal to about 687 lb. per in. of wheel diameter. As this is obtained in conjunction with much lower unsprung weight per axle, these new diesel-hydraulics are likely to be much easier on the track, and on their own wheel-treads, than the mass-formation diesel-electrics.

The power installation is most complete, and throughout is to that high technical level engendered by the use of the Maybach engine, whose altogether exceptional standard of design and construction was analysed in North America in S. A. E. paper no. 367 A read at the St. Louis convention in June 1961. Each of the two engine equipments is complete in itself, and each comprises a model MD. 870 16-cylinder 60-deg. V engine, pressure-charged and charge-air cooled, and resiliently mounted on vertical-and-shear rubber bolcks; an in-built heat exchanger for the engine lubricating oil; two side radiator banks and roof-mounted fans driven hydrostatically on the Behr system and controlled to infinite speed variation by thermostats; a main cooling-water circuit which includes engine jackets, lubricating-oil heat-exchanger and two transmission-oil heat-

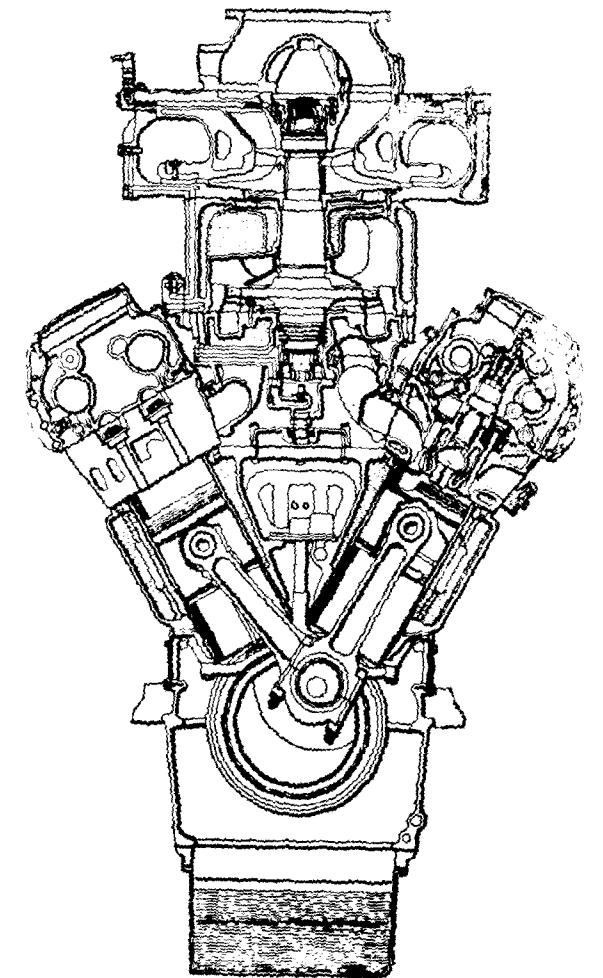


Fig. 3. Cross-section of Maybach 16-cylinder V-engine, type MD 870.

exchangers; a secondary water circuit for the charge-air cooling; a cooling-water pre-heater to permit of warm starts and to prevent any freeze-up during long lie-by periods at high altitudes or in winter weather; a pre-lubricating pump and switch control to prevent engine starting until adequate oil pressure has been built up in the main rail; and an engine-air filtration system in which the air from side panel filters is ducted through oil-bath filters to the pressure-charger intake.

Though the Maybach MD engine range, extending from 400 to 3,600 b. h. p. from one cylinder and with extensive standardisation and interchangeability of parts, is well known and widely used throughout Western Europe, and in many other parts of the world, and the 16-cylinder 2,000 b. h. p. model itself is, among others, installed in German and in English series locomotives, the design has not been so well known in North America until the appearance of these

4,000 b. h. p. locomotives. Designed definitely to provide sustained high power on low weight and quick revolutions, it has certain unusual features to cater for these requirements, namely: (a) a welded-steel one-piece tunnel crankcase complete with cylinder block; (b) a short and stiff crankshaft, for which the roller main bearings are housed in the tunnel and surround the circular crankwebs, a form of construction which permits about 72 per cent of the engine length to be occupied by main and big-end bearings; (c) a fork-and-blade rod system with plain big ends of great length and rigidity, designed to permit of full fluid friction under all conditions of speed and loading; (d) a pressure-oil piston-cooling system with a large quantity of oil in circulation, applied through telescopic tubes to two-piece pistons; (e) three inlet and three exhaust valves per cylinder to give adequate breathing and exhaust capacity with low thermal and inertia stresses despite the high rating and high speed of the engine; and (f) a unit fuel pump-injector on each cylinder head.

Model MD 870 is an engine with 16 cylinders 185 mm by 200 mm and a U. I. C. rating of 2,000 b. h. p. at 1,500 r. p. m., equivalent to a brake mean pressure of 13.9 kg per sq. cm (198 lb. per sq. in.), a piston

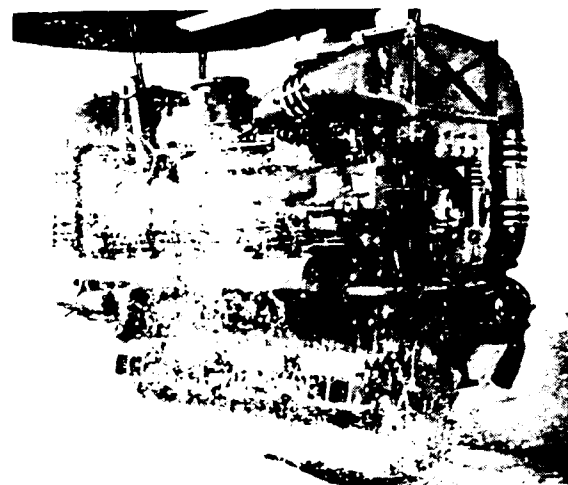


Fig. 4. Dressing designed for the use of Maybach 16-cylinder diesel engine, type MD 870, U. I. C. rating 2,000 b. h. p. at 1,500 r. p. m.

speed of 10 m. per sec. (32.8 ft. p. m.), a specific output of 23.3 b. h. p. per litre of piston-swept volume, and a dry weight of 6,875 kg. (14,900 lb.), or 3.3 kg. (7.25 lb.) per b. h. p. It is equipped with two Maybach vertical unit pressure-burgers each with its own charge-air cooler.

Engine control from the cab is by the Knorr pneumatic system, that is by air pressure working on a diaphragm in the engine governor and thereby actuating the fuel rack.

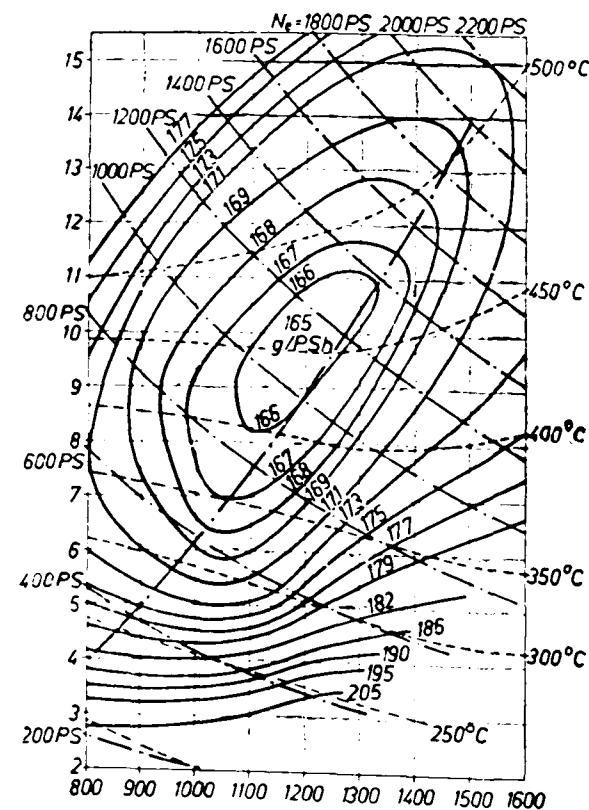


Fig. 5. Characteristic curves of intercooled Maybach MD 870 16-cylinder engine.

The fuel consumption loops given here in Fig. 8 show what a wide range of economical working is provided, and how, for the standard rating, the propeller curve—one of the most important features of matching engine and transmission in diesel-hydraulic locomotives—runs through the belt of low specific fuel consumption over the whole working range.

In these American installations some of the auxiliaries are driven off the engine and others off transmission shafts. The high-capacity three-cylinder reciprocating compressor, for example, is driven off the free end of the engine by vee-belts and further belt drives lead to the two hydrostatic pumps for the cooling fans.

From each transmission an auxiliary dynastarter is driven through a flexible coupling.

Performance of these locomotives has been well shown on extensive tests in Europe prior to shipment. For these tests standard Continental buffers have been fitted to the locomotive, but before shipment these will, of course, be replaced by the normal American centre couplers.

In the first instance one locomotive was tested in accordance with the brake locomotive testing method of the German Federal Railway, which method is being preferred by this railway for tractive effort tests because in this way inertia required for correct measuring is ensured, whereas tests conducted on graded routes will give less reliable results owing to the frequently changing resistance of the line. The route from Munster to Emden in the North German plains is particularly suitable for such tests as it has but slight differences of level and a few curves only. In view of the hydro-dynamic brake of the new locomotive type the tractive efforts were checked when running in the direction to Emden, while braking forces were measured when running in the direction to Munster with the steam locomotives employed being used as brake locomotives or as haulage units, respectively.

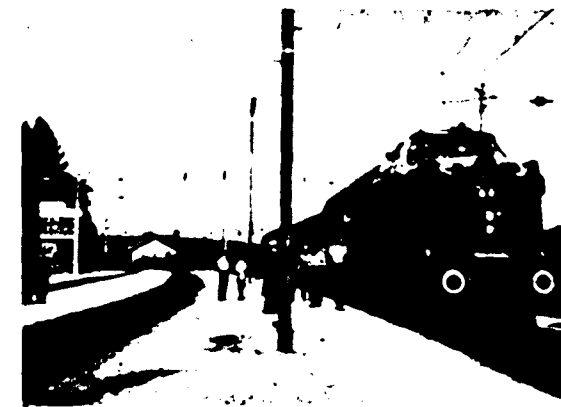


Fig. 6. 4,000 b. h. p. diesel locomotive, type ME 4000, equipped with 2 Maybach MD 870 engines, with dynamometer car and total trailing load of 879 tonnes (84 axes) on the Southern incline of the Semmering line.

These test runs were made in March and April 1961, for speeds up to 80 km. p. h. (50 m. p. h.) two steam locomotives of the most powerful German class 45 were used, but for speeds over 80 km. p. h. (50 m. p. h.) two steam locomotives of class 18 were selected. The test train was made up of the 4,000 b. h. p. locomotive, the dynamometer car, two equipment wagons and the two braking

locomotives. The following conditions were tested: tractive effort, track speed, fuel consumption, engine speed, inlet and outlet temperatures of cooling water, lubricating oil and air as well as oil pressure in the hydraulic system of fans. At the same time all parts were subjected to a function test, while the



Fig. 7. 4,000 b. h. p. locomotive with 860 tonnes trailing load after arriving at the highest point of the 18-mile long Northern incline of the Semmering line having a maximum gradient of 2.823 per cent (1 in 39.7).

dynamic brake forming part of the hydraulic transmission was adjusted according to the results obtained.

These tests showed a high degree of similarity between measured and projected tractive-effort values and they clearly demonstrated the efficiency of this 4,000 b. h. p. locomotive. The smooth running condition of the engine over the entire speed range and the low noise level in the driver's cab were laudably mentioned. The hydro-dynamic brake of the diesel locomotive proved to be sufficiently powerful to prevent acceleration by the steam locomotives beyond a speed of km. p. h. (18.6 m. p. h.).

After termination of these test runs the locomotive was again transferred to Southern Germany and a further locomotive was then subjected to road tests there and in Austria, especially on long curved up and down gradients of 2.8 per cent (1 in 40), with a dynamometer car again being used to do the measuring and recording.

Between the 3rd and 7th July, the locomotive was tested in the presence of senior officials of the above mentioned American railroads and of prominent representatives from European railways, on the Austrian main line connecting Vienna with Italy,

including the well-known Semmering incline where the trains have to be taken up to an altitude of 980 m (2,950 ft.) by means of a long 2.5 per cent gradient with constant reverse curves of 189 to 300 m radius. Each day a scheduled freight train of 850 tonnes average weight (940 short tons) was hauled from Wiener Neustadt to Marzschling and a corresponding one, weighing 891 tonnes (980 short tons) on an average, back again. In consideration of the permanent way the O.B.B. had imposed a speed limit of 45 km p.h. (28 m.p.h.). On the steepest sections with gradients of 2.5 to 2.52 per cent combined with curves of less than 300 m radius a balancing speed of 29 km p.h. (18 m.p.h.) was maintained.



Fig. 8. Map and gradient profile of the Semmering line, one of the severest mountain railways in Europe.

On various occasions, the train was brought to a halt and restarted on up-grades. For example, on the severest gradient of 2.5 to 2.52 per cent, which with curves taken into account offers a track resistance of about 2.7 per cent, a start was made from standstill with a trailing load of 867 tonnes (958 short tons). At a draw-bar pull of 36.3 tonnes (80,000 lb.), the train began slowly to move without jerks at notch 10 and was accelerated up to balancing speed by gradually moving the power control handle up to full load notch 15. The limitation of the train load to 875 tonnes (962 short tons) (Northern incline) and to 935 tonnes (1030 short tons) (Southern incline) was necessary mainly on account of European coupler strength, but also to comply with signal sections and the length of the sidings.

It was a point of interest for the representatives from European railway companies to note that the single-unit diesel-hydraulic locomotive was capable of hauling trains which on the recently electrified Semmering line are regularly hauled by two electric locomotives of 6- and 4-axle arrangement with a ones-

hour rating of 5,100 to 3,200 h.p., making a total of 8,300 h.p. in total. These locomotives allowed to maintain a higher track speed.

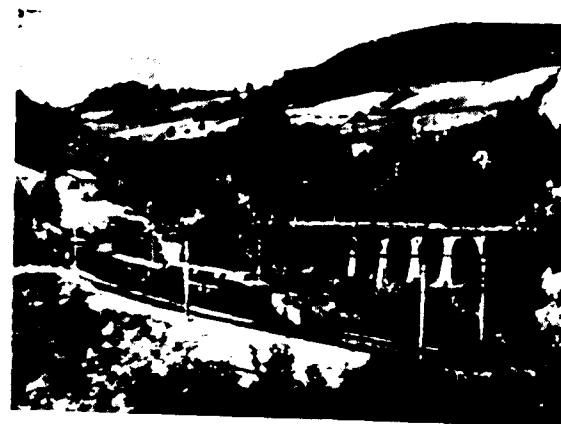


Fig. 9. Photograph of the diesel-hydraulic 4,000 h.p. locomotive ML 4000 on the Semmering line, hauling an 850-tonne freight train (75 axes) of a gross 500 m in length. The photograph shows the train in the reverse loop known as "Killer Ring". The last goods wagons are still in the Pöchlarn and tunnel.



Fig. 10. The scenery of the Southern Pacific and Denver & Rio Grande Western railroads, where the descent of the 4,000 h.p. locomotives, type ML 4000, was worked.

On the descents the dynamic brake was applied in the speed range below 45 km p.h. (28 m.p.h.), this being in conformity with the speed limit imposed by the O.B.B. However, within this range it was possible to control the whole train down the entire gradient, using the dynamic brake at a steady speed of about 35 km/h. Only where speed was restricted to 20 or 10 km p.h. (12.5 or 6.2 m.p.h.) was it necessary to apply the air brake as well. The heat produced by the braking was evacuated in the heat exchangers and by the radiators while the engines were operated at a slightly increased idling speed with a view to maintaining the drive for the fans.

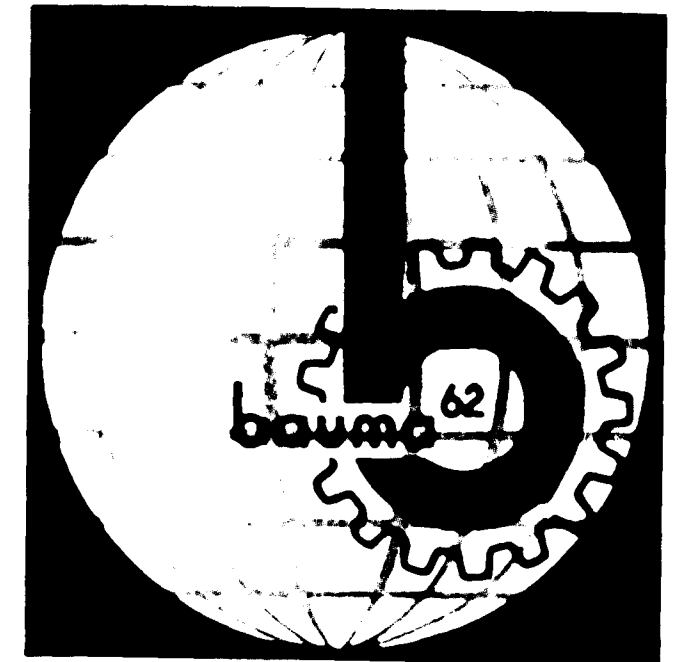
Mid-summer temperatures were experienced during these test runs, rising on some days to as much as 32°C (90°F) in the afternoon, more especially in the morning.

After the last test runs have been done, all six locomotives will be shipped to Houston, U.S.A., and then transferred under their own power to their depots in California and Colorado respectively.

The Southern Pacific Company, one of the largest class I systems in the U.S.A., with an average of 66, was for many centuries and is to remain one of the almost exclusive users of single-unit diesel locomotives. In day-to-day diesel use, its system runs from California and spreads eastward through the States Nevada, into Nevada and southward into Oregon. The system is also characterized by its long haulage along the Mexican frontier to El Paso. Its chief feature is by the 4,000 miles long network of a sub-system, the party, the Texas and New Orleans Route, 1,000 miles which stretches to Houston, Texas, to the Gulf of Mexico, and even to New Orleans, Louisiana, from California. It is on part of these routes that the three 4,000 h.p. European locomotives are to work, though they are first to be tried out on a 50-mile rise at gradients of 1.8 to 2.5 per cent with 11-degree curves on the Rocky Mountains section of the transcontinental line from San Francisco and Oakland to Ogden, Utah, rising to an altitude of 7,030 ft. (2,140 m).

The Denver & Rio Grande Western Railroad, a 212.8-mile system, lying entirely above 3,000 ft. (912.50 m) and rising to summits as high as 10,700 ft. (3,190 m). To reach these heights, the main transcontinental section, Denver — Montezuma — Dotsero — Salt Lake City — Ogden — has a long gradient of 1 in 50 (2 per cent) combined with 11-degree curves, while the order is, climbing up to the main route, westward from Denver, known as the Tennessee Pass line, has 13 miles of 1 in 33 (3 per cent) gradients combined with 8.2-degree curves. It is on these two routes that the three 4,000 h.p. locomotives are to be used, in heavy, diesel-hydraulic service and will often be operated in multiple unit to give up to 12,000 h.p. at U.C. ratio 2 at the head of the train.

Apart from the specific duties for which these locomotives are intended, they will also be of general interest for a high proportion of all trains in the U.S.A. is hauled by two or more locomotives, so that the use of single high-powered units should result in remarkable savings in service and maintenance.



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September 10th to 24th, 1961

CZECHOSLOVAK TRADE COMMISSIONER'S PRESS CONFERENCE

ADDRESSING the Bombay Press, the Acting Trade Commissioner of the Czechoslovak Socialist Republic in Bombay Mr. J. Roskot, gave an account of the forthcoming Third International Trade Fair in Brno, Czechoslovakia, its characteristic feature and also the results achieved in the two previous meets. "Specialisation in Engineering fully in accordance with the requirements of Czechoslovak economy and foreign trade" was the main feature of the Fair, Mr. Roskot stressed.

He added "the exhibits comprising the maximum range of products include engineering, power engineering, transport equipment, light-current and heavy-current electrical engineering as well as other branches closely allied to engineering and metallurgical production".

The following is the text of his address:—

"I am very happy to welcome you all at this conference both on behalf of the Management of the Brno Trade Fairs and the Trade Representation of the Czechoslovak Socialist Republic in Bombay. The object of this meeting, as you are aware, is to give you some first-hand information about the Third International Trade Fair to be held at Brno from 10th till the 24th September, this year.

Before going into details, you will, perhaps, allow me to tell you in just a few words the characteristic feature of the Brno Trade Fairs and the results achieved at the two previous meets. Specialisation in engineering, fully in accordance with the requirements of Czechoslovak economy and foreign trade, has become essentially the main characteristic feature of the Trade Fair. Consequently, the aim of this Third International Trade Fair at Brno, which, incidentally, is carrying on the tradition of the Prague Sample Fairs and the Brno Engineering Exhibitions of the past, is to demonstrate to the world the rapid growth and high standard of Czechoslovak engineering industry, to



Mr. J. ROSKOT

foster international trade, to deepen and promote existing business relations, to achieve economic cooperation on a large scale and to encourage the exchange of goods between individual countries.

Considering the strictly specialised nature of the Brno Trade Fair, the exhibits will be arranged according to the respective branches. The exhibits comprising the maximum range of products include engineering, power engineering, transport equipment, light-current and heavy-current electrical engineering as well as other branches closely allied to engineering and metallurgical production. As in previous exhibitions, machine tools of all kinds continue to be the dominant feature of the Trade Fair.

Apart from Czechoslovak Foreign Trade Corporations about 500 foreign exhibitors from thirty different countries participated in the first and second Trade Fairs. Among the exhibitors were represented the most prominent and best known firms from Europe and overseas, displaying approx. 7,500 exhibits characterised by high technical standard. In spite of the specialised nature of the Trade Fair, a number of exhibitors from economically less developed countries also took part in it.

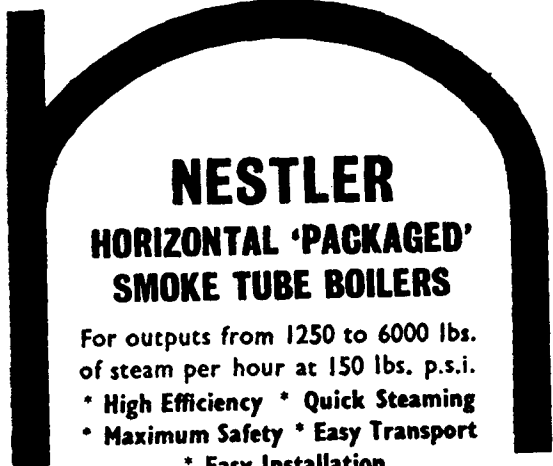
Another evidence proving the fact that the International Brno Trade Fair has won in a short time an outstanding reputation among the World Trade Fairs is the high number of visitors. 22,400 foreign guests from 68 countries visited the Trade Fair in 1960, whereas in 1959 only 13,500 visitors from 43 countries came to see the First International Trade Fair at Brno.

There is a noticeable departure in the arrangement of exhibits in this year's Trade Fair, in that unlike previous Fairs where some countries displayed collective exhibits, the exhibits in the Third International Trade Fair will be arranged exclusively according to branches. The conception of collective exhibition has been completely dropped and the respective countries participating in the Trade Fair will be separately represented in the "Pavilion of Nations". Among the European and overseas countries who have announced their participation in the 'Pavilion of Nations' are Afghanistan, Argentine, Belgium, Bulgaria, Ceylon, Finland, France, Great Britain, Guinea, Indonesia, Italy, Japan, Yugoslavia, Canada,

Cuba, Lebanon, Hungary, the G. D. R., the German Federal Republic, Norway, Poland, Austria, Roumania, The U. A. R., the Soviet Union, Spain and Switzerland. Negotiations with several other countries concerning their participation in the 'Pavilion of Nations' are in progress.

According to nomenclature a vast range of products belonging to the same branch and displayed by a great number of exhibitors will be concentrated in 12 pavilions. This will give the visitors a unique opportunity to get acquainted with the exhibits belonging to the same branch, appraise them and compare the individual products from various technical aspects.

As on previous occasions, the Czechoslovak Scientific and Technical Society will again hold four International Scientific and Technical Symposia and a number of Specialists' Days concerning the exhibited branches during the forthcoming Trade Fair. The attention of the Symposia will again be directed to—



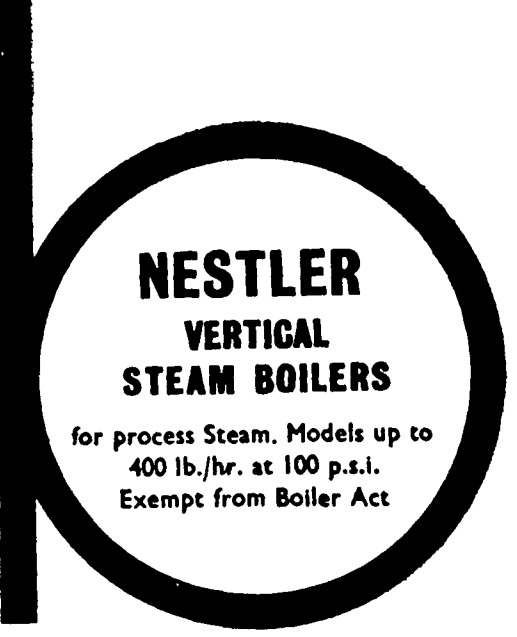
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wards the solving of some of the problems which still continue to puzzle scientists all over the world.

The Fair will be open to the public daily from 9 a. m. to 6 p. m. except on Wednesdays, which are reserved exclusively for technical experts, businessmen and other interested parties from Czechoslovakia and abroad. The number of visitors to be admitted on these exclusive days will be limited to 40,000. Visitors on other days are estimated to be about twice that number.

In case of need, all foreign visitors will be given free medical treatment. Health service in Czechoslovakia ranks among the most advanced in the world since medical care, including both prevention and hospitalisation, is rendered to all citizens of Czechoslovakia free of charge. This principle is also applied to all foreign visitors to Czechoslovakia, including those coming to see the Trade Fair.

Gentlemen, what I have mentioned now are but only a few principal points. Before I finish though, let me say a few words about the participation of countries and firms in this year's Trade Fair. More than 500 exhibitors from 35 countries will participate in this year's Trade Fair, and the great interest shown in it by one and all demonstrates that Brno will again become an important and busy meeting place of representatives of trade and industry.

The Soviet Union, the People's Republic of Poland and the German Democratic Republic will be among the countries participating with the largest number of exhibits, while other countries of the socialist camp,

Hungary, Bulgaria and Roumania will also have a significant share in this year's Trade Fair.

Among the other countries participating with the largest number of exhibits will be great Britain, Switzerland, Austria, the German Federal Republic, Italy, Sweden, Belgium, France, Denmark, the Netherlands and Liechtenstein. USA and Japan are among some of the exhibitors from overseas.

As in previous years, most of Czechoslovakia's Foreign Trade Corporations will again participate in this year's Trade Fair. They will exhibit a number of products based on most up-to-date technology produced by many factories. The largest exhibitions will be organised by STROJIMPORT, STROJEXPORT, TECHNOEXPORT, MOTOKOV and KOVO. Other Czechoslovak Foreign Trade Corporations such as OMNIPOL, METALIMEX, PRAGOEXPORT, FERROMET, CHEMAPOL, CZECHOSLOVAK CERAMICS, GLASSEXPOT, CENTROTEX, OMNIA and UNICOOP will have smaller but none the less interesting exhibits.

Further information concerning the exhibition programme of the respective corporation will be found in the printed material which will be distributed amongst you now.

Gentlemen, I wish to thank you on behalf of the Management of the Brno Trade Fairs, the Trade Representation of the Czechoslovak Socialist Republic in Bombay and on my own behalf for accepting our invitation to this Press Conference and for giving me your attention during this brief talk.

Indian Engineers Discuss Mining Problems in Britain

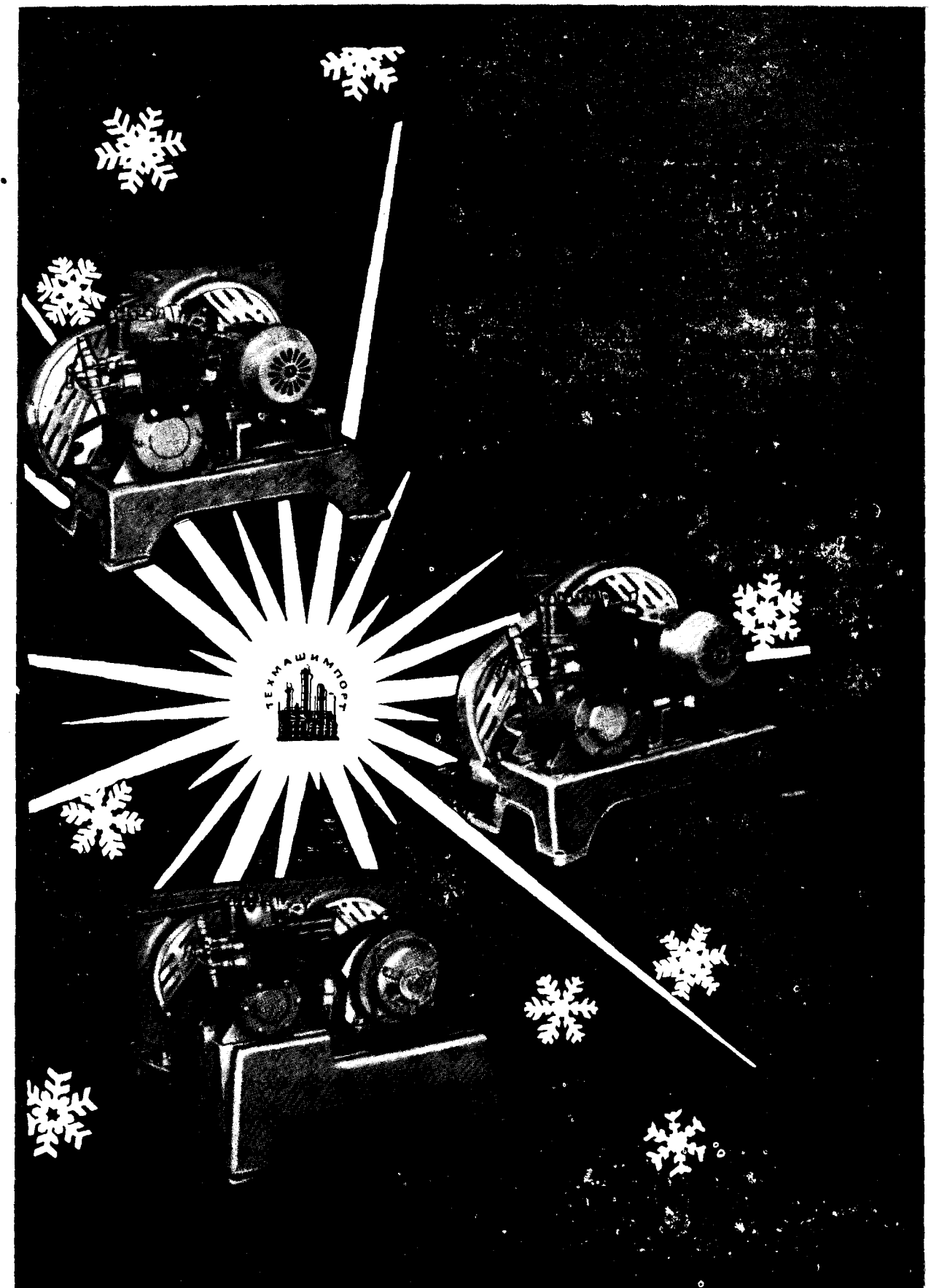
Four Indian mining engineers have just visited the Waterside works at Ipswich, Suffolk, of Ransomes & Rapier Ltd., manufacturers of giant walking draglines, and discussed with representatives of the firm problems of open-cast mining.

They were Mr. S. P. Ahuja, a colliery manager whose home is in New Delhi; Mr. M. Vasudevan, administrator and technical head of a group of mines in Andhra Pradesh; Mr. B. G. Pradhan, administrator and technical head of a group of mines in Nasik; and Mr. M. K. V. Subbiah, an official from

Secunderabad. At the firm's works they saw the construction of draglines and a film showing the vast machinery in operation at various open-cast sites.

Before touring the factory, the Indian visitors saw a working scale model of a 1,650-ton dragline inspected by the Queen recently.

The Indian officials, who are in Britain under the Colombo Plan, left later for Newcastle, where they will see open-cast mining in operation.



Engineering Notes & News

A new portable self-contained unit which will provide automatic emergency lighting immediately on an A. C. mains failure has been introduced by a British firm. The equipment is designed for use in places where permanent emergency lighting schemes are impracticable.

The unit is housed in a sheet steel container, the battery and charger being set in separate compartments. Fitted on top is a swivel-mounted lamp which is automatically switched on by a relay should the A. C. mains supply fail. An on/off switch is mounted on the front and the unit is normally left connected to the mains supply, a small neon indicator lamp showing that the mains supply to the lamp is healthy. Normally fitted with a 36-watt bulb to give $3\frac{1}{2}$ hours' emergency light, the equipment will provide $1\frac{1}{2}$ hours stand-by lighting when two bulbs (not exceeding 60 watts in all) are used. It is suitable for A. C. mains 200/250 volts, 40/60 cycles.

The battery, designed for use on trickle charge, comprises a 12-volt assembly of two 6-volt units, each with a capacity of 12.5 Ah. at the 10 hour rate. Each battery is assembled in a three-compartment container moulded in translucent polystyrene. At average room temperature topping up is only necessary two or three times per year and maintenance is negligible. The new equipment weighs 30 lb. complete, plugs in to any power point and no special wiring is required.

* * *

The latest lightweight portable fire pumps being produced by Coventry Climax Engines Ltd., largest manufacturers of fire pumps in the Commonwealth, will be shown at the International Civil Defence Conference at Montreux, Switzerland, October 7—17.

Among the firm's exhibits will be an ultra lightweight pump which is the latest model in the Coventry Climax 'featherweight' range. It has a minimum output of 250 gallons per minute at 100 lb. pressure per sq. inch. and weighs 200 lb. fully fuelled. The firm claim that it is the smallest, lightest and most powerful pump in the world for its capacity.

Another unit will be a portable pump with an output of 500 gallons a minute at 100 lb. pressure per sq.

inch and weighs 415 lbs. fully fuelled. With a 1500 c. c. overhead camshaft power unit—similar to the famous Coventry Climax motor racing engine.

* * *

The first of a new range of battery-operated delivery trucks—they have transistorised controls which for the first time utilise battery capacity to the full without waste—has been announced in Britain.

The new method of control gives smoother operation to the two-pedal vehicles and it is now possible to "inch" a vehicle into a tight parking space.

Because of this more efficient control, the vehicles have a slightly higher speed and have a wider radius of operation. They also have a new battery recharging system. All that is required is to plug into a 13-amp. mains plug. This means that such vehicles will no longer have to return to a fixed charging station for their power-unit to be recharged. The battery can be given a booster charge from any 13-amp. mains plug within two hours, the full capacity charging time being about six hours.

In the electronic charging equipment on the vehicle the necessary voltage transformation is obtained by phase firing a silicon controlled rectifier. Transistor circuits maintain the charging current constant independent of mains fluctuations and battery voltage changes. The charge is automatically terminated as usual.

The new principle of transistorised control equipment is expected to have many additional applications in all fields of electric traction and D. C. motor control.

* * *

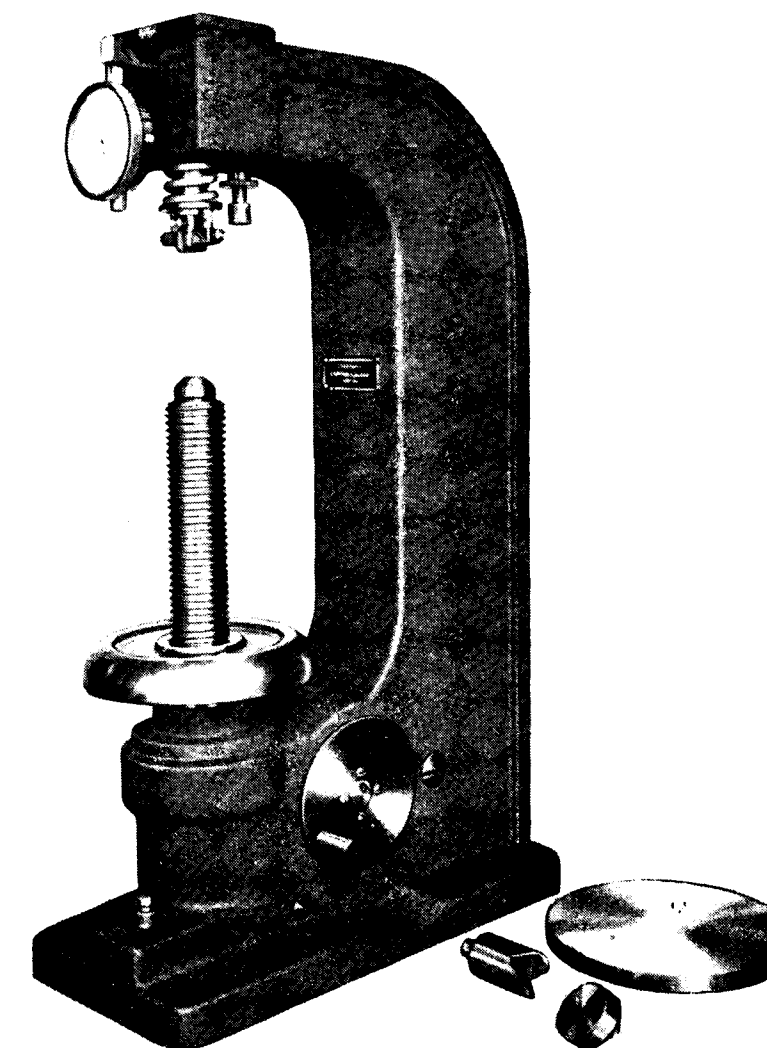
What is believed to be the largest gear unit ever manufactured in Britain has been completed at a plant in northern England. Ordered by the Davy and United Engineering Co., Ltd., of Sheffield, the gear unit will ultimately drive one of the roughing stands of the new hot strip mill now being built at Newport, Wales, for Richard Thomas and Baldwins Ltd.

The main gear wheel and shaft alone weigh 60 tons.

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This and the other double helical gears for the unit were cut by a combination of hobbing and end milling techniques. The gear wheels were supported on rollers and roughed out on an end milling machine so as to reduce the amount of heavy cutting on the large hobber.

The two reduction sets have gears with face widths of 48 and 55 inches respectively and, in order to handle the largest of these gears in the works, it was necessary to utilise two 35-ton cranes in tandem.

* * *

Since the announcement in March by Marconi's Aeronautical Division of the manufacture of two new sub-units for the AD 7092 series of airborne automatic direction finders, substantial quantity orders have been placed for the equipments by leading air-lines.

The AD 7092 series automatic direction finder was put into manufacture some 12 years ago and such was the advanced nature of its design that over 3,500 of these equipments are giving good service with airlines and air forces all over the world. The two new sub-units are on offer to improve still further the efficiency and reliability of the AD 7092 series and to prolong its life. The incorporation of modern techniques considerably reduces the weight and power consumption.

British European Airways propose to convert all their AD 7092D radio compasses to incorporate the new AC power unit, type XSA 3484. Alitalia, Austrian Airlines, the Indian Airlines Corporation, Turkish Airlines, British United Airways, and the Finnish Air Force have also placed substantial orders. Trans-Canada Airways likewise intend to replace all the existing vibrators on their AD 7092G equipments with the transistorised switching unit type XSA 3304. British United Airways, Austrian Airlines, the Indian Airlines Corporation, Cunard-Eagle Airlines, Turkish Airlines, Alitalia and the Finnish Air Force have also placed industrial orders for the two sub-units.

* * *

A transistorised data logging system capable of reading information from 100 transducers every second by a fast sequential scanning process is being developed for use at Britain's Royal Aircraft Establishment, Farnborough, to examine the behaviour of models in a high-speed wind tunnel which simulates flight conditions at very high mach numbers.

Wind tunnel tests can involve as many as 50 different transducers—strain gauges, thermocouples and so on—and these have to be scanned as rapidly

possible so that significant variations of strain, temperature and pressure, are not missed.

The system performs five basic functions: scanning, amplification, digitisation, coding and presentation. A number of scans are made during a test run, which may last for just a few seconds or as long as a minute.

* * *

A British firm has introduced a new design of switchgear equipment to control electrical power supplies at voltages approaching that of lightning. Voltages of this magnitude are becoming necessary for feeding power economically over great distances, such as exist in India, Australia, and North and South America.

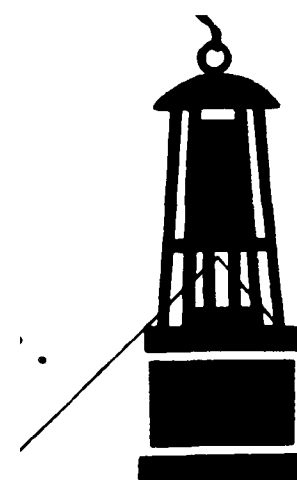
The new equipment was introduced to engineers at a conference held by the firm, English Electric, at Stafford, in the Midlands. The delegates saw multi-million-pound test machinery which has been installed to prove the reliability of the switchgear before it goes into service. This machinery also ensures that the gear can deal swiftly with faulty conditions, such as short circuits caused by birds or falling trees, which could impose on the equipment voltage surges of up to 1,500,000, volts, comparable to the full power of a lightning flash. The capacity of the test equipment has recently been doubled to prove very-high-duty switchgear, worth £1,500,000, ordered for Britain's new 400,000-volt Grid system.

MAIN PROBLEM

In any electricity supply system, writes an industrial correspondent, means have to be provided for switching power into and out of supply lines and for dealing quickly with faults that could cause severe damage to generating machinery if left uncorrected for a few seconds.

The main problem in switching off electrical power, particularly at the high currents and voltages common today, is to put out the electric arc that forms and keeps the current flowing even when the switch is pulled out. In high-voltage, high-power switches, the arc is normally blown out by a powerful blast of air. This is done more quickly and reliably than before in the new design by pressurizing the whole switch assembly with dry air, which ensures that the arc is not only blown out immediately but prevented from re-forming. The new equipment is compact, makes use of reliable and cheap new high-strength materials, and is built from standard components to lower costs.

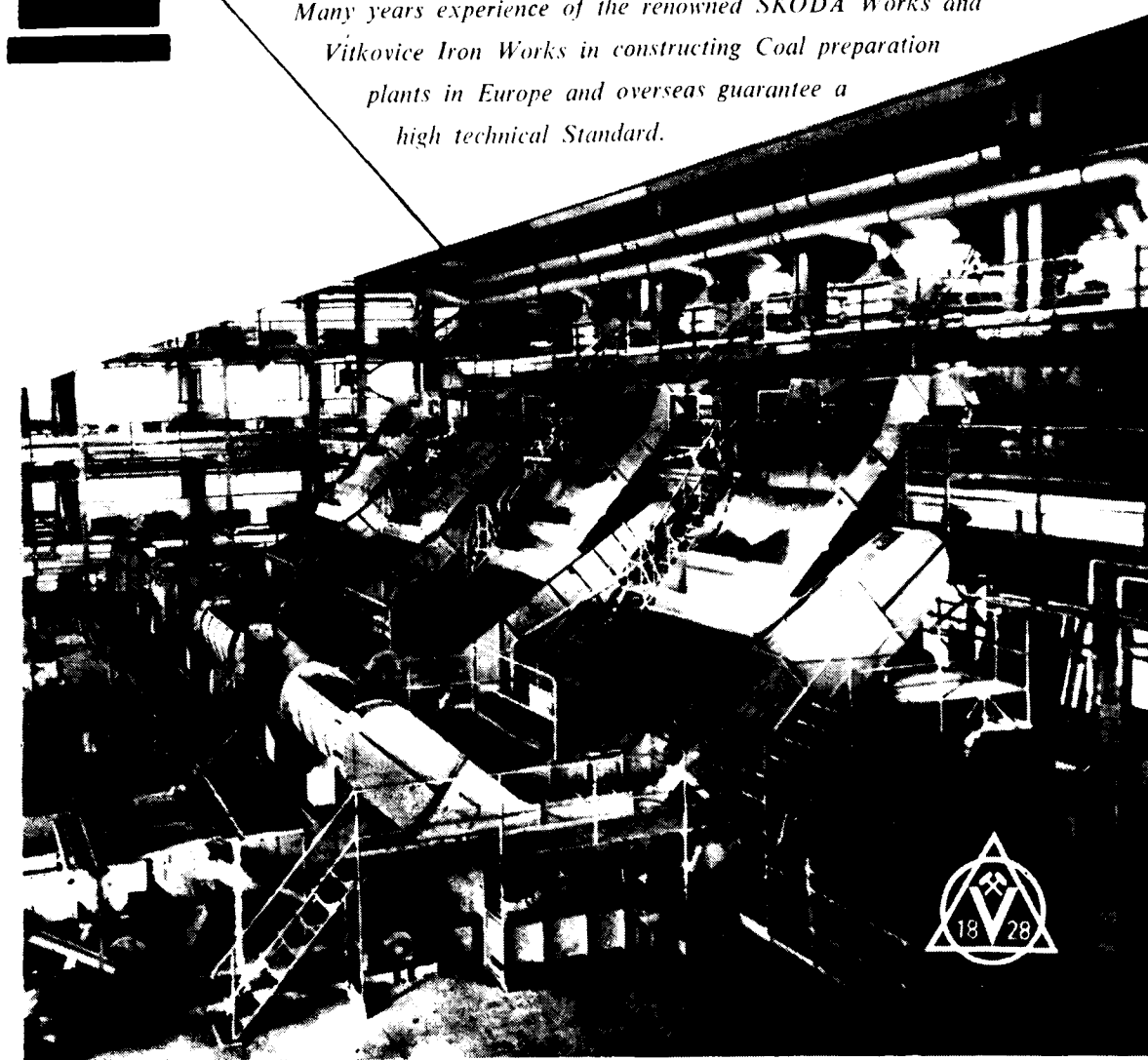
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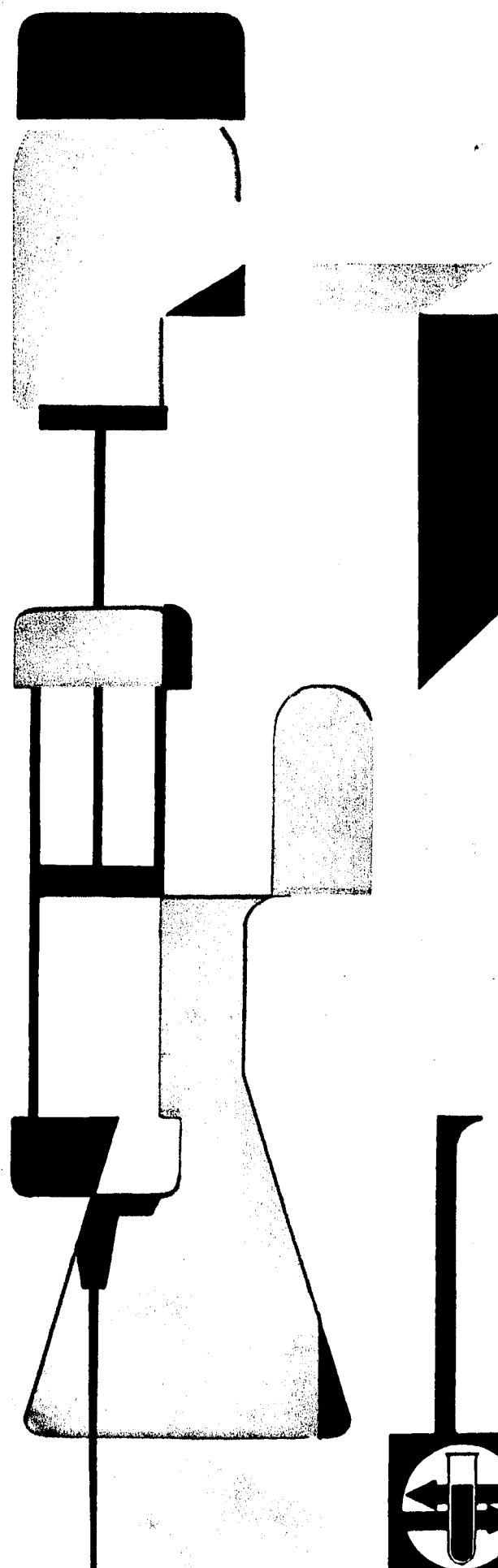
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