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JOURNAL OF INDUSTRIAL ENGINEERING

ELECTRICAL INDUSTRIES ANNUAL SUPPLEMENT

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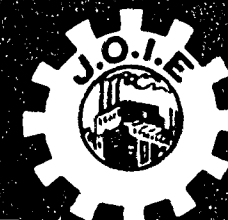


12 - 27 April 1961

MILAN TRADE FAIR

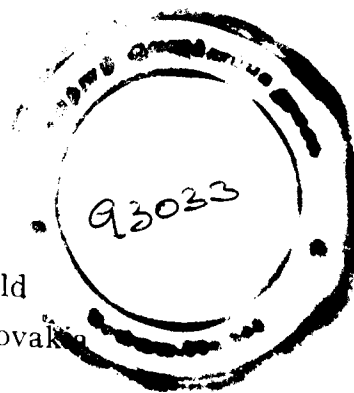
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SIXTH EUROPEAN MACHINE TOOL EXHIBITION

Paris - September 1960

THE piercing of components such as electrical and aircraft panels, which is generally slow and costly on account of the small size of the batches and frequent changes of tooling, can be performed rapidly, accurately and economically on the British Wiedemann Turret Punch Press model RA.41P, and modifications or complete changes of layout present no difficulty.

The apertures to be pierced are located from a master template by means of a high speed pantograph table and depressible stylus. The templates themselves can be made on the machine. Standard tooling is used, mounted in rotatable turrets which can be provided with 16, 18 or 20 stations and any tool set can be instantly indexed to the operating position.

Since only the stylus enters the template, and not the punches all template holes are made $\frac{1}{4}$ " (or 6 mm) diameter irrespective of the size or shape of the apertures in the finished work. The template and the work are clamped on the machine with their datum edges against fixed stops so that they are in correct relation-

the stylus is moved from one template hole to the next the work blank moves in relation to the punch. As soon as the stylus enters a hole in the template and is fully depressed, the press operates.

Coloured lines are painted on the template to link all similar apertures in the work and by following these routes the number of turret and work movements is reduced to a minimum. Similarly coloured tabs on the turret indicate when the appropriate punch is in the operating position.

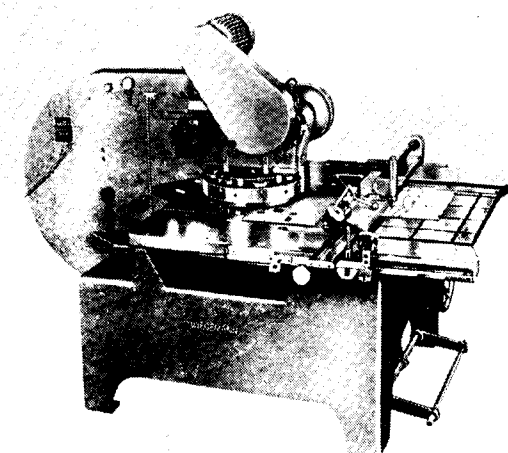
Rotation of the turrets is synchronised to ensure precise alignment of the tool set which is positively located in the operating position. An interlock prevents accidental operation of the press between stations. Tools for louvres, transformer and instrument cut-outs countersinks, knock-outs for conduits, as well as combination corner cropping tools and plunge tools, in addition to a range of circular tools and regular shapes can be mounted in the same turret and are readily interchangeable.

A typical example of the speed with which work can be produced on this machine is the piercing of a 1.6 mm. thick mild steel chassis with a total of 68 apertures varying from 3.18 mm. to 34.93 mm. in diameter as well as slots, the largest of which is 120 mm. $\times$ 72 mm, in a total floor-to-floor time of 4 min. 7½ sec.

The punching pressure capacity of 13,600 Kg. permits apertures up to 76 mm. diameter to be pierced in 1.9 mm. 50 mm. diameter in 3.175 mm, and 30.16 mm. in 4.75 mm. thick mild steel plate. The press which has a throat depth of 28" is driven by a 1 H.P. motor. Alternative table sizes, 24" $\times$ 24" or 40" $\times$ 28", are available.

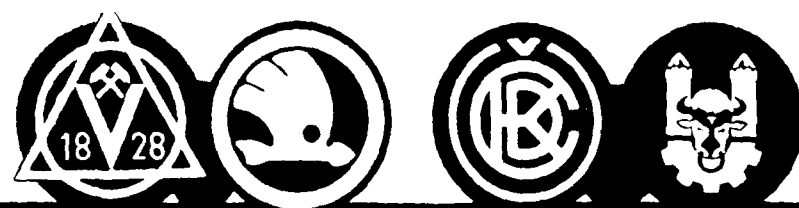
The DOWDING Universal Hobbing Machine model V.8 has been developed for rapid production of the more accurate gears up to 8" (203 mm.) diameter, 7" face width (175 mm.) and 12 D.P. (2 module). The machine has an indexing range from 6 to 400 teeth, including most prime numbers.

Spur gears, spirals up to 60° either right or left-hand,



British Wiedemann Turret Punch Press Model RA. 41P with pantograph table & stylus for rapid piercing.

ship, the template being clamped to the surface of the stationary table and the work blank to a pantograph carrier which can be moved in relation to the punch centre-line by means of the stylus handle. As

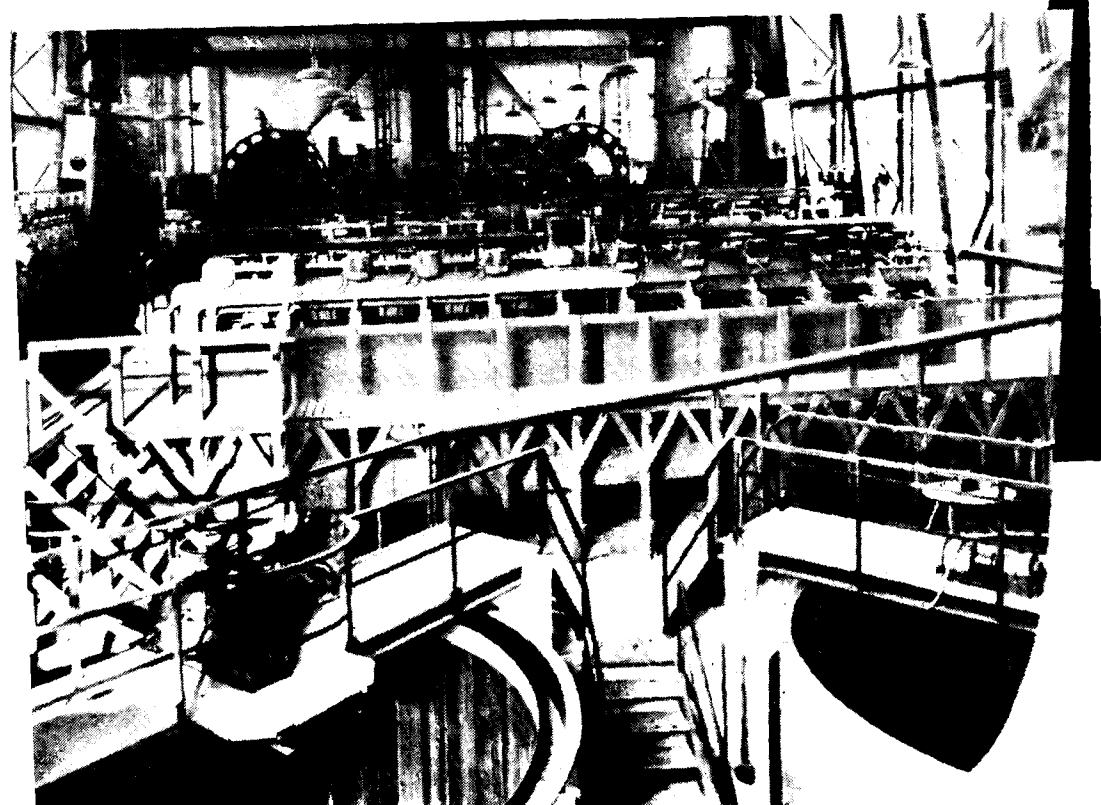


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EDITORIAL NOTICE

Technical Contributions

189

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Articles should be elaborate supported by illustrations, wherever available, and should be of a high order. Only original photograph prints should be sent and drawings should be on drawing paper or cloth in India ink. Ferroprints are not accepted.

Summary of technical papers read before professional Institutions or at meetings of Engineers are also accepted if they are of sufficient interest to the Industrial Engineers.

All contributions intended for publication in any particular issue should reach the Managing Editor 30 days prior to the scheduled date of publication. Publishers reserve the copyright of contributions published in the Journal and reproduction thereof either in full or in part will be permitted only with the previous consent of the Editor.

Manuscripts should be typewritten, double spaced, on one side of the paper only with sufficient margin on either side, with sheets numbered in order. The name of the author and his full address should appear on the first sheet of the writeup.

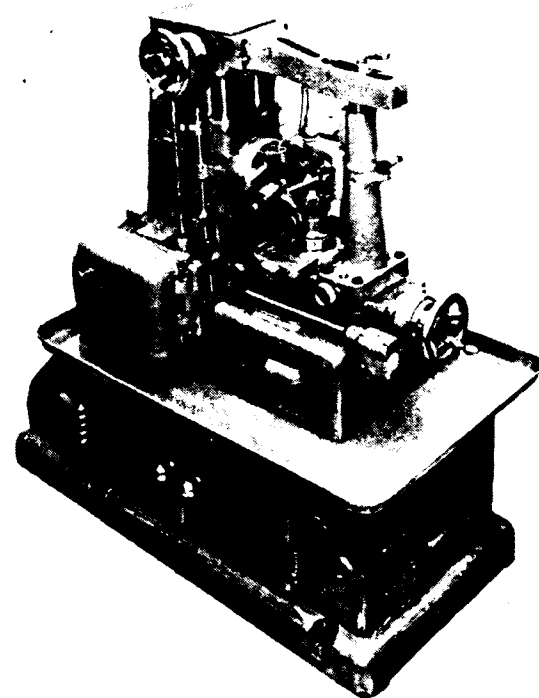
Unused manuscripts will not be returned unless return postage is paid. Accepted manuscripts are not returned and all photos, illustrations, drawings etc., will be retained by the Editor after publication unless there be special reasons or request for their return to the author.

Manufacturers of plants and equipments can send in writeups from their Technical Staff or Chief Engineer about any new technical features, developments, research notes and news having a bearing on their manufactures and which would be of sufficient interest to the Industries.

The Managing Editor reserves the right to delete, amend, or add any paragraph/paragraphs to the contributions.

Accepted original contributions would be paid for at our rates, if desired

chain and film sprockets, wormwheels and worms can all be produced at high rates and an exceedingly high standard of accuracy achieved. The machine is fully universal, with built-in differential gearing ensuring



Dowding Universal Hobbing Machine Model V.8 for more accurate gears up to 8" (203 mm.) dia. 7" (178 mm.) face width. 12 DP (2 module).

maximum lead accuracy and permitting the feed and indexing to be changed without affecting the set-up for the lead. The differential also permits the return of the hob head for a second cut without losing pitch position. Either climb or orthodox hobbing methods can be used.

Cam operated plunge feed is available providing rapid automatic plunge feed with fast approach and automatic return of the table for work loading. It also permits precise control of the depth of cut on repetition production of wormwheels and spurs of narrow face width. For wormwheels of high spiral angle a tangential feed hob head is available which is interchangeable with the standard radial feed hob head. An air-operated tailstock is also available for rapid loading and unloading.

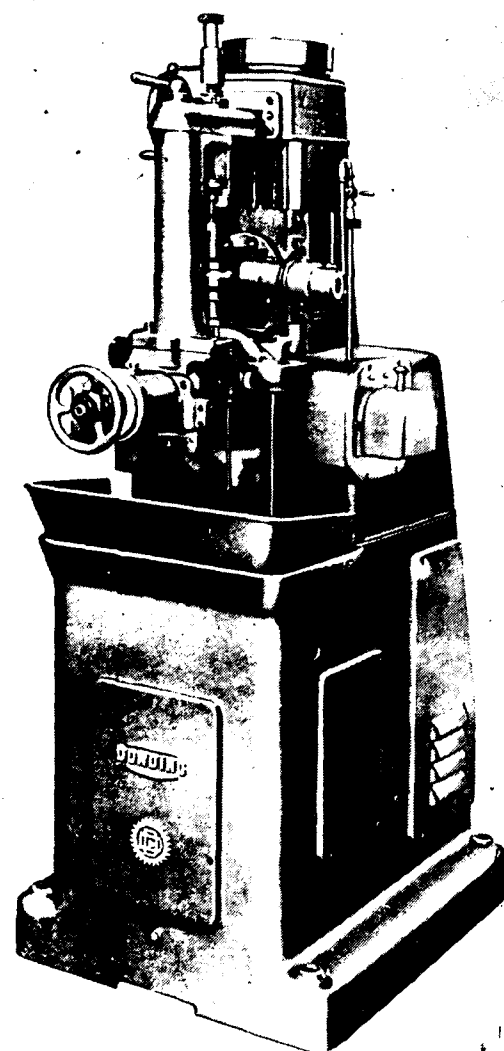
Ten hob speeds can be obtained by means of readily accessible pick-off gears which are kept constantly

lubricated and feeds of .008" (.2 mm.) to .120" (3 mm.) can be selected.

The machine is exceedingly rigid, easy to operate, accessible and the controls are well grouped.

The DOWDING Universal Hobbing Machine, model V.4 has been developed for production of the smaller gears such as those used in the clock, meter, instrument, and light engineering industries. It is a rigid machine capable of fast, accurate production.

With built-in differential gearing the V.4 is fully Universal and exceedingly versatile. In addition to spur gears up to 4" (101 mm.) diameter, 4" (101 mm) face width and 20 D.P. (1.25 module), spirals up to



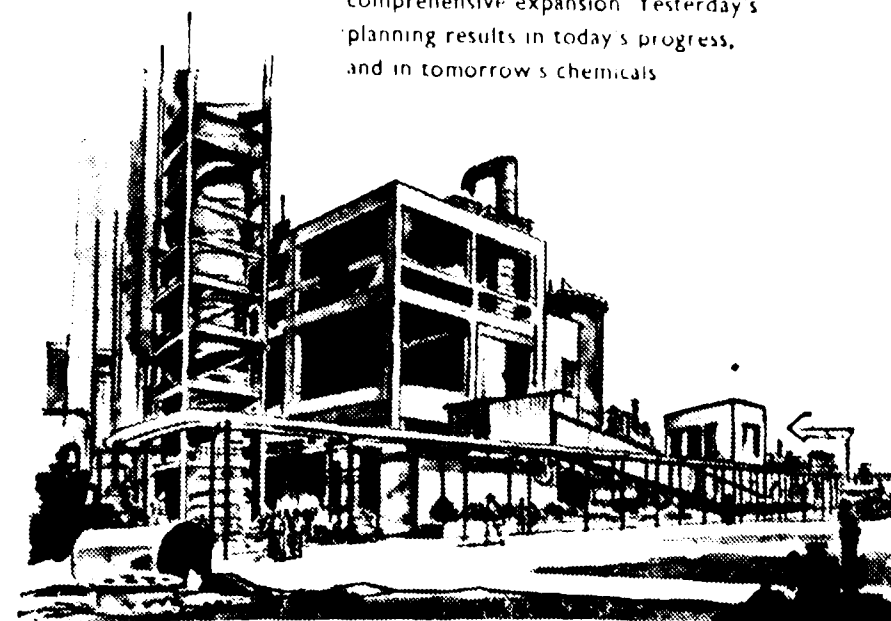
Dowding Universal Hobbing Machine Model V.4 for the smaller gears up to 4" (101 mm) dia. x 4" (101 mm) face width. 20 DP (1.25 module).

Another step forward

With the inauguration of their new Steam Tube Drier, the largest of its kind in India and designed to handle 300 tons of Soda Ash per day, Tata Chemicals have taken another major step forward in their plans to expand the production of Soda Ash.

The entire task of erecting and commissioning this equipment, as well as of the design, engineering and putting into operation of other important new units of the plant like the Brine Refinery and the Ammonia Still, has been entrusted to Tata technicians who are turning blueprints into reality.

As India's Five Year Plans strive to raise our standard of living, Tata Chemicals make their contribution through comprehensive expansion. Yesterday's planning results in today's progress, and in tomorrow's chemicals.



TATA CHEMICALS LIMITED
Bombay House, Fort, Bombay.

60° both right and left-hand, film sprockets and worm-wheels can be produced and any number of teeth between 6 and 400 can be generated. The machine is easy to set-up and simple to operate. An engraved scale on the hob head enables the head to be quickly and accurately set to the required angle and a device is provided for centring the hob which can be adjusted axially. A large diameter graduated ring on the plunge feed handwheel permits the depth of cut to be quickly and accurately set. Safety limit stops are provided to obviate accidental overrun.

Cam operated plunge feed can be fitted and provides automatic plunge feed with fast approach and automatic return of the work table for loading and unloading. This attachment permits precise control of the depth of cut for repetition production of wormwheels and spurs of narrow face width. A tangential feed hob head, additional equipment is readily interchangeable with the standard radial feed head for wormwheels of high spiral angle. A bayonet-operated tailstock is provided for rapid loading.

There are 4 hob spindle speeds from 180 to 510 r.p.m. and feeds from .010" to .10" (.25 mm to 2.5 mm) can be obtained. The machine is driven by a 1 H. P. motor and there is a separately motorised coolant pump.

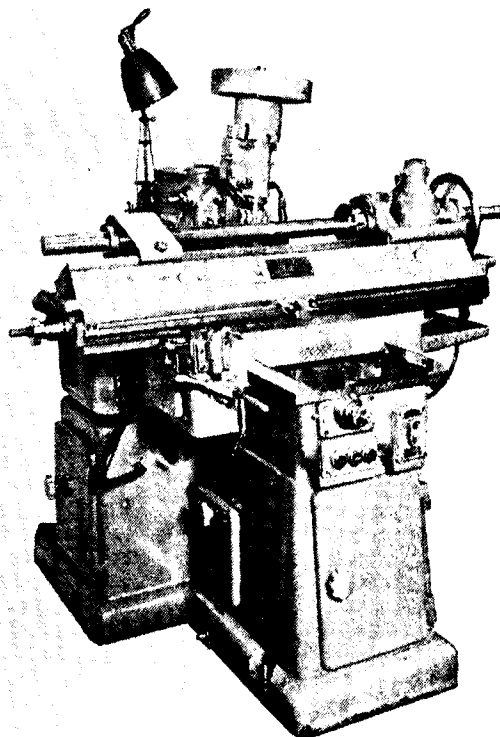
The DOWDING Horizontal Universal Hobbing Machine, model H.7 has been developed especially for the rapid, accurate production of long splines—parallel or taper—gears integral with long shafts, and high angle spirals. The machine is powerful and rigid.

Spur or helical gears up to 7" (178 mm.) diameter and 8 D. P. (3.25 module) with any number of teeth from 4 to 75 can be generated, maximum hobbing length being 19" (483 mm.). Shafts up to 24" (610 mm.) in length can be mounted between centres and up to 3" (76 mm.) diameter will pass through the work-spindle bore.

The machine is fully universal, with built-in differential gearing to ensure maximum lead accuracy and to allow feed and indexing gears to be changed without affecting the lead, so that when cutting mating gears with different numbers of teeth they can be generated with exactly the same lead.

A knee saddle and former can be fitted for taper hobbing and the attachment, which can be readily disconnected for normal hobbing, also permits gears

to be hobbled in between bearings, cams, or shoulders. Optional equipment includes heavy duty or high spiral angle hob heads.



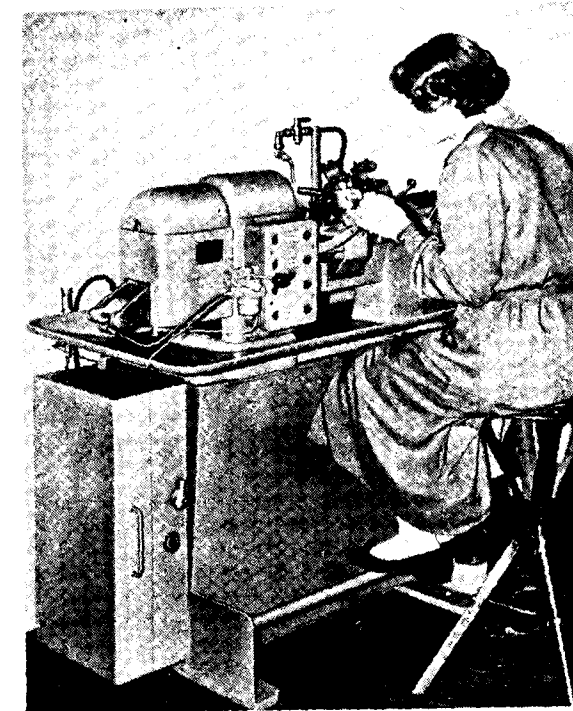
Dowding Horizontal Universal Hobbing Machine model H.7 for long splines and gears on long shafts and taper hobbing. 7" (178 mm) dia. 8 DP (3.25 module) hobbing length 19" (483 mm) spindle bored 3" (76 mm).

The H.7 is provided with 6 hobbing speeds from 69 to 196 r.p.m. changed by means of pick-off gears which are readily accessible and constantly lubricated whenever the machines are running. Feed rates are variable from .003" to .120" (.08 to 3 mm.). The machine is driven by a 3 H. P. motor, an auxiliary motor driving the coolant pump.

The new model Accuratool Capstan and Second Operation Lathes are provided with finger tip control and are designed for operation in the seated position. With the new method of control the motions performed by the operator are considerably simplified and can be performed much more rapidly.

Any required spindle speed can be instantly selected from an exceedingly practical range and rapid spindle braking has also been incorporated enabling savings of 10 to 15% to be made in actual production times.

The design has been carefully studied from the standpoint of reducing operator fatigue to a minimum. Ample leg room is provided and a full length rail can



Accuratool Capstan and Second Operation Lathe with Finger Tip Control for seated operator.

be used as a foot rest. The machine itself has been moved forward on its base to bring all controls nearer to the operator who, thus seated, can work continuously without fatigue, so ensuring a more constant flow of work from the machine.

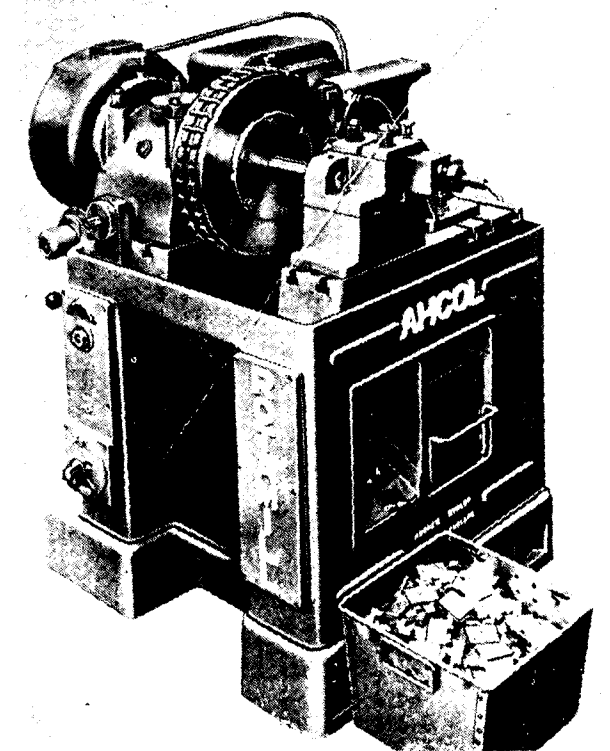
The machine is rendered exceedingly versatile by the extensive range of equipment available. Besides enabling the user to select only the equipment necessary for his own needs, this also permits the same basic machine to serve both as Capstan Lathe and Second Operation Lathe according to the equipment selected. Alternative head stocks can be provided for $\frac{5}{8}$ " or $1\frac{1}{2}$ " (16 or 21 mm.) bar capacity but with either headstock work up to 3" (76 mm.) diameter can be accommodated.

The machine can be provided with an air operated collet, if required, which can be used in conjunction with an air operated swing stop. The turret slide is optional equipment, the star wheel being light and well balanced. An air-hydraulic operated turret slide is available for precise boring and turning operations. There is also a drilling and boring tailstock which is

interchangeable with the turret slide. A lever operated compound slide provides a simple arrangement for many second operation jobs, and since it can be swivelled to 45-deg. it is especially useful for taper turning. Further additional equipment includes a lead screw operated cross slide and a thread chasing attachment for large diameter work. The machine can be fitted with an air operated spindle brake if required.

The Accuratool is a precision machine, rigidly constructed so that close tolerances can be held while maintenance costs remain exceedingly low. The machine is supported on a strong fabricated steel base in which are housed the motor and multi-plate clutch unit. Coolant is delivered by a self-contained pump from a reservoir that can be quickly removed for cleaning. If required, a compressor unit can be fitted for operating Puckert Bar Feed.

The Accuratool has a centre height of 4" (101.6 mm.), the spindle being bored either $21/32$ " or $27/32$ " (16.7 or 21.5 mm). The effective length of bed is $24\frac{3}{4}$ " (610 mm.). Either 8 spindle speeds from 75 to 3000 r.p.m. or 16 from 39 to 3000 r.p.m. are available as standard, but a number of alternative speeds can be provided and for certain simple applications the gearbox can be dispensed with.



Ahcol Rotamill semi-automatic rotary milling machine.

The AHCOL ROTAMILL semi-automatic Rotary Milling Machine has been developed for rapid continuous milling of simple jobs such as the production of slots, flats, faces, etc.

The machine is easy to operate and the tooling very simple. The parts to be milled are inserted into simple fixtures spaced round a continuously rotating work drum, clamping and unclamping being performed automatically where practically as the components enter and leave the cutting zone. Alternatively, parts that are awkwardly shaped and difficult to hold, can be clamped and in simple fixtures mounted on the face plate and the machine can be set to provide normal feeds while cutting with fast traverse between stations—a method which can also be used for small batches. In both cases milling proceeds while the

parts are being loaded, and the milling process continues uninterrupted.

The machine is exceptionally rigid. The spindle is integral with the face plate and machined from Meehanite. The standard work drum is 12" (305 mm.) in diameter. Cutters up to 6" (152 mm.) in diameter can be used and can be ganged up to 6" (152 mm.) in width, endwise adjustment being provided. The work spindle can be moved towards or away from the cutter spindle and a graduated collar on the leadscrew indicates increments of .001" (or 0.02 mm.). Four cutter spindle speeds 132, 211, 330 and 528 r.p.m. are provided. The standard machine is normally supplied with a 5 H.P. motor, but either 7½ or 10 H.P. motors can be fitted to increase its capacity for metal removal.

THE FRENCH MACHINE-TOOL INDUSTRY

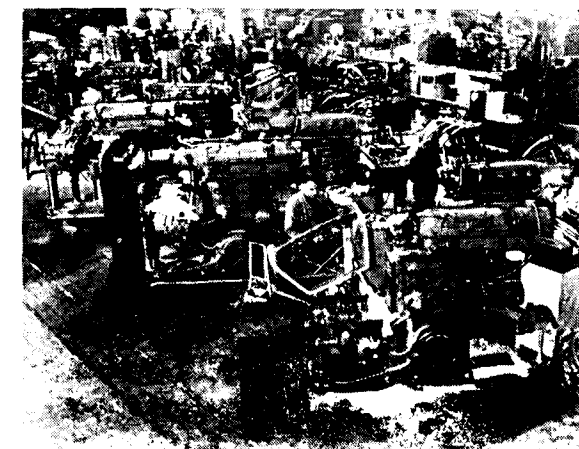
DURING a recent business trip to France and after visiting the plants of several machine-tool builders, important foreign industrialists expressed their conviction that the applications of automation in France, as witnessed by the shops of a large automobile manufacturer, were ahead of anything they had seen so far either in Europe or the United States. This conviction exactly reflects the opinion of many foreign and native technicians who have been able to see and appreciate these installations which presently appear to constitute the most advanced example of automation in assembly-line machining operations existing today.

Here is a line of special machine-tools and transfer machines nearly 1½ miles long which provides—practically without break in continuity—for the complete machining of components of an automobile engine at a rate of 1,400 engines per day. Entirely designed and built in France, this installation marks a high point for the French machine-tool industry in the constant pursuit of progress on which it has been engaged since the building of the machine-tools was started in France at the beginning of the 19th century.

Although England is universally recognized as the cradle of the machine-tool industry and although such shops were not created in France until several decades later, it is nevertheless a fact that a number of French inventors have been pathfinders in this field even for such relatively basic equipment as the planer and the lathe. France then can justifiably claim a long tradition of experience and accomplishment in this field where many other nations are now attempting to create or develop a machine-tool industry able to compete on the world market.

More than centenary and enjoying a solid reputation for an equal length of time, the French machine-tool industry has come to the fore, since the second world war, both on the domestic and on the international market. In the wake of the war came the realization in many countries that one of the factors of a sound industrial economy is the possession of a modern and capable machine-tool industry. The machine-tool has been the basic instrument in reducing the work week from 70 hours in 1850 to 60 hours in 1899 and to 40 hours in our

time. The machine-tool made it possible to reduce the time for building a car from 5,000 hours in 1910 to 250 hours today.



Some of the 62 Huron Milling machines installed in the premises of De Havilland Aircraft Corp/England.

The French machine-tool industry has had a large share in the astonishing progress toward liberation from the drudgery of work made by man within our memory and will continue to contribute to these developments whose end is not yet in sight. By its character and size, the industry does not appeal to the imagination as do the automobile or aviation industry. The following few figures are intended merely to furnish a basis for evaluation and must be understood in relation to population when compared with the industries of other countries.

PRODUCTIVE CAPACITY

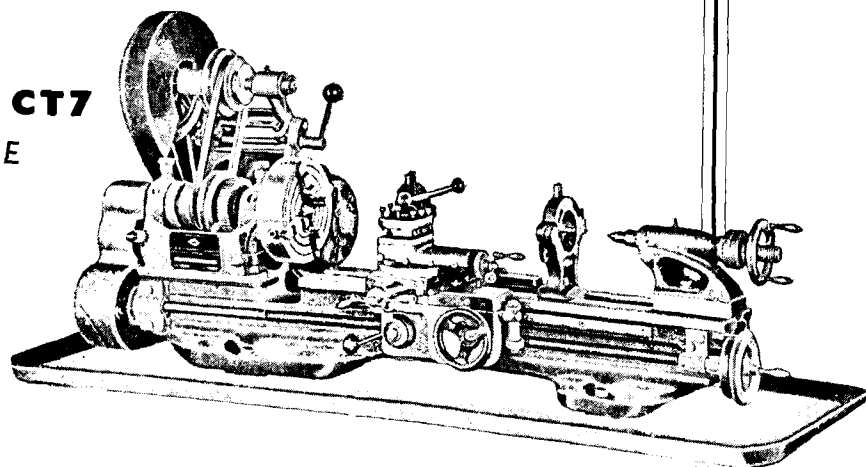
The total manpower employed by French manufacturers of wood and metal working machinery is practically stable at about 22,000 people of which 19,000 work in the latter and 3,000 in the former branch. Such stable employment conditions are explained by the fact that this is generally highly skilled labor, requiring a long period of general training and of special training for the particular requirements of the machine-tool industry.

Production of the 250 companies specializing in machine-tools has appreciably increased since the end of the war over the 28,000 tons of 1938 by

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going to 43,000 tons in 1950, 50,000 in 1955, 55,000 in 1956 and 60,000 tons in 1957. The manufacturers derive particular satisfaction from the fact that they were able to cover 60% of internal requirements in 1957. This is an extremely gratifying percentage because the rapid evolution and augmentation of manufacturing methods and the increasing speed and accuracy of machining operations have inevitably led to a multiplicity of different types and models of machines so that no one country can pretend any longer to cover the entire range of modern machines. Sales and outlets for many of the specialized machines would simply be too small in one country and even such highly developed machine-tool industries as those of Great Britain and Switzerland cannot supply all the domestic needs and must have recourse to importation. Although supplying the domestic market to such a large extent, the French manufacturers have been able to increase export figures very satisfactorily during recent years.

EXPORT PRODUCTION

Exports of French machine-tools started from nothing after the war and quickly rose to 20,000 tons, representing 14,000 million francs, in 1952. Subsequently they diminished but still amounted to 11,400 tons and 7,000 millions in 1955 but have gone up to 12,000 tons and 10,000 millions for 1957. These exports are unequally divided between the two general groups with a much larger share constituted by metal than by wood working machinery. Naturally directed initially to neighboring countries, they have since become extended to far distant countries and now French machine-tool manufacturers are represented on most world markets. Any statistical data reflect only imperfectly the standing acquired on export markets by the industry which is much better expressed by some of the orders filled and some of the countries to which they were shipped that are indicated below:

- 200 vertical lathes, in part heavy-duty, to Great Britain from a single French manufacturer and 60 vertical lathes exported to the United States;
- 160 radial drilling machines of the same make to the United States for the shops of a car manufacturer know the world over;
- 450 semi-automatic turret lathes of the same make to England;

- 200 heavy-duty universal milling machines to Great Britain from a well-known French manufacturer, of which 72 went to the De Havilland Company;
- 26 milling machines to South Africa, also from the above manufacturer;
- Over 300 milling machines to the United States from another manufacturer;
- Over 100 different machines to Spain from a single export sales group, including 70 lathes with a swing of 5 ft. 8-3/4 in. and 32-3/4 ft. between centers;
- 3 steel or light alloy wire drawing and hot-stamping installations to Spain from a French manufacturer specializing in high pressure hydraulic equipment;
- Several banks of heavy duty power presses to Italy for a large Italian automobile maker;
- 65 lathes and milling machines to Argentina and Brasil including 30 turret lathes to a single plant in Sao Paulo;
- A number of different machines and types for a large tractor building plant in Argentina and for a diesel engine maker in Brasil as well as for the installation of the Chimbote Steel Mills in Peru and the Paz del Rio Steel Mills in Colombia.

* * * * * *

The large international industrial fairs have contributed their share to making known the achievements in design and construction of the French machine-tool industry, particularly those of Paris in 1951, Bruxelles in 1953, Milan in 1954, and Hannover in 1952 and 1957. The industry is now preparing for the next one in the new buildings of the National Industrial and Technical Center at Paris in 1959. These fairs have not only brought sales to the industry but led to a steadily increasing number of patent licenses being granted to such highly developed industrial countries as the United States, Great Britain, Belgium and Japan among others.

MODERN MACHINE-TOOL DESIGN

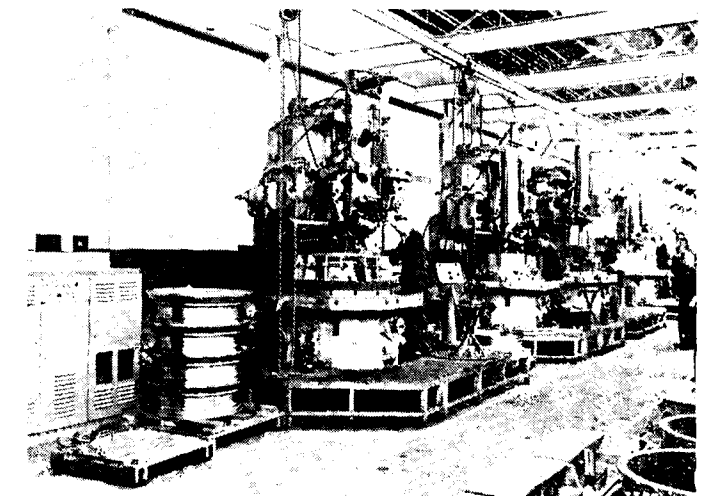
Modern machine-tools must (1) speed up production, (2) improve quality and reduce cost of the piece, and (3) reduce the intervention of the operator

to the minimum. These guiding principles have been adopted by the industry and incorporated in many new designs.

Machining speeds have been substantially increased by the generalized use of cemented-carbide tools. Well-known French lathe manufacturers years ago already designed equipment for spindle speeds up to and over 3,500 rpm. At the time, many considered this excessive but subsequently these speeds became generalized and may soon be raised again through the use of the new ceramic cutting tools. A French manufacturer also appreciably increased the customary cutting speeds of planers and designed his equipment for a second cut on the return stroke. Another manufacturer of gear-cutting machinery developed a unit in which the hob revolves at speeds up to 600 rpm. The resulting considerable increase in output can be raised further by the automatic feed delivered with this machine. The same high speed ratios are also found on the various types of shapers built by another large company. All machines have had to be constructed to new standards of solidity and rigidity to withstand the considerable stresses from the heavy cuts at high speeds utilized today.

New machining processes have found a wide field of application and among them one of the most striking examples is the copying process. There are now in use mechanical, hydraulic and electronic copying methods and most of the well-known lathe manufacturers can deliver their machines with reproduction devices designed by them which are remarkably accurate and rapid. The adoption of automatic machining cycles has been applied to many other types of machines as well and has made of certain copying lathes—which can also be equipped with special tools and devices for given operations—automatic high-output machines requiring the minimum of interference by the operator. In addition to these, the French industry now produces shapers, milling machines, planers and vertical lathes equipped with copying attachments.

In designing new and in redesigning existing types of machines, the French manufacturers make a special effort to incorporate in the design, in addition to the precision with which the parts are machined, features which will protect the accuracy built into the machines as long as possible. Recent new methods include machining by electric spark for which machines have been designed in several countries and particularly in France. In many cases, large scale mass production has led to the abandon of so-called universal machines and their replacement by special



Vertical Boring and Turning Mills installed in the Bristol Aeroplane Co., at Bristol.

equipment built exclusively for a given purpose and sometimes performing just one single operation.

Several French manufacturers have for many years concentrated on building units, designed for drilling, tapping, boring and milling, with an amazing flexibility of utilization. Very soon this flexibility led to their being mounted in groups of several of such machines and this in turn led to the development of the transfer machine. In the transfer machine, a work piece is automatically transferred from one processing station to the next and undergoes a considerable number of operations without ever being manipulated by the operator until the completion of the cycle.

WOODWORKING MACHINES

In this field, technical progress has without doubt not been as marked by spectacular innovation either in improvement of existing or development of new equipment and methods as in metal working. However, constant steady progress is noticeable both in the construction of the machines and in their utilization. Precision is no longer considered as the exclusive attribute of metal working equipment and it is now possible to really speak of "machine-tools for woodworking".

The requirements of modern production methods here also have been translated into high-output machines, working with much greater accuracy and savings of material than before as for example in the sawing of logs. New techniques have appeared and led to the development of new machines. This has been true in the veneer and plywood industry, and in that for the manufacture of wood fiber or pressed wood panels.

A NEW INDUSTRIAL SPECTROSCOPE*

By Heinrich Scheller

WHEN following the course of development of instruments built for the purpose of spectrochemical analysis, a conspicuous increase of major types of spectrographs will be noted, often equipped with electronic radiation detectors and with devices permitting the direct indication of the results of measurement and analysis.

Yet, practical spectrochemical methods have shown that the development also of the visual types of metallurgical spectroscopes, viz., those that yield analytical results by direct observation of the spectrum without the use of the photographic plate or of the photoelectric detectors, has in no way come to a standstill. As a matter of fact, owners of spectroscopes (including for instance, the SPECTROMAT made by Fuess, Berlin, or the STYLOMETER made by Stankoinport, Moscow) are beginning to extend the range of application of their instruments by subsequently equipping them with photometric devices.

To meet the respective requirements of the market, the JENA Zeiss works have built an INDUSTRIAL SPECTROSCOPE of outstanding optical and mechanical efficiency designed in a way which permits its application in the various fields of industrial material testing.

The new industrial spectroscope was supposed to be primarily an auxiliary instrument for rapid spectrochemical analyses for all kinds of metals. It was to be used where numerous metal specimens are to be routine tested qualitatively and quantitatively for their composition and where the spectrochemical methods depending on plates are too time wasting, but where on the other hand the electronic, direct-indicating methods require excessive investment in apparatus and personnel.

The principal field of application for the Industrial Spectroscope would therefore be in the small and medium-sized industrial and research inspection laboratories, e. g. in metal and semi-finished product stores, in annealing and tempering plants, in scrap yards and scrap re-claiming depots, foundry

laboratories, metallurgical, metallographic and mining experimental stations and similar inspection points where the speedy recognition of a certain quality of material is frequently of great economic importance.

With suitable preparation of powdered specimens or of solutions pressed in the shape of pellets or by means of auxiliary carbon electrodes, it will be possible to extend rapid visual analysis with the Industrial Spectroscope to non-metallic materials.

Amongst other applications envisaged are the following: spectral observation and measurement of flames, in particular of converter flames, of lamps, fluorescent tubes and other gas discharge tubes.

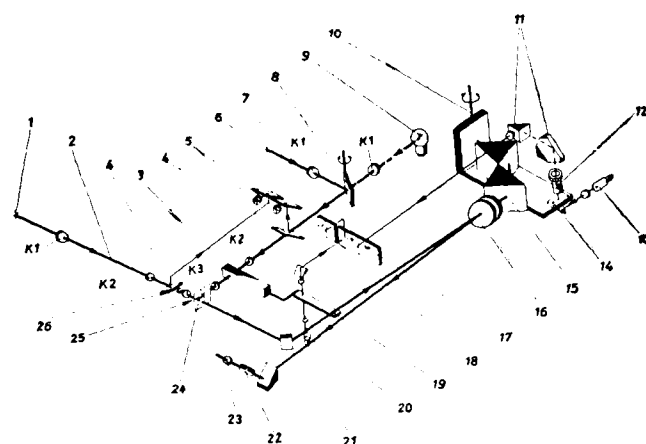


Fig. 1. Optical diagram of the Industrial Spectroscope 1. Analytic light arc; 2. Analytic ray path; 3. Neutral wedge; 4. Semi-reflecting mirror; 5. Monitor ground glass screen; 6. Comparison light arc; 7. Comparison ray path; 8. Rotatable deflection mirror; 9. Comparison bulb; 10. Autocollimation mirror; 11. Deflecting prisms; 12. Micro-objective; 13. Projection lamp; 14. Wavelength scale; 15. Dispersion prisms; 16. Collimator and telescopic objective; 17. Ground glass screen for projection of the scale; 18. Ground glass screen for the projection of the Y/E scale; 19. Y/E scale; 20. Projection lamp; 21. Deflecting mirror; 22. Eyepiece slit; 23. Eyepiece; 24. Entrance slit; 25. Dividing prisms (not drawn); 26. Neutral filter.

At Leutwein's suggestion the Industrial Spectroscope was provided with a photometric device, of a basic design determined by him. By means of this

the often difficult and subsequently faulty estimation of line intensities for the purpose of semi-quantitative determinations with homologous line pairs were to be replaced by reliable measurements.

In addition to intensity measurements on emitted spectral lines, this arrangement then permitted also the carrying out of absorption analytical measurements for the speedy quantitative inspection of coloured glass filters, coloured solutions or plastics, etc.

OPTICAL DESIGN

The optical performance of the Industrial Spectroscope was determined from data in the literature and from our own practical experiments. It is obtained with two 60° prisms (15 in Fig. 1) in autocollimation, i. e. with reflection of the dispersed light a plane mirror (10) and double transmission through the prisms. With the action of 4 prisms, this corresponds to a base length of altogether 240 mm. For the image-forming system a new type of objective (16) (focal length $f = 530$ mm) has been designed which has an extended chromatic correction from C to g (H 656 mμ to Hg 436 mμ), and thus results in an extended chromatic flatness.

The requirement for rapid and reliable evaluation is met by the well-known principle of the reference spectrum. The Industrial Spectroscope is thus capable of reflecting alongside the analytic spectrum (1,2 Fig. 1) a second spectrum (6, 7, 8), say, of a pure substance, of the basic metal, of a standardised alloy or also of a certain gas or gas mixture.

According to experience the comparison of spectra alongside each other considerably facilitates the examination of a doubtful spectrum; even an unskilled person will get a clear impression of complicated spectra, such as those of alloyed steels, for instance, if he can simultaneously observe the spectrum of pure iron.

The two spectra touch along a very fine separating line produced in front of the slit by a new type of dividing prism (25) which precludes shading or irradiation of the separating line. The entrance slit (24) itself is symmetric and accurately adjustable to 1 μ. Contrary to a fixed slit it can therefore be adapted to the individual task, i. e. it can be adjusted sufficiently narrow for complex spectra and qualitative determinations and sufficiently wide for spectra with few lines or for quantitative or absorption measurements.

According to the principle of intermediate image formation, the light sources are being depicted in the prisms by the condenser systems (K_1 to K_4).

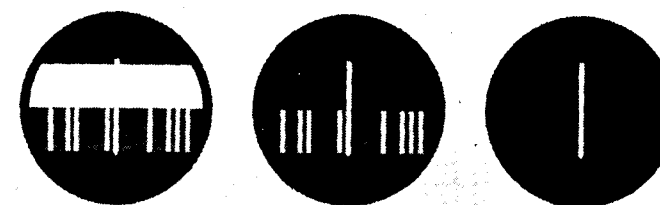


Fig. 2. Diagram of the photometric process (a) continuum and line spectrum; (b) eyepiece slit masks pseudo-line; (c) eyepiece slit in photometric position includes also analysis line.

For visual observation two eyepieces are available (23 and 39, Fig. 3) an 8-power one for low-power view, and a 22x-power one for resolving all details furnished by the dispersing system.

We deemed it indispensable for industrial application to provide an accurate and direct wavelength determination. Simultaneously with the rotatable autocollimation mirror there moves accordingly a wavelength scale (14) which is projected at 40 times magnification on to a ground glass screen (17). It lies in the visual field of the observer in a shaft (37, Fig. 3) above the eyepiece and is not affected by the brightness of the room. The wavelength of a spectral line set in the centre of the eyepiece is therefore read direct without tables or graphical conversion.

The photometric method provided required a continuous reference spectrum furnished by a rigidly incorporated and well-adjustable filament lamp (9). Its light can be focused at will into the reference beam (8). For photometric matching a neutral wedge (3) is used. Its extinction covers the range $E = 0$ to $E = 3$, i. e. three powers of ten of the brightness of the continuum. The neutral wedge adjustment is again read off a projected scale (19) the ground-glass image (18) of which also lies in the observation shaft.

As auxiliary optical devices two further small ground-glass discs (5) are provided in the observation

shaft. On these the images of the light sources appear in such a manner that their position relative to the optic axis and their burning state can at any time be checked, i. e., whether molten beads have formed, whether the specimen has become red hot, or whether the light arc wanders away because of the formation of slag, etc.

PHOTOMETRIC PRINCIPLE

The photometric principle used is that suggested by Leutwein. It reposes on the visual comparison of an analytic spectral line with a so-called "pseudo-line" which is separated from a continuous spectrum in the eyepiece (23) by means of an exit slit (22).

This principle has the advantage that for any optional analysis line an absolutely isochromatic standard of brightness (Fig. 2) is immediately available. The search for isochromatic homologous lines, which in line-deficient spectra is usually impossible and in complex spectra frequently causes confusion, is done away with.

The respective brightness ratio between continuous and line spectrum can be laid down for each analytic specimen by a single photometric measurement of a basic metal line (e. g. iron line). This standard line may be situated in any, easily measurable wavelength range of the visible spectrum.

The photometric measurement values are—corresponding to the characteristics of the neutral wedge—proportional to the logarithms of the spectral line brightness, i. e. according to conventional nomenclature, to the Y-values. Their differences ΔY , are accordingly criteria of the logarithms of concentration of the emitting elements. Calibration curves are compiled as in the spectrochemical evaluation with plates in the $\Delta Y/\log k$ - or $\Delta Y/\log q$ -diagram.

A spectral extinction scale next to the neutral wedge scale permits the direct reading of the extinction figures in absorption measurements.

MECHANICAL DESIGN

The optical part of the Industrial Spectroscope is in a dustproof casing (35, Fig. 3) which can also be used on its own separate from the Base (45). On the right are placed two coaxial rotating knobs (41) for scanning the spectrum through the field of view. The coarse motion ensures a rapid survey of the spectrum, the fine motion permits precision setting of the width

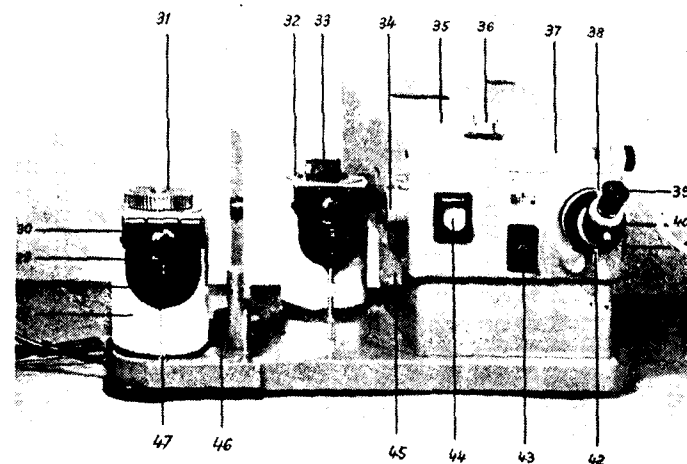


Fig. 3. View of the Industrial Spectroscope

27. Analysis spark stage; 28. Altitude adjustment; 29. Mounting and 30. Rotation of the counter-electrode; 31. Analytic specimen; 32. Comparison spark table; 33. Comparison specimen; 34. Light entry aperture; 35. Spectroscope casing; 36. Slit micrometer; 37. Observation shaft; 38. Adjustment of eyepiece slit width; 39. 7x Eyepiece; 40. Oblique viewing tube; 41. Knobs for spectrum scanning; 42. Height adjustment of the eyepiece slit; 43. Switch for projection lamp; 44. Revolving filter; 45. Base which can be separated from spectroscope; 46. Switch for arc discharge; 47. Remote control switch.

of one line only, i. e. with approx. 10 μ accuracy of the image position. A further knob on the right serves for matching the neutral wedge. On the front, comfortably at the height of the head, there is an oblique viewing tube (40) for the eyepieces (39). In the eyepiece tube the slit mechanism for masking the "pseudo-line" is situated. The exit slit can be inserted on a precisely adjustable slide (42) into the double spectrum.

The eyepiece connecting piece can be interchanged by means of a rapid changer for a miniature camera for documentation of the spectra of important specimens.

Above the eyepiece lies the observation shaft (37) for wavelength and extinction scales and for the monitoring ground-glass screens of the light sources (Fig. 4).

For adapting the brightness of the lines to the optimum sensitivity of the eye during photometric measurement, a filter dial is used (44).

On the left of the casing are the two light-entry apertures (34) for analysis and reference beam as

well as the switching lever for interposing the comparison lamp. Two discharge tracks inside the two spark stages (27, 30) serve as spectral light sources for the emission analysis of solid substances. The analytic and reference specimens (31, 33 (Fig. 3) are merely placed on the metal contact plates of the ceramic spark tables and do not require any further attachment. The counter electrodes, radial copper or carbon discs, can be rotated from the outside (3) in such a manner that the arc point of the discharge can be renewed 20 times. For changing the counter-electrode the entire mounting (29) is swung out from the table. This interrupts a remote control contact (47) which immediately switches off the energising voltages. Large insulating caps above the sparking table provide protection against accidental touching of the live parts.

ELECTRIC EXCITATION

A high-frequency A. C. continuous arc is used for spectral excitation. As excitation unit for operating the Industrial Spectroscope a new small continuous arc producer has been designed by the Technisch-Physikalisch Werkstätten (TPW) in Thalheim/Erzgeb. It is also suitable for spectrographic excitation of materials which evaporate only with difficulty.

PERFORMANCE OF THE INDUSTRIAL SPECTROSCOPE

The optical performance of the Industrial Spectroscope becomes obvious by its high dispersion (Fig. 6). At 5000 Å (green) it is $D=20$ Å/mm and is increased with the 8x eyepiece to $D=2.5$ Å/mm and with the 22 times eyepiece to $D=0.9$ Å/mm at a clearly visible distance. For this purpose the resolving power of the optical system is just about utilised, so that at 5000 Å, 0.3 Å can still be separately discerned (Fig. 5). The resultant effective resolving power therefore is $\lambda/\Delta\lambda=17,000$. The spectrum appears very clear and bright without ghost lines and background insofar as this is not caused by the excitation. The separating line between the double spectra is formed sharply and without ancillary phenomena.

The spectrum between 4000 and 7000 Å has at the image plane an actual length of 140 mm, which through the eyepieces appears magnified to abt. 1000 mm or approx. 3000 mm. The range within the visual field at green (5000 Å) covers more than 2/5 Å in spite of the high linear dispersion (Fig. 6). Even below 4000 Å it is still possible to carry out observations up to 3900 Å.

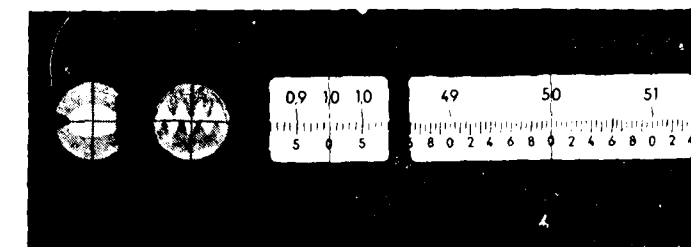


Fig. 4. View into the Observation shaft Projections

(a) of the analytic light arc
(b) of the coil in the comparison bulb
(c) of the extinction scale
(d) of the wavelength scale

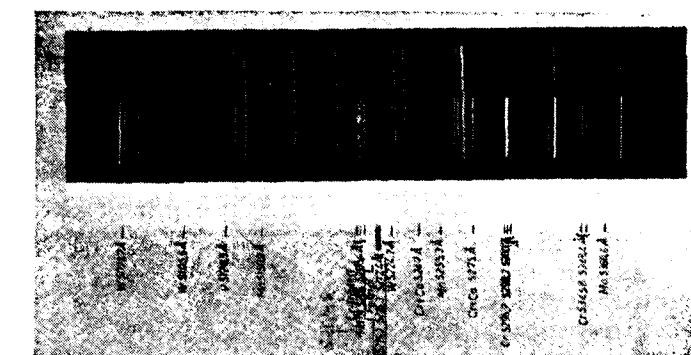


Fig. 5. Section of the double spectra, of the Industrial Spectroscope when setting to 5216 Å. Actual impression with 8x eyepiece.

Above: Pure iron spectrum
Below: Spectrum of an alloyed steel

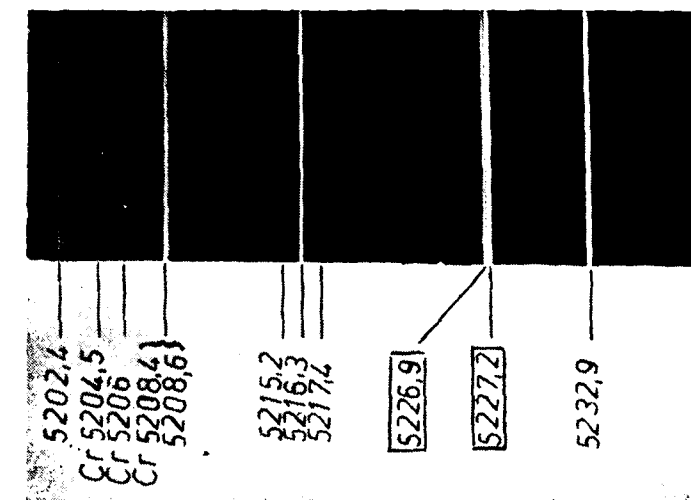


Fig. 6. Resolution of Fe 5227.2 and Fe 5226.9 Å with the Industrial Spectroscope, eyepiece 22x

The high dispersion meets all the demands made on it according to literature and practice on the separation of spectral lines in routine visual analyses (Figs. 5 and 6). It is readily possible to recognise with certainty the principle detection lines of alloying elements in highly alloyed steels of any kind, in cutting and hard metals, also in metals with a tungsten basis, and to separate them from disturbing lines. The clarity and brightness of the spectra permits also the detection of weaker lines of lower quantities of elements.

As the emission of the elements varies according to their spectral excitability, it is impossible with visual spectroscopy, as with all spectrochemical methods, to determine a lower detection limit. On the average this limit ranges round 0.01 to 0.1%, in individual instances, however, it varies from 0.001 to 1%. The detection limits stated in the literature, e.g. by D. M. Smith (1), are in every instance safely attained. Also the molecular bands

(1) D.M. Smith : Visual lines for spectroscopic analysis. Published by Hilger, London, 1952.

serving for the detection of elements, where no sensitive detection lines are emitted in the visible range, appear clearly in the Industrial Spectroscope, e.g. those of A10 or B e0.

Experience with quantitative measurements has proved that with smoothly burning light source, i.e., lamps or discharge tubes, an average relative measurement accuracy of the brightness value of $\pm 4\%$ is obtained with a fluctuation range of $\pm 2\%$ to $\pm 6\%$ over a colour range of 6600 to 4400 Å and a brightness range of 3 orders of magnitude.

These values are altogether within the scope of the expected measurement accuracy which in rapid visual methods are also considered permissible.

* Lecture held at the 8th International Spectroscopic Colloquium in Lucerne, Sept. 1959, and at the 2nd Czech Spectrographic Congress at Tatranska Lomnica, Oct. 1959. The original text will be published in a separate issue on the 8th Colloquium of the Swiss Journal "Chimia", published by H. R. Sauerländer & Co.

BALTIC THERMAL POWER STATION—FIRST STAGE COMPLETED

The first stage of the Baltic thermal electric station (300,000 kilowatt capacity) was completed in Tallinn with the commissioning of the third turbine.

The total capacity of this station will amount to 1,625,000 kilowatts at the end of the Seven-Year Plan (1965). It will be the only Soviet thermal station working on shale and the biggest station of this kind in the world.

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Signature of Publisher

A NEW UNIVERSAL ROLL-SEAM WELDING MACHINE

By Adrian Seligman
London

THE mass production of drums and tanks, or the fabrication of sheet metal sections for use, say, in the construction of railway carriages, require seam welding machines which are both fast and reliable in operation. The SAGU 125 air-operated universal roll-seam welder, being produced in Britain for the first time by Electro Mechan-Heat Limited of Kingston-upon-Thames, is the result of many years development work by its Belgian designers.

The most interesting feature of this machine is the siting of the motor on top of the upper arm, the drive being transmitted by a vertical shaft and gearing through the air cylinder and welding head to the upper electrode. This obviates the array of external shafting, gear boxes and knurl drives which encumbers a seam welder whose motor is in the main structure of the machine.

The SAGU 125 can be adjusted for circumferential or longitudinal seam welding by simply rotating the upper head through 90° in either direction, and

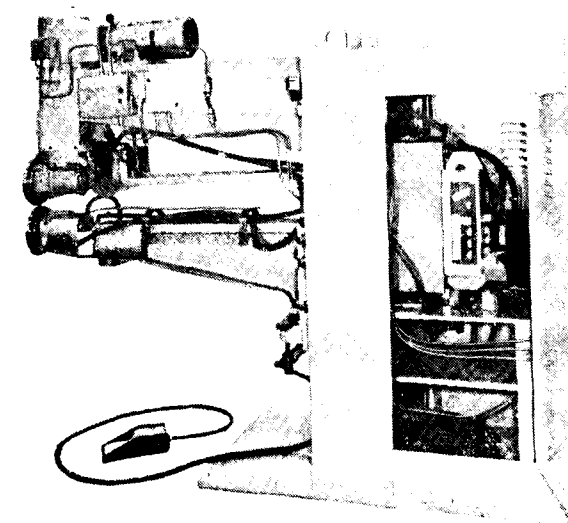
exchanging the lower arm extensions shown in photograph No. 3. The vertical shaft is driven from a 3-phase KOPP variable speed motor developing 0.5 h.p. at 1000 r.p.m. A reversing switch allows circumferential welds to be made clockwise or anti-clockwise, as required.

The shafts on which the upper and lower rollers are mounted, revolve in ball race and needle bearing assemblies, which ensure reduced friction as well as numerous line contacts for current transfer. The motor can be set by means of a variator to run at speeds between 310 r.p.m. and 2,800 r.p.m., giving lineal feed rates of 1 ft. 11 ins. p.m. to 21 ft. 6 ins. p.m. between the electrodes, as follows :

WELDING SPEEDS IN INCHES PER MINUTE

Wheel Speed: R. P. M.	Wheel Diameters :				
	7"	7½"	8"	8½"	9"
1.035	22.8	24.4	26.0	27.6	29.2
1.15	25.3	26.1	27.9	29.7	31.5
1.30	28.6	30.7	32.8	34.9	37.0
1.45	31.9	34.2	36.5	38.8	41.1
1.625	35.7	38.2	40.7	43.2	45.7
1.75	38.5	41.3	44.1	46.9	49.7
1.90	41.8	44.8	47.8	50.8	53.8
2.10	46.2	49.5	52.8	56.1	59.4
2.30	50.6	54.2	57.8	61.4	65.0
2.50	55.0	58.9	62.8	66.7	70.6
2.82	62.0	66.4	70.8	75.2	79.6
3.00	66.0	70.7	75.4	80.1	84.8
3.33	72.7	78.1	83.6	89.0	94.4
3.60	79.2	84.8	90.4	96.0	101.6
4.00	88.0	94.3	101.0	107.0	113.0
4.40	96.8	103.0	110.0	117.0	123.0
4.90	108.0	115.0	123.0	131.0	139.0
5.40	119.0	127.0	136.0	144.0	153.0
6.00	132.0	141.0	151.0	160.0	170.0
6.60	145.0	155.0	166.0	177.0	187.0
7.30	160.0	171.0	183.0	194.0	206.0
8.10	178.0	191.0	203.0	216.0	228.0
9.10	200.0	214.0	229.0	243.0	258.0

NOTE : Should it be necessary to allow for frequent variations in welding speed (as, for example, when negotiating short radius curves on the corners of petrol tanks) the variator mechanism may be fitted with a pedal-operated pneumatic control.



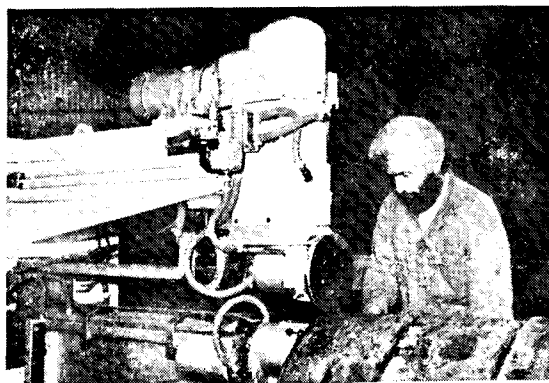
Introducing the Sagu 125 Welding Machine

Photo No. 1. This general view of the Sagu 125 universal seam welder shows the sturdy design of main frame and transformer housing, providing easy access for maintenance, and the compact arrangement of driving unit, air cylinder and ancillary controls on top of the upper welding arm.

GENERAL CONSTRUCTION

Rigidity has been achieved by using heavy formed steel sections at the front of the frame, thereby permitting a minimum of steelwork at the rear; this, in turn, ensures easy access for maintenance to the transformer and ancillary equipment inside the frame. Transformers of different types and ratings according to the length of welding arm may be fitted.

The lower arm is cast in special high tensile copper alloy and is bolted into a T-slot pad mounted on the front of the main frame. This allows horizontal adjustment to line up the lower electrode with the upper electrode after the latter has been turned to the right or left for longitudinal welding. The lower arm can also be raised or lowered by means of a chain-link jacking device to compensate for reductions in electrode diameter due to wear.



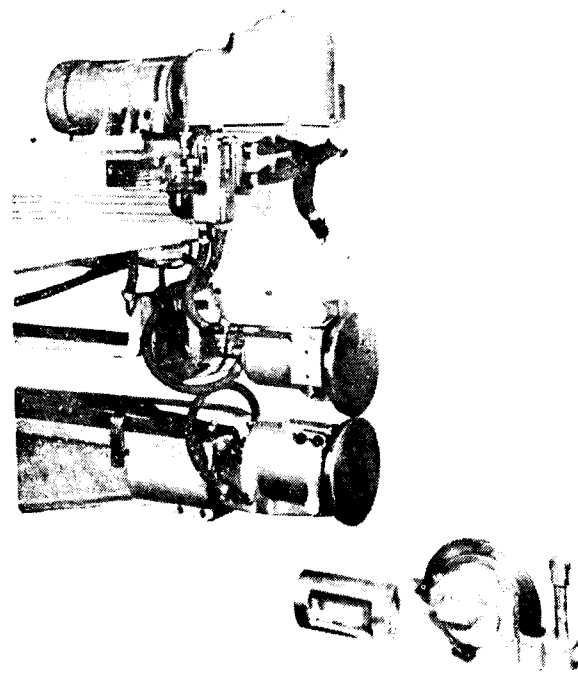
A new Universal Roll-Seam Welding Machine

Photo No. 2. An operator at the Wolverhampton works of Electro Mechan-Heat Ltd., demonstrates the use of the Sagu 125 machine in circumferential roll seam welding.

On either side of the upper head casting there are pads to receive tools for reshaping the rim of the electrode should it mushroom under the effects of heat and pressure.

TRANSFORMERS

The prototype SAGU 125 welder, recently completed at the Manor Works, Wolverhampton, factory of Electro Mechan-Heat Limited (see photograph No. 1) has been fitted with a single phase A. C. 400/440 volt stacked core transformer, which is water-cooled, vacuum impregnated and fully tropicalised. Transformers suitable for voltages from 200 volts to 500 volts supply can be provided.



Introducing the Sagu 125 Welding Machine

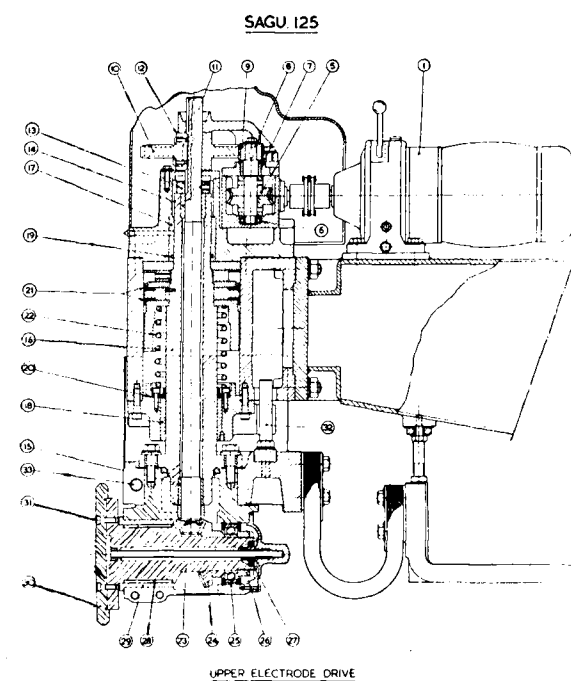
Photo No. 3 Retooling the Sagu 125 to change from circumferential to longitudinal welding is a quick and easy process. The spigot of the alternative lower electrode is inserted into the end of the lower arm, where it is clamped in position by means of two bolts on the under side of the arm. The locking screw of the large split collar at the base of the upper welding head is eased, allowing the upper electrode with its associated gearing to be rotated through 90° to right or left as required.

An 8-step tap-link panel is mounted on the transformer and protected by a hinged cover with a perspex inspection panel. Power ratings, for a total working time of not more than four minutes, may vary between 50 KVA and 160 KVA, with the following outputs on different types of seam welding operation:

55 KVA for a	100%	duty cycle (i. e. continuous welding)
80 KVA for a	50%	" " (i. e. continuous welding)
90 KVA for a	40%	" " welding with periodic pauses or continuous spot welding)
100 KVA for a	30%	" " (i. e. groups of spot welds)
123 KVA for a	20%	" " welds with intervals
160 KVA for a	12%	" " between groups)

PRESSURE

The equipment is pneumatically operated by means of an air cylinder also mounted on top of the upper arm. The piston operates a ram with a maximum travel of 1.97 inches, through the centre of which runs the vertical shaft driving the upper roller.



Sagu 125 - Principal Components of Upper Electrode Drive.

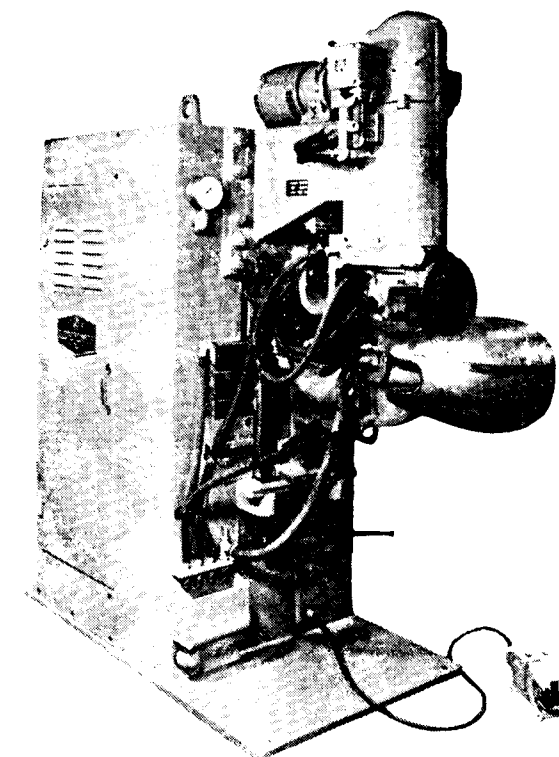
1. Variable Speed Motor 5. Worm Wheel 6. Worm Wheel Bearing 7. Bearing Bush 8. Worm Wheel Spindle 9. Pinion 10. Spur Gear 11. Central Shaft 12. Key 13. Lock Ring 14. Upper Bearing Bush for Shaft 15. Lower Bearing Bush for Shaft 16. Ram 17. Upper Bearing Bush for Ram 18. Lower Bearing Bush for Ram 19. "O" Ring Seal 20. Ram Lower Packing Ring 21. Piston Cup Washers 22. Coil Spring 23. Electrode Spindle 24. Bevel Wheel 25. Spindle Ball Bearing 26. Rear Lock Nut 27. Rear Seal Ring 28. Needle Rollers 29. Outer Needle Race 30. Electrode Wheel 31. Electrode Fixing Screws 32. Guide Rod 33. Locking Screw for Head.

A maximum welding force of 1,625 lbs. between the electrodes is derived from an air cylinder pressure of 70 p. s. i. Welding is initiated with a 2-stage foot switch, first pressure causing the upper head to descend while second pressure switches on the welding current. A square "D" switch on the motor casing ensures that the welding current cannot begin to flow until the correct pressure has been built up in the air cylinder.

The air supply to the cylinder is fed through a NORGREN lubro-control unit, comprising filter, pressure regulator with gauge and automatic lubricator. A demisting chamber can be incorporated in the supply line if desired.

COOLING

The machine is water-cooled throughout, being supplied through a 3/4 i. d. hose. One main and six



Introducing the Sagu 125 Welding Machine.

Photo No. 5. A special purpose version of the Sagu 125 roll seam welding machine used for assembling the fuel tanks of motor cycles.

subsidiary stop cocks allow various sections of the cooling system to be isolated for easy maintenance.

The electrode rollers are efficiently cooled by means of ducts machined as close as possible to the rims of the wheels, while still making adequate allowance for wear. All cooling circuit return lines discharge into a funnel-shaped collector on the front of the main frame; this enables the flow of water to be checked visually.

WELDING CAPACITY

Throat Depth:		Welding Capacity:	
Connecting Power:		Mild Steel:	Stainless Steel:
19½ inches	120 KVA		
31½ inches	100 KVA	2×13 gauge	2×14 gauge
39 inches	75 KVA		

SPECIAL PURPOSE MACHINES

The SAGU 125 welder may be modified to carry out particular tasks. Photograph No. 4 shows a machine specially designed for use in fabricating the heat transfer fins of electrical transformers. The machine in photograph No. 5 is used for the assembly of motor cycle fuel tanks.

The contact-free and self cleaning action Pneumatic Measuring Control Instrument "Pneumat"

By Gerhard Meister and Helmut Rasch

THIS article discusses the problems set to the Pneumat and their solution. It also gives a description of the instrument and the results obtained with it, especially in respect of its property as a contact-free measuring instrument with a fixed scale independent of the effect of curvature of the object under measurement. This property to the best of our knowledge, distinguishes the "Pneumat" as a measuring instrument from all hitherto known pneumatic measuring and control instruments.

With the increasing demands on manufacturing processes and the restriction of tolerances connected with it, there is likewise an increasing demand for direct supervision of the manufacturing process, since the setting elements of machine tools, which carry out power and measuring functions at the same time, are no longer abreast of these demands.

Sensitive measuring in the machine of an order of magnitude around 1 micron, as required for certain grinding processes, is carried out under much more exacting conditions than those applying in precision measuring and inspection rooms for precision measuring techniques. These conditions are in particular: impurities, lubricating and cooling agents, measurement on a moving object where measuring values are variable with time.

The above effects result in the following demands being made on the measuring process and the measuring instrument:

Self-cleaning of the place to be measured, contact-free and thus non-wearing measuring process, satisfactory vibration-damping properties of the measuring elements with relatively rapid indicating facility.

For contact-free self-cleaning measurement in the machine measuring with air seems to be indicated. This measuring process has been used for several decades in precision measuring technology (Solex method). The air pressure used for this purpose (500 mm water-column = 0.05 atm.) results in a very

simple design of the control and indicating instrument (by means of the water column), but it does not suffice for self-cleaning of the measuring point. The linear measuring range of the Solex method is at approx. 40 microns relatively small, and the damping properties, as well as the setting speed of the liquid column are in general insufficient for control measuring purposes, even though sometimes such devices with photoelectric scanning of the liquid column were built [Forster, Bad Nauheim (1)] for automatic measuring and sorting instruments.

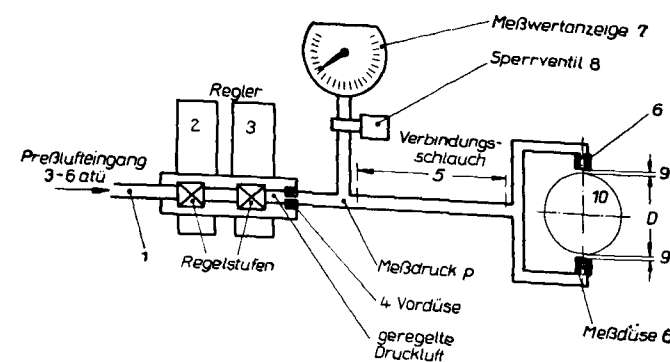


Bild 1

Fig. 1. Working diagram: (1) Scale (2) Stop valve (3) Connecting hose (4) Measuring nozzle (5) Free space between nozzle and workpiece (6) Workpiece (7) Measuring pressure (8) Primary nozzle (9) Regulated compressed air (10) Regulation steps (11) Compressed-air inlet 3 to 6 atü (gauge pressure)

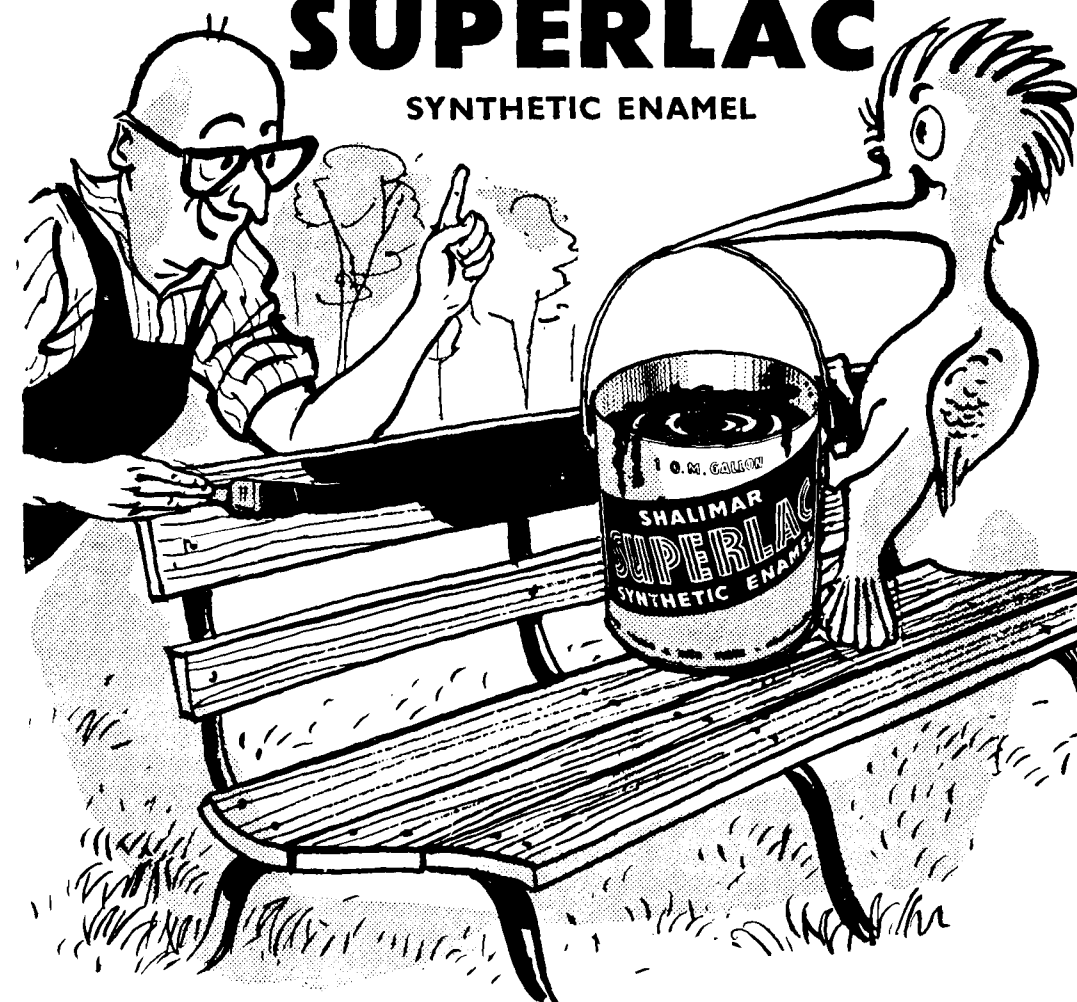
The following demands were placed on a measuring instrument to satisfy the requirements in question:

1. Provision of a pressure regulator for the required increased, highly stable compressed air input, with indicator.
2. Choice of the air pressure not higher than a point at which the self-cleaning of the place to be measured is just about ensured, the air consumption as well as the noise generated and cooling effect being however

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still tolerable by the person measuring in the precision or control room. Closely connected with the air pressure selected in the linear measuring range obtainable and the measuring accuracy.

3. Independence of the value of a scale division of the indicating instrument in microns from the curvature of the cylindrical surface of the measured object blown on directly by the measuring nozzle (e. g. in external circular-grinding processes).

Pneumatic measuring processes can be followed up mathematically on a thermodynamic basis, idealistic assumptions usually having to be made, to make them accessible to calculation without undue difficulties, e. g. by disregarding internal friction and boundary layer effects, assumption of purely adiabatic changes of conditions, laminar flow curve, etc.⁽²⁾

Thus the results obtained can only provide a basis for qualitative discussions. Nevertheless, it is possible by these means to draw some important conclusions regarding some particularly outstanding features, such as the classification of the phenomena into those with speed of flow in the nozzles being above the propagation speed of sound ("overcritical" speed) and those where this is not the case.⁽²⁾

The above mentioned methods do not suffice for calculations of the dimensions for the design of measuring instruments (notwithstanding the just mentioned correlation with the propagation of sound particularly affecting the choice of the measuring pressure) so that the course of development of these instruments has a largely experimental tendency.

In the course of the development work, the abundant assistance available in an organization as the VEB Carl Zeiss JENA, working on a wide physical basis, proved most helpful. In the course of the work it was possible, therefore, freely to resort to the efficient precision measuring and technical aids and manufacturing facilities, as well as to those of various special laboratories of our Works, such as optical and schlieren measuring instruments, for the direct observation of flow processes prevailing at the measuring point.

In this manner the "Pneumat" was created, an instrument fully satisfying the afore-mentioned conditions for pure precision grinding work (Figures 1—3).

The "Pneumat" consists of a base unit (Fig. 2) containing the highly stable pressure regulator with air filter and the indicating instrument with adjustable contacts for signal lamps or machine control, as well

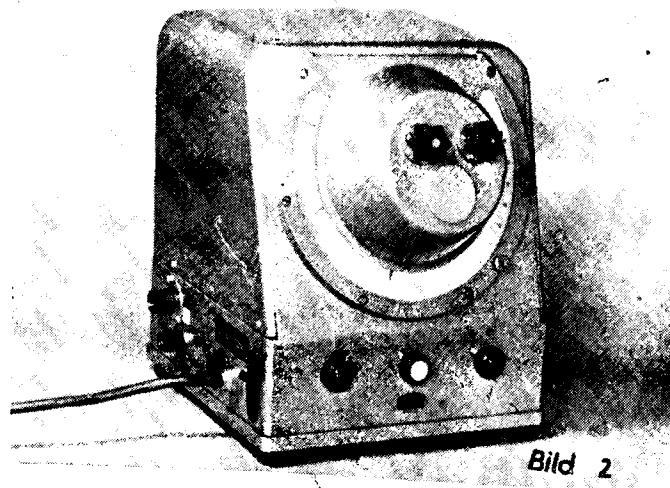


Fig. 2. Basic instrument with pressure regulator and indicator dial.

as magnetic stop valve which is programme-controlled from the outside. The stop valve makes it possible to close the measuring circuits when the workpiece surface is interrupted, to be subsequently ready for measuring without any appreciable loss of time. The remaining accessories (Measuring head with measuring nozzles) differ according to the measuring task and are very adaptable. Especially for the measured control of circular grinding machines it is remarkable that it is possible not only to plunge-cut grind, but—as thorough tests have shown, also to length-grind very long shafts by measured control with extreme precision, especially with regard to cylindricity (see Figures 3 and 4). The attachment of the pneumatic measuring jaws with two diametrically placed measuring nozzles on to the machine is uncritical due to its insensitivity to slight shifting relative to the axis of the workpiece. The admissible displacements in both possible directions are listed in the following technical data as differential working range.

Table 1 lists the technical data of the Pneumat; only a few more remarks should be made to supplement these, especially regarding the required independence of the scale division value in microns (Measured value conversion) from the curvature of the direct measured cylinder, this demand being also fulfilled under point 3.

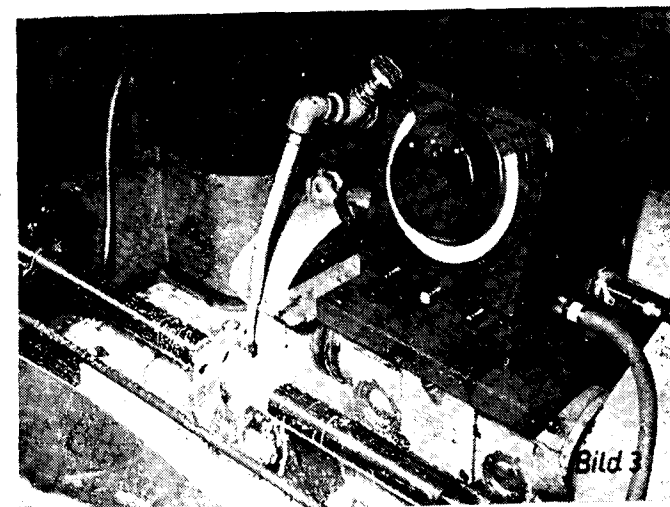


Fig. 3. "Pneumat" attached to circular grinding machine.

As illustrated in Figures 5 and 6, in contact-free circular grinding the workpiece is blown on directly from the measuring nozzles, i. e. the exit slit determining the quantity of air emerging per time unit, is formed by the measuring nozzle on the one hand, and by the workpiece surface on the other.

Thus, usually not only the micro-shape of the workpiece surface (the roughness) but also the macro-shape (curvature) enters into the measuring process.

By adopting special measures in the course of thorough investigations, it has been achieved that with the Pneumat the measured value converted from the dial is practically independent of the fact, whether the change in dimension is observed on a very small or very large cylinder diameter, over the entire measuring range of the jaws of the nozzle which can be set to fixed basic values.

This makes the Pneumat, in this instance and according to our knowledge, the first contact-free and self-cleaning measuring instrument in a machine, with a fixed scale graduation value over the entire useful range of the jaws which at present ranges between 15 and 60 mm dia. For this reason it will take but one single standard gauge with which to effect the basic adjustment of the nozzle-jaw.

It is therefore possible to measure directly and absolutely, for example, the shape of slightly conical cylinders, the change of diameter of which does not exceed the measuring range of the jaws or else measurably to check the effect and size of slideway errors in the length-grinding of long workpieces (Figures 3 and 4).

The fact that the market offers other pneumatic measuring instruments for use in the machine (Etamic, Feinprüf-Göttingen, Merker-England, Sheffield-U. S. A., Johansson-Sweden) does not constitute a contradiction to the above statement.

With these instruments there is no contact-free measurement and therefore no freedom from wear and no self-cleaning of the measured point, because the measurement of the Workpiece is first taken by a mechanically contacting intermediate probe which is usually tipped with hard metal. The measuring nozzle is therefore always faced with a surface of the same nature thus eliminating the effect of the curvature of the object to be measured.

Whilst in other instances, contact-free measurement actually prevails, work is carried out however only with a fixed control point during the measure-controlled process. The indicating scale could be altogether dispensed with here; in fact we would not in this case have to deal with an actual measuring instrument for an extended measuring range and the existing effect of curvature would not interfere in any way.

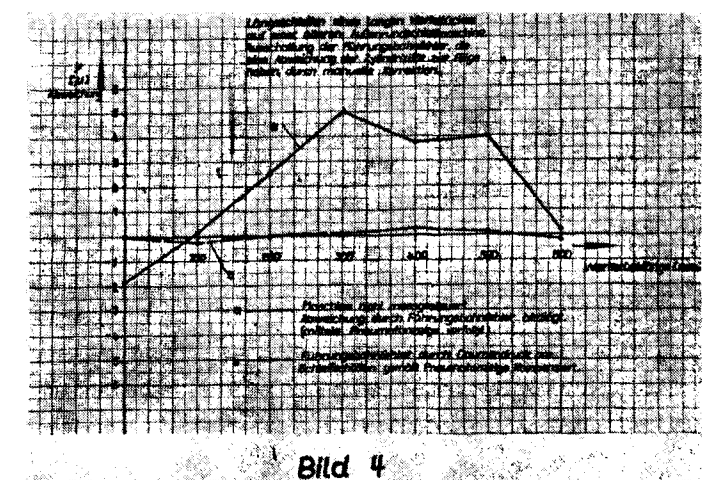


Fig. 4. Long-grinding of a workpiece on an older-type external circular grinding machine. Elimination of errors in the guideways, which result in a deviation from the cylindricity of the workpiece, by manual correction.

- machine is not automatically controlled, its deviation is a result of the errors in the guideways traced by means of the "Pneumat" indication;
- error in the guideways being compensated by pressing the thumb into the carriage of the grinding machine according to the "Pneumat" indication;
- deviation
- length of workpiece

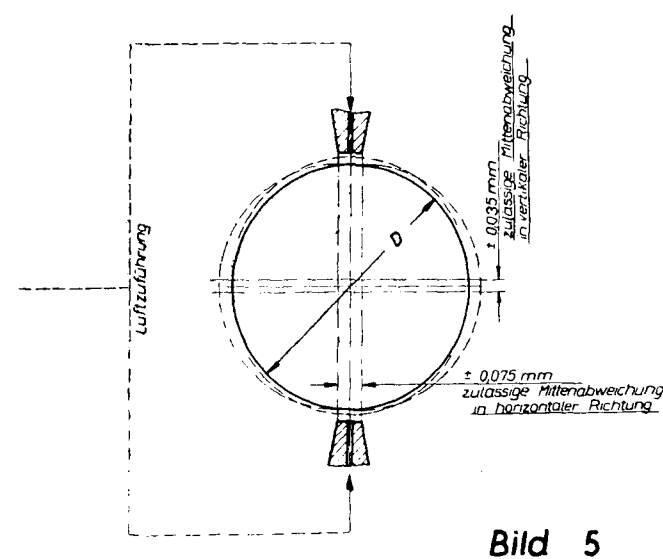


Bild 5

Fig. 5. Arrangement of nozzles in the measuring jaw:

- (1) ± 0.035 mm permissible deviation from the centre in vertical direction
- (2) ± 0.075 mm permissible deviation from the centre in horizontal direction
- (3) Air supply

In the "Pneumat" all possibilities are combined; viz., to measure contact-free in the machine during operation, to work measure-controlled only with pre-selected control points, or finally to work in measuring and control processes outside of the machine by means of the fixed scale and, with the aid of the latter, by means of rapidly and accurately adjustable tolerance signal contacts. This represents an exemplary solution of the component assembly system which is so important for the automatic controlling and regulating systems.

The disadvantage of the automatic control and regulating systems is that for a variety of the most diverse measuring tasks many special instruments are required in small numbers. This is counteracted by the possibility of combining the same basic instrument with the special measuring nozzles selected and mounted according to the measuring tasks allocated to them.

Thus the major component of the measuring equipment can be economically manufactured in bulk.

In the meantime, the Pneumat has given good results in several applications for testing and in manufacture.

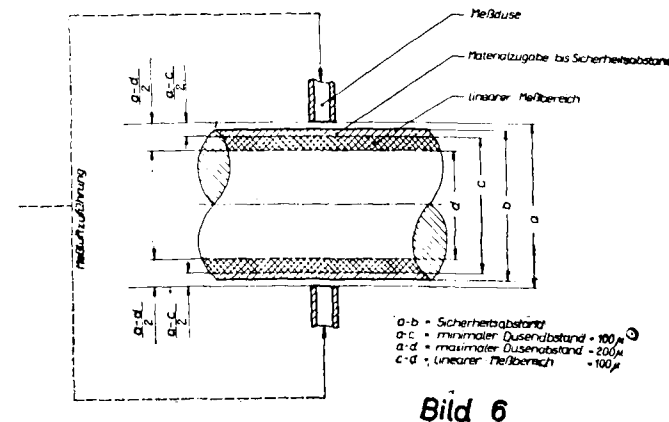


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Fig. 6. Nozzle distances and working range: (1) Measuring nozzle (2) Material allowance up to safety distance (3) Linear measuring range (4) Air supply, a-b = safety distance a-c = minimum nozzle distance = 100 u, a-d = maximum nozzle distance = 200 u, c-d = linear measuring range = 100 u

Fig. 7 illustrates the result of the automatically controlled plunge-cut grinding process on an external circular-grinding machine SA 200 made by VEB Schleifmaschinenwerk, Karl-Marx-Stadt, the scattering over a series of 35 parts of 50 mm diam. being within a 1 u interval.

It should be noted in addition that due to the extreme precision of the measuring-control process the blunting of the grinding wheel could be followed very clearly. If measurement of the parts was carried out sufficiently long after the grinding process for the temperature rise caused by the grinding to be completely compensated, deviations in the diameter of the parts, arranged in the sequence in which they had been manufactured, resulted in a saw-tooth shaped diagram. The steps of this diagram as maximum diameter deviations corresponded very accurately to the basic diameter of the parts of 50 mm plus the maximum heating achieved before each adjustment of the grinding wheel as well as to the heat expansion coefficient on the raw material used. The most interesting information obtained about this grinding process with the Pneumat under workshop conditions permits one to consider these effects where this is thought desirable. This is frequently the case in precision manufacture in the precision mechanical industry.

At VEB Carl Zeiss, for instance, work often occurs requiring high precision of long fittings for measuring purposes (Figs. 3 and 4). For this purpose the axis should be ground to fit the existing bearings to an extremely close tolerance.

Due to deviations from straightness in the slideways of the grindings machines and the effect of bending of long parts as well as the degree of blunting of the grinding wheel these fittings had to be finally finished by hand.

By using the Pneumat as illustrated in Fig. 4 these fittings could be produced systematically and be taken off the machine ready and evenly produced over their entire length. The bushes were for this purpose measured with the Pneumat and the internal mandrel and the respective axis ground according to the direct measuring indication of the Pneumat. This application illustrates with especial clarity the importance of a possible measurement with a fixed scale graduation value as mentioned under point 3, this requirement being fulfilled by the Pneumat.

I should like to take this opportunity to thank especially all Members of the Staff of the Institute for Machine Tools, Karl-Marx-Stadt, and the Instrument Grinding Works of VEB Carl Zeiss JENA for assisting the design-team of the Pneumat in their thorough testing operations in the testing field and in production.

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- (1) Forster, A.: Automatisches Messen in der Fertigung (Automatic Measuring in Production), Werkstatttechnik und Betrieb, 90th Year (1957) journal 8, pp. 482 and 484.
- (2) Wiemer, Lehmann, Pich: Pneumatische Meßgeräte (Pneumatic Measuring Instruments) Feingerätetechnik, 7th Year (1958) journal 2.

DATA

Measuring range (referred to the diameter)	100 u
Measuring accuracy.....within	± 1 u
Minimum nozzle distance from the workpiece (referred to the diameter)	100 u
Maximum nozzle distance from the workpiece (referred to the diameter)	200 u
Differential working range of the measuring head in the direction of the axis of the measuring nozzle	± 35 u
In a direction perpendicular to the axis of the measuring nozzle and workpiece	± 75 u

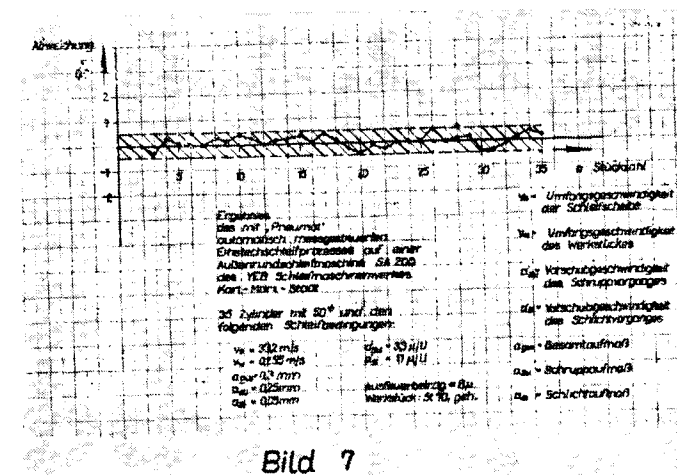


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Fig. 7. Result of the plunge-cut grinding process, automatically controlled by the "Pneumat", on an external circular grinding "machine" "SA 200" made by VEB Schleifmaschinenfabrik Karl-Marx-Stadt.

(a) deviation, (b) quantity = 35 cylindrical parts of 50 mm ϕ , grinding conditions being as follows:

$V_s = 33.2$ m/sec, $V_w = 0.255$ m/sec, $A_{ges} = 0.3$ mm, $a_{su} = 0.25$ mm, $a_{sj} = 0.05$ mm, $a_{su} = 3.3$ u/U, $a_{sj} = 1.1$ u/U, Sparking out abrasion ≈ 8 u, material: St. 70, hardened,

V_s	= Peripheral speed of grinding wheel
V_w	= Peripheral speed of workpiece
a_{su}	= Feeding speed during the rough-grinding process
a_{sj}	= Feeding speed during the fine-finishing process
A_{ges}	= Total amount of material removed
a_{su}	= Amount of material removed in the rough-grinding operation
a_{sj}	= Amount of material removed in the fine-finishing operation

Adjustable range of the measuring head from...15 to 60 mm dia.	
Maximum coolant effect as compared to dry measuring	0.3 u
Indicator-time constant	.. 0.6 x
Accuracy of tolerance signalling	.. ± 0.2 u
Thickness measurement on vibrating objects to be measured between two measuring nozzles (bands foils etc.)	
Amplitude	30 u
Frequency	up to 140 c/s
(have no effect on the measured value indication)	
Maximum air consumption, referred to 3 atm...700 litres/hour	
Input pressure (compressed air supply or similar)	3...6 atm. gauge
Scale value (2.8 mm)	.. 1 u

JOHANNSEN Single-belt Sanding and Buffing Machine - Model BSME

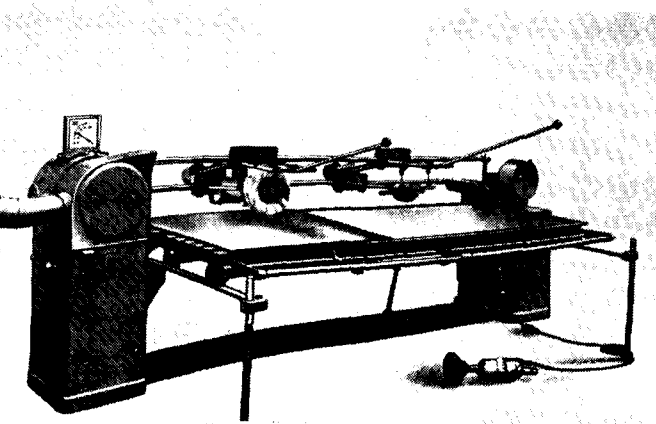
THE single-belt machine is employed wherever the work volume is not sufficient to utilize the full capacity of a double-belt grinder. It is also much better suited for fine and wet grinding since it permits better observation of the progress of sensitive work, giving the operator at the same time a better "feel" for the grinding pressure. Otherwise, operation and design are similar to those of the double-belt grinder. The machine can be equipped with a wet grinding device, a brushing and buffing unit, and a hand grinding attachment. The wet grinding device consists of a simple band sprinkler with pump, drop feed bucket, and distributing brushes which do not touch the belt so that they are not subject to wear. Dropfeed supply is easy to regulate and a container is provided to collect excess grinding fluid.

By continuously wetting the grinding belt, the grain is kept open and fully effective, the work piece is

cooled, and grinding quality improved. With soft material, too, and especially with aluminium, wet grinding is indicated to obtain a clean finish.

Like the grinding device, the brushing and buffing unit is arranged movably above the table. Contact pressure on the brush and buffing mops is effected by hand. The polechanging motor is layed out for 1500 and 3000 rpm.

A Hand grinding attachment is recommended for the correction of pronouncedly faulty work. The metal is briefly ground to make the faulty spots clearly visible. After all faults have been eliminated by means of the hand grinder, the hand grinding marks are ground off uniformly with the belt. For all work on this machine, only the inexpensive paper grinding belts are used.



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Automation of Feed Cycles on Czechoslovak Knee-type and Plane Milling Machines

By A Special Engineering Correspondent

AUXILIARY times in milling operations are caused mainly by the movements of the workpiece in conjunction with the work cycle proper. These movements are as follows: engaging and disengaging of the machine run, of the table or head-stock feed, in-feed of the workpiece to and withdrawal from the tool, etc. The non-productive time caused by the in-feed and withdrawal represents 20 to 25 per cent of the total auxiliary time.

For modern machine tools such solutions are looked for which would limit auxiliary times to a minimum. Modern heavy-duty milling machines are equipped with rapid traverse, braking of the work spindle, remote control of feeds, a device measuring the table position, a conventional and climb milling attachment, automatic feed cycles, etc. All these attachments and design features on the milling machines enable a certain degree of automation of the work cycles of plain milling operations of a relatively short duration. By this automation of the

feed cycle the production time proper in current milling work is reduced on an average by 8 to 10 per cent.

The most simple case of automatic control of a work cycle on milling machines is the use of adjustable stops which are set along the work table according to the required length of its stroke. The stops in both extreme positions of the table limit its feed to the left and right.

When the stop strikes against the end switch situated on the saddle, knee or bed of the milling machine an electric contact disengages the electromagnetic clutch or the feed motor and the work feed of the table is stopped. However, the next table feed must be engaged again by hand. These stop systems can also be employed with the cross feed of the table and with the vertical feed of the knee according to the nature of the milling machine design.

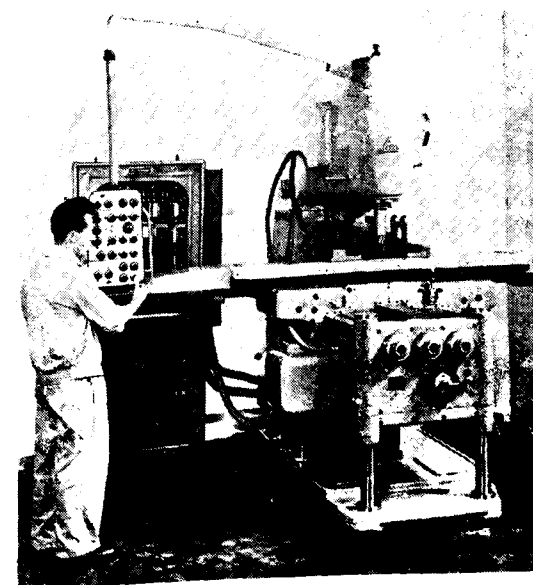


Fig. 1. FB 40 V vertical knee-type milling machine with stop-operated programme control of the rectangular feed cycle by means of a punched tape.

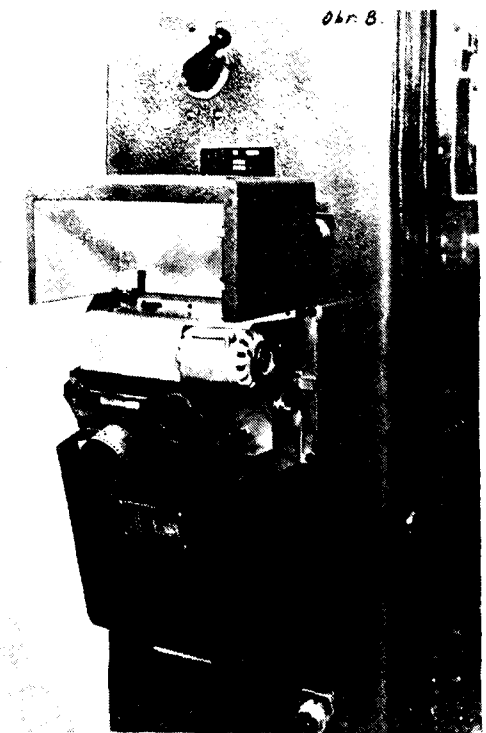


Fig. 2. Reading attachment.

The Czechoslovak knee-type milling machines of the FA series are normally fitted with these stop systems. Apart from this, on special order the machines can be supplied equipped with the so called "jump feed attachment" which, besides the stops at the extreme positions of the work table, are equipped with additional stops. These additional stops automatically change over the rapid traverse to the work feed and vice versa as a result of which, and with the help of two or more work-holding fixtures, auxiliary times during clamping in the course of the milling operation can be substantially reduced. The number of stops depends on the number of changes from the rapid traverse to the work feed. This attachment enables a large number of combinations of the automatic feed cycles.

Tab. II-2

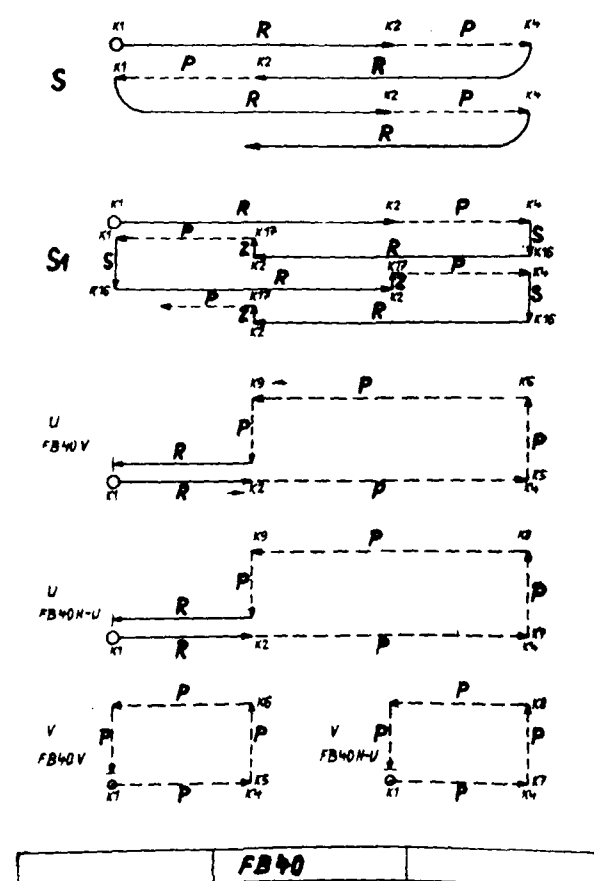


Fig. 3. Examples of rectangular feed cycles.

The knee-type milling machines of the new FB series are equipped with automatic lowering of the knee by 0.5 mm. This lowering attachment is controlled by a stop at the longitudinal table feed. By the withdrawal of the workpiece the tool is

protected against wear in the course of its rapid return motion and at the same time the machined surface is protected against damage. Automatic withdrawal of the tool from the machined surface at the rapid return motion is also employed on the unit head plane milling machines FR series. There are two alternatives in this case: the whole milling head-

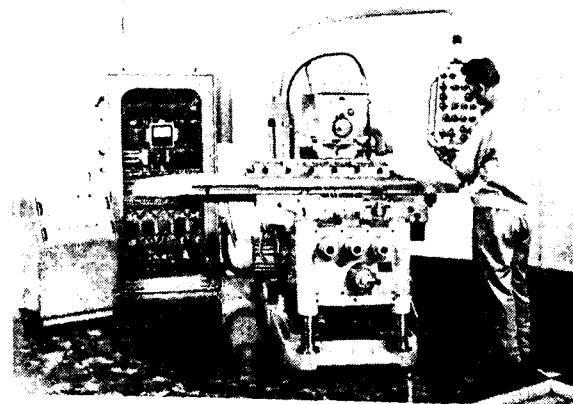


Fig. 4. FB 32 H horizontal knee-type milling machine with stopless digit-type programme control of the rectangular feed cycle by means of a punched tape.

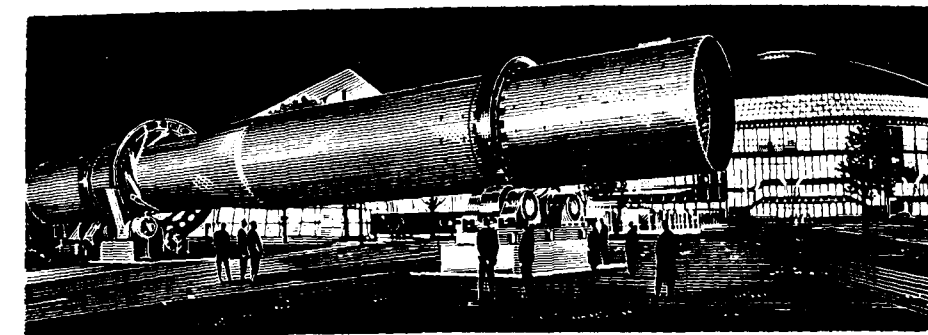
stock is withdrawn by 0.05 mm, or only the spindle sleeve is withdrawn by a pre-selected value. Before each withdrawal first the locked headstock or spindle sleeve is automatically released. After its in-feed into the original position the headstock or the spindle sleeve is automatically locked again. The withdrawal and return movement as well as the in-feed into the original position and the locking of the individual above mentioned machine groups of the plane milling machines of the FR series are controlled by hand by depressing of the pushbuttons or automatically by adjustable stops.

The milling machines of the FB and FR series are designed and built to enable automation of the most complicated rectangular feed cycles by means of attachments. When working on the knee-type milling machines of the FB series the workpiece moves alternately in three directions which are at right angles to each other in either sense, at different speeds and by work or starting (slowing down) the feed, or by rapid traverse. All movements of the table, slide and knee are derived from a common asynchronous electric motor through a gearbox with ten electromagnetic clutches. Six of the clutches serve for selection of the direction and sense, three of them for selection of the feed speed, while one clutch acts as a brake for the feed mechanism. The motor is not disengaged while changing the feed, but runs always

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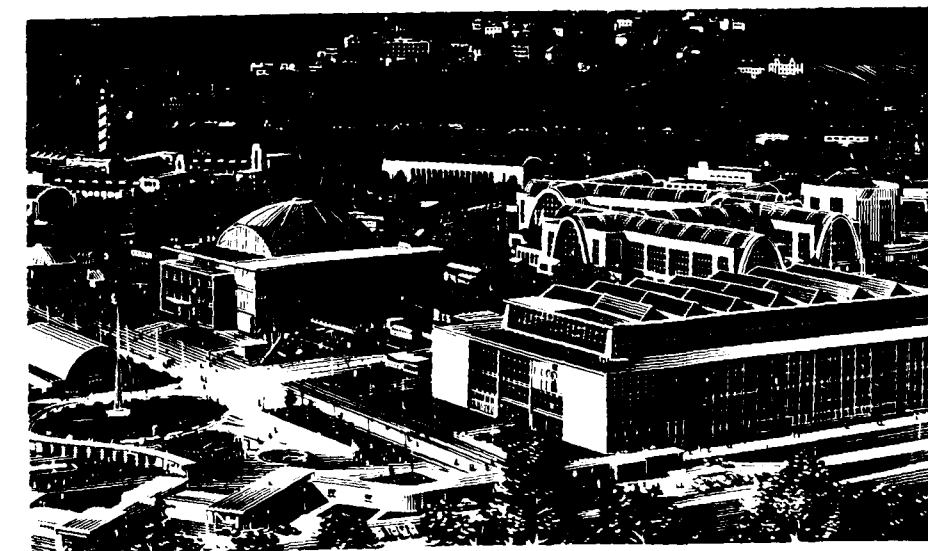
10th to 24th
SEPTEMBER 1961

To the man with a question on his mind!

The more heat is generated over the impending European free trade area the more we must temper our criticisms of designing in British industry. For some companies a radical change of attitude is needed along the lines put forward in the following article. Dr Murray is what he has prescribed for others: a design specialist on the board of directors. His work for 'Whitehead' fabrics is well known; his connections with 'Waverite' laminates and 'Spectrum' fabrics were described in DESIGN for April and May. The case he argues rests solely on Britain's need to compete successfully in a



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in the same sense at constant speed. The knee is lowered and raised by an additional asynchronous motor engaged by a reversing contactor. The change of the number of work spindle speeds and of the rate of work feed is not automated, but effected by hand.

The automatic feed cycle of the milling machine is programme-controlled by a punched tape 35 mm wide divided into blocks of a standard length of 76 mm. Each block comprises a certain number of holes for the intended movement. The punched tape consists of a smaller or larger number of such blocks according to the intricacy of the whole feed cycle. The commands given by the system of holes in the

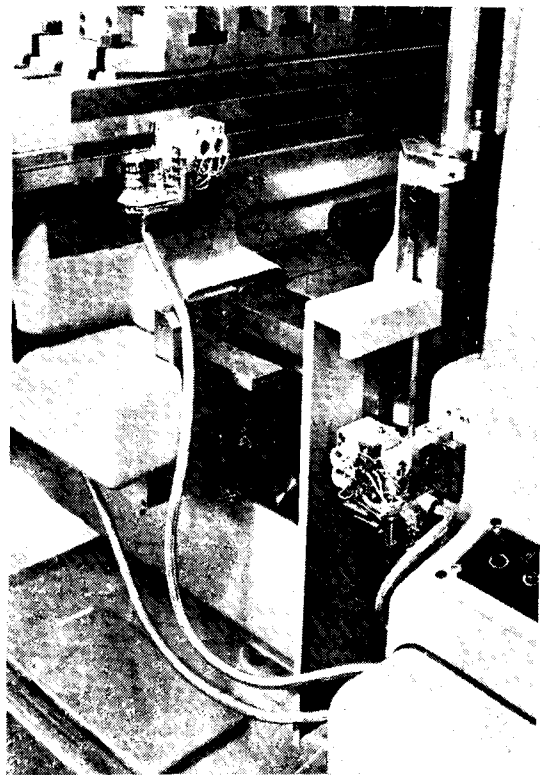


Fig. 5. Longitudinal and vertical measuring device of the stopless digit-type programme control.

punched tape are picked up by a reading attachment and transmitted by a system of relays to the feed drive. The contactors controlled by stops emit impulses for feeding the punched tape by another block in the reading attachment.

The reading attachment consists of a set of contact needles closing only those electric circuits for which a hole is provided in the punched tape. The tape is fed after each partial feed whereby the reading of the information is picked up at rest. Before the tape is

fed first the head of the reading attachment with the contact needles is opened and after the punched tape has been fed by one block the head is pressed to the tape again. The contact needles are depressed by a spring and can pass through the holes in the tape only.

The tape is punched by a plain hand-operated attachment and after the punching has been finished both ends of the tape are pasted together. The punched tape is prepared in the technological department and can be used several times and kept in stock for repeated production. Several machines for the same work can be controlled by one tape. The

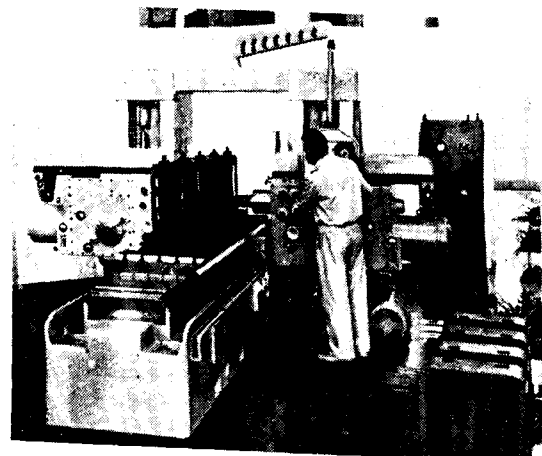


Fig. 6. FRM 6 plane milling machine with stop-operated programme control of the rectangular feed cycle by means of a punched tape.

technologist must ascertain the cutting conditions which should be strictly adhered to especially as far as the feed rate is concerned.

Milling machines adapted for use of the above described stop-operated programme control of the rectangular work cycle are set up as follows:

- (a) preparing of the working process in the technological department,
- (b) preparing of the punched tape,
- (c) setting and clamping of the workpiece on the work table of the milling machine,
- (d) setting up of the stop on the milling machine.

The digit-type control of the rectangular cycles of the FB milling machines is a further stage of development of these machines which until now have operated in a rectangular feed cycle controlled by stops. The use of this stopless system of programme control requires determination of the length of stroke of the workpiece in all three co-ordinate axes and, in

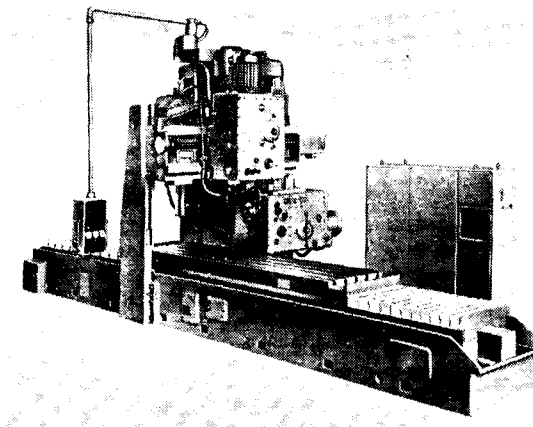


Fig. 7. FRO 8 plane milling machine with stop-operated programme control of the rectangular feed cycle by means of a punched tape.

the case of knee-type milling machines, also selection of the system of holes in the punched tape. On the block of the tape numerical information about the length of the feed path in a pure decade code and further on information for the control proper of the machine functions of the programmed work cycle are given. For measuring the position of the work table glass bars with marks of a pitch of 0.04 mm and a bulb ray falling on a photoelectric cell are used. By photoelectric picking-up through a double vernier an electric impulse for each feed movement of the work table of 0.01 mm is obtained.

The length of the table movement is pre-selected on the punched tape and attainment of the respective position of the workpiece is indicated on the measuring device. Preselection of the length of movement of the work table or knee in any direction of the space coordinate axes is carried out by punching in a complete block of the punched tape where 50 needles are provided. The vertical columns represent ten digits from zero to nine while the horizontal lines from above represent the hundreds, tens, units, tenths and hundredths of millimetres. This method of registration is called the plain decade code.

The functions assigned to the needles in the block of the punched tape with the stop system remain unchanged also for stopless control. Attainment of the position of the work table or knee is indicated on the measuring device. As soon as the whole punched tape in the reading attachment is fed to its end the needles trace the new block and engage the respective functions. In the field of the plain decade code the needles connect through the punched holes the contact board with the electronic impulse device,

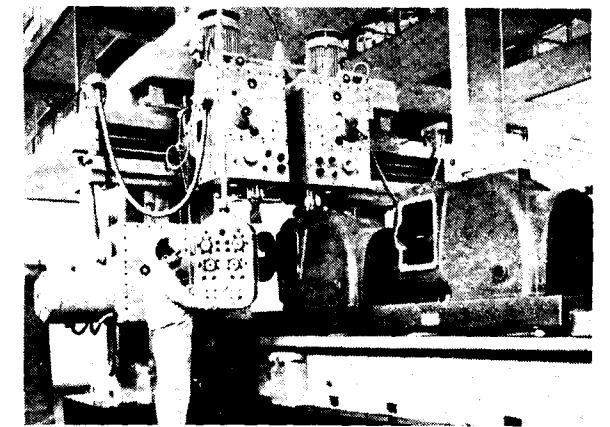


Fig. 8. FRP 12 plano-milling machine with stop-operated programme control of the rectangular feed cycle by means of a punched tape.

the so called deatron counter and pre-select in it the respective number, of the electrical impulses corresponding to the punched number whereby one impulse represents a table or knee movement of 1/100 mm. As soon as the table or knee movement caused by the connection of the respective function in the functional field of the punched tape block starts the measuring device proceeds to emit electrical impulses into the deatron counter, the number of these impulses corresponding to the movement of the table or knee in hundredths of a millimetre. The registering mechanism—the deatron counter—counts the impulses and as soon as the number of the pre-selected impulses equals the impulses received from the measuring device it emits a signal equivalent to the signal sent out when the stop strikes on the limit switch in the stop system of the programme control, and the punched tape is fed by another block. The number pre-selected on the tape is thus a sort of symbolic stop which, by way of registration, can be “adjusted” in any place. Since the longitudinal, cross or vertical movements of the workpiece occur successively the deatron counter is common for all three directions. It is always switched over by a relay to that coordinate axis where a movement is carried out.

CONCLUSION

The FB knee-type milling machines and the FR plane milling machines with an automatic feed cycle operated by stops or without stops, according to the prepared programme, are important helpers in single-part and small lot production. The rectangular feed cycle can be used to advantage for the machining

of a large number of variously shaped parts. The automatic cycle enables the attendance of several machines at once so that also those parts can be machined economically in the case of which no advantage can be seen by mere comparison of the

production time with the time required on a standard milling machine. The means of obtaining the automatic cycle are relatively simple so that this method of automation involves low investment costs which are soon recovered.

Selling Prices of Ferro-Silicon — Tariff Commission Enquiry

Opening the public inquiry into the question of revision of selling prices of ferro-silicon held at the Tariff Commission's office, Shri K. R. P. Aiyangar, Chairman of Tariff Commission, said: "Ferro-silicon is widely employed in metallurgy for finishing carbon steels and for producing alloy steels with special mechanical and physical properties. Production of steel, which is the most vital industrial material, is expected to increase from 2.6 million tons in 1960—1961 to 6.9 million tons in 1965—66. Ferro-silicon will thus be required in ever increasing quantities."

Shri Aiyangar observed that although all the raw materials required for the manufacture of ferro-silicon were available indigenously, its production had lagged behind the demand necessitating imports and a drain on the country's extremely limited foreign exchange resources. It was hoped that due care would be taken to ensure that, in future, the indigenous production of ferro-silicon kept pace with its rapidly increasing demand. Either directly or indirectly steel entered into final cost of practically every consumer article and for that reason it was essential to prevent undue increase in steel prices. This applied equally to all those items which went into the making of steel. The Chairman emphasised that the producer of ferro-silicon should try to offset the unavoidable increase in the cost of production as far as possible by taking advantage of large-scale production, keeping abreast of modern techniques and increasing operational efficiencies.

After tracing the history of price fixation, Shri Aiyangar stated that the Mysore Iron and Steel Works, the only producer of ferro-silicon in the country had asked for an increase in the existing selling prices because the cost of production of ferro-silicon had gone up. The annual rated capacity of the Works was assessed at 5,570 tons in 1953 and no additions had been made to it since then. Production of ferro-silicon of all grades rose from 3,808 tons in 1953 to 4,417 tons in 1954 and 5,184 tons in 1955. There was a slight decline during 1956 and 1957, production

being 4,523 tons in 1956 and 4,621 tons in 1957. From 1958 onwards, production again went up to 5,675 tons in 1958 and to 7,203 tons in 1959. Production during the first six months of 1960 had been 3,123 tons.

The discussions that followed related to annual domestic demand, raw material and consumable stores used in the manufacture of ferro-silicon and quality and selling prices of the indigenous product.

* * * * *

EXHIBITION OF SEMI-CONDUCTORS FOR INDUSTRIAL PURPOSES

An exhibition of semi-conductors for industrial purposes, specially staged for producers and users of electronic equipment, was held in London recently at Mullard House.

The aim of the exhibition was threefold: to give examples of the widespread use of semi-conductors in an increasing number of industrial and scientific applications; to produce the Mullard Company's new computer-based system of life-testing; and, third, to present the complete range of the company's industrial semi-conductor devices, together with full technical data and applications information.

Nearly 150 exhibits, the products of 100 different electronics firms, were shown. Every item incorporated Mullard semi-conductor devices of one kind or another and between them the exhibits formed a representative cross section of the company's industrial markets. Categories included industrial control systems; computers, medical electronics; r. f. and a. f. communications equipment; test gear; measuring instruments; and a wide range of sub-units such as power supplies, amplifiers, converters, regulators and so on.

ELECTRICAL INDUSTRIES ANNUAL SUPPLEMENT

LARGE BRITISH-BUILT HYDRO-ELECTRIC PLANT

The British electrical industry is capable of manufacturing hydro-electric generating plant of any size and for service anywhere in the world. This article describes some of the larger hydro-electric installations for which plant has been made in Great Britain, and shows the way in which the industry in this country has gone forward to meet world demand, even though the opportunities for installing such large Machines have not, in the past, occurred in the home market.

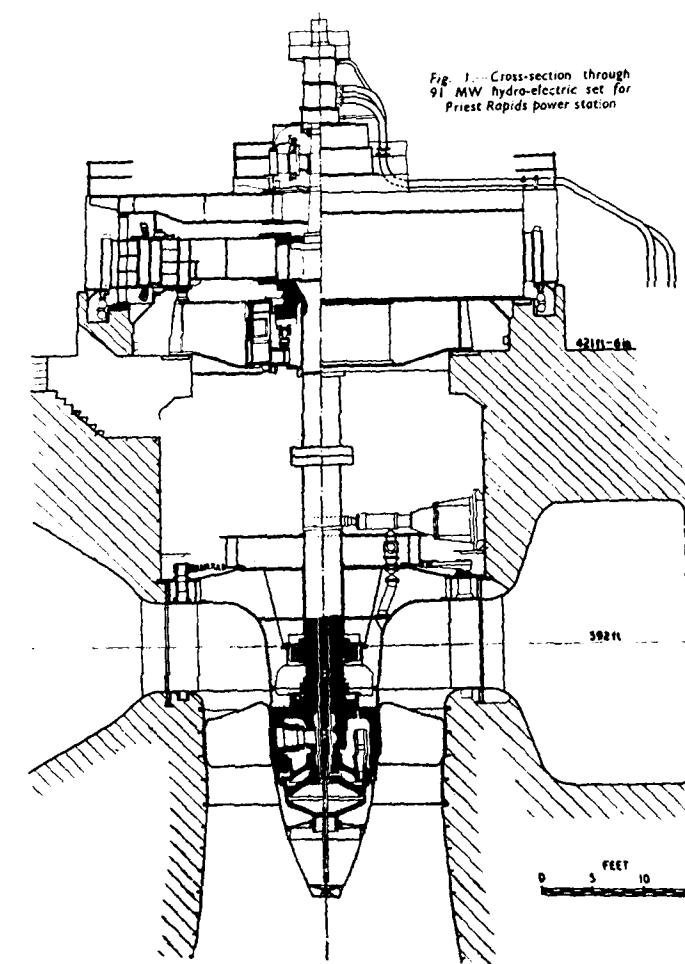
ENGINEERS concerned with thermal power stations have become accustomed to thinking of individual steam turbine driven alternator sets with ratings of 200 MW and up to 550 MW, whereas the average size of machines in Great Britain before 1950 was in the range 30 to 100 MW. These very outstanding increases in size have been associated with advanced steam conditions, even into the super-critical range, and with hydrogen-cooled alternators operating at relatively high overall thermal efficiencies of well over 30 per cent.

Water turbines and their associated generators, even in smaller sizes, have overall efficiencies of up to 90 per cent. Thus, the advantages of increasing size are not comparable with those of the steam plant. Despite this, the maximum output of individual British hydro-electric units has, during the past ten years, increased from 80,000 h.p. to 200,000 h.p. During the previous ten years, the increase was from 40,000 h.p. to 80,000 h.p., thereby making a five-fold increase in twenty years. As in the case of steam turbines, the increase in capacity of the high-voltage power networks has permitted such large units to be incorporated in systems without difficulty, but here the similarity between the two types of prime movers ceases.

The planner of a hydro-electric project has to accept the water pressure which can be developed within the limitations of the topography of the area in which he works, and he cannot, in a given area, increase the pressure in the output. The water quantity must, therefore, increase in direct proportion to the increase in output and the linear dimensions on this basis will increase with the square root of the output. However, another factor is involved with the increasing size of machine and that is, that for a given design of turbine operating at a given head (water pressure), the speed

varies inversely as the square root of the output. These two factors operating together result in the physical size of the water turbine and alternator becoming very large and fix the limit of the rating which can be obtained when the head is low.

Theoretically, there is no limit to the physical size,



and Fig. 1, which is a cross-section through one of the Priest Rapids water turbines and alternators being manufactured by the English Electric Co., Ltd., shows the largest turbine so far made in this country. The alternator has only been slightly exceeded in size by the two machines made by the same company for the McNary power station, which is also in the United States. The maximum output of the Priest Rapids power station will be 910 MW and this is provided by ten sets running at 85.7 r.p.m. The plant is being supplied with only a short time interval between each set, to meet a load which is anticipated to demand the full station output as soon as the plant is in full service.

The sub-division of the plant into ten sets was largely dictated by the physical size of the individual parts, such as the alternator and turbine shaft, the forgings for which are so large that only a very few forges in the world could produce them. A further important advantage in limiting the output of each turbine is that the depth of excavation for the draught tube, which is directly proportional to the runner diameter, would have to be increased if the output was increased. Two of the alternator shaft forgings, which weigh 108 tons each as forged and 69 tons in the rough machined state, can be seen in course of manufacture in Fig. 2. If the number of machines had been reduced and the output of each set increased to give the same total for the station, the speed of the machines would have been reduced and the shaft diameter increased,

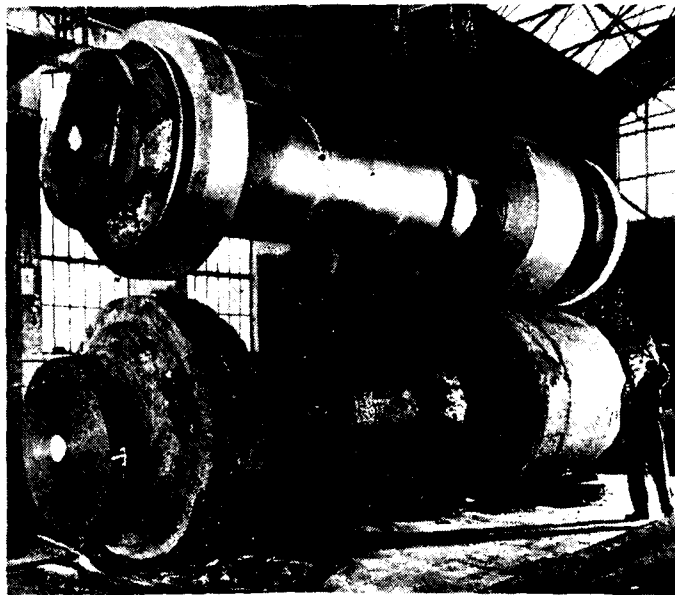


Fig. 2.—Black and rough machined forgings for the Priest Rapids alternator shafts.

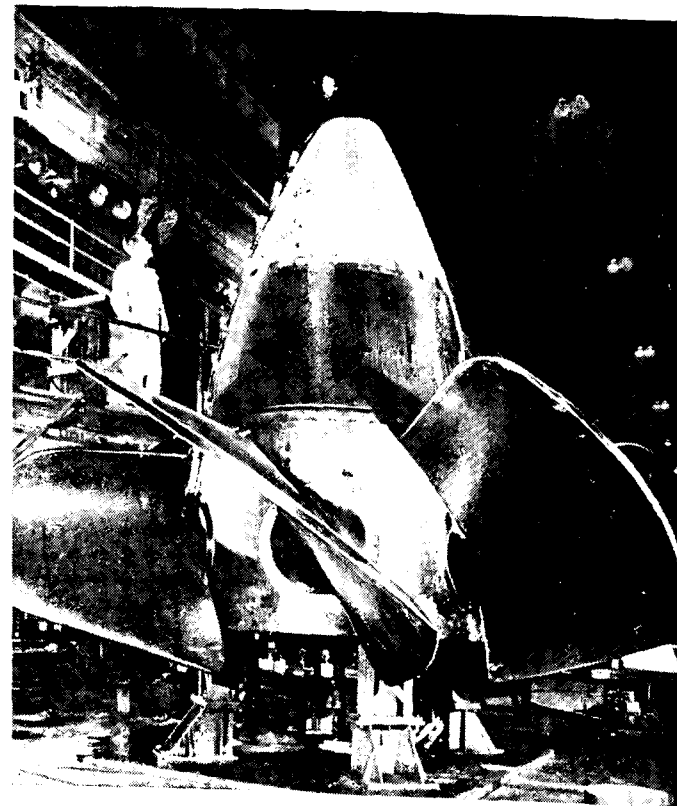


Fig. 3.—Works assembly of water turbine runner for Priest Rapids.

with a corresponding increase in forging weight. This would have reduced still further the number of available suppliers, although this limitation could be overcome if fabricated shafts were adopted.

The sets at Priest Rapids are of the Kaplan type, so the runner is conveniently divided into a number of parts which, individually, are not large. This does away with transport difficulties. The runner has six blades, each of which is a steel casting with an integral trunnion, and the diameter across the blades as assembled in the cast steel runner hub is 23 ft. 8 in. When the turbine is in service, the angle of the blades is adjusted by an oil pressure operated servo-motor in the hub, so that the given water flow characteristics are maintained through the turbine even when there is a variation in the head from 33 ft. to 84 ft. Under these conditions, the Kaplan turbine gives higher outputs at low heads compared with the fixed-blade alternative.

The turbine runner is completely assembled in the works (see Fig. 3) and this involves the provision of special apparatus to handle the various parts of the complete runner, which weighs 155 tons. Even the nuts

for the blades weigh 6½ cwt. and, obviously, these cannot be handled by a fitter without lifting tackle. The runner is assembled in an inverted position at the works as this avoids lifting separate components from below, but, as it would not be possible to turn the runner over, it is assembled in the correct position at site, and again special tackle has to be provided. The remaining components of the turbines and alternators are bulky and almost entirely of fabricated steel construction. The physical size of the various components is so large that special machine tools and handling facilities are essential for their manufacture. A general view of the English Electric erecting shops at Netherton, where the turbines and alternators were made, is shown in Fig. 4. A final assembly of one of the Priest Rapids turbine stationary parts is in the foreground, while part of the machine shop can be seen in the background.

When the head, and consequently the water pressure, is low, as it is at Priest Rapids, unlined concrete water passages can be used to convey the water from the reservoir to the turbine. Three passages feed into a scroll casing. This is illustrated in Fig. 5, which also

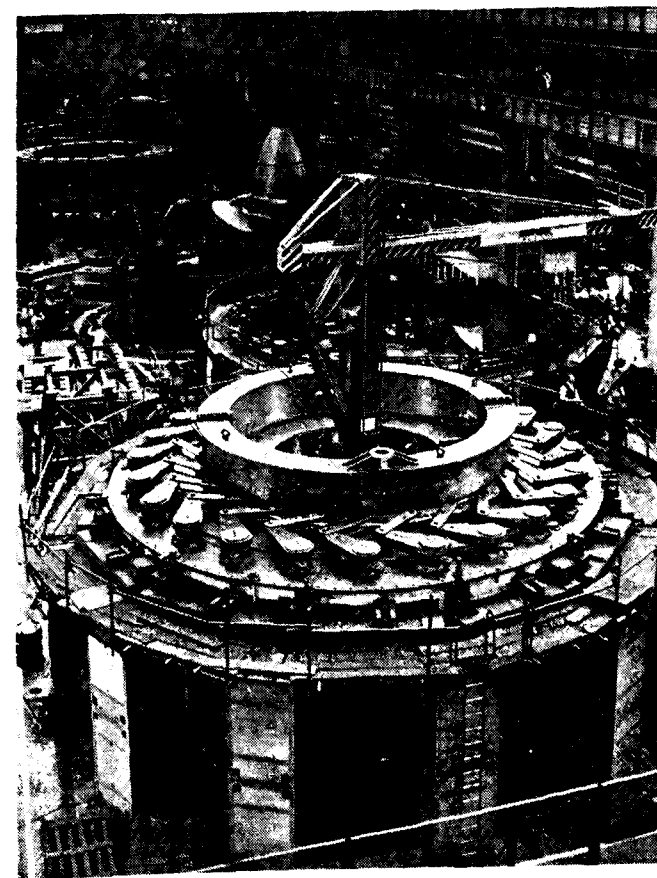


Fig. 4.—Assembly of turbine stationary parts for Priest Rapids and general view of the English Electric assembly bay.

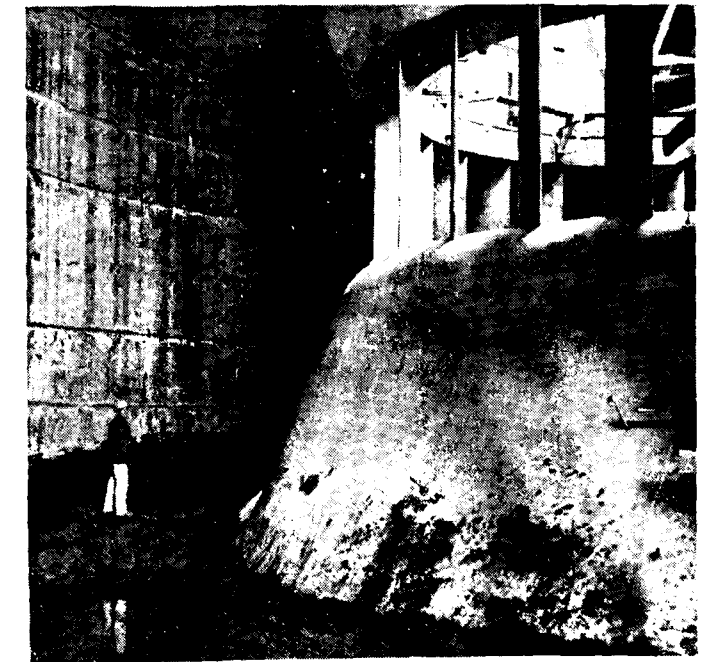


Fig. 5.—Interior of concrete scroll casing and fabricated stay ring for a Priest Rapids turbine.

shows the fabricated steel stay ring breaching the throat which leads water inwards to the turbine runner.

In accordance with normal American practice, the alternators are not completely assembled or tested in the works, but sub-assemblies are carried out to prove that matching parts will go together. The rotor, which has a rim built up of steel laminations, is therefore assembled completely for the first time when the individual components arrive at site, and so far this operation has been taking place smoothly. The weight of the rotating parts of the machine plus the load due to the hydraulic thrust arising from the passage of water through the turbine, all of which adds up to a total of 1,600 tons, is taken by a pivoted pad-type bearing mounted underneath the rotor. High-pressure oil can be fed between the bearing pads and the thrust collar on the shaft to establish an oil film when starting the machine from rest. Owing to transport limitations, the stator is divided into six parts. Both the core and windings are completely built in the works, apart from the coils and joints in the stator.

The rate at which the electrical system load is building up in the United States and the presence of large rivers, such as the Columbia, have already led to machines of the size being installed at Priest Rapids, but the power systems of countries like India have not, so far, reached such a stage of development. The

REPRESENTATIVE SELECTION OF MODERN WATER TURBINES WHICH HAVE BEEN DESIGNED OR HAVE BEEN SUPPLIED OR ARE UNDER CONSTRUCTION BY BRITISH MANUFACTURERS

Name	Country	Type	Manufacturer	Number of units	Output in b.h.p. per unit	Net head feet	Speed r.p.m.	Overall runner diameter	
Chute-des-Passes	Canada	Francis	E.E. Co.	5	200,000	540	200	13	8
Bersimis I	Canada	Francis	E.E. Co.	4	175,000	875	277	11	11
Kariba	Rhodesia	Francis	Boving	6	140,000	280	167	13	6
Snowy TI	Australia	Francis	E.E. Co.	4	134,500	1,095	375	9	3
Priest Rapids	United States	Kaplan	E.E. Co.	10	131,000	84	85.7	23	8
Belesar	Spain	Francis	Boving	3	105,000	436	214	10	4
Ffestiniog	Wales	Francis	E.E. Co.	4	105,000	970	428	8	5
Eildon	Australia	Francis	Boving	2	82,100	235	150	12	5
Rihand	India	Francis	E.E. Co.	5	77,000	225	150	12	11
St. Lawrence	Canada	Propeller	E.E. Co.	16	75,000	81	94.7	21	0
Los Peares	Spain	Francis	Boving	3	73,800	306	214	9	5
Cabril	Portugal	Francis	E.E. Co.	2	73,000	384	214	10	9
Table Rock	United States	Francis	E.E. Co.	4	68,000	190	128.6	14	0
Ponte Coberta	Brazil	Francis	E.E. Co.	2	62,000	115	115.4	15	10
Salto de Castro	Spain	Francis	Boving	2	59,000	125	107	15	11
Clachan	Scotland	Francis	E.E. Co.	1	56,000	897	428	7	8
Hirakud	India	Kaplan	E.E. Co.	2	52,000	87	150	15	9
Sir Adam Beck No. 2 (Pumped Storage)	Canada	Deriaz	E.E. Co.	6	45,000	83	92.3	22	4
					(These units operate in reverse as 55,000 h.p., 4,600 cusec, 5 ft. head pumps)				
Hirfanli	Turkey	Francis	E.E. Co.	3	44,000	197	187	10	11
Finlarig	Scotland	Impulse	Boving	1	42,000	1,250	375	9	8
Tungatinah	Tasmania	Francis	Boving	5	35,000	935	600	5	10
Atiamuri	New Zealand	Francis	E.E. Co.	3	30,000	81	125	13	7
St. Fillans	Scotland	Francis	Harland Engineering	1	30,000	785	600	5	1
Invergarry	Scotland	Kaplan	E.E. Co.	1	28,000	167	250	9	5
Waipapa	New Zealand	Kaplan	Boving	3	24,000	53	125	16	0
Owen Falls	Uganda	Kaplan	Boving	8	21,000	62	150	13	7

development of the Rihand River in Uttar Pradesh, India, is therefore being carried out with water turbines and alternators which are, nowadays, generally accepted as of average size. As the turbines have to operate at a medium head varying from 143 to 250 ft., Francis type machines have been adopted. The total power station output has been divided between five sets, each having a rating of 55 MW, and there is room for

a sixth set should it become necessary to extend the station in the future. The runner of a Francis turbine cannot conveniently be split for transport and this component, therefore, limits the size to which it is possible to go with this type of machine. The Rihand runner has a diameter of 12 ft. 11 in. and, when allowance is made for the minimum amount of packing, it is the largest size of component which can be

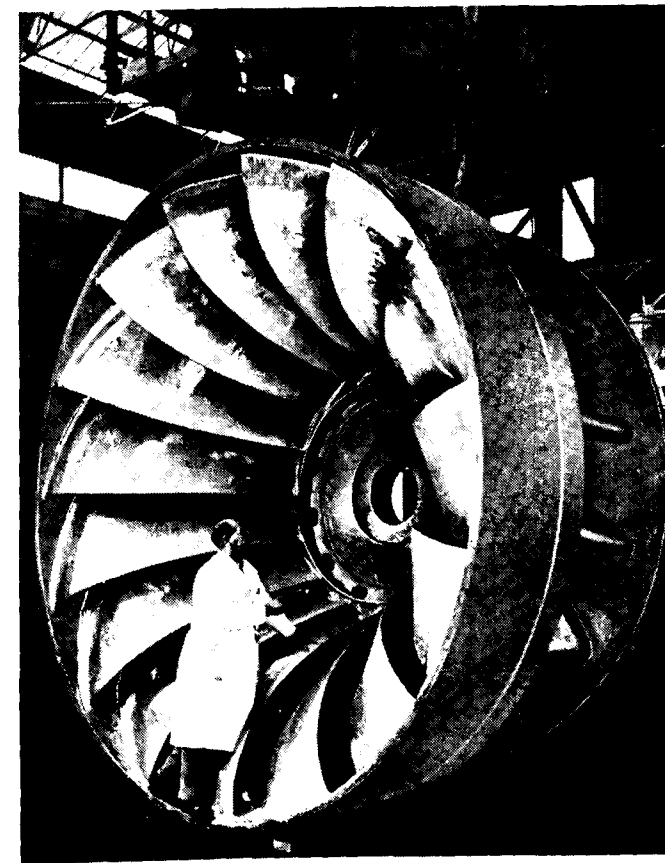


Fig. 6.—Inspection of one of the turbine runners for Rihand power station

transported by rail from Calcutta Docks to the power station. The runner is a single-piece steel casting (see Fig. 6) and extensive testing of a geometrically similar but reduced scale model runner was carried out at the English Electric hydraulic laboratory at Rugby.

Tests of this nature are a very necessary part of the development of the designs for large water turbines and, in the case of Rihand, particular attention was paid to the performance of the turbine under those conditions where there is a risk of cavitation. This phenomenon occurs particularly when the amount of suction in the draught tube becomes high, with an increase in load, causing the formation of very small bubbles in the water. The formation and collapse of these minute bubbles could cause serious pitting of the steel surface. The same effect takes place if the stream line of the water flow through the runner is disturbed, due to operation at loads or heads outside the normal range.

These cavitation conditions can be simulated on the test berth in the hydraulic laboratory (see Fig. 7) which

operates with a closed water cycle, so that the pressure in the turbine draught tube can be reduced to an amount well below that which will occur at site. From these tests it is possible to assess the amount of stainless steel protection which it is necessary to weld on to the runner blades in the area liable to cavitation damage. It also makes it possible to decide upon the exact form of the runner blades and the number of blades required on the runner. Obviously, these factors must be determined before the first of the machines is installed in the power station, and it is only possible to do this with the aid of model turbines and extensive testing facilities.

The water pressure for Rihand is higher than at Priest Rapids, so a fabricated steel spiral casing is needed to lead the water from the pipeline into the turbine. This spiral casing would be far too big to transport, even if it were divided into quarters. It is, therefore, assembled at the works to prove that the plates have been correctly formed and then it is broken down again into sections small enough to transport with ease. During the trial assembly, clamps are welded to the outside of the spiral casing so that they can be used later on for re-assembly at site.

The same procedure is followed for the draught tubes, each of which is fully erected in the works, as can be seen from Fig. 8. It will be seen that the draught tube liner extends around the bend of the tube. This arrangement speeds up site construction, as it eliminates the need for the complicated shuttering which would otherwise be necessary.

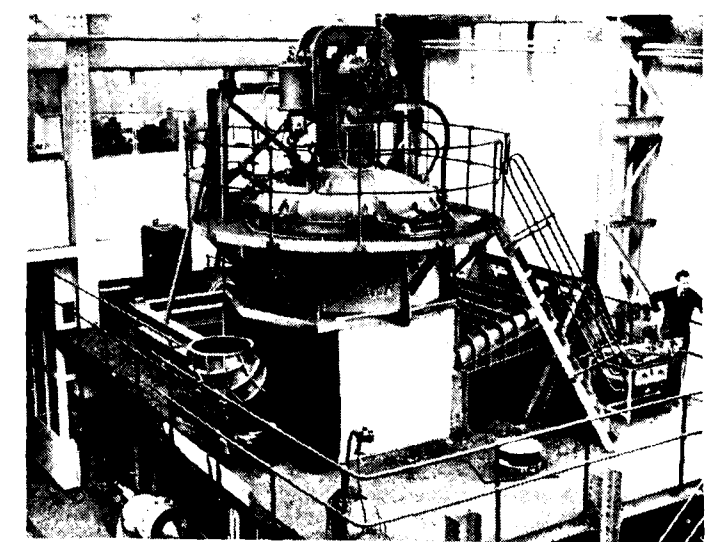


Fig. 7.—Cavitation test rig for water turbine runners, spiral casings, and draft tubes in the English Electric hydraulic laboratory at Rugby

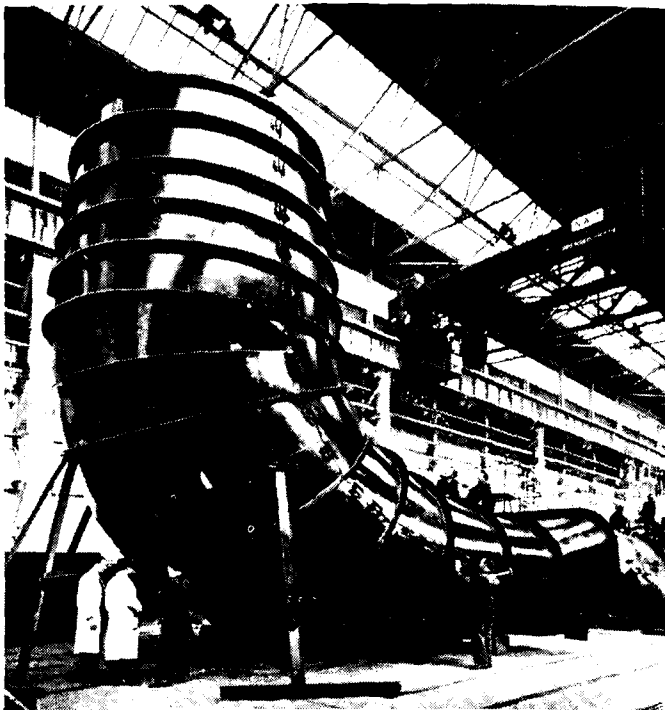


Fig. 8.—Works assembly of fabricated steel draught tube for Rihand.

The alternators run at 150 r. p. m. and are rated at 61 MVA. Like the machines for Priest Rapids, they are of the umbrella type, in which the thrust bearing is situated below the rotor. In this case, the first of the five alternators was completely assembled in the works, so that a full series of performance tests could be carried out. Fig. 9 shows a rotor being assembled preparatory to those tests. The tests included a full kVA heat run, which was carried out by running the machine as a synchronous motor at approximately zero power factor, the reactive load being provided by reactors.

Water turbine driven alternators have to withstand the maximum speed which the machine might attain if full load was lost from the generator, and the guide vanes, which regulate the quantity of water, failed to shut. In the case of Rihand, this means that the rotating parts of the alternator must be designed to withstand running at 273 r.p.m., compared with the normal running speed of 150 r.p.m. The alternator was tested at this speed by running it as a synchronous motor connected to a variable-frequency motor-generator set capable of producing the necessary over-frequency to give the required speed. In the case of alternators driven by Kaplan turbines, this runaway speed can be as much as three times the normal running speed.

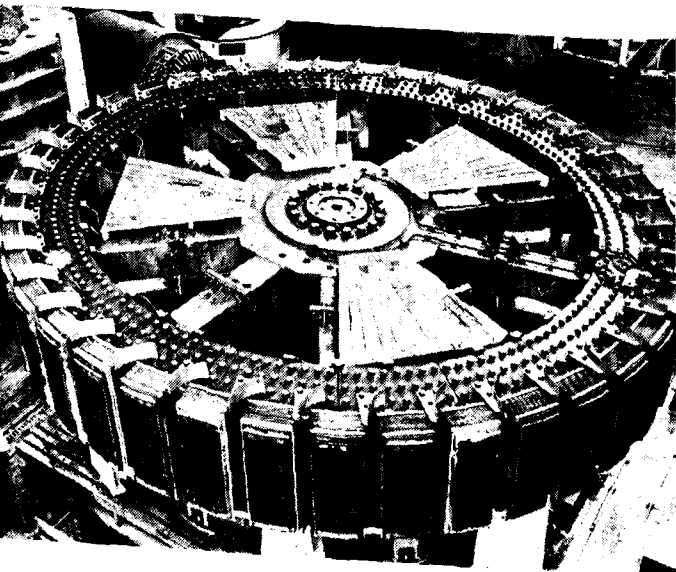


Fig. 9.—Rotor for the Rihand alternator during assembly for works test.

The four turbines installed in Snowy T-1 underground power station are now all in operation.

The alternators which have already been described are low-speed machines and are well within the maximum practical output which can be obtained for those speeds. It is possible to design machines for outputs above the curve, but they are rather expensive. Two of the English Electric alternators for the Kemano

One of the most significant developments in hydro-electric engineering which has taken place during the last few years is the extension of the range of heads for which Francis turbines can be designed. The Snowy T-1 power station in Australia is one example of a high-head Francis turbine installation. The net head of these machines is 1,095 ft., and they each have an output of 134,500 h.p. Because of the high head, the water quantity for this large output is small when compared with an installation such as Priest Rapids, and the problems which are involved are concerned more with the technique of form and welding thick plates rather than very large sizes. The maximum thickness of the plate for each of the spiral casings is 2½ in., and the hydraulic pressure test was carried out in the works at 900 p.s.i. The turbine runners are also of fabricated construction and it is interesting to compare Fig. 10, showing one of these runners undergoing final inspection in the works, with Fig. 3, which illustrates a runner for Priest Rapids. Each of the runners develops roughly the same maximum output, which gives a good indication of the variety in hydro-electric engineering.

WATERWHEEL ALTERNATORS OVER 60 MVA RATING SUPPLIED OR UNDER CONSTRUCTION
BY BRITISH MANUFACTURERS

Name	Country	Type	Manufacturer	Number of units	Rating in MVA per unit	Speed r.p.m.	Total thrust load tons	Rotor diameter inches	Stator core length inches
Bersimis 1	Canada	V.T.B.	A.E.I.	4	138	277	496	205	105
Kemano	Canada	V.T.B.	E.E. Co.	2	132	327	430	194	97
Kariba	Rhodesia	V.U.	A.E.I.	6	111	166.7	677	309	77
Bhakra	India	V.T.B.	A.E.I.	5	100	166.7	853	268	85
Priest Rapids	United States	V.U.	E.E. Co.	10	95.5	85.7	1,600	418	58
Belesar	Spain	V.T.B.	A.E.I.	3	88	214	500	240	65
McNary	United States	V.T.B.	E.E. Co.	2	85	85.7	1,740	421	64
Ffestiniog	Wales	V.T.B.	A.E.I.	4	78.9	428	310	145	92.5
San Esteban	Spain	V.T.B.	A.E.I.	4	75	214	520	222	85
Eildon	Australia	V.T.B.	A.E.I.	2	66.6	150	552	310	50
Aura	Norway	H.	{ A.E.I. G.E.C.	3	62.5	428	—	* { 127 136	100 95
Los Peares	Spain	V.T.B.	A.E.I.	3	62.4	214	400	211	70
Rihand	India	V.U.	E.E. Co.	5	61	150	320	298	42
Cabril	Portugal	V.T.B.	E.E. Co.	2	61	124	406	207	75

*This station contains machines of two different British designs
V.T.B. Vertical two-bracket V.U. Vertical umbrella H. Horizontal

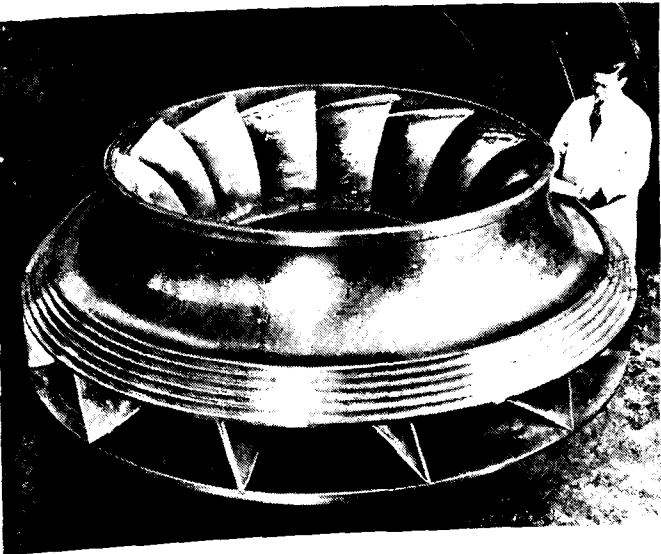


Fig. 10.—Runner for Snowy T.1. turbine being inspected in the works.

power station in Canada, which feeds the aluminium production plant at Kitimat, have a maximum rating of 132 MVA with the machines running at 137 r.p.m. The alternators are of the two-bracket design in which

the thrust bearing is above the rotor and there is a guide bearing above and another below the rotor. The construction of these machines is interesting in that eight steel plates, each 1 ft. thick, are used to form each rotor hub. The plates are shrunk on and keyed to the alternator shaft (see Fig. 11).

The British electrical industry has been bold and imaginative in the way that it has gone forward to meet the world demand for large hydro-electric plant, even though opportunities for installing such large machines have not, in the past, occurred at home. Not only have large water turbines and alternators of British manufacture been installed overseas, but water turbine designs, developed and model tested in Britain, are being successfully used for the manufacture of machines in Canada. Notable examples are the four A.E.I. turbines supplied to the Bersimis power station in Quebec. Each machine operates with a head of 875 ft. and has an output of 200,000 h.p. This output has been exceeded recently by the Chute-des-Passes turbines in Canada, the first of which develops 245,000 h.p., which is the highest output from a water turbine in the Western World. There are five similar machines

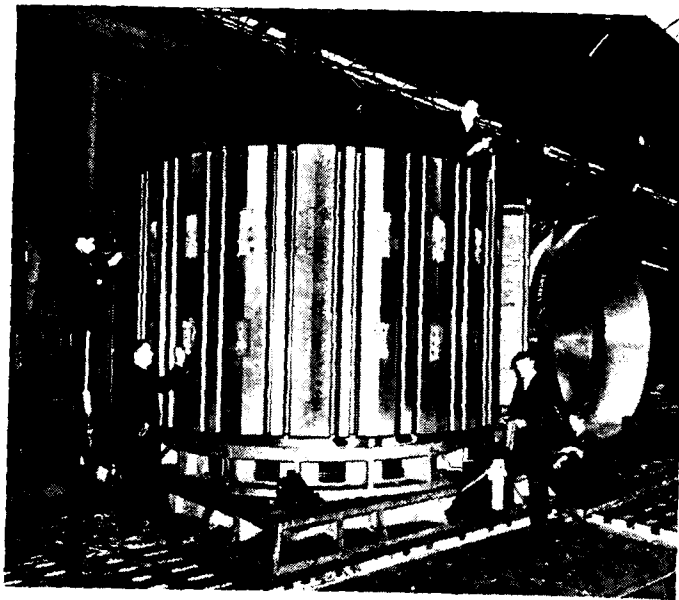


Fig. 11.—Rotor for the Kemano alternator during machining in the works

in the power station and they are controlled by electro-hydraulic governors manufactured in the United

Kingdom. Other power stations for which water turbine designs have been supplied to Canada are the St. Lawrence power station, where there are sixteen 75,000 h.p. units, and the Niagara pumped storage scheme, where six 45,000 h.p. Deriaz reversible pump turbines are in operation.

The experience which the British electrical industry has gained on small machines of advanced design techniques, which have been put into service in Scotland, has been used to good effect. This sort of experience has been used in the past to develop the water turbines for Snowy T-1 and Bersimis, referred to above. These are based on experience gained on the Loch Sloy power station, while the Chute-des-Passes turbines are based on the experience gained from the machines at Rannock, which have been operating in Scotland for nearly thirty years. It can thus be seen that the design and manufacturing experience is available to meet the challenge presented by the call for even larger machines, which will undoubtedly be needed in the future.

(Courtesy: "ELECTRICAL REVIEW", London.)

KUNDAH HYDRO-ELECTRIC PROJECT

An agreement had been reached with the Government of Canada for collaboration in the third and the final stage of the Kundah Hydro-Electric Project, stated Shri Jaisukhlal Hathi, Union Deputy Minister of Irrigation and Power, in a written reply to a question by Sarvashri P. C. Borooah and Iqbal Singh in the Lok Sabha.

The assistance expected from Canada was dollars 22.2 million on account of foreign exchange component. In addition, assistance to the equivalent of dollars 25 million would be made available from the sale of Canadian commodities provided to India, to meet the major portion of the rupee expenditure on the project.

The complete plant and equipment etc., required to be imported, would be supplied by Canada, the Deputy Minister added.

In a written reply to another question by Shri Borooah, Shri Hathi stated that Kundah Power House No. 2 had been commissioned and inaugurated, with two generating sets of 35 MW each. The third set of 35 MW was expected to be commissioned shortly and the fourth unit of 35 MW in 1961-62.

The estimated cost of the project covering stage I (Power House No. 1—40 MW) and Stage II (Power House No. 2, 140 MW) was Rs. 35.44 crores.

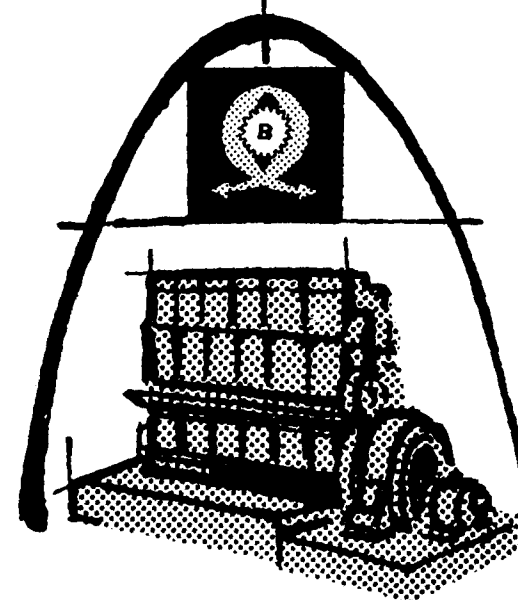
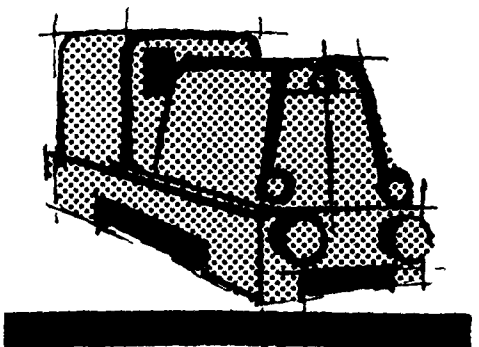
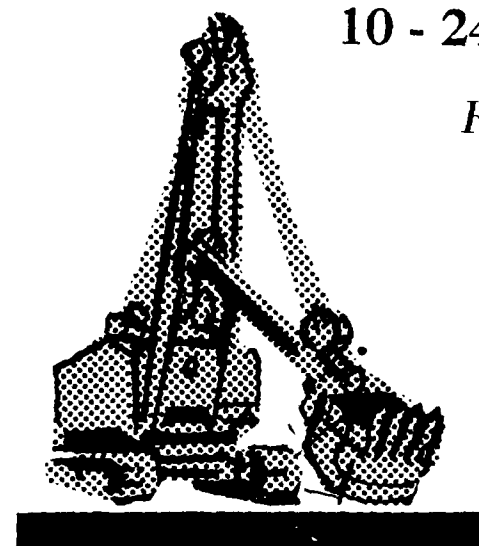
The foreign exchange component of Rs. 12.5 crores for the two stages, was being met by Canadian aid.

** ** **

MADRAS INDUSTRIALIST SEES LATEST U.K. DIESELS

Mr. S. Anantharamakrishnan, Chairman and Managing Director of Simpson & Co. Ltd., Madras, the manufacturers in India of the Perkins Diesel engine, has been touring the main Diesel-engine plant of the Perkins group of companies at their headquarters at Peterborough, England, and seeing the group's latest advances both in production and design.

Simpsons have manufactured Perkins Diesel engines in India for a number of years under an agreement with the Peterborough company. It is estimated that there are now more than 85,000 Perkins Diesel engines operating in India, mostly in passenger transport and goods vehicles.



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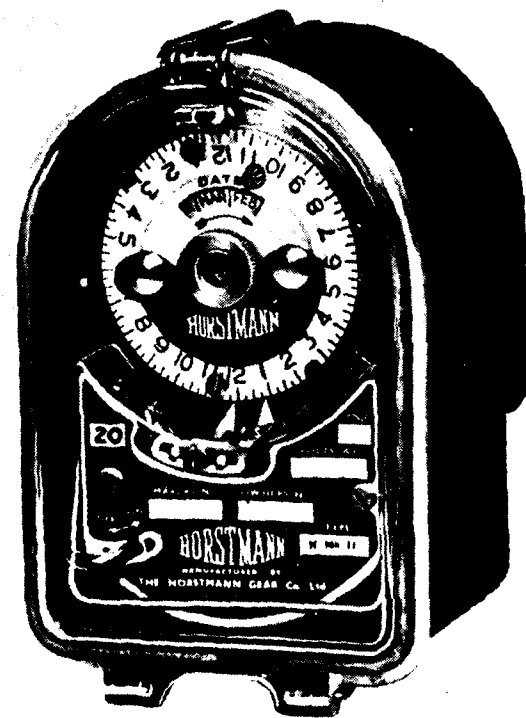
Head Office: 65, Golf Link Area, New Delhi

Branches: { BOMBAY 171/172, Jamshedji Tata Road, Bombay-1 CALCUTTA P-38, Mission Row Extension, Calcutta-13 MADRAS 35/5, Mount Road, Madras-2

NEW TYPES OF ELECTRIC TIME SWITCHES

THE Horstmann Gear Company of England are well known as manufacturers of high quality electric time switches which include models for the automatic control of street lighting, off peak tariff schedules, electric signs and shop window lighting as well as switches for industrial and domestic use. The full range covers hand wound models (15 and 40 day run), synchronous models, and electrically wound models, with or without spring reserve.

The types 'K' Mark 11 and 'Y' Mark 11 time switches are well worthy of attention. Both are used extensively for street lighting and for 'off' peak tariff control, but they have many other uses such as for the control of space heating. The former is a synchronous motor driven switch suitable for use on 200/250 volts 50 cycles time controlled frequency, and units for most other voltages and



Horstmann
Type "K"—Mark 11 Time Switch with Solar Dial.

frequencies can be supplied to order. Hand set or solar compensating dials can be provided and a visual running indicator is fitted. The switchgear can be operated manually without interfering with the normal automatic sequence.

The type 'Y' Mark 11 switch is electrically wound and incorporates a 12 hour spring reserve, otherwise it is similar to the type 'K' Mark 11. The capacity of both these switches at 250 volts is 30 amps A. C. resistive load or 20 amps A. C. inductive load. They can be supplied in either metal weatherproof boxes or in neat moulded boxes at a slightly extra cost.

The new Horstmann AUTO TIMER is proving extremely popular. It is a portable timer by means of which domestic electrical appliances can be automatically controlled by turning a single knob. It can be plugged into any convenient point and the appliance to be controlled, such as a convection heater, fire, blanket, radio or T. V. set etc, is simply plugged into the socket on the timer. The Unit is arranged to switch ON for any period up to 4 hours and operation can be delayed for any period up to 14 hours. It will automatically switch OFF at the end of the pre-set period.

Other new time switches recently introduced by the Horstmann Company include the types 'V' Mark 11 and 'Q' Mark 111 models. The former has a capacity at 250 volts of 30 amps A. C. and has been specially developed to meet the more complex requirements of modern programming schedules and in particular those schedules used for 'OFF' peak tariff control. The latter is designed principally for the control of multi-tube fluorescent street lighting where two circuits have to be switched ON at dusk, one circuit switched OFF at midnight and the other at dawn. Either a synchronous or electrically wound movement can be supplied, the latter incorporating a minimum reserve of 12 hours. The capacity at 250 volts is 10 amps A. C. per circuit.

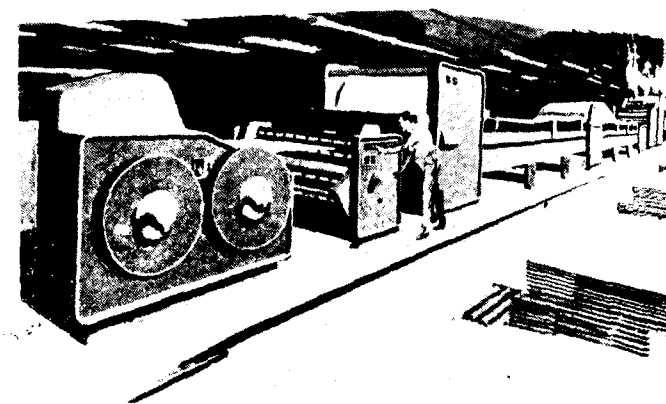
The Company will be very pleased to provide full information concerning switches to meet any particular requirements.

First Fully Integrated Corrugated Board-Making Unit Developed By S & S Corrugated Paper Machinery Company

A new concept in the production of corrugated paper board—the development of a fully integrated machine with every component, from feed to delivery end, redesigned to meet the competitive requirements of modern high speed production—has been announced by S & S Corrugated Paper Machinery Co., Inc.

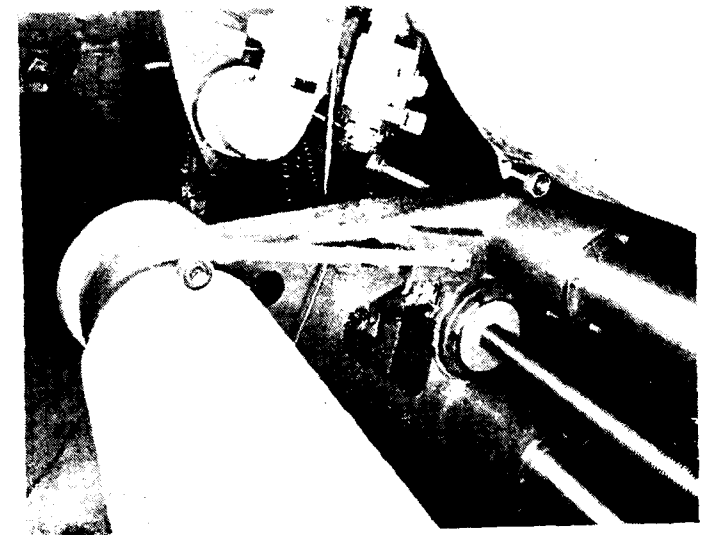
Under development for more than three years, the "Corrubiner"—a term emphasizing the straight line integration of corrugating and combining units—is the result of the S & S research and development group's concept to design and develop—not just a component here and there—but an entire corrugator having superior performance characteristics. These engineers correlated the latest trends in automation, simplicity of operation, ease and economy of maintenance and rugged construction; while functional styling, modern appearance, reliability and accessibility were contributing responsibilities of the design group. The composite result is a corrugating machine that is completely integrated in every unit and component.

A philosophy of high quality together with functional styling governed the new design. Raymond Loewy Associates handled the styling. Dr. Albert Shields, Vice-President in charge of engineering, claims that previous Loewy designs have been not



Artist's rendering of new S & S "700" Corrubiner. The completely integrated configuration carries out the fundamental design concept of operational simplicity, low cost maintenance, precision control of product quality, automatic control, and sequential automatic order changing.

only superior in appearance but, because the design engineers were forced to think about details at greater length, the resultant machines were functionally superior. He is convinced that this corollary has been proved again in the Corrubiner design.

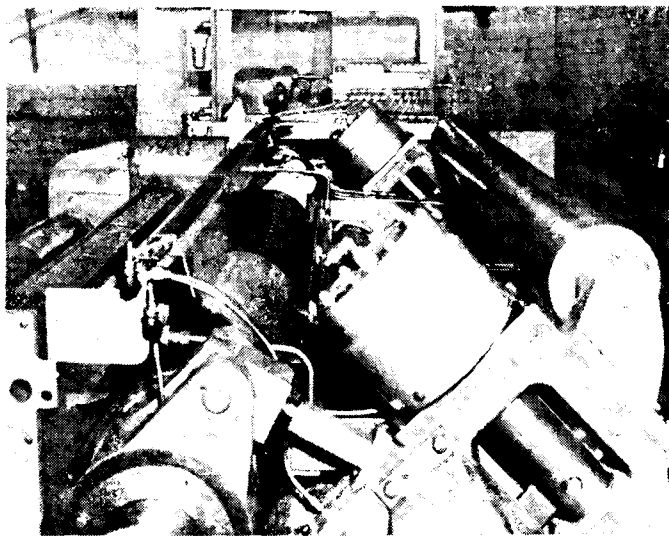


Paper Tensioning Device on S & S Type MRQ Shaftless Mill Roll Stand. A potentiometer, actuated by a linkage that rides the roll diameter, proportionally adjusts the brake torque as the roll diameter decreases to maintain constant paper tension.

Corrugating plant operators will be particularly interested in the ease and speed with which Corrubiner setups can be changed from order to order—without shutting the machine down. This feature is characterized as:

SEQUENTIAL AUTOMATIC ORDER CHANGING

Sequential automatic order changing is a step—controlled rather than a time—controlled sequencing that automatically takes full advantage of optimum time for each stage of order changeover. That is, as each step is completed, the next one is automatically actuated and there is no built-in time delay to slow the changeover cycle. Also, the completion of each step triggers the next one in a chain-reaction sequence that eliminates waiting time but also assures that no operation will take place until the preceding step has been completed.



Single Facer Unit. Differential type, tapered speed glue roll drive, precision ground corrugated rolls, improved rigid design of finger bars, pendant control station for simple threading of liner & medium, one-man operation, easy convertibility from starch to silicate, are some of the outstanding features of this unit.

After pre-selecting the length of the sheet on the cut-off and the direction of index for the slitter, the operator has only to press the start button at the conclusion of a run.

Should it be desirable to stop the sequence at any step, the emergency button stops the double backer d-c motor and the automatic changeover controls. The pre-set information is cancelled while the sequence may be manually continued.

A look at the new Corrubiner, from feed to delivery end, will highlight the following design and engineering features that are of significant operating importance:

BUILT-IN WIRING

An important feature is the completely concealed wiring and recess mounted control stations. The wiring is fitted in heavy-wall conduit and all control and power wiring are fed into a common terminal box on each machine. Wiring is performed according to the most stringent municipal electrical codes. The only wiring required when installing is to connect the power leads. The purchaser of the first machine of this type reports a saving of over \$ 20,000 on electrical installation cost due solely to the pre-wiring feature.

SHAFTLESS MILL ROLL STAND

The Type MRQ Shaftless Mill Roll Stand represents

an important design advance that has been field tested. The most noteworthy refinements are: faster production, more uniform product, less liner waste, faster splicing, one man operation without hoists, and constant paper tension.

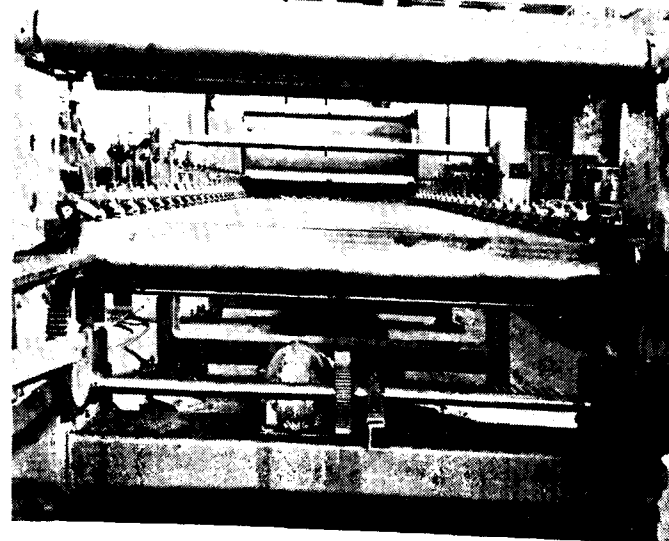
To maintain uniform paper tension a potentiometer, actuated by a linkage, rides the roll diameter. As the roll diameter decreases, brake torque is proportionately lessened, so that paper web pull is always the same.

Other features exclusive on the MRQ are: power loading and unloading of rolls up to 60-in. diameter; power control of roll from loading position to running position; loading from either side of stand to allow top or bottom splices continuously at the discretion of the operator; all controls can be adjusted from the operating side of the machine.

To prevent production delays and possible injury to the operator, many safety devices have been added, among which are: guards to protect the brakes from accidental damage, and safety switches to stop the operating motor should a roll jam against the base plate.

SINGLE FACER

To allow a precisely controlled amount of adhesive to be applied to the corrugating medium at all speeds,



Double Backer (Model HE). Automatic pneumatic loading of upper belt tension and improved design rack and pinion type belt with brake motor lifting are outstanding features that add to the convenience and operating ease typified by single point raising of weight rollers.

a mechanical differential type taper glue roll drive has been incorporated.

Also, a most significant quality control consideration has governed the making of corrugating rolls; these rolls are forged chrome-molybdenum steel, case hardened after machining and precision ground to close tolerances, extreme accuracy and fine finish. The combination of advanced grinding techniques and the extremely hard working surfaces greatly increases roll life and maintains constant accuracy in the exclusive flute contour.

Contributing to the overall objective of simplifying machine operation, a pendant type control station allows easy threading of liners and medium, and one-man operation. The pendant also keeps the controls away from heat and moisture of the machine.

To assure uniform, high quality board manufacture by keeping the corrugating medium more tightly in the flutes as it travels from the corrugating roll nip to the pressure roll, the finger bar has been made more sturdy and rigid.

GLUE STATION

Since the function of the glue station is similar to the single facing machine, a positive, trouble-free drive for the glue roll is provided by means of a tapered-speed, mechanical device. Pneumatic loading of the weight roller for flute height can be adjusted by means of a readily accessible knob on the operating side, and the weight lifting control may be operated either automatically or manually. The wrap of the single-face paper around the glue roller is easily adjustable; the frame is of heavy cast iron construction for greater rigidity and stability; while each glue station can be made inoperative by a pin-clutch.

Additional glue units can be added because of the modular design basis utilized.

DOUBLE BACKER

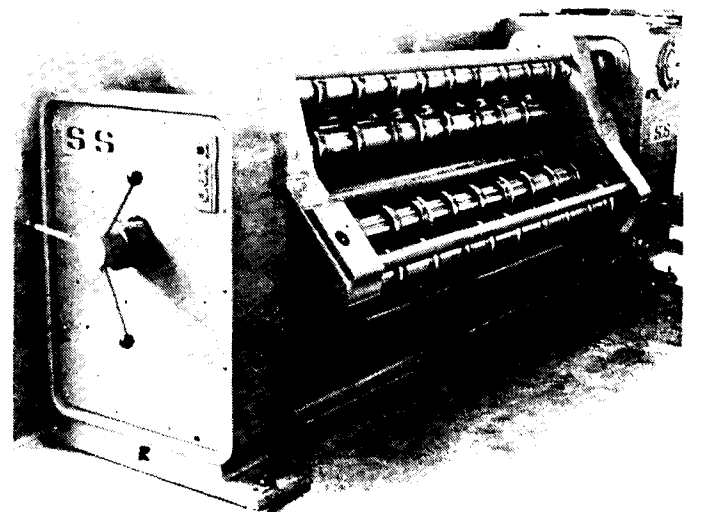
The Double Backer is of unique modular design, providing for mounting a great majority of moving parts in the three main floor sections with two connecting sections between these three units. These two sections—the heating or drying, and the cooling or pulling section—are designed similar to a bridge. This concept permits much more rapid erection in the box makers' plant; an important advantage

since the size of the double backer makes shipment in a knocked down condition necessary.

Extremely rugged cast side frame construction assures accurate alignment essential to high speed output. Automatic pneumatic tensioning of the upper belt increases belt life.

The weight roll lifting mechanisms are hidden behind steel guards but are easily accessible and can be raised from the operating side of the machine. Among the many options offered is a belt drum stand with extra large belt drums for very high speed operations.

Improved design of the belt lifting mechanism has been developed, with a trouble-free rack and pinion unit, fully protected from heat and dirt.



Model HJM Six Bar Triplex Slitter Unit. Slitters can be converted readily for either left or right hand drive and all heads are interchangeable with other S & S converting-finishing slitter-scorers. Design improvements include 6-in. diameter shafts, power indexing and heavier cast side frames. An automatic side register or edge control system moves the slitter from side to side, following the web movement precisely, and automatically adjusts lateral stray of the web.

SLITTER

Whether 4-bar or 8-bar duplex, 6-bar or 12-bar triplex slitters are desired, all have been redesigned with heavier cast side frames, 6-in. shafts, power indexing and other engineering refinements. Slitters can be converted readily for use in the automatic corrugator, for either left or right hand drive, and all heads are interchangeable with other S & S converting-finishing slitter-scorers.

A separate automatic side register or edge control system is available for use with triplex slitters. By moving the slit from side to side, following the web movement precisely, any lateral stray of the web is automatically adjusted.

CUT-OFF UNIT

The newly designed cut-off incorporates a simple balancing principle that does not interpose additional driving elements but adds many desirable operating results.

A balancing fly-wheel is mounted on the hub of the crank driving the knife bar. Thus, the flywheel is concentric with the knife bar but not keyed to it. The knife bar is driven by the conventional rotary drag link mechanism for which S & S cut-offs are so well known. On this latest design, a similar drag link mechanism, driven from the same internal gear but 180 deg. out of phase, drives the balancing flywheel. Thus, as the knife bar is accelerating the flywheel is decelerating, and when the knife bar is decelerating the flywheel is accelerating.

All of the drive elements up to and including the internal gear have uniform angular velocity while only the crank and associated knife bars accelerate and decelerate. By the addition of only two moving parts (the flywheel and the link) the entire mechanism is balanced.

All parts are statically balanced so that the inertia of the wheel approximates that of all other rotating parts related to the mechanism, and one

counterbalances the other. The resulting dampening effect substantially reduces vibration in the machine and wear of vital parts.

Welded knife bars reduce weight with subsequent reduction in inertia forces. The blades have double the usual number of jacking screws to increase setting accuracy and decrease adjustment resettings.

The cut-off register control consists of the following components: web scanner, selector switch, correction motor, control panel, mechanical phase shifting device. The components are closely integrated to assure proper registration between the continuously moving pre-printed web and the cut-off knife. A high quality, more uniform product results, while waste is substantially reduced.

To further reduce waste, an automatic device corrects for variations in sheet length not due to the cut-off and other inherent variables.

SHEET STACKER

An automatic pile squaring device with mechanical, sequential controls is available with a standard high slip motor for slow acceleration of the piles. Three sets of adjustable hold-down springs on the upper slow delivery and two sets on the lower delivery result in uniform, squared piles. Smooth side delivery, with tilt tables installed between belts, prevent narrow sheets from tipping out of position.

Manual controls that can duplicate the automatic sequential controls are provided if required.

BRITISH RAILWAYS TRY OUT ELECTRONIC SIGNAL SYSTEM

A radio telemetering system, which is particularly suitable for diesel engine and gas-turbine application, has been developed by the British Internal Combustion Engine Research Association. The new system overcomes all the disadvantages of previous methods of obtaining information from moving parts on the variation of physical qualities, such as strains, temperatures, relative displacements and the like.

The BICERA system is made of transistor circuits

encapsulated in an epoxy resin which cures at room temperature and gives protection against oil, dirt and humidity. Additionally it gives great mechanical strength. It has already been successfully tested in three applications — strain gauging, temperature measurement and needle-lift pick-up. The system has the advantage that connecting cables are dispensed with and it can be employed on oscillating as well as rotating parts. It is suitable for transmitted signals indicating a wide range of physical qualities.

Electrical Engineers Exhibition 1961

By A Special Technical Correspondent

BBRITISH Insulated Callender's Cables Limited will occupy Stand F10 at the tenth Electrical Engineers Exhibition being held at Earls Court from 21st to 25th March, 1961.

The BICC Group—the largest cablemaking organisation in the World—designs, manufactures and installs cables, accessories and complete overhead equipment for railway electrification; for the supply of electricity to cranes, mines and quarries; for the distribution of high-voltage current generated in large power stations at home and overseas; and for the underwater transmission of electricity by submarine power cable. The Group also provides cables for aircraft and ocean-going ships.

Featured in the Power Cables display will be a show piece incorporating a sample of the 100kV d. c. single-core submarine cable which will be laid in May 1961 on the bed of the English Channel as part of the power link between the national grid systems of Britain and France. The contract, which was placed by the C.E.G.B. jointly with BICC and AEI, calls for the manufacture and laying of two 15-mile submarine lengths and the two related land cables.

Other notable power cable exhibits relate to supply and installation contracts. There will be two examples of giant 330kV single-core oil-filled cable: the 0.85 square inch cable for the Kariba Hydro Electric scheme and the 0.25 square inch cable for the T2 Power Station of the Snowy Mountains (Australia) Hydro Electric Scheme. Although these cables will be installed on a 330kV system, they are designed to be equally suitable for operation on the projected 400kV system of the C. E. G. B.

Also to be exhibited are the 2.15 square inch 230kV single-core oil-filled cable for the Hydro Electric Power Commission of Ontario, 230 kV and 69 kV single-core oil-filled cables for service in British Columbia, a 66kV three-core oil-filled cable with Corrugated Seamless Aluminium sheath and PVC oversheath and a 161kV single-core oil-filled C.S.A. cable for service in China and on Formosa respectively.

Samples of power cables for home contracts will include a 132kV single-core oil-filled cable for the C.E.G.B. to augment the Kingston-Wimbledon and Chessington power supplies and a 25kV oil-filled concentric C.S.A. cable with aluminium conductors supplied to the British Transport Commission for their railway electrification scheme.

In addition, there will be shown a range of PVC and polythene insulated cables, including P.V.C. insulated cables with solid aluminium conductors.

A number of new products developed and manufactured by the Accessories Division will be on show for the first time. Among these are two new ranges of cable glands designed for threaded-entry fixing—the “G” range comprising general purpose glands for rubber or plastic non-metal sheathed cables installed indoors or outdoors; and the “H” range for metal and non-metal sheathed armoured and unarmoured cables in flameproof, watertight and similar installations.

Other Accessories Division developments include new types of flameproof and weatherproof 3.3kV, 300A bolted cable couplers and adaptors meeting revised British and current International Standards and complying with C.E.G.B. recommendations for connections to auxiliary motors in power stations. There are also new sheet steel junction boxes for use with mineral insulated cable multiple rising main systems with “off-peak” loading.

The BICC Group is currently fulfilling major contracts for the design, supply and erection of overhead equipment for the high-voltage a. c. electrification of main line routes of British Railways. Large contracts of a generally similar nature are being carried out by the BICC Group for the Indian Railway Board, and in 1960 BICC successfully completed the first section of high-voltage a. c. electrification for the Indian Railways.

The “Communications” theme of the Exhibition will be emphasised by the exhibits of the Telephone Cables Division. Specially screened telephone cables required for replacing trackside telephone wires have

been designed and manufactured by BICC and are being installed by the Group's contract organisation, BIC Constructions Co. Ltd.

Some idea of the problems which had to be overcome in providing these trackside telephone cables is shown by a special display feature at the Exhibition. A number of samples of telephone cables, each having a feature of special interest, will also form a part of this exhibit.

The Mineral Insulated Cables Division will display bare and PVC sheathed 440-volt and 660-volt M. I. cables for rising mains and meter connection. These will be shown with their respective boxes, cut-outs and other equipment manufactured by the Accessories Division. Also on show will be the latest developments in M. I. thermocouples used in conjunction with the Accessories Division's thermocouple distribution boxes. M. I. thermocouples are being supplied for all nuclear power stations. Practical demonstrations will be given of the technique of terminating M. I. cables. Mineral insulated cables, which have a wide application, are being installed in the new P. & O—Orient passenger liner, "Oriana", and will be installed in the Bristol Type 188 all-steel supersonic research aircraft.

Chief among the Winding Wires Division exhibits will be various types of rectangular strip drawn from rod rolled in the new fully automatic Copper Rod Rolling Mill at Prescott. These include Bicalex and Polyester No. 1 enamelled strip for the windings of electric motors, and continuously transposed strip and paper covered strip for transformer windings. Various grades of enamelled winding wires having different insulations to meet particular needs will also be shown—for example, Bicalex round wires of the type used in refrigerator motors.

A comprehensive range of cables and accessories will be shown by the Wiring and General Cables Division. These will include a selection of plastic insulated wiring system cables and flexible cords; television distribution cables, including the newly developed longitudinal copper taped type, as well as a range of T. V. relay cables; radio frequency cables and miniature multiway cables, together with moulded polypole couplers and R. F. connectors; telephone handset and connection cords and PVC internal telephone cables. Railway signalling cables will be displayed, as will be P. T. F. E. cables and equipment wires for aircraft. Also of interest will be the PVC armoured multi-core cables,

(Continued on page E.17)

the cores of which have been made more readily identifiable by a new type of printing.

The Capacitor Division, which has recently made advances in the field of cubicle—type Biclor capacitors, will show one of the new 33kVAr Biclor MW cubicle capacitors, complete with contactor and relay. There will also be a twin 100kVAr composite cubicle assembly having individual contactors and multi-stage relay, together with overhead busbar trunking.

The main exhibits of the Panelec Heating Division of BICC will be the Rewirable and Solid Embedded floor warming systems. The former, which was the first rewirable system to be marketed in this country, uses lead sheathed heating cables which can be withdrawn and replaced, if necessary, without disturbance to the floor finish. The Solid Embedded system meets the demand for a cheaper form of floor warming. Recommended for use during the installation of this system is the "Panelec" Fault Monitor, a portable transistorised instrument which gives audible and visual indication of any damage that may be sustained by the cables.

Superimposed on a display of specially toughened Butyl Rubber insulated NBR/PVC sheathed cables for road warming systems will be photographs of The Mound, Edinburgh, its surface completely clear of ice and snow when driving conditions were particularly bad. Also being shown will be a model hotbed to illustrate the layout of "Panelec" horticultural heating cables in garden frames.

BICC-BURNDY Limited, the electrical connector specialists, will show a selection from their vast range of products for making connections in every kind of electrical installation, from aircraft and missile wiring and electronic circuits to power station busbar systems. Products displayed include HYFEN and STAPIN solderless multi-contact units for electronic systems, including printed circuit connections, and UNIRING crimped single-piece connectors for coaxial and screened cables.

The popular HYDENT range of insulated and uninsulated connectors and terminals for solid, stranded and flexible conductors will be shown, together with a variety of compression tools including automatic magazine-fed machines for bench-mounting. Compression and bolted connectors for overhead transmission and distribution lines will be shown, as well as bolted connectors for busbars and earthing

Arc Welding Sets exported by Rumania

Motor-generator welding sets for connection to A.C. network Diesel driven generator welding sets. Transformers for hand welding

WELDING technique has extended together with the general advance in industry as riveted constructions have been superseded by welded constructions and as welding has begun being used in large volume new work such as: steam boilers for thermo-electric power stations, equipment for the chemical industry, cement mills and kilns, high-tonnage vessels, etc.

As a consequence, the manufacture of welding sets has greatly developed in countries with an advanced industry. In Rumania, for instance, such sets are manufactured in large quantities, being successfully sold both in the home and in the international market. Here are some of the arc welding sets manufactured in Rumania today, and exported in large quantities (through the Industrialexport enterprise in Bucharest):

Type GES motor-generator arc welding set and type TASM welding transformer

Type GES arc welding sets made in Rumania consist of a squirrel cage motor for connection to a three-phase network of 200, 380 or 500 V and of a D. C. generator of a special design. The two machines are mounted in a well-ventilated common casing, fixed on 4 metal wheels. The star-delta starting switch of the driving motor and the graduated scale welding current control device are located on

top of the casing. The generator's armature and the motor's rotor arc have a common shaft.

Simple and accurate control of the welding current, a good dynamic characteristic ensuring excellent stability of the arc throughout the range of the welding current, whatever the temperature of the windings of the control device may be, convenient commutation and perfect adaptation of the welding qualities to the requirements of the electric arc, are particularly important factors in achieving faultless welding.

Furthermore, the design of the generator ensures quick voltage recovery—maximum 0.05 sec.—after the short circuit caused by welding and also lowers the voltage in no-load running.

The arc welding sets are supplied for intermittent welding currents up to 350 and 500 A at a 65 per cent running factor.

Technical data

	GES 350	GES 500
— Welding current at a 65 per cent running factor	350 A	500 A
— Welding current for continuous welding	280 A	400 A

(Continued from page E.16)

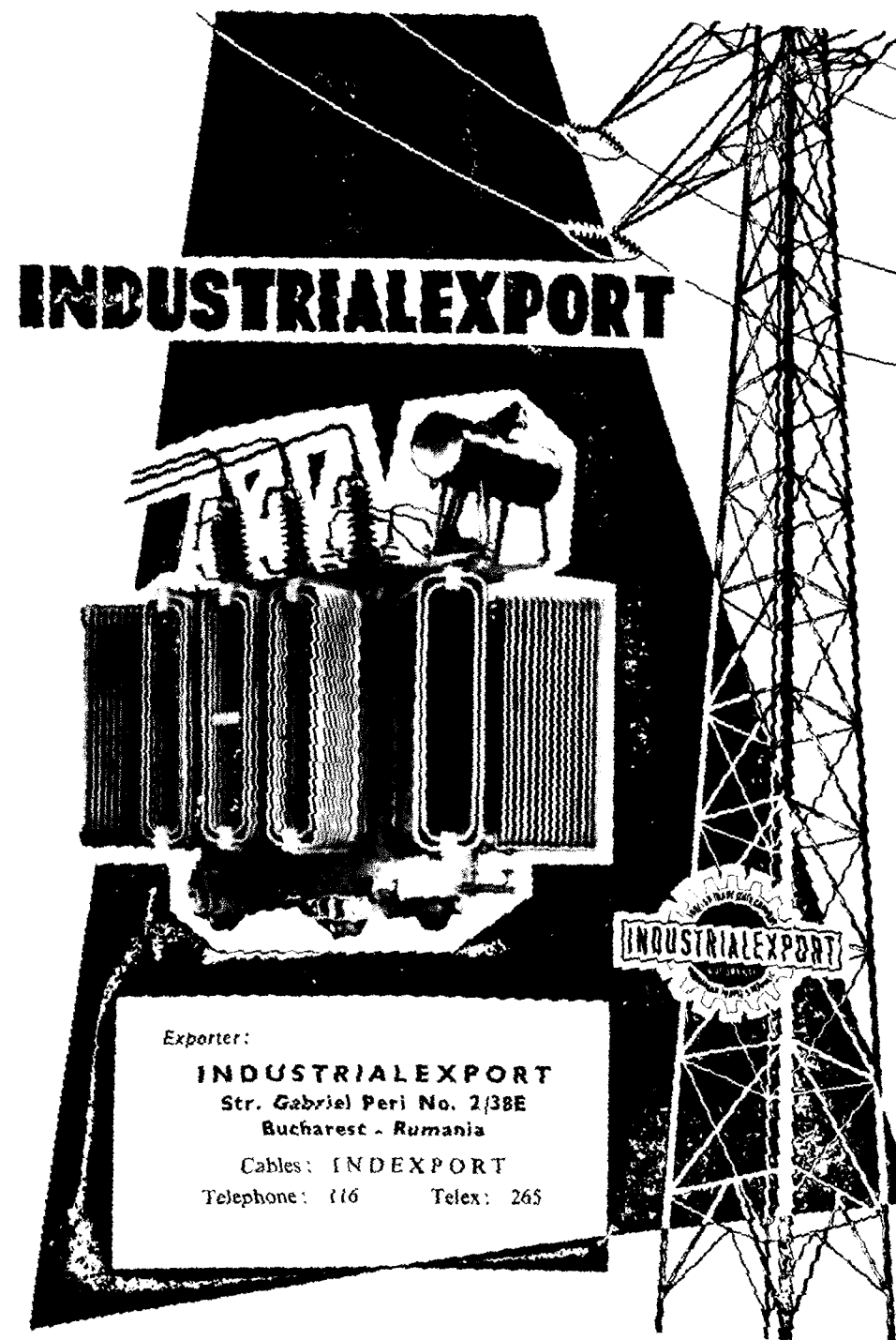
connections. Other BICC-BURNDY products to be shown include NYLOCLIP nylon cable-hangers and THERMOWELD fusion welding kits.

The contribution of Electric Transmission Limited to the BICC Group display will include, among overhead line equipment, a typical vibration damper for large conductors as used on river crossings; a section of a wood-pole line with crossarms; tension insulator sets and accessories; and a "Dimex" single-porcelain oil-filled suspension insulator for high-

voltage transmission lines. There will also be shown examples of EETEE isolators and switches which the BICC Group supplies and installs for overhead line contracts and for the overhead electrification of railway systems.

Publications also are an indispensable method of communication. To this end the BICC Stand—the most comprehensive display effort of its kind ever to be made by the Group at home or abroad—will be very fully stocked with descriptive material.

Relying on a rich experience in the country's rapid electrification and the production of the required equipment, Rumania has for many years supplied the international market with:



Exporter:
INDUSTRIALEXPORT
Str. Gabriel Peri No. 2/38E
Bucharest - Rumania
Cables: INDEXPORT
Telephone: 116 Telex: 265

ELECTRIC MOTORS:

asynchronous, three-phase with squirrel-cage rotor or slip rings, in sundry designs: drip-proof, enclosed, fire-damp proof, for tropical climates, etc., for powers upto 1000 kw.

POWER TRANSFORMERS:

three-phase, under oil immersed for any powers between 20KVA and 50,000 KVA, up to 132KV Special transformers for tropical climates may be supplied on request.

WELDING CONVERTERS:

type GES-350 and GES-500 of 350 A and 500 A welding current respectively, for connection to a three-phase grid of 220, 380, 440 and 500V.

GENERATING SETS:

of 30 KVA, 400/231 V, 1500 r.p.m., driven by 45 HP Diesel Engine, mounted on a common casing, provided with skid or wheels, water-proof.

March 1961

JOURNAL OF INDUSTRIAL ENGINEERING

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— Total current range at rated voltage	80-400 A	100-700 A
— No-load voltage	80 V	90 V
— Generator voltage	30 V	35 V
— Motor's rated power	14 kW	28 kW
— Speed	1450 rpm	1450 rpm
— Dimension of electrodes	2-8 mm	3-10 mm

The wide current range of the set makes it suitable for the welding of light materials.

If no electric current is available, the GES 350 welding set is manufactured, driven by a 45 HP Diesel engine. The Diesel is directly coupled to the generator by a flexible coupling.

Welding making use of A. C. with transformers is recommended whenever there are simple operations to be performed and which may be effected with normal A. C. electrodes.

To that end, Rumania manufactures type TASM 300 welding transformers, designed for hand welding, using single-phase A. C. and a 300 A welding current with an adjustment range between 75 and 480 amp.

The transformer consists of a two column magnetic core made of laminations (on which the primary,

main secondary and reactive secondary windings are mounted); a regulation device (consisting of a movable magnetic core actuated by means of a threaded axle and crank), the housing and a carriage provided with two wheels and two legs.

The service voltage in rated working conditions is of 32 V; the service voltage required by the arc depends on the intensity of the welding current. Thus, it varies from 23 to 39 V. The no-load service voltage is of maximum 74 V, respectively 63 V for the two adjustment ranges of the secondary circuit. The active rated power of 18.5 kVA for an efficiency of ≈ 0.86 and a power factor $\cos \approx 0.56$.

The design of the TASM-300 transformers makes it highly efficient in high grade welding; it is moreover, easily handled and of low running costs.

The up-to-date technical features of the aforementioned sets as well as their faultless construction have led to ever increasing orders coming in from abroad. Thus, Rumania exports a considerable number of arc welding sets to various countries, amongst which: Czechoslovakia, Turkey, India, the United Arab Republic, Iraq, etc.

At present, Rumania's industry is about to turn out new types of welding sets among which automatic welding ones, so that the export possibilities of the Industrialexport company will shortly be widened in that sector, too.

NEW BRITISH REACTOR BROUGHT INTO USE

A new nuclear reactor, named Nestor, has been brought into use at the atomic energy establishment at Winfrith, in southern England, to act as a source of neutrons for sub-critical assemblies of nuclear fuels and moderators.

The United Kingdom Atomic Energy Authority announced in London on March 14 that the reactor core, control gear and instrumentation were designed and installed by the Hawker Siddeley Nuclear Power Co. Five sub-critical assemblies can be driven simultaneously by the reactor, which represents a major advance in the use of a reactor as a

neutron source.

The nuclear fuel in Nestor is an alloy of highly enriched uranium and aluminium in the form of aluminium-clad plates arranged around a graphite cylinder. Natural water is used both as coolant and moderator. The experimental assemblies will be placed in "caves" formed in the shielding at the sides and above the reactor. The whole shielding is so arranged that the "caves" can be rebuilt to facilitate the research programme. The sub-critical assemblies will be used to obtain experimental data for graphite, natural water, and heavy water moderated power reactors.

THE ELECTROPOLISHING OF STEELS

By

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 THE formation of lustrous, highly reflecting surfaces by the anodic dissolution of metal under certain special conditions was noted a century ago. However, scientific and industrial interest in anodic polishing dates from the work of Jacquet.¹ The present position as regards the industrial applications of electropolishing is that while undoubtedly the process is basically to a large extent in its infancy, it has already been applied fairly well in certain fields e. g., in the finishing of surgical instruments, automobile parts, cutlery, reflectors etc.

THEORY OF ELECTROPOLISHING

The mechanism of electropolishing has been the subject of some speculation. The theory of electropolishing is complicated and no single mechanism will account for all the facts. The distinguishing feature of electropolishing is that it combines both smoothing (removal of large scale irregularities or macropolishing) and brightening (removal of smaller scale irregularities or micropolishing). Various theories have been put forward to explain this anodic phenomenon.

Jacquet² first proposed that an especially viscous liquid layer, containing dissolution products is set up next to the metal surface having a relatively high electrolytic resistance and being nearly plane on its outer surface, it enhances the dissolution of "hills" rather than 'valleys' of the metal surface thus leading to polishing. Elmore³ suggested that the diffusion of the dissolved anode material plays the important role in bringing the polishing effect. He also gave a mathematical analysis of the expected limiting diffusion conditions across the liquid layer. The simple early theories could explain only macropolishing and not micropolishing. Evans⁴ suggested that the accumulation of anodic products in the cavities of the metal surface caused by the greater difficulty of their removal by diffusion or flow leads

to anodic passivation by a solid film on the Muller model of the concavities while the convexities remain active; consequently only the hills dissolve. However this does not easily explain the fact that a fully polished anode continues to dissolve evenly with polishing if the electrical conditions remain unchanged.

Vernon and Stroud⁵ later Hoar⁶ & Jacquet⁷ emphasised that electropolishing consists of two distinct but related processes namely brightening of the surface accompanied by its levelling or smoothing. Hoar and Mowat⁸ suggested that brightening due to suppression of etching is in fact the real characteristic of polishing and Edwards⁹ showed that anodes dissolving with etching become macroscopically smoothed almost equally well as those dissolving to a bright surface. Hoar and Mowat⁸ further suggested that etching is suppressed by the formation of a thin compact film on the anode during polishing. Hoar and Farthing¹⁰ by Mercury drop wetting test have studied the surface of copper specimen after electropolishing and have given experimental evidence to show the existence of a thin film on the surface. A more general hypothesis to account for brightening by random dissolution is the acceptor mechanism proposed by Halfawy¹¹ and developed later by Edwards¹² and Wagner¹³. Halfawy¹¹ profounded the acceptor theory according to which it was not the diffusion of metallic ions but the distribution and availability of the anions near the asperities and depressions which control electropolishing. Edwards¹² has further developed the idea stating that polishing was due to the impoverishment of the anolyte in respect of acceptor. Hickling and Higgins¹⁴ suggested on the basis of a concentration gradient of dissolved metal in the diffusion layer over the anode; the diffusion of metal salt out of a cavity is slow compared with that over a peak. A mechanism of electropolishing and brightening has been postulated by Doss¹⁵ and his co-workers. According to them, the electropolishing process can be easily understood if the

existence (during polishing) of a unimolecular or fine grained polymolecular solid film of a dielectric is postulated. According to Shpitalsky¹⁶, the transformation of the matt surface of the anode into a bright surface occurs only under the special conditions of anodic polarisation of the metal electrode and only in a solution of an electrolyte which generally forms complexions with the given metal.

According to the present theories, the formation of a relatively thick viscous layer around the anode controls the 'smoothing' and the formation of a thin film on the surface of the anode, controls the 'brightening' action.

A critical review on the theory and mechanism of electropolishing is given by Hoar¹⁷ and Fedotov and Grilikhes¹⁸.

ADVANTAGES OF ELECTROPOLISHING

The electropolishing process possesses many radical advantages over mechanical polishing processes. Electropolishing is quicker than mechanical polishing. Large specimens can be polished as quickly as small specimens. On the one hand extremely small areas can be polished using special techniques while on the other hand larger articles of complex shape can be polished by using auxiliary cathodes to obtain a uniform current density. It reduces the cost of polishing articles of complex shape such as those having thin walls or embossed fluted patterns. The inside of the articles is polished just as easily as the outside. The type of personal skill needed for mechanical polishing is not required in electropolishing and once the conditions of electrolysis have been determined subsequent operation becomes a matter of easy routine. The electropolishing gives nearer approach to the true structure. The mechanical polishing is in fact polishing by abrasion. It involves a modification in depth of the superficial layer of metal with subsequent levelling of the surface by viscous flow of the material. Thus the superficial layers of mechanically polished metals have a structure which is quite different from that of the bulk of the material. In electropolishing the surface becomes more homogenous. Electropolishing can produce surfaces free from deformed zones. This is particularly the case of the soft metals such as lead and tin. Thus specimens intended for metallographic study can be polished electrolytically to a degree of perfection comparable to that obtained by any competent mechanical polishing. The attack of etching reagents is more reactive on an electropolished surface

than on the same metal polished mechanically, and a better contrast is obtained between the constituents. Non-metallic inclusions and flaws are more easily and clearly brought and suffer less risk of damage than in surfaces produced by mechanical polishing. In electropolishing, it is possible to control the amount of metal removal during the polishing operation. The stress rupture strength of some alloys to be used in high temperature service can be improved by electropolishing. Mechanical polishing leaves the usual stressed metal skin that recrystallises at lower temperature than the body of the part thus lowering the stress at which rupture will occur. An electropolished surface being free from stressed skin and subsequent recrystallisation of the surface at the temperature than the bulk of the alloy can be 15—20% stronger. Electropolished articles exhibit improved corrosion resistance.

However there are some limitations to these processes and it is when these limitations are appreciated that the best possible use will be made of the advantages which electropolishing undoubtedly offers.

Electropolishing requires the use of homogenous alloys without drawing marks and inclusions. These faults do not interfere with the process, but they are not obliterated as in mechanical polishing and indeed tend to be thrown into relief. Heavy tool marks cannot be economically removed. It is not possible to achieve true mirror planeness since a limitation is imposed by the structure of the alloy being polished. Surface defects such as seams, non-metallic inclusions etc. are clearly revealed. A single imperfection in a metal surface stands out as a potential cause of rejection of electropolished article.

In spite of these difficulties it may be said that the anodic polishing of stainless steel has reached the point where it can be considered to be an important established process. Stainless steel was a natural choice for electropolishing because it is difficult to polish mechanically as it has a high coefficient of friction which causes overheating and burning of the surface, long and costly grinding and buffing operations. Commercial applicable methods are now available for producing lustrous, smooth, slick surfaces on stainless steel, carbon steels, low alloy steels, high speed alloys, and Nickel chromium iron alloys.

ELECTROPOLISHING PROCESS

Electropolishing is a special case of anodic pheno-

menon as it is known that a metal anode can be etched, polished, partially passivated or completely passivated depending upon the operating conditions and the type of solution used. In electropolishing the metal to be polished is made the anode or the positive pole of an electrolytic cell containing a special electrolyte. The continued solution of the metal occurs in such a way that irregularities on the surface are removed and the surface becomes progressively smooth and bright. The composition, temperature of the bath and the anodic current density are the most important factors of operation.

As explained by Wernick²¹ the nature of electropolishing depends upon the ability to form a comparatively high electrical resistance layer and the anode surface due to anodic polarisation which is capable of filling in surface irregularities and presenting a fairly level surface at the layer solution interface. Chemical or structural heterogeneity constitutes a serious difficulty in electropolishing. It is very difficult to polish steel electrolytically to the same degree or perfection as it has non-metallic inclusions. Mirror like planeness of the surface by electropolishing is dependant on uniformity of grain size, homogeneous structure, freedom from non-metallic inclusions. With carbon steels of the type, most generally met with, the situation is more complicated, since various factors enter into the picture. In choosing an electrolyte, it should be remembered that all the phases present dissolve at substantially the same rate, or else there would be selective attack of one phase or the other giving rise to an etch pattern. An ideal electrolyte should be capable of operating at normal temperatures and possess infinite life. The preparation of the electrolyte must be easy. The electrolyte should not be abnoxious or dangerous in use. The essential features of an electrolyte are as follows:—

1. It should contain electrolyte possessing oxidising properties.
2. It should be capable of dissolving the anodic products.
3. A limited and a definite amount of water should be present.

In successful electrolytes current density is the controlling factor. The current density controls the

anodic film, the formation of which is of great importance in electropolishing. It has been both theoretically and experimentally established²² that at lower current density, etching takes place. At limiting current density (where polishing is achieved) the current density remains constant, the voltage alone rises showing that the film formed under those conditions offers a high resistance. At higher current densities gas evolution and pitting occurs. Under these conditions the anodic film is destroyed and local overheating destroys the polishing conditions.

The quality of the polish obtained depends upon the nature of the surface taken, particularly the surface condition. The surface that had been finely ground had the smoothest surface and highest degree of lustre.

The general aspects of electropolishing have been well covered by Wernick²³ and Jacquet²⁴. The fundamental requirements of the process have been dealt with.

The choice of the composition of the electrolyte is governed by the electrical conductivity of the solution and its ability to form a viscous layer on the anode. Perchloric acid is mostly used as a constituent of all the polishing baths, as it is capable of keeping the anodic material in solution. All the disadvantages of the perchloric acid bath is that the very high concentration of perchloric acid, the rise in temperature and the contact with organic matter are undoubtedly the factors responsible for the explosion. The danger may be got rid of by replacing acetic anhydride by acetic acid. Strong solutions contain perchloric acid and acetic anhydride or acetic acid. Less concentrated solutions contain perchloric acid, and ethyl alcohol or such mild addition agent. With pieces of steel electropolishing under industrial conditions with an aceto-perchloric acid bath has been shown to improve the microprofile²⁵. A mirror polish was got in the perchloric bath whereas strong relief effects were found at the grain boundaries on polishing in an industrial phosphoric sulphuric acid bath²⁶. Perchloric acid solutions are mainly used for finishing small hard tools. Iron and its alloys, particularly stainless steel are polished electrolytically as these are difficult to polish by mechanical methods. Baths containing perchloric acid and the operating conditions are given below:

No.	Composition of the bath	Operating conditions	Remarks
1.	50 ml per chloric acid ^{27,28} (sp.gr. 1.6) 1000 ml glacial acetic acid	c.d. 40-80 A/dm ² V. 25-45 V t 25°C T 15-30 sec.	Useful for pure iron or austenitic agitation is necessary. Conditions depend upon the age of the bath.
2.	185 ml perchloric acid ²⁹ 765 ml acetic anhydride 50 ml water	c.d. 4-6 A/dm ² t 30°C T 3-5 min	The solution should preferably contain a small amount of iron or aluminium. Of all the baths this one has the maximum throwing power. Works well for polishing of small specimens of iron and steel.
3.	250 ml perchloric acid 750 ml acetic anhydride	c.d. 150-300 A/dm ² t 20-25°C T 5-15 mts	Useful for polishing both carbon and stainless steels.
4.	36 ml perchloric acid ³⁰ 97 ml water 500 ml methylated spirit	c.d. 0.3-1 A/dm ²	Specimen horizontal above the cathode.
5.	200 ml perchloric acid ³¹ 700 ml ethyl alcohol 100 ml glycerol	c.d. 1 amp/cm ² V 40-47 T 10-20 secs	Can be used for ferrow silicon with high silicon content.

It has been said by Jacquet that the perchloric acid baths gives excellent results in polishing small samples. But those baths cannot be conveniently used in the industrial polishing of the same metals and alloys. Industrial electrolytes most commonly used for steels are mixtures in various proportions of sulphuric acid and phosphoric acid. Often an addition agent chromic

acid is used. Baths containing phosphoric acid, sulphuric acid and addition agents are dealt with by John F. Jumer³². The bath composition and the operating conditions are given for both carbon steels and stainless steels.³³

Some of the baths commonly used are given below.

No.	Bath composition	Operating conditions	Remarks
1.	Phosphoric acid 42% ³⁴ Sulphuric acid 34% Water 24%	Source 6V 0.03 amp/needle alternating immersion and withdrawal	Used for making very fine needles in stainless steel, cleaned in 10% hydrochloric acid.
2.	Phosphoric acid ³⁵ 74-80% Chromic acid 13-10% Iron 1% Water 12-19%	q.d. 50-200 A/ft ² t 70 Voltage 8-12 V	Works well for carbon steels.
3.	Citric acid ^{36,37} 30-70 parts Sulphuric acid 10-30 parts	c.d. 8-23 A/dm ² t - 85°C	Industrially used for stainless steels.
4.	Sulphuric acid by wt. 40% Phosphoric acid 49.5% Water 10.5%	c.d. 500 A/ft ² t 100-190°F	Used for polishing carbon steels.

Uhlig³⁹ has described the use of glycerine and phosphoric acid mixtures for polishing 18/8 stainless steels. The composition of the electrolyte and the operating conditions are as follows:

Phosphoric acid	42%
Glycerine	47%
Water	11%
c.d.	105 A/dm ²
t	100°C

He has investigated that the reflectivity of stainless steel was high, metal loss was low and pitting was not found if the bath was operated above the room temperature. He has studied the effect of variation of phosphoric acid, effect of water addition, effect of temperature and effect of current density on reflectance of electrolytically polished 18/8 stainless steel in phosphoric acid glycerine mixture. The important function of glycerine in the bath is to prevent the pickling action of phosphoric acid at elevated temperatures.

The following solution⁴⁰ is used for polishing carbon Manganese steels by Sparks.

300 ml sulphuric acid
600 ml phosphoric acid
150 ml water
35 ml dextrose or teepol (0.9 ml)
Cathode: stainless steel
Voltage 7 to 8.5 V
C.D. 2.7 — 6.5 A/dm ²
t = 60—70°C
T = 10 min.

The composition and the working conditions for polishing stainless steels are described in detail⁴¹ in a British patent which describes the electrolytes based on mixtures of phosphoric acid, sulphuric acid and water. Satisfactory polishing is achieved by addition agents. A typical electrolyte⁴² has the following composition.

Sulphuric acid	55 parts by weight
Phosphoric acid	22 parts by weight
Water	23 parts by weight
Aniline (addition agent)	2 parts by wt.

OPERATING CONDITIONS

c.d.	0.5 to 1.5 A/inch ²
t	55°C
T	5 to 30 minutes.

A commercial polishing solution according to Lippert⁴³ consists of sulphuric acid, chromic acid and methyl alcohol.

110 ml sulphuric acid
600 gms citric acid
250 ml methyl alcohol
Cathode: stainless steel
C.D. 8—55 A/dm ²
T = 1—3 minutes
t = 50—125°C

The methyl alcohol can be replaced by butyl, propyl or ethyl alcohol or glycerol.

A feature of electrolyte based on sulphuric acid, citric acid is their stability in use and the simplicity with which they can be maintained in view of the spontaneous precipitation of iron compounds from solution.

Phosphoric acid saturated with chromic acid^{44, 45} is used for superfinishing. High current densities (namely) of the order of 100A/dm² are used for a period of one minute. Charlesworth and Hobson⁴⁶ give examples where stainless steel articles with areas of 50 sq. ft. have been polished successfully.

An experimental study of electropolishing of 18/8 stainless steels has been made by Evans⁴⁷ and most of the research on industrial electropolishing has been directed towards the polishing of iron and its alloys, particularly stainless steel and iron since these are polished with great difficulty by mechanical means. A fairly large number of electrolytes have been proposed by many workers but most of them are not used in practice.

Orthophosphoric acid, sulphuric acid, chromic acid bath has also been used for polishing plain carbon steels and an experimental study has been made by Sheno et al⁴⁸.

After the solution has been used for sometime the finish tends to deteriorate due to the reduction of chromic acid. However it is found that the life of the bath can be considerably increased by minimising the reduction of chromic acid using a diaphragm⁴⁹. A wide variety of electrolytes based on phosphoric acid and sulphuric acid⁴⁹ has been proposed and patented⁵⁰ for polishing of stainless steel.

APPLICATIONS OF ELECTROPOLISHING

The best scope for electropolishing lay in its application to stainless steels which are among the most difficult metals to polish mechanically. Stainless steels possess properties which make them suitable for electro-polishing because they are generally relatively clear and free from slag and inclusions and have a homogeneous structure. Further more they are resistant to corrosion which simplifies the problem of post electropolishing operations. Since plain carbon steels and low alloy steels usually contain some inclusions and defects, the process is generally used for machining for burr removal and in the preparation for plating etc., rather than finishing for appearance.

A review on the applications of electropolishing of stainless steels and other alloys is given by Geokiefer¹⁹ and new industrial uses of electropolishing process is dealt by Jacquet²⁰.

Most of the applications may fall in the following classification.

1. Detection of defects—structural heterogeneities and cracks are immediately brought out. The ability to reveal fine surface imperfections has led to the use of Electropolishing as a routine inspection method in cases where 100 percent inspection is necessary e.g. turbine blades for jet engines. In heat treated steel springs (polished after coiling) or piano wire springs (wire polished previous to coiling) all metallurgical defects are exposed. Decarburised surface layers, a source of fatigue failure is eliminated by electropolishing.

It is possible to control the treatment so as to dissolve a precise amount of metal which is important in salvaging over sized parts. An example of this application is the forming of special profiles for gear teeth. The selective electrolytic solution of burrs and fins is rapid and economical and can be applied to parts which cannot be handled mechanically e.g., zips, wire, strips, needles etc.

Electropolishing increases the capacity for plastic deformation of several metallic materials. Applied to the Planks to treatment permits deep drawing of 25% chromium irons as well as the spinning of molybdenums, operations which are practically impossible with the as rolled machine polished or pickled sheets. If a metal surface is electropolished prior to electroplating, the bond obtained is much stronger than that with a mechanically polished surface, due to better

continuity across the bulk metal plated layer interface. The process has been used in the preparation of samples for the following studies.

1. Optical properties, chemical and magnetic properties.
2. X-ray and Electron diffraction studies.
3. Hardness testing studies.
4. Oxidation and corrosion studies.

Stampings and pressings which need deburring are found to have the burrs removed during the electropolishing operation. Polishing of wire baskets, after fabrication is quite uneconomic by mechanical means, but quite simple electrolytically. Tubing has been polished internally in lengths upto 10 ft. An electropolished internal surface has many advantages for piping in the food, textile, and chemical trades, where contamination of fluids has to be scrupulously avoided. Perforated stainless steel trays used in the atomic energy applications requiring repolishing between each processing cycle, were a good example of the value of electropolishing. It not only provides a speedy process, but also polish the inner surface of the perforations, which are inaccessible to mechanical polishing. Corrosion resistance is improved in the case of electropolishing steels. This process is said to be excellent for polishing stainless steel wire products, such as refrigerator shelves, metal racks and kitchen tools etc.

Commercially applicable methods are now in use for producing lustrous, smooth, stick surfaces on stainless steels, carbon steels, low alloy steels, high speed steels, Nickel chromium iron alloys etc. The variety of products now receiving commercial attention are refrigerators, toasters, electric irons, cutlery, flatware, halloware, pans, kettles, surgical and dental instruments and equipment.

Electropolishing finds application in superfinishing engineering pieces as it is necessary to obtain the required surface state by removing the minimum of material and retaining the dimensional accuracy of the part and the integrity of its form.

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The mechanical efficiency of a transformer depends upon the strength of the weld of its cooling tube

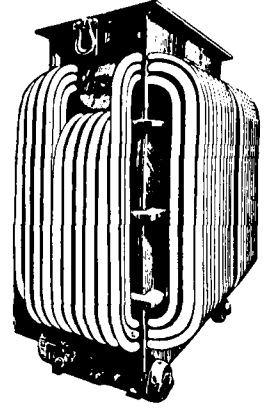


THE SLIGHTEST weakness in the weld leads to a leak and affects the working of the transformer. Thanks to the special process of Electric Resistance Welding adopted, TRU-WEL ERW steel cooling tubes are leak-proof. Heat for welding is generated by the resistance of the joint to the flow of an electrical current of high amperage. No metal is added to the weld, nor is the steel altered chemically in any way.

In short, the tube is as strong at the weld as at any other point.

Every TRU-WEL tube is hydraulically tested according to the requirements of the specifications to ensure that there is no leak anywhere.

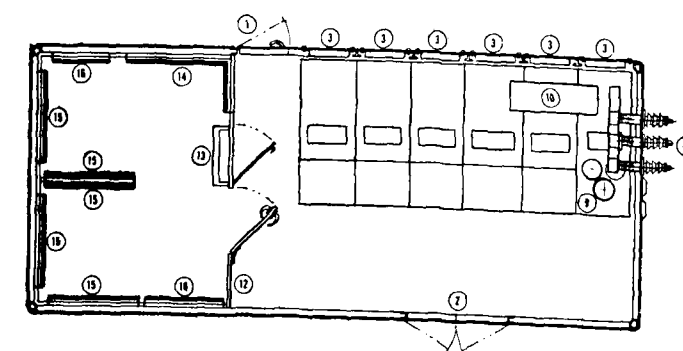
Samples are also tested at regular intervals. A test piece is placed on a cone and a hydraulic ram bears down until the outside diameter of the tube is expanded to the required amount. The weld reacts in the same way as the rest of the tube. An excellent proof of the weld's toughness.



TRU-WEL
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STEEL TUBES

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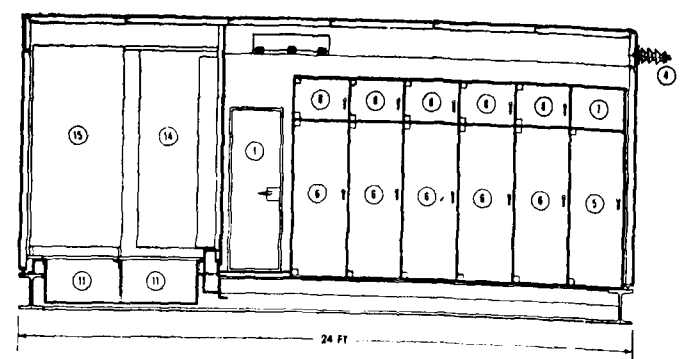
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SECTION 7

CONTROL UNIT OUTLINE

- | | |
|--------------------------------|--|
| 1. Access Door | 9. Surge Protective Equipment |
| 2. Service Door | 10. Control Power Transformer |
| 3. Removal Panel | 11. Battery Compartment |
| 4. Power Terminals | 12. Annunciator and Control Fuse Panel (Panel) |
| 5. Transformer Compartment | 13. Fuse Panel (Panel) |
| 6. Circuit Breaker Compartment | 14. Master Control Panel |
| 7. Access Panel | 15. Unit Control Panel |
| 8. Transformer Compartment | 16. Auxiliary Control Panel |



individual unit ratings for base load service of 1250 kW at 900 RPM, 60 cycles, and 1100 kW at 750 RPM, 50 cycles. The largest Plant, consisting of five generating units and one control unit, known as the Model MU62BL, has a rating of 6250 kW for 60 cycles and 5500 kW for 50 cycles.

Each engine generating unit is a unitized package which is housed in a sound-insulated, weatherproof enclosure and mounted on a fabricated rolled steel base with provisions for lifting and jacking. The arrangement of equipment is shown in the outline drawing (Section 6).

All of the controls for up to five generating units are contained in a single control unit which has the same type of enclosure and mounting as the generating unit. The arrangement of equipment is shown in the outline drawing (Section 7).

These plants are designed for completely automatic

(Continued on page E.31)

operation and can be equipped to serve as the sole source of power or to supply peaking and reserve capacity for an existing power system.

The installation of these plants is extremely simple. In most cases a foundation of crushed rock and timbers will be adequate. They do not require the expense of concrete foundations, hold-down bolts, or precise leveling.

To place the power plants in operation requires only: the installation of a central fuel storage tank, a simple fuel piping system from the storage tank to the units, running electrical connections between the generating units and the control unit, and connecting to the user's distribution system.

A similar line of Power Plants, except that the Diesel engine is turbo-charged, has been developed by Electro-Motive for use by U. S. utility companies as peaking and reserve power. Each unit has a rating of 2000 kW at 900 RPM, 60 cycles.

ELECTRONIC SUMMATION METERING

THE great expansion of digital computation has almost entirely depended on the speed and reliability of electronic switching circuits as logical devices.

Aron impulse summation metering equipment was initially developed when these advantages were recognised but had not been fully demonstrated. Cold-cathode switching circuits were used, but were bulky and required relatively large driving supplies.

Complete transistorisation therefore followed, the equipment size being appreciably reduced and the driving power brought down to a level appropriate for supplying from a service battery.

Particular attention has also been paid to mechanical design. It was not, for example, possible to achieve the overall summation accuracy which might be expected from the circuitry while depending on contacting impulse transmitters on the impulsing meters. Photo-electric transmission was therefore introduced, and a very high standard of reliability immediately followed. Duplicate and totaliser register performance also depends to a large extent upon the reliability of the driving motor, which may be continuously operating at tens of impulses per second for several years; special impulse motors have therefore been developed to meet this stringent requirement.

It has been recognised that many users may be poorly equipped to deal with electronic faults on site. Simple and reliable test facilities have therefore been incorporated in the impulsing meters and summator

which will quickly indicate the faulty unit. Easy unit replacement is arranged and the service engineer is encouraged to exchange units on site and to analyse troubles in the Test Room or Workshop.

Aron impulse summators are assembled from standard channels—comprising a duplicate register, impulse motor, and an encapsulated bi-stable transistor store—mounted on frames of standard geometry. The most widely supplied units are for four-channel summation but twelve or more have been supplied, in some cases with import and export metering and nett summation included.

The extreme accuracy which characterises this equipment has justified the design of a maximum demand indicator of very high resolution. A ten-turn, platform-scale M.D.I. has therefore been introduced which enable effective scale lengths up to 210" to be provided. The mechanism includes a pulse store which accepts incoming pulses during the resetting period.

The high totaliser pulse rate common in Aron summation equipment makes the direct operation of many existing printometer mechanisms impossible. Pulse division, by electronic or photo-electric means, may therefore also be required. Printometer operation is then controlled by power-transistor pulse amplifiers.

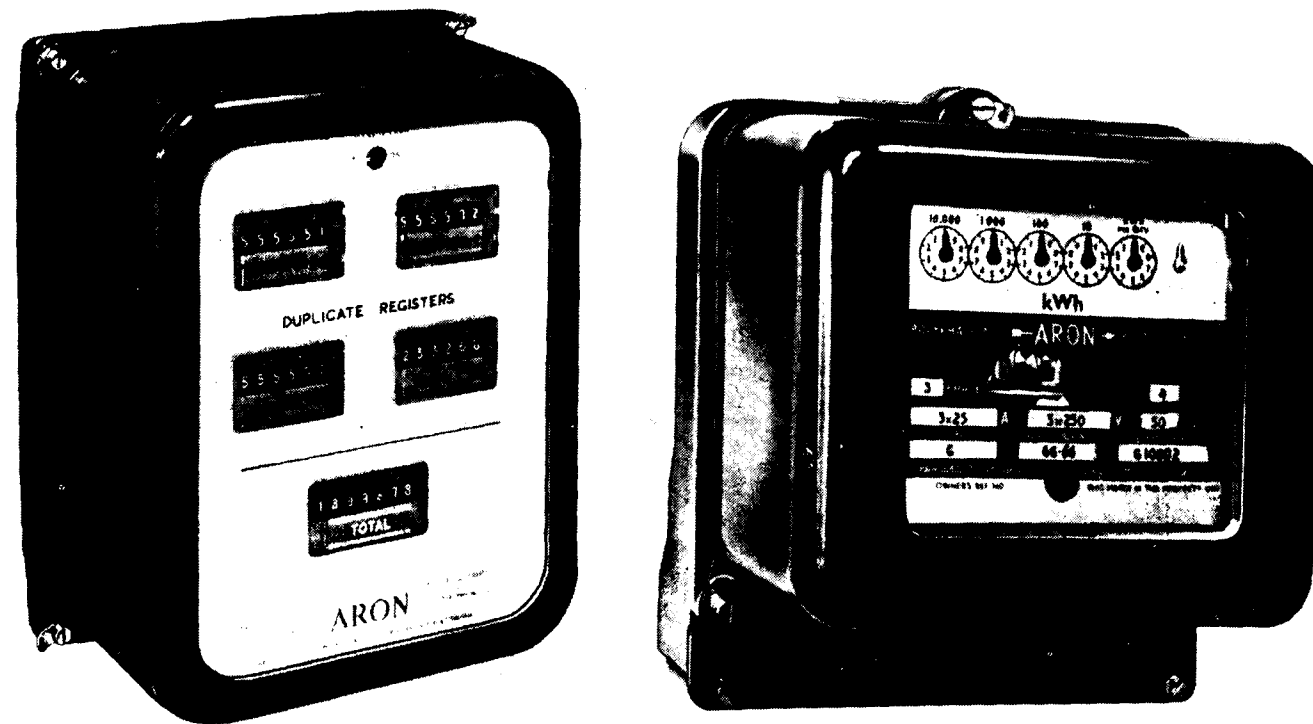
In order to meet a demand for equipment of this kind which is less expensive but retains the underlying advantages of electronic techniques, a commercial

(Continued from page E.30)

It is expected that these plants, known as the Model MU, will be offered for base load service at a rating per unit of 1500 kW at 720 RPM, 60 cycles, or 750 RPM, 50 cycles. The MU 100 Plant, consisting of five generating units, would have a total output of 7500 kW for base load.

Either the MU-BL or MU Plants may be supplied

with from one to five generating units to suit a particular application. Where the need for future expansion is foreseen, the control unit may be equipped originally with the controls required for the generating units that may be added later. This keeps the original investment at a minimum and permits future expansion with the least possible delay and expense.



SINGLE-DISC POLYPHASE METER

The Aron Type 'G' Polyphase Meter is a single-disc unit of advanced design. It is compact (7½" high x 7" wide x 6" deep), accurate (1½% over a 60:1 current range), and particularly robust.

Although an all-metal rotor is used the interaction between driving elements is negligible. The special frame design, and hinged front panel, provide easy access to all components, and all adjustments may be reached from the front or top of the meter. Type 'G' Meters satisfy B.S. 37: Part 4: 1954 in all respects. Whole current meters can be supplied upto 100A rating, and Maximum Demand Indicators with internal or external tripping are also available.

grade four-channel summator has recently been introduced, where there are no duplicate registers, and the totaliser is of the pointer type. A test unit is, however, available which enables individual input

channels to be tested, and associated faults to be isolated.

[For more details please contact : ARON METERS LTD., London]

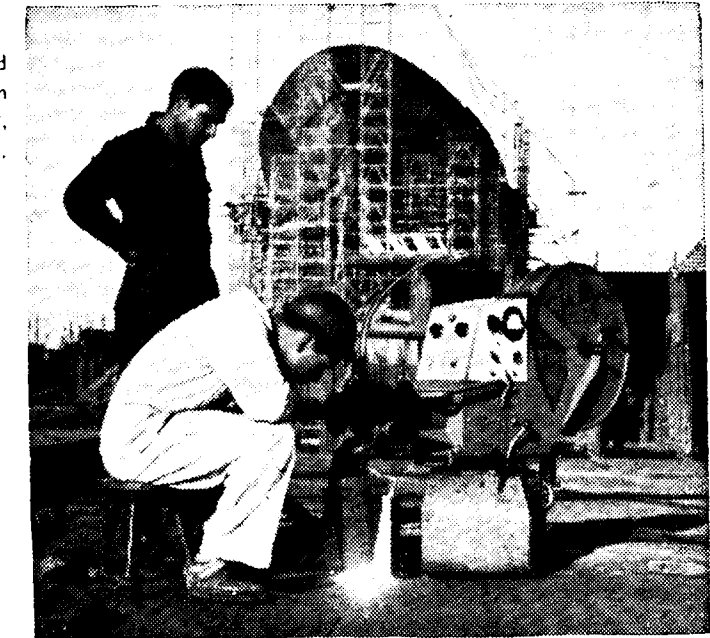
Britain's Council of Industrial Design wins Italian award

Italy's coveted "Golden Compasses" prize for outstanding contributions to industrial design was won in 1960 by Britain's Council of Industrial Design. This unique organisation with a modest government grant has no powers, nor does it design itself; it works purely by persuasion, advice and practical aid to those interested. But it has helped to raise standards of design in British industry and the world demand for British goods to new heights.

Its great "shop window" in London is a permanent but changing exhibition of what is judged by independent experts to be the outstanding examples of

modern British design. There also is the Design Index, a photographic and samples record of about 10,000 different goods in current production, and a Record of Designers containing details of more than 2,000 top industrial designers in every field. In addition, in many ways, the Council works to persuade the public to demand the retailer to stock, and the industrialist to make, good designs. With the electronic age bringing novel and more complex apparatus, the industrial designer is becoming more and more vital to modern industry, and so is the part played by the Council of Industrial Design.

FUSARC self-propelled machine in operation at the Hindustan Shipyard, Vishakhapatnam.



5

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INDIAN OXYGEN LIMITED

GENERAL MOTORS Announce New Diesel Power Plants

By Our Engineering Editor

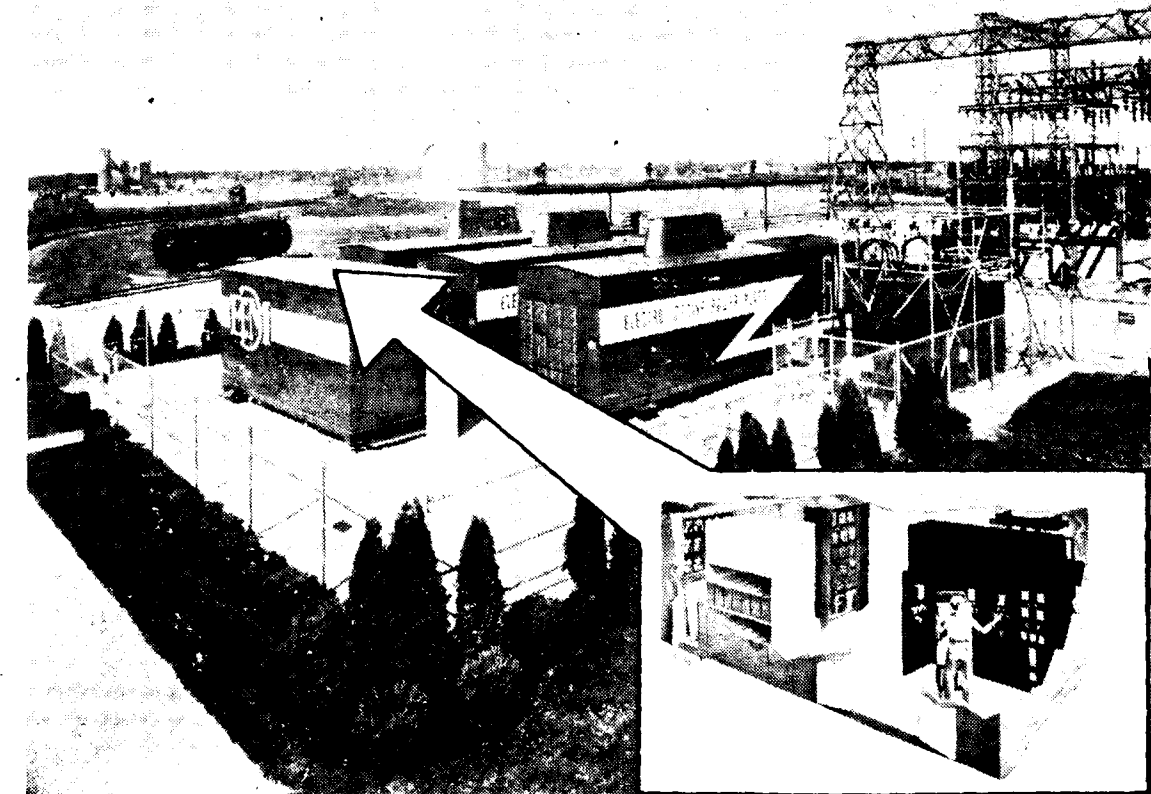
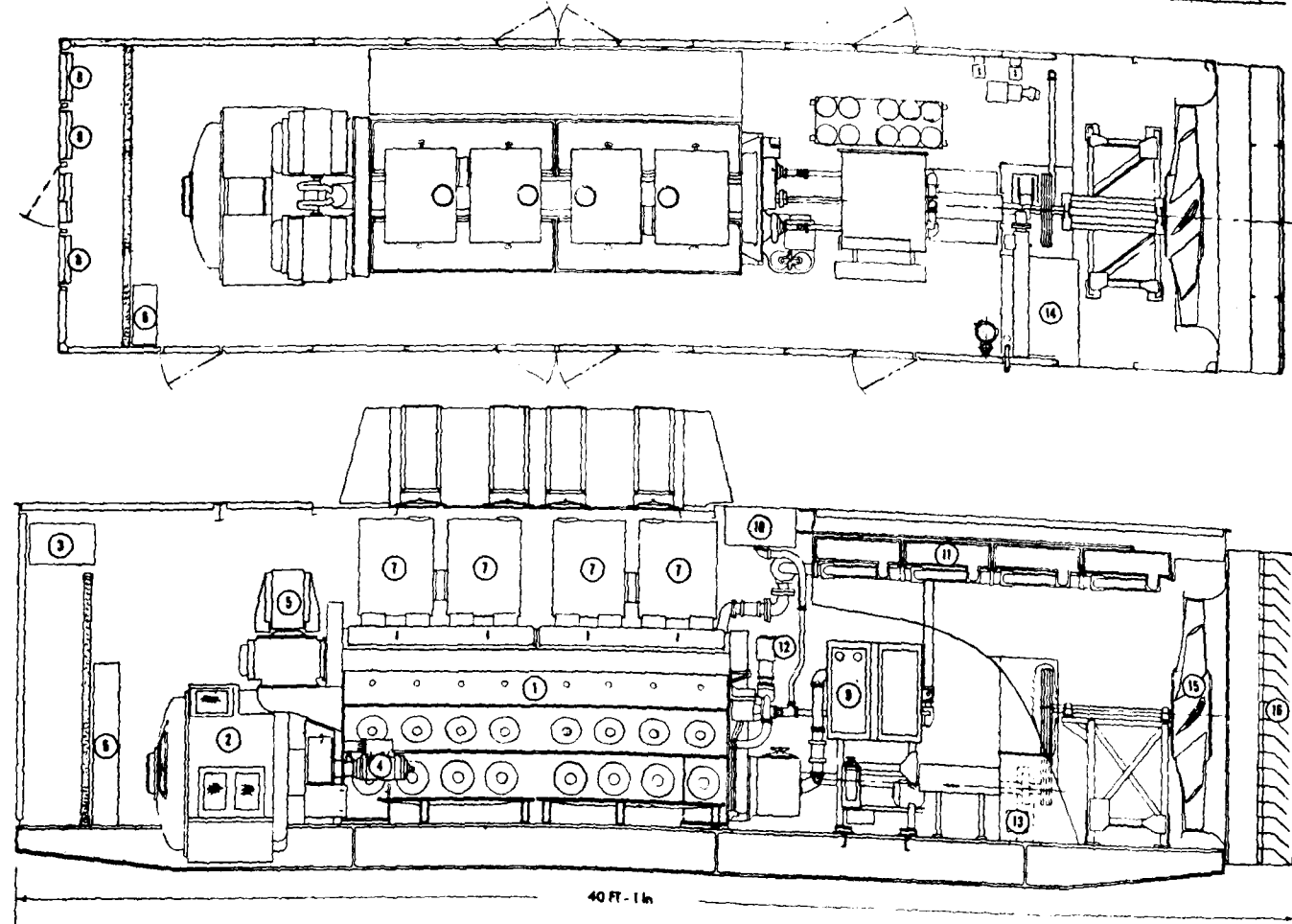
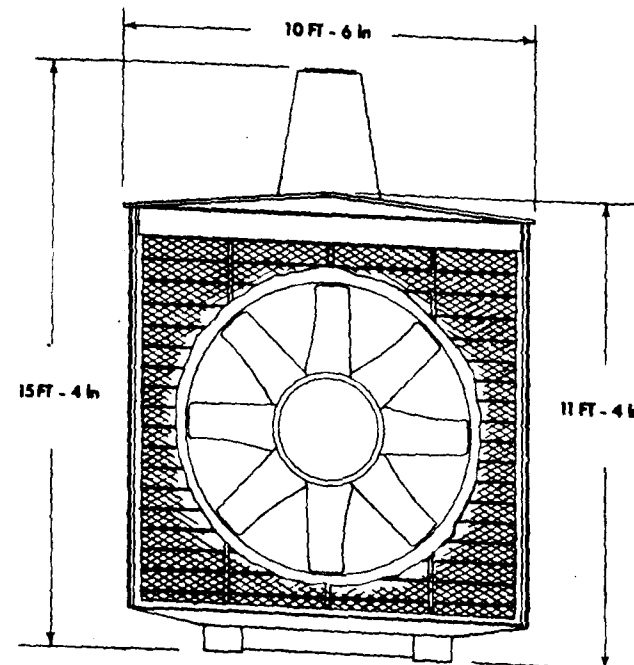
GENERAL MOTORS Corporation, Electro-Motive Division, La Grange, Illinois, announced recently a new and unique line of complete, self-contained, Diesel Power Plants. These utilize the latest improved version of the Series 567 Diesel Engine of which some 40 million horsepower have been produced over the past 25 years.

These Plants, identified as the Model MU-BL, have

SECTION 6

GENERATING UNIT OUTLINE

- | | |
|-------------------------------|----------------------------|
| 1. Engine - GM Model 16-567D | 9. Engine Control Cabinet |
| 2. Synchronous Generator | 10. Water Tank |
| 3. Exciter [Model A20] | 11. Radiators |
| 4. Engine Starter Motor | 12. Governor |
| 5. Engine Air Filter | 13. Water Circulating Pump |
| 6. Generator Control Cabinet | 14. Fuel Day Tank |
| 7. Exhaust Manifold & Muffler | 15. Cooling Fan |
| 8. Engine Room Air Filters | 16. Radiator Air Inlet |



NEW GM 3600 KILOWATT ELECTRO-MOTIVE POWER PLANT

AS ILLUSTRATED—this new GM 3600-KW Electro-Motive Power Plant consists of three MP 26 diesel generator units designed to produce 4160 volts, 50 cycle, 3600-KW for peaking duty or 3300-KW for continuous duty, and one MC 26 control station, complete with remote start equipment and associated switchgear for the delivery of the entire power output to a single output bus connection.

THIS NEW, LOW-COST STANDARD POWER PLANT—the MU-BL is completely automatic, thoroughly reliable, fully-equipped for unattended operation. It offers 90-second availability for full load from standing start. It is sound-deadened for quiet operation anywhere it may be needed. Integrated with existing plants, the MU-BL improves system efficiency

while substantially reducing fuel, labor and maintenance costs. Up to five generating units may be handled by one control station for a total of 6000-KW peaking or 5500-KW base load.

DESIGNED FOR QUICK, SIMPLE, ECONOMICAL INSTALLATION—the new GM 3600-KW Electro-Motive Power Plant is transported easily from one area to another by rail, highway or barge. Its design, construction and performance is completely backed up by the worldwide General Motors organization. Your local GM representative will be glad to show you how a GM Electro-Motive Power Plant can help you improve your service and lower your operating costs.

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Resistance Welding of Steel Sheets by Foil Butt Seam Weld

By Dr. Ing. Ferdinand Busse

Managing Director, Peco Elektrische Schweissmaschinenfabrik
Rudolf Bocks, Munchen-Pasing, Germany

THE advantages of the normal overlap seam weld are well known — clean weld seam surface without deformation, high welding speed, small energy costs, and no special preparation on the weld edges except removal of scale and oxides. A further step is to butt seam weld the material without losing the above mentioned advantages.

It is possible to obtain a butt seam weld of steel sheets with resistance welding machines by placing a thin steel foil on both the sides of the edges to be butt welded and welding the sheet metal together with the foils. As the foil is very thin it does not serve the purpose of butt strap. However, theoretically it may be assumed that the foil is indispensable. The necessary electrical resistance which is present in the usual overlap welding is missing when butt welding and the foil provides this resistance theoretically even to an increased degree.

A number of machines for this welding process has been developed by Messrs. PECO Elektrische Schweissmaschinenfabrik Rudolf Bocks, Munchen-Pasing, Germany, and the method of foil butt seam welding employed in these machines is outlined in the following paragraphs.

1. PRINCIPLE

Fig. 1 shows the fundamental arrangement of the foil butt seam weld. It is true that the current which flows through both the electrode rollers is causing a heat centre automatically, but only both foils

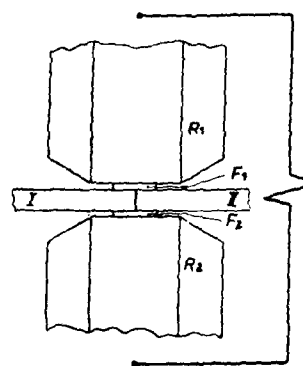


Fig. 1. Foil butt seam welding I and II sheet metals to be welded together F 1 and F 2 foils R 1 and R 2 electrode rolls.

accomplish the actual flowing of the current through both sheet metals. Without a foil the current might flow immediately through one sheet metal only and heat this one, but would not furnish sufficient heat for welding at the edge of the other sheet metal. This explains the well known fact that sheet metals placed together in the butt way, cannot be welded together with certainty without the use of foils. It must be kept in mind that the foil serves as bridge in the sense of a distribution of current on both sheet metal edges. Because of this bridging effect the foil strip has to be placed by all means in the very middle of the seam, i. e. on the point of contact of both the sheet metal edges to be butt welded. The right placing of the foil on the seam must be done properly, since the foil is very narrow (width about 3-4 mm, thickness about 0.2 mm), and a slight moving to the side when feeding the foil would cause the loss of the effect as bridging element and the mutual welding together of both the sheet metals would be impossible.

The above mentioned centred automatic placing of the foil is only possible by means of a feeding device which reaches right to the point of contact of the electrode rolls with the sheet metal (Fig. 2). Only

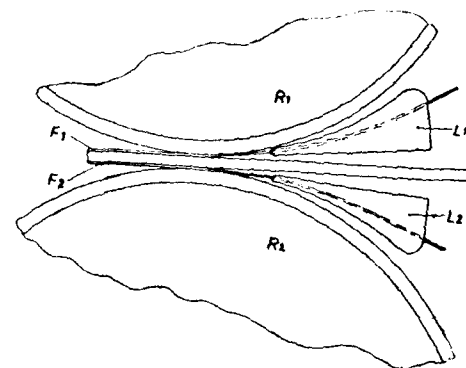


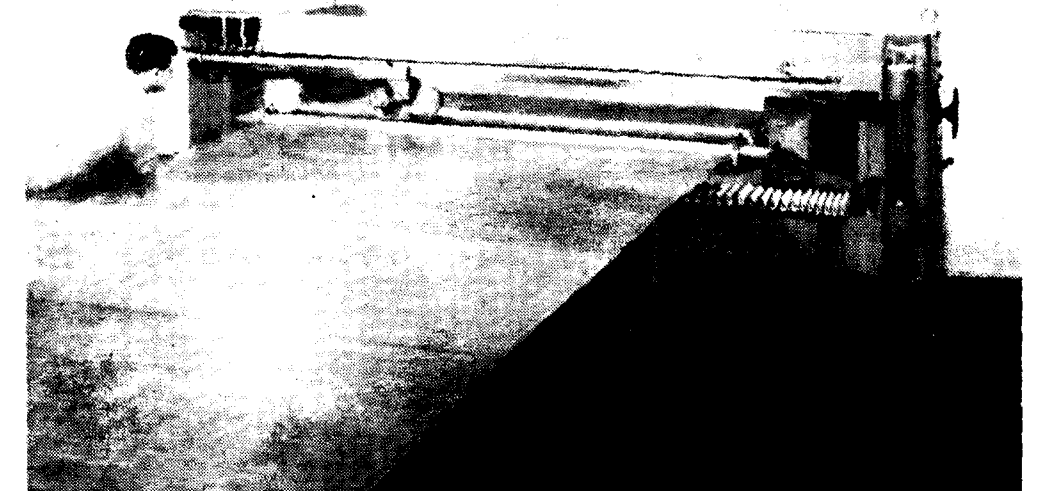
Fig. 2. Controlled feeding of the foils L 1 and L 2 feeding devices.

thus a lateral deviation of the strip can be avoided, especially as the strip right at the welding point is already considerably heated before welding and has the tendency to move sideways.

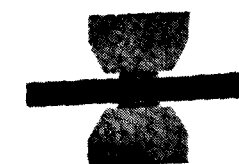
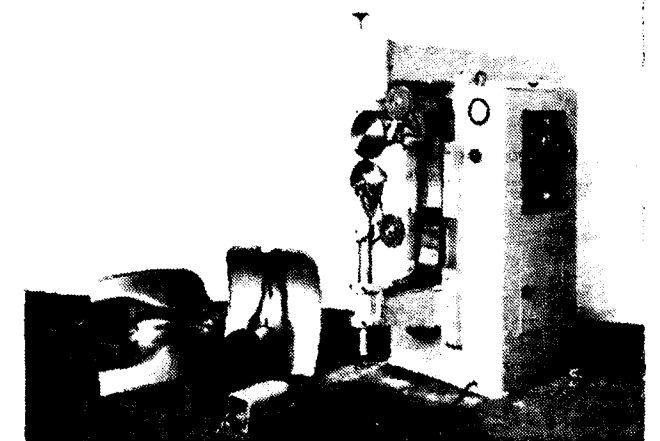
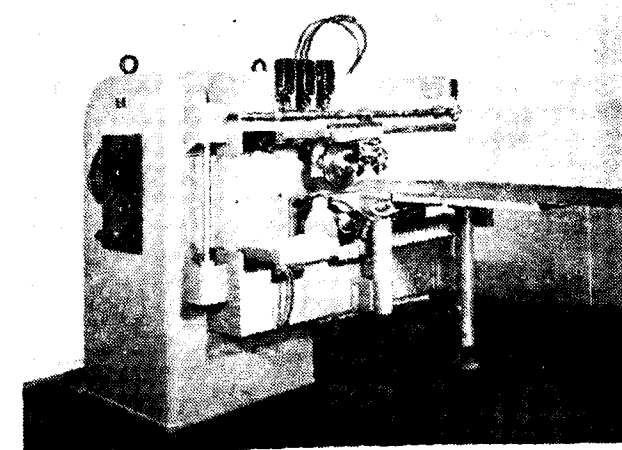


FOIL BUTT SEAM WELDING MACHINES

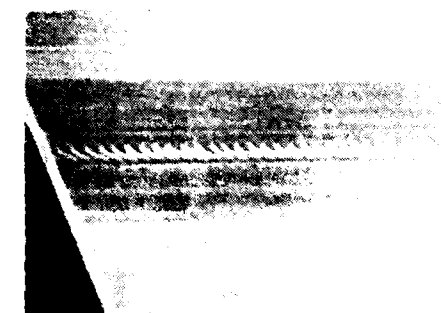
Cross bar foil butt seam welder for the welding of sheets with width up to 4000 mm, steel sheets having thickness from 0.8 to 3.0 mm.



Openside seam welder Model NPH 500 for foil butt seams for sheets varying up to 1000 mm width and thickness from 0.6 to 2.5 mm.



↑
Principle of the foil butt seam



↑
Resistance welding machine Model Nlr 30 St with deep throat special arms for foil butt seam welding for formed sheet metal parts
←
Appearance of the foil butt seam

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The pressure, i. e. the pressing of the material of both sheet metals which has become soft, is of course of considerable importance in resistance welding. By looking at Fig. 3 it can be seen that the pressure P exerted by the electrode rollers is applied normal to the surface if compared with the overlap weld. Naturally at the foil butt seam weld pressure must also be applied transversally on the seam weld (P_v), so much the more as the direction of the pressure of the electrode rollers lies parallel to the seam weld, and consequently tries to separate the latter. The necessary transverse pressure on the butt seam weld can be obtained indirectly by means of firmer chucking both the panels to be welded, at which the force SP must be higher than the welding pressure P . By thus holding both the sheets before welding to a firm, but not homogenous, structure, the following action will take place. Due to welding heat the weld zone tends to expand which is resisted by the chucking force so that there is a resultant transverse force P_v created thermodynamically. This is in addition to the static pressure P exerted by the electrode rollers in direction parallel to the same weld. Thus conditions indispensable for each kind of resistance welding are present.

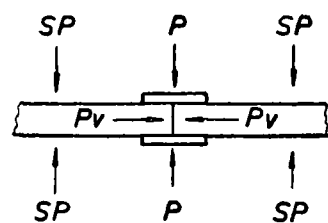


Fig. 3. Preparation of work material of the foil, welding speed, requirement for energy.

The sheet metal edges to be butt welded together must be of uniform thickness i. e., for instance, it is not possible to butt weld sheet metal of 3 mm. thickness with that of 1 mm.

The surface of the weld metal must be clean within the range of the electrode rollers i. e. it must not be covered with oxide or scaling films. Between both of the edges to be butt welded, a gap of more than about 0.3 mm. is not allowable. This can be fulfilled without difficulty with any good sheet metal cutter, or with metal panels as delivered from the rolling mill. The foil material consists of bright soft iron strip of 4 mm. width and 0.2 mm. thickness. The welding speed which can be reached by the foil butt seam welding ranges from about 3.0 m. per minute to 0.8 m. per minute, the weldable sheet metal thickness being between 0.8 mm. up to 3.5 mm.

As to the energy requirement for the foil butt seam weld it is in the lower range of the weldable sheet

metal thickness, i. e. up to 1.5 mm. the same or even a little higher than with the overlap welding. The situation changes very advantageously for the foil butt seam welding with the thicker gauge sheets up to 3.5 mm. Values of about 60% of the overlap seam welding are sufficient. It is therefore possible in case of the larger cross bar machines for the foil butt seam welding of weld lengths of 2500 mm. to operate with only 110 kVA (at 3000 mm. with about 125 kVA and at 4000 mm. with about 145 kVA). The mentioned kVA values pertain to the sheet metal thickness from 0.8 to 3.5 mm.

QUALITY OF SEAM

By using the foil butt seam welding it is absolutely possible to obtain a water-proof and air tight weld sufficient for all strength requirements. Besides, the weld seam stands the well-known ball thrust tests for strength and has been used in cases where the deformation is up to 180° in the longitudinal direction caused by smallest radius. The weld seam owns its good qualities to the fact that in spite of the advantageous small heating zone there is no sudden chilling in the weld seam or its boundary zone. Numerous tests conducted on such foil butt seam welds by The Institute for Material Research of the Technological College, Hannover, show that the fatigue strength of these welds is as high as 34 kg/mm² as compared to 16 kg/mm² of fusion welds. Similar results have been obtained also by the Confederate Testing and Experimental Laboratory in Zurich. Fig. 4 shows the



Fig. 4. Ball thrust test of a foil butt seam.

good conditions of a foil butt seam weld during ball thrust test.

At the butt seam welding the heating zone visible by the tempering colour amounts to maximum 20 mm. Because of this fact the welded part has almost no deformation.

Besides the working with practically no deformation there exists another advantage of the foil butt seam

weld, i. e. there is generally no extra work arising from the butt seam welding, because the thickening of the welded seam in comparison with the condition before welding amounts to only from 0.10 to 0.15 mm. If there is the need that this thickening should be removed for some reasons a slight grinding or passing through a planing machine is sufficient.

APPLICATIONS

Due to the fact that there is practically no distortion of foil butt seam weld and that it leaves a clean seam surface, foil butt seam welding machines have been proved to be of great advantage in the manufacture of steel doors. It is possible to manufacture efficiently doors of varying dimensions by quick welding together the individual panel sections of the door. In order to weld formed sheet metal parts (see Figs. 5



Fig. 5. Formed sheet metal parts after being foil butt seam welded.

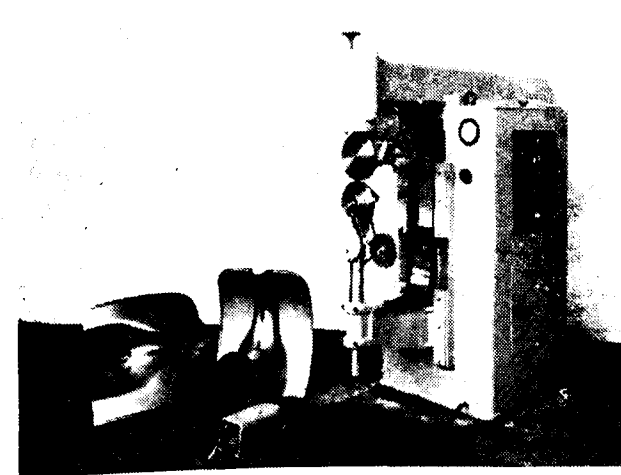


Fig. 6. Resistance welding machine for foil butt seams with working samples.

& 6) by means of a foil butt seam, special machines have been developed, which butt weld e. g. motor scooter fenders, which when manufactured in one piece would require very expensive machines and tools. The butt weld is performed so properly that extra treatment, i. e. grinding of the seam is no more necessary. Fig. 5 shows that the butt weld can stand even very sharp edged distortions of sheet metal on a spinning lathe. The figure represents on its right side a washing machine tub pressed after being butt welded, and in the centre there is a water pitcher pressed after welding. Gasoline tanks for motorcycles are being increasingly manufactured on foil butt seam welding machines.

Fig. 7 shows a cross bar foil butt seam welding machine for wide sheet metal panels up to 4000 mm. seam length. It is especially used for the railway carriages and body manufacture and for the construction of large parts, particularly for the side walls as well as for the roofs of railway wagons. The welding is done in the following manner: Both of the sheet metals to be welded together are placed exactly underneath the middle of the rollers of the seam welding machine by means of special gauging devices. The sheets lie flat on a table formed of magnetic plate chucks. By simple turning of a lever the sheets are chucked by means of the magnetic force of the magnetic plate chucks and are fixed in position.

The moving rollers of this welding machine weld the sheet metal with speeds up to 2.5 m. per minute, and the welding current is controlled by means of an Ignitron equipment with the aid of an automatic phase shift heat control. The automatically unrolling foil is fed to the upper and lower side of the edges of plates and then welded. The cutting of the foils at the end of the seam is done automatically. There is no manual work in operating the machine. The result of the welding is amazing, even with welded sheet metal panels of 4000 mm. there is practically no distortion to be seen and the weld is regular and homogeneous along the whole seam length.

The openside machine shown in figure 8 has been developed especially for the welding together of sheet metal bands up to 500 mm. width with sheet thicknesses between 0.6 and 2.5 mm. The welding is completely automatic. Such machines are operating to best advantage in carriage construction, cold rolling mills for welding bands for continuous feeding through annealing and sealing furnaces and other sheet metal industries.

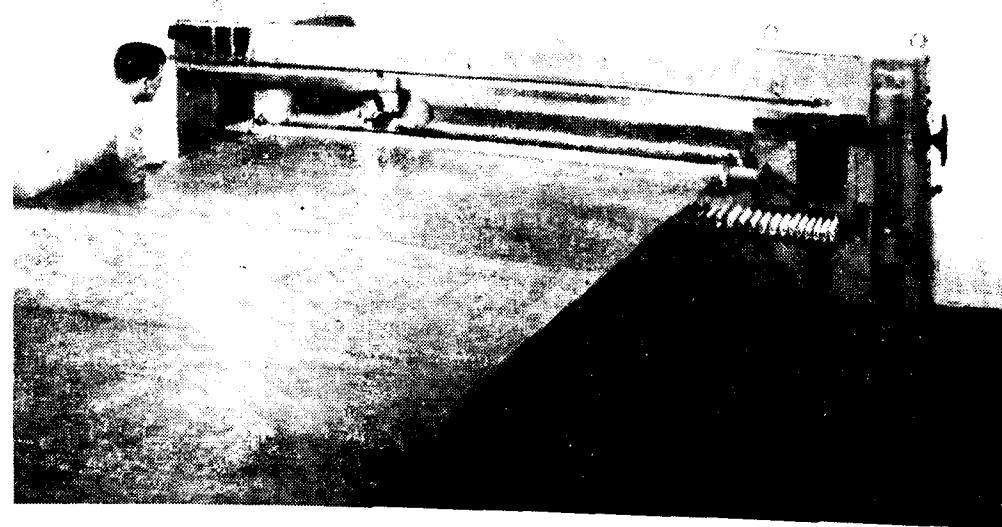


Fig. 7. Cross bar foil butt seam welding machine for foil butt seams of large sheets.

RESUME

Taking into account the various factors, the foil butt seam welding can be used successfully over a wide range of applications. The advantages are so numerous—no distortion of sheets, clean seams without practically no thickening, high resistance, high welding speed, and relatively low welding current.

The foil butt seam weld is not a substitute for the easier overlap weld, which is generally executed with higher welding speeds, but when a butt seam weld is required, the foil butt seam weld is superior to other processes in the range of 0.8 to 3.5 mm. sheet metal thickness, especially in such cases where after welding a smooth surface is required and thickening of the seam cannot be tolerated, or where a deformation has to be avoided under all circumstances.

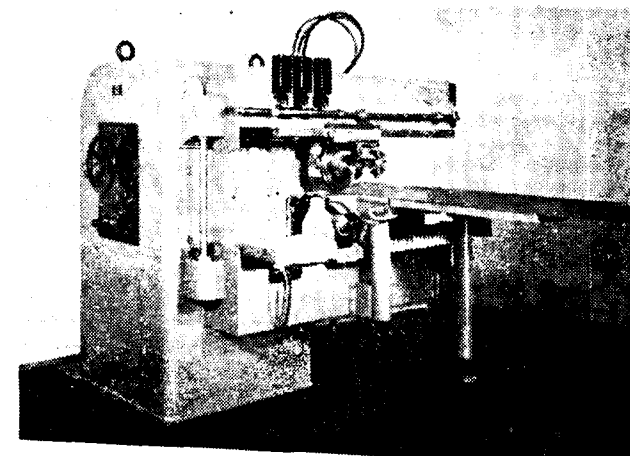


Fig. 8. Semi-portal foil butt seam welding machine.

The foil butt seam is filling the gap which exists between the resistance overlap welding and the different procedures of the gas and electrical fusion welding.

PROGRAMME-CONTROLLED METAL CUTTING

A programme-controlled gas-cutting machine has been designed by Ukrainian scientists. This was announced at a welding technology conference by Boris Paton, Director of the Ukrainian Electric Welding Institute. The machine is controlled by a programme-carrying magnetic tape ensuring the required accuracy of metal cutting. The Institute's researchers are developing a computer-controlled machine capable of selecting the components required for the most economical sheet cutting.

Some Latest Types of Electrical Equipments From Czechoslovakia

By A Technical Correspondent
of STROJEXPORT Enterprise in Prague.

TYPE BTB AIR-BLAST DISCONNECTING SWITCHES

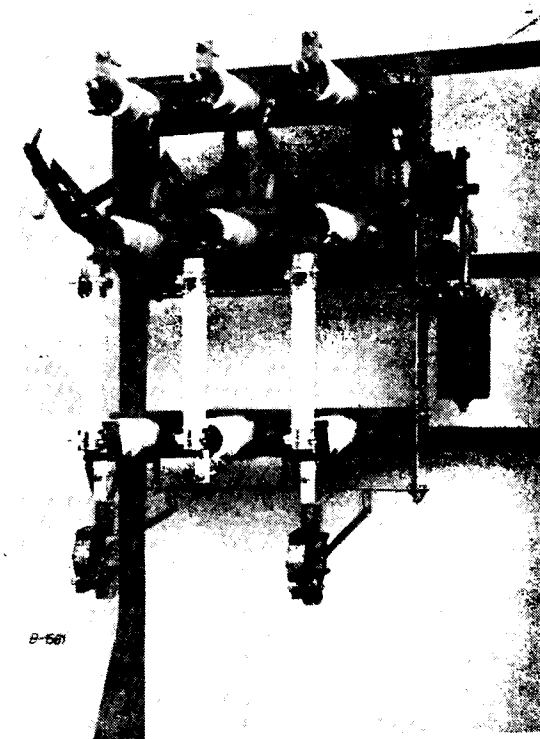
AIR-BLAST disconnecting switches find application wherever not too frequent switching of lower loads is required e.g. in restricted industrial grid branches, short electric lines, etc. The disconnecting switch can be supplemented by high capacity fuses which, during short circuits, disconnect up to the magnitude of their rupturing capacity. It can also be used instead of a high-capacity circuit breaker whenever over-currents higher than the value corresponding to its rated tripping output appear. Its combination with fuses can be used only in instances where a short interruption of operation necessary for

replacing the fuses is admissible. The type BTB air blast disconnecting switches operate without oil and without any outside means of arc extinction. Compressed air required for interruption of the produced electric arc is produced by the disconnecting switches themselves during the tripping motion.

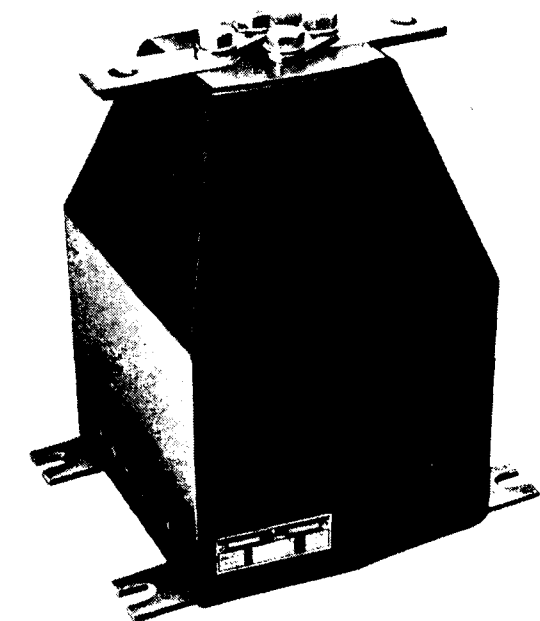
Types BTB disconnecting switches for 10 and 22 kV, with hand pneumatic drive are manufactured. They can be supplemented with direct overcurrent relays in two or three phases and auxiliary and signalling contacts which are situated outside the disconnecting switches.

MEASURING TRANSFORMERS CAST IN RESIN

The EJF Works in Brno started to manufacture in 1960 a new type series of current measuring transformers with insulation made of epoxide resin. The



Type BTB Air-Blast Disconnecting Switches.



Measuring Transformers Cast in Resin.

change in manufacture and supply of the new types is an important milestone both for the manufacturer and the consumer.

The new types of transformers cast in epoxide resin are considerably lighter than the existing types with porcelain insulation and have also smaller dimensions. In many instances they show an increase of outputs and precision, and with current measuring transformers also an increase of the ratio of the dynamic to the thermal current. These new types are resistant against moisture and fungi so that they can be applied under all climatic conditions.

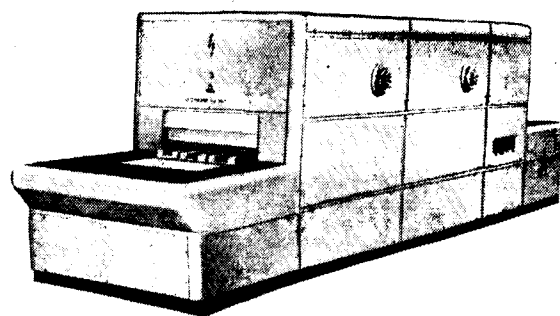
The measuring transformers are manufactured in various designs such as supporting, bush-types, single and two-core, for different short circuit classes, etc.

CONTINUOUS DIELECTRIC DRYING PLANT

The Type EDV 2 dielectric tunnel drier is intended particularly for hardening foundry cores, but it can be used also for drying some textile materials.

The drying plant is of modern design. The material intended for drying is carried on an aluminium belt conveyor through an HF field under two voltage electrodes. The second earthed electrode is formed by the aluminium belt conveyor. The conveyor speed is adjustable. A structure of angle steel pieces forms the frame of the drying plant.

The driving and tensioning shafts are mounted in self-aligning bearings. The drying plant is fitted with an exhaust equipment for removing the produced vapours. A type GU 15 electronic generator is used as a source of HF power.

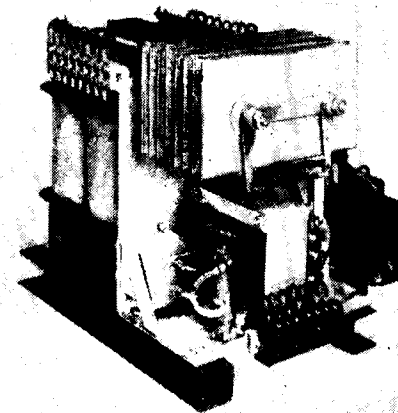


Continuous Dielectric Drying Plant.

The input of the drying plant is 3.5 kW and its performance 250 to 450 kg of foundry cores per hr., or 10 to 15 lit. of evaporated water. It is fitted with a 800 mm, wide belt conveyor the maximum load bearing capacity of which is 500 kg. Its height adjustability above the belt conveyor amounts to 80 to 300 mm.

MAGNETIC DIMMERS

The Czechoslovak Industrial Automation Works in Praha has developed and manufactures modern equipment for the control of stage lighting systems using magnetic amplifiers.



Magnetic Dimmers.

The main element of this equipment is formed by magnetic dimmers for control of the intensity of the individual lighting circuits based upon the principle of magnetic amplifiers. The dimmers and control desks can be arbitrarily mounted since they are coupled only electrically and not mechanically as were the old systems incorporating Bordonni transformers. Various light combinations are easily attainable and presetting of the light stage is also possible.

With due regard to standardization of electric light sources the magnetic amplifiers are manufactured with a maximum output performance of 2 and 5 kW. The magnetic amplifier 2 kW can be used for one or more light fittings of a total minimum output of 40 W, maximum 2 kW. The magnetic amplifiers 5 kW can be used for a minimum load of 100 W.

The control desk enables remote control of individual light sources. Potentiometers, which can be controlled either independently, or as an entire group, are used for the control system.

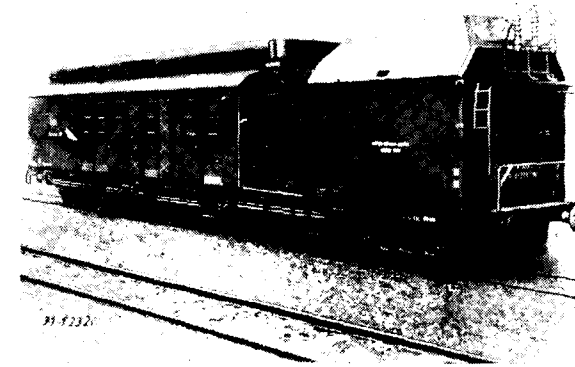
In places demanding a quick change of lighting the stage is preset by means of a double control desk. The Industrial Automation Works manufactures also electronic dimmers which can be used with advantage for the control of fluorescent tubes as well.

MOBILE, CONVERTER SUB-STATION

2500 kW, 1650 V

The mobile converter sub-station 2500 kW, 1650 V is manufactured by the World famous Czechoslovak ČKD Works in Praha.

The whole unit is mounted on an eight-wheel railway wagon of a loading length of 20 m. The wagon is divided into the H. T. space, main feeding transformer, the rectifier space, the ventilation space and



Mobile, Converter Sub-station 2500 KW, 1650V.

the handling space. 2 air-cooled mercury rectifiers are used for current rectifying, each being rated for a continuous current of 760 A at 1650 V with a 50% overloading capacity, i. e. 1140 A for 2 hours, and 200%, i.e. 2280 A for 1 minute. Each rectifier consists of six single-anode vessels which are mounted on a common stand and form an independent unit. A rough vacuum rotary air pump, a high-vacuum mercury condensing air pump, a Mc-Leod vacuum gauge, etc. form the equipment of each rectifier. The engine house contains also a formation transformer 77/135 kVA.

The handling space contains handling switchboards, a five-cell d. c. switchboard, an a.c. switchboard with measuring apparatus 35 kV, and automatic protective apparatus for the auxiliary network 380/220 V.

The H. T. cabin contains a three-pole disconnecting switch 35 kV, 200 A, current and voltage instrument fuses, transformers, a service station transformer with

an output of 100 kVA, an expansion circuit breaker 35 kVA, and other apparatus.

The main transformer is a three-phase, oil-cooled type of machine with an output of 2800 kVA. It is of outdoor design and is mounted on the wagon platform.

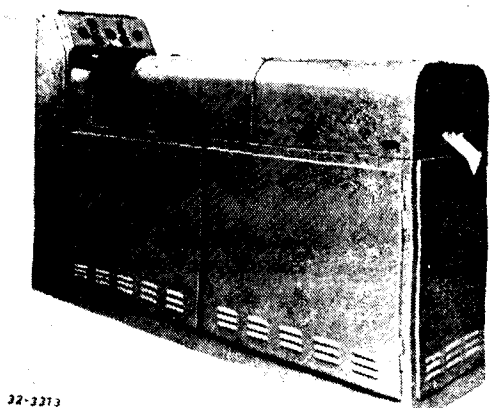
Mobile converter sub-stations are used to advantage whenever a supply of direct current for definite short period is required, as an auxiliary converter sub-station in case of emergencies, and for similar purposes.

TYPE JSO K 50 MEDIUM-FREQUENCY AUTOMATIC HEATER

A high technical standard in hot operation and maximum effectiveness of engineering production can be attained only by means of such thermal equipment that is capable of ensuring precise and rapid heating of products and semi-finished products. The induction automatic heaters manufactured by the ZEZ Works, Praha, meet fully this requirement. The design of this equipment has enabled the introduction of modern technology in the engineering industry, particularly in mass and large serial production, and thus utilization, for example, of the efficiency of modern forging machines and presses.

The displayed type JSO K 50 automatic machine which operates with a frequency of 4000 c/s has an input of 50 kVA and attains a temperature of 1250°C.

It is suitable for heat treatment of material 22 to 70 mm. in diameter and 50 to 300 mm. long. The

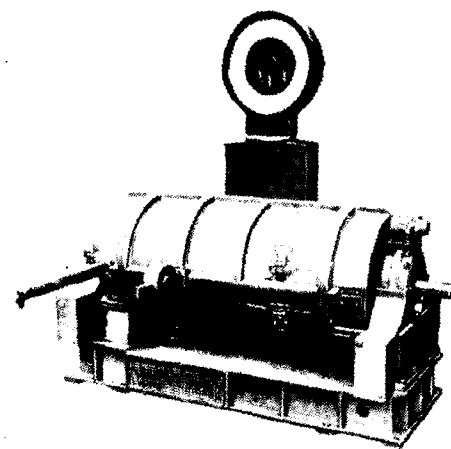


Type JSO K 50 Medium Frequency Automatic Heater.

capacity of the machine is approximately 130 kg. per hour. An HF generator manufactured by the BEZ Works in Bratislava is used as a source. The series of medium frequency JSO K heaters is manufactured for outputs of from 56 to 500 kVA. In addition to medium frequency, automatic heaters the ZEZ Works, Praha, manufactures machines also for the industrial frequency. The wide manufacturing programme of the national corporation of ZEZ, Praha, includes also induction melting furnaces and all types of resistance furnaces.

TYPE KS 56B-4 THREE-PHASE COMMUTATOR DYNAMOMETER

The KS series three-phase shunt wound commutator dynamometer is a product of the well known Czechoslovak MEZ factories. It is fed into the stator and used for direct measuring of the moments of driving and driven machines. In the first place it operates as



Type KS-56B-4 Three-Phase Commutator Dynamometer.

a generator—a brake—and is used for determination of the output, efficiency and functional characteristics of the driving machine. In the second instance it operates as a motor for determination of the input, efficiency and functional characteristics of the driven machines. The Czechoslovak type KS 56 B-4 dynamometer has all the advantages demanded from these pretentious machines. In commutator dynamometers the stator is mounted in a rotary manner in bearings. On the horizontal axis of the dynamometers there is mounted on one side of the stator an arm actuating an automatic incline weighing machine gauged in kgm, while on the other side there is a counter-weight by means of which the zero position of the dynamometer is preset. The torque produced during loading affects the stator according to the principle of action and reaction. The output of the dynamometer shaft is then determined in accordance

with the moments in kgm read on the scale of the dynamometer weighing machine and according to the revolutions per min. read on the speedometer on the control desk.

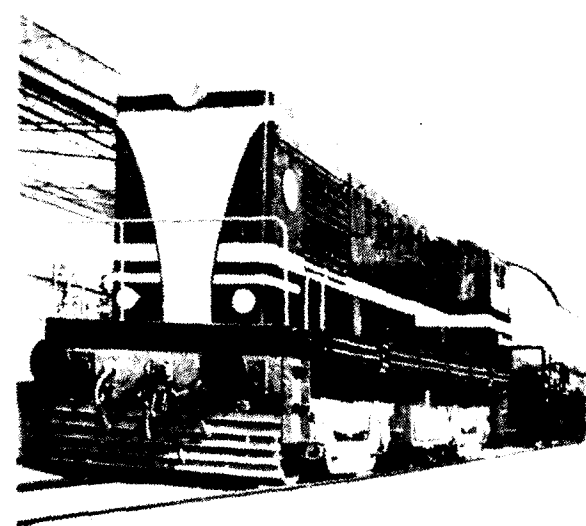
The commutator dynamometers have a great advantage in that the power generated in braking of the driving machine is recuperated directly to the normal industrial grid and that power from the industrial grid is used directly for speed control during driving of the machine without changing the current system. Another advantage of commutator dynamometers is their precision and sensitivity of measuring, easy control, infinitely variable speed control within the range of 5:1 to 30:1, small constructional space and low initial cost.

The Czechoslovak MEZ Vsetin factory manufactures a great number of commutator dynamometers ranging from a type for 10 kW at 3000 r.p.m. up to a type for 480 kW at 2400 r.p.m. The type KS 56 B-4 has an output of

280 kW at 2800 r.p.m.
150 kW at 1500 r.p.m.
60 kW at 600 r.p.m.

The outputs are given for the generator operation. For the motor operation they are lower by 10%.

ČKD T 435.0 TYPE HEAVY-DUTY DIESEL-ELECTRIC LOCOMOTIVE



ČKD T 435.0 Type Heavy-duty Diesel-Electric locomotive.

(Continued on page E.43)

TOROIDS TODAY

THE last four or five years has seen a renewed and increasing interest in the application of toroidal winding which had its first use in the very early days of telecommunication, and was synonymous with only the most expensive type of component.

The never ending demand by designers for better performance in equipment has lead metallurgists and chemists to produce transformer core materials of outstanding characteristics, and in nearly all cases this may be exploited to the limit only when the transformer is designed in toroidal form, hence renewed interest in this technique of winding.

The art has always been regarded as some what expensive, and while it obviously cannot compare with conventional winding, the cost need not be prohibitively higher, especially when compared with the vastly improved performance obtained in certain types of components such as magnetic amplifiers, low level I.F. input transformers, filter coils, and tapped decade transformers.

These types of components often demand materials of very high permeability and this is represented by the 77% nickel or Super MuMetal group of alloys. Great care is needed in handling this material for mechanical strain or bumping can very seriously reduce its permeability.

(Continued from page E.42)

The works manufacturing the ČKD T 435.0 type diesel-electric locomotive has a 30-year old tradition in making diesel traction vehicles.

This locomotive is used mainly for shunting purposes in railway shunting yards but it is also well suited for servicing main and branch line freight trains and for shunting work in plant yards. Its maximum speed, tractive force and axle load correspond to the described versatility of the locomotive.

It is provided with a robust ČKD low-speed engine which secures a faultless supply of power even under the most difficult conditions encountered in the shunting yards.

To obtain maximum results the material is wound up in the form of rings from tape (as thin as .005" to .008"), it is then heat treated and finally fitted into a plastic or rigid case which then gives the core mechanical protection and also provides the former on which the windings can be placed.



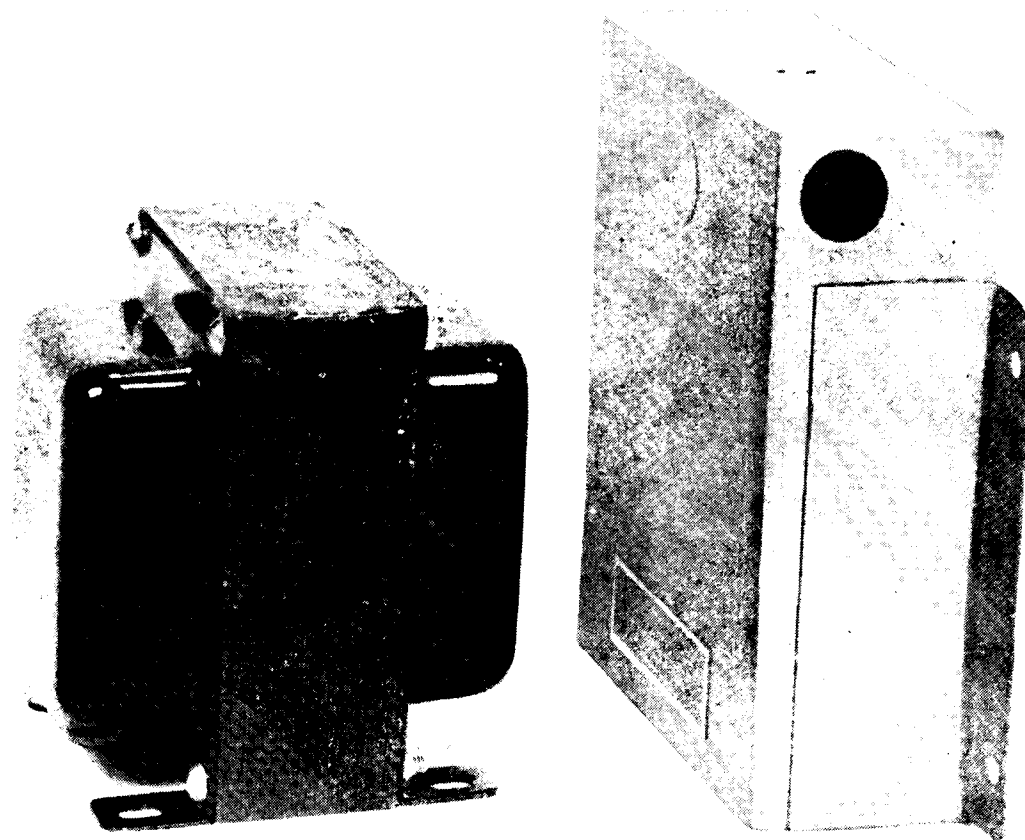
A five Kilowatt transformer for a high current charger.

Before the advent of synthetic enamel and resin insulation of winding wires, the problem of eliminating the short circuit turn was always very real, and double types of insulation such as double silk and enamel, rayon and enamel, and sometimes cotton and enamel, were often used to improve reliability in this respect. This was, of course, wasteful in terms of winding space,

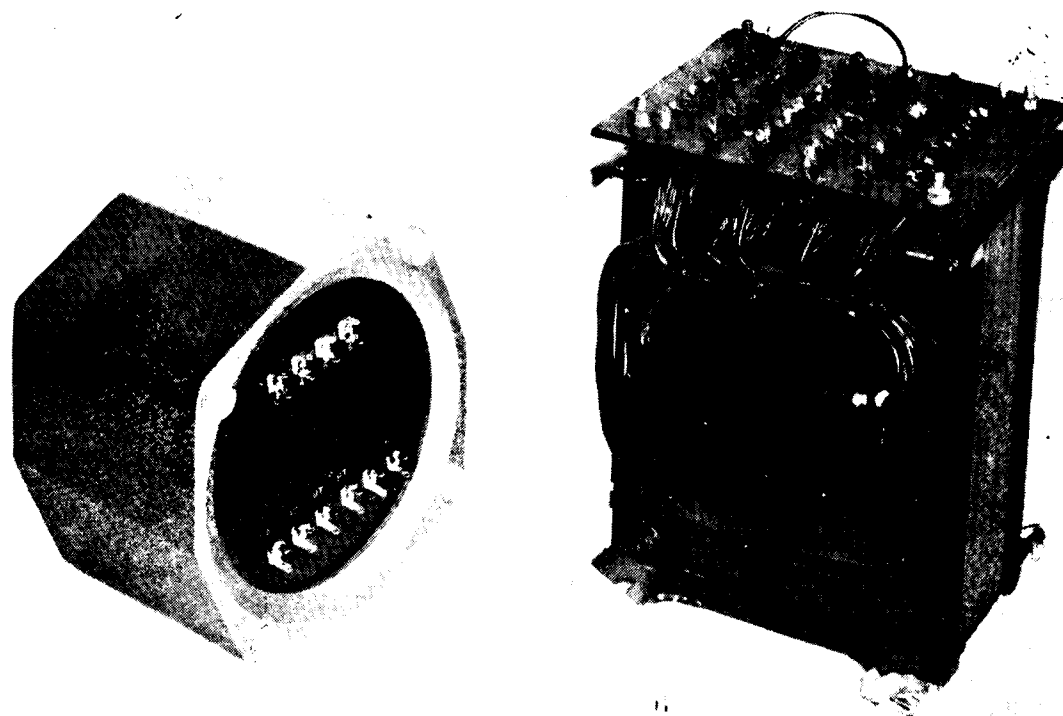
Here are the main technical data: Bo' Bo' wheel arrangement, rail gauge 1,435 mm to 1,676 mm (4'—8½" to 5'—6") power output 750 HP, weight 60 tons (59 long tons), maximum speed 60 to 70 km/hour (45 to 49 miles/hour).

If required, this ingeniously designed locomotive can be adapted for work in extreme temperatures varying between +40 and —50° Centigrade (+104 and —58° Fahrenheit).

All the abovementioned equipments are exported by the world-renowned Czechoslovak Enterprise STROJ-EXPORT, PRAGUE.



An example to show the considerable saving in plan area of a chassis when a toroidal mains transformer is used, both units are of equal rating.



An example of the compact nature of toroidal construction, the components are of equal rating.

and meant that the maximum potentiality of the toroid was not always fully exploited. The modern finishes, however, are so tough, that damage to wire by abrasion is almost unknown, providing the correct winding technique is observed. The full dielectric strength of the insulation is also realised so that additional insulation to that of the wire covering is usually for mechanical purposes only. The increased weight of copper which can thus be wound, due to the reduced volume of insulation and coupled with the much decreased magnetised ampere turns at normal flux density, means that toroids can now be wound with a reactance to resistance ratio in excess of a 1000-1. This can be a useful feature in the design of potential transformers which often need to be connected in cascade. An example would be the ratio transformers in the reference system of an automatic machine tool controller.

Improvements in recent years have not been confined only to materials and wire insulation. The toroidal winder itself has undergone much development especially the wire holding shuttle which can now wind down to finished internal wound diameters of less than 50 thousandths of an inch. This means much smaller coils and greatly increased number of turns to the cubic inch. 40,000 turns is not uncommon and under certain conditions winding speeds of 2000 T.P.M. are frequently achieved.

The ability to wind fine wires on to very small cores has stimulated the interest in storage cores for computers. This work has been carried out by hand, but where several secondaries must be wound with close tolerance in terms of turns, self capacity, or leakage reactance, then the machine winding will be superior although not always quicker.

This fine wire winding on high permeability cores is also to be found in the miniaturization of magnetic amplifiers, and quite complex control units can be built into a volume much less than a one inch cube.

The mains transformer wound as a toroid can also offer certain advantages. One is the much reduced magnetic leakage field, which can be useful in high gain compact equipment, such as portable oscilloscopes and low frequency amplifiers.

The normal transformer under these conditions is usually worked at low flux density which means increased weight and volume, whereas the toroid can

work at high flux density and yet still show much lower leakage fields; a further advantage lies in the fact that the leakage field will be symmetrical and its field pattern can be predicted with considerable accuracy. This can be quite important when considering the position of fixing a transformer on a chassis of compact layout.

The dissipation of heat generated by the copper losses can also be much improved. This may be summarised in the following way. The conventional transformer has a winding whose length is generally a third to half the mean iron path length, and of the complete winding; at least one half of its area is enclosed within the area of the closed iron loop, this means that the temperature gradients of the windings are complex and far from uniform. In the case of the toroid we start with the advantage that the core watts loss will always be lower than with a stack of punched laminations, and second, the winding is able to occupy the full iron path length, this means that the copper has a greatly increased surface area available for cooling, therefore, the temperature gradient is much more uniform. Hot Spots are avoided thus greatly increasing the life of insulation material. The geometry of the toroid enables the centre of gravity in an assembly to be kept very low, a most useful point where vibration and high impact conditions are present.

Square loop materials such as HCR when employed to utilise the square loop characteristic always have the most sharply defined boundary when the material is wound as a toroid. A typical case here is the transformer used in a transistorised DC-DC converter. The transistor has to supply two components of current, one to the load and the other the magnetising ampere turns to produce saturation. The smaller the magnetising the more accurately its peak value is defined, and the problem of assessing the margin of safety in transistor current is reduced to simple terms.

This short note by no means exhausts the field of use of this most interesting component and trends indicate a considerable increase in its application during the next few years. Development work in hand in many laboratories foreshadows a partnership between toroid and semi-conductor where their characteristics combine to offer great savings in size and weight not only in the low power radio/electronics field but in the "heavy engineering" of industrial control.

[For details: Aveley Electric Ltd., U. K.]

CLOTHING THAT CAN SHED A STAIN

Clothes that can suffer a severe stain, and yet be wiped clean! This is the latest announcement to come from a U.K. manufacturer. A chemical preparation is impregnated into the finished cloth and the result will be suits, dresses and coats that are stain resistant to a certain number of fluids including tea, coffee, beer, fruit juices, ink, ice cream and jam.

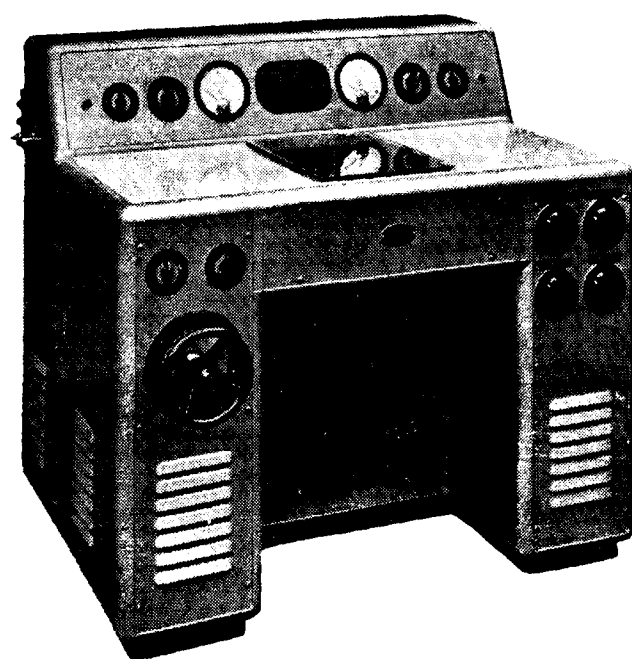
Firstly the chemicals and their mixture remains a secret. But in the U.K. manufacturers of most fabrics—stain, cotton, rayon as well as wool mixtures—can now have their cloths impregnated. This will be done under a house-to-house agreement, and then, when a push-button machine unit to carry out the process has been fully developed and tested—it will take about a year—the firm will cope with the sale of machines and the process.

* * *

HELPING BRITAIN'S RURAL INDUSTRIES

A great many small factories and workshops in country towns in England and Wales have grown to meet the bigger demands of industry, mainly agriculture, and a lot of them have been helped by the Rural Industries Bureau, set up in 1921 as part of a Government scheme to combat the drift of the countrymen to the town.

The Bureau has technicians and instructors at its London headquarters available to travel wherever their services are needed, while others work permanently at various centres. This year, Britain's Board of Trade, with the help of the Bureau, is sponsoring a display of goods made by country workshops in Britain at the 13th International Handicrafts and Trade Fair at Munich, Germany, from May 31 to June 11. Besides traditional woollen and leather goods and pottery, the range of products will extend to sports goods, metal work and musical instruments.



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Budapest Industries Fair Supplement

BUDAPEST INDUSTRIES FAIR 1961

MAY 19 - 29

By A Special Overseas Correspondent

BUDAPEST FAIR 1961, the annual industrial fair of Hungary, will be held this year from 19th May to 29th May and the gates of the fair will open at 10 A.M. and will be the centre of attraction for all overseas businessmen. The Budapest Fair is one of Europe's oldest shows. Besides its character as a general display of goods, great stress is laid on the telecommunication technique and the manufacturing of instruments.

The Fair grounds admeasure about 260,000 Sq. M, and the situation is picturesque in the heart of the Town Park. From 22nd to 26th May, the Fair gates will remain closed to the public but will be open only to businessmen, experts and scientists from abroad with a view to providing them with an opportunity to discuss business matters with Hungarian counterparts and also visit the numerous exhibits in a calm and undisturbed manner.

1961 Fair — Some Important Data

Total area of the pavillions:	53,000 Sq. m.
Open-Air Area total:	105,000 Sq. m.
Number of Exhibitors:	1050 (home) 400 (foreign)
	from 17 Countries.

Last year visitors were about 1.1 million and this year this target is likely to exceed.

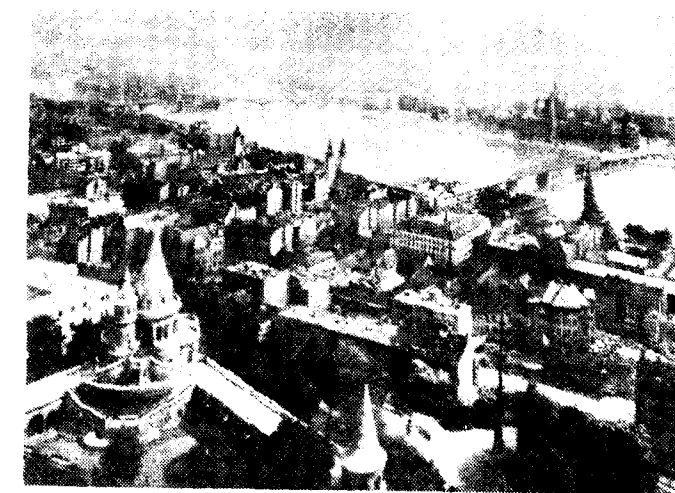
Like in the past years, this year too, the Fair Bureau will have a meeting place where foreigners can meet each other. The meeting place will be open for every foreign exhibitor and visitor. Services at the meeting place include long-distance phone lines, telex service, money-market quotation indicators, money exchange tellers, type-writing and copying service, subagency of the Hungarian Travel Bureau, and several other amenities.

BUDAPEST, THE CITY OF SPRINGTIME

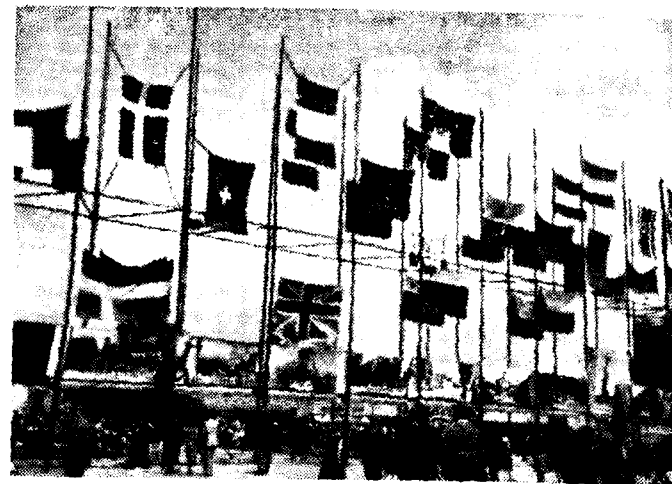
The beautiful panorama of Budapest, recognised all over the world, her natural riches, beautiful aspects the monuments reflecting a historic atmosphere, her buildings and museums which are worth seeing indeed, her rich culture, her lively mundane life, last but not least the famous hospitality of her inhabitants; all these make a staying here, no matter, in which season it is, the source of never to be forgotten memories.

Though Budapest is, before all, the city of the spring-and-summertime, this metropolis with a magnificent location has many curative thermal springs, a gift that makes her one of the most beautiful health-resorts of Europe. Besides, Budapest is known as the city of good eatables and drinks. The world-famous Hungarian cuisine art and the excellent Hungarian wines are something exceptionally delicious for the foreigner.

The 2000-years-old history of Budapest has left



A view of the beautiful city of Budapest



Entrance to the BUDAPEST FAIR where the national flags of the participating countries are fluttering

behind a great many of historical monuments and buildings. Besides, the Pest (BUDAPEST is comprised of 2 cities BUDA & PEST) side of the town is one of the youngest metropolises of the world. This city, big as she is, shows to-day a peculiar harmonic combination of old and new of romantic memories with the rhythm of the pulsating life of our time. Situated on both sides of the Danube, this city with her nearly 2 million inhabitants is in the middle of Europe, being as far from Moscow as from London, Kiev, Paris, Stockholm or Istanbul. Budapest, the kind hostess, says welcome to the visitors of the Fair coming from all corners of the world.

BUDAPEST IS AWAITING YOU

Budapest's host, the Municipal Travel Bureau says a hearty welcome to all the exhibitors and visitors of the Fair. The Municipal Travel Bureau takes care for their accommodation, holds theatre and concert tickets at disposal, organizes extra programmes, promotes the better understanding of Budapest's cultural life by arranging sight-seeing autobus tours. Foreigners will be serviced by trained guides and interpreters in about 15 languages. The information service of the Bureau renders every information one might need on Budapest. The Municipal Travel Bureau of Budapest is in every respect at the disposal of the guests of the Fair. Some phone numbers worth noting are:

ROOM RESERVING SERVICE: 180-201, 381-106

INFORMATION SERVICE: 382-061

BOOKING OF THEATRE AND

CONCERT TICKETS: 181-190

BUDAPEST FAIR 1960

Budapest Industrial Fair 1960 occupying a total area of 260,000 sq. m. that is by 40,000 more than that of last year, marched up 1030 inland and 398 foreign exhibitors of 19 countries. The foreign trading companies coming from socialist countries represented several hundreds of producing industrial enterprises. The number of visitors was well above one million also this year.

Studying the detailed data of pages 2-3 relating to the last and previous Fairs, it may rightly be said that judged by the development shown, Budapest a regular site of spring industrial sample fairs ever since 1906, has regained its place among important international fair organizers. As to the size of surface occupied as well as the number of participants and visitors, technical equipment or the variety of service rendered, Budapest Industrial Fair has surpassed many a well-known international fair.

In the analysis of the achievements of this year's Fair special consideration must be given to the fact that it has fully complied with one of its principal tasks; it gave a true picture of the great development Hungarian economy, particularly Hungarian industry have shown in the years 1945-1960, i.e. during the 15 years passed since the liberation of the country. The magnificent muster of Hungarian industry gave a comprehensible idea about the process, which as a result of expanded industrial bases, of the creation of new branches of industry and of a considerably higher technical level has turned Hungary from a backward agrarian country into one possessing a well-developed industry. The fact that the volume of industrial production in this country has grown to three and a half times as much as it was fifteen years ago has



Night illumination of the Hungarian Food Industry Pavilion at the Budapest Fair

played a decisive part in raising national income to double and a half that of the pre-war level.

However bold in its outlines, the Fair succeeded in giving a true picture of the modernization of Hungarian industry, accelerated especially in the past few

years, and about the structural transformation of Hungarian industry, which corresponding to the economic possibilities of the country, gives predominance to labour absorbing, partly traditional branches as e.g. electricity, telecommunication, instrument making etc.

Data explained	1957	1958	1959	1960
Total area required by the Fair (sq. m)	140 00	160 000	220 000	260 000
Covered halls and other				
covered space for home exhibitors (sq. m)	18 300	22 860	26 900	27 106
for official representatives of socialist countries (sq. m)	—	3 140	6 293	6 377
individual and group exhibitions of western firms (sq.m)	—	—	3 035	13 815
other fair buildings (sq. m)	2 618	3 116	4 517	4 876
Total covered space (sq. m)	20 918	29 116	40 745	52 174

	1957	1958	1959	1960
Open air space				
Home exhibitors (sq. m)	3 900	4 500	5 940	7 958
Official representatives of socialist countries (sq. m.)	—	2 100	2 850	5 650
Individual and group exhibitions of western firms (sq. m)	—	—	2 804	3 590
Other fair buildings (sq. m)	4 072	5 820	7 298	7 086
Total open air space (sq. m)	7 972	12 420	18 892	24 284
Total covered and open air space required for the purposes of the Fair (sq. m)	28 890	41 536	59 637	76 458
Utilization of the Fair area for exhibitions, in per cent	20,6%	25,6%	27%	29,4%

The international character of the Fair was more manifest this year than ever before, both as regards socialist and capitalist countries. The exhibition of socialist countries of considerably richer choice paid more attention to the international division of labour than those of previous years. Also this gave a special stress to the growing significance of the Fair as an opportunity for a mutual study of demands and exports supplies as one of the decisive pre-conditions of a closer and more effective economic co-operation.

The number of exhibitors coming from western countries had doubled and it was for the first time that some countries like Sweden or Canada had sent representatives of their industries to participate in the Fair. This may be understood as a proof of the favourable consideration industrial and commercial

circles in capitalist countries have given to the trade results of the 1959 Fair on the one hand, and of their wish to avail themselves of the possibilities Hungarian foreign trade, ever growing in turnover also in its relations with western countries, has to offer them, on the other.

Further remarkable achievements of this year's Fair are that exhibitors coming from capitalist countries thought it important to display their latest products in their shows and that the number of participants of world wide reputation was also larger than before.

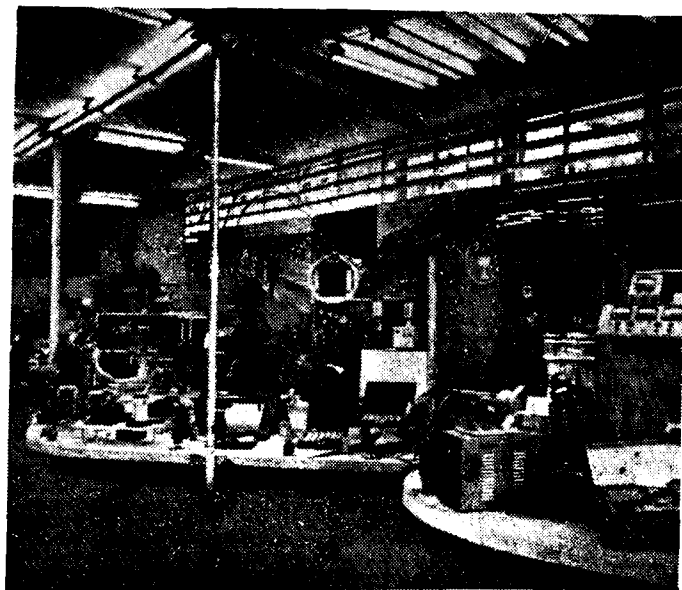
A further step was taken by this year's Fair also on the way of making Hungary, marked out for this purpose also by its favourable geographical situation, an important thoroughfare of trade between East and West. This year's Fair gave an opportunity, besides

actual transactions concluded, also for more trade information and for establishing connections on a larger scale between western firms and not only Hungarian partners but also with the foreign trading companies of other socialist countries.

The methods and means of information regarding both home and foreign exhibitions had also improved. Consequently, experts of the Hungarian industry and scientists could study the development of the technical level in various industrial fields more thoroughly, and foreign visitors could fully recognize the aim of Hungarian foreign trade to expand the structure of its exports, first of all in its western relations, in the field of industrial products.

We may conclude in saying that besides having preserved its character of a general sample show preparatory trends indicating the formation of certain crucial points around several branches could also be observed at the Fair. Besides the International Automobile Show, which has become almost traditional, telecommunication and instrument making were also very rich in international representation and deserve being resolutely improved when outlining the tasks of coming Fairs.

Following a report on the Hungarian exhibition the present final report will discuss countries represented by official shows, then the display of goods arranged by private foreign firms and a special chapter will be given to the International Automobile Show.



Exhibits of the Soviet Instrument Industry at the 1960 Budapest Fair

Data explained	1957	1958	1959	1960
Number of exhibitors				
Hungarian large-scale industry	173	321	547	487
light industry (state local ind.)	142	135	79	118
co-operatives	271	253	227	329
small-scale industry	287	284	179	96
Total of inland exhibitors	873	983	1032	1030
Foreign exhibitors				
trading companies of socialist countries	—	73	139	99
exhibiting companies of western countries	—	—	151	299
Total of foreign exhibitors	—	73	290	398
Total of exhibitors of the Fair	873	1056	1322	1428

A MUSTER OF HUNGARIAN INDUSTRY

It may be rightly said about this year's Fair that by its increased dimensions, its better arrangement in contents and subject it has contributed to the accomplishment of one of its tasks, to render a survey on the development of industrial production which, in the course of the fifteen years elapsed since the liberation of the country, has been raised to three and a half of the pre-war volume, and to give an idea on the high level of its products, better than ever before. It is due to this improved industrial production that about two thirds of Hungarian exports—it was one third in 1945—are made up by industrial products coming for the most part from the heavy and machine industries.

As to heavy industry, an important part was taken at the Fair by the demonstration of the quick pace of progress made by electric power production with a special view to the planned new huge power plants and to the meeting of the rapidly growing demands in electric power shown by agriculture. The exploitation of nature's treasures hidden in the womb of the Hungarian soil was demonstrated to visitors of the pavilion of the mining and crude oil industries by modern equipment such as damp-proof mine locomotive capable of hauling 100 cars or the drilling equipment mounted on a truck. Great interest was shown in the manifold utilization of carbonic acid particularly for

cooling purposes gained in large quantities in gas form in Hungary.

The pavilion of the Hungarian chemical industry was a highlight of the Fair. One could find there besides plastics and synthetic materials the famous Hungarian specialities in medicines. Visitors could learn there that in Hungary, one of the countries richest in bauxite in the world, bauxite mining is 18 times, alum earth production 48 times and aluminium metallurgy 19 times more than they were in 1945. A maquette showed the expansion work being done in the Light Metal works of Szekesfehervar which will soon become one of the largest and most up-to-date plants of its kind and where the capacity of aluminium semi-products and rolling will be multiplied. The latest product of Hungarian aluminium industry, metal gallium, one of the rare metals, was also exhibited.

In accordance with its crucial role played in economy *metallurgy and machine industry* gave an exhibition largest in dimension and contents in the Fair. 187 national enterprises took an area of nearly 12,000 sq. m. to display their latest products. Many of them found this as a first occasion to appear before the public. Machine tool industry alone was represented by 51 machine tools, 23 of them new products, and several single purpose machines not manufactured so far, coming from 15 factories. There was also an improved version of the spark erosion machine "Erosimat" that was awarded a Gold Medal at the Brussels World Exhibition in 1958.

The high level of Hungarian machine building was proved by latest models as e. g. the 600 HP remote controlled diesel ship engine of the Lang Factory, exporters to all corners of the compass, machinery for the chemical and food industries or full equipment for fruit and tomato trituration made by the Iron and Steel Foundry of Kobanya, the high capacity centrifuges and new system separator cleaning 5000 litre wine or other liquids an hour, presented by the Zuglo Machine Factory. The model of the Budapest Elizabeth Bridge under construction in the form of a cable bridge was exhibited by the makers of the cable structure, the Budapest Cable and Stranded Wire Factory. A novel idea has been realized by the especially light lifts with their cabins made of aluminium made by the Hungarian Lift Factory, the new type refrigerators produced by the Jaszbereny Metal Spinning and Sheet Factory, manufacturers also of the world-famous Heller-Forgo cooling elements. From a long line of sanitary appliances mention should be made of the nine-bulb 25,000 lux surgical lamp of

the Factory of Hospital Equipment, which gives a shadeless concentration of light to one point, and of two further novelties: an operating table for gynecological and another one for orthopedic surgery. There were further exhibited various household equipment as kitchen ranges and stoves operated by infrared rays, products of the Budapest Factory of Gas Apparatus, the signal lamp smoothing iron and special percolator of the co-operatives of the iron industry.

Telecommunication plays an important role in the rapidly progressing structural transformation of Hungarian industry. One of its most outstanding representatives at the Fair was the Orion Factory, an exporter to 45 countries, which exhibited a rich choice of latest-type wireless and TV sets, made for the most part with printed circuits. Several of the TV sets with video tubes of 53 cm. and 110 degree and one of them of colour filter construction. The Szekesfehervar VT factory had also brought TV and radio sets, one of them was a transistor table model. Among the latest products one could find a new crossbar telephone exchange and an automatic exchange for apartment houses, (BHG Factory), a stereophonic, four-speed tape recorder (Budapest Radiotechnics), the latest Tungsram products: TV video tubes, vapour lamps, semiconductors, high-power rectifiers with germanium diodes (Konverta Factory), small-sized but high-output thorium transmitter valves (Hungarian Anode Valve Factory), novel type slot automatic phone apparatus (Telephone Factory), miniature and sub-miniature spare parts (Remix) etc.

Hungarian *instrument industry*, which in the course of the past ten years has raised its production almost tenfold and has set up a number of factories, appeared with a separate exhibition this year. In spite of the exhibition being arranged only of the instrument constructions of the products of the last 1 or 2 years we could see several hundred instrument novelties from the fields of electric, electronic, shop management,



A view of the Heavy-Industry Pavilion of Hungary at the Budapest Fair—Exhibits arranged by the Energy, Mining and Chemical Industries of Hungary dominated the whole Show

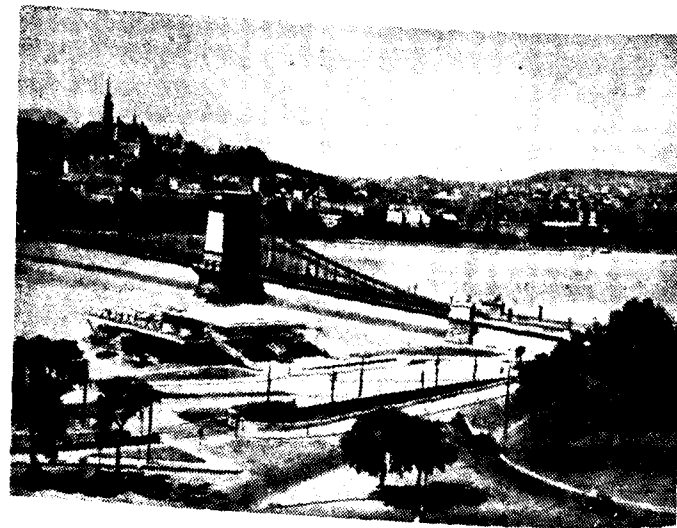
laboratory, material testing and medical instruments. Even a superficial report on them would surpass the dimensions of our present report. The products of crucial national industry were completed by those of co-operatives and private instrument makers.

The show of the *building industry* was focused this year around the 15 year housing improvement plan. A foretaste about the 1 million of new flats being built was given by various pieces of built-in furniture which will be applied in 40 per cent of flats that are to be built during the Second Five Year Plan between 1961—1965. Besides giving account of big establishments created during the fifteen years passed since the liberation the plans of further establishments were also put on show. Experts were greatly interested in new building materials, porcelain insulators, building machines, such as a six and twenty t/m tower crane. The perlite weekend-house whose series production will be started in the near future was also a great success.

The 3000 sq. m. pavilion of state light industry displaying also the products of national local industry, co-operatives and craftsmen awaited its visitors with a gaudy panorama. The largest branch of light industry, cotton industry scored appreciation with its exhibition on "an ideal home" and with its "Four seasons" arranged from printed cotton representing all colours of the rainbow. Besides well-formed, fashionable articles presented by the leather and footwear industries, due attention was paid to the 10 fully furnished living-rooms of the national furniture industry which were awarded the title "The most beautiful product of 1960".

It was for the first time that national food industry gave a full picture of its activities on the Fair. Among the curiosities of its glass pavilion we should mention the quick-service snack bar combined with a show of the products of canning industry and the exhibition of cosmetics and house-hold equipment. Friends of tobacco and good wines could find here the specialties of Hungarian tobacco industry and also the world famous vintage wines of Tokaj, Eger, Csopak and Balatonfüred.

Home trade had a pavilion of its own this year showing modern serving equipment and the possibilities in a household mechanized according to the latest principles. The many-sided universal kitchen machine, as well as the models of well equipped kitchens and pantries were most popular with visitors.



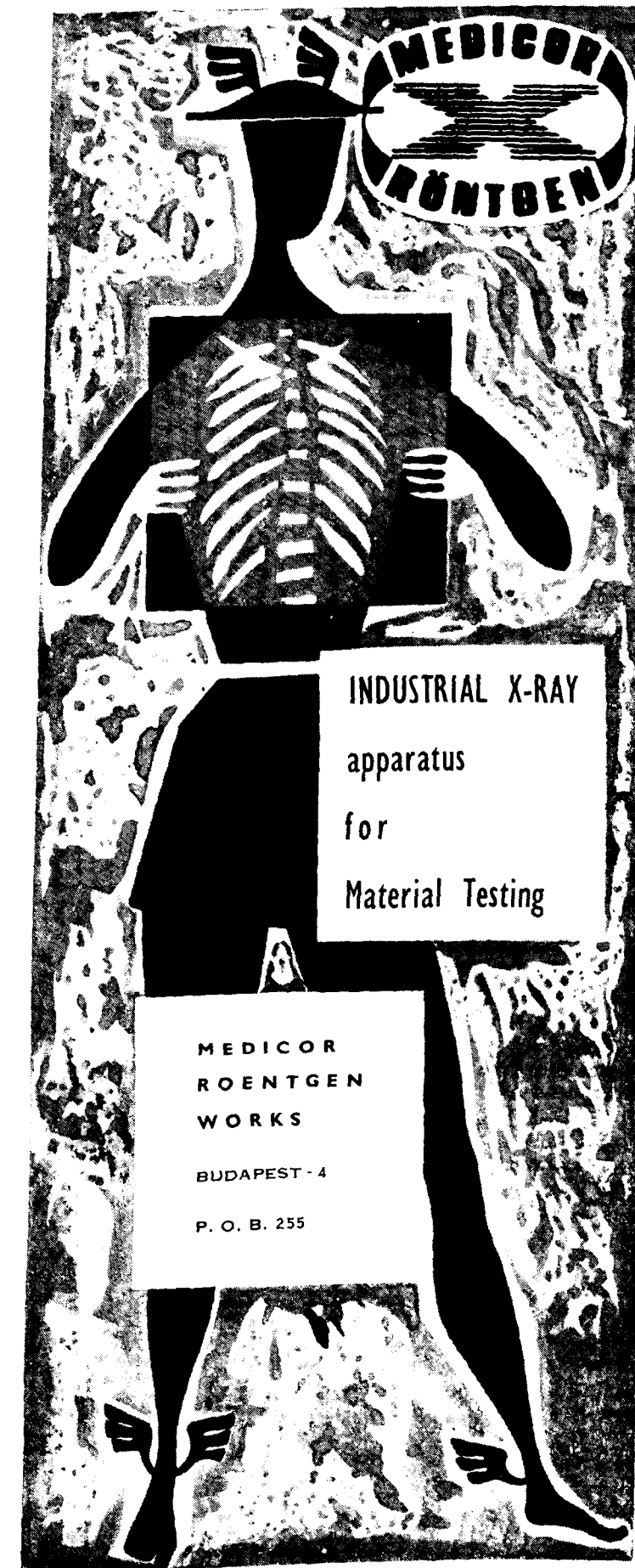
The beautiful CHAIN-BRIDGE in Budapest

Articles of artistic character found a rich representation also at this year's Fair. Outstanding among them were the silver fancy goods, silver-smith's articles and golden jewels made by the State Mint. 50 years old Hodmezovasarhely Maiolica Factory presented maiolica vases, jugs, dishes and other fancy articles, exported to many parts of the world. 121 home-industry and folk-art co-operatives set up a separate pavilion always crowded with friends of folk art.

Home and foreign visitors were greatly interested in special shows like that of the Hungarian Bureau of Standards or the labour protection exhibition of the Trade Unions Council and especially in the exhibition of the National Office of Inventions presenting the latest important Hungarian inventions. They had a great choice at their disposal from which they had taken first of all inventions that will be utilized in the branches of industry most important in the realization of the Second Five Year Plan (e.g. telecommunication instruments). Some of them are of international significance, as e.g. the invention concerning the production of gallium, a humidity measuring instrument for welding electrodes, a periodic spectral photometer, a condenser increasing resolving power for microscopes operated with transmitted light, a new-type, high capacity sifter, a special thermometer to eliminate over-heating of electric motors, a new air, cushioned type prism grinding machine whose output exceeds 6 to 20 times that of former types and a long line of other important inventions.

ATTENDANCE

The number of inland visitors to the Fair was



Represented by:

J. N. MARSHALL & CC

107, Mahatma Gandhi Road

BOMBAY-1

1.1 million, 25 per cent of whom came from the country. This figure largely corresponds to last year's level of attendance, i. e. it is by 200,000 more than it was in 1957 and by 100,000 in excess of the 1958 figure. In accordance with the ever more international character of the Fair, there was a substantial increase in the number of visitors coming from abroad. 5926 visitors came from abroad; that means almost four times as many visitors as there were last year (1534). Among the visitors of the Fair you could find outstanding representatives of the economic life of socialist countries and notable personalities from western countries as well.

Data explained	1957	1958	1959	1960
Average space occupied by one exhibitor (sq. m.)	21,0	24,6	27,5	36,6
Covered space (sq. m.)				
Open-air space (sq. m.)	5,0	6,0	9,0	17,-
Average space required by one exhibitor (sq. m.)	26,0	30,6	36,5	53,6
Average space requirement of inland exhibitors (sq. m.)	26,0	27,8	31,8	34,1
Average space required by one company from the socialist countries (sq. m.)	—	71,8	65,7	121,4
Average space required by one company from the western countries (sq. m.)	—	—	38,7	58,2

BUSINESS TRANSACTIONS

In appraising the success of an international fair the



A panoramic view of BARTOK Open-air Theatre in Budapest

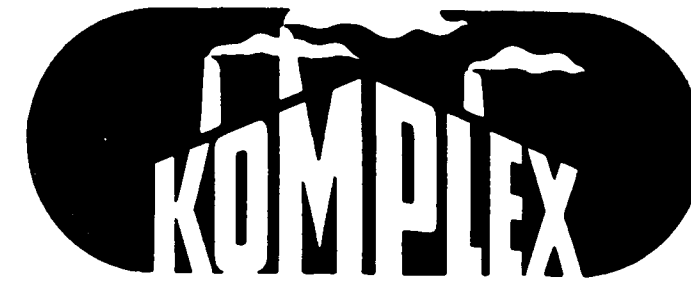
number and value of the business transactions concluded on the spot cannot be considered as solely and absolutely decisive points. The many-sided presentation of goods, mutual information, the meeting of interested specialists on an international level usually contribute to the enlargement of existing business relations and to the creation of new connections that may result in important business transactions to be carried into effect only after the closing of the fair.

Yet we can state that also during the time of the 1960 Budapest Industrial Fair business transactions amounting to very important sums were concluded. Through their representatives sent to Budapest, foreign enterprises and business establishments purchased goods in a value of about 50 millions of dollars from Hungarian foreign trading companies and, at the same time, the latter bought goods amounting to about 10 millions of dollars. In addition, an important commercial activity developed among exhibitors coming from foreign countries, particularly between representatives of socialist and western countries.

GIANT CHEMICAL PLANT

Almost every day trainloads of machines, bricks, reinforced concrete and other materials arrive at the Shatilki station in Byelorussia, where the erection of a huge artificial fibre plant and houses for its workers has started. The main building of the plant will take up an area of eight hectares. It will be about half a kilometre long.

The builders have decided to complete all main work on the acid-processing unit and on the textile, finishing and repair shops this year. The plant will be turning out scores of tons of rayon fibre daily.



Export Programme

POWER PLANTS

Complete thermal power plants, heating power plants and back-pressure power plants
Complete hydraulic power plants
Steam turbine units up to 50 MW with condensing, back-pressure and bleeding type turbines
Water turbine alternator units, Pelton, Francis and Kaplan turbines
Transformer stations and switching equipment
Prof. Heller's air-cooled condensers for steam turbines
Transmission lines up to 132 kV.

METALLURGICAL WORKS

Seamless steel pipe works
Cable factories/manufacturing steel-aluminium cables/Welding electrode factories
Alumina factories
Aluminium works and other installations for the aluminium industry

EQUIPMENT FOR THE MACHINE INDUSTRY

Agricultural implement factories
Electrostatic painting equipment
Small Scale Industries/works for manufacturing spring washers, toys and other small plants for the metal and timber industries.

BUILDING MATERIAL PLANTS

Brick works
Plants for manufacturing reinforced concrete elements and railway sleepers
Glass factories/for manufacturing hollow glass, glasspane, medicine bottles, glass tubes, thermos flasks, insulating material and safety glass

Special technological processes for surface building and civil engineering works

EQUIPMENT FOR THE FOOD INDUSTRY

Fruit and vegetable canning plants
Tomato juice canning plant
Canning line for green peas
Canning line for fruit juice
Canning line for making jam and stewed fruit
Canning line for making "lecsó" /stewed onions, tomato and paprika/
"J" diffusion automatic equipment for continuous diffusion for beet sugar processing
Slaughter houses/processing also by-products/and individual machines for the former
Meat processing plants, Dairy plants, Cooling units, Refrigerating plants, Cold storage plants, Ice factories, Poultry killing and processing, Grain mills, Grain sorting and cleaning equipment
Granaries/silos/Rice husking mills
Rice polishing plants
Bread making factory
Paprika processing equipment
CHEMICAL INSTALLATIONS
Plants for the production of oxygen
Factories for manufacturing pharmaceutical products
Ozonizer plants
DESIGNING AND BUILDING OF
Large river bridges, Railway bridges, Swing bridges, Shipping sluices, Retaining sluices, Hotels, industrial buildings, settlements, hospitals, hydraulic constructions, civil engineering, road building.

KOMPLEX, HUNGARIAN TRADING COMPANY FOR FACTORY EQUIPMENTS

Budapest, V., Dorottya u. 6. Telex: 610

For further details please contact:

THE TRADE REPRESENTATION OF THE HUNGARIAN PEOPLE'S REPUBLIC IN INDIA

18, Golf Link Area, New Delhi

TRADE COMMISSION FOR THE HUNGARIAN PEOPLE'S REPUBLIC

In Bombay
"Revills", 45, New Cuffe Parade
Bombay-5

In Calcutta
6/2, Gurusaday Road
Calcutta-19

Manufacturing of Special Electric Machines in Hungary

THE Hungarian electric industry can in fact boast with a remarkable past, having enhanced so early as at the beginning of this century progress of technics by many important achievements. After having overcome the difficulties of the subsequent decades a new prosperous impulse has been taking place in its development.

The experience obtained in the last decades and the competence of the Hungarian engineers is pointed out particularly in the manufacture of special electric machines meeting multiple and various requirements. In the line of small machines the Factory for Special Electric Machines, rebuilt and enlarged after the second World War, has already attained noteworthy results. It can satisfy not only the demands of the home market, but by means of the absolutely reliable execution of all orders received from many foreign countries, this factory has secured for herself such a market in which the volume of its exportation is limited only by its manufacturing capacity.

The self-excited generators, registered by the factory, have for a long time been chief export articles of hers. In these machines the problem of maintaining the voltage at a constant value was solved inside the machine itself without any exterior device. They are built for outputs of 1 to 18 KVA. They are excellently suitable as current generators in mobile sets or as generators in very small hydroelectric power stations. Besides, at this moment, a new range of similar machines is in preparation for outputs of 10 to 100 KW. These machines will meet even the most exacting requirements and will be supplied with a voltage regulation independent of the number of revolutions and of the frequency.

The DC machines are very light and their main feature is a good stability. Furthermore, in the case of dynamos, their voltage is variable within large limits, and in the case of motors their speed is adjustable on a large scale. These machines are supplied not only in the drip proof type but also in the P 33 protection type i.e. with built-on fan cooling and completely closed, with dimensions slightly greater than those of drip-proof type.

Type EMZ 56 K 4 9, 4 KW 220 Volts 1500 r. p. m. Mixed excitation.

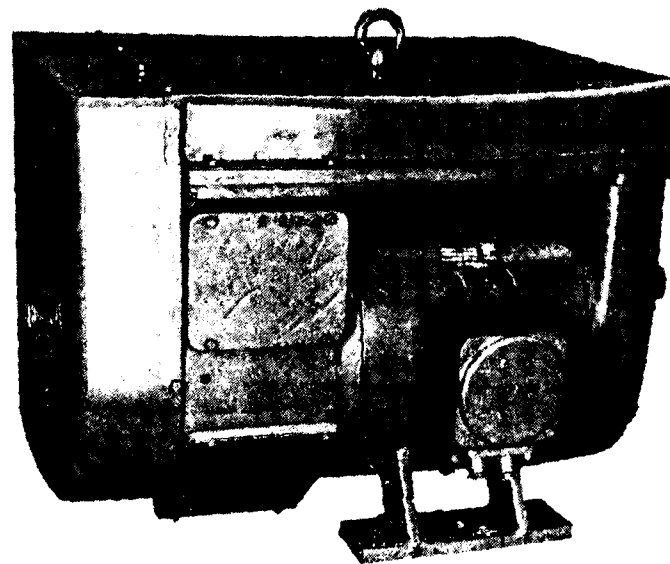


Fig. 1. DC motor with radiator cooling.

(The machines of this range are fitted with the most up-to-date cooling system mentioned here. They provide 70% of the output of the open type machine.)

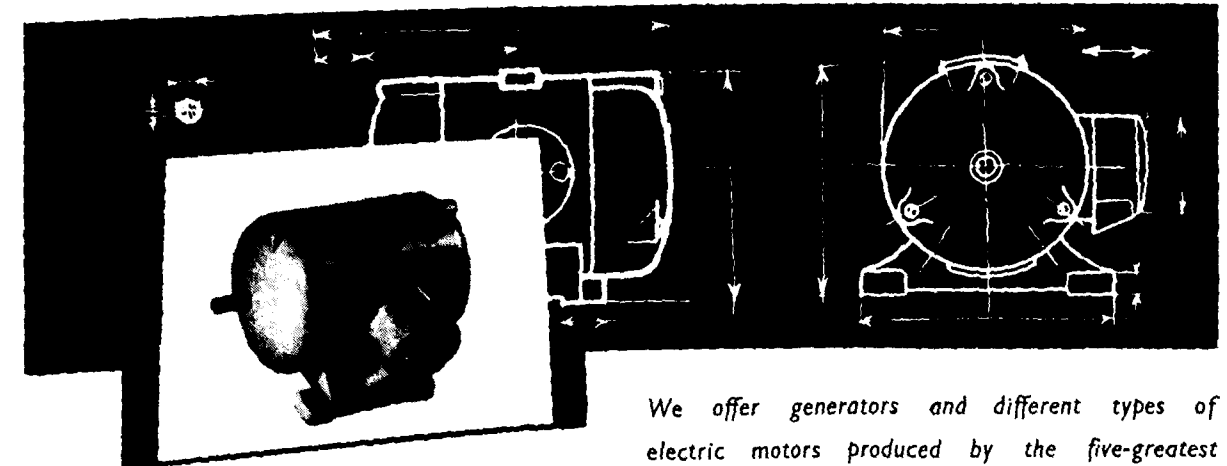
Our range of galvanic dynamos of 500 to 2000 amps, is noteworthy by the oddly small dimensions, however, these machines are absolutely test-proven and solid. These machines, as well as other dynamos, can be supplied with separate exciter, built on the dynamo, providing constant excitation current. Outputs up to 100 KW. We build also high speed DC machines with an r.p.m. up to 12,000, and outputs up to 20 KW.

In the field of converters the DC/DC and the DC/AC single phase or DC/AC three-phase sets are built, according to the requirements of the purchaser.

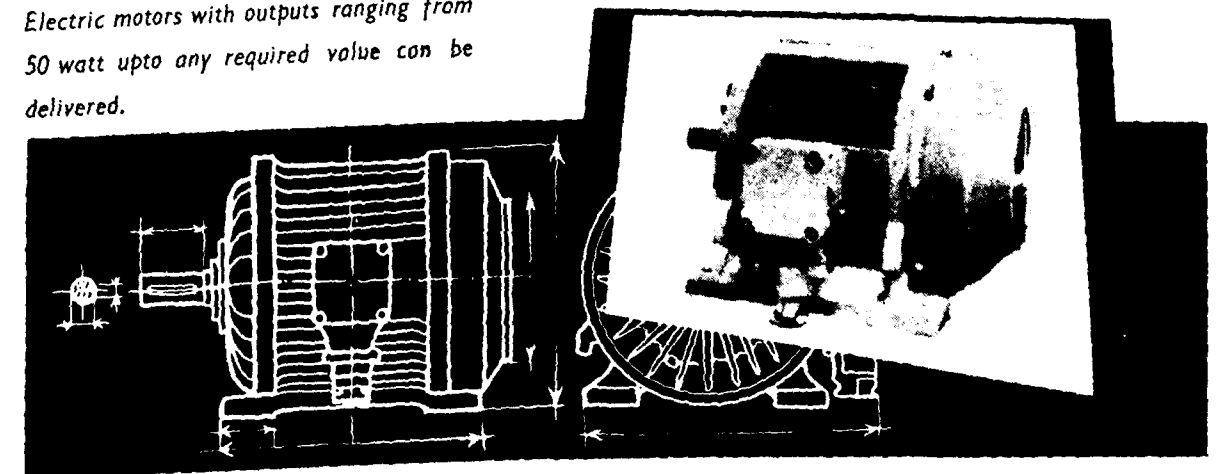
Type 56 J 4, 18 KW, 9 Volts, 2000 amps, 1440 r. p. m. Separate excitation: 26 volts, 26 amps.

(The separate excitation permits to maintain the current of the galvanic dynamo at a constant value independent of the outer load.)

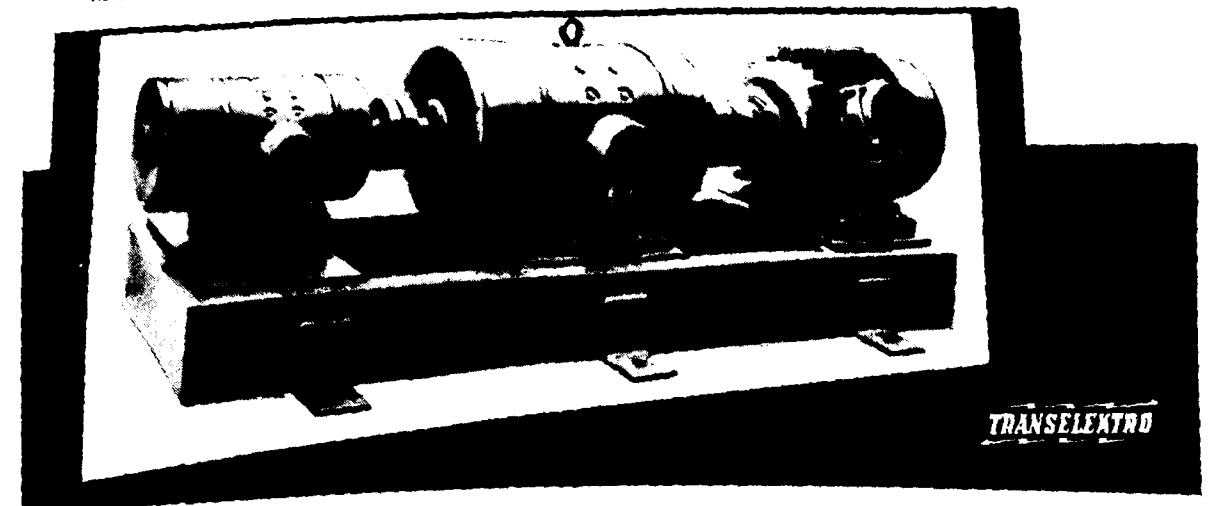
TRANSELEKTRO HUNGARIAN TRADING COMPANY
FOR ELECTRICAL EQUIPMENT & SUPPLIES
Letters: BUDAPEST 62 P. O. B. 377 Telegrams: TRANSELEKTRO, Budapest



We offer generators and different types of electric motors produced by the five-greatest heavy-current works of Hungary among which figures the well-known GANZ Electrical Works. Electric motors with outputs ranging from 50 watt upto any required value can be delivered.



FOR FURTHER DETAILS PLEASE CONTACT:
THE TRADE REPRESENTATION OF THE HUNGARIAN PEOPLE'S REPUBLIC IN INDIA
18, GOLF LINK AREA, NEW DELHI
TRADE COMMISSION FOR THE HUNGARIAN PEOPLE'S REPUBLIC
IN BOMBAY 45, New Cuffe Parade, BOMBAY-5
IN CALCUTTA 6/2, Gurusaday Road, CALCUTTA-19



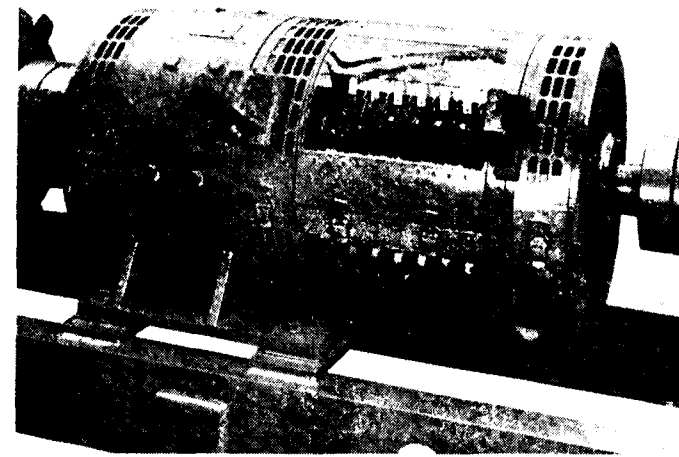


Fig. 2. Galvanic dynamo.

Our manufacturing scheme includes also various kinds of commutator motors for DC and single or three-phase AC. The shunt or series motors up to 10,000 r. p. m. and 1 KW, the repulsion motors up to 3 KW. The three-phase commutator motors are made for rotor feeding, in the drip-proof and also with self ventilation or floor ventilation in the closed type.

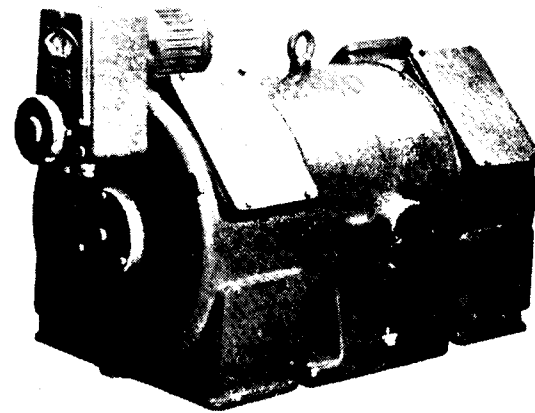


Fig. 3. Schrage Motor.

Three-phase shunt commutator motor, fed by the rotor. With separate ventilation, protection type P33. Intake and discharge of cooling air can be carried out by channels in the floor linked to the motor under the shields.

Type VKZT G 4 5-15 KW, 700-2100 rpm. 380 V three-phase, 50 cps. With built-on servomotor, permitting hand or remote regulation.

Our machines are suitable for hand control or remote control by means of a servo-motor. The band of speed regulation is 1:3. For the time being the output limit is 30 KW. The low frequency commutator converters are built in several sizes and for different frequencies. Their utilization renders possible to make drives fitted with normal induction motors and suitable to provide slow speeds. The slow speed may be 1/5 and 1/10 of the normal service speed. Drives with frequency converters can also be built for obtaining high speeds. Our special three-phase induction motors are supplied with speeds up to 21,000 r. p. m., our slip-ring frequency converters for frequencies of 100 to 350 cps. in three-phase design, complete with built-in driving motor.

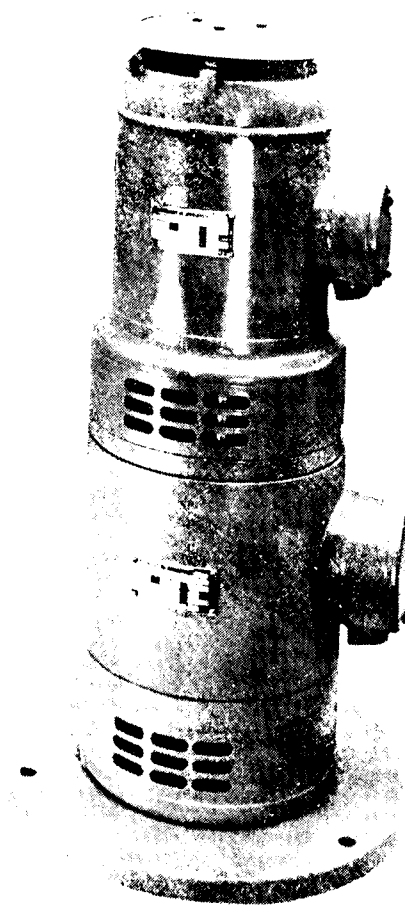


Fig. 4. Asynchronous vertical frequency converter (with two iron cores)

Converter

Type VPH 47 D 6 2 KVA 42 V three-phase, 187 cps. 27, 2 amps. 2800 rpm. Excitation: 380 V three-phase, 50 cps. 1, 4 amps.

Driving motor

Type VRX 38 D 2 1,7 KW 380/220 V three-phase, 50 cps. 2800 rpm.

In our range of induction regulators for voltages up to 1000 Volts, we are in a position to supply machines in which the voltage, the regulation of voltage and the regulation of phase angles can be set in accordance with the specifications of the purchaser, with built-on fan or with natural cooling. Regulation can be remote controlled by means of a handwheel or built on servo-motor.

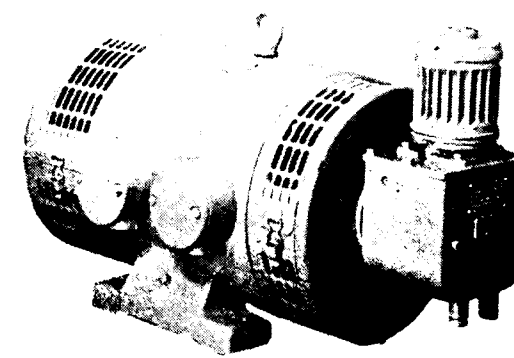


Fig. 5. Induction regulator with natural cooling.

Type VIN 69 0 2 Internal output 4, 5 KVA three-phase, 50 cps. Primary: 380/220V 9, 3 amps.

Secondary: p—760 V for voltage regulation.

With built-on servo-motor, with limit switch, permitting remote control.

We supply machine groups for special purposes as e. g. Ward-Leonard sets for speed regulation, or calibration sets with sinusoidal wave generators, etc., with pedestal bearings or tilting stators for phase angle adjustment, if ordered.

We make also different sorts of auxiliary motors for the branch services of locomotives, ships, railway wagons, etc., in accordance with the specifications of the Standard indicated by the purchaser. Machines meeting the specifications of the German VDI or the English Lloyd's Register may be ordered, too.

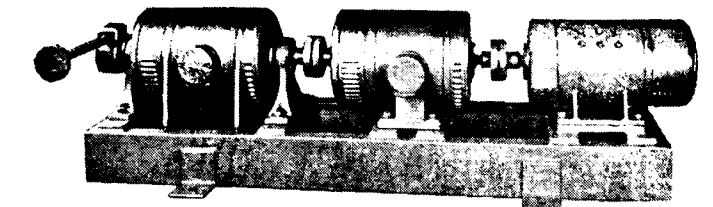


Fig. 6. Sine wave generator set for calibration. (Overharmonic content under 2%)

Current generator: Type SSH 65 D 2 2 KVA 24/14V, 50 amps. Power factor 0,8, 50 cps. 3000 rpm. Excitation: DC 220 Volts.

Voltage generator: Type SSK 65 D 2 0,8 KVA, 380/220 V 2 amps. 50 cps. 3000 rpm.

The stator can be turned over by 180° by means of a worm gear hand driven for the adjustment of the phase angle. Excitation: 220 V DC.

Direct-current driving motor: Type EMH 34, L 4, 4, 5 KW, 220 Volts 2700 r. p. m. The number of revolutions can be adjusted between 2700-3200 r. p. m.

The experts of the Factory are permanently at the disposal of the purchasers by giving informations and advices for any driving problem and in selecting the possible best solution.

FIREPROOF CURTAINS

A curtain fabric that never wrinkles, stretches, shrinks or fades, never needs ironing, is completely fireproof and can be washed, dried and rehung in seven minutes, was one of the high-lights of the National Household Textiles and Soft Furnishings

Fair held at Earls Court, London, from February 27 to March 3. Curtains in this unique material, a glass fibre, can be bought ready to hang in three drop-lengths, representing 60 per cent of average requirements, and planned to fit the normal 48 to 52-inch wide window.

Hungarian Export of Factory Equipment on the Upgrade

THE rate of growth of Hungary's engineering and precision mechanical industries has been particularly fast during the last ten years. As a result, machinery and equipment have in recent years come to claim the largest share of Hungarian exports, accounting for 35 to 40 per cent of the total—a percentage that is on a par with (and in some cases even surpasses) the proportion of machinery in the exports of the leading capitalist countries. By 1959, the volume of Hungary's steadily climbing machinery exports had reached \$ 350,000,000 and is expected to approach the \$ 400,000,000 mark in 1960.

The principal buyers of Hungarian machinery and precision instruments are the socialist countries, with the Soviet Union heading the list and followed by Czechoslovakia, China and Poland. Substantial quantities are taken by the other socialist countries.

Round two-thirds of Hungary's machinery and precision instrument exports to the capitalist world is going to underdeveloped countries, while one-third finds its way to Western Europe. Oversea exports in recent years were divided among Hungary's principal buyers in those parts of the world as follows:

	1957	1958	1959
	Value (\$000)		
United Arab Republic	8,032	8,611	7,487
India	2,377	2,097	2,786
Iran	494	434	519
Brazil	1,355	1,431	1,661
Argentina	1,584	1,371	2,036

Besides the countries in the above table, many other countries are taking substantial quantities of

Hungarian machinery and equipment, and few overseas countries today indeed have no business ties with Hungarian export agencies. The overseas countries, including most of those which recently acquired political independence, are making purposeful efforts to achieve independence economically also. To this end, having taken stock of their natural resources and existing industrial potential, they are drawing up economic development plans, in which attention is usually paid to transport, power, telecommunication and mining (vitally important for the building up of a domestic industry). Apart from exploiting their local resources, these countries are increasingly relying on imports of manufactures of (as well as the low-interest commodity loans made available by) the socialist countries.

In contrast to the industrially advanced countries, which usually buy single units, these countries in the early stages of industrialization have a tendency to purchase, first of all, complete factory outfits, as these make it possible for them to skip various stages of industrial development.

Hungary, who foresees a 14 per cent increase in her machinery exports in 1960, has taken note of this tendency and is now stepping up her exports of complete factory equipment.

Hungarian-built hydro-electric and thermal power stations are supplying electricity in India and Egypt. In the Lebanon, Hungary is cooperating in a power-station enlargement project, and one Hungarian-built 32-megawatt steam turbine is scheduled to go into operation shortly. In the class of low-capacity power stations, demand is greatest for the diesel-electric groups. Concerning this group, an inquiry has been received from the Sudan, and Iraq has secured option for a 12-mW power station.

Means of transport—for the most part railway equipment, with a minority of road vehicles—constitute an important item in Hungarian exports to overseas countries. Hungarian-built rolling-stock has been known abroad, including the overseas countries, for a long time, and Hungary is commonly known to be a major exporter of these lines in many parts of the world. Thus, Argentina has for several decades been purchasing rolling-stock from Hungary—up to the end of 1963, she is to receive Hungarian-built diesel motor trains and carriages to the total value of \$ 16,000,000. On an Argentinian order, Hungary has supplied and commissioned several oxygene plants.

Exports to overseas countries of Hungarian machine tools also have acquired considerable importance in recent years—exports to those areas of general-purpose machinery and complete factory outfits have been boosted particularly of late. To Egypt, Hungary has supplied or is to supply complete installations for a factory for medical instruments, a factory for electric wiring, and a factory for electrodes. Consignments to other countries include a match factory, a radio station and other complete outfits. Countries in which timber is in short supply are displaying keen interest in factories for armoured concrete sleepers. Thus, orders or inquiries soliciting offers for such equipments have been received from the Sudan and several Middle East countries.

Such Hungarian products as telecommunication equipments, modern flour-mills, general food processing equipments, cannery outfits, slaughter-house equipments, electric bulb and lighting tube factory installations, etc. enjoy a good reputation throughout the world. Negotiations with Cuba on a number of points have now reached an advanced stage; they concern a roughly \$ 5,000,000 contract for telephone equipment to be supplied by Hungary over the next few years and Hungarian supplies of complete factory outfits of a similar volume, as well as Hungarian cooperation in planning Cuba's microwave installations and supplies by her of part of the necessary equipment.

Two Hungarian-built automatic telephone exchanges were put into operation in Syria recently, while a third is now being installed, with parts still arriving. Negotiations are in progress with Syria concerning the proposed supply by Hungary of slaughter-house equipments and the erection of an electric bulb and lighting tube plant. For Hungarian flour-mills, an inquiry has been received from Burma, and some are to begin operating in Iraq shortly. Iraq has placed an order for a high-capacity canning factory to produce canned fruit, vegetables and tomatoes. The complete outfits of an electric bulb factory and an accessory glass factory have been supplied for Indonesia. In all probability, Hungary will build for Indonesia twelve 1,200-ton vessels in the next few years.

Apart from installing and putting into operation the factories whose outfits have been supplied—and if customers so desire—Hungary's highly qualified engineers and technicians readily share their manufacturing experience with experts of the buyer countries. Even now experts from many overseas



BUDAPEST FAIR

May 19–29, 1961

Greatest show of Hungarian Industrial Production
and exhibits from several foreign countries

Total area of the Fair in Városliget 260.000 sq. m.
Number of exhibitors 1.400
Number of visitors 1.1 million

REDUCTION ON FARES

BOOKING OF HOTEL-ROOMS

FOR FURTHER INFORMATION PLEASE APPLY TO:

The Hungarian Foreign Trade Representations, The Travel Agency IBUSZ, Budapest
and other Travel Agencies abroad and Fair Bureau, Budapest, XIV., Városliget Hungary

countries are in Hungary for long stays, studying various departments of industry and agriculture. Besides helping foreign experts improve their knowhow, Hungary has undertaken to *train* experts as well, and so a number of Asian and African students are now pursuing their studies at Hungarian universities and academies on Hungarian state scholarships.

Hungary frequently promotes the industrializing efforts of purchasing countries by making available to them Hungarian patents and familiarizing them with manufacturing technologies. Her continuing economic consolidation is making it increasingly possible for Hungary to grant her customers further payments facilities and thus enable them to buy more Hungarian machinery and equipments.

PROTECTION TO ELECTRIC MOTOR INDUSTRY — TARIFF COMMISSION'S ENQUIRY

Shri K. R. P. Aiyangar, Chairman, Tariff Commission, said that the electric motor industry had grown steadily under tariff protection and, during the last five years alone, its capacity and production had increased threefold. He added that the industry was now on the threshold of further large scale expansion and diversification of output. Shri Aiyangar was opening the public inquiry in the question of continuance of protection to the electric motor industry beyond December 31, 1961.

The Chairman impressed upon the manufacturers the need to development a more dynamic attitude in adopting the latest designs and techniques followed by their counterparts in foreign countries for improving quality of their products and effecting all possible economies in costs of production, so that they could serve better the customers at home and abroad.

Tracing the history of tariff protection granted to the industry and the industry's progress since the last inquiry in 1958, Shri Aiyangar said: "Some progress has also been made in production of motors of higher ratings and in the diversification of the patterns of production and production techniques".

At the time of the last inquiry in 1958, there were 15 units in the large-scale sector manufacturing electric motors with a total annual capacity of about 600,000 h.p. on single shift.

At present there are 27 units with an annual installed capacity of 1,129,040 h.p. on single shift. Sanction has been accorded for installation of additional capacity of 821,900 h.p. which includes establishment of 25 new units.

The production of motors by the large-scale sector during the last three years was 641,03 h.p. in 1958, 592,049 h.p. in 1959 and 612,171 h.p. in 1960 (January–October). As against 31 small-scale units registered with the Development Commissioner in 1958 having

a capacity of 130,000 h. p. per annum, there were 74 units in 1959 with a production capacity of 266,204 h. p. and production being 70,064 h.p.

The discussions that followed covered estimates of demand (present and future) for electric motors, quality, supply position of raw materials, export possibilities, c. i. f. prices and selling prices of indigenous motors.

Dr. S. K. Muranjan and Shri J. N. Dutta, members of the Commission were present at the inquiry.

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HYDRO-ACCUMULATING STATION TO PRODUCE CHEAP ELECTRICITY

The project of the first Soviet hydro-accumulating electric station has been designed by Moscow power engineers. It will be built to the north of Moscow in the area of Zagorsk, on Kunia River. The station's total capacity will be 585,000 kilowatts.

A lower basin will be built on the river and an artificial lake of 14,000,000 cubic metres of water will appear on one of its banks. Eleven million cubic metres of water will constantly circulate there and back. The drop between the two basins will be some 100 metres.

Original reversible turbines will be used at the Zagorsk Station. When it will be necessary to raise the water, they will function as pumps, and as turbines when generating electricity. The electricity from the new station will be several-fold cheaper than that produced by a steam station of the same capacity.

Designs are now being prepared for some other hydro-accumulating stations.

"OUR DISTRICT MANAGER OFFERS YOU . . ."

(By a Correspondent of NIKEX Hungarian Trading Company)

THE share of production equipment and of complete factory equipment in Hungarian exports is on a steady increase. This fact is of considerable advantage to countries whose industries are developing at a fast rate, because their foreign trade contacts with our country constitute a strong incentive to their national industries.

The District Managers of the foreign trade companies handling the exports of industrial equipment have been exploring possible ways Hungarian industry and foreign trade could best contribute to the economic development of their partners, e. g. by planning, technical cooperation, the supply of factory equipment, etc.

We have requested the district managers of two foreign trade companies to give such information to the readers of *Hungarian Foreign Trade*.

Rudolf Schutz, District Manager for the Middle and Far East, KOMPLEX Hungarian Trading Company for Factory Equipment:

Mannesmann-type tube manufacture was introduced in Hungary seventy years ago, and its technology was improved by a Hungarian patent between the two world wars. This Hungarian patent was taken over by countries with the most highly developed industries. The experience gained during many decades of tube manufacturing is being utilized by Hungarian industry in the production of equipments for tube manufacture, such as pushbenches, medium and heavy pilger mills.

Nine pilger mills have been built by Hungarian industry in the past decade to satisfy domestic requirements as well as customers abroad. For instance, three complete tube factories—incorporating various pilger mills, hydraulic engine rooms, rectifier stations, electric driving motors and control equipment—are being supplied to the Chinese People's Republic. The largest among these is a tube factory consisting of three pilger mills, with an annual capacity of 150,000 to 200,000 tons.

Hungarian industry is building three principal types

of seamless tube manufacturing equipment, pushbenches, medium and heavy pilger mills. The pushbenches produce steel tubes of 63.5—133 mm diameter, the medium pilger mills such of 102—216, mm and the heavy pilger mills such of 165—318 mm diameter. Requirements for prestressed reinforced concrete sleepers has increased all over the world. This is due to the shortage of timber as well as to the construction of tracks which have to support heavier loads and to the increased use of welded rails. Our enterprise has already delivered factories for the production of reinforced concrete sleepers to a number of countries. The factory possessing an annual capacity of 300,000 reinforced sleepers is very modern and the production plant requires a personnel of only 140 because the processes—from the preparation of materials to the shipment of the reinforced concrete sleepers—have been mechanized. The technological equipments of the reinforced concrete sleeper factory weigh 800 tons in all.

The easily located brick factory is one of our new export lines. Needing no foundations, the factory may be erected next to clay deposits. It has a capacity of 2,500 normal-sized bricks per hour, but can also produce other sizes of bricks and also roof tiles. The technological equipment and the large-span light-metal structure of the building weigh 31 tons in all.

Komplex is supplying both heat-engine and hydro-electric power station equipment to countries with developing industries. Power station equipment with a total of about 300 Megawatt capacity has been supplied by our enterprise in the last four years. Economical development very often demands heavy investments in locations lacking electric power supply. Small transferable power stations of 0.8—1.5—4.5 Megawatt capacity, of which we are exporting four or five a year, are indispensable in such cases. The transferable small power stations satisfy the power demands of towns in the process of industrialization, of industrial districts and of large industrial developments. The small power stations operate in block connexion so that a number of units may be located at the same site. A complete small power station comprises 0.8, 1.5 or 4.5 Megawatt capacity power units,

coalhandling, water-treatment and electrical equipment as well as the necessary pipelines. The small stations can be operated with cooling equipment of various kinds, such as cooling towers, air-condensation cooling, etc. Air-condensation cooling permits their location at sites lacking water supply. The small power stations operate dependably at altitudes of 2—3,000 m and under extremes of climate.

Our company can also render aid to industrializing countries by the supply of complete food-processing plants. We can offer, among other things, quickly assembled flour mills of 20 ton/day capacity.

Hungary possesses a considerable capacity in the production of canning machinery. Our exports in this line amount to 25 to 35 fruit and vegetable canning factories a year. We are also exporting up-to-date refrigeration plants, completely automated poultry dressing lines with preliminary cooling and deep-freezing plants—100 to 150 of these lines with an hourly capacity of 500 to 1200 are being produced every year—as well as all kinds of complete meat-processing plants.

Komplex also undertakes the construction of highways and bridges abroad. At present, we are building a 500-metre railway bridge in the Syrian province of the United Arab Republic and have been commissioned by Iraq to construct 400 to 420 m bridges across two tributaries of the river Tigris. Besides civil engineering jobs, we are also submitting plans in the field of building construction and send out our specialists to supervise operations.

Dr. Sandor Falus, District Manager for India, NIKEX Hungarian Trading Company for Products of Heavy Industry:

Our company assists in the industrial development of our partners in numerous fields of the heavy industry. The trade relations between India and Hungary may serve to illustrate our activities in this respect. India possesses very large coal fields which are being explored at present. Our contribution to this work is the supply of mining equipment, including shaft-winding and shaft-sinking equipment, loading facilities, coal-cutting combines, conveyors and winches. Other services, such as the exploration and sinking of shafts, the construction of aerial cableways, as well as

the supply of stone-quarrying and magnesite-burning equipments, etc., are also welcome by those interested in mining development.

Numerous types of crushing machinery and equipment are being produced in Hungarian factories. We have concluded a contract with the Republic of India for the supply of the entire equipment of a chipboard factory. Worth mentioning among the more important heavy industrial equipments to be delivered to India are metallurgical equipment—arc furnaces of varying capacity—and seaport equipment (portal cranes, floating cranes of 5 to 100-ton capacity). At a competitive bidding we obtained an order for portal cranes to be installed in the port of Cochin. The biggest crane factories in the world were among our competitors in this case, yet our offer proved to be the most advantageous as regards both engineering and costs.

We promote the establishment and development of our partners' industry not only by shipments of ready-made products, plant and factory equipment, but also by giving technical aid. Nikex has already concluded a number of cooperation agreements with the Republic of India, and we intend to make proposals for other agreements.

Hungary, on the basis of these cooperation agreements, submits the licences, engineering plans and—if required—the entire technological equipment required for fabrication, as well as engineering aid for starting production.

A cooperation agreement has been concluded with India for the production of crabs and we are at present negotiating cooperation for the manufacture of cranes. The Hungarian partners, in this case, will promote the building of cranes in India by factory equipment and blueprints.

We are supplying complete enamelling equipments for the Indian chemical industry on a cooperation basis. This plant will be of a very high capacity and permit the production of autoclaves and of other equipment for the chemical industry. Besides the licences, Nikex will place all plans and the complete engineering equipment at the disposal of its Indian partner and will deliver the enamelling factory in a state ready for production.

THE EXPORT PROGRAMME of the Hungarian Telecommunication Industry

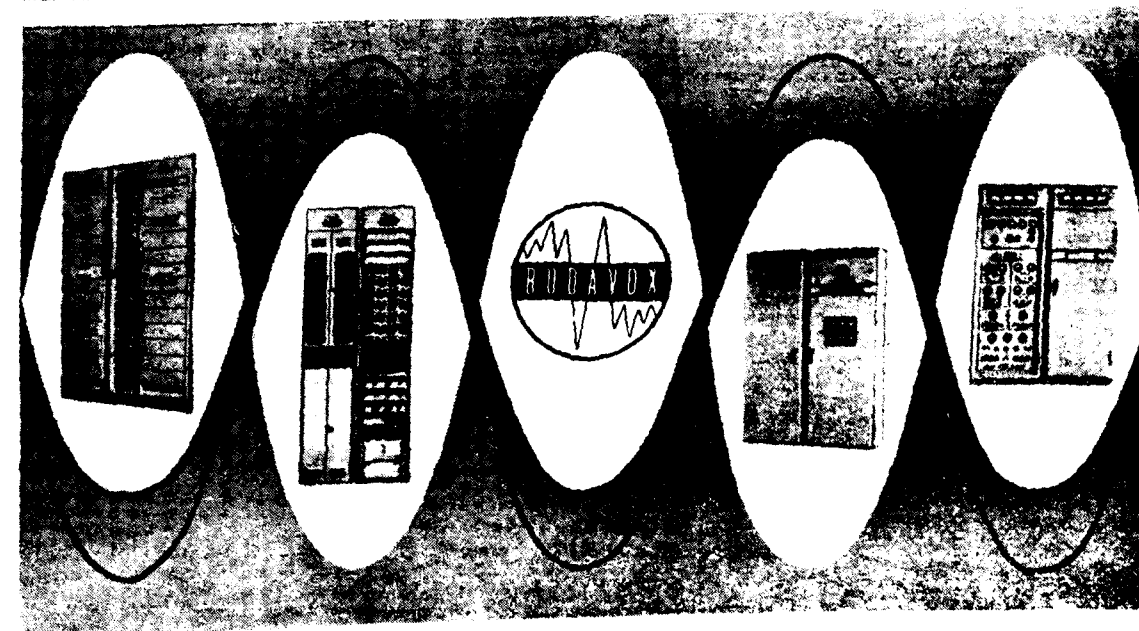
THE origins of Hungary's telecommunication industry date back to the days when, shortly after the introduction of the wired telegraph service, the first telegraphs of Hungarian manufacture made their appearance.

The earliest items of telecommunication equipment—Morse keyboards, relays and printers—were entirely

made by hand. As to their quality, it will suffice to say that even today after 70 to 80 years of operation, they still give trouble-free service.

Close in the heels of large-scale telegraph apparatus production, Hungarian engineers patented an invention. The *Hollos Morse printer*, designed by engineer Hollos was acknowledged the world over as

TELEPHONE APPARATUS - CB & LB SWITCHBOARDS - AUTOMATIC TELEPHONE EXCHANGES - REPEATER STATION EQUIPMENTS - MICROWAVE MULTIPLEX EQUIPMENTS - SHORT-WAVE & MEDIUM-WAVE BROADCASTING TRANSMITTERS - MOBILE & PORTABLE TRANSCEIVERS - TRANSMISSION MEASURING INSTRUMENTS - HIGH FREQUENCY GENERATORS



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Trade Commission for the Hungarian People's Republic
IN BOMBAY IN CALCUTTA

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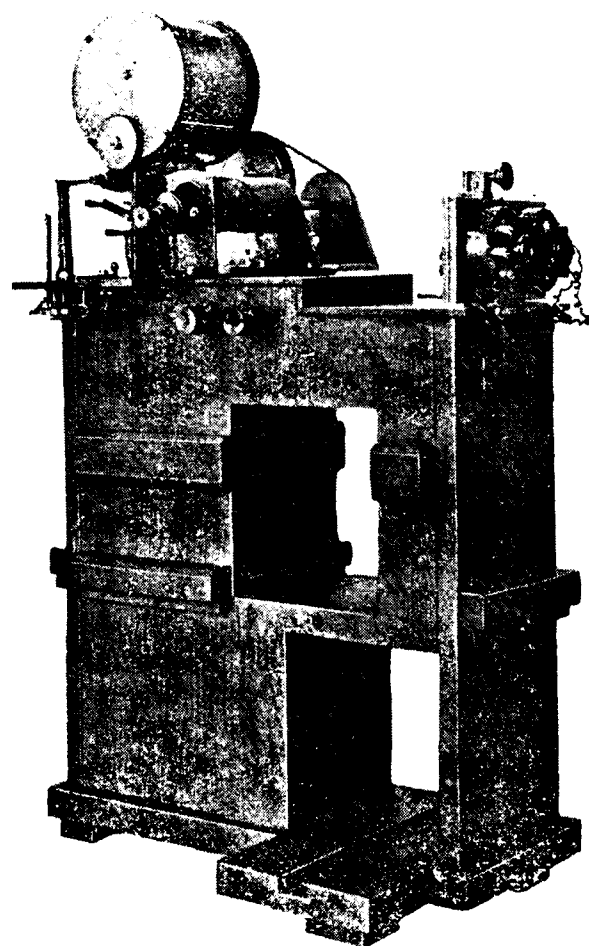
6/2, Gurusaday Road, Calcutta-19

one of the best in design and construction alike for almost half a century.

The first teleprinter in the world, the *Pollak—Virag high-speed telegraph*, was another Hungarian invention of international significance. The ingenious mechanism, patented in all industrially developed countries, traced letters on photo-sensitive paper by means of a moving mirror.

Shortly after Bell's invention was made public, the production of telephone sets was started in Hungary. The first sets were, naturally, rather bulky as compared with contemporary units.

In this field, too, substantial improvement was brought about by Hungarian engineers. It was *Tivadar Puskas*, a Hungarian, who applied the principle of multiplication to CB exchanges for the first time. The first CB city exchanges were also associated with Puskas who built the first city



World's First Teleprinter,
The Pollak-Virag High-Speed Telegraph

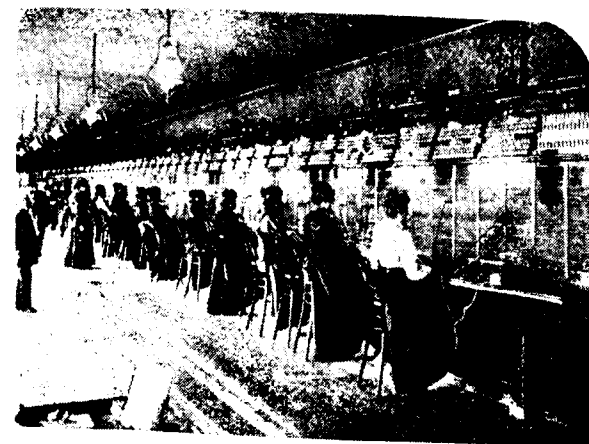


The editorial office of the Budapest Telephone News Service

exchange connecting several hundreds of subscribers in Budapest.

The manufacture of city exchanges necessitated the production of other auxiliary equipment, and soon telecommunication equipment was produced in Hungary on a large scale, increasing rapidly in volume in step with the growing domestic and export requirements.

The central broadcasting of programmes was realized in Hungary previous to the invention of the radio. The telediffusion of programmes, also invented by Tivadar Puskas, enabled the diffusion of music, other entertaining programmes and news bulletins from a central studio over telephone wires to subscribers. The invention was realized in country-wide proportions well before the first world war, and it remained popular long after the war only gradually succumbing to its powerful rival, the radio.



The First Telephone Exchange in Budapest

The spectacular growth of the telecommunication industry after the first world war made its effect also felt in this country. Inventions of outstanding importance were adapted to industrial production by the dozen. Immediately after the war the manufacture of automatic telephone exchanges started, primarily to satisfy domestic needs, Budapest and a number of other Hungarian cities being among the first to build a fully automatic telephone network. Exportation of this type of equipment soon commenced, first to the neighbouring Balkan states and to Turkey. The requirements of these states were almost entirely covered by the Hungarian telecommunication industry.

Hungarian telecommunication engineers have contributed to the development of automatic telephone exchanges with a number of outstanding inventions even in case of exchanges not commercially developed in Hungary. Thus, among others, the system of *twin subscribers* was a Hungarian invention. The system permits of connecting two low-traffic subscribers to a wire pair, each subscriber having a separate call number. The capacity of ex-

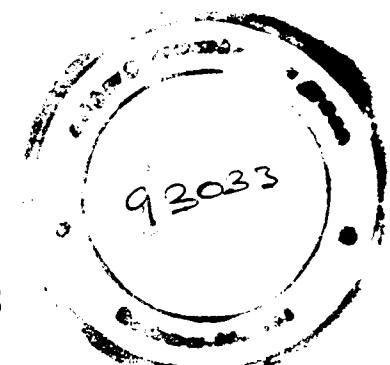
changes could be substantially increased in this manner. *Coin box apparatuses*, operated through the exchange, constitute another Hungarian patent. Large numbers of these apparatus are being exported to neighbouring countries as well as overseas.

Hungary has adopted the rotary-type automatic exchange for general use. Having proved their value in service, a large number of such Hungarian-built exchanges have been put in operation in Hungary and abroad. Thanks to the obvious advantages of the system and the excellent quality of the equipments, a substantial number of exchanges are being exported annually partly as extensions for existing ones and partly as new exchanges.

Hungary was one of the first countries to produce radio valves. Hungarian-made valves have acquired a reputation far beyond the borders of this country and constitute a substantial portion of exports in the field of telecommunication engineering. In addition to radio valves, equipment for their manufacture is also being exported.



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Up-to-date Automatic Telephone Exchange

Side by side with the production of automatic telephone exchanges, the manufacture of amplifying apparatus for telephony, loading coils and long-distance telephone cables was also started. The trunk line from the Austrian frontier to the Yugoslav border passing Budapest, all parts of which were produced in this country, was built immediately after

the first world war.

The manufacture of carrier frequency equipment was begun subsequently, primarily that of three-channel and twelve-channel equipment of which considerable numbers were exported in the between-wars period to the Balkan states. The bulk of Hungarian

exports in the field of telecommunication engineering consists of this type of equipment.

The manufacture of radio transmitting equipment including broadcasting transmitters, special-purpose transmitting stations and portable transmitter-receiver sets was also started a long time before the outbreak of the second world war.

Development was subject to a rapid increase after World War II. A large number of inventions was applied and the Hungarian telecommunication industry did its best to keep abreast of international competition. A separate chair for telecommunication engineering was established at the Budapest Technical University at which hundreds of young telecommunication engineers qualified every year. Research and development work was started on a large scale in the laboratories of telecommunication factories and research institutes alike.

To further expedite production, new factories belonging to the telecommunication industry were founded.

Among newly manufactured products, the recently developed *carrier frequency equipment* family soon to be produced in series deserves special mention. Besides a three-channel and a twelve-channel equipment, the family includes 120-channel and 600-channel equipment employed with coaxial cables i.e. on microwave links. Exports of carrier frequency equipment have considerably increased of late, the bulk of the equipment produced going abroad at present.

24-channel carrier-frequency telegraph equipments belonging to the same group are now also manufactured and exported to several countries. The export of news broadcasting stations is also on the steady increase and new types of radio equipment are placed on the market such as telephony and telegraphy transmitters, ultrashortwave radio and telephony equipment and FM transmitters of various size.

The manufacture of twenty-four-channel microwave radio equipment was also commenced recently, substantial numbers of which have already been exported. The production of television transmitter stations is also under way.

Though not designed for purposes of telecommunication, high-frequency generators also belong to this class of equipment. Coupled to appropriate equipment, they serve for induction or capacitor

heating and have gained rapidly ground in factories employing modern manufacturing technology.

All cable and line types for telecommunication purposes are manufactured by the Hungarian cable factories. The capacity of these plants is a multiple of domestic requirements, enabling substantial annual exports.

Apart from the production of new-type equipment, the modernization of formerly built telecommunication apparatus is also going on at full speed. In addition, novel design CB and LB telephone equipment, coin box apparatuses, mine telephones, etc. are also manufactured.

Private automatic exchanges are now available in improved designs. Beyond satisfying all requirements, they offer considerable advantages in respect of installation and maintenance.

The production for home and foreign markets of spare parts and special telecommunication instruments has also been stepped up.

A number of factories turn out various types of resistances, potentiometers and capacitors used in telecommunication practice. The production of the special iron cores employed in various types of coils and of various permanent magnetic materials has satisfied the requirements of telecommunication equipment manufacturers in every respect.

Selenium rectifier cells and complete rectifiers are also included in the export programme.

Major export deals have already been concluded in transmitter valves of various power ratings.

The schedule of industrial research includes experimenting with new raw materials, tropicalization of various types of equipment, up-to-date packaging, development of test methods, quality control of export products, etc.

One of the results already achieved has been a reduction to one third of the weight and space requirements of the three-channel and twelve-channel carrier frequency equipments through the employment of new materials and the redesigning of some parts. The same process is being applied to other items of equipment e. g. to miniature valves as well.

Novel design and construction is also responsible for the increased performance of the recently

marketed CB and LB telephone sets.

Now that the Hungarian telecommunication industry has substantially increased its exports to subtropical and tropical countries, a separate Institute has been established to deal with the problems of tropicalization. The new CB and LB telephone sets as well as other equipment can now be supplied in tropicalized finish if so specified.

The importance of adequate packaging, especially in case of overseas exports need not be stressed. Manufacturers provide precise specifications through the intermediary of the Hungarian Institute for Packaging Technique so that the packing of even the most sensitive parts (e.g. electronic valves) is such that they will stand up to the severest transport hazards.

Along with increased requirements new testing methods and instruments must be developed. A

newly established Institute is dealing with the standardization of testing methods. The observation of these standards has already been made compulsory for all factories concerned. The reference standards prescribed by the CCIF, CCIR and CCIT are controlled at another Institute ensuring the full compliance of Hungarian telecommunication products with CCIF, CCIR and CCIT specifications.

During the events that took place in the autumn of 1956 in Hungary the telecommunication industry suffered only a negligible damage. Owing to this favourable circumstance and to the rapid recovery of the country's entire industry, Budavox is in a position to carry out its export programme according to schedule. The company is now making every effort to expand its markets and add to the good name of its lines by the meticulous execution of all orders, the continuous improvement and modernization of Hungarian telecommunication products and a strict adherence to delivery terms.

High-Power Broadcasting Transmitters

Over the past ten years Hungary's highly developed radio industry has built a great number of short and medium-wave broadcasting transmitters for clients abroad.

The earliest types of short-wave highpower broadcasting transmitters were built for a 100 kW carrier frequency output power, with wave change facilities for the radio-frequency power stages by means of variable coils. To keep pace with contemporary broadcasting requirements, the continuous tuning systems of these first types, covering a single short-wave band, had to be replaced by one extending over the entire short-wave range.

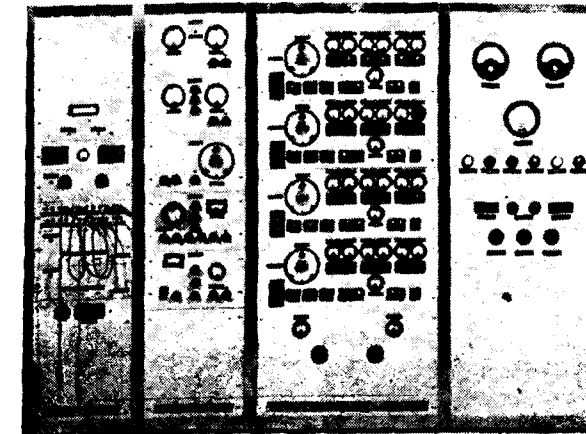


Two 100 kW Short-wave Transmitters, "A" side

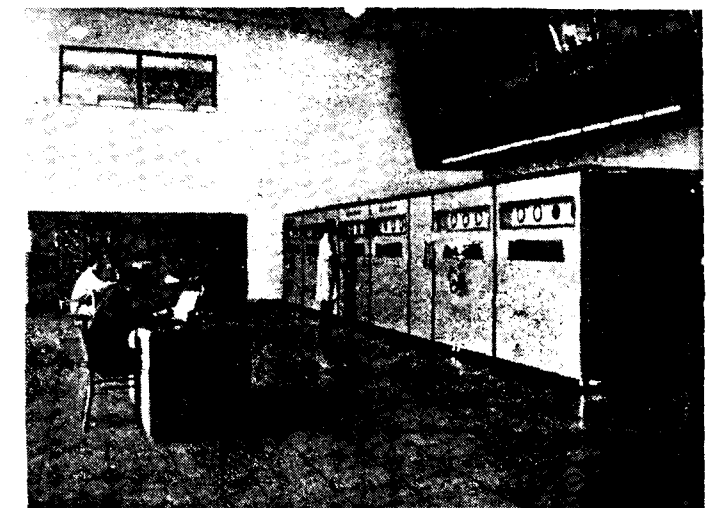
Accordingly, a new 120 kW short-wave transmitter has been designed, the remote control system of which offers continuous tuning facilities in a range of 6 to 22 Mc. The unit complies with all demands of high-fidelity wireless transmission and affords an



Antenna Tower for a High-Power Transmitter



100 kW Short-Wave Transmitter Line Amplifier, Monitor and Radiofrequency Exciter



135 kW Medium-wave Transmitter

uninterrupted daily service of 18 hours at a maximum ambient temperature of 40 centigrades. The radio-frequency final stage is fitted with an earthed grid-circuit.

The class "B" high-level modulator supplies power for the radio-frequency penultimate and final stages. All stages of the transmitter have A. C. heating. A built-in compensator makes for a low noise level. The power stages obtain their plate voltages from a grid-controlled high-power rectifier. The transmitting valves are water or air-cooled. The equipment, designed from both the electrical and mechanical points of view along modern principles, is fitted with all the requisite measuring instruments, signal and control devices. An automatic interlocking system takes care for the safety of the attending personnel. The operating data of the transmitter can be checked with the built-in monitoring devices.

The equipment is complete with an antenna array, fitted with automatic remote control and reversing switch. Each antenna array permits two transmitters and eight aerials to be coupled. For foolproof operation with increased radiation power, the equipment can be supplemented with a separate unit which is instrumental in combining the operation of two broadcasting transmitters or more, by their parallel connection, and includes all necessary circuit elements and monitoring devices.

Two complete 135 kW medium-wave broadcasting transmitters have recently been supplied for the Chinese People's Republic and are performing duty there to entire satisfaction.

They are equipped with pure tungsten-filament valves,



HUNGARIAN FOREIGN TRADING COMPANY BUDAPEST V.
Nador u. 31/hd.

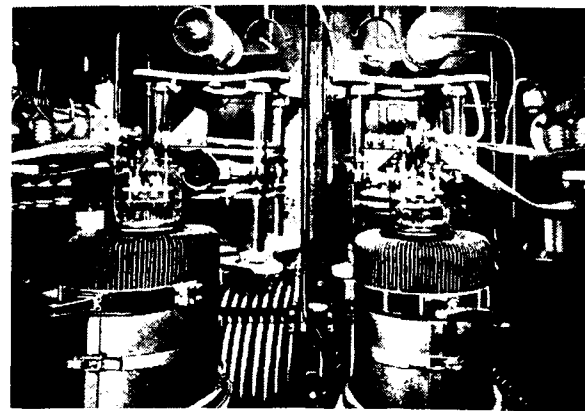
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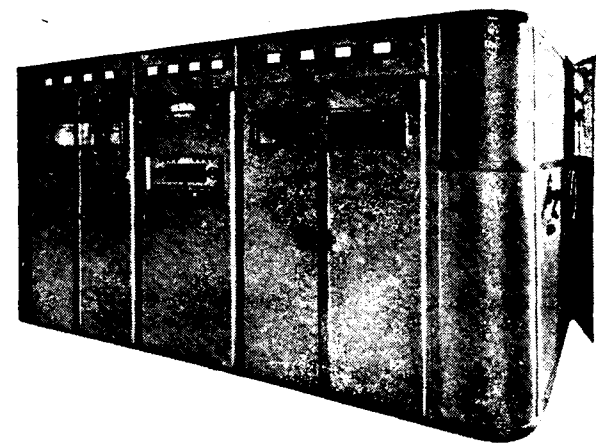
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KAYJAY ENGINEERS

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25 kW Medium-wave Transmitter Radiofrequency Power Stages



15 kW Medium-wave Monoblock Transmitter

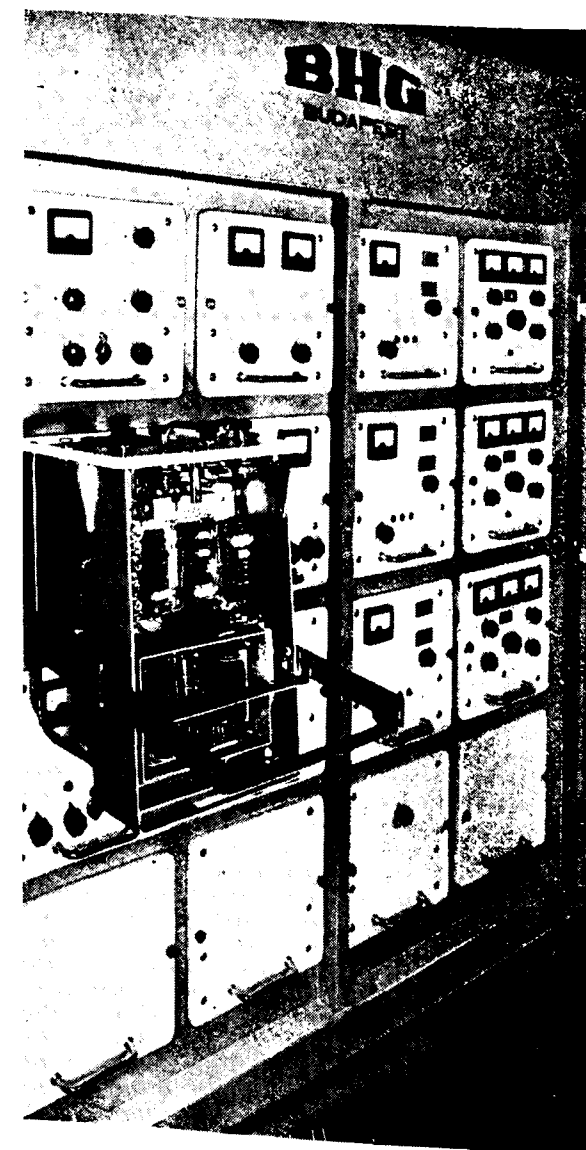
exhibiting favourable technical features on the whole, save their total efficiency which is below the required standard. As to the development of thoriated filament valves, there is a general tendency towards reduced dimensions. Accordingly, in the laboratories of the Hungarian transmitter tube industry suitable valves have been worked out for each type of broadcasting equipment.

Air-cooled, thoriated filament valves have first been used in the monoblock type 15 kW medium-wave transmitter. The results obtained suggested next their employment in the 25 kW medium-wave transmitter, where they again proved highly serviceable. Experience encouraged the designers to introduce them gradually on a wider basis, by making use of them in a 100 kW high-power short wave transmitter. In fact, the latest 140 kW medium-wave transmitter is fitted throughout with thoriated tungsten filament valves.

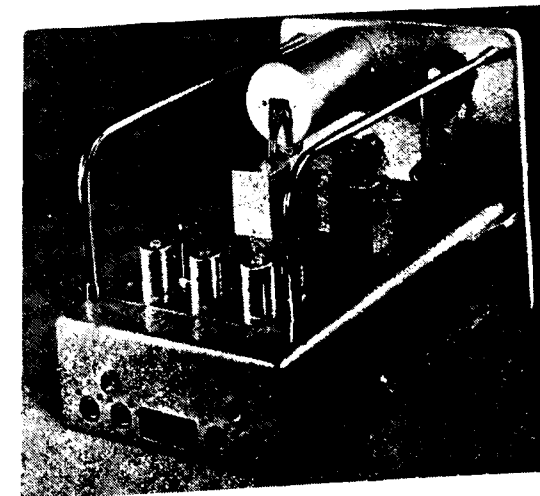
The last-mentioned high-fidelity broadcasting equipment has a carrier output power of 140 kW over the entire wave range and is capable of a 100 per cent modulation. The frequency coverage extends from 525 to 1605 kc.

The transmitter operates with a total efficiency of 50 per cent; the harmonic distortion of the usual audio-frequency band rates to 2.5–3.5 per cent; the unbalanced noise level is –60 db. The frequency stability and the radiation of harmonics comply with CCIR specifications.

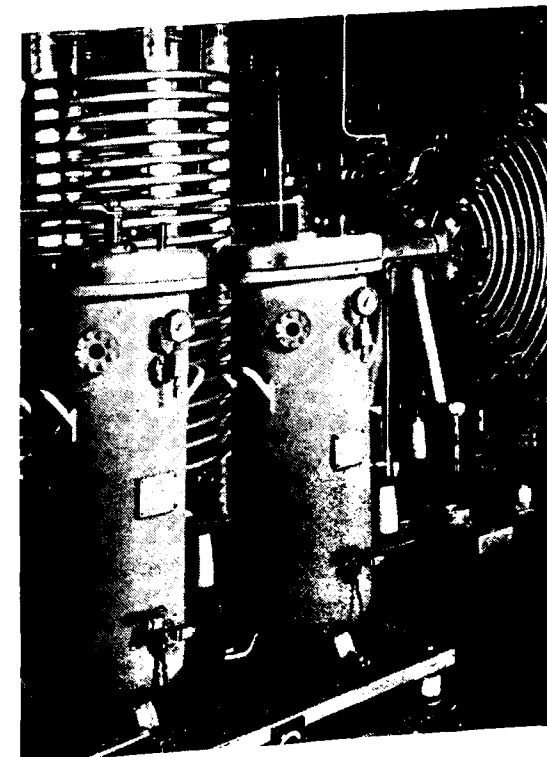
The radio-frequency chain includes the exciter, the low-power amplifier and the radio-frequency penultimate and final stages. The exciter is made up of a crystal-controlled and a self-excited oscillator with



Plug-in Chassis Type Units in Tilted Position



Plug-in Type Line Amplifier



Medium-wave Transmitter Radiofrequency final stages output circuit

buffer stages. The lowpower amplifier is inductively coupled to the grid circuit of the penultimate radio-frequency stage which comprises the single valve.

A high-frequency interstage transformer joins the anode circuit to the push-pull final stage which includes a driving phase inverter. The secondary of the high-frequency interstage transformer constitutes the grid circuit of the final stage. The tuned anode circuit joins the radio-frequency transmission line by

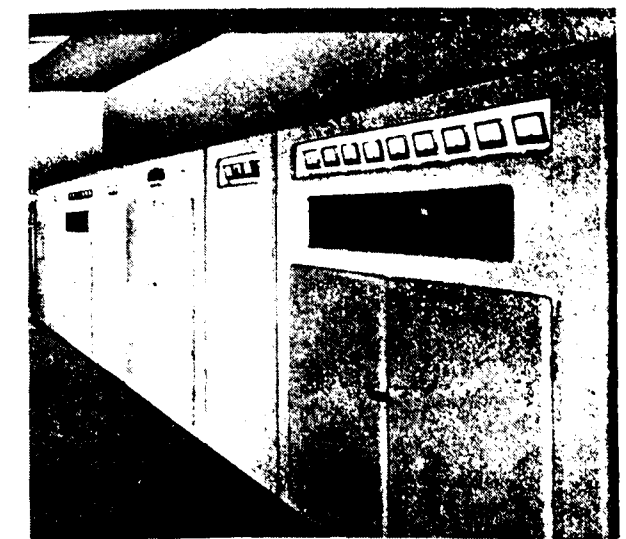
the intermediary of a radio-frequency transformer of continuously adjustable mutual inductance, with a series resonant circuit at the secondary. The characteristic impedance of the feeder line is 150 ohms.

The audio-frequency chain includes the line amplifier, the low and medium-power audio-frequency amplifiers, a cathodefollower driver stage and a parallel high-level class "B" modulator. All stages except the line amplifier operate in push-pull connection.

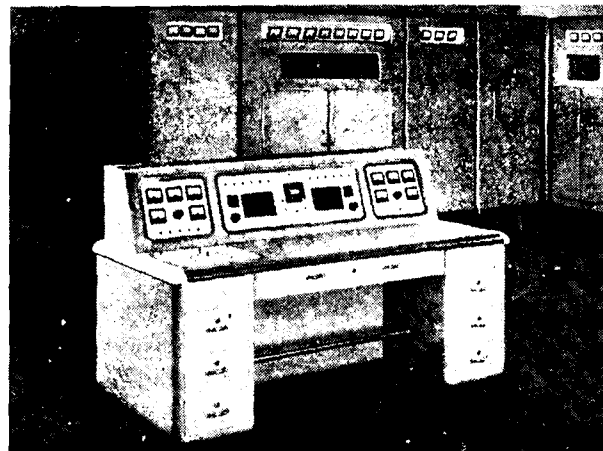
The audio-frequency harmonic distortion is diminished by negative feedback.

The valves of both the radio and audiofrequency high-power stages have A. C. filament supply. For increased noise suppression, the filament voltages for the four tubes of the AF and the four of the RF final stages are phase-shifted at angles of 45 degrees. The phase shift is attained by a special connection of the several filament transformers which are fed from the stabilized 380 V power network.

High tension for the power stages is supplied by six grid-controlled hot-cathode mercury-vapour rectifier valves and can be adjusted continuously. The input power supply unit consists of individual cells with plug-type interrupters. The cells are either of the feeding and tapping or of the insulating and metering type. The transmitter is of the semi-monoblock design. The main units are arranged behind the front panel. The instruments for checking the operation of the transmitter occupy the upper part. The



High-Power Transmitter Control Panel



Control Desk

controls and switches on the front panel are provided with locking doors.

There is a separate control board carrying the

Major Step Forward in the Development of Gas Turbine Engines for Vehicles

An industrial gas turbine, designated the Austin 250 has been announced by the British Motor Corporation. It is the result of 12 years' secret development during which time the only published facts have concerned a turbine driven car which served as a mobile test bed.

B. M. C. engineers say that it is an important step towards the final production of a vehicle powered by a gas turbine. The unit burns almost any suitable type of cheap fuel and develops 250 b. h. p. It measures only 37 ins. long, 35 ins. wide and 51 ins. high. A. B. M. C. statement says that although this unit is specifically designed for industrial purposes, "it is at the same time a major step towards the final production of a vehicle turbine and it will be seen to be one of the links in the Corporation's chain of development of this interesting type of prime mover:— First, the Austin turbine driven car, registration number 'TUR 1'—a vehicle turbine to assess all the problems; secondly, intensive component research to overcome these problems; then the production of the Austin 250 Industrial Gas Turbine to consolidate the turbine itself as a reliable unit. Finally the B. M. C. is now undertaking further research on specific vehicle turbine problems which it is anticipated will culminate in the development of a 250 h. p. vehicle gas turbine for high speed heavy commercial vehicles and other forms of transport. This is the B. M. C. plan for

instruments, signal lamps and switches necessary for normal operation.

Located externally are the E. H. T. transformers and filters, the modulation transformer, the moving-coil voltage regulating transformer for A. C. heating, and other units.

There are mechanical interlocking devices to protect the attending staff against accidents. Not until all high-tension parts have been insulated and grounded, can the door of the H. T. cubicle be opened.

Facilities are provided for combining two transmitters in parallel operation. The transmitter inputs have common drive with phase synchronization. The combination unit keeps the two transmitters entirely apart from each other. Their united output is rated at 280 kW. In case of a breakdown in one of them, the other is switched automatically to the power network, without interruption of the broadcast.

the introduction of the gas turbine into the highly competitive fields of commercial vehicle and ultimately car manufacture."

* * * * *

A NEW DEVICE TO INCREASE BRAKING EFFICIENCY FOR CARS

A new device to increase braking efficiency for cars, has been introduced by Dunlop. It is a mechanical booster which supplements the normal foot pedal pressure in applying the brakes.

Assistance is applied directly to the brake pedal by a vacuum-operated bellows unit. Vacuum is supplied from the engine through a reserve tank which maintains the supply and provides a reserve for braking even when the engine is not running. A special safety non-return valve is incorporated to ensure this reserve.

An official of the firm says that in the event of having to remove the mechanical booster for any reason, it is not necessary to dismantle the hydraulic system, as the booster does not contain any hydraulic parts. A safety feature is that the booster can be fitted to twin master cylinders providing two completely independent systems, one operating the front brakes and one operating the rear brakes. The 'E' type Jaguar, the new 150 m. p. h. two-seater, is fitted with the mechanical booster.

TRENDS IN MACHINE TOOL DEVELOPMENT AND THE BUDAPEST INDUSTRIAL FAIR 1960

By LÁSZLÓ LAZÁROVICS—ISTVÁN LAJTAI

Mech. Engineers

AT international exhibitions, the products of different countries are displayed side by side making you feel that a comparison on an international scale cannot be avoided.

Which points should be observed in such a comparison? The same machine exhibit is looked at from quite different angles by a design engineer, a technologist, a sales engineer and a form designer. But all these points are covered by the single thesis: a machine tool is expected to produce technically well defined jobs as economically as possible. Even when formulating this thesis, some considerations should be borne in mind. It is by no means true that a fully automatic machine will produce more economically in every respect than another with a lower degree of automation. It might happen that the former has an essentially lower piece time and, consequently, piece costs, on the other hand, however, the net costs of the machine are several times higher than that of the latter. The economic significance of increased cutting speeds, is quite different according to the necessary waste time. Even these two examples show that the right choice of machinery cannot be effected but after a thorough knowledge of the workpiece and the number to be produced of it.

The up-to-date manufacturing technology has put the target to produce the single pieces with as little machining as possible or even to eliminate it entirely. With the up-to-date machine tools, thus, the greatest importance is attributed, not to the amount of stock removed, but to trueness to shape, precise dimensions and surface quality of the work. These properties are of the greatest importance as up-to-date production and assembly is only possible with interchangeable pieces.

The main development trend of machine tool production is automation, a device that has become fashionable and high-sounding and thus not avoid of certain abuses. All the up-to-date machine tools

have more or less automation built in. The limits are indicated by automatic releases and the automatic plant. It must be stated by economical calculations which degree of automation is justified in a machine used for a certain purpose. One may take it as granted that it is always right to employ automatic safety devices (limit switch, power limiter), devices relieving the attention of the operator, reversing switches and a mechanization of always repeated dull operations. For a long time the development in the machine tool trade had the principal aim to make a full use of the possibilities granted by the carbide tips and in the last years, the ceramic tips. As a

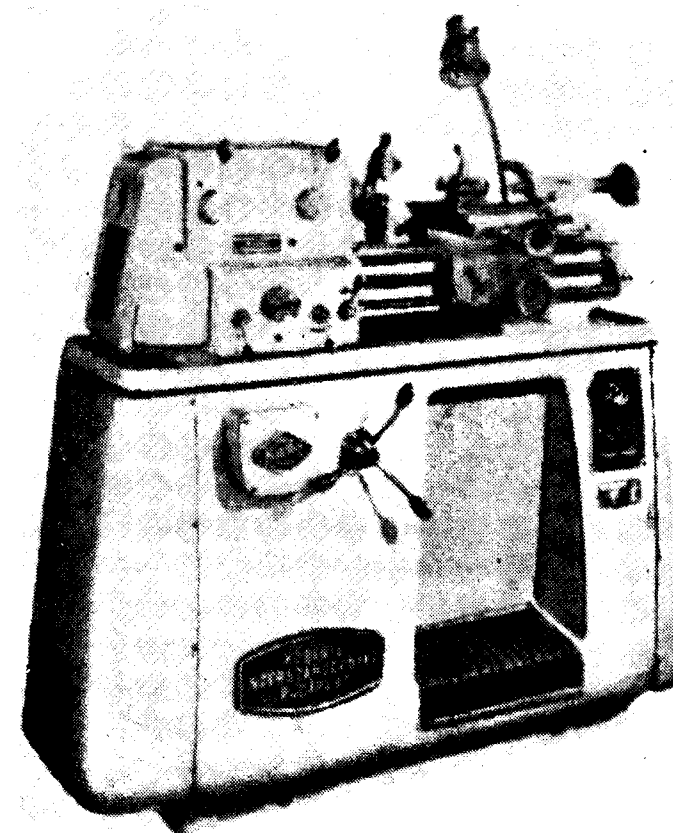


Fig. 1. Universal Precision Lathe MEUS—200

result of these efforts the useful cutting times have shrunk to such an extent that an increased number of possibilities have become available by the decreased waste times. Steps in this direction were the reduction of control levers or the single control lever. It is also of great importance how handy a distribution is designed to the single operating elements such as levers, push-buttons, etc. The suspended control boxes represent means for a convenient operation.

A diminution of waste times is also aimed at by the pre-selection system as far as it is possible to set the technological data of the subsequent operation during the performance of the actual machining operation (therefore pre-selection) and at the end of the same operation the automatic switch, by a movement of the hand, changes over to the technological data of the subsequent operation. A further step in this sense is the time-pattern control where the single operational data are recorded on punched cards, perforated tapes or magnetophone tapes.

An ever increasing space is required by the copying processes, whole machines are produced according to this principle or also the copying device forms an adaptable accessory of the machine. It may be employed to special advantage for the copying of intricate shapes.

Methods of active measurement help us to save the time for controlling the work and setting the cut. Its principle is, in fact, nothing but a control system. The measuring device establishes the difference between the desired and the actual sizes and forms from these data the signal for the operation, setting the machine in the suitable sense. The active measurement is also very advantageous from the point of view of decreased rejects. For the

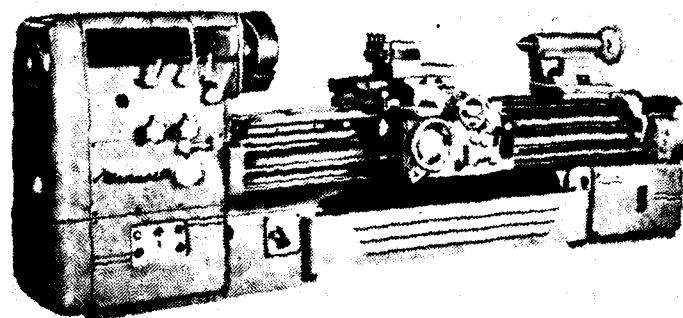


Fig. 2. Universal Lathe EU-630

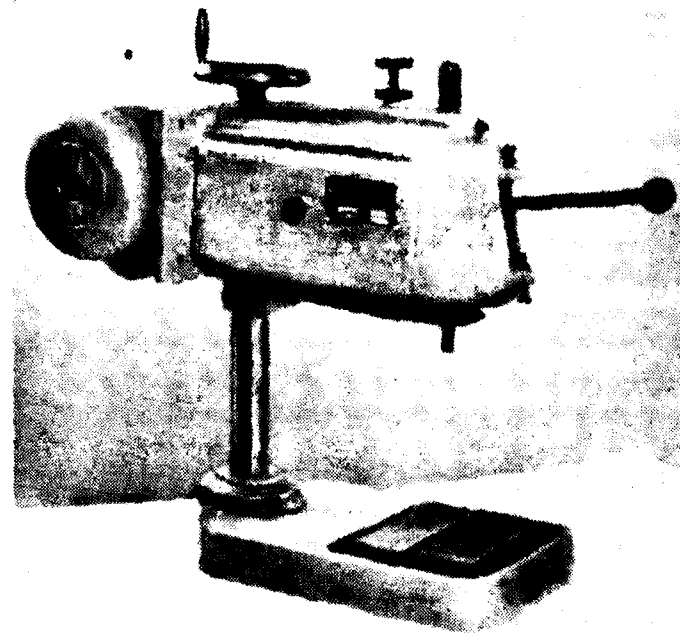


Fig. 3. Hand-Controlled Tapping Machine MF-6

time being, a peak performance of the active measurement is represented by the selective grinding method where the bore is produced to a given pin—or vice versa—with pre-determined clearance.

For operational safety the easy and convenient reparability of the machines is of utmost importance. This requirement is to be provided for by the designers of the machine and if they are not aware of it the user will pay heavily for their negligence.

We started with our considerations with the view that an economical operation is the most important feature of the comparison, and prime costs are of a decisive weight. Decreased prime costs are the more important for marketability as the buyers very often do not carry out correct economy calculations but decide on the purchase of the machine only by the selling price.

A powerful means for decreasing the prime cost of a machine is a cut in designing, testing and production costs. Production costs are most effectively reduced by the use of up-to-date manufacturing methods, production of standard and typified pieces in great series, and the assembly from interchangeable parts.

The most effective method of cutting first costs is given by a design and a production from pre-designed, tested and produced parts or units, which

rod, disc or intricate shapes. An infinitely variably spindle drive and other data of its operation ensure a good machining of steel, non-ferrous and light metals.

Waste times are reduced by stops placed on the bed and the automatic release device built into the slide system by which the machining of stepped shafts is made possible.

Max. swing over bed	200 mm
Range of spindle speeds	60—3,150 r.p.m.
Feed of longitudinal slide per revolution of main spindle	0.01—0.52 mm/rev.
Motor power	1.7 kW

Universal Lathe EU-630 (Fig. 2.)

A heavy-duty lathe, equally suitable for roughing and finishing. The power of the motor built in and the wide range of speeds enable the operator to set the most up-to-date cutting characteristics.

The closed-design threading and feed box are built together with headstock. A quick operating action is made possible by the sliding key design.

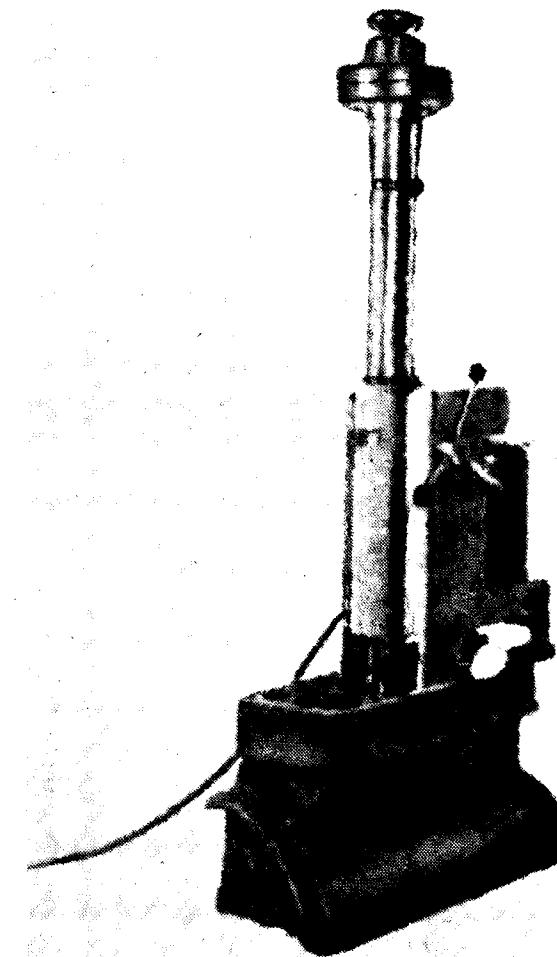


Fig. 4. Portable Cylinder Boring Machine HF-60

are just aggregated in a suitable manner, actually nothing but a special formulation of the "building block" principle, under which the machine tool industry prepares different machining units, frames, beds, tables, feed and control-units as well as distance pieces.

So far the aspects of machine tool development have been looked at on the world scale, mentioning the development trends in this domain. When looking around in the Hungarian machine tool industry, we find results more or less in every field.

SURVEY OF THE MACHINES ON THE FAIR

Universal Precision Lathe Meus-200 (Fig. 1.)

This lathe is produced in a lead screw and feed rod design. It is equally suitable for machining parts of

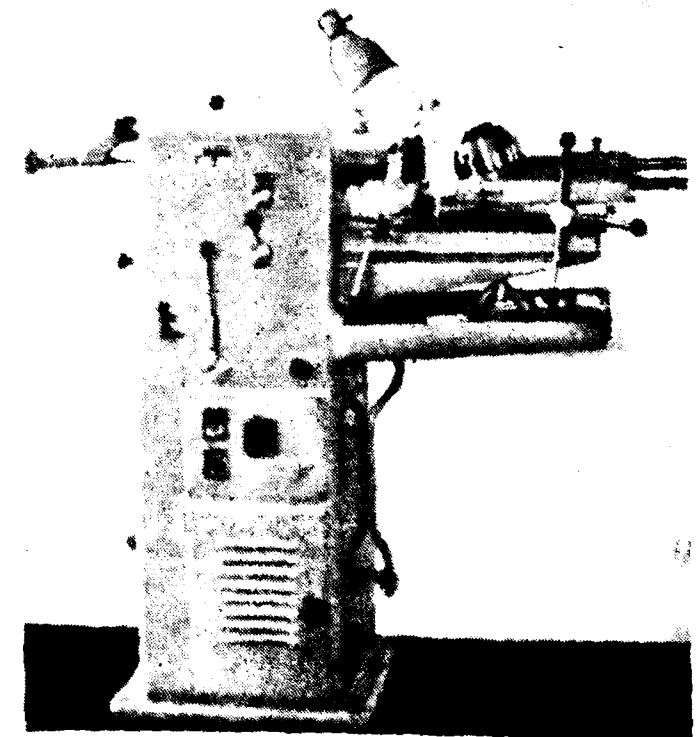


Fig. 5. Turret Lathe RMK-18

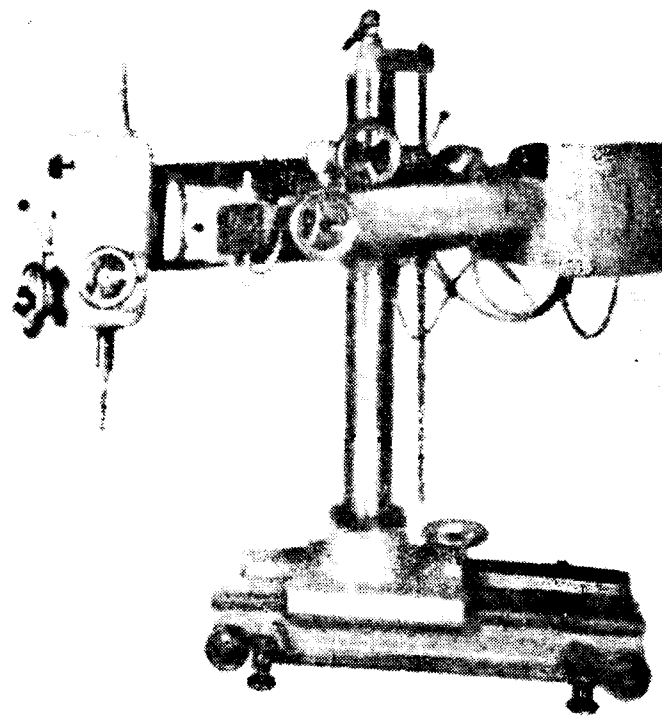


Fig. 6. Portable Radial Drill FRH-30

The slide system shows a quick-change tool head and a rear recessing tool head. A precise limitation is possible both with the longitudinal cross slide by adjustable stops. In order to ensure convenient control, all main drives may be controlled from the slide.

A broad choice of accessories is available for this lathe, among others conical copying and hydraulic copying attachment, etc.

Max. swing over bed	630 mm.
Range of spindle speeds (18 stages)	20—1000 r.p.m.
or	25—1250 r.p.m.
Feed of longitudinal slide per revolution of main spindle	0.03—2.18 mm/rev.
Motor power	14 kW

Turret Lathe RMK-18 (Fig. 5.)

The lathe RMK-18 is developed from the lathe family EMK, with certain alterations. It is equipped with a turret head for 6 tools and a cut-off slide system. Its design with a bar feed mechanism enables this

machine to machine economically parts made from bars. Quick clamping of the stock is effected by collected chuck. A great advantage of the lathe is that by changing over just one lever the quick speed of the main spindle may be adjusted to thread cutting or tapping. The machine has a rigid design and may be delivered on request also with a coolant system. This lathe type may be adjusted into a common lathe at any time by using its auxiliary accessories (thread cutting slide system, tailstock).

Max. swing over bed	200 mm.
Range of speeds	120—2,700 r.p.m.
Main spindle hole	19 mm.
Maximum length to be machined by the turret head	80 mm.
Stroke of the cut-off slide	80 mm.
Motor power	1.1 kW

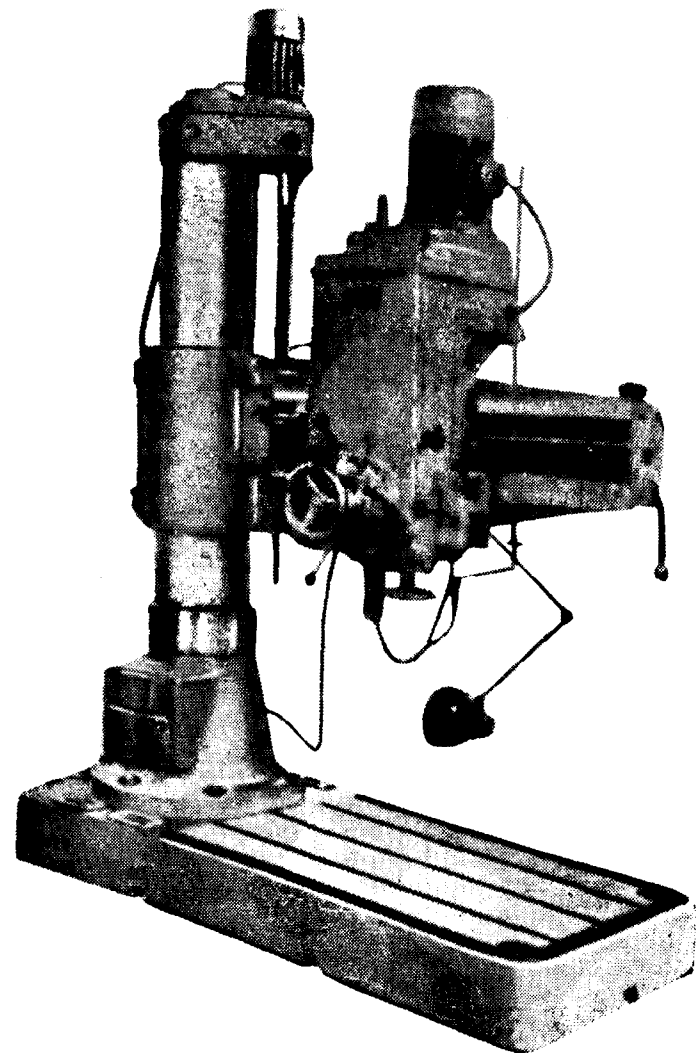


Fig. 7. Radial Drill RF-1

Hand-Controlled Tapping Machine MF-6 (Fig. 3.)

The hand-controlled tapping machine type MF-6 has been designed for tapping parts under mass production. The desk-type machine has a columnar design, the head may be adjusted to the desired height. The main spindle is driven by the motor through a double clutch system so that the tapping may be reversed by actuating a lever. The control of this lever is effected according to the thread depth by adjustable stops. In order to shorten waste times, reversing speed is 1,26-fold greater than the cutting speed. In spite of the high speed the machine operates with little noise and quietly.

Maximum tapping diameter	M6
Maximum tapping depth	20 mm.
Range of speeds	1,000—1,500 r.p.m.
Overhang of the machine	200 mm.
Dimensions of the table	120×160 mm.
Motor power	0.35 kW

Portable Cylinder Boring machine HF-60 (Fig. 4)

The cylinder boring machine is suitable for boring the cylinders of various vehicles such as diesel or petrol engines. It is portable and may be placed immediately on the work. Its quick and convenient clamping is ensured by a claw type device which is placed into the adjacent cylinder bore. Precise orientation to the work is effected by centering pins.

The boring spindle is driven by a V-belt. The stroke may be adjusted according to the length of the cylinder to be bored. Replacing of the spindle into its original position is possible by hand, actuating a lever.

The tool-adjusting screw allows a precision within the range of 0.01 mm. The relative adherence to the dimensions of cylinder bores to each other may be controlled by a dial indicator.

Cylinder diameters to be bored	63—120 mm.
Spindle travel	350 mm.
Range of speeds (3 stages)	250—630 r.p.m.
Motor power	0.35 kW

Radial Drill RF-1 (Fig. 7.)

Machine tool for direct or fixture boring of medium-size work. It can be started or reversed—on request—direct by the motor or by multiple-

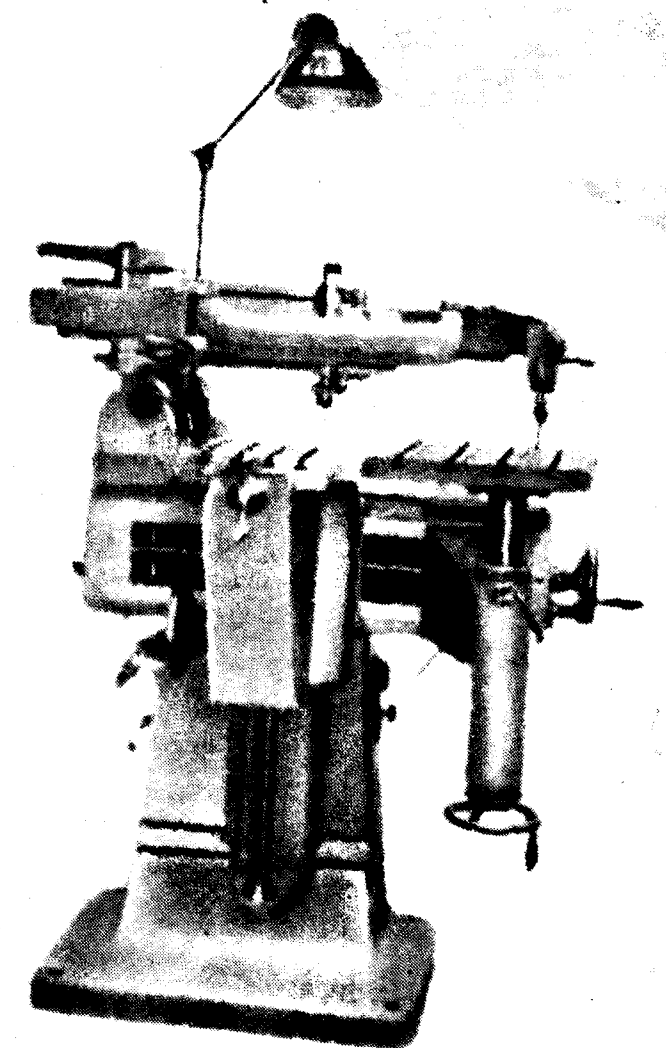


Fig. 8. Pantograph-Copying Milling Machine

disc clutches. The speeds and feeds can be set by a manual lever each, according to the values shown by dials round the lever. Behind the figures in use actually a signal lamp is switched in. In order to facilitate tool changes, indicating bore depth etc., the drilling spindle may be separated from the drive by turning a manual disc. The main spindle drive is protected against overload by a shear pin. An interlocking device arrests the start of the machine as long as the sliding wheels are not precisely on their place. The main spindle may be fed manually or mechanically. The desired bore depth may be pre-set with high precision.

After being positioned above the bore, the clamping of the drilling head and of the arm are secured by a manual lever. The vertical movement of the arm may

be controlled by a push-button. For this operation release and clamping are automatic.

Maximum drilling diameter	32 mm. $\circ$
Maximum drilling depth	300 mm.
Maximum arm overhang	1,000 mm.
Range of spindle speeds	45—2,000 r.p.m.
Range of feeds	0.05—1.25 mm/rev.
Motor power	2.2 kW

Portable Radial Drill FRH-30 (Fig. 6)

This drill is suitable above all for steel construction works, assemblies or drilling of large-size parts, difficult to transport.

The drilling head is perpendicular to the arm and may be rotated around a horizontal axis by 180° and around the column by 360° . The main and auxiliary drive are located in the head part. The feed may be either manual or mechanical. The drilling spindle may be operated also by a manual fine feed.

The drilling arm is joined to the column by a mechanically raised or lowered sliding sleeve. The head may be tilted around the horizontal rotating axis at the sliding sleeve by $\pm 15^\circ$.

The column is removable by hand along the slide. The ground plate is supported by rolling wheels, in the drilling position the drill may be put on four adjustable supports, ensuring thus a rigid position.

Maximum drilling diameter	25 mm. $\circ$
Maximum drilling depth	250 mm.
Maximum arm overhang	800 mm.
Range of speeds (8 stages)	95—750 r.p.m.
Range of feeds (2 stages)	0.05—0.1 mm/rev.
Motor power	1.3/2.2 kW

Nut Tapping Automation FMA-8

The machine is suitable for tapping bright hexagon nuts of standard sizes from M3 to M8. The nuts to be tapped are poured into the feeder from where the gripping mechanism forwards them arranged in order, one by one, into the clamping device. Tapping is effected by a hooked tapping tool (bent-shank tool) and therefore the tapper may operate, without releasing the nuts, in continual series. The tap may be

controlled by changing wheels; it is spring-operated. All organs are operated by curve discs. In order to ensure a good surface quality the machine is also equipped with a cooling pump. When a faulty nut is fed in or the tap breaks, the machine stops automatically. The tapped nuts reach the box suspended on the side of the machine through a guide channel.

Range of nuts to be produced	M3—M8
Number of pieces per hour	1,200—2,000
Range of spindle speeds	800—1,000 r.p.m.
Motor power	0.45 kW

Nut Countersinking Automation MAS-10 (Fig. 10.)

The automation has been developed for double-sided countersinking of bright hexagon nuts of standard size from M3 to M8. The nuts to be processed are poured into the feeder and get by automatic feed into the clamping device placed into the central line of the main spindles. The countersinking is made by countersinking cutters clamped into chucks, simultaneously from both sides. The feed may be controlled by change wheels. The machined nuts slide into the box suspended on the side of the machine through a guide channel. The driving motor, the coolant reservoir and the pump are placed into the box-type frame. The machine needs no supervision, operating quite automatically after the nuts had been placed into the feeder.

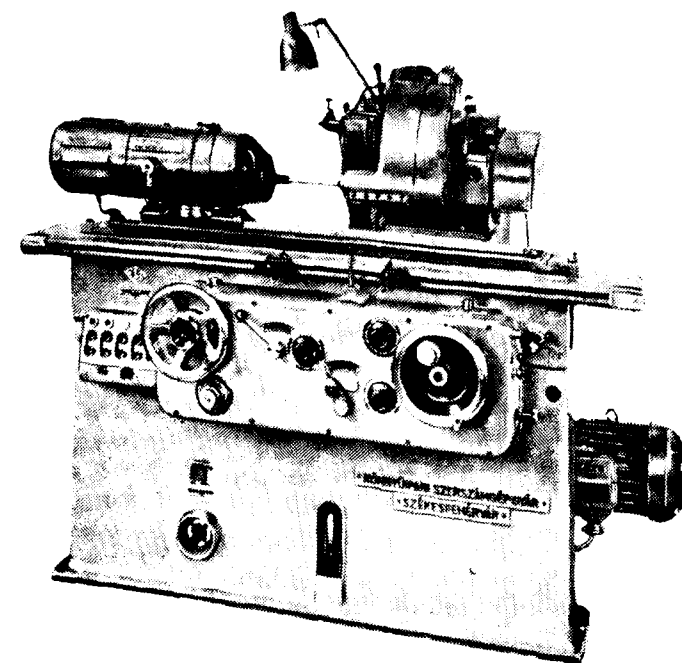


Fig. 9. Universal Cylindrical Grinding Machine KU-250

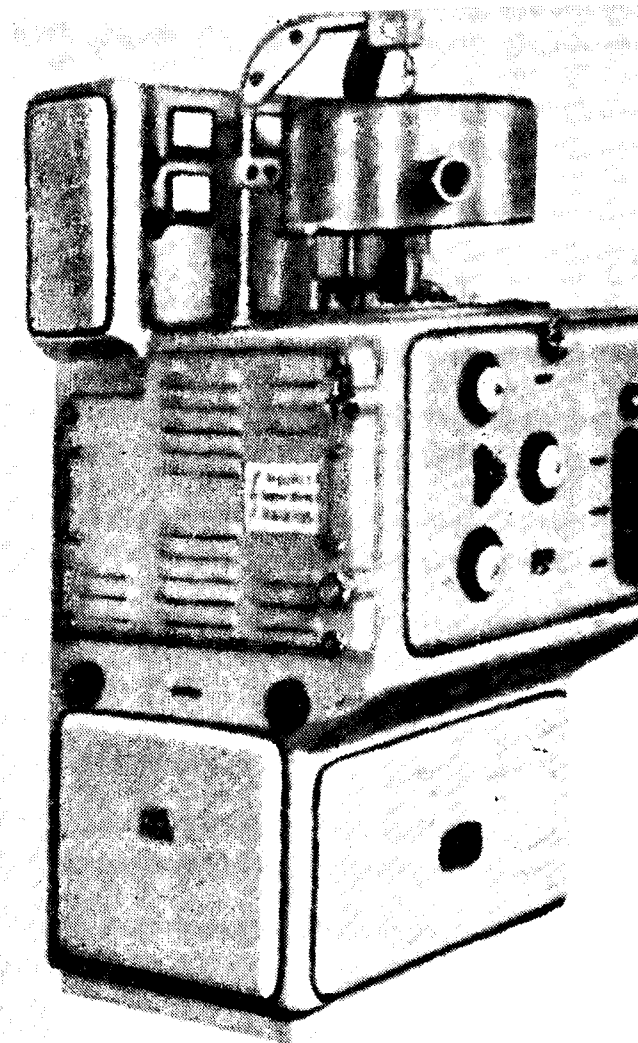


Fig. 10. Nut Countersinking Automation MAS-10

Range of nuts to be countersunk	M3—M10
Number of pieces machined per hour	1,200—2,000
Range of spindle speeds	800—1,000 r.p.m.
Motor power	0.45 kW

Pantograph-Copying Milling Machine MP-200 (Fig. 8)

The machine is suitable for simple engraving of plane surfaces, production of relief work, casting dies, with enlargements and reductions to proportions between 1 : 1.5 and 1 : 10.

The knee-type work table may be adjusted in three directions, perpendicular to each other, by its prismatic slides. The joining arms are provided with special bearings and may be moved in different planes of the space.

The machine is provided with a specially broad selection of accessories among which the more important ones are: grinding fixture, circular table, tilting circular table, electric recording device, swinging vise, letter templates, etc.

Dimension of table	200×315 mm.
Range of spindle speeds (6 stages)	1,500—8,500 r.p.m.
Useful tool diameter	4—8 mm.
Motor power	0.25 kW

Universal Cylindrical Grinding Machine KU-250 (Fig. 9)

The machine is suited for inner and outer grinding surfacing and grinding both long conical surfaces with small slope angles or short steep cones.

The longitudinal feed is effected by the table, the cross depth by the grinding wheels slide. Both motions may be carried out either automatically or manually.

The table speed may be infinitely varied, its travel can be limited by stops.

The transverse feed may be periodical or infinitely repeated (infeed grinding). The periodical feed may be operated on the left, right, or on both sides of the work. For infed grinding the feed is automatically repeated according to the set value.

The amount of roughing and finishing allowance as well as the back feeding can be adjusted.

An active measuring device can also be fitted on the machine, in this case the machine is controlled by the dimensions of the work. With an active measuring device, the grinding is effected in a fully closed cycle.

After the outer diameter is ground, the bore grinding may be performed without dechucking the work.

Maximum diameter to be ground	250 mm.
Maximum length to be ground	500 mm.
Workpiece speed	63—500 r.p.m.
Table speed	0.2—6 m/min.
Motor power	2.2 kW

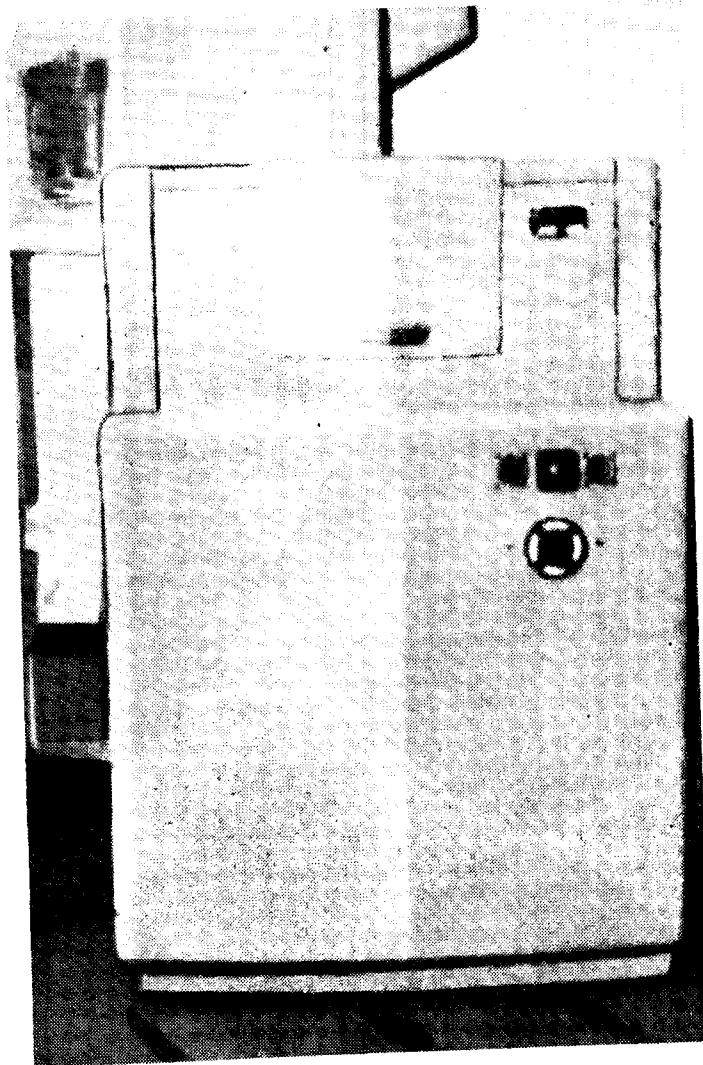


Fig. 11. Mica-plate Silvering Equipment CSE-10-4

Belt Grinding Machine SzCs-200

The machine may be employed to grind various metal castings, bakelite workpieces or lumber. The belt drum is driven by the electric motor placed into the socket through a three-stage belt-pulley. The belt guide in the form of a table may be tilted as required from the horizontal to the vertical plane. The axial distance between the belt drums is adjustable since the grinding belt should be stretched to necessity. The quick change of the grinding belt is ensured by the bracket-like design of the drum. The machine frame is further equipped with a supplementary table to be positioned in any desired angle, ensuring a possibility to grind plane, angular surfaces.

Table dimensions	220×600 mm.
Speed of the grinding belt	10, 15, 20 m/min.
Motor power	1 kW

Mica-Plate Silvering Equipment CSE-10-4 (Fig. 11.)

The equipment has been developed to provide single parts with a very thin metal (silver) layer. The evaporation of the plating metal is performed in an evacuated space. The air is drawn off by a vane-type forevacuum pump to a final pressure of 5×10^{-2} , then by the diffusion pump built into the machine to a final pressure of 10^{-4} . The machine is also equipped with instruments to meter the forevacuum. The work space is provided with a rotating plate onto which the parts to be plated are placed. The work space is covered by a bell and contains also the built-in ionizing candle and the evaporation unit. The electrical equipment is mounted into the attractively shaped machine frame.

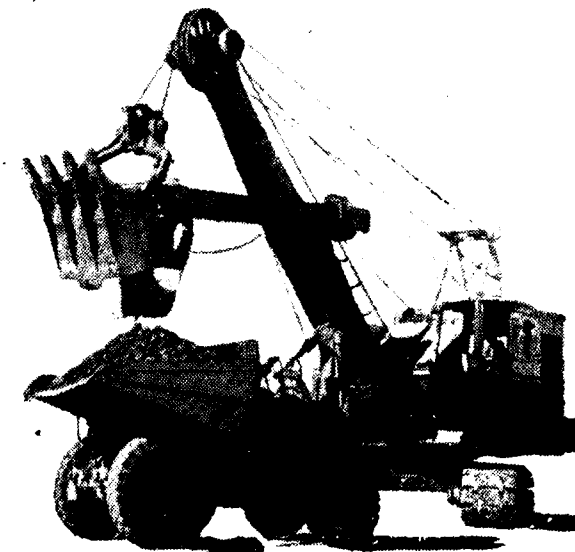
Value of final vacuum	1×10^{-4} Torr
Dimensions of vacuum bell	○510×200 mm.
Ionization voltage	2,000 V

Plastic Injection-Moulding Machine FöM-50

The plastic injection-moulding machine has been developed for automatic production of thermoplastic material parts. The machine performs the tool closing and injection in a hydraulic way, this system dispensing with the precise adjusting of the tool. A built-in pump with two liquid circles and three pistons supplies the necessary pressure. The valve-type control yields full automation and makes it possible for the machine to work upon a manual, semi-automatic or automatic scheme. In case of semi-automatic or automatic performance the machine is controlled by a servomotor guided by interoperation, post-pressure and cooling time limiters; these elements are built into a separate case. The torpedo is surrounded by two automatically controlled heating jackets, with an independent current circle each. The machine is fed by volumetric feed. The work is kicked out by an adjustable stop. The nozzle pressure may be controlled by a leaf spring assembly. With its practical design the frame provides for the moulded parts to drop into a box. The protecting cover excludes the risk of any accident.

Injection output	50 g
Maximum number of parts	180 pieces/hr.
Maximum injection pressure	1,200 kg/cm ²
Injection power	16 tons
Die closing power	50 tons
Die opening path	320 mm.
Motor power	4.5 kW
Heating input	2.5 kW

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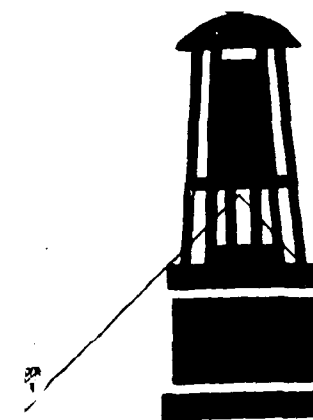
MACHINE FOR ADHESIVE APPLICATION

A fully automatic solutioning machine for preparing metal components for bonding with rubber has been designed and built in the U.K. The machine will process medium to large batches of small components at fast rates and may be used to give one or two coats of adhesive. It can handle flat, cylindrical or irregular shaped articles up to 5 ins. diameter $\times$ 6 ins. high at the rate of eight per minute, or articles $2\frac{1}{2}$ ins. $\times$ 6 ins. high at 16 per minute. Both the internal and external surfaces can be coated and work-holders may be used to mask areas to be left uncoated.

Components are loaded onto work-carriers located on trays, immersed in a degreasing tank, and while still warm are fed onto solutioning machine conveyor, passing through a pre-heat oven usually controlled at approximately 80°C.

The trays dwell at the first spray station while the work carriers are raised and rotated as automatic spray guns are traversed to coat the required areas. The work carriers are then returned to the trays which pass through a drying oven onto a return conveyor. This carries them to the second spray station, and through the drying oven to the unloading point.

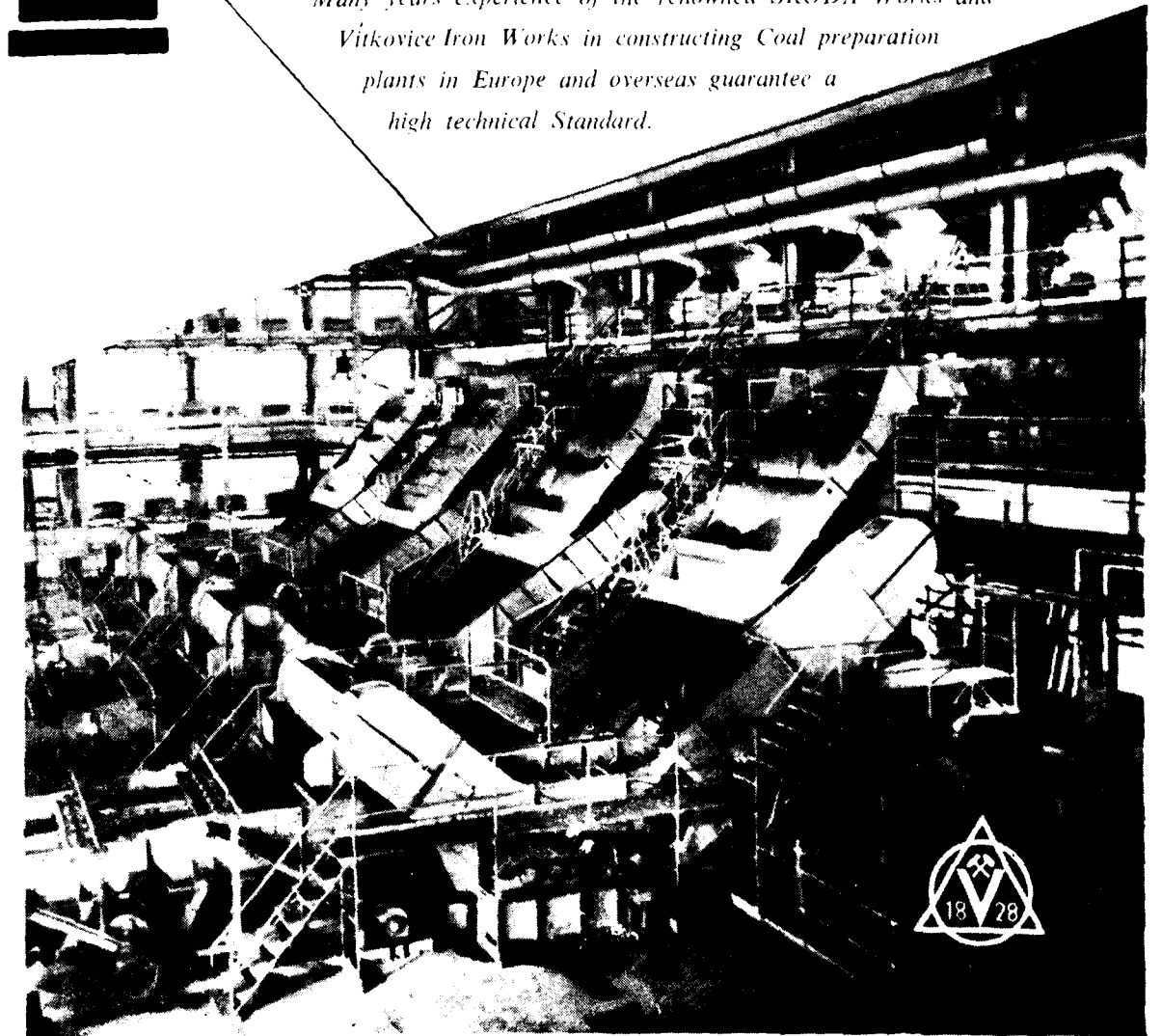
To conserve floor space and labour the machine has been compactly designed to allow one operator both to load and unload as well as cope with the degreasing if the tank is conveniently situated. Control panels are provided at each spraying station, while all movements are controlled from a centrally positioned camshaft provided with simple adjustments.



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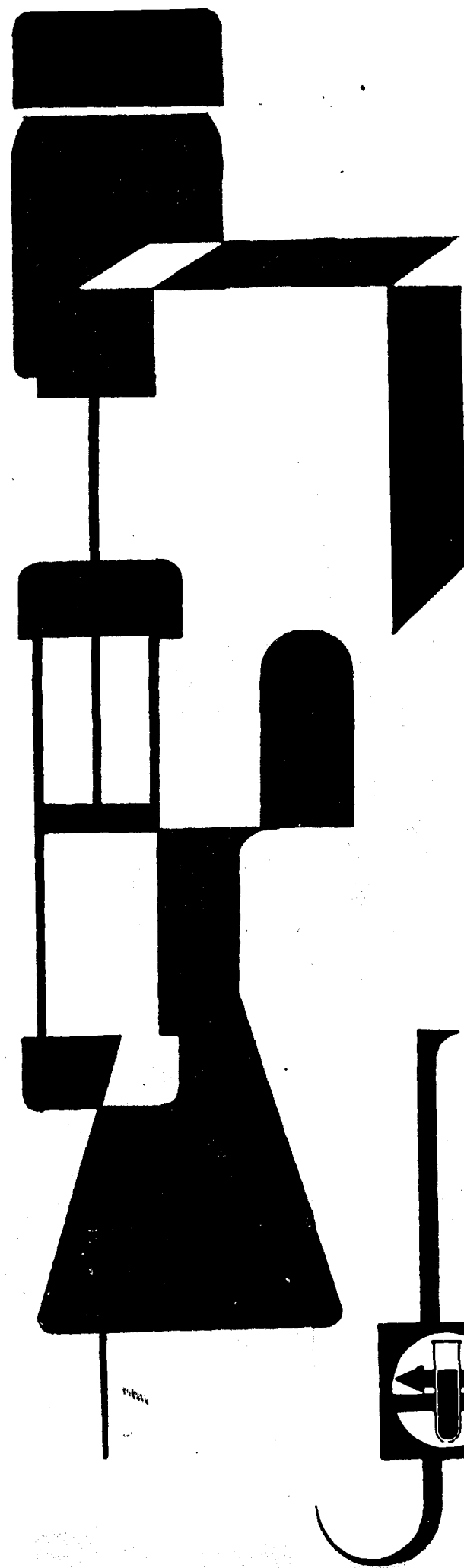
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