

Journal of Industrial
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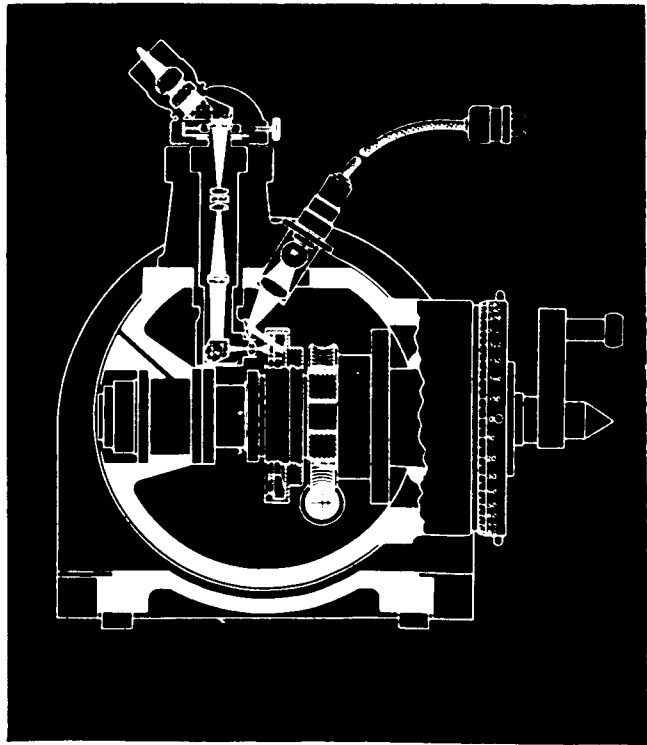


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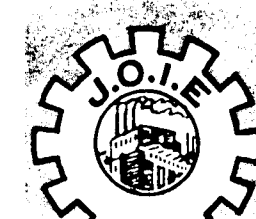
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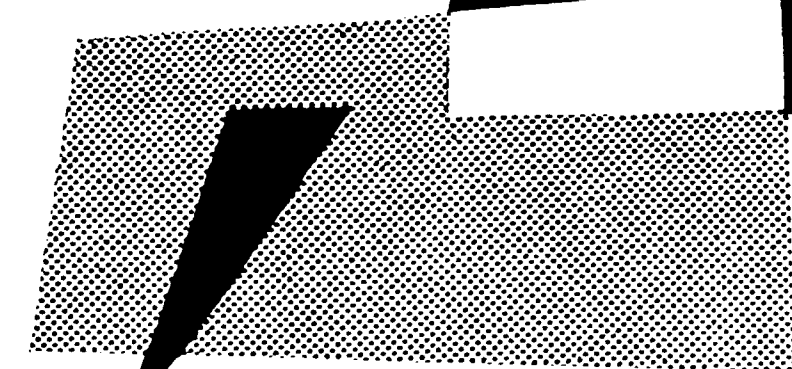
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NEW ZERO ENERGY REACTOR

The United Kingdom Atomic Energy Authority has decided to build a zero energy fast reactor at the Atomic Energy Establishment, Winfrith. The reactor has been named "ZEBRA" (zero energy breeder reactor assembly). It has been designed to permit the study of the neutron physics of a wide variety of fuel assemblies containing uranium and plutonium. The assemblies under study will be built up by loading fuel elements into a steel matrix — approximately a cube of side 10 ft.

The fuel elements contain both fuel plates and plates of neutron-absorbing material: the latter will be used

to simulate the nuclear properties of the coolant and structure material which would be required in a power reactor. ZEBRA will be operated at room temperature and the heat output from the nuclear reactions in the core will be kept very low so that no cooling system is necessary. It is planned to commission the zero energy reactor during 1962. ZEBRA will be used to obtain information needed for the design of a prototype which is likely to be the next step in the development of the fast reactor by the Authority. The work at the A. E. E. Winfrith will complement that carried out at the Dounreay Experimental Reactor Establishment.

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96 locomotives of 1,700 h.p. BB single-engined
12 locomotives of 1,600 h.p. BB double-engined
159 locomotives of 1,200 h.p. BB single-engined
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MATERIALS UTILISATION

■ TODAY'S engineers, designers, and researchers face problems of economy not confronted in many years. Old words with revitalized meaning will be added to Management's vocabulary. These are "competition", "budgets", "costs", and similar words that demand scrutiny of all operations, including engineering and product development functions. "Proceed with design; investigate new materials with renewed vigour; continue adequate research, *but watch your costs*," seems to be the order of the day.

We are now living in a world of competition which means that prices of our product must be reduced or that quality must be improved without a corresponding price rise. Whether it be a purchase for personal or business needs, the buyer today is looking for more value for his money. The situation therefore calls for a thorough search for each and every way of saving money, no matter how insignificant.

There are various ways of reducing production costs. Improved materials handling, better tooling, better control over processes to reduce scrap loss, salvage of rejected parts, all representing the mechanical methods of controlling costs, are some of the important steps in this direction. These methods are readily apparent and being widely practised.

On the other hand, there are methods of reducing costs that are not so readily apparent. These methods could be grouped under the general heading of materials utilisation, and to date have been least exploited. No industry is immune to savings through the better use of engineering materials. It is a simple matter to shift from one material to another that is cheaper. But it takes imagination and engineering ingenuity to change from one material to another, or from one material form to another and at the same time maintain quality and reduce costs.

The problem of cost reduction through better materials utilisation breaks down conveniently into four divisions:—(i) Selection of various raw materials, (ii) Selection of the form in which the material is to be used, (iii) Better design to take full advantage of the properties of the materials, (iv) Marketing of manufactured products. Within each of these four divisions there may be accumulated the comparative costs of two or more materials for an equivalent use.

Immediate savings can often be made through the simple expedient of changing from one material to another, without making any other substantial change in form or in processing methods. For example, it is sometimes possible to use low alloy or carbon steel in making products in which high alloy steels have previously been used. Low alloy steels are known for their ease of forming and if the parts manufactured from them, are carburized or given special heat treatments, they can in many cases meet the service requirements. Plastics and other non-metallic materials often replace metals with resultant cost reductions and often with improved characteristics.

Sometimes material is selected that will far outlast the product in which it is used. Selection of the best materials without considering the economics and performance requirements of the product into which the part will be incorporated, is a sheer wastage of money.

Machining is one of the most expensive process today; thus if it can be reduced appreciably in the making of a product, there will automatically be a substantial saving. This factor plays an important part in selecting the form in which the material is to be used. A very common example of this can be found in the use of tubing rather than bar stock for making bushings which would normally be machined from solid.

By introducing design changes, considerable savings can be effected in material utilisation. For example, it is possible to use thinner sections generally if reinforcing webs are used wisely. Mild steel weldments can similarly replace many malleable castings or cast iron fittings. The case of machine base is cited as an instance in point.

Marketability of end product is an important factor in choosing materials. Good appearance and such other esthetic factors as colour, shape, etc., while not so important for industrial goods as for consumer goods, also constitute an important factor in material selection. There does seem to be an unmistakable trend towards lightweight products as the population ages, as a means of saving on materials handling and transportation expense.

Another important market trend is towards parts made from materials of greater corrosion resistance. There is an increasing awareness of the waste, often irrecoverable due to corrosion.

Although not fully exploited yet, another way of reducing material cost is miniaturization. Generally speaking miniaturization is finding its most fertile grounds in the making of electrical and electronic components. However, the same general ideas can be used in larger equipment such as in electric motors which have undergone complete redesign in recent years to make them smaller, more compact and more powerful. A huge saving in material has been a side effect in this case, but it shows what can be done.

In view of the increasing importance of cost in to-day's manufacturing picture, the material utilisation poses a big problem to our industries and it is high time that a concerted attack is made to the problems of cost reduction through channels which might have been overlooked.

Concrete-Mixing Plant Built in Turkey with Soviet Assistance

A concrete-mixing plant, built with Soviet assistance, was commissioned on the outskirts of the city on 3-8-60. Soviet specialists took an active part in its construction. The plant is equipped with the latest Soviet machinery. All production processes are mechanized, while the mixing and delivery of concrete are automated. Only three men are needed to control all mechanisms. The plant's output is about 50,000 cubic metres of concrete a year. In the course of the plant's construction, Soviet engineers trained Turkish specialists who can now themselves control the automatic installations.

QUEST FOR UNDERGROUND WATER RESOURCES

SECOND PROJECT LAUNCHED ON THE HEELS OF SUCCESSFUL EXPERIMENTS

By D. Mehta

Chief Engineer, Exploratory Tubewells Organization

THE first phase of Asia's biggest concerted drive for a systematic exploration of ground-water resources has just come to a fruitful end in India. The Exploratory Tubewells Organization of the Union Ministry of Food and Agriculture aided by the American water well industry has completed 282 bore holes in different parts of the country. The results obtained are encouraging and not altogether free from surprises.

Following the success of the pilot project, the Government of India have now launched upon a second project which is being carried on by Indian engineers without any foreign assistance. Aided and advised by the Geological Survey of India, the engineers of the Exploratory Tubewells Organization move from place to place, boring holes in the ground and opening up tremendous possibilities of using underground water for agricultural and other purposes.

Water spells prosperity for a nation and is the key to its expanding and developing economy. Already the demand for water for the development of India's agricultural economy, her rapid industrialization and improved conditions of public health is increasing so fast that the country is faced with a possible shortage of water in the near future. No doubt, our surface water resources are of a very high magnitude—the total run-off being an estimated 1356 million acre feet—yet it is not always possible to conserve water for our needs in time of seasonal requirements. The bulk of it, therefore, goes waste and runs into the sea. In regions like Rajasthan surface water is in acute scarcity and poses a serious problem to their development. In other areas, on the other hand, where the annual rainfall is 100 inches or even more there is no water during the 8 months of the non-monsoon periods for winter irrigation and in summer even for domestic purposes.

The necessity for tapping the sub-terranean source is, therefore, of paramount urgency in the present context of our development programmes.

In the pilot project experiments were carried out in 15 areas selected with the expert advice of the Geological Survey of India in river valleys, coastal and deltaic regions, and such other places which were occupied by softer and poorly consolidated sedimentary rocks and were considered potential sources of groundwater. Areas of hard and crystalline rock were avoided purposely so that our first effort should bring us quick results in opening out such new and virgin areas as were geologically feasible for development of lift irrigation, the object being to explore in detail the geological structure and groundwater potentialities of these areas.

PHENOMENAL YIELD

An outstanding instance of striking a phenomenal yield of 51000 gallons of water per hour in the heart of the Rajasthan desert gave this organisation a colourful start. This well, located in Chandan in the district of Jaisalmer, may be the fore-runner of more wells in its neighbourhood in the near future. We may have hit upon a big underground lake or an ancient sub-terranean stream. Surprisingly nine other attempts in this region of about 80000 sq-miles extending from Jaisalmer and Botia on the west to Ratangarh and Sikar on the east were abortive although some of the holes were drilled to a depth of 1000 ft.

In U. P. and Madras, we came across regions where plenty of groundwater is available under artesian and sub-artesian conditions. In the districts of Jaunpur, Faizabad and Sultanpur in the U. P. it was found that the most suitable and plentiful water bearing formations lay 500 to 600 feet below ground level. It is not surprising that the Irrigation Department of U. P. had given up these districts as bad areas for groundwater development as their existing wells did not go deeper than 500 ft. so tapping only their granular zones with limited yields which dwindled to a nominal discharge in due course. The discovery of the water resources gave hope to the agricultural workers and local farmers.

In Bombay the organisation explored portions of Purna and Tapi valleys and part of Saurashtra and Kutch. Results here although encouraging to a degree were not as promising as expected. In Kutch, however, a sizable area has been recommended for large scale groundwater development. Similarly in Bihar, Orissa, Andhra and Madras the explorations have given positive results and a number of tubewells could be sunk in proven areas for extending irrigation facilities and thereby increasing the food output of the country.

Explorations in areas selected in U. P. and West Bengal were highly satisfactory, giving almost cent per cent results. Results in Kerala were not very encouraging. Punjab was only partly successful in that the quality of water in some areas was saline and unsuitable for drinking or irrigation. Operations in the Brahmaputra valley in Assam are well under-way and results so far obtained are satisfactory.

NEVER ENDING PROCESS

These investigations are a never ending process and a continuous search for groundwater is necessary. In places where subterranean supplies are exploited, it is equally necessary to keep a close watch, and seasonal observations must be recorded to guard against excessive pumping. A balance must be struck between the input and output of subsoil water for

specific areas, to avoid depression of the water table to an extent that pumping becomes uneconomical. Like surface water, groundwater reserves should also aim at judicious distribution, economic utilisation and planned conservation.

The knowledge of the occurrence and movement of underground water has been considerably advanced by scientific method and the old concept of the willow-wand or the magic diviner is fast fading away. If water movement underground has an aura of a mystery about it, it is largely because such water is invisible to the naked eye. Today by the help of geophysical equipment coupled with actual boring operations, examination of lithological logs and hydraulic structure, the underground source of this vital fluid can be charted almost as accurately as if it could be seen. Using this knowledge it is possible to gain an understanding of the underground conditions and advise those interested in exploiting them to their advantage. That is the objective and pursuit of this organisation.

It is hoped one day to discover buried lakes under deserts and flowing rivers under arid dry plains because it is obvious that the hard packed earth covers large and unlimited reservoirs of millions of gallons of water slowly filtered through porous layers of sand and gravel on its way from the Himalayas with its heavy precipitation and melting snows all the year round to the sea.

NEW COMPUTER TO OPERATE AT SPEEDS APPROACHING THAT OF LIGHT

Atlas—the electronic digital computer now under development at Manchester University—is expected to be the ultimate in present generation digital computers and will operate at speeds approaching that of light. Information in the machine is represented by electrical impulses which are transmitted through wires at near-light speeds, but they still take an appreciable time compared to the speed of operation of the machine itself.

As no information can be transmitted faster than the speed of light, Atlas is pressing on this “light barrier” which will prevent any machine operating on present day principles from going any faster. To minimise this problem Manchester University and Ferranti engineers have so designed the machine that the length of wires for carrying pulses will be as short

as practical. This is a significant stage which has been reached in computer design—and a remarkable one when it is realised that the computer industry, a post war development, is still only in its infancy.

Atlas will be one of the world's two fastest and most powerful computers. The only other machine comparable in performance is a giant U. S. computer which will cost considerably more than the British machine, which will be about £1 to £3 million, depending on the size of the installation. The computer will be approximately one thousand times faster than the world's first commercially available computer built by the same firm ten years ago, and 100 times faster than Mercury, currently Europe's fastest computer.

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TOWARDS A SELF-GENERATING ECONOMY

By A Special Feature Editor

Solid Foundation Laid for Heavy Industry

A DECADE OF INDUSTRIAL DEVELOPMENT

THE Indian Republic has completed the first decade of its existence—ten years of stresses and strains but also of solid progress in many fields. Among the most significant achievements of the last ten years is the solid foundation that has been laid for development of heavy industry, so vital to our national strength.

In any economy, heavy industry depends on a balanced growth of heavy engineering industries including machine tools, machine building & metallurgical industries and basic chemical industries. The Second Plan, while laying emphasis on a substantial expansion of the steel industry, also envisaged a simultaneous advance in the field of machine building and basic chemical industries through a joint and co-ordinated effort of the public sector and private enterprise.

OUR ACHIEVEMENTS

The extent of our achievements in the last 10 years or so can best be appreciated by a look at a cross-section of the existing heavy industry in the country. Currently, India is producing about 1.3 million tons finished steel, 12,000 wagons and under-frames, and sizeable quantities of sugar mill machinery (Rs. 2.5 crores), cement, chemical, construction and agricultural machinery (Rs. 3 crores), about Rs. 4 crores worth of machine tools, 30,000 diesel engines, 34,000 automobiles and 2 million ball bearings, besides electric motors to the tune of 6 lakhs H. P., one million KVA of power transformers and 283 million running feet of welding electrodes. The value of industrial machinery now being produced in India is about Rs. 120 crores per year as against less than Rs. 10 crores annually five years back.

When more steel becomes available in the near future with production in the three steel plants increasing, the output in many of these industries would be substantially raised.

On the metallurgical side, we are at present producing 16,000 tons aluminium, 7,000 tons of copper, 16,000 tons of ferro-manganese as well as some quantities of zinc, lead and antimony. Again, in regard to heavy chemicals, substantial capacity has been developed in the country for items like caustic soda, soda ash, sulphuric acid, cement, etc. New lines of production have also been established in items like hydrogen peroxide, industrial and mining explosives, ammonium nitrate, acetone, etc.

MAJOR EXPANSION IN NEXT THREE YEARS

While the existing capacity in the country is thus not insignificant, substantial addition to the heavy industry potential of the country will be made with the completion during the next three years of a number of Public Sector projects now under varying stages of construction. Among the more important of these projects are the Heavy Electrical Project at Bhopal, the Heavy Machine Building Plant and Heavy Foundry and Forge at Ranchi, the Coal Mining Machinery Plant at Durgapur and the proposed foundry at Hindustan Machine Tools, Bangalore.

The Heavy Electrical Project at Bhopal will manufacture large power transformers, control and switch gear, motors, generators and turbines, etc. Production is expected to commence during the middle of this year and reach an estimated output of Rs. 12.5 crores by 1963—64. The Heavy Machine Building Plant being set up at Ranchi, will have a capacity to manufacture 45,000 tons of heavy machinery items comprising blast furnace equipment, steel-making equipment, cranes, rolling mill equipment, coke oven plant, etc. It will also produce spare parts for these. This plant is expected to commence production in 1963. The Foundry Forge at Ranchi which will also start production more or less simultaneously, will have a capacity of about 70,000 tons of different types of castings and forging in the first stage. The Coal Mining Machinery Plant at Durgapur will turn out 30,000 tons of mining machinery items every year and will commence production in 1963. It will have

its own foundry forge. Another foundry which is being set up at Hindustan Machine Tools will appreciably add to the country's capacity for quality castings.

PROGRESS IN PRIVATE SECTOR

In the private sector also, rapid development is in progress. Already the production of sugar mill, textile and chemical machinery has recorded substantial improvement. There has also been a considerable increase in the manufacture of structures and foundry capacity, which will have a major effect in increasing the indigenous content of automobile industry.

In the current year substantial additional capacity in respect of a number of items like transformers, structures, steel castings, etc. will materialise. More units are being established raising the capacity of aluminium to 90,000 tons per year and zinc and lead to 15,000 tons and 8,000 tons per year respectively.

Some other major projects for making industrial machinery will go into production in the next two or three years. For example, proposals for the manufacture of paper, fertilizer, chemical and other types of industrial machinery in Orissa in collaboration with three prominent West German firms; the proposal to set up a plant for manufacture of cement machinery at Durgapur with the assistance of a British firm, etc.

FUTURE EXPANSION PROGRAMMES

Much as all this will amount to, it is clear that very much more has to be attempted in the next Plan. The country can ill-afford at this juncture to be preponderantly dependant on imports.

Towards the rapid expansion of heavy industries in the country, a number of important expansion programmes has been decided upon. The capacity of the Heavy Machine Building Plant at Ranchi is proposed to be doubled to 80,000 tons of plant and

machinery per year. When this materialises, the plant will, among other machinery, turn out steel machinery enough for setting up one steel plant of one million tons capacity every year. In regard to the Bhopal plant, a programme of four-fold expansion of output to Rs. 50 crores per annum by the beginning of the Fourth Plan is being currently finalised, in anticipation of the large demand in the near future for heavy electrical equipment, thanks to the large-scale expansion of power schemes in the country. The Durgapur Coal Mining Plant will also expand its production to almost double the original estimate. Besides, it will also produce equipment for oil drilling, a field of immense possibilities. The Hindustan Machine Tools, another Government undertaking, has finalised an expansion programme to double its production by 1963.

Government have recently announced their decision to set up in the Public Sector two projects for the manufacture of structural plates and vessel works. The capacity of these two works which are expected to go to production by early 1962 will be about 10,000 to 12,000 tons each.

NEW SCHEMES UNDER CONSIDERATION

Apart from these schemes, Government have also under consideration a number of new proposals for developing heavy industry in the country. Among these are the setting up of two new Heavy Electrical Projects one with Soviet collaboration and another with Czech collaboration for production of equipment like hydro and steam turbines, diesel generators, motors, transformers and switch-gears. Another project for setting up a heavy machine tools plant is being undertaken with Czech collaboration. The exact size and scope of these projects are yet to be settled.

The programme sketched above, it should be understood, does not represent the totality of development to be taken in hand in the Third Plan period. Still more schemes are to be considered and finalised. The schemes approved already for implementation will cover a wide range of heavy industry and make a major contribution towards creating a self-generating economy.

The Engineering Industry-The mainstay of the Czechoslovak Third Five year plan

By Miroslav Sigl, Prague

FOR the years 1961-65 Czechoslovakia is preparing a third Five year plan, which is a concrete programme for the completion of the construction of socialism in Czechoslovakia and a contribution to the economic competition of the two social systems of the world. The industrial and agricultural production will change their qualitative structure in such a way, that the socialist sector will produce 96.8% of the social product. Highly specialized branches of the national economy will be one of the supply bases of the socialist camp and will contribute to increase the production of the socialist countries to more than half the world's production by 1965.

During the third Five year plan the engineering industry will still remain the main factor in the development of the national economy of Czechoslovakia. It has to provide the means of production to insure not only the growth of the other branches of the national economy, but also to widen its own production basis and also to contribute its share in a substantial increase of export deliveries. In recent years the rate of growth of engineering production has increased so fast, that in the year 1965 it will be possible to achieve a volume of production 161% higher than in the year 1957. That means, that the Czechoslovak engineering industry will at the end of the third Five year plan produce more products in one month than during one whole year in 1937. The greatest increase of production is to be achieved in these branches of the industry:

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chemical and rubber plants	340
plants for the production of building materials	304
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power plants	186
metal working and shaping machines	186
rolling mill trains	174

The role of the engineering industry as the main factor follows from the necessity to provide the basic branches of Czechoslovakia's national economy with the most modern technology, to reconstruct transport, to carry out far-reaching mechanization in agriculture, to mechanize exhausting manual processes in industry and building construction and to introduce automation particularly in the heavy industry. On the other hand the Czechoslovak engineering industry has certain commitments, which are due to its role in the socialist camp and which foresee, that Czechoslovakia will meet certain requirements of the other countries of the socialist camp by supplying them with production means which require great amounts of highly skilled work. Of particular importance is the participation of the Czechoslovak engineering industry in the building of plants which will jointly insure a widening of the raw material base of the socialist countries. Thus for example a 150 MW nuclear power plant will be developed, power plant boiler-turbine-generator sets of up to 200 MW, fully automatized, for very high input steam conditions including hydrogen cooled generators, will be built. For conveyor transportation in mines the engineering industry is building units of outputs up to 1000 tons per hour, for metallurgical plants automatic rolling mill trains with substantially higher rolling speeds and the highest automation for the production of one million tons of rolled stock. The chemical industry will receive new equipment for continuous production processes with a maximum of automation for the rubber industry, plastics and synthetic fibers production and plant for the production of synthetic rubber.

During the third Five year plan the railroads will transport three-quarters of the passengers and freight by electric and Diesel engine locomotives, which also have to be built by the Czechoslovak engineering industry. They will be Diesel engine locomotives up to an output of 2000 HP, as well as d. c. and a. c. electric locomotives up to an output of 4250 kW.

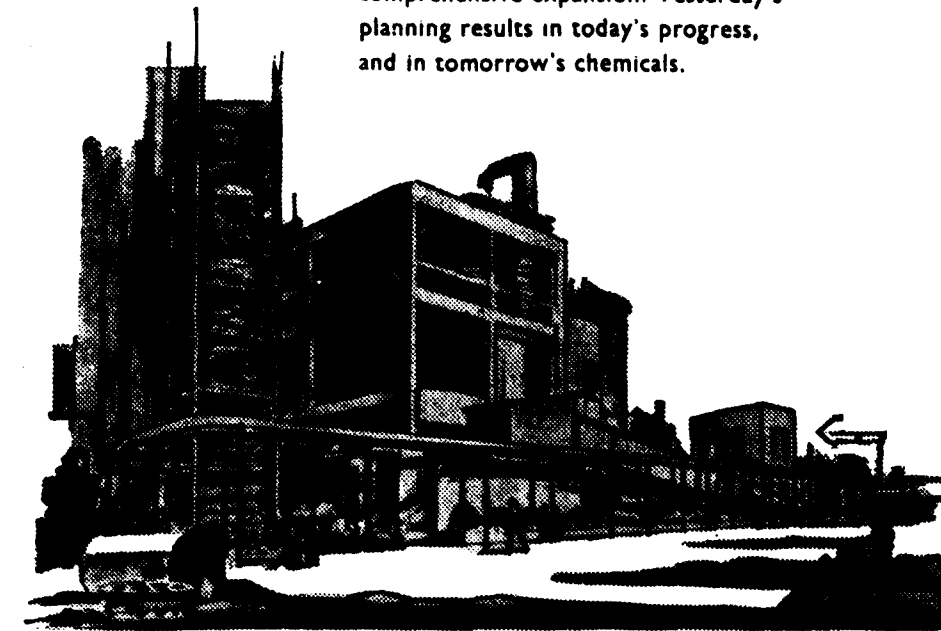
For socialist agriculture the Czechoslovak engineering industry will manufacture at least 200 new types of machines, particularly combined sugar beet

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.



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harvesters, loaders, manure spreaders and equipment for the mechanization of live stock production. Besides that it will supply 96,000 tractors, 110,000 trailers, 20,000 loaders, 15,000 threshing machines, 10,900 combined grain harvesters and 10,000 combined sugar beet harvesters.

Great tasks are facing the workers and engineers of the Czechoslovak engineering industry in the production of food processing machines, machines for the consumer goods industry, in the field of roller-bearings, electrical measuring apparatus, telecommunication equipment parts and information processing machines.

The decisive means to fulfill the above mentioned tasks will be the further development of the technique and technology of the engineering production. The 55% increase in the productivity of labour in the engineering industry will be achieved above all by the mechanization and automation of production processes, new technologies and a progressive method of work organization. Thus for example almost 12000 new automatic and semi-automatic machine tools of which at least 7500 will be programme operated, will be introduced, 3000 single purpose machines, several dozens of automatic production lines, and at least, 1000 automatic forming machines and the same number of automatic and semi-automatic welding machines will be put to work in mass production processes. On the whole it is expected, that the number of machines with a higher degree of mechanization and automation, including machines provided with supplementing devices, will increase up to the year 1965 to about twice the present day number.

Today the Czechoslovak engineering industry produces about 80% of all types of machines produced in the world. Such a wide assortment of types naturally renders the organization of mass production very difficult. Therefore grave structural changes

will have to be undertaken, which are being influenced by the co-operation and division of production programmes among the member countries of the Economic mutual aid council. Thus for example Czechoslovakia will produce electric locomotives, hydraulic turbines, rubber and shoe machines, later chemical plant, power plants and metallurgical plants for the whole socialist camp. The construction of blast furnaces will be concentrated in the USSR, Poland and Czechoslovakia. Czechoslovakia will receive combined harvesters from Hungary, printing and paper machines from the German Democratic Republic etc.

The planned specialization of production in Czechoslovakia and the co-operation of the productions of the socialist countries does not lead to their economic isolation from the rest of the world. On the contrary—thus are created the prerequisites for the economic co-operation of the two world systems. This can be also seen from the fact, that engineering products play a constantly greater role in the Czechoslovak foreign trade and that their share of the total exports will increase from the present day 40% to approximately 55% in the year 1965. Even though the majority of the deliveries of engineering products will be destined to socialist countries, the export of engineering products to capitalist countries will increase from the present 23% to 33% in the year 1965. Simultaneously with the growth of the exports of machines their imports will also grow.

The higher level of the engineering industry will strengthen the position of Czechoslovakia among the mature industrial countries of the world, will help to equip the other socialist countries with products of the highest technical standard and at home will contribute to the main goal and idea of the whole third Five year plan—to the raising of the standard of living. And in a socialist Czechoslovakia that is the primary aim.

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THE TRAVELLING WAVE ELECTRON LINEAR ACCELERATOR

By Reginald J. Beadle*

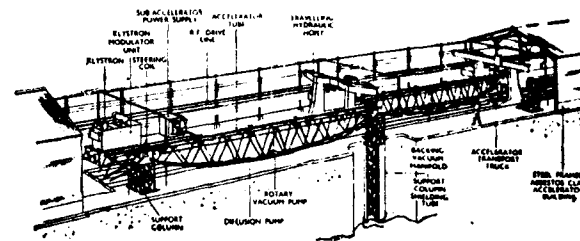
ATOMIC particles which carry an electric charge, such as electrons, are amongst others used to explore the nucleus of the atom. Electrons are also used to produce penetrating X-radiation and to bring about physical and chemical changes in a wide variety of materials. For all these purposes it is necessary to give the electrons high kinetic energy. This is done by accelerating them to high velocity. In many cases the velocity reached is so close to that of light that further acceleration results in an energy gain which is evidenced, according to the relativistic concept, as an increase of mass of the electron.

The electron, in common with other charged particles, can be accelerated by the force which it experiences in an electric field. The energy it gains in this field is directly proportional to the potential difference through which it travels and has come to be expressed in terms of this potential difference. It has become customary to speak of an energy of so many electron volts (eV). In the high energy range a million or a thousand million electron volts (MeV or BeV) is a convenient unit.

A simple example of an electron accelerator is provided by the familiar X-ray tube. Here electrons are given energies of tens or hundreds of thousands of electron volts in the field produced by a steady direct potential applied across the tube. The product of this potential (volts) and the electron current (amperes) gives the power (watts) available in the stream of electrons. This power is drawn from the generator which supplies the potential.

There is a practical limit to this form of accelerator due to the difficulties encountered in the insulation of potentials in excess of a few million volts. The essence of high energy accelerator is the increase of energy well beyond this limit without the use of a very high potential. This is achieved, in the cyclotron and synchrotron, by constraining the particle to move

along a spiral or circular path and so through the same relatively small potential difference several times. In the linear accelerator the particle is caused to move along a straight line through a succession of small potential differences or, alternatively, accelerated in a continuous manner by the electric field of a radio wave moving with the particle at the same velocity. Here, the electron power is derived from the radio wave and hence from the radio frequency power source. This machine—the travelling wave linear accelerator—has found particular application to the acceleration of electrons.



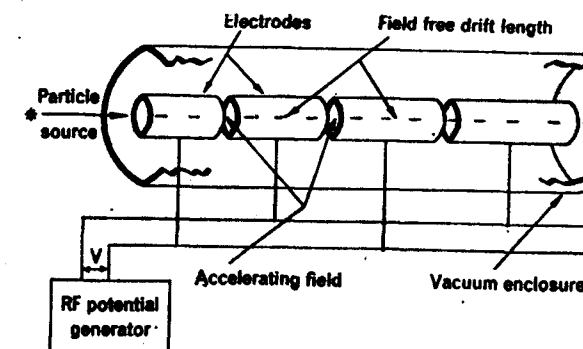
The particular advantage of the linear accelerator is the ease with which sufficiently large numbers of particles may be injected into and extracted from the machine. This is an advantage not shared by the circular accelerator. Further, the only limit to the energy which can be achieved is set by the physical size and cost which increase more or less linearly with energy, whereas, in the circular machines at energies of 5 to 6 BeV the motion of electrons in a circular orbit results in considerable energy loss by radiation. This loss is, of course, reflected in the cost of the equipment which rises steeply at this point and the circular electron accelerator becomes very unattractive.

It is necessary, in all accelerators, to evacuate the region in which the particles are accelerated in order to avoid energy loss and deflection of the particles by collision with gas molecules.

* Reginald J. Beadle author of this article, is a graduate of the Royal College of Science and served a four year apprenticeship to electrical engineering with Metropolitan-Vickers Ltd. Later, with the same company, he was engaged in high voltage research, and development of the electron microscope. From 1954, with the Mullard Research Laboratories, he was concerned with the design and development of linear electron accelerators, especially those applied to radiotherapy and industrial radiography. He joined the Vickers Group in 1957 and is with Vickers Research Ltd.

LINEAR ACCELERATOR HISTORY

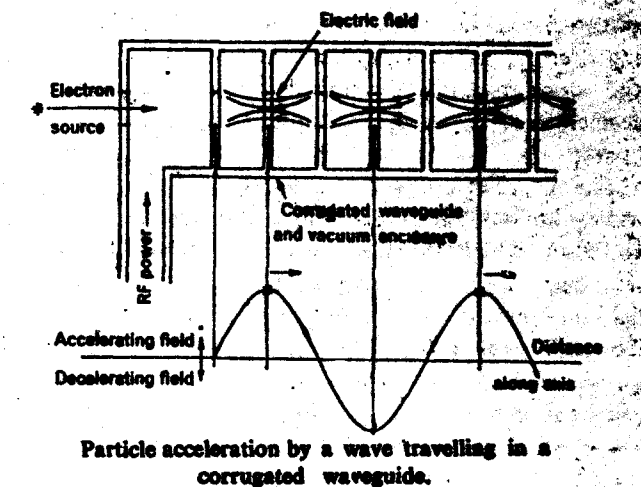
The forerunner of the modern accelerator was investigated by Wideroe in 1928 and further developed by Sloan, Lawrence and Coates between 1931 and 1934. This work is the first example of successive linear acceleration. The particles move along a tube through a series of accelerating fields set up between tubular electrodes. These electrodes are connected alternately to opposite terminals of an oscillatory potential generator. The frequency of the generator and the lengths of the electrodes are so arranged that during negative half cycles when the field would retard the particles they are travelling in the electrode tubes and are shielded from this field. As the particle velocity increases during the transit of the tube it is necessary to increase the electrode length in order to maintain the correct time interval during which the particles are shielded. This time interval and the electrode lengths are directly related to the time of reversal of the generator polarity. It follows, then, that if high energy is to be gained in a reasonable length of tube the generator must operate at high



An early form of particle accelerator.

frequency and, further, it must set up strong fields between the electrodes. The latter implies that it must supply considerable power and that the high frequency losses in the electrode system must be small. At the time of the early experiments at frequencies of a few megacycles/second powers of only a few kilowatts were available. It was not until the second World War that really promising radio frequency power sources made an appearance. These valves (magnetrons) were developed for radar and gave megawatt pulses of power at frequencies of the order of 10^9 cycles/second and together with the new high frequency (microwave) techniques gave promise of practical linear electron accelerators.

Two possible microwave versions were considered and developed; in one, the radio frequency power



is supplied to a series of resonant cavities set up along the particle path. The resulting electric fields in the cavities are so phased that the electron always sees an accelerating rather than a retarding field during the transit of the system. The second solution, a travelling wave accelerator, uses a special waveguide to carry the radio frequency power. This power is carried in a mode that gives rise to an axial electric field and is, therefore, suitable for acceleration of particles along the axis. By careful control of the parameters of the waveguide it is arranged that the velocity of the field is equal to the electron velocity at all points along the axis. The electrons are grouped at points of maximum accelerating field and are subject to this field during the whole of the transit of the tube. The energy gain is then simply the product of this field and the path length.

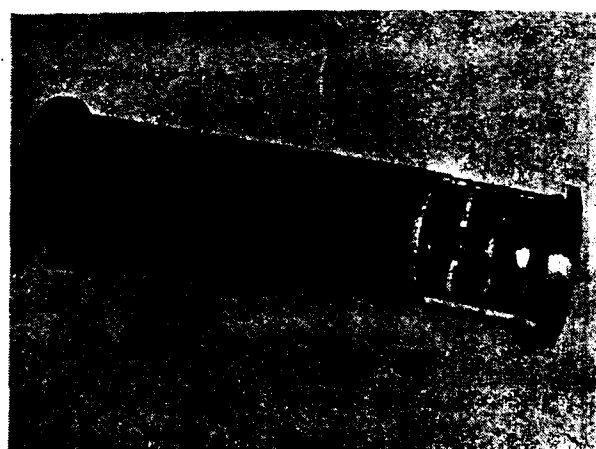
Accelerators of both types were closely investigated shortly after the war. The work of Fry, Walkinshaw, Mullett and Shersby-Harvie which started at the Telecommunications Research Establishment in the United Kingdom, and of Hansen, Ginzton and Chodorow at Stanford University in America, provided a design basis for most of the travelling wave linear electron accelerators which have since been applied to research, the treatment of cancer, industrial radiography and materials processing. Machines of this kind have been developed in this country by Bareford and Kelliher, new both of Vickers Research Limited, at the Mullard Research Laboratories and by Miller and others of Metropolitan-Vickers.

MODERN DESIGN

The design and construction of present day electron linear accelerators involves a considerable variety of skills and techniques. Included are those

of precision mechanical engineering, light structural engineering, vacuum practice, microwave engineering, and some recently developed skills associated with accelerators.

The heart of an accelerator is the special tube or waveguide which carries the radio frequency power and along which the electrons are accelerated. If the waveguide design is such that the travelling electric field is constant along the axis, as is desirable, then the energy gain V of the electrons in L metres of guide supplied with W watts of radio frequency power can be shown to be given by the simple expression: $V = \sqrt{WLZ(1-\mu-n)}$ where μ is equal to the fraction of the radio frequency power which flows to waste at the end of the accelerator, n is the fraction of the radio frequency power converted to electron power and Z is the shunt impedance of the guide. This is a measure of the electric accelerating field



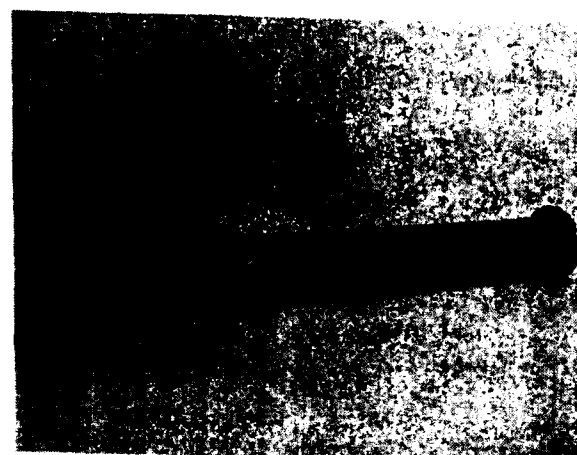
A short length (part sectioned) of 3 in. diameter corrugated waveguide for operation at 2,856 Mc/s.

associated with the radio frequency wave in the waveguide for a given power loss, which appears as heat, in the waveguide walls.

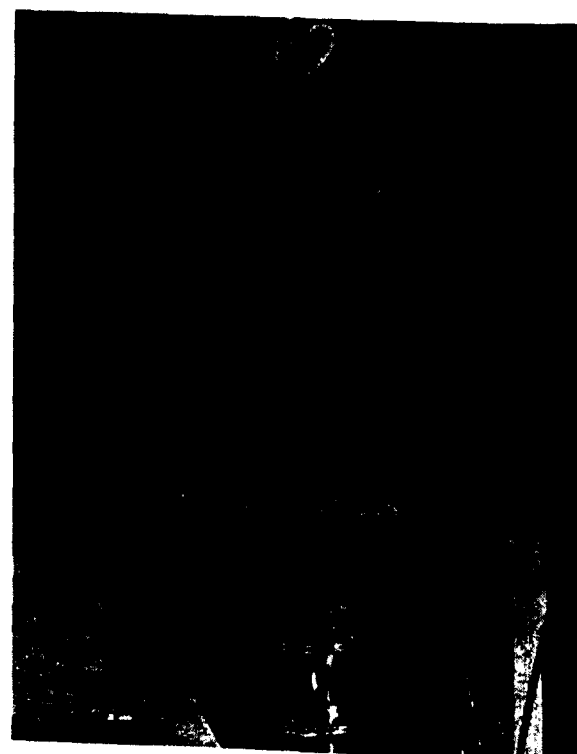
It is seen from this expression that length may be traded directly for both power and shunt impedance. Now the latter increases as the square root of the operating frequency so it is clearly desirable that for high energy gain in a short length the frequency should be as high as possible consistent with the availability of a suitable power source. These power sources are normally switched or pulsed on for periods of only a few microseconds several times every second. It is in this way possible to operate at very high power during the pulse with only moderate average power.

The energy gain is, however, seldom the only criterion—often the emphasis is upon a high average current of high energy electrons. The production of such a high power electron beam requires high average radio frequency power which is more readily available at lower frequencies.

Practical designs operate in the frequency range of 500 to 10,000 Mc/s. Most of the existing machines are grouped around 3,000 Mc/s and employ between

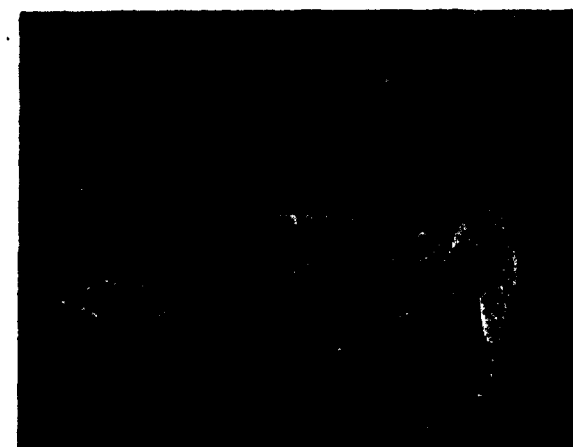


The junction and water jacket of a one metre length of corrugated waveguide.



20 MW 3,000 Mc/s Klystron amplifier in development at Vickers Research Ltd.

one and twenty magnetrons or klystrons each delivering between one and twenty megawatts of pulse power. The pulse duty cycle, the product of pulse length and repetition frequency, denotes the ratio of average to pulse power available and is usually in the 10^{-3} to 10^{-4} region being governed by the limitations of the particular power source.



The Vickers 4 MeV accelerator for radiotherapy.

For operation of 3,000 Mc/s the accelerator waveguide is about three inches diameter and carries 'loading' irises at one inch intervals. The dimensions of the guide and irises control the velocity and magnitude of the accelerating field. The dimensional tolerances which apply to the inside of this structure are of the order of 0.0001 inches. Various alternative techniques have been applied to the constructions of this guide including:

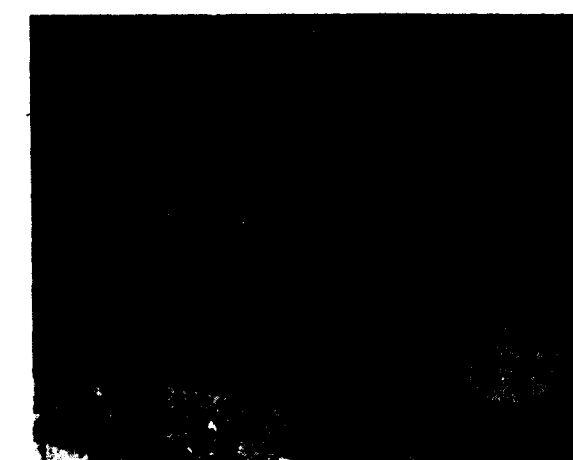
- 1 Machining and hard soldering of copper 'cups' or of copper discs and cylinders.
- 2 Shrinking of copper discs into a copper tube.
- 3 Compression stacking of copper discs and cylinders with plated indium joints.
- 4 Electroforming of a copper cylinder over a stack of copper discs and aluminium spacers—the latter being subsequently etched away.

An electroforming process which produces good quality, oxygen free, high conductivity copper has been developed at Vickers Research Ltd. and it is found that the fourth method of guide manufacture is the most satisfactory in that it leads to minimum dimensional change of the machined components

coupled with excellent vacuum and radio frequency properties.

The radio frequency power loss in the walls of the waveguide results in a temperature rise. This must be restricted to a few degrees to avoid significant dimensional changes—which result in field velocity changes—during operation. The most simple and effective control is obtained by water jacketing the waveguide. This jacket also provides mechanical support for the waveguide which, in a typical case, is made in one metre lengths. Several such units coupled together and provided with vacuum pump and radio frequency waveguide connections form a complete accelerator or sub-accelerator tube. This, together with vacuum pumps is mounted on a lattice girder framework which provides the required mechanical stability and also sufficient rigidity for transportation as a complete vacuum sealed unit. Further, in a large accelerator, such an assembly allows for rapid service replacement of a complete sub-accelerator.

The velocity of an electron is almost constant and equal to the velocity of light once the energy is in excess of a few million electron volts. This is rather convenient in that a high energy accelerator may be formed by a series arrangement of a number of identical sub-accelerators.



Oil immersed 100 MW pulse modulator.

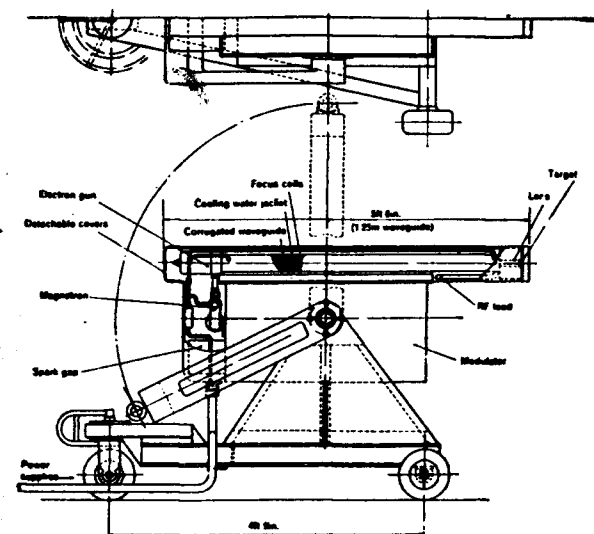
The length of, and power feed to, the individual sub-accelerators is determined from an economic stand-point by equating the cost of the power source to that of the sub-accelerator and all other items whose cost is proportional to length. A length of twenty metres is allied with a pulse power source of twenty megawatts in the design study of multi-B₂V

linear electron accelerators carried out at Vickers Research Limited. Other considerations—particularly those of maintenance and available space modify this conclusion both above and below the 5–30 BeV energy range.

POWER SOURCES

For relatively low energy, low power machines such as are used for radiotherapy and industrial radiography the magnetron oscillator, associated with a ferrite isolator in the waveguide feed, is a satisfactory and inexpensive radio frequency power source. The isolator absorbs any power which may be reflected back from the accelerator, particularly at the start of the power pulse, and which would otherwise disturb the operation of the magnetron. Almost all high energy designs that demand greater pulse power than is available from a single valve however, are based upon the use of klystron amplifiers driven from a single oscillator.

During the last few years amplifier development has shown that a larger power output per valve is available than from a magnetron and, moreover, when a single driver is used, the phase and frequency of the output of each valve are automatically synchronised. This ensures that the acceleration conditions in each sub-accelerator, once set, remain correct from this viewpoint.

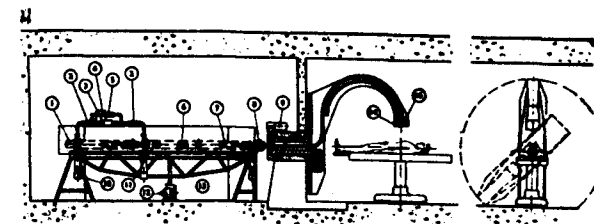


4 MeV accelerator for industrial radiography.

A high power, 3,000 Mc/s klystron amplifier is being developed at Vickers Research Ltd. The power target is twenty megawatts pulse, five kilowatts

average, with a power gain of 50 to 60 decibels and an efficiency of 40 per cent.

The supply voltage required by these valves ranges from tens of kilovolts for magnetrons to hundreds of kilovolts for klystrons. Pulse length of a few micro-seconds and repetition rates of fifty to one thousand per second are used. The modulators which provide



A 35 MeV accelerator for electron therapy: 1. Electron gun. 2. Waveguide window. 3. Phase shifter. 4. Klystron. 5. Power monitor. 6. Three one metre lengths of waveguide with stainless steel water jacket. 7. RF load. 8. Rotary vacuum seal. 9. Motor and gear box. 10. Diffusion pump. 11. Low impedance coils wound over water jacket. 12. Rotary vacuum pump. 13. Modulator. 14. Detector for servo centring. 15. Scanning coils.

these pulses are basically similar to those of a radar set. In application to accelerators careful design is necessary to ensure that the pulse amplitude is constant to within close limits so as to avoid radio frequency power variation and consequent changes of electric accelerating field and therefore of electron energy.

Recent development at Vickers Research Ltd. has shown that high power modulator design can be effectively 'miniaturised' by elimination of individual component tanks and by oil immersion of all components and connections in one tank. A reduction in volume by about a factor of ten is achieved in this way.

A four hundred kilovolt, one hundred megawatt pulse modulator has been constructed in this form to serve the klystron development programme. A slightly smaller version of this is used to power a 100 MeV, twenty metre long accelerator which is in construction in the form of a sub-unit of the Vickers multi-BeV design. In this case the klystron is also oil immersed in the modulator tank and replaces the four hundred kilovolt bushing on the test modulator.

This form of modulator/klystron assembly is particularly attractive in a multi-BeV design as it makes service replacement of these major units a very reasonable proposition. This must be the

aim in such a design if the operation/maintenance duty factor is to be high.

DESIGN AND APPLICATION

The most recent example of high energy accelerator design is that of Stanford University, USA who propose to construct a two mile long, 45 BeV linear electron accelerator as a physical research tool. Mention has already been made of the Vickers design study of a similar machine which could be a practical proposition in the United Kingdom.

Moving towards the lower end of the energy scale around 10–100 MeV, linear accelerators find application as injectors for high energy orbital machines and as accelerators in their own right in the physical research field.

Increase of interest in linear electron accelerators for radiotherapy is evidenced by the recent determination of the Ministry of Health to equip all the regional centres with 4 MeV X-ray machines. The Vickers design for this duty takes full advantage of the recent advances in magnetron and accelerator technology to minimise the size, weight and cost of the equipment and to reduce the demand for skilled attendance. For instance; the one metre long accelerator waveguide is 'sealed-off' so eliminating the need for a vacuum pumping system. Intended to serve the same field is a 12/36 MeV design for direct

electron therapy. The advantages of the isocentric mounting of the 4 MeV machine are retained here by deflection of the electron beam through 270° in a combined gantry/magnet which is able to rotate about the axis of the accelerator. The klystron/modulator unit is identical to that of the multi-BeV design.

Closely associated with the 4 MeV medical machine is an accelerator for industrial radiography. This unit employs the same accelerator tube, power supplies, &c., as the medical machine in a mounting which provides for suspension from the shop crane at any angle. Limited angular movement is possible when mounted on a trolley on the floor. High resolution radiographs of steel twelve inches thick may be obtained in less than one hour with this equipment.

A further industrial application is exemplified by a medium power, processing accelerator. An electron power of five kilowatts with an energy of 10 MeV is available for sterilisation of pharmaceutical products, pasteurisation of foodstuffs, irradiation of plastics, hydrocarbons, &c. Although materials irradiation is still in the early stages of investigation and development it is worth mention that the technology exists for the design and construction of linear electron accelerators capable of yielding continuous, megawatt beams. Such design could, when required, be applied to large scale radiation processing.

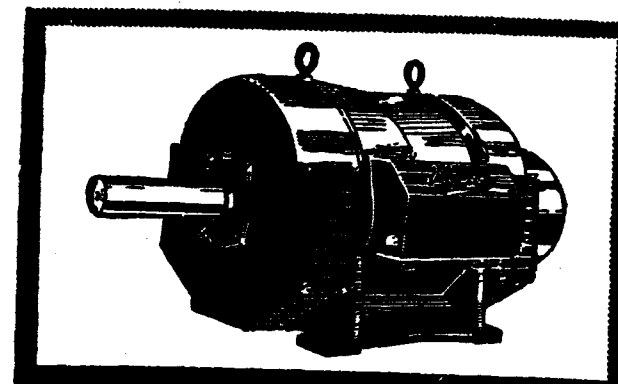
(Courtesy: "The Vickers Magazine".)

Growing German Demand for British Diesel Engines

Nearly 30,000 Perkins diesel engines have been sold to Germany in the last seven years. They have been bought by leading German manufacturers for use in their products on the German home and overseas markets. The firm say that the growth of their activities in Western Germany dates from 1953. In that year, the Peterborough organisation supplied about 200 four-cylinder agricultural diesel engines to Gobr Class Maschinenfabrik, of Harzewinkel, for installation in combines.

Since then, sales in Germany for agriculture, vehicle

industrial and marine applications have increased eight-fold. Although the Class organisation continues to be Perkins' largest German customer—it took many thousands of Peterborough-made engines in 1959 and has placed larger orders for delivery this year—many more leading agricultural and industrial machinery manufacturers are now offering Perkins diesel engines as first equipment. The chief factors which have led to this sales record in the birthplace of the diesel engine, are the price and economy of Perkins engines and the company's reputation for world-wide after-sales service.



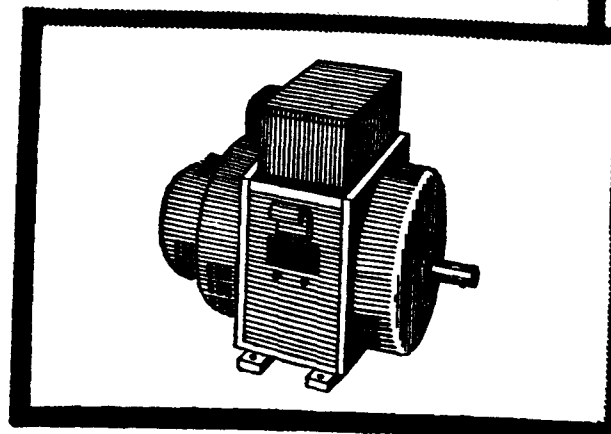
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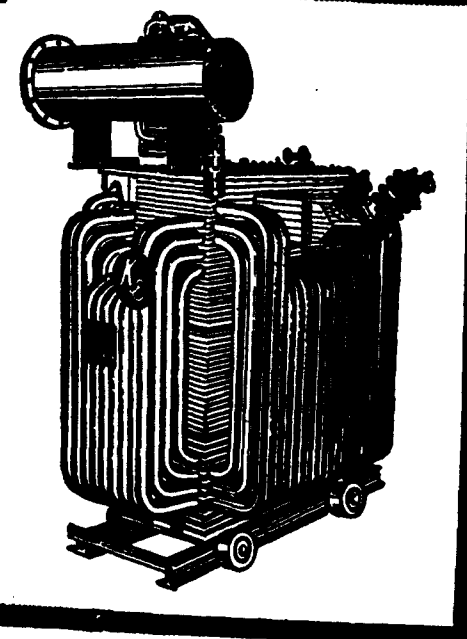
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BOMAS-216

A NEW TYPE OF ELECTRO-POLISHING INSTRUMENT AND ITS APPLICATION

By Rolf Zetzsche

Berlin—G. D. R.

[This contribution by Rolf Zetzsche, our late scientific Departmental Manager, was first published in "Kleppig Fachberichte für die Berg-, Hütten-, Metall- und Maschinenindustrie" (Kleppig Professional Reports for the mining, smelting, metal and machinery industry) Journal 7/1957, Kleppig-Verlag, Düsseldorf.]

INTRODUCTION: Under the term, "electrolytic polishing", also sometimes called "anodic polishing" or "anodic brightening", the deliberate anodic abrasion of a metal surface under clearly defined test conditions is understood. The main conditions affecting this polishing process are the composition and temperature of the electrolyte, the applied voltage, anodic flux density and motion of the electrolyte. The existent literature on electrolytic polishing has already become so extensive that it is advisable to refer to it in collective reports. (Benninghoff, Tegart.) The extensiveness of the literature is due to the fact that the processes in electrolytic polishing depend on many factors and are therefore not always clearly appreciated.

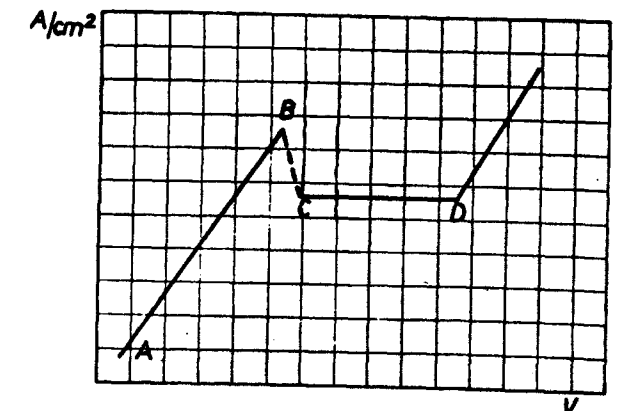


Illustration 1. Current-density voltage curve (diagrammatically)

The first known publications in this field date back to 1907 and 1910. In 1907, Ernst Beutel published an article entitled: "A substitute for hand polishing of gold articles" in a "Veröffentlichung der chemisch-technischen Abteilung des k. k. Lehrmittelbüros für gewerbliche Unterrichtsanstalten" (Publication of the chemico-technical Dept. of the imperial and royal educational aids office for trade teaching institutes), Vienna. This electro-polishing of gold articles suggested 50 years ago received no further attention from the profession and was at first forgotten. The first German patent on electro-polishing was granted to Eugen Spitalsky in 1910, valid from the 25.3.1909 under DRP No. 225 873. After these two works, the studies of Jacquet and his colleagues deserve special mention. Jacquet carried out electro-polishing on nickel, aluminium and copper in 1929. From that date onwards this field was ever increasingly, and subsequently more systematically, investigated. Jacquet had already endeavoured to develop quantitative ideas as to what were the condi-

tions under which electro-polishing can be carried out. He ascertained the basic dependence outlined in Illustration 1 of the anodic density of current A/cm^2 and bath-voltage V . Three ranges of curves can be distinguished. Within the range A—B no brightening of the metallic surface takes place, but rather a greater or lesser etching. The proper brightening effect can be noticed only in the horizontal part of the curve C—D, whilst from D onwards abrasion with a simultaneous evaporation of gas on the anode takes place. As during brightening, i. e. within the range for the part of the curve C—D, the formation of a liquid, viscous, and in some cases a coloured film was observed on the surface of the anode, this anodic film was regarded from the very beginning as a characteristic and significant feature of the polishing process. A further characteristic property of electrolytic polishing is the considerable removal of minute elevations up to the almost complete smoothing of the surface of the anode. This means that the "peaks" have preference over the "troughs" in the removal from the micro-surface

profile on the anode. This could be initially explained by two possibilities:

1. The elevations of the surface ("peaks") are removed for preference, because within the anodic film the gradient of the electric field which is greater at the "peaks" results in a stronger concentration of ions and thus in a greater speed of disintegration.
2. Above the peaks the thickness of the anodic film will be thinner than above the "troughs". The film having a considerably lower specific conductivity than the electrolyte, the direct-current resistance above the elevations is lower so that with a stronger current more material is removed.

Without going into theoretical details of the electropolishing process, it should be mentioned that both these ideas have certainly contributed positively towards present-day beliefs. A number of considerations, however, still require debating if the electropolishing process is to be explained and thus quantitatively mastered.

Description of the Polishing Instrument: Very soon after the experiments carried out by Jacquet had become known, endeavours were made to apply electropolishing for metallographic purposes. These experiments were successful. Various firms tried to design instruments for electrolytic polishing in metallography to meet the ever increasing demands of metallographers. Several of these instruments have proved successful, last but not least the "Disa Elektropol" designed by Struers, Copenhagen. This instrument and others make electropolishing possible if a certain condition is observed. According to the qualification of the user a certain source of uncertainty naturally results from the degree for better or worse to which this "prescription" is adhered to.

In order to eliminate this factor of uncertainty, VEB Carl Zeiss JENA have built an electro-polishing instrument to the specification laid down by the author whereby it is possible to observe microscopically the surface to be polished in the course of the polishing process. The instrument can be seen in Illustration 2. It consists basically of two parts, the actual polishing instrument, including the microscope, and the power unit. With this, the voltage applied can be continually varied thus enabling the user to



Illustration 2. Electro-polishing Instrument made at Jena.

observe the test and simultaneously to set the voltage most favourable for the electro-polishing process. The density of the current-voltage curve, as diagrammatically shown in Illustration 1, can thus be traversed and the most favourable values ascertained by means of microscopic observation. In addition, it is possible to continually vary the velocity of flow of the electrolyte by means of the power unit. Observation is carried out with an approx. 210 times magnification using the lens system Apochromat $15 \times / 0.30$ and the eyepiece K 15 xe. Microscopic observation is carried out in bright-field incident-light illumination. The "MF" photomicrographic device can be attached and the processes occurring during polishing recorded photographically either on a plate size $6\frac{1}{2} \times 9$ cm or on miniature film whilst still observing at the same time. The electrolyte pumping unit is incorporated within the instrument and is designed in such a manner that the electrolyte can be changed very quickly.

During operation the polishing instrument is completely closed so that the user cannot come into contact with the electrolyte or the live parts. The polished surface is circular and of a diameter of 6 mm. This dimension was chosen, as it is sufficient for most cases occurring in metallography. If it is desired to examine larger areas, several such circular surfaces on the testpiece will be polished. To prepare the testpiece, it is sufficient to sectionally polish a flat surface, as is usual in metallography.

The degree of roughness of the polished section depends on the demands placed on the structure to be produced. A degree of roughness produced by an emery paper grain of 120 or 220 is sufficient. For finer work, it is usually sufficient to use up to grain size 0. With the height of a testpiece of approx. 30 mm, the largest testpiece diameter can be approx.

100 mm. If the diameters are smaller, approx. 70 mm, testpieces can be fixed up to a length of 100 mm.

The power unit is provided for 220 Volts A. C. and permits variable control in the pumping unit and also the electrolysis circuit. Suitable measuring instruments provide an opportunity for reading the optimum polishing values obtained and to apply them, if required, to large-scale experiments. The power unit is connected by means of a cable to the actual polishing instrument.

Application of the instrument: On hand of the current-density voltage curve reproduced in Illustration 1 it is now intended to demonstrate the adaptability of the instrument. We wish to describe how electro-polishing of α -brass is carried out when traversing the current-density voltage curve whilst simultaneously observing microscopically the polishing process. At this juncture, it should be mentioned that when polishing α -brass in a phosphoric acid electrolyte, the current-density voltage curve was actually measured in the manner shown on the diagram (Illustration 1).

The original state of the surface to be polished can be seen in Illustration 3. The voltage between cathode and anode is at first arranged to be within the CD range of Illustration 1. After switching on the current, the ground surface is coated immediately by a dark skin breaking after a short period into larger or smaller ragged pieces which are carried away by the flowing electrolyte (see Illustration 4). The surface to be polished keeps on brightening and the polishing grooves flatten quickly as can be easily discerned on Illustration 5. Once the surface is smooth, the voltage can, for instance, be reduced by continuous regulation and grain boundary etching be



Illustration 3. Polished brass surface, final magnification 400 x.

produced (see Illustration 6). If a grain surface etching is required, the voltage is still further reduced and there is the possibility to interrupt the entire process at a suitable etching stage. Illustration shows an image of a structure thus produced.



Illustration 4. Commencement of electro-polishing of brass, final magnification 400 x.



Illustration 5. Planing of grooves in the course of electro-polishing, final magnification 400 x.

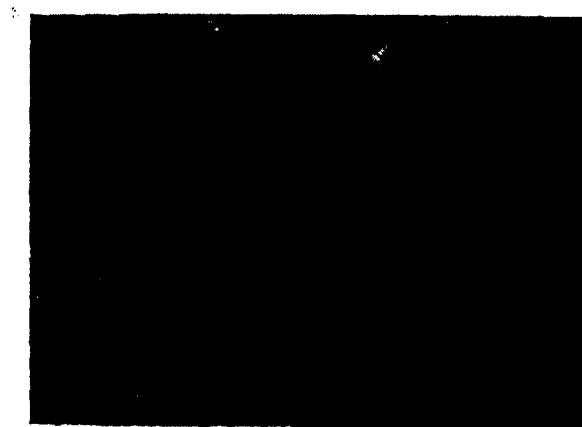


Illustration 6. Slightly etched α -brass, 400 x.

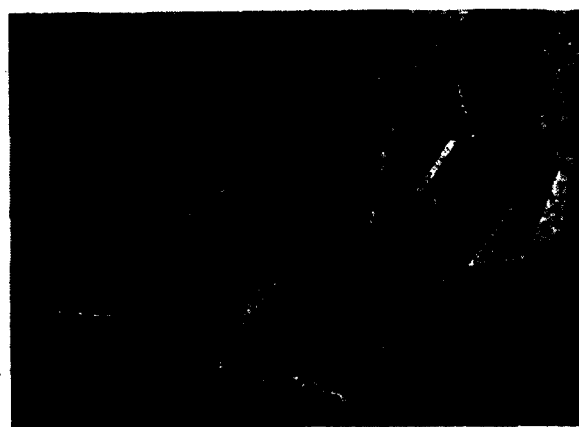


Illustration 7. Strong etching of grained surface in α — brass, 400x.

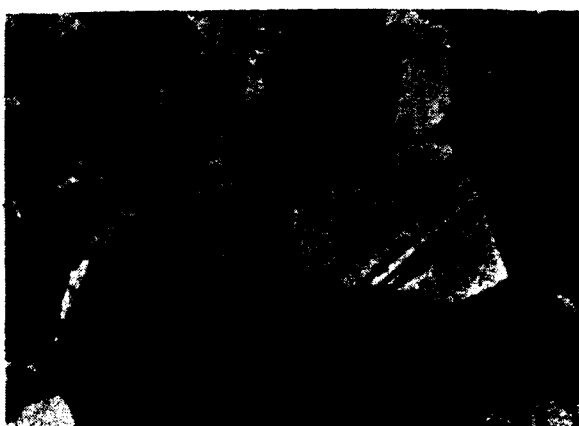


Illustration 8.



Illustration 9.

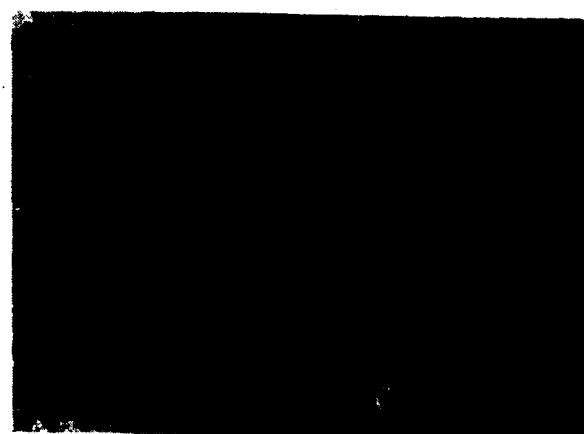


Illustration 10.



Illustration 11.



Illustration 12.

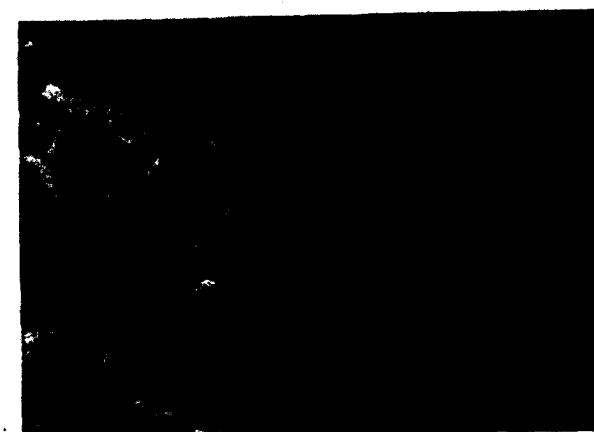


Illustration 13.



Illustration 14.

(Illustration 8 to 14. Except for giving the magnification, all is obvious from text. Final magnification 400 x)

During etching we are within the AB-range of the current-density voltage curve. If the etching was excessive (overetching), a "non-selective" abrasion can again be produced by increasing the voltage. Thus, a smooth surface is obtained, i. e. the testpiece does not have to recuperate, but all processes can be carried out at short intervals. Illustrations 8—11 may serve as examples. In Illustration 11 the surface of the testpiece still shows some relief, but is almost smooth.

If the voltage is increased up to point D, oxygen is separated off at the anode and undesirable pittings occur, as clearly shown in Illustration 12. This voltage range should therefore be avoided.

Not all current-density voltage curves have the course diagrammatically shown in Illustration 1. Many of these curves are almost linear, i. e. the horizontal section of the curve visible in Illustration 1 is either

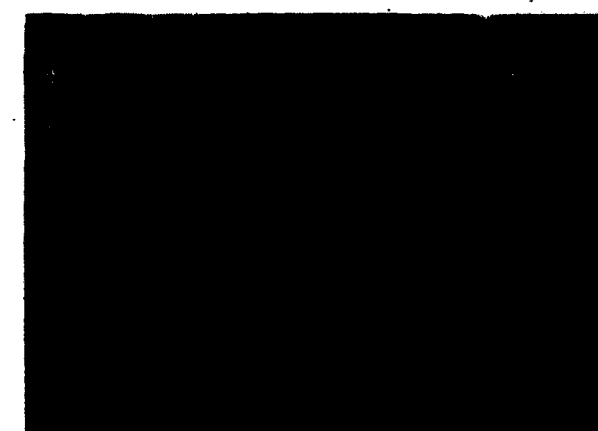


Illustration 15.

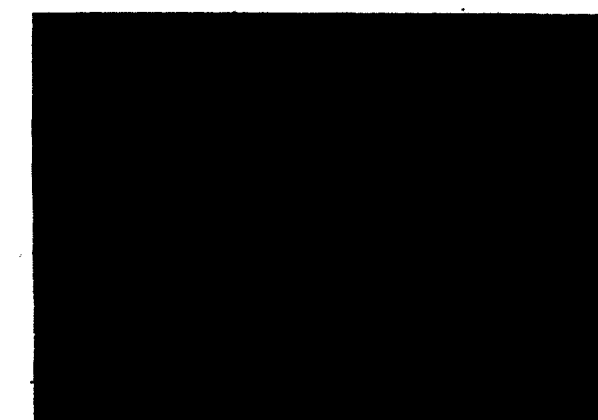


Illustration 16.



Illustration 17.

(Illustration 15 to 17. Except for giving the magnification, all is obvious from text. Final magnification 400 x)

just noticeable or not present at all. With such a current-density voltage curve it is usually possible to polish or brighten with the simultaneous occurrent generation of oxygen. Illustrations 13—17 may serve as examples of this, illustrating the electro-polishing of

ckel. When switching on the voltage within the polishing range, a dimple-like structure is initially seen (see Illustration 13) getting gradually flatter, until the brightly shining surface visible in Illustration 17 appears. If a metallographic test is to be taken,



Illustration 18. Strong etching of grained surface in nickel, 400 x

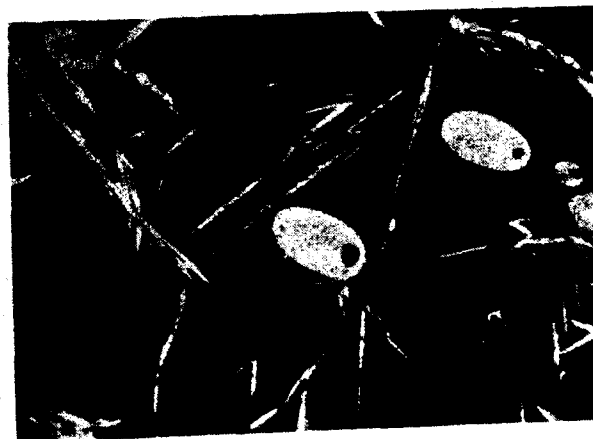


Illustration 19.



Illustration 21.

etching, can be carried out with a lower voltage. Illustration 18 shows the structural image thus obtained.

Illustrations 19—23 are intended to demonstrate the electro-polishing effect on tool steel (it was heat-treated, and quenched in water to obtain coarse needle martensite and residual austenite). Illustration 19 shows some tetragonal martensite in a lot of residual austenite etched more or less normally. If this etching is to be made to disappear, an appropriately adjusted polishing voltage should be used. Via intermediate stages (Illustrations 20, 21 and 22) the condition of the surface as shown on Illustration 23 is obtained. The same spot was photographed always during polishing.

Electro-polishing is more important for soft metals than for hard metals. How essential it is to prepare the test accurately in order to obtain a perfect physical result may be shown in the example of

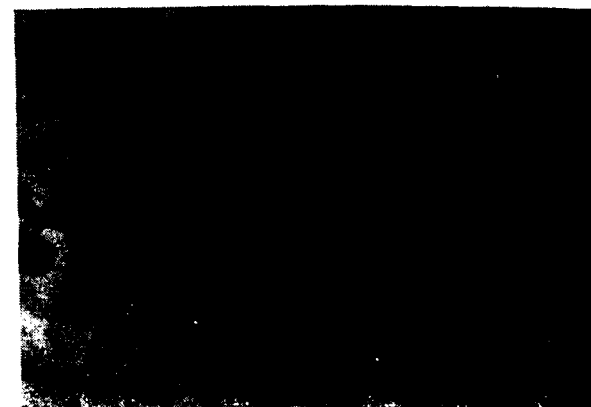


Illustration 22.

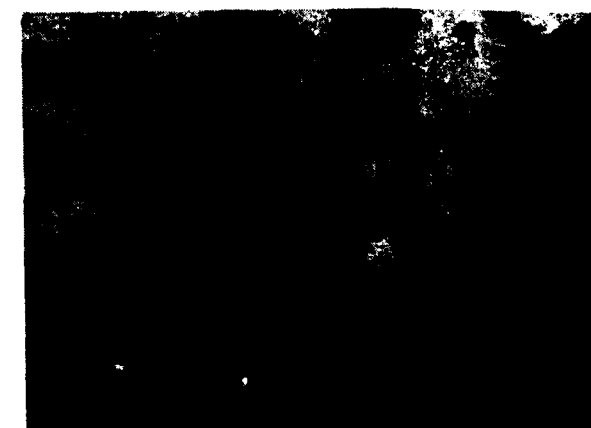


Illustration 23.

(Illustration 19 to 23. Except for stating the magnification, all is obvious from text. Final magnification 400 x)

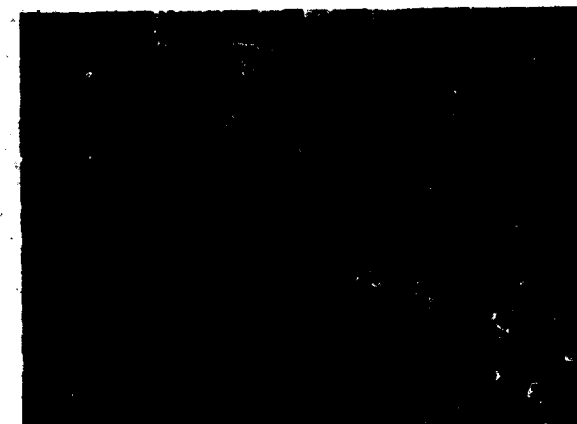


Illustration 24. Surface domain of tin, 125 x.



Illustration 25. The same spot on the tin testpiece as on Illustration 24, after 0.15 mm had been anodically removed, 125 x.

“tin”. Illustration 24 and 25 demonstrate the same spot on the testpiece. Illustration 24 was taken approx. 5 seconds after the switching on of the polishing process. Polygon-shaped crystals can be discerned lying close to the surface of the testpiece, illustrating the structure formed by the polishing process. If polishing is continued, the structure shown in Illustration 25 appears approx. 0.15 mm below in original surface of the testpiece already more closely approximating the real structure of the casting. (The visible twins have been added artificially by producing the “tin cry”). In actual fact, this example demonstrates that the method of preparation is not immaterial in metallography, if perfect physical evidence is to be obtained.

Final conclusions: As the reader will have been able to deduce from the above remarks, the electro-polishing instrument described is not only suitable for producing satisfactory metallographic etchings, but serves generally for exploring all surface processes

in the course of electro-polishing. Additionally, the most favourable polishing or brightening conditions can be speedily and unequivocally ascertained with this instrument without having to compile a current-density voltage curve. The possibility of carrying out simultaneous microscopic observation, permits, furthermore, immediate information as to the suitability of the electrolyte used and the quality of the material to be polished. Furthermore, economical polishing resulting from the process can be reliably ascertained from the degree of roughness.

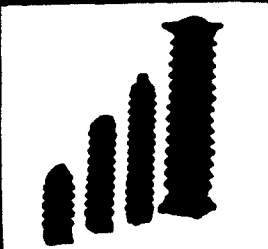
At this juncture, it is not intended to emphasize again the special advantages of electro-polishing; this has been already done at various times in the literature. Only one point should be emphasized: the above described electro-polishing instrument is a new venture in electro-polishing, as with the assistance of microscopic observation of the polishing processes an increased knowledge hitherto impossible is obtained. This applies equally to pure research and to the technological problems arising in surface treatment. To the technician, economic problems will also be of some importance. The above-described instrument enables him to test quickly and reliably the efficiency of polishing baths, quality of materials and polishing instructions.

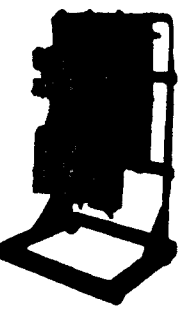
Summary: An electro-polishing instrument has been described which makes it possible to follow the polishing process microscopically. The applications of this instrument have been demonstrated by several examples, especially with regard to metallography. From all this, the conclusion can be drawn that this instrument will also be applied, in a subsidiary process, where electro-polishing is used for surface-coating processes.

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NEW AUTOMATIC MACHINERY FOR COLOURED CONCRETE ROOFING TILE MANUFACTURE

By Adrian Seligman

LONDON

*A thousand million concrete tiles per year now made
on Adams Powel machines throughout the world*

A NEW factory for the production of coloured concrete roofing tiles to be erected near San Francisco by *Jaywoth Permaroof Inc.* will be one of the most modern installations of its kind in the world. The automatic machinery for the production of the tiles is to be made by *Adams Powel Equipment Limited*, of Gateshead-on-Tyne, England. The supply of this machinery will be financed by *Tile Development Ltd.*, a company recently formed by Mr. W. S. Powel to promote the sale of British machines for the production of the modern concrete tile in America.

FULLY AUTOMATIC PROCESS

The plant will be fully automatic and will consist of a "U"-form conveyor system 70 feet long and 10 feet wide, on which oiled aluminium pallets carrying the freshly made tiles will pass through the different machines at 60 per minute.

The tiles will be untouched by hand until they are finished and ready for the stockyard; the pallets will never be touched. As a result, the labour content of the tiles can be reckoned at 1/3 man-hour per 100 super feet of roof.

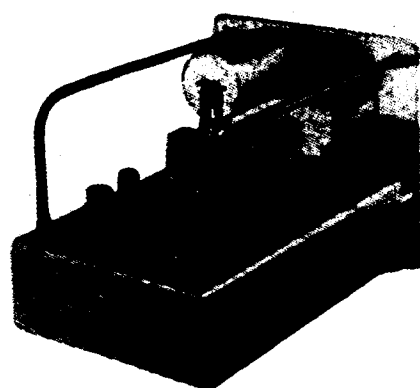
TWO NEW MACHINES

The factory will produce interlocking tiles of the "Chateau" pattern, designed to have a covering capacity of exactly 100 tiles per hundred square feet, so as to facilitate costing and measurement. They will be finished in a semi-glaze, similar to that used with such success on Australian concrete roofing tiles.

In addition, two electrically driven semi-automatic machines which embody a new principle at present

This photograph shows "Double Roman" tiles as they leave the tile-making machine after extrusion through the die. The two circular "bacon slicer" knives are trimming the edges of the tiles down to the actual width of the pallet which has also passed through the die. The tile on the extreme right of the photograph has now reached the two wire cables on which it will travel through the finishing process.

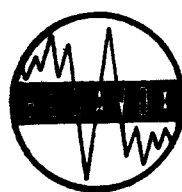
being developed by Adams Powel Equipment Ltd. will be installed for the production of special shapes, such as ridge, hip and valley tiles.



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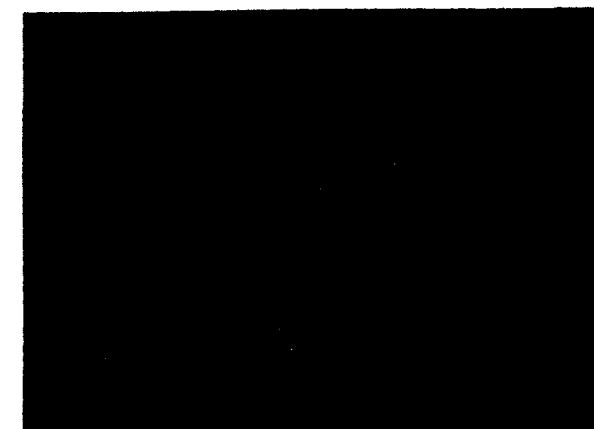
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A type ITM. 120 machine, capable of producing 2,000 15" x 9" (38,1cms x 22,9 cms) Marseilles pattern Interlocking tiles every hour. This machine can be used as a stationary fixture or can be mounted on rails. In the first case it discharges the tiles on to a conveyor or to the finishing process, the empty pallets being brought to the machine on a conveyor and placed into a magazine; in the latter case the machine, which discharges the tiles into the drying racks, moves along rails adjacent to the racks during the process.

ONE THOUSAND MILLION TILES PER YEAR

It was recently calculated that at least 1,000 million tiles per year are now being made throughout the world on Adams Powel machinery, and this figure will increase annually. During 1959 alone, 8 new concrete tile-making works in West Germany were equipped by the Company, while 2 plants were recently shipped to Bulgaria and 2 to Australia.

Belgium, Holland, Malaya, Burma, Israel and most parts of Australia and Africa are among other areas to which Adams Powel tile-making machinery has been supplied.

EXPANDING MARKETS

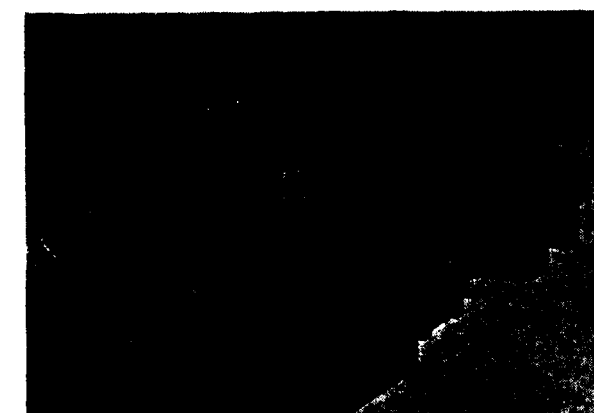
Mr. W. S. Powel, the Company's General Manager, who recently returned from a three months tour of Australia, intends shortly to visit Spain and other areas. His main purpose will be to negotiate agreements with well-established engineering firms in each country, whereby the basic structures, including the conveyor systems of the plants, would be built locally, while specialised machines required for the different stages of the process would be supplied from Britain.

THE PROCESS IN DETAIL

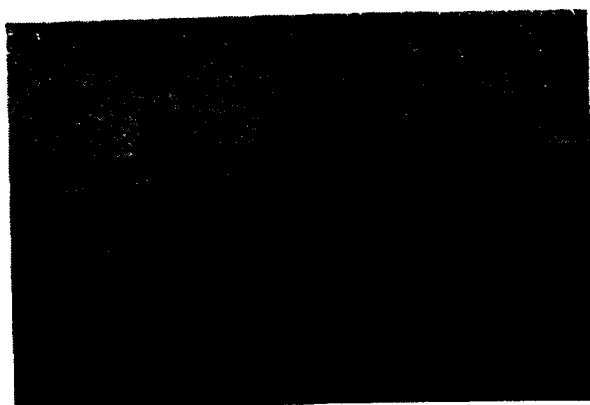
Concrete used for tile-making must be of high mechanical strength and free of any vegetable or soluble matter or particles greater than .078 inch (2 mm) in diameter. It normally comprises 1 part of cement to 4 parts of sand by volume, and is mixed in a counter-current machine, whence it is transferred mechanically to a tile-making machine on one main conveyor system.

Pallets, travelling along the conveyor in a continuous band at up to 60 per minute, are coated with a suitable parting oil before they enter the tile-making machine. Here a layer of mortar is extruded onto the moving pallets and a roller with a patterned surface; it emerges as an unbroken ribbon, shaped to the cross section of a particular design of tile. Further on a V-shaped knife descends to cut this ribbon into tile-lengths with slightly bevelled ends. These pass through cabinets in which they are sprayed with liquid cements containing metallic oxide or synthetic pigments to give them a plain or multi-coloured finish.

If desired, the tiles can now be passed through an automatic granule applicator, which gives them a dressing of coloured particles, made either from crushed natural minerals or from sand fused with metallic oxides to produce any shade from black to



A type 252 machine specially designed for the production of large "Double Roman" type tiles and "Double Pantiles". This machine is used on a continuous conveyor system whereby the empty pallets arrive on the conveyor and enter the machine automatically. The cabinet further along the conveyor contains oil spray jets which coat the pallets with the necessary mould oil to facilitate subsequent separation of the tiles from the pallets. This machine operates automatically at up to 2,500 tiles per hour.



A double action tile making machine which will be one of the machines supplied by Tile Development Ltd., to Jaywoth Permaroof Inc., for their new factory near San Francisco. The guards have been removed to show the mechanism in detail.

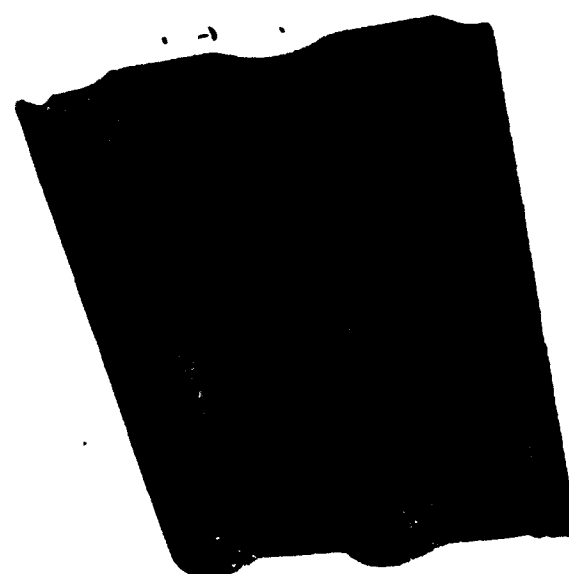
The machine will produce any standard type of tile from the 15" x 9" (38,1 cms x 22,9 cms) Marseilles pattern to the large "Double Roman" or the "Californian Shake" (a flat tile designed for low pitch roofs).

A production speed of up to 60 tiles per minute or 3,600 tiles per hour can be achieved. The machine is fully automatic and can be arranged to feed the pallets continuously without any pause, or alternatively with a pause of approximately 1/6th of a second at the moment when the knife descends on to the concrete to cut the tiles into the required lengths.

bright red or green, or even white. In the new Californian plant, however, a granulated surface will not be applied; as the tiles leave the spraying cabinet, parallel belts travelling at different speeds will rotate them through 90°, while still moving forward towards a second cabinet in which their ends will be flashed with matching or complimentary colours.

Next, the tiles are automatically divided into groups of six and delivered sideways to an automatic racking system. Forklift trucks transfer them to curing rooms where they remain for 24 hours at a controlled temperature of 38° Centigrade and a humidity of 80%. They are then returned to the racks and later to the main conveyor system where revolving disc-shaped knives detach them from the pallets. After separation a different conveyor delivers the finished tiles to the stockyard or stacks them vertically on their edges, while the pallets return along the main conveyor to be automatically cleaned and oiled ready for a fresh supply of mortar.

Automatic racking and curing systems for the new Californian plant will be built by *Columbia Machine*



This tile is the typical of the "Double Roman" or "Double Roll" pattern ("Doppel Pfanne" in Germany).

There are many variation of this design, particularly in the type of sidelock and in the form or shape of the roll itself. The "Doppel Pfanne" type has become extremely popular in Germany where almost every plant installed by Adams Powel Equipment Ltd., over the past few years has been arranged for production of this tile.

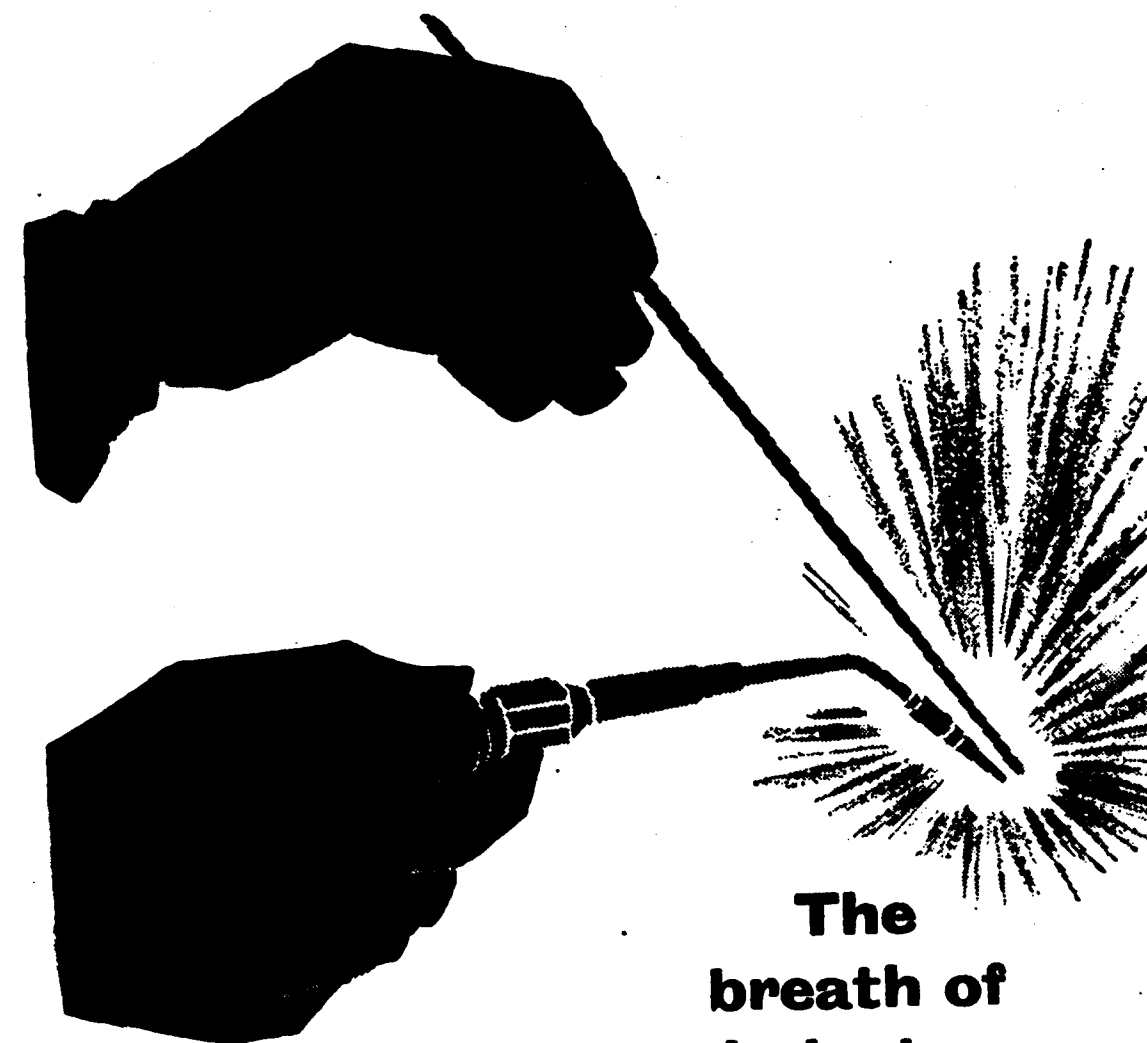
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Inc. of Vancouver, Washington.

Tiles of very great beauty, often guaranteed for up to 50 years against any kind of mechanical deterioration, are made in this way. Some manufacturers will also guarantee their colours. The tiles are waterproof and therefore immune to damage by frost. Production costs are low, since no skilled labour is required and no fuel consumed, nor is there any wastage in burnt or deformed tiles such as is unavoidable in the clay tile manufacturing process.

For these reasons, as well as the widespread demand for a "new look" in roofing materials, more and more clay tile manufacturers are turning over to concrete tile production, using Adams Powel machinery. To keep pace with their differing requirements and the local conditions of taste and climate which govern them, new and modified machines are constantly being developed at the Gateshead Works of Adams Powel Equipment Limited.



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CONGESTION and confusion at the entrance has been eliminated for passengers using Pan American World Airways' revolutionary new terminal at New York International Airport.

The world's largest air curtain—an 89-by-ten-foot portal that occupies the front of the unique building—removes congestion caused by funneling passengers through several doors and confusion as to which doors are “in” and which are “out”.

The wide entrance area, which permits free passage in or out at any point, works by means of blowers concealed in the roof of the three story terminal. They gently move 600,000 cubic feet of air past the entrance every minute—or enough in an hour to change the air in 6,000 five-room houses.

Although these blowers move the air at a speed of 1,150 feet a minute, their down-draft is so gentle it can't muss a lady's hair. And since the direction of the air is down, there's no skirt problem.

At floor-level, the curtain's air is sucked through a grille and into ducts that return it to the blowers. (Incidentally, it's been found that dogs won't walk through the curtain. Apparently they're suspicious of the floor grille, and puzzled by the soft current of air coming from an invisible source).

This air curtain was designed by the terminal architects (Tippetts, Abnett, McCarthy and Stratton with Ives, Turano and Gardner) working with Sulzer Brothers, Inc. especially for the air terminal that brings the plane to the passenger. But the practicality of air curtains has been proved by their use in structures of all types.

The second-largest air curtain—41 feet wide—has been in successful operation at Harrah's Club in Reno, Nev. And another large curtain is used daily by thousands of shoppers at Oppenheim Collins department store in New York City.

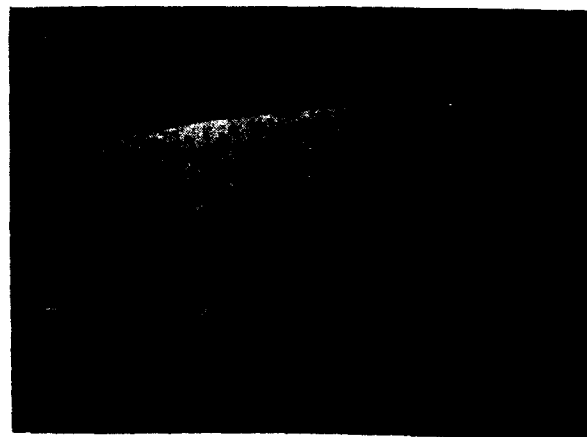
SUSPENSION BRIDGE CONSTRUCTION BRINGS PLANE TO PASSENGER

The air terminal that brings the plane to the passenger is the result of soaring architectural imaginations and down-to-earth facts.

The facts were gathered by Pan American World Airways, in three decades of serving international air travellers, and from hundreds of minute studies of airports around the world.

When these were compiled in 1956, Pan American selected the architectural firm of Tippetts, Abnett, McCarthy and Stratton, designers of the forward-looking new airport in San Juan, P. R. Associate architects were Ives, Turano and Gardner.

When the airline laid its ideas before the architects, it stressed one over-riding principle: the plane must



THE AIR TERMINAL THAT BRINGS
THE PLANE TO THE PASSENGER:

This is Pan American World Airways' new Jet-Age terminal at New York International Airport. The overhanging roof protects passengers and planes from the weather and the building's oval shape eliminates corridors and old-fashioned “sheepruns”. Passengers are now only a few easy steps from their Clippers.

be brought to the passenger to protect people from the weather and eliminate walking.

The project on which Turner Construction Company started work in June, 1958 is a “living” structure that adjusts to wind and weather. It contains elements of suspension bridge design in addition to construction techniques more commonly used in buildings.

The overhanging roof is cable-suspended 114 feet out from the three story structure, the upper two floors of which are glass-walled. The roof's outer edge is 50 feet above the ground—high enough to provide clearance for a jet Clipper's tail.

This roof covers more than four acres, with a 528-foot major axis and a 422-foot minor axis. It rests on two clusters of vertical members. The outer oval, 228 feet shorter than the roof, contains 32 reinforced concrete piers.

And the inner hub, a hexagon at the core of the structure, consists of six tension columns. These are weighted by a 3,500,000-pound concrete anchor buried 27 feet underground, beneath 10,000,000 pounds of sand.

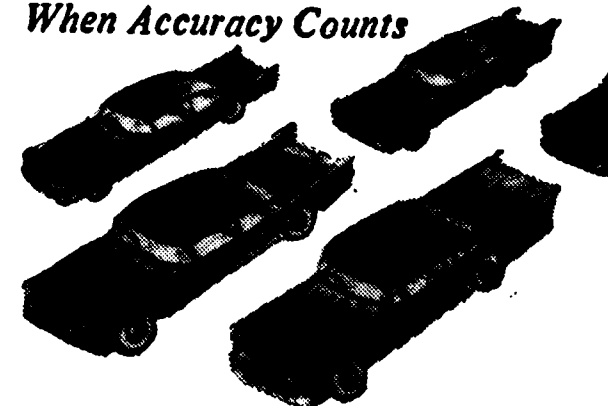
The inner tension columns do not support the roof—they hold it down. Bolted to these columns are the 32 cantilevered pre-stressed steel girders which frame the roof. Each girder is held in place by six 2½ inch cables secured to the outer end of the girder, passed over a 15-foot-high post at the middle of the girder, and tied back to the inner end of the girder a few feet before its connection to one of the tension columns. Nearly six miles of cable were used.

It was spun by the Bethlehem Steel Company and “tuned” like violin strings in pre-stressing the roof girders, which were made by the Lehigh Steel Company.

The roof, of reinforced concrete and steel, covers more than four acres, and could enclose the playing field at Yankee Stadium. Its entire underside is covered with acoustical cellular glass, a cinder block-like substance that absorbs sound. Installation was supervised by acoustical engineer Lewis Goodfriend.

The structure was aerodynamically tested by the General Applied Science Laboratory, of Hempstead, L. I., for flutter and vortex phenomenon. These studies showed the wind velocity that might cause flutter is well above the design velocity, which exceeds

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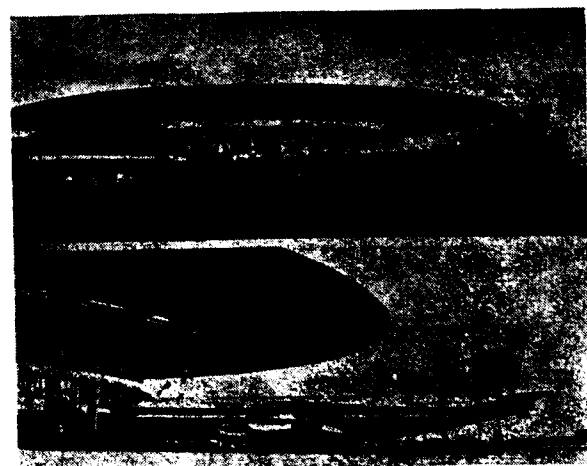
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150 miles an hour. This is more than twice hurricane force and far higher than the strongest wind ever recorded in New York—113 miles an hour, in October, 1954.

Although this gigantic roof keeps passengers out of the rain, this very weather protection created an added problem for the architects. The upside-down-umbrella shape of the roof meant that rainwater would collect near the center in a volume that could fill a small town reservoir. This was allowed to drain through downspouts built into the 32 supporting piers.

A necklace of skylights placed near the piers follows the outline of the roof. And a hexagonal skylight at the core combines to give the building the appearance of a giant bull's eye when seen from the air at night.

A special underground air-conditioning system for waiting aircraft pipes cool air from four mechanical equipment rooms in the terminal to covered pits at each plane position. A total of 16,000 feet of transite (cement asbestos) piping 18 inches in diameter carries the cool air to the ground pits where flexible 12 inch hose is used to pipe it into the waiting aircraft. There's one pit for jets and one for the smaller piston



AIR TERMINAL'S ROOF SHIELDS PASSENGERS AND PLANES: Pan American World Airways' revolutionary new terminal brings the plane to the passenger. Six giant jet Clippers can nestle under the overhang of this roof that's cantilevered 114 feet out from the oval glass-walled building at New York International Airport. Soggy arrivals and departures are a thing of the past for passengers, ground personnel, baggage, cargo, and mail, and passengers never need climb a stair to board their flight. Adjustable walkways take them right into the plane's cabin. There is a sight-seeing balcony, too, for bird's-eye views of the apron and runways.

planes at each of the eight positions. This is the first built-in ground aircraft air-conditioning system at any airport.

The world's largest air curtain, measuring 89 feet wide by ten feet high, forms the convenient entrance to the terminal. There are no small doors to create congestion and confusion as to "ins" and "outs".

Inside, there is more than 50,000 square feet of floor space devoted to passengers' comfort, and so laid out that few questions need be asked. Another 50,000 square feet are used by the behind-the-scenes personnel who keep things moving.

From the time the passenger arrives on Pan Am's 17-acre grounds, he can see his plane. He drives up along a six-lane roadway that curves right under the roof overhang and behind a 200-foot-long-by-24-foot-high glass windscreen that is decorated with huge bronze statues of the signs of the zodiac, the work of the prize-winning American sculptor Milton Hebard.

The terminal's glass walls permit an un-obstructed view of the apron and nearby runways. (These walls, of course, are non-load-bearing, the great weight of the roof being borne by the 32 reinforced concrete piers.)

Near the entrance is a new type of electronic flight information board, more easily read than conventional boards, which lists accurate-to-the-minute departure and arrival times, and is clearly visible from any point in the check-in area. This board will be connected with Pan American's Reservations and Sales offices in Long Island City and its offices in the East Side Airlines Terminal.

The passenger is guided to any one of eight loading areas by theatre-type lighting, designed by Broadway's Jean Rosenthal. As departure time nears, the lights in the lounge area are dimmed, and the boarding area is highlighted. (Should the passenger be dozing, there is also a loudspeaker).

FACTS AND FIGURES

- * The new Pan American Jet-Age Terminal is capable of handling eight fully-loaded 120-passenger jet Clippers every hour.
- * Its eight lanes of roadways can handle 60 to 64 cars or taxis every two minutes, or 1,800 vehicles an hour.

- * The four-acre roof (it could cover the playing field of Yankee Stadium) has a 528-foot major axis and a 422-foot minor axis.
- * This elliptical steel-and-concrete roof is cable-suspended 114 feet out from the three-story structure. The outer edge is 50 feet above the apron.
- * The overhanging roof provides shelter for as many as six aircraft at one time. Two extra positions are available, with expansions space for more if needed.
- * Nearly six miles of 2½ inch cables are used to keep in place the 32 pre-stressed girders which frame the roof.
- * The first built-in ground aircraft air-conditioning system at any airport carries cool air underground through 16,000 feet of transite piping to covered pits at each of the eight aircraft positions.
- * Unique baggage check-in facilities immediately inside the air curtain utilize specially-designed conveyors, which move baggage on and off scales without delay.
- * An arriving passenger's bags, removed from his aircraft under cover of the overhanging roof, are awaiting his selection in uniquely-designed removable bins within eight to 11 minutes after his plane has rolled to a stop.
- * An 89-by-ten-foot air curtain—the world's largest—gently moves enough air in one hour to ventilate 6,000 five-room houses.
- * The terminal contains a total of 100,000 square feet of floor space—50,000 for the passenger area, and 50,000 for the behind-the-scenes personnel who keep things moving.

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Works Administrator of VEB Carl Zeiss JENA

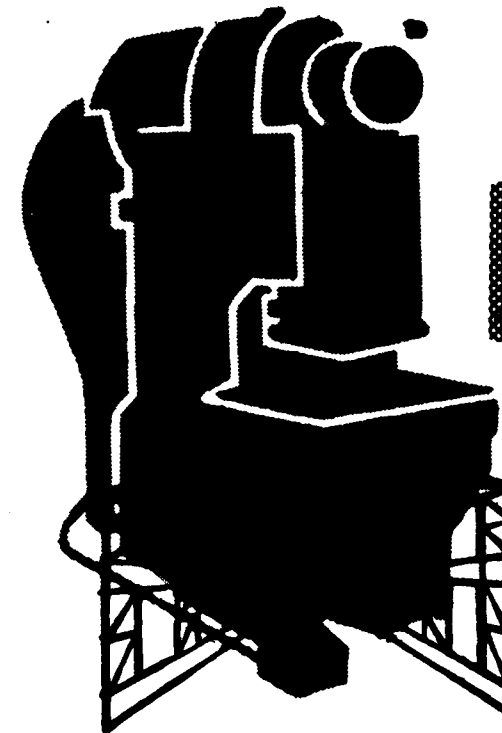
60 years of age

ON 4th of August 1960, Dipl. Ing. Dr. Ing. Hugo Schrader, Works Administrator of VEB Carl Zeiss JENA (German Democratic Republic), celebrates his 60th birthday. Occupied in leading positions since 31 years in this largest opto-finemechanical factory of the world, Dr. Schrader is now chairman of the Board of Directors for about 15 years. Under his leadership, the heavily damaged and dismantled Works have been rebuilt and have reached new summits in engineering and in scientific achievements. Development and production of opto-finemechanical and opto-physical Zeiss instruments such as microscopes, opto-physical measuring instruments, prism glasses, telescopes, astronomical instruments, photolenses, surveying and photogrammetrical instruments, industrial fine-limit instruments, have been extended after 1945 to the following new fields of activities: Growing of crystals, electron microscopes, diamond-impregnated tools, constructional elements for control and regulating systems, supersonic and vacuum engineering, radiation detectors, semi-conductors and semi-conductor engineering, radiation measuring instruments and nucleonics, photoelectrical instruments, X-ray screen image camera and X-ray screen-image cine equipment, electronic computing machines, miniature camera "WERRA" etc. Within these 15 years under the management of Dr. Schrader, the Zeiss Works in Jena developed and prospered as never before during their 114 years of history: Today, 18,600 employees including engineers and scientists, bring about an output of more than four times that achieved in the most prosperous business years between the two world wars. The same applies to the export of Zeiss Jena instruments which likewise had an increase by four times as compared with the aforementioned period. At present 102 countries all over the world are supplied with Zeiss Jena instruments.



DR. SCHRADER JENA

Since 1950 Dr. Schrader has been appointed chairman of the All-German Professional Standards Committee Finemechanics—Optics and since 1957 vice-president of German Standards Association for the whole of Germany. His exemplary work has brought him quite a number of awards, e. g., the National Prize of the GDR (1st class), a nomination to Honorary Senator of the Friedrich-Schiller University Jena, and the Golden Badge of Honour of the Board of Engineering of the GDR.



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CZECHOSLOVAKIA AS A MACHINE TOOL EXPORTING COUNTRY

By A Special Correspondent

Press Service, Praha - Czechoslovakia

THE important position occupied by machine tools in the field of technical and economic activities can best be judged by the part played by them in the past in the development of all industrial branches. Since they are the basic means of production they govern the standard of production technology of the entire engineering industry and thus also the productivity and efficiency of that industry. Czechoslovakia has a remarkable tradition in the manufacture of machine tools, for the beginnings of this production can be traced back to the period before the First World War. As an example there is the TOS Works in Celakovice which this year celebrate the fiftieth anniversary of its existence and the products of which, supplied under the trade mark of TOS-Volman, are well-known all over the world, or the Skoda Works which celebrated its one hundredth anniversary last year.

The high technical standard of Czechoslovak machine tools is also reflected in the fact that Czechoslovakia now holds fifth place in the world among countries exporting machine tools. The branch of cutting and grinding machine tools will have passed through a period of considerable expansion by the end of the Second Five-Year Plan. Taking the value of machines produced in 1955 as 100%, the corresponding figure at the end of 1960 will reach 188.5%. A further considerable expansion of production is anticipated in the subsequent years. It is only natural that technical development in this field is influenced, to a great extent, by the requirements of the Czechoslovak engineering industry which faces the task of accomplishing considerable enlargement of the volume of production and a substantial increase in the productivity of work. This can, of course, only be achieved by the development of a new technology of production based upon mechanization and automation, with the help of automatized heavy-duty precision machine tools. It cannot certainly be denied that these trends of development coincide with the endeavours which are manifesting themselves also in other economically highly developed countries. We are therefore convinced that the newly developed Czechoslovak machine tools will, with their design and workmanship, render a good account of themselves on the world machine tool market.

The main characteristics of these machines are the improved basic properties of precision as well as of dynamic and static rigidity and a higher degree of mechanization and automation. The application of these principles is shown below in a few examples.

All Czechoslovak lathes can be equipped with a hydraulic copying attachment and certain sizes also with an attachment for the copying of non-rotary shapes. The types SU 35, SU 50 and SU 63 of Czechoslovak heavy duty lathes, if equipped with a type IKS hydraulic copying attachment, can, in addition, be equipped with a further simple device which permits production in an automatic cycle.



Centre Lathe Type SU 35

This converts a universal machine into a simple semi-automatic copying machine which renders good service even when parts are machined in small batches. An advantage consists in the fact that the attachments need not be dismantled, for the machine can be arranged for normal turning by a simple process.

The acme of copying turning has been reached in the semi-automatic copying lathes of the SP series with programme control. They have the advantage of a fully automatized work cycle with the possibility of simultaneous work of two carriages, the type SP 25 permitting the machining of shafts with steps at both ends with a single clamping. Each of the carriages can repeat a cut four times, without the tracer being



Semi-automatic Copying Lathe with Programme Control Type SP 25



Semi-automatic Copying Lathe Type SP 31

in contact with the template during the first three cuts. In the course of the work cycle the necessary changes of speeds and feeds take place automatically which permits the work to be done under the most favourable cutting conditions. The setting-up of the machines is made considerably easier by the use of punched cards prepared beforehand.

The series of semi-automatic copying lathes consists of the following three sizes:

	SP 12	SP 25	SP 31
Swing over bed	125 mm 4 29/32"	250 mm 9 27/32"	315 mm 12 3/8"
Maximum turning diameter	100 mm 3 15/16"	180 mm 7 1/16"	250 mm 9 27/32"

A very rich automatic cycle has been applied to the type AB 80 single-spindle camless automatic lathe. The machine is intended for bar stock work in a chuck. It is also suitable for the machining of blanks which are inserted either by hand or by means of a



Camless Automatic Lathe Type AB 80

magazine equipment. Since no cams are required for work on the machine and since the setting-up of the machine does not require any more time than the setting-up of a turret lathe parts can be machined economically even in small batches. Therefore the type AB 80 automatic lathe replaces in many cases turret lathes, which it surpasses by its output and by the quality of its work. Thus, for instance, when the body of a sliding gear was machined from a forging on a type AB 80 machine, an output higher by almost 100% was achieved than on a turret lathe.

On this machine all the movements, the feed of the material and its clamping are done hydraulically. The automatic cycle is controlled by stops and micro-switches. The bar capacity is 80 mm (3 1/8"), the diameter of a workpiece in a chuck being 240 mm (9 7/16").

The milling field is represented by a newly developed range of bracket milling machines of



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✓ which the sizes FB 40 and FB 50 are already being supplied in horizontal, universal and vertical designs. The machines are marked, in comparison with existing production milling machines, by remarkable rigidity of all parts of the machine and by the possibility of machining even involved parts in an automatic cycle. On these machines the control of all the movements is centralized on a control panel. In the design of the machines has been utilized all experience gained in the manufacture of earlier types, all the discoveries of modern machining technology and the knowledge gained from the plants of domestic and foreign buyers of the machines. The machines have been thoroughly adapted to permit

cemented carbide tipped tools to be utilized to the full and downcut milling to be applied. Their operation has been simplified and automatized. The machines have been provided with programme control, either with a punched card or with a punched tape. A great advantage consists in the possibility of simultaneous engagement of all three directions of feed which permits the milling of slanting surfaces and a cutting down of idle times. The tool is protected against unnecessary wear during the return movement by the knee being lowered by 0.5 mm (0.02").

The series of these machines will consist of the following five sizes :

	FB 20	FB 25	FB 31	FB 40	FB 50
Dimensions of table of standard design	mm 900 × 200 ins. 35 1/4 × 7 7/8	280 × 1250 11 × 49	320 × 1400 12 1/2 × 55	400 × 1800 15 3/4 × 70 3/4	500 × 2000 19 1/2 × 78 1/2
Size of steep taper in spindle	40	50	50	50	55
Output of driving motor in kW	3	3.5	10	15	30
Weight of machine	kg 1500 lbs 3300	2100 4630	4000 8820	6000 13230	9000 20940

The development of horizontal boring and milling machines is also directed towards considerably increasing the rigidity of the frame of the machine. The horizontal boring and milling machines of the WH series, which will be manufactured in three sizes with a headstock spindle diameter of 63, 80 and

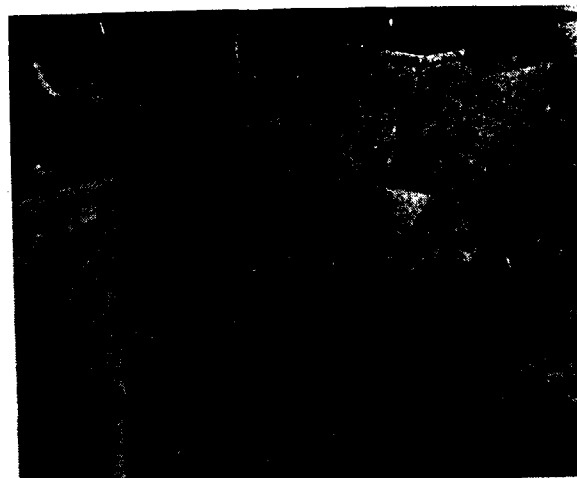
100 mm (2 15/32", 3 1/8" and 3 15/16") respectively, represent the most progressive design of machines of this kind.

High precision of the machine is ensured by perfect optical equipment for the setting of co-ordinates and a modern system of bearings of the nitrided spindle. The type WH 100 affords, apart from the features of the smaller types, the possibility of programme setting of co-ordinates, measured without the use of tracers, with the possibility of reading the numerical equivalents of the setting on the headstock housing. All the feeds are infinitely variable. For all the machines optional equipment is under consideration which will permit milling, grinding of flat surfaces and boring and grinding of tapered holes.

The development of grinding machines, which are rendering excellent service due to their high technical standard and reliability, aims not only at even greater perfection, but also at complete automation. Among the machines under development are machines of a



Horizontal Boring Mill WH 63 with Projection Optical Equipment



Centreless Grinding Machine BB 6

unit head character which, combined with a measuring station, magazines and feeders, it will be possible to connect into production lines. A machine among those the production of which has recently been started, which already corresponds to the standard of a fully automatized machine, is the type BB 6 centerless grinder which is intended for multiple and quantity production of parts of high and very high precision with diameters ranging from 1.5 to 63 mm ($1/16''$ to $2\ 15/32''$). It is equipped with a semi-automatic infeed cycle and an equipment for automatic compensation for the wear of the grinding wheel. It is particularly well suited, due to its high precision and optional equipment permitting full mechanization, for the automatic machining of rollers and taper rollers for antifriction bearings and similar mass production parts.

A machine also marked by high precision and a high output is the type BUT 63 centre grinder for heavy workpieces which is intended for precision heavy duty grinding of faces and hollow surfaces and for throughfeed and infeed cylindrical grinding with the table fixed or oscillating. It is universal with an automatic cycle, for heavy duty grinding both in batches and of individual pieces. The swing is 630 mm ($24\ 3/4''$), the maximum weight of the work-piece being 2500 kg (5570 lbs).

New machines lay, of course, increased claims also

Non-Ferrous Metallurgy Research Institution set up in Uzbekistan

The first Central Asian Non-Ferrous Metallurgy Research Institution has been set up in Almalyk, the centre of Uzbekistan's polymetallurgical industry. The new research institution which has 20 laboratories and an experimental concentration mill has already undertaken studies to assure further technical progress in the production of heavy non-ferrous metals and elements accompanying them. Its staff includes eminent Soviet scientists and specialists in the mining, concentration and smelting of non-ferrous metals.



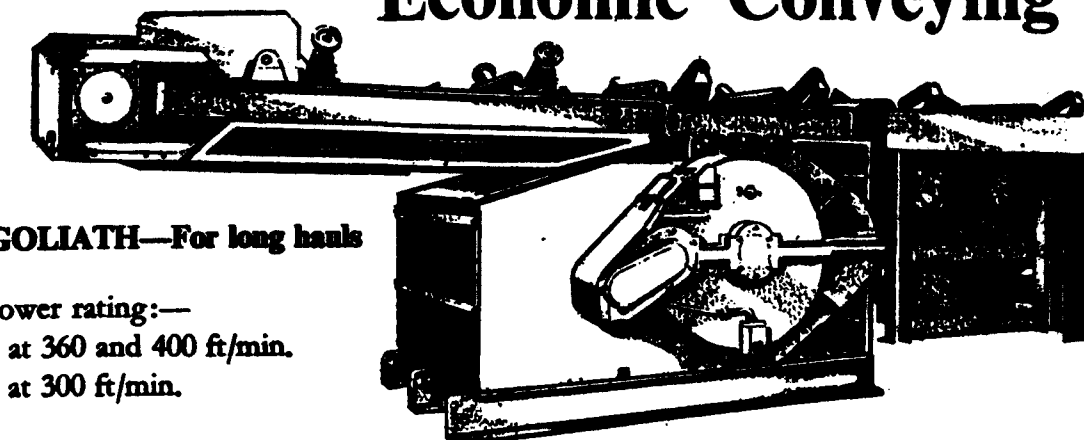
Cylindrical Grinding Machine for Heavy Workpieces BUT 63

on the provision of technical-advisory services, often even when the quotation is submitted, because it is becoming necessary to an increasingly greater extent to offer, together with a machine, also the technology of production of the part for the production of which the machine has been enquired about. On the part of Czechoslovak manufacturers and of the export corporation these services will, of course, be rendered on an adequate scale.

In conclusion, the fact must not be omitted that, in every economic set-up, also rather simple universal machines will for some time find application side by side with new, progressive machines. It is therefore necessary that such machines continue to be produced in Czechoslovakia in a limited assortment as long as their manufacture is economically justified.

The main task to be accomplished in future years by Czechoslovak machine tool manufacturers is the introduction on a larger scale of the manufacture of modern machines with a high productivity of work. We are convinced that this is the correct trend of development both from the point of view of the demand itself as well as that of the present progress of the technology of production and the claims of the customers ensuing from it.

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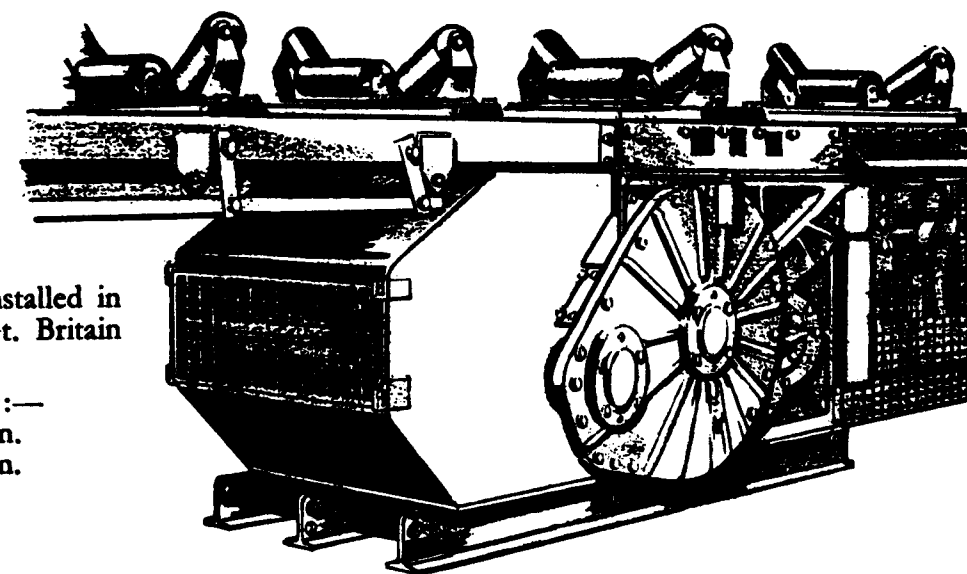
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LARGE DRY DOCK CRANE

By A Technical Correspondent

A CRANE for dry dock service must satisfy a number of specialised requirements and is normally designed to suit the particular dock concerned. With the advent of the super tanker and the development of corresponding dry dock facilities, there is an increased need for cranes of large capacity and outreach whose design and construction involve a number of inter-related mechanical, structural and electrical problems. Such a crane, designed and built by Stothert and Pitt, Ltd., Bath, was recently put into service at the new Queen Elizabeth Dock at Falmouth. This crane, which can be seen in our illustration, weighs 636 tons unloaded, and at minimum radius its jib nose is some 247 ft. above quay level. The dock accommodates tankers up to 85,000 tons deadweight and the crane duties were specified in consideration of probable lifts to be handled in the overhaul of such vessels. To meet the requirements the main hook capacity of the crane was settled at 48 tons with a maximum working radius of 105 ft. which takes it 11 ft. beyond the centre line of the dock. There was also required on the crane an auxiliary hoist having 15 tons capacity up to 156 ft. maximum radius and 12 tons capacity out to 175 ft. radius to enable loads to be handled at the remote side of the dock. Finally, provision was required for the occasional lifting of 61 tons on the main hook.

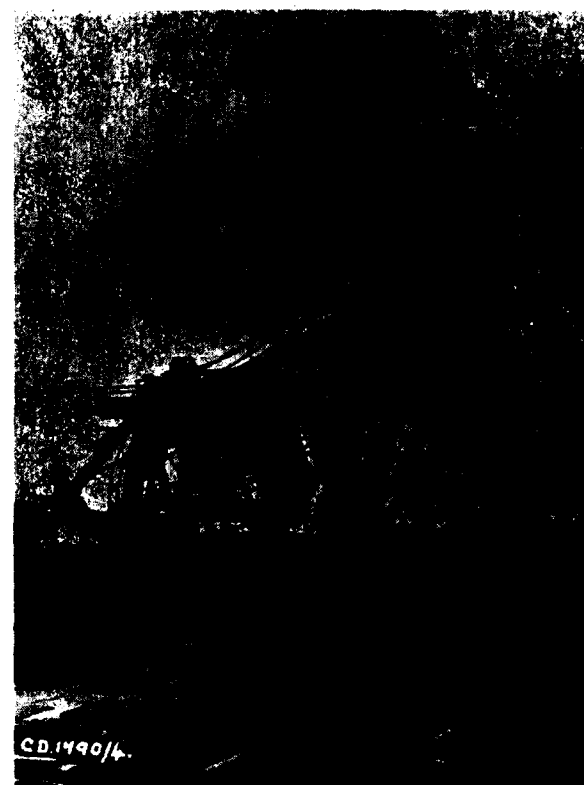
For very large luffing jib cranes there is a practical limit at which the use of wire rope purchases to hold the jib gives place to the screw and nut system. In the case of this crane the use of the less expensive rope system was made possible by achieving an accurate level luffing characteristic and by reducing jib weight as far as practicable. The weight of the jib itself is closely balanced by a sliding counterweight suspended at the rear of the crane. As both the main and the auxiliary hooks are made to follow a horizontal path when the jib is luffed, the luffing drive has only to overcome friction, inertia and wind resistance, and can be of comparatively low power. Different means are used to achieve the level hook path on the main and auxiliary hoists. On the auxiliary hoist there is a modified six-part "Toplis" reeving which produces the desired effect by the positioning of the pulleys and multiple rope reeving. The main hook is suspended by four parts of rope

necessitating a more complex system in which the anchor part of the purchase is wound on a section of the luffing barrel. Here again pulley positions play a part in ensuring accuracy of level hook path. The makers state that the measured deviations on test were $\pm 2\frac{1}{2}$ in. for the main hook in 60 ft. range and ± 5 in. for the auxiliary hook in 107 ft. range.

The crane jib weighs 55 tons, and is of rivetted lattice braced construction having main chords and bracings in high tensile steel to B. S. S. 548. It is 195 ft. long overall and can be derricked from a position with the nose at ground level by a modified reeving of the rope system, an arrangement which facilitates erection and maintenance painting. For the twin part reeving which support the jib from the superstructure apex, there are used $1\frac{1}{2}$ in. diameter steel wire ropes of 6/25 construction. Two parts are wound on a 5 ft. diameter cast iron barrel which also winds the ropes supporting the jib counter-balance at the rear of the superstructure and the main hoist compensating part referred to above. Although this



A jib crane with a capacity of 48 tons at 105 ft. radius, which has been installed at the new Queen Elizabeth dry dock of Silley Cox and Co., Ltd., at Falmouth, can be seen in the photograph. This crane of level luffing design has been constructed to the particular requirements of the dock which is capable of handling tankers of up to 85,000 tons deadweight. It was designed and built by Stothert and Pitt, Ltd., of Bath and we are indebted to the chief engineer of the company, Mr. T. E. R. Torrance, M.A., A.M.I.Mech.E., for the details given in the description.



Crane with jib during assembly and lowered to quay level.

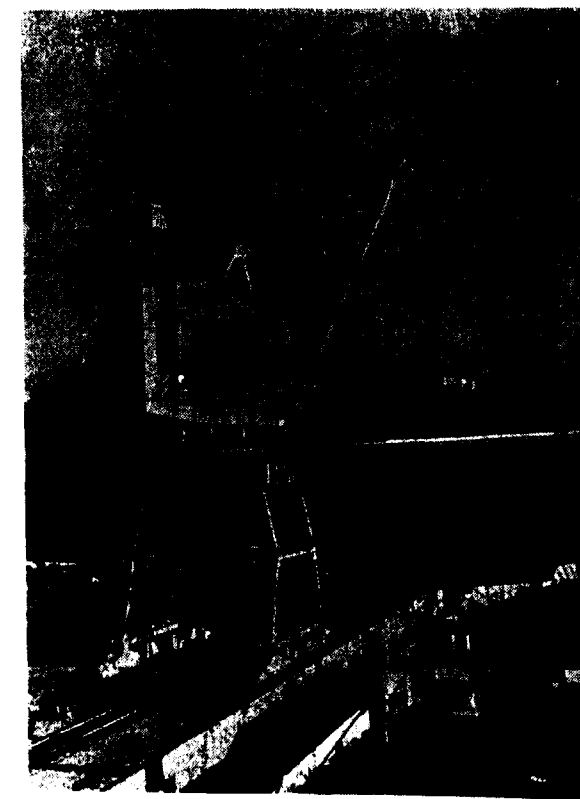
luffing barrel weighs 8 tons, it requires only about 25 h. p. to luff a 48-ton load at an average speed of 40 ft. per minute, by reason of the accurate balancing and level luffing characteristics of the crane. The slip-ring motor used for this motion is contactor controlled and rated at 45 h. p. to provide for adverse wind conditions.

The crane superstructure is supported on a live ring of conical rollers with a centre pin for location. The slewing motion is driven from a 35 h. p. slip-ring motor giving a speed of 0.4 revolution per minute or 440 ft. per minute at the maximum radius of the auxiliary hook. In this motion a worm and spur gearing transmits the drive to a steel slew pinion engaging a rack of 160 pins made integral with the circular girder on which the superstructure revolves.

Welding has been used extensively in the construction of the crane: in the plate girder construction of the truck top, circular girder, segmental girders and machinery bed, the single web form has been adopted in preference to the double web owing to the possible danger of unchecked and unobserved corrosion occurring inside the latter. The design and size of some of the major welded components is shown in one of our illustrations. The legs of the gantry are

also of welded construction, but for making the field joints and assembling the main lattice braced parts of the crane structure rivetting has been used. The total weight of structural steelwork is about 315 tons and every component was grit blasted at site before priming painting, a precaution which was considered worth while in view of the corrosive marine atmosphere and the very high cost involved in repainting such a large structure.

Ship repair work demands extreme flexibility in the hoisting control because many lifts are made from lower decks of the vessel through restricted access trunkings. With the load out of the driver's view and obstructions to be avoided at various levels, it is necessary to provide smooth speed variation down to low stable creep speeds which can be maintained for long periods. For these reasons the use of Ward Leonard control was an obvious choice, and both the main and auxiliary hoists are driven by d. c. motors from a single 42 kW motor generator set which can be switched to either machine as required. The main hoist has a rated speed of $7\frac{1}{2}$ ft. per minute for 48 tons load and a mechanical change of gear ratio is provided to give 15 ft. per minute for 24 tons load. The hoist motion driving motor develops 50 h. p. at 720 r. p. m. and is a compound wound machine with



Crane serving a ship in dry dock.



Large welded component during assembly at maker's works.

a separate motor-driven cooling fan to provide for long runs at low revolutions. The auxiliary hoist has a motor of similar design, but of 40 h. p., giving a rated hoisting speed of 30 ft. per minute with 15 tons load.

In a dock which is frequently called upon to serve unfamiliar ships, it is helpful to have some means of knowing the weights of component lifted and for this purpose both main and auxiliary hoists have been equipped with electronic weighers. For these weighers rope deflector sheaves in the crane superstructure are linked with load cells, the readings being shown on

dials in the driver's cabin. An accuracy of $\pm 1\frac{1}{2}$ per cent was obtained with this equipment on test.

To comply with the requirement for an occasional lifting duty of 61 tons with the crane the main hoisting motor and machinery are designed for this greater capacity. In the case of the structure, use was made of the duty classification in British Standard 2452 which covers high pedestal jib cranes. The structure is designed to the Class II or "Normal service" permissible stresses for 48 tons load, but the Class I or "Occasional service" stresses are not exceeded with the 61 tons load.

As time is important in ship repairing and heavy lifts may have to be travelled the length of the dock, the design of the crane travelling motion received special attention. With the crane handling a 48-ton load in 5 lb. per square foot wind the most heavily loaded bogie assembly carries a load of 255 tons. The six centre flanged wheels which share the load at each corner run on double 90 lb per yard flat bottom rails. Three of the bogie wheels at each corner of the crane are driven to obtain favourable distribution of tractive effort under varied loadings. The driving motors are mounted on the bogie structures complete with their worm and spur reduction gear units, the four motors being contactor controlled on the Igranic "Torquil" system and totalling 140 h. p.

FERRO ALLOYS

The following three Indian Standard Specifications published recently by ISI are the latest additions to the series of Indian Standard Specifications for Ferro Alloys: (1) IS:1467-1960 Ferro Tungsten (2) IS:1468-1960 Ferro Titanium (3) IS:1469-1960 Ferro Molybdenum. These standards cover requirements regarding the size, chemical composition, sampling and supply of their respective materials.

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LeTourneau's New Earthmoving Equipments

By A Special Technical Correspondent

IN one sweep—with the announcement of tandem scrapers—LeTourneau—Westinghouse Company has virtually doubled the number of machines it offers in its earthmoving equipment line. Marketing Vice President L. A. DePolis, who made the announcement, stated that tandems are currently available behind all three sizes of the company's two-wheel Tournapull prime movers, as well as with the recently introduced four-wheel Speedpull. Total capacities with the tandems range from 18-cu. yds. in the D size to 56-cu. yds. in the model B.

The L-W tandem system is extremely flexible. Coupling or uncoupling the second scraper can easily be accomplished in 30 minutes or less. One hitch pin forms the mechanical connection, while quick connect plug-ins provide the hook up for electric cables and air hoses.

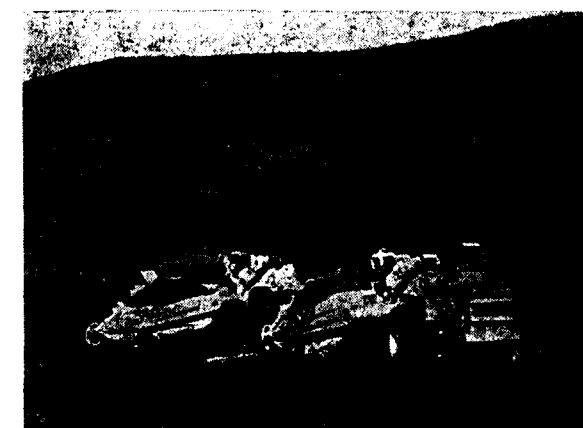
The result is that the equipment owner can double or halve his equipment capacity at will to tailor the machines for different types of jobs or changing conditions on the same project.

One of the most important advantages in tandemizing is that the capacity doubling process does not call for a bigger more powerful pusher. Because the scrapers are loaded one at a time, loading resistance is about the same as it would be if there were only one scraper behind the prime mover. In loading time, the process of loading tandems is actually faster than if each scraper had its own power unit, because the time taken for the pusher to position for the second load has been eliminated.

According to D. K. Heiple, Sales Development Manager for L-W, the move to tandems offers the equipment owner a broad selection of prime mover and scraper combination to meet varying requirements. Presently the purchaser can choose from 17 available teamings of horsepower and capacity.

The idea of doubling-up scrapers in tandem for greater capacity is not new. However, Heiple stated, "The L-W approach makes the idea practical." Principal problems experienced with tandems in the past, he explained, were awkwardness and lack of maneuverability due to extreme length, plus the complication of running long reeves of cable from the rear scraper to a power control unit on the prime mover. The L-W system, he claims, eliminates both of these drawbacks.

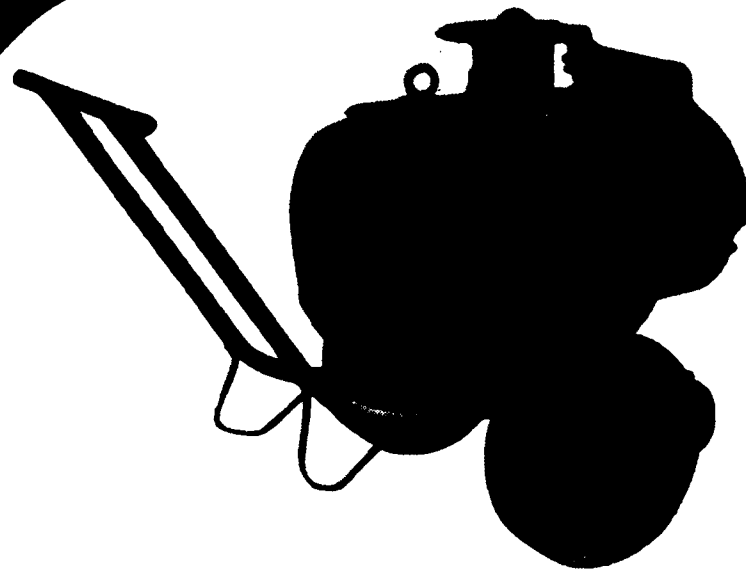
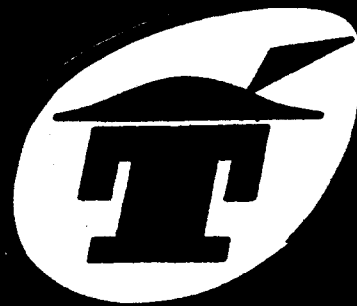
Electric controls for the rear scraper, just like the ones on the front, transmit the power for tailgate, apron and bowl lift through electric cable eliminating the long runs of wire rope. The maneuverability problem was solved by dispensing with the front axle and wheels of the second scraper and letting it ride "piggyback" on the rear of the front scraper. This shortened the tandem's overall length and permits the second scraper to turn a full 90-degrees in relation to the front scraper.



NEW L-W TANDEM SCRAPER. LeTourneau—Westinghouse announces availability of a line of tandem earthmoving scrapers ranging in capacity from 18 to 56 cubic yards. The second scraper can be quickly removed to convert to conventional single unit operation. Pictured is the Model C version — capacity 36-yards.

The result is that the L-W tandem very closely approaches, and in many instances surpasses, the maneuverability of conventional single scraper self-propelled units of comparable carrying capacity. As illustration, Heiple pointed out that a model D Tournapull with tandem scrapers totalling 18-yards capacity can make a 180-degree turn in less than the 32' 7" space required by the C with single 18-yard scraper.

Company officials are quick to point out that the introduction of tandems opens "capacity-doubling" possibilities to the vast majority of owners of Tournapull scraper combinations already in the field. Almost all such electric control rigs, built since 1947 can easily be tandemized. According to the engineers, the job can be done in the field at modest cost. Kits to do the job will be available before the start of the 1960 dirt season.



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HAULPAK LINE UNITS

A revolutionary new off-road-hauler—heralded as the first all new truck in a quarter-century is announced by LeTourneau-Westinghouse Company, Peoria, Illinois. According to Merle R. Yontz, President of the firm, who made the announcement, the truck is available in three sizes: 27 ton and 32 ton end dump models, and a 80 ton bottom dump.

The units are called the "Haulpak" line, and are unusual because of their rugged simplified design. The "Haulpak" can't break a spring, because it has no springs. Four big pistons, acting like giant shock absorbers are used instead, so it rides on air, not steel. Conventional axles have been eliminated too; its exclusive "Hydrair" suspension system makes them unnecessary. There are no tie rods or exposed steering linkage either. The entire steering system is protected within or above the frame line, giving the Haulpak almost twice the front end ground clearance of conventional trucks.

To make day-to-day servicing fast and simple, chassis grease fittings have been completely eliminated. Special bearings lubed and sealed at the factory need regreasing only if disassembled. Repair time is speeded up too, by easy accessibility and quick individual removal of major components without the need for removing other elements.

The Haulpaks are shorter than conventional trucks of comparable capacity. Its 130-inch wheelbase is about three feet shorter than most 22-30 ton haulers. As a result, it is extremely maneuverable. It can turn completely around in a circle only 44½ feet in diameter, which is about the same as the larger passenger cars.

The 27-ton Haulpak model is powered by a Cummins 335 horsepower turbocharged engine and operates at speeds up to 35.4 miles per hour. With a Cummins 375 horsepower turbocharged engine the 32-ton model has speeds up to 38.8 mph. The 80-ton Haulpak bottom-dump is powered by a Cummins V-12, 450 horsepower engine and operates at speeds up to 40 mph. All three have torque converters which provide 4 forward ranges and 2 reverse. They incorporate automatic lock-up to eliminate torque converter slip and utilize maximum engine RPM for higher truck speed.

Despite Haulpak's big hauling capacity, it is extremely easy to handle. Power steering and power

brakes, are standard equipment. For further ease of operation and driver comfort, the option list even includes cab air-conditioning.

The design engineers point out that every feature of the Haulpak line is based upon scientific study of practical needs. In order to make it more rugged, the complicated and sometimes troublesome "automotive-type" assemblies have either been eliminated altogether or replaced by tougher "earthmover-type" components. An example of this replacement is found in the use of the L-W power-transfer differential in the Haulpak. This unit is identical to the one used for ten years on L-W Tournapulls and other heavy equipment built by the firm. Using a simple friction principle, it automatically transfers the bulk of engine power from a slipping drive wheel to the one on the best footing.

Use of the "Hydrair" suspension system and box-beam frame allowed design of a new, better loading, better dumping body. While the Haulpak provides greater ground clearance its body cradles its load low, thus lowering the center of gravity and improving stability. The smooth, clean body interior is free of a dump-retarding tail lip and lets the twin hydraulic hoists raise the body to 70° for dumping full loads completely in only 15 seconds.

To keep wet, cold material from sticking to the body surface, an exhaust heated body is standard equipment. Exhaust circulates through the hollow box-section supports of the body, with outlets located at the extreme rear, away from the operator.

The braking system of the Haulpak is in reality two systems co-ordinated and controlled by the standard brake pedal. When descending grades under load where retarding is desired, the operator presses the pedal lightly. The first stage of the pedal travel controls the Torqmatic retarder which is an integral part of the transmission. This slows the hauler instantly. When a full stop is desired depression of the pedal into the second stage applies the multiple-disc air brakes, in addition to the retarder. These brakes, which provide from 4680 to 5148 sq. in. of stopping surface, are air cooled and cleaned by filtered air under pressure from an independent compressor.

Even the details of the Haulpak cab are the result of scientific study. The canted windshield precisely angles the glass to prevent glare and distortion; and

to resist clinging of moisture or frost. Location of the various control handles and levers is also the result of comfort and safety engineering.

The 80-ton bottom-dump, like the rest of the Haulpak truck line is a new unit developed by LeTourneau-Westinghouse Company. It is a bottom dump coal hauler designed for use in coal strip mining operations where big capacity haulers are desired to make extraction more economical. Body struck capacity of this 80-ton unit is 100 cubic yards.

According to officials of LeTourneau-Westinghouse, they "threw away the book" on conventional truck design when they started to work on the Haulpak. Merle R. Yontz, President of the firm, explains, "We wanted a tough, fast, high-production hauler which would be cheaper to run, simpler to maintain, and easier to operate—one that would make more money per trip for its owners. To get all this at the same time in the same machine we did the only thing that could be done—we designed the Haulpak starting from scratch."

A mobile medical colour television unit from Britain will shortly begin a three month demonstration tour of Australia. The unit has already been used in Britain to televise, in full colour, clinical procedures and intricate operations carried out by surgeons in order to demonstrate their methods to the medical profession. The vehicle, which is divided into three sections, weighs 8 tons gross, 2 tons of which is accounted for by the colour TV apparatus.



Super Tow Type Vibration Roller,
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THE POLISH MACHINE TOOL INDUSTRY

By A Special Correspondent

THE Polish machine tool industry is well known on the international markets and looks back on an established tradition covering not only the period between the two world wars but reaching far into the XIX century. In this industry real possibilities of sustained development appeared after comparison with the period after the First World War, the output of the Polish industry has been multiplied by four, and the range of machine tools produced has been expanded to include about 200 models.

At the same time, machine tool exports have been extended to more than 70 countries, including countries having high technical standards like USA, Canada, Great Britain, France, Sweden etc. Export production receives special attention. Every new type of machine tool for export is subjected to an operation test of a year's duration in the most onerous condition, and is subsequently examined by a commission of experts. Only on receipt of a satisfactory certificate from such a commission is the machine tool concerned allowed to be exported. Every machine tool exported is also examined by "Polcarga"—an institution for comparing all exported goods with to Polish or Schlesinger standards.

Sole exporter of all machine tools produced by the Polish Industry is the "Metalexport"—Foreign Trade Agency—Warszawa, ul. Mokotowska 49.

The range of Polish machine tools available for export can be divided into the following four basic groups.

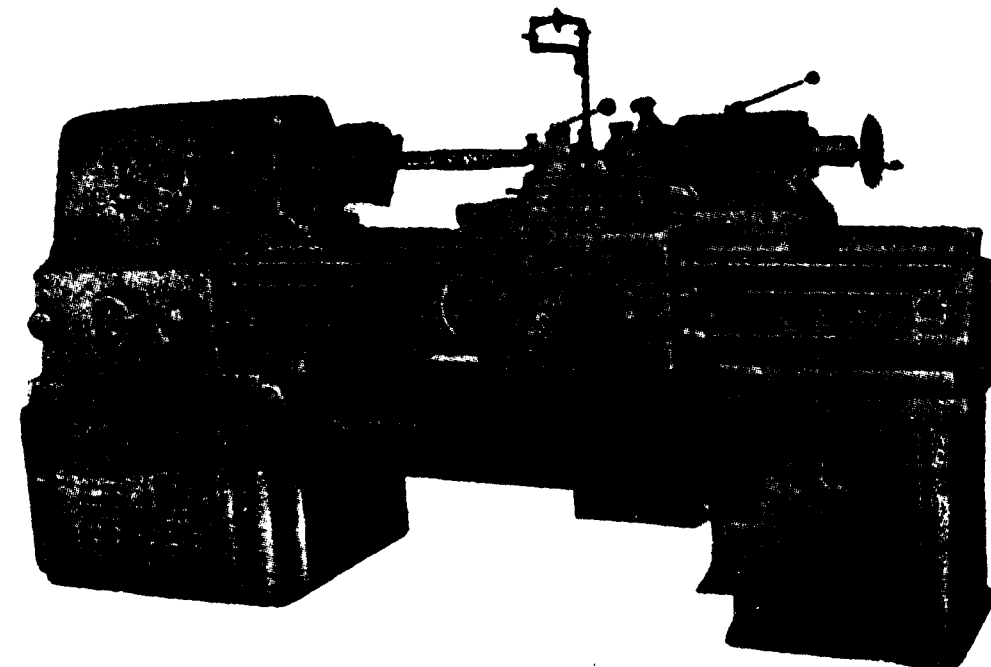
- I. Metal cutting machine tools,
- II. Machine tools for railway workshops,
- III. Metal forming machine tools,
- IV. Wood working machine tools.

I. METAL CUTTING MACHINE TOOLS

1. LATHES

This group includes a wide range of diameters and turning lengths, from the 120 W watchmaker lathe type TZ-40, up to the heavy duty lathes, TCA 125/160, which machine work-pieces up to a weight of 16,000 kg.

For workshops not engaging in serial production, or for reconditioning workshops, there are two types of



TUB-32 Universal Lathe

multiple lathes—TUE-35 and TUG-48 with turning diameters of 350 mm. (13 $\frac{3}{8}$ in.) and 480 mm. (18 $\frac{3}{8}$ in.) respectively, and turning length up to 2500 mm. (81 in.).

The following universal lathes are designed for production purposes, viz. TSS-150 with a turning diameter 300 mm. (11 $\frac{3}{8}$ in.), distance between centres 600 mm. (23 $\frac{3}{8}$ in.) or 1000 mm. (39 $\frac{3}{8}$ in.) and TUB-32 with turning diameter of 360 mm. (14 $\frac{1}{4}$ in.) and turning length 1000 mm. (39 $\frac{3}{8}$ in.) or 1500 mm. (59 in.).

Among lathes of other sizes special interest attaches to the high speed lathes TUC-40/50 with 400 mm. (15 $\frac{7}{8}$ in.) or 500 mm. (19 $\frac{3}{8}$ in.) turning diameter and turning length 750—2000 mm. (29 $\frac{1}{2}$ —78 $\frac{3}{4}$ in.). These are remarkable for high efficiency and are intended for machining with cemented carbide-tipped tools.

Special attention is directed to the production lathe PD 24 with a hydraulic copying attachment, designed for efficient and accurate serial turning of stepped diameter shafts, taper and formed shafts. Turning diameter up to 240 mm. (9 $\frac{1}{2}$ in.), turning length 375 mm. (14 $\frac{3}{4}$ in.), or 600 mm. (23 $\frac{3}{8}$ in.).

Universal lathes include a unified train of lathes TR, with the following turning diameters:—450 mm. (17 $\frac{3}{4}$ in.)—TR 45; 540 mm. (21 $\frac{1}{4}$ in.)—TR 55; 680 mm. (26 $\frac{3}{4}$ in.)—TR 70; 900 mm. (35 $\frac{1}{2}$ in.)—TR 90; 1000 mm. (39 $\frac{3}{8}$ in.)—TR100.

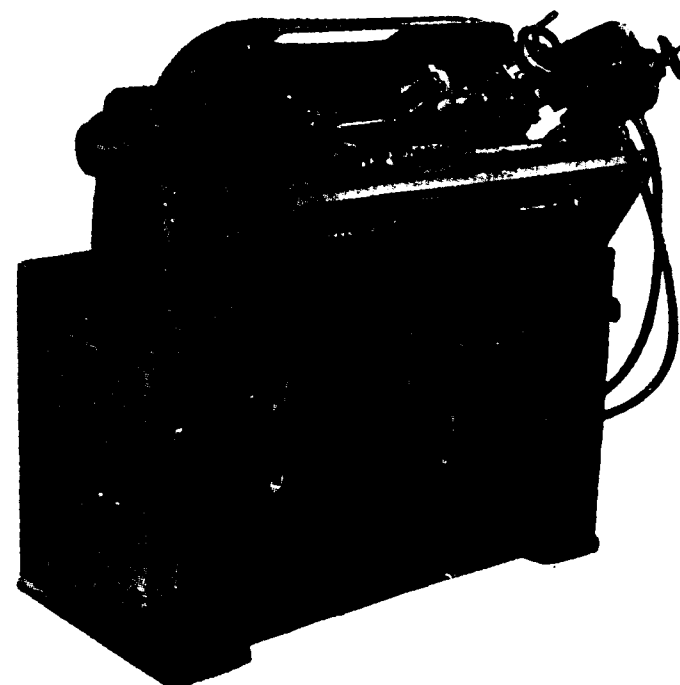
Turning lengths within the range of 1000—6000 mm. (39 $\frac{3}{8}$ —236 $\frac{1}{2}$ in.).

Heavy duty universal lathe type TCA 125/160 is for machining workpieces with max. turning diameter 1250

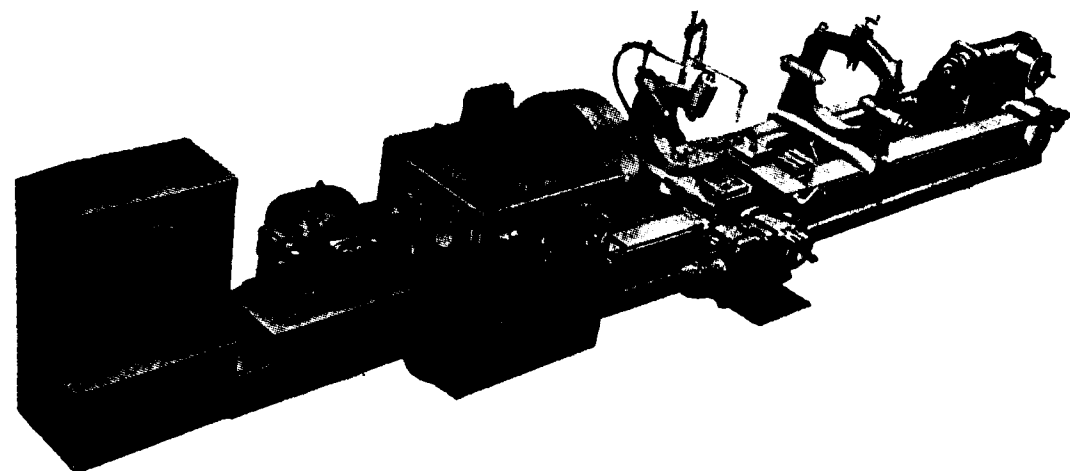
mm. (49 $\frac{1}{2}$ in.) or 1600 mm. (63 in.) and turning length 3000—15,000 mm. (118—590 in.). This lathe by means of special attachment can extend the standard range of operations and turn formed surfaces using the hydraulic copying method.

2. TURRET LATHES

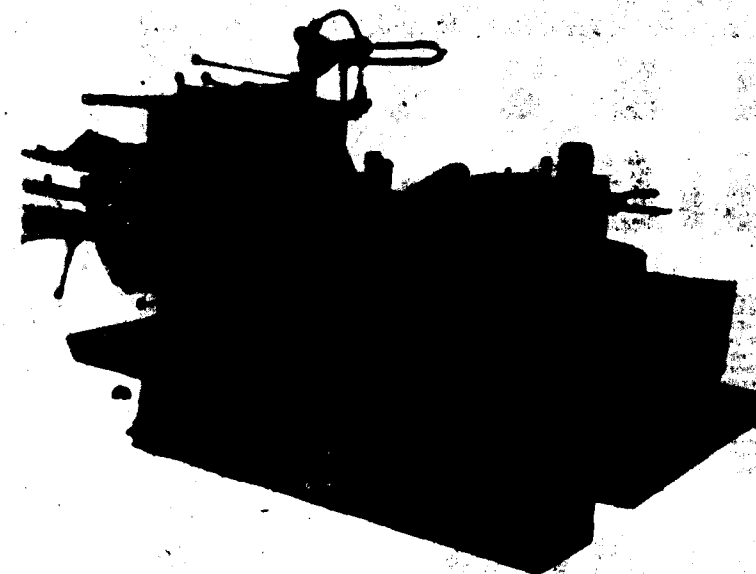
Two sizes are available for export: Rv 32 spindle bore 32 mm. (1 $\frac{1}{4}$ in.) and Rv1 63—63 mm. (2 $\frac{1}{2}$ in.), vertical axis to the turret head. On both these types bar stock and chucking operations may be carried out.



TPD-24 Production Copying Lathe



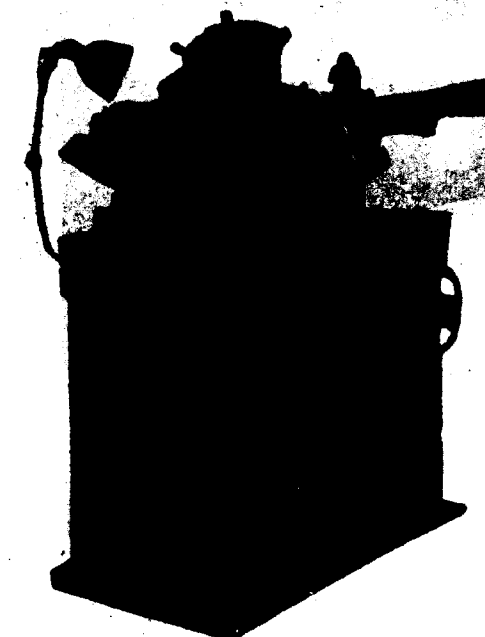
TCA-125/160 Heavy Duty Lathe



RVL-63 Turret Lathe



ATL-40 Automatic Turret Lathe



BPU-4 Automatic Lathe

3. AUTOMATIC LATHES

The range of automatic lathes includes three types of longitudinal automatic lathes BP-U4, BP-U7 and BP-U12 with spindle bore of 4.7 and 12 mm. (1 $\frac{1}{8}$, 1 $\frac{1}{2}$ and 1 $\frac{1}{4}$ in.) respectively, and a turret automatic lathe ATL40 having 40 mm. bar diameter (1 $\frac{5}{8}$ in.).

4. VERTICAL TURNING AND BORING MILLS

This group includes three sizes of vertical turning

and boring mills: KNA 110, KCF 200 and KCF 320 with table diameters 1100 mm. (43 $\frac{3}{4}$ in.), 2000 mm. (78 $\frac{1}{2}$ in.) and 3200 mm. (126 in.) respectively.

The KNA 110 is equipped with a turret head on the upper saddle and also with a side saddle. The mills KCF 200 and KCF 320 have two upper saddles and one side saddle.

All three types are electro-hydraulically controlled and have a preselecting arrangement for presetting table speeds.

5. DRILLING MACHINES AND HORIZONTAL BORING AND MILLING MACHINES

Drilling machines are represented by 10 different models. The smallest are the bench drilling machines WSA6 and WS15 with drilling capacities (in steel) of 6 and 15 mm. (1 $\frac{1}{4}$ and 1 $\frac{1}{2}$ in.) respectively. Next in size are the pillar drilling machine WE20 with a drilling capacity of 20 mm. (1 $\frac{1}{2}$ in.), and modern column drilling machines WKA25 and WKA40 with drilling diameter 25 mm. (1 in.) and 40 mm. (1 $\frac{1}{4}$ in.).

Radial drilling machines include 5 sizes: light radial drilling machine Wrs 25/08 with drilling diameter 25 mm. (1 in.) and drilling radius 800 mm. (31 $\frac{1}{2}$ in.). Wrs50 (1.6) and Wrs 50/2 are heavy duty machines on which it is possible to drill in steel up to 35 mm. (1 $\frac{3}{8}$ in.) at a radius of 1600 mm. (63 in.) or 2000 mm.

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(78½ in.). The heaviest types of radial drilling machines Wr 80/2.5 and Wr 80/3.2 have a drilling capacity up

to 80 mm. (3¼ in.) diameter in steel on a max. radius of 2500 mm (98½ in.) or 3200 mm (126 in.).

Horizontal boring and milling machines are built in two sizes with a spindle diameter of 80 mm. (3¼ in.) in the CWC model and 110 mm. (½ in.) in the HWC model.

Horizontal Boring and Milling Machine HWC Both types have a remarkably wide range of speeds and feeds, as well as great accuracy in machining.

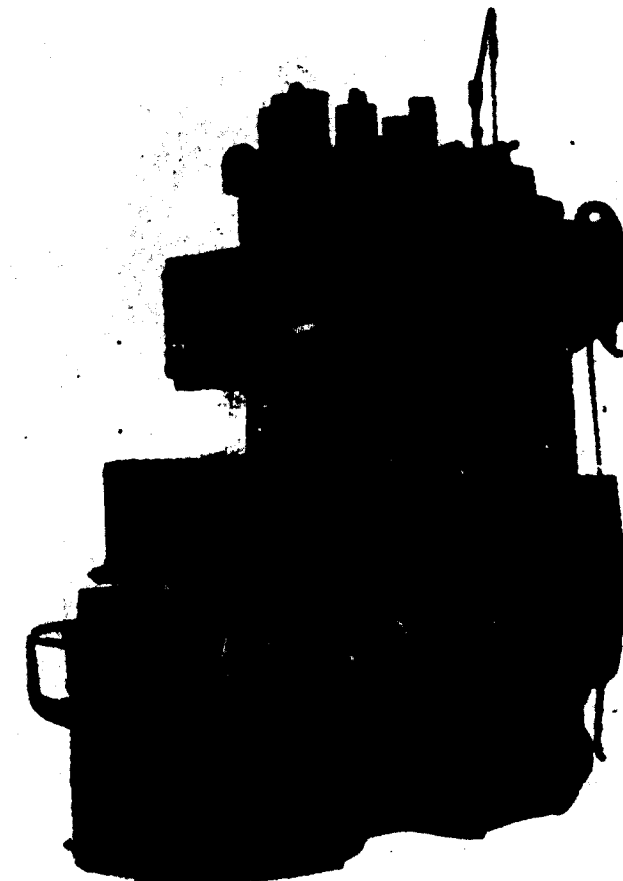
6. THREAD CUTTING MACHINES

Thread cutting machines are produced in two sizes GWA16 (up to 16 mm.—½ in) and GWC27 (upto 27 mm.—1-1/16 in.). These machines can be used for dia-cutting external threads.

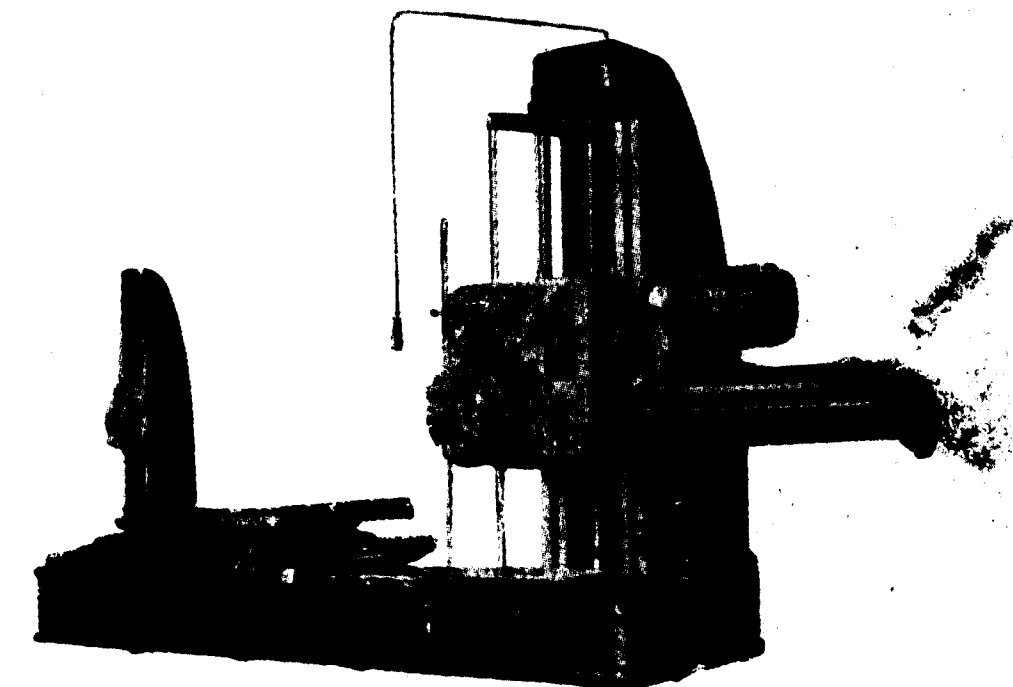
The thread rolling machine WGH80 is used in the mass production of bolts or other components with threads, producing an accurate and smooth thread within the range 3—85 mm. (¼—3½ in.) diameter and up to 125 mm. (4½ in.) length.

7. MILLING MACHINES

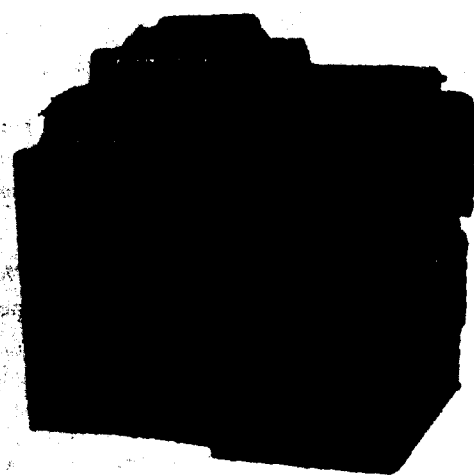
There is a wide range of milling machine types and sizes. The smallest are the bench milling machines: horizontal FXZ and vertical FYZ. Ample equipment enables various operations within the range of work required by watchmaking and precision mechanics.



KNA-110 Vertical Turning and Boring Mill



HWC Horizontal Boring and Milling Machine



WGH-80 Thread Rolling Machine

The tool-room milling machine FNA-26 with table dimensions 700x2600 mm. (27-9/16x10 1/2 in.) has ample equipment which makes it widely used in tools rooms.

Unified milling machines—universal FWB25, horizontal FXB25, and vertical FYC25, with table dimensions 1120x260 mm. (44-1/16x10 1/2 in.) and main motor power 4.5 KW/7.1 HP—can be effectively used in production or in tool-rooms. Unified milling machines of series F are built in three models: horizontal FXA, vertical FYA and universal FWA. The universal machines are produced in three sizes—31, 39 and 41 of table dimensions 1350x310 mm. (53 1/4 x 12-3/16 in.), 1600x390 mm. (63 x 15 1/2 in.) and 200x410 mm. (78 1/2 x 16 1/2 in.) respectively; the horizontal and vertical milling machines are in two sizes—31 and 41, of table dimensions 1350x310 mm. (53 1/4 x 12-3/16 in. and 2000x410 mm. (78 1/2 x 16 1/2 in.) respectively.



FNA-26 Toolshop Universal Milling Machine



FYA-41 Vertical Milling Machine

These milling machines have remarkably high output and accuracy, and the ample special equipment allows for slotting and rack cutting in addition to standard operations.

8. GRINDING MACHINES

The modern design of grinding and sharpening machines enables a series of precise surface finishing operations.

The cylindrical grinding machine SJW, with a 300 mm. (11 7/8 in.) grinding diameter and 1000 mm. (39 3/8 in.) grinding length, makes it possible to grind cylindrical and taper workpieces. By using an additional attachment, it can also be used for inner grinding.

The internal grinding machine SOA-100 enables the grinding of cylindrical and taper bores, in diameters ranging within 12—100 mm. (1/2—4 in.).

Horizontal surface grinding machines SPA-15 and SPB-30 with horizontal spindle axis have table dimensions of 150 x 450 mm. (5 7/8 x 17 3/4 in.) or 300 x 1000 mm. (11 1/2 x 39 3/8 in.), respectively. The surface grinding

HUMBOLDT

design and build

complete
metallurgical plants
for
non-ferrous metals

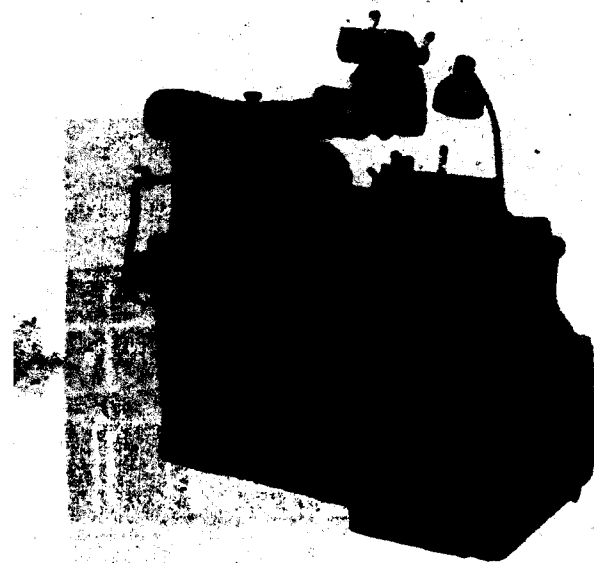
hydrometallurgical
and thermal processes

such as
roasting
leaching
electrolysis
cementation
blasting methods

for
lead, copper, zinc, tin,
nickel, gold, silver, etc.

further:
sintering plants, calcining
plants for kieselgur,
bauxite etc.

KLÖCKNER-HUMBOLDT-DEUTZ AG · KÖLN



SOC-100 Internal Grinding Machine

machine SAA30 with vertical spindle axis and table working surface of 300 x 750 mm. (11½ x 29½ in.), is a powerful machine tool working with segmental grinding tool, driven by an electric motor of 10 KW (14 HP.)

The multi-spline shaft grinding machine ZWA-150 is for finishing operations up to a diameter of 90 mm. (3½ in.) and length of 1500 mm. (59½ in.). Roll grinding machine SHIA90 is for finishing operations on rolls up to a diameter of 900 mm. (35½ in.) and up to a length of 6000 mm. (236 in.). Maximum weight per roll 20,000 kg. (44,000 lbs.). Sharpening machines include the universal tool and cutter grinding ISAB, triple cutter grinding and lapping machine SAR, circular saw sharpening machine Ocr140 for saw blade diameters 350—1400 mm. (13½—55½ in.), drills sharpening machine NWA-63 with diameters ranging within 10 to 63 mm. (½—2½ in.) and the universal sharpening machine NDA125 for circular, band and logframe saws.

9. PLANING MACHINES

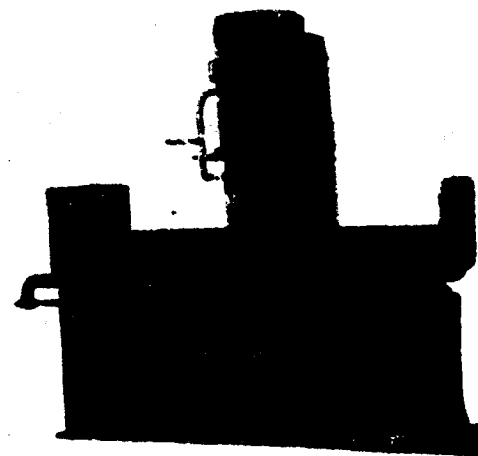
These can be divided into two groups: shaping machines and longitudinal planing machines. Shaping

machines PAA-40 and PAA-60 with max ram stroke of 410 mm. (16-3/16 in.) or 610 mm. (24 in.) are widely used in reconditioning workshops and tool-rooms.

Double column planing machines HDA80, HDB125, HDC160 and HDC225 have planing widths of 800, 1250, 1600 and 2250 mm. (31½, 49½, 63 and 89 in.) respectively, and planing length from 2,000 up to 15,000 mm. (78½ up to 591 in.). Planing machines HDC160/225 are driven by a Ward-Leonard system, the cutting speed reaching 75 m/min. (82 yard/min.).

10. SAWING MACHINES

The Range of metal sawing machines exported includes: Hydraulic hacksaws with max. cutting diameter of 120 mm. (4½ in.)—PM120 and 300 mm. (11½ in.)—PR300. Automatic hydraulic control and fast ideal stroke motion give a high output.



SAA-30 Surface Grinding Machine

With the hydraulic circular saw CRA-710 it is possible to cut material up to 250 mm. (9½ in.). Stepless adjustable feeds allow optimal cutting conditions to be chosen and an hydraulic bar-feeding table increases the output, enabling effective use to be made of the saw in every production workshop, especially in raw material stocks.

A HYDRO-POWER PLANT IN THE PAMIRS

The Soviet Union's highest situated hydro-power plant, the Murghab station, is under construction in the Eastern Pamirs, some 4,000 metres above sea level.

A big dam will bar the swift flowing Ak-Su mountain river to form a big reservoir. From this lake, the water will be sent to the turbines through a three-kilometre-long canal dug in permafrost soil. The station will provide electric current for the town of Murghab and all localities within a radius of 50 kilometres.

Instruments for technical precision measurements

Dipl. Ing. Heinz Zill

Jena - G.D.R.

VEB Carl Zeiss Jena with its tradition of 112 years, also possesses an efficient department for technical precision measuring instruments. This department was one of the first of its kind in Germany, as it was founded as far back as November 1918. In the course of the years numerous precision instruments have originated there and at the time of writing more than 60 units are included in the present price list. Many of these designs have set an example to all manufacturers of precision instruments with regard to their form and efficiency. The existing range is continuously supplemented by new developments resulting from the requirements of our times, and our manufacturing programme includes mechanical, optical, mechanical-optical, mechanical-electrical as well as optical-electrical measuring and testing methods. Due to the structure of the entire Works, the centre of gravity of which—as is well known—is in the field of precision optics the optical precision measuring instruments are the largest item produced, but because of rapidly developing automation the number of instruments working electrically is growing.

The instruments can be divided into the following principal groups:

1. Instruments for length measurement (incl. thread measurement).
2. Profile projectors.
3. Instruments for angle—and division testing.
4. Instruments for measuring gear wheels.
5. Instruments for surface measurement.
6. Various instruments.

With such an extensive range, it is only possible to select a few characteristic examples within the framework of this article.

When, at a Conference of German Scientists and Physicians in Bremen on the 16th September 1890 Ernst Abbe described the "Comparator Principle" subsequently named after him, so laying the foundation of a scientific approach to precision measuring problems, he supported the correctness of his theory by designing an instrument in which his ideas were

realised. This Abbe thickness gauge from 1890 still exists in the same basic form in the *Abbe Vertica Metroscope* (1) which differs from the original mode only by improvements in design resulting from the possibilities afforded by advanced manufacturing techniques. As an optical-mechanical measuring instrument it is suitable for direct length and thread measurements (Determination of thread pitch diameter according to the three-wire method) over a range of



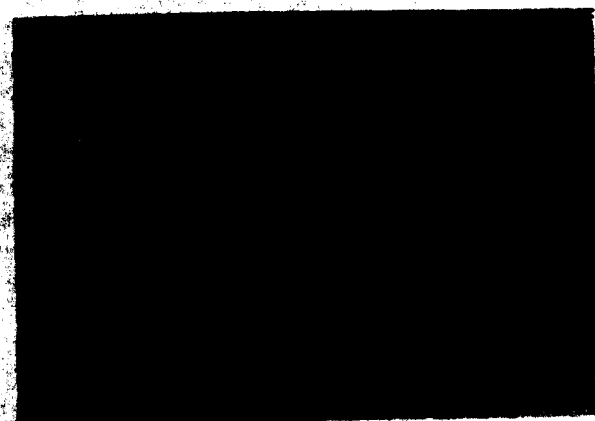
Abbe Vertical Metroscope (1)

200 mm. The 100-mm-precision glass scale is read by a spiral microscope. The maximum inaccuracy of

the instrument is $\pm (1,5 + \frac{L}{100}) \mu$, a value which

can be reduced further by $\frac{L}{100}$ when using the

included table of scale errors. The possible applications of this instrument are considerably extended by the horizontal mounting of the Abbe-measuring element in the *Universal Horizontal Metroscope* (2), and a number of accessories have made it into a universal instrument. The stable base in conjunction



Universal Horizontal Metroscope (2)

with a table which can be adjusted horizontally and vertically, tilted and rotated permits direct measurements and difference measurements on plane, cylindrical and spherical objects externally or internally, also thread measurements on male and female screw threads. With a measuring device using a magic eye as indicator, bore diameters of 1–50 mm. can be measured on electrically conducting objects without measuring pressure. For series measurements the Abbe measuring element can be replaced by an optical-mechanical precision indicator by means of which difference measurements can be carried out by comparison with a standard over a measuring range of $\pm 100 \mu$ and with a maximum inaccuracy

$$\text{of } \pm \left(0.5 + \frac{L}{100} \right) \mu.$$

For greater lengths, the *Length Measuring Machine* which has already been produced for up to 6 metre lengths is used instead of the *Universal Horizontal Metroscope*.

This is made possible by the steel-glass scale being situated underneath the measuring range and the first order errors occurring due to the violation of the comparator principle being compensated by an ingenious optical arrangement, the so-called Eppenstein principle. Whilst the decimetres, millimetres and tenth of millimetres can be read directly on the scale

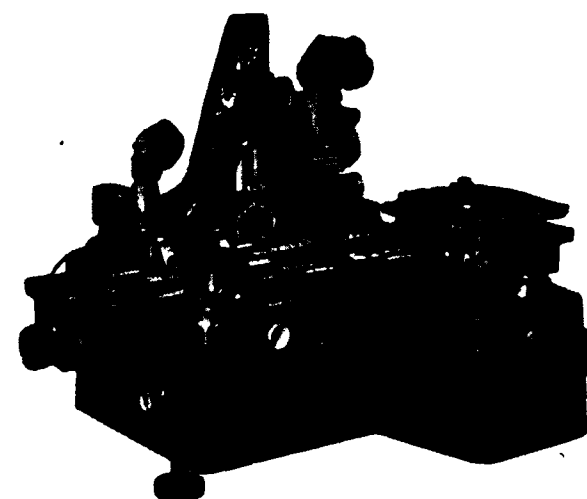
from the reading microscope, the hundredths and thousandths of a millimetre are obtained with a mechanical-optical precision indicator which at the same time ensures a constant measuring pressure. In the *Universal Length Measuring Machine 3 m* (3) this arrangement has been further extended so that measurements can be made not only with physical scanning but also without contact pressure, and it



Universal Length Measuring Machine 3 m (3)

is possible to use silhouette and axial section methods with measuring knife edges. In addition to measuring end gauges, slip gauges, racks and precision gauge blocks this measuring machine serves primarily for the measurement of lead screws; by means of auto-collimation from a 12 face polygon it is possible to adjust accurately the rotation of the screw about its axis to determine periodic errors. The test piece is placed on a special lathe-bed whilst the measuring carriage moves next to it on a base provided with a steel-glass scale. Thus it is possible to scan the test piece with the measuring instrument over its entire length. A special arrangement of three co-ordinated collimators makes it possible to obtain a reading on the scales free from guide error ($1/10 \mu$ can be estimated) through a microscope with 75 times magnification.

Among the co-ordinate measuring instruments, the *Universal Measuring Microscope* (UMM) (4), of which more than 1000 in the present design have already been supplied, occupies a leading position. The instrument, developed from an optical screw-thread measuring comparator, permits in its present design not only the complete measurement of screw-threads, but also the determination of angles on templates, stamping tools and profile gauges, side angles on cutting tools, milling cutters and broaches as well as shape inspection of any kind in rectangular and circular co-ordinates.

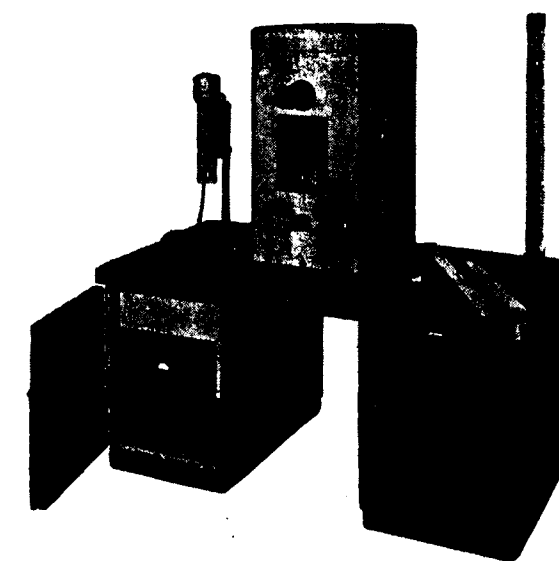


Universal Measuring Microscope (UMM) (4)

Greatest attention has been paid to high precision. The glass scales of 200 or 100 mm length are read with a spiral microscope, the test piece being sighted through interchangeable objectives and eyepieces with a total magnification of 10, 15, 30 and 50. The movable sliding carriages for the longitudinal and transverse movements operate by means of high precision ball bearings on hardened and lapped steel slides, so permitting the test pieces to be set precisely at all positions. Due to its versatile application and the accuracy attainable with it, the *Universal Measuring Microscope* has become standard equipment in the test room.

Where all its possible applications could not be utilized and where its purchase would be too expensive, the *Toolmakers Microscope* is used in its place with a measuring range of $150 \times 75 \text{ mm}$, a rotary attachment reading to $3'$ and two 25 mm micrometer gauge screws as measuring elements. The sighting microscope has the same optics as the UMM; generally, the optical systems of the coordinate measuring instruments made in Jena are interchangeable.

The *Interference comparator* (5) is available as a basic instrument for length measurements of highest precision by means of light wavelengths. It permits direct and difference measurements on parallel-slip gauges, as well as the determination of parallelism and planeness of slip-gauge measuring surfaces and the determination of the coefficient of thermal expansion of the raw material from which the slip-gauge is made. Direct length measurements can be made up to 125 mm, difference measurements up to 200 mm.



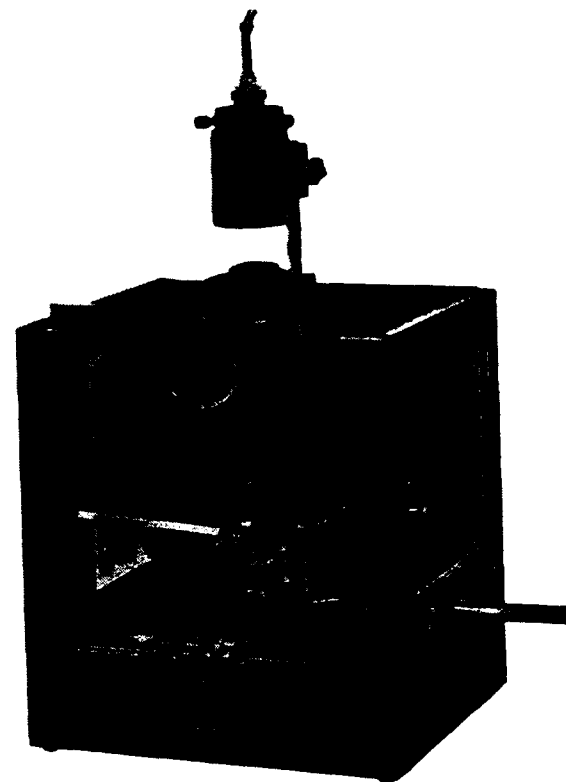
Interference Comparator (5)

A helium, krypton or white light source is used. With direct measurements the measuring inaccuracy is

$$\pm \left(0.00002 + \frac{L}{1500000} \right) \text{ mm. A double casing}$$

protects the instrument from the body heat of the operator and from possible temperature fluctuations. In addition, the casing permits warming to the correct temperature of the 6 assembled parallel slip gauges, thus enabling quick working. All auxiliary apparatus is conveniently arranged on the working table belonging to it.

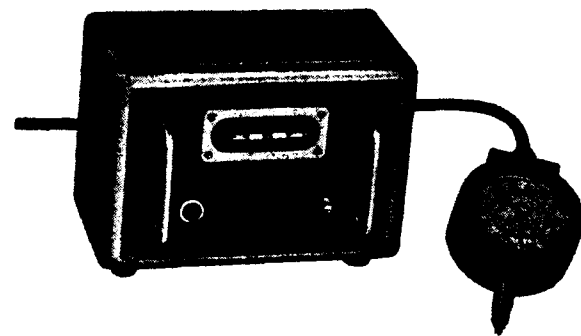
Where slip gauges are to be evaluated as accurately as possible, not interferometrically, however, the *Projection Opto-Mechanical Indicator* 0.2μ (6) is rendering useful service. As difference measuring instrument it permits a quick and certain comparison with a calibrated standard. Reading of the scale on the ground glass disc is easily possible even in rooms with daylight illumination. This instrument is also protected from the heat radiated by the operator by a heat protecting casing with heat absorbing robon glass. Removing of the measuring pin and shifting of the slip gauges is effected from outside the protective case by means of a lever system. The specimen table is provided with 5 hard metal ribs and can be changed for special tasks, for instance for foil and wire measurements to other specimen tables. With this instrument—there exists also the same model with 1μ scale value—special attention has been paid to the smallest possible inaccuracy, the maximum



Projection Opto-Mechanical Indicator 0.2 u (6)

being $\pm (0.05 + \frac{\Delta}{400})$ u, where Δ equals the difference of the indications for testpiece and standard in u.

These length measuring instruments are supplemented by the *mechanical precision indicators* which are particularly popular in the workshop, being easy to handle and having a low measuring inaccuracy. The *Automatic Control-Tolerance Indicator* (7) deserves special mention because of its particularly



Automatic Control-Tolerance Indicator (7)

suitable design for automation. It is equipped with adjustable electric contacts; when the indicator passes over them a circuit is closed. This makes it possible to control a machine or a sorting device, light signals may be activated by it or the instrument can be used as part of multiple testing equipment. The great advantages of the Automatic Control-Tolerance Indicator are the simple setting of the contacts by means of control curves, the enforced coordination of the contact position with the position of the tolerance marks on the measuring scale, the uniformly accurate indication over the entire measuring range of ± 60 u irrespective of the position of the contacts and the casing which is proof against sprayed water. The contacts also remain true over hundreds of thousands of switchings.

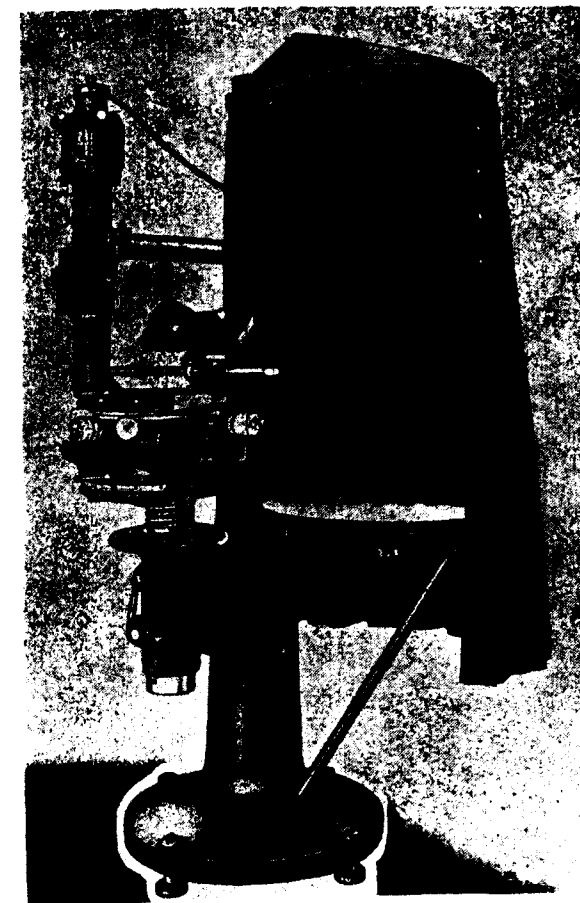
With a deviation of the measured value of ± 0.1 u, a reversing span of 0.5 u, a measuring capacity of 150 p and free lift of 3 mm the maximum deviation between tolerance mark adjustment and contact within a range of ± 50 u is 0.8 u.

For profile parts (e. g. profile gauges and shaping tools) and also shaped parts in the precision



Contour Projector 320 (8a)

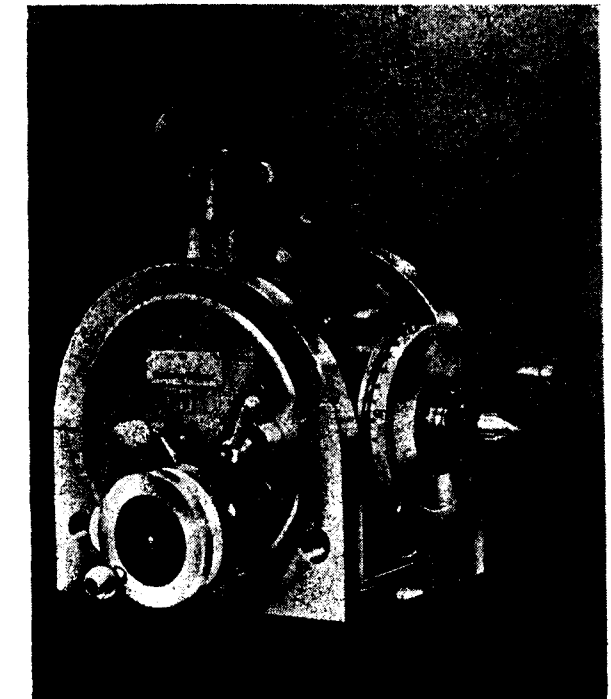
engineering industry such as components of watches, calculating machines, typewriters and sewing machines, profile projection is used for preference. Jena supplies for this purpose 3 instruments, each suitable for different applications. The Contour Projector 200 and the Contour Projector 320 illustrated in Figure (8) have ground glass discs as projection screens, whilst the large *Contour Projector*



Contour Projector 600 (8b)

600 (diameter of screen) produces an upright image on the projection screen. All three instruments can be used with either transmitted or incident light, or with both simultaneously. The Contour Projector 600 can also be used with lateral illumination which is especially suited for the testing of threads and milling cutters. The instruments magnify 10, 20 and 50 times, greatest attention being paid to them being as free from distortion as possible (permissible error 0.3°/100). As a matter of course all instruments are equipped with a telecentric path of rays to ensure the maintenance of the selected enlargement irrespective of the focussing.

As examples of the large number of Angle and Division measuring Instruments we would like to mention the *Optical Dividing Head* (9), the Angle Division Tester, and the Coincidence Level. The former was designed in Jena as far back as 1920 and thus set the example for many designs still on the market today. Contrary to the mechanical dividing



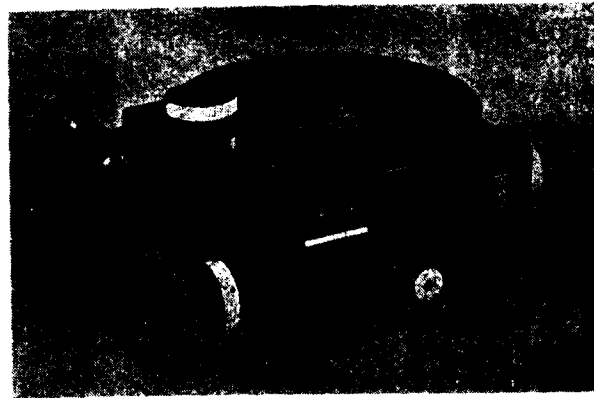
Optical Dividing Head (9)

heads, the worm is not used for measuring, but for transport only; the accuracy of the instrument, which as standard has a glass dial with an optical vernier reading to 10" situated on the main axis, remains constant for a practically unlimited period. There exists also a smaller model of this instrument which can be even attached to small machine tools owing to its light weight (with head-stock only 18 kilos).

Both instruments can be used for making divisions of gear wheels, notched discs, star wheels, perforated discs, graduated plates, shafts with keyway etc. In the testing department they are used for checking the angles of finished parts, e. g. camshafts; curved plates and angle measuring instruments.

The *Angle Division Tester* (10) is used for inspecting these dividing heads, especially the mechanical ones, where the transmission elements which are also used for measuring, suffer wear and

tear in the course of time. With this instrument also gear wheels, slotted discs and polygons are tested, while angles and circular divisions required in the manufacture of graduated plates and slotted discs, toothed and worm gears, can be set. The instrument

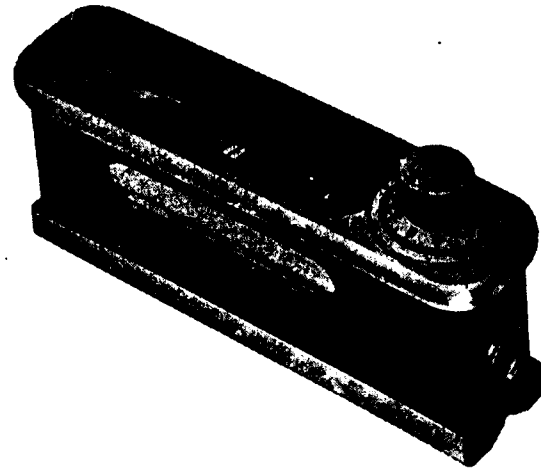


Angle Division Tester (10)

which can be used horizontally as well as vertically works as follows: In the casing is a precision graduated glass circle divided into 360° which is firmly connected to the take-up bush and which corresponds to a coarse graduated circle let into the outer wall. Furthermore, the casing contains an autocollimation telescope by means of which the instrument is aligned on a mirror fixed nearby in a firm position free from vibration. The reading of the value thus made possible is taken at 2 diametrically opposite places (coincidence reading) to avoid eccentricity errors of the graduated circle. The two images of the graduated scale visible in the eyepiece are made to coincide by means of an optical micrometer with the result that the angle on the graduated scale can be read to 10 minutes and the minutes and seconds read in a special window. From this initial position the setting of the required angle is effected, this being obtained with a measuring accuracy of 3 seconds. For gear wheels and slotted discs the instrument is supplemented with a rotating sphere contact device with a precision indicator to obtain the same contact relations. The parallel path of the rays existing between the telescope and the mirror permits within certain limits a parallel displacement of the instrument and the mirror without impairing the measuring process. The diameter of the take-up bore is 45 H 6 with an approx. length of 120 mm.

A specially interesting precision direction-indicator is the *Coincidence Level*. By suitable optical and mechanical arrangement (11) it is made possible for a change in angle of $2''$ corresponding to an inclination

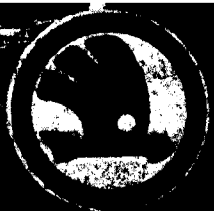
of 0.01 mm/m, to produce an apparent movement of the bubble of 0.8 mm. This instrument is, therefore, especially suited for the construction of precision machines where great demands are made on straightness and accurate angles; it has a total measuring range of ± 10 mm/m corresponding to $\pm 34'$. By using a 20" level the advantage of



Coincidence Level (11)



Surface Testing Instrument by Prof Schmaltz (12)



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MADRAS

rapid centering is maintained despite the high reading accuracy.

The conception of surface shape is of great importance for judging the fitting, friction and corrosion resistance and also for aesthetic reasons. For such investigations the *Surface Testing Instrument* designed by Prof. Schmalz (12) provides the possibility of producing a profile picture of the surface as a non-destructive optical section. With this instrument rough depths of 50 to 0.5 μ in size and the groove intervals can be measured in their actual size. As the profile picture is produced without measuring pressure, all distortions are eliminated, this being unavoidable with caliper instruments due to rounding off of the contact needle, lateral shifts or defects in the electrical components. Thus this instrument, as well as the interference microscope is



Gear Wheel Measuring Instrument (13)

a basic instrument for surface measurement as it reproduces the surface as it actually is. A photographic device makes it possible to provide a record of the measurements and a complication of specimen charts.

Gear wheel measuring instruments form another extremely important group of instruments. The

exacting demands made nowadays e. g. on the teeth of fast moving and measuring gears require most accurately shaped teeth, i. e. the maintenance of close tolerances on the various defined values of a gear-tooth system. Exact knowledge as to the sizes which are so essential for the manufacture of gear wheels is provided by the *Gear wheel measuring instrument* (13). With these independent measurements of the base pitch, the circular pitch, the thickness of the tooth, the width of the gap, as well as the concentricity of spur gears, bevel gears, helical gears and worm gears with a modulus 0.5 : 10 and the pitch and the untrue running can be made on the graduated indexing discs. The testpieces up to 380 mm in diameter are fixed between the tips of a tilting and rotatable clamping arc, two precision indicators with a scale value of 1 μ serve as measuring element and as measuring surfaces interchangeable calibrated edges or spheres are used according to the type of measure-



Involute Tester (14)

ment. For gear wheels of larger diameter the measuring device can be removed from the apparatus and attached straight on to the processing machine or a guide plate. The measuring device on the apparatus can also be replaced by a two-sided cylindrical testing attachment, with which functional test of

a gear wheel in conjunction with a master wheel or the pairing wheel provided for the gear, can be carried out and recorded by a mechanical recorder with a 100, 200 and 500 magnification. Further supplements to this apparatus designed according to the unit construction principle for other important testing possibilities are being prepared.

Another important gear wheel measuring instrument is the *Involute Tester* (14) with which the basic circle and the shape of the flanks of involute spur gears (inside and outside) can be measured. Any required pitch circle from 2.5 to 207 mm. can be continuously set with this instrument, or the unknown pitch circle of the gear wheel determined. For this

purpose a precision glass scale which is read with a spiral microscope is provided as standard. The design of this instrument which obviates the keeping of stocks and the exchange of many graduated pitch circle discs, is very rigid. The involute errors are magnified by an electric recording instrument 1:1000.

The measuring instruments described above represent only a section of the manufacturing programme of a Department of the Jena Works with its 18000 employees. It is a special advantage of these Works that they belong to an industry settled for generations in Jena and which have a stock of experts and scientists at their disposal ensuring the best tradition regarding precision and efficiency.

SLEEPERS FOR INDIAN RAILWAYS

The initial trials at the Sleeper Plant of Durgapur Steelworks were successfully carried out when the sleepers were produced for the first time at the Plant Site.

This plant is designed to produce sleepers for both Broad Gauge and Metre Gauge railways.



The Sleeper Plant at Durgapur Steelworks

Sleeper bars are produced in the continuous Billet and Sleeper Bar Mill and cut to length in the Sleeper Plant by a down-cut shear and transferred by means of a conveyor to a walking beam type of furnace for reheating. This furnace is fired by Mixed Coke Oven reheating. This furnace is fired by Mixed Coke Oven and Blast Furnace gas obtained from the works system, and is capable of heating 15 tons of sleeper bars per hour.

From the furnace, the bar goes directly to the 250 ton press, where both the sleeper forming and hole punching are carried out in one operation.

The sleepers are carried by conveyor to the tar dipping tank being descaled enroute by means of high pressure water jets. After dipping and cooling, they are weighed, inspected and stacked to await despatch.

The Sleeper Plant has been built by Davy and United Engineering Co. Ltd.,—a Member Company of ISCON—the British Consortium constructing the Steelworks at Durgapur.



AUTOMATED TELEVISION ASSEMBLY

The production lines at the General Electric Company's television factory at Coventry are now, the firm claims, the most fully automated in the world, with a high degree of mechanisation at all stages of assembly and testing. Capable of producing two models every minute, the new methods have achieved an increase of 100 per cent. in output and a 50 per cent. saving in space since their introduction. In addition they have enabled the Company to reduce the cost of direct labour in each television set by one third. A high proportion of the personnel working on television production—nearly one in three—is engaged on inspecting or testing. There is also a system of "Quality Control" to pinpoint unusual and unexpected troubles.

MODERN MACHINERY FOR ROAD CONSTRUCTION

ABG, Allgemeine Baumaschinen-Gesellschaft, Borsingfeld/Lippe, West Germany, are the leading manufacturers of road building machinery, preferably vibratory equipment, producing vibration rollers, vibrating plate compactors, asphalt finishers, aggregate layers, concrete spreaders, concrete finishers, and joint cutters.

Here, some machines of the comprehensive ABG-line:

Biggest self-propelled vibration roller, model Alexander: It has a dead weight of 6.9 tons and can be ballasted up to 8 tons. Due to the good balance between the specific soil pressure and the great diameter of both rolls, a perfect level surface is obtained. High surface output due to the large width of



both drums of 1350 mm (53.1"). The frequency is infinitely variable from 2000 to 3000 r. p. m., corresponding to 33—50 Hertz. Power unit: 33 HP Deutz diesel engine, air-cooled, with electric starter.

Model SW, the heavy duty vibration roller with a high compaction effect, many hundreds of which are used with success in road construction. Stability, high climbing power and a low centre of gravity make this roller an indispensable help on every large site. The Model SW has a service weight of 4.2 tons with equal big drums of 1000 mm (39.4") width and 850 mm (33.5") diameter and is equipped with a 20 HP Deutz diesel engine. Achieving a high compaction depth it is particularly suitable for all sub-base works and the compaction of aggregate and other bearing slabs. By changing the frequency the vibration effect can be accommodated to every kind of slab. Besides these

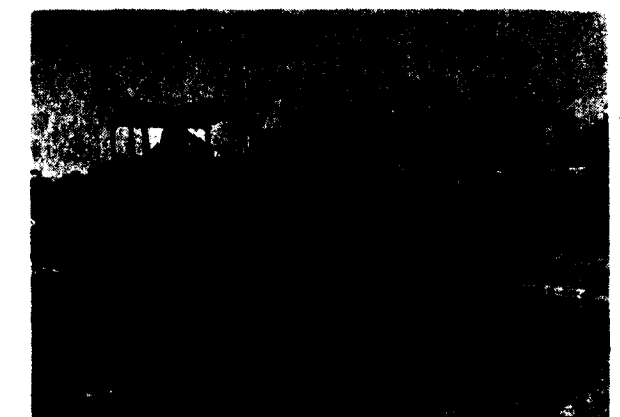
two biggest self-propelled rollers there are two smaller ones: Model MW with a service weight of 2.5 tons, reaching a comparable compaction effect of 18 tons and model LW, which has a service weight of 1.2



tons, achieving a compaction effect up to 12 tons. These last two are meant for operation on smaller sites, but like the others also able to compact the sub-base as well as the surface slab.

To complete the ABG roller line, here are short descriptions of the two tow-type vibration rollers:

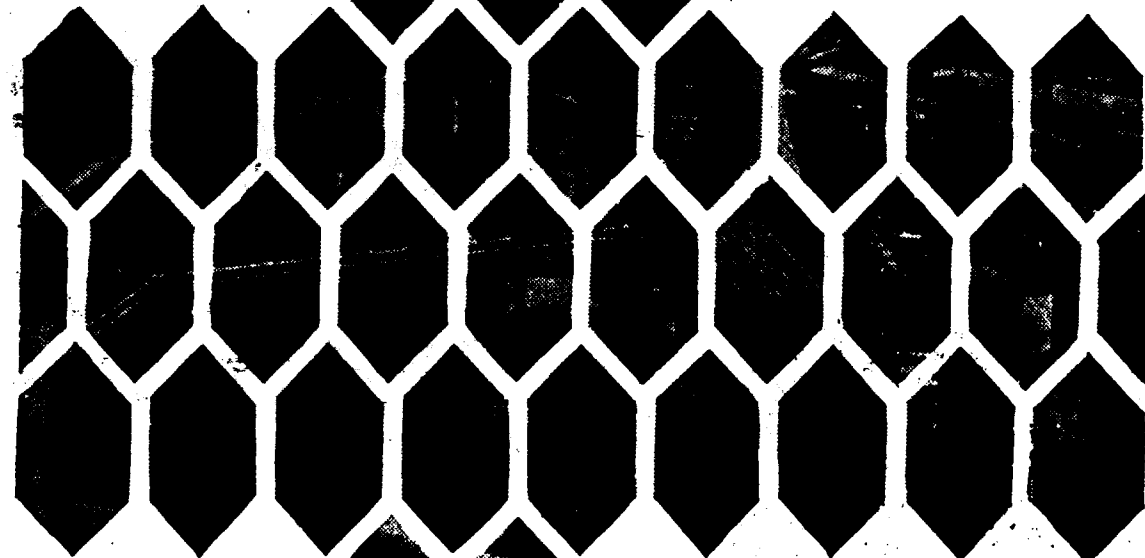
The model SAW is the heaviest and most powerful vibration roller yet on the market, a comparison with other compaction plant is hardly possible. The high dead weight of 8 tons, combined with the



great force of the vibrator produce a compacting effect, which make it possible to use this machine on soils, which have hitherto been compacted by dropping weight machines (tamping crane rammers),

a hive of
activity

Indo-British co-operation at Durgapur is building a modern integrated steelworks for India, with a production capacity of one million ingot tons and provision for a greater output under the Third Plan. In this enterprise, thirteen leading companies of Britain's steelworks engineering industry, working jointly as ISCON, have made available their technical know-how, and are training up in their U.K. factories hundreds of Indian technicians who will man this industrial giant.



ISCON

INDIAN STEELWORKS CONSTRUCTION CO. LTD.

Davy and United Engineering Company Limited, Head Wrightson & Company Ltd. Simon-Carves Ltd. The Wellman Smith Owen Eng. Corp. Ltd. The Cementation Company Ltd. British Thomson-Houston Co. Ltd. The English Electric Co. Ltd. The General Electric Co. Limited. Metropolitan-Vickers Electrical Export Co. Ltd. Sir William Arrol & Company Ltd. Cleveland Bridge & Engineering Co. Ltd. Dorman Long (Bridge & Engineering) Ltd. Joseph Parks & Son Ltd. Iscon Cable Group (Siemens Edison Swan Ltd. and Pirelli General Cable Works Ltd.)

BRITISH COMPANIES WORKING FOR INDIA

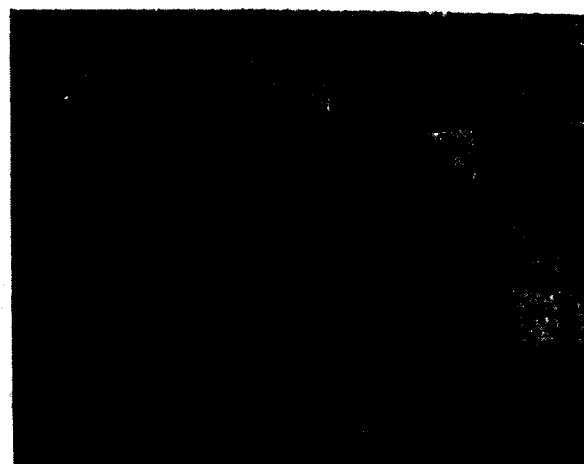


sheepfoot or pneumatic-tyred rollers only. Due to the width of the drum of 2000 mm (79") and the amazing depth effect of up to 1.5 metres (5 ft.), the output in terms of compacted cubic yards is many times higher than that reached with other plant. Power unit is a 56 HP Deutz diesel engine at 1500 to 1800 r. p. m., variable through governor.

The smaller brother is the model AW 25 with a dead weight of 3.3 tons. It has a drum of 1400 mm (55.1") width at a diameter of 1100 mm (43.3"). Power unit is a 25 HP Deutz diesel engine at 1600—2000 r. p. m., enabling the roller to produce a compaction effect up to 25 tons.

Both tow-type rollers are preferably used on high and irregular fills, which occur on many Autobahn, bridge, airfield, railway, and road construction sites, as well as on embankments, dikes, etc. Bad weather is no obstacle for these rollers as long as the tractor is worth all right.

Especially the 8 ton roller SAW has been used for the compaction of soils which hitherto have been regarded not to be suitable for compaction by vibration. On several Autobahn sites this roller was tested on



cohesive material and broken rock, and the compaction result was very much higher than estimated. After 4 passes on a layer of sandy gravel up to 1.40 metres (4.6') thickness figures were measured of more than 100% proctor density. These figures were achieved on cohesive material up to a depth of 1.50 metres (4.9').

Vibrating plate compactors for earth work, concrete and bituminous slabs:

Last year ABG developed two new plate compactors being particularly powerful and designed to be used on larger jobs. The biggest is model PV 40 with a service weight of 700 kg (1540 lbs.), base plate size 900 x 700 mm (35 x 28"). A 10 HP Diesel engine at 2800 r. p. m. develops effective power of blows up to 5 tons.

Model PV 25 has a service weight of 450 kg (990 lbs.) with a base plate size of 800 x 600 mm (32 x 24"). Equipped with a 7.5 HP Diesel engine and centrifugal clutch this machine reaches a compaction effect up to 3 tons.



Both plate compactors are provided with pneumatic road wheels which can easily be removed or attached. They have been approved as highly efficient compactors, and are generally in use for the compaction of frost blankets and for soil and aggregate consolidations. Working speed for both machines is 10—20 metre (11—22 yds.), independent from the kind of material to be compacted. They are working satisfactorily also on difficult soils and can take all usual up-grades.

Here is a picture of the compaction results achieved with the model PV 40, measured by university experts. After three passes figures were gained of 100.5%, 99.5% and 99.5% improved Proctor density at a depth of 7 cm, 30cm and 60 cm (2.7, 11.8, and 23.6 inches). At the rate of one pass a surface output of 800—850 m²/h (957—1017 sq. yds./h) can be achieved for both types of compactors. Several models PV 40 can be coupled to a bigger unit like all other older types of ABG plate compactors, in order to be able to cover a larger area, requiring one operator only.

Other plate compactors:

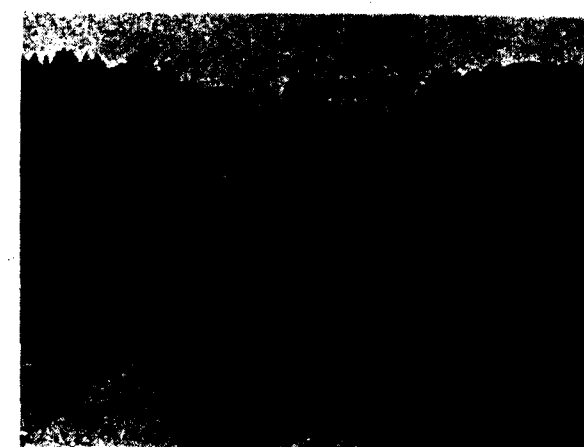
Model SPV, which has been designed especially for the compaction of bituminous slabs. The base plate measures 500 x 500 mm (20 x 20"), it is heated by the exhaust gases and particularly suitable for patch work, the compaction of bituminous slabs on yards, parking grounds, foot-paths, cycle tracks, etc.

Model PV 600

Service weight 180 kg (400 lbs.), base plate 500 x 600 mm (20 x 24"), compaction effect about 1 ton.

Model PV 400

Service weight 140 kg (310 lbs.), base plate



400 x 400 mm (16 x 16"), compaction effect about 3/4 ton.

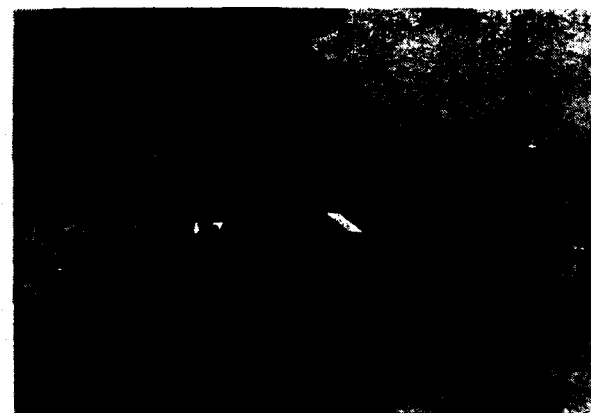
Model GV (Trench Compactor)

Service weight 130 kg (290 lbs.), base plate 350 x 600 mm (14 x 24"), compaction effect about 1 ton.

To complete the line here are some features of other ABG machines:

The Asphalt Finisher, Model SF, can be used besides bituminous materials also for aggregates, and unlike other similar makes the finisher also distributes and compacts materials that has been windrowed into the sub-base in front of the machine. The model SF is supplied for a working width of 2.25—3.75 metres (7' 4"—12' 4"); hopper capacity 5 tons.

Concrete/Asphalt Spreader, Model BV, can be supplied with hoppers 2 or 3 cu.m. (2.6 or 3.9 cu.yds.) to be charged from the sides or the front of the



Fully automatic Concrete Finisher VAZ 60, 2.50—7.50 metres (8.2—24.6 ft.) working width. Excellent compaction of slabs up to 60 cm (23.6") of concrete in one pass. New articulated carriage achieved an evenness on a German Autobahn site recently, which on a length of 16 km (10 miles) was only in 4 cases higher than 4 mm (5/32 inch).

Both machines working together as a so-called "concrete train" reached a daily output on several German and Austrian sites of 600—750 metres (656—820 yards) for sub-slab and top slab concrete. The average output was 450 | 600 metres (492—656 yds.) of concrete.

Similar machines are the Hand-propelled Finisher and the Marginal Strip Finisher, the first of which is a very good equipment on smaller sites.

machine. No pre-compaction because of the special design of the hopper. Automatic distribution of the material over the whole working width of 3.00 to 7.50 metres (9.8—24.6 ft.). Upon special request also 2.5, 8 and 9 metres (8.2, 26.3 and 29.5 ft.)

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Contribution of Richard Sutcliffe to the Mining Industry

By A Special Correspondent

THE formation of the National Coal Board in Great Britain was undertaken at a period in the history of the British mining industry when re-equipment and re-organisation became necessary to offset the deficiencies of the war years, whilst in addition, a steadily rising demand for coal put a constant strain upon both equipment and human resources.

In many cases this strain was accentuated by concentrating the initial development effort upon the equipment to win coal from the working face, with the result that the handling plant at all points outbye,—gate conveyors, trunk conveyors, winding and cleaning plant was faced with sustained peak loads well beyond the capacity for which it was designed.

With this in mind, the Company has concentrated upon the manufacture of conveying equipment of a steadily rising power and capacity, capable of handling ever increasing peak loads for still greater distances, and, where even these units proved incapable of covering every demand made upon them, developed equipment specifically designed to meet abnormal conditions.

As a typical instance of a machine to overcome abnormal operating conditions, the bunker conveyor is an outstanding example.

Analyses of many stoppages in handling systems has shown that a very large proportion have their origin in the inability of one unit to handle the peak load. The result is a slowing down or complete stoppage of the previous units in the system causing an even greater peak load to accumulate, which must be cleared before normal handling can be resumed. Further investigation shows that in nearly every case the proportion of the total load which causes the stoppage is comparatively small. With this in view it becomes clear that a temporary storage system immediately prior to the bottleneck, which can store the accumulation of small surpluses during times of peak load, and release them in periods of reduced load, will allow uninterrupted operation of the handling plant.

Usually, it is found that the bottleneck is the shaft winding capacity, and with this in view, the bunker conveyor is sited as near as possible to the shaft bottom. Its capacity is small compared to the flexibility it provides.

Previous attempts to provide storage capacity by the use of a bunker conveyor have failed because in every case they acted as one of the series in the handling system and were therefore required to accept the whole of the oncoming peak load at the tail end and yet at the same time, only discharge to ensuing units the smaller load which the least powerful could handle. Unlike these previous attempts, the "Sutcliffe" Bunker Conveyor is a by-pass unit located underneath one of the main conveyors. As such it only receives feed when the bottleneck capacity is exceeded, and when this occurs, no matter what the rate of feed, the discharge to the outbye unit is always at the predetermined rate, the surplus being stored in the bunker conveyor by progressively moving the point of feed inbye as required.

As the bunker conveyor can be installed at any suitable point in a roadway of little more than average cross-section, it is obviously a quick and easy method of securing bulk storage underground, but in addition it is both cheaper to instal and operate than a vertical staple bunker excavated in the strata, which not only needs means of filling and emptying but which, in addition, is a prolific source of coal degradation.

The bunker conveyor owes much of its success to the novel method of propulsion by hydraulic rams, which not only provide a shockless and almost noiseless power transmission to the conveying chains and plates, but at the same time eliminate the bulky and heavy reduction gear unit that would otherwise be necessary. Similarly, the use of hydraulic power from the same pumping unit provides energy for the chain tensioning gear and for operation of the travelling plough.

Where space is at a premium, the Bunker Conveyor has much to commend it, and obviously scores heavily

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over storage in tube or mine cars which not only need much greater room for the same buffer capacity, but in addition demand the use of a larger labour force to provide and discharge the same storage capacity.

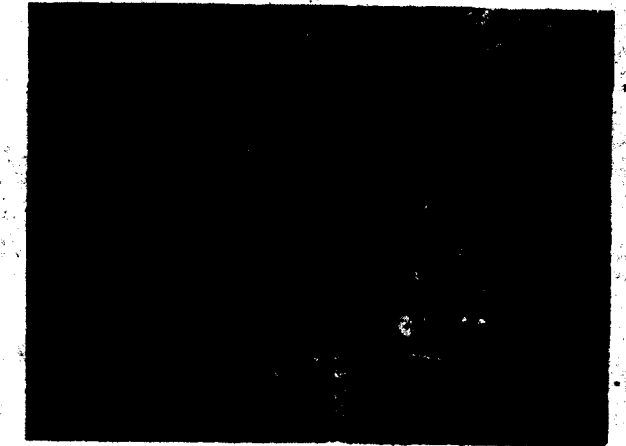
One of the major factors in the development of the mining industry has been the rapid and wide-spread increase in the use of the belt conveyor to the point where it has become the principal means of handling coal underground. Naturally, this results from the appreciation that intrinsically the belt conveyor is cheaper to instal, maintain and operate than the older traditional means of handling by haulage, is more flexible, requires less power and supervision, and is quieter and safer in operation.

As supervision is largely limited to control of the conveyor at the delivery point, the natural endeavour is to extend each unit as far as the strength of the belt will allow, and with this in mind, much development has taken place in the design of multi-drum driving units to utilise to the full, belts of normal construction.

With the advent of modern synthetic fibres, increased load can be applied to a belt of a given width, and to take full advantage of this situation the upper limit of economic belt conveying is being raised considerably by the introduction of a range of heavy duty machines. One of these, the Sutcliffe "Two Hundred", has a range of 200 H. P. upwards according to speed. Still larger machines can be supplied as required suitable for installations of 500 H P. or more, capable of making full use of the existing range of belts, and each has been designed to ensure optimum operating conditions for the belt, thus ensuring a long and economic life, and, in addition, has had particular attention paid to ease of installation and maintenance.

Foremost among the provisions for care of the conveying belt is the hydraulically operated loop take-up gear.

Automatic belt take-up gear is a comparatively simple matter on surface conveyors where unlimited headroom allows the easy insertion of a dead weight tension gear at any suitable point. This condition rarely, if ever, applies underground, whilst in addition the need to add lengths of belt to extending gate conveyors causes complications in installation and operation. The normally accepted method of providing for both initial tension and extension of the con-



Automatic Hydraulic Loop take-up shown fitted to a Sutcliffe "Tiger" 90-HP conveyor.

veyor is the loop take-up gear, introduced some thirty years ago by the late Richard Sutcliffe, in which a long horizontal loop of belt is stored in a suitable frame attached to the driving unit, and is both paid out for extension purposes, and taken in to increase initial tension by the use of a hand operated winch.

Time has shown that in inexperienced hands the winch gear can provide a too ready means of applying excessive tension to the belt with consequent detriment to its life, and to obviate this undesirable feature, the hydraulic loop has been introduced.

In this arrangement the pull of the belt in the loop is taken on one end of a pivoted lever, the other end of which is supported on a calibrated spring which has been pre-set at the required figure. This in turn determines the maximum load that the belt is required to transmit. Should the tension in the belt rise above the pre-determined figure, the spring is further compressed, thereby operating a piston valve which controls the supply of oil from a small pump driven from the input shaft of the driving unit, and which is used to operate a hydraulic motor providing power for the winch gear. Thus compression of the spring operates the valve in the "pay out" direction, and when sufficient belt has been paid out to allow its tension to fall to normal, the spring returns the valve to the neutral position and winch motion ceases. Conversely, insufficient belt tension causes belt to be wound in as required.

It will be seen from the foregoing that under all conditions of use or misuse, the tension in the belt cannot rise above the pre-determined figure, which, being within the recognised limits of safe loading,



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with full tractive power of 45 and 50 tons respectively, the six electric motors of this high capacity industrial locomotive set the train into motion. It has a service weight of 150 and 170 tons respectively and is built in the German Democratic Republic. Decades of experience in the building of electric locomotives were necessary for this new development which in the sphere of railroad vehicles is known as an outstanding achievement by the VEB Lokomotivbau Elektrotechnische Werke "Hans Beimler", Hennigsdorf, near Berlin.

In order to obtain first class running qualities with this hinged locomotive, the mechanical part and the top frame have been partitioned. Both parts rest elastically on the front and back bogie and jointly on the central one. In each part of the top frame is a driver's cabin, adjoining a spacious engine room. The collectors are worked by means of compressed air. The driving engines, starting and breaking resistance are separately ventilated altogether and immensely efficient industrial locomotive without competition.

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gives the maximum possible protection for the belt and hence an increase in its life.

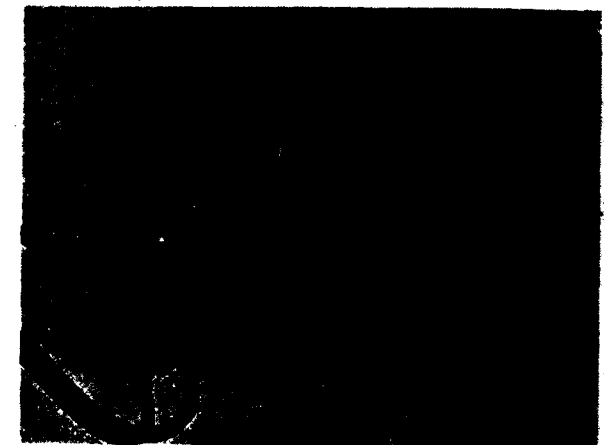
Similar advantages are derived from the use of hydraulic power to operate tub and mine car control gear. A typical example is the Tub Puller consisting of two guided pushers with counter-weighted horns operated by automatically controlled hydraulic cylinders disposed between the rails. This can be arranged to operate automatically once the valve is put in the "on" position, and a string of tubs or mine cars will continue to feed through thereafter without interruption.

For charging cages or tipplers, the chain ram, which consists of a guided steel ram supported on ball bearing rollers, energised by means of a flat link chain, is also on show. Power in this case is provided by a rotary hydraulic motor driving by chain to the drive sprocket.

Retarding of tubs and mine cars is effected by a controller in which the retarding friction is applied by dual lateral pressure members engaging with the carrying wheels, the pressure and release being effected by hydraulic cylinders in combination with coil compression springs. A simpler tub stop, which engages with the axle of the tub, and which has its primary use in the location of tubs at a definite point, has provision for the absorption of shock imparted by the oncoming tub, in the shape of long compression springs. The release and engagement of the catches is by a small hydraulic cylinder operated from the common control desk.

In mining operations there are many instances when water is required to be pumped at high pressure where some type of ram pump is the obvious choice. A typical and growing use for these pumps is the energisation of ramming gear on armoured chain face conveyors, which make use of mine water to which soluble oil has been added to minimise corrosion. To fill this need, and at the same time to eliminate the cumbersome treble ram pump, a Sutcliffe direct acting water pump has been developed.

This has as its basis a self-contained power pack, in which an electric motor drives a rotary oil pump which supplies oil at pressure to a double acting cylinder, the piston of which is connected to a yoke driving the two pistons of the water pumping cylinders. As the oil cylinder is provided with an automatic instantaneous reversing valve, the delivery of water is maintained



"Gladiator" Hydraulic Drill and Power Pack.

practically continuously and in an unvarying quantity. As the whole of the equipment is mounted on the power pack, movement as the face advances is a very simple operation.

Where drilling of standard shot holes is required, past practice has demanded either the use of compressed air for driving drills, with the attendant compressors, or else the use of electric drills normally working on reduced voltage and possibly on high frequency. To overcome the deficiencies of these systems the Gladiator rotary hydraulic drill has been introduced. Comparing favourably in weight with electric drills of even less power, the Gladiator drill receives oil at pressure from a 5 H. P. power pack situated in the gate which pumps oil through a closed system at the required pressure. The power pack contains a pressure relief valve which ensures that not only is the electric motor protected from overload, in the case of the drill bit striking an immovable obstruction, but in addition the torque on the drill is limited to that which can safely be maintained by the operator. As the energy stored in the rotating parts of the drill is very small, there is no shock on striking such an obstruction as in the case of an electric drill in which the rotor rotates at a high speed. Instantaneous control is effected by a trigger contained in the handle whilst the chuck has provision for water infusion when this is required. Being non-electric it is, of course, impossible to endanger the operative from this source, whilst its cast iron construction eliminates the incentive sparking which might result from the use of aluminium and similar alloys.

Many other advantages accrue from the use of this arrangement and which are demonstrated by the

reduced maintenance of the drill and its associate equipment.

Hydraulic power is also used to advantage in the operation of armoured chain face conveyors, particularly in situations where electric power at the face is inadmissible. The ability to locate the prime mover

at any convenient and safe point in the main roadway reduces congestion of the face at the driving unit through the elimination of bulky electric or compressed air motors and their accompanying gearboxes. This reduction in physical size of the driving head renders roof support much easier and proves a valuable asset where roofs are comparatively weak.

World's most powerful Hydro generator built in Leningrad

The world's most powerful hydro-generator has been put out at the Elektrosila Works at Leningrad. This "absolute world champion" with a capacity of 225,000 kilowatt has been designed for the Bratsk Hydro-electric Power Station now under construction on the Siberian Angara River, which in turn will be the biggest of its kind in the world. The capacity of the new hydro-generator is big enough to supply 20 big industrial undertakings with electricity. The new Elektrosila hydro-generator is 50 per cent more powerful than the generator manufactured at the Swedish "Stornorfors" firm and more economical in the expenditure of electro-engineering materials per kilowatt hour capacity.



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Low Cost of Vacuum Treatment of Molten Metals

By C. G. W. Overton, B.Sc.(Eng.), A.M.I.Mech.E., A.M.I.E.E.

THE vacuum melting furnace has proved an expensive but useful tool in the production of better alloys and of cleaner metals. Stream de-gassing equipment, alternatively, greatly reduces costs but is only suitable for relatively large batches of metal and has a limited effect on chemical analysis and, therefore, properties. In practice it is limited in use to large forging ingots. Various ladle de-gassing systems are also in use but are limited in the degree of de-gassing that can be obtained in a practical time bearing in mind the difficulty of keeping metal hot in a ladle.

Birlec-Efco (Melting) Ltd. (Sometimes referred to as "BIRLEFCO")* now offer a de-gassing and vacuum refining unit which overcomes many of these criticisms. It is relatively inexpensive but gives close control over temperature and pressure. Turbulence of the metal in the vacuum vessel is induced electromagnetically and therefore cycle times are reasonably short.

NEW BIRLEFCO VACUUM REFINING UNIT

A unit of this type has recently been installed at the Birmingham Works of Henry Wiggin and Company Limited for the vacuum refining of special alloys. Basically it is a 15 cwt. Mains Frequency Induction Melting furnace housed in a tiltable vacuum tank.

A water-cooled copper induction coil, which is supported by a magnetically shielded steel framework, forms the furnace proper. Special insulating techniques and careful design work have eliminated the difficulties of handling high voltages in vacuum, ensuring that no troubles arise through electrical breakdowns within the furnace.

The choice of mains frequency was based not only on the lower cost of the mains frequency electrical

gear when compared with H. F. equipment but also on the inherently greater degree of turbulence which a Mains Frequency furnace imparts to the molten metal. This turbulence stirs the bath thoroughly and brings new metal to the surface where gases and volatile metals can be drawn off.

The present installation has a rating of 300 kW and is arranged for connection to a low tension three-phase supply. 300 kW gives this unit ample power for melting duty, though, for refining service only, a maximum rating of 200 kW would suffice.

The vacuum tank, which houses the furnace, is mounted on trunnions and tilted by twin hydraulic cylinders. The tank movement produces an approximately lip-axis pouring effect from the furnace, and a retractable bridge over the top flange of the tank carries the metal stream.

Hydraulic controls open and close the vacuum tank lid and pneumatic clamps lock the lid on to the tank.

The furnace mouth carries a refractory cover and this cover has holes which correspond with a viewing port in the chamber lid. This refractory cover reduces heat losses and cuts down the loss of metal by splashing.

The vacuum pumping lines are connected to the tank concentrically with the tilting trunnion and in this way pumping connections are not demounted when the furnace tilts. The present installation includes a three stage pump set which gives ample gas handling capacity over the whole range. Automatic controls maintain the correct pumping sequence and a dust trap protects the pump set from damage by fumes and metal splashes.

Pirani and dial gauges monitor the furnace pressures.

The whole equipment was designed for use by relatively unskilled personnel with a minimum of technical supervision.

*The representatives of Birlec-Efco (Melting) Ltd., in India, are Associated Electrical Industries (India) Private Ltd., 6, Mission Row, Calcutta-1.

FURNACE OPERATION

A typical vacuum refining cycle occupies about one hour. Liquid metal is brought to the furnace by ladle and, when the furnace is charged, the hydraulic ram lowers the lid into position over the chamber and pneumatic clamps lock it in place. The chamber pressure is then reduced to about 200—300 microns in about 15 minutes.

During refining sufficient power is applied to the furnace to ensure thorough stirring of the molten metal and to maintain temperature at the desired value.

After vacuum treatment air is admitted back into the furnace, hydraulic gear raises the lid and the retractable spout is placed in position. The temperature of the metal is adjusted and checked by dip thermocouple and various other checks are made, after which the furnace tilts, pouring the vacuum refined metal into a ladle for casting or teeming in the conventional way.

RESULTS

The application of vacuum to the melt removes gas and volatile metals. The results obtained have been extremely satisfying and the high temperature properties obtained on vacuum refined metals have exceeded those forecast, basing the estimates on work done in the laboratory. A standard basic refractory lining is in use and gives satisfactory lives. It is rammed around a normal type former and presents no special problems.

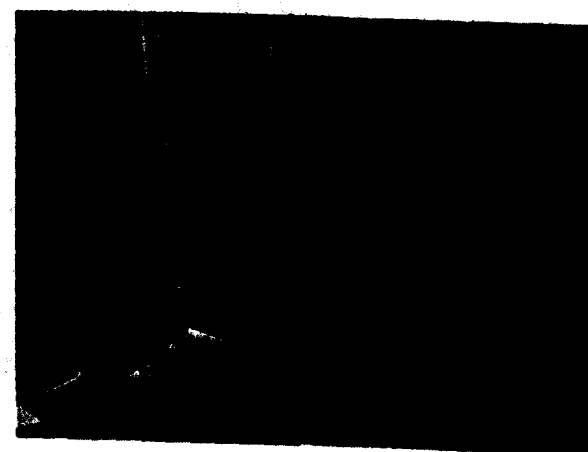
The properties obtained on vacuum refined metal are particularly gratifying since they come from a furnace which produces the desired effects at a fraction of the cost of an equivalent conventional vacuum melter. With a reasonable degree of utilisation actual costs are only a few annas per pound of metal treated.

CONCLUSIONS

The Mains Frequency de-gassing and vacuum refining furnace can bring practically all the benefits of vacuum melting into the foundry and melting shop at an extremely low capital and operating cost. It provides a tool which gives close control over gas content, chemical composition and metal temperature. This vacuum treatment method involves relatively

small changes in an existing melting shop and, since the equipment normally has fully automatic control gear and ample safety interlocks, it does not demand the extensive training of operators.

Mr. K. PADMANABHAN



Mr. K. Padmanabhan, Sales Manager, Industrial Rubber Products and Dunlopillo, Dunlop, India, returned from the U.K. in August, after an extensive study tour. Mr. Padmanabhan visited associate factories in the U.K. to study the latest production methods and developments in the manufacture of conveyor and transmission belting and other industrial rubber products. He also visited associate factories in France and Germany.

SIZES AND SHAPES FOR FIREBRICKS

The purpose of IS : 1526-1960 Sizes and Shapes for Firebricks prepared recently by ISI is to meet the need for dimensional standardization for refractories in this country which has assumed great importance in view of the large programme of industrial expansion anticipated during the next few years and also because of the decision of the Government of India to changeover to the metric system. The standard specifies nominal sizes and shapes for firebricks of 230 mm. series. Its scope is limited to those shapes which are mostly used in steel plants and those which are common to several other industries. Indian Standards for sizes and shapes of 300 mm. (or 12 in.) and higher series of firebricks and for silica bricks are under preparation.

THE CHEMICAL INDUSTRY IN CZECHOSLOVAKIA

By Our Special Correspondent

THIS year, Czechoslovakia is celebrating the 15th anniversary of her liberation from Fascist occupation.

It is an indisputable fact that in all branches of activity, Czechoslovakia has made striking achievements which manifest themselves in the rising living standard of the people.

Numerous Indian friends have obtained first-hand evidence of this development during their visits to our country.

In this article, we wish to outline the attainments of one important sector of the Czechoslovak

economy—the postwar development and future outlook of the chemical industry.

In the course of the war, production in Czechoslovakia's chemical plants was severely curtailed, many being almost completely destroyed.

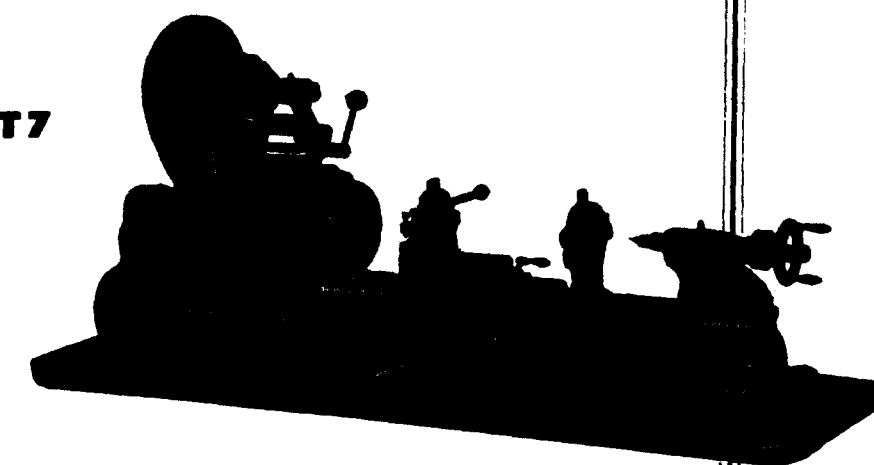
After the liberation from Nazi occupation the chemical industry, together with the other sectors of industry, was nationalized as part of the socialist reconstruction of the State.

The Czechoslovak people went to work at once on the reconstruction and renewal of existing plants, a

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well as on a programme of modernization of the industry and the establishment of new branches of manufacture.

The first Two-Year Plan saw the completion of the reconstruction programme; production was renewed everywhere and as early as 1948 the chemical industry topped the prewar output level by 10%.

The succeeding economic plans assigned high priority to the chemical industry with the result that in 1959 the gross production value was 3.5 times that of 1948.

A substantial renewal and expansion programme was carried out especially on oil refineries and coal tar processing; a large plant for the manufacture of tar dyestuffs and pharmaceutical materials was completed and the production of basic inorganic chemical materials expanded.

In the course of the twelve years from 1948 to 1959, investment in the chemical industry totalled about 14 milliard Kcs (i. e. approximately 950 crores (Rps)).

The goals set for the chemical industry under the third Five-Year Plan beginning in 1961 are even more ambitious. The third Five-Year Plan is a development programme for a highly advanced socialist economy and will do much to strengthen the industrial character of Czechoslovakia. Under the terms of the industrial development programme, the chemical industry is given first place among all industrial sectors. For this reason, the directives for the detailed chemical development programme under the third Five-Year Plan assign exceptionally large sums, totalling more than 20 milliard Kcs (1333 crores (Rps)), for investment in this industry.

The chief production tasks to be fulfilled during the coming Five-Year Plan may be outlined in several figures. The following output levels are to be attained by 1965:

- 1,000,000 tons of sulphuric acid
- 3,000,000 tons of fuels
- 100,000 tons of chemical materials
- 300,000 tons of nitrogenous fertilizers
- 300,000 tons of phosphate fertilizers
- 180,000 tons of plastic materials.

Raw materials for this development will be supplied by Czechoslovakia's own mineral resources, such as coal, magnesite, calcium carbonate, etc.

Source materials not available locally will be supplied chiefly through cooperation with the member countries of the Council for Mutual Economic Aid, in particular the USSR.

An important contribution to the expansion of Czechoslovakia's raw material supply will be the transport of crude oil from the abundant Soviet deposits to Czechoslovakia by a special pipeline.

The fulfilment of these tasks, arising out of the ambitious rate of development of the chemical industry, will be aided—last but not least—by the high level of general industrial development of the country, based on the outstanding degree of expert training and qualification of workers, technicians, and engineers.

In the sphere of foreign trade in chemical materials and products, Czechoslovakia figures both as an importer and exporter, a fact which is only natural in view of the importance and rapid advance of the industry.

Czechoslovak chemical products are found on markets throughout the world. The chief export items up till now have been basic materials and semi-products of the chemical industry, in particular those of the coke-processing and petrochemical sectors, while final products have been less frequently represented.

Exports from Czechoslovakia to India at the present time include pharmaceutical materials, sodium hydrosulphite, potassium permanganate, sodium sulfoxylate, ultramarine blue, tar dyestuffs, organic intermediate products, etc.

The industrial and agricultural development programmes undertaken by India, as indicated by experience gained in other countries, call for increased supplies of further chemical raw materials, semi-products, and final products. India is moreover engaged in establishing her own chemical industry. It is justifiable to conclude, therefore, that the opportunity exists for a substantial increase in the exchange of chemical products in the course of the coming years.

The Specialized Development of Liquid Level Sight Gauges, Relief Valves and Resilient Grip Mounting Bolts

By G. R. Young
Sales Promotion Engineer

THE possibilities of a world wide market for products of a narrowly specialized nature have provided the incentive for many firms to concentrate on the development and manufacture of articles which would otherwise be made, either by the consumer because they are unobtainable, or by a manufacturer whose main interest lies over a large range of fittings.

The associated companies of Seetru Limited and Resilient Grip Limited of Bristol, England, are taking advantage of this situation by concentrating their efforts on the production of the highest quality Liquid Level Sight Gauges, Relief Valves and Resilient Mounting Bolts.

SEETRU LIQUID LEVEL SIGHT GAUGES

These gauges are patented in many countries and have been developed to provide an ideal method for the indication of liquid levels, the simplest of these is called the "Lightweight" model and consists of a glass or plastic sight tube connected at its bottom end to the banjo shaped collar. This collar can either be fitted directly to the face of the storage tank by means of a special adaptor, or may be connected into the pipe line leading from the tank thus alleviating the necessity of boring an extra hole for the gauge in the wall of the tank. Using this method, the flow of liquid through the banjo is uninterrupted and an accumulation of sediment is discouraged as a result.

Many variations of this simple design are available to provide flexibility of operation, such as automatic safety valves, drain valves, shut off valves and top tank connection (for use with volatile and pungent liquids or where maintenance of pressure or vacuum within the tank is desired). The automatic safety valve is the most important development and is fitted in the banjo collar and operates under an excess flow of liquid into the gauge. Therefore, should the sight tube be broken or the glands damaged and caused to leak, the safety valve will operate and stop any loss of liquid. This is a most important accessory and provides an excellent

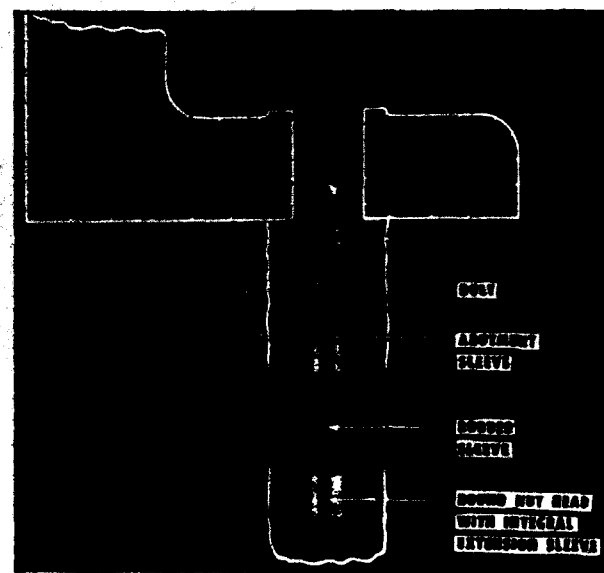
deterrent against fire risk or the escape of dangerous chemicals.

One of the difficult problems of gauge design was to provide a gauge that could be easily repaired and cleaned without first emptying the tank. Seetru Limited have successfully solved this problem in the



design of their "Quickmount" Gauge. The sight tube and banjo are similar to that of the "Lightweight", but it is mounted on special nipples fitted to the wall of the tank. These nipples have a manually operated screw valve in the centre and a straight portion of outside diameter over which the banjo is

located and secured by a hexagon nut, the banjo being sealed on either side by 'O' Rings. Hence, when the manual valve is shut the whole of the sight tube and top and bottom banjo assembly, or only the one banjo if the top of the gauge is open, may be quickly removed for maintenance and cleaning. It is easy to appreciate the value of such a gauge, maintenance time being cut to a minimum as the plant need not be shut down. Such a gauge, when fitted with drain valve and automatic safety valve is called a "Complete Quickmount" gauge and provides an absolutely safe installation for fuel oil plants or where conditions may call for frequent cleaning and continuous running of the plant.



A push button gauge has also been developed for use on ships. This is the "Marine" gauge and conforms to the standards set by Lloyds of London. Great care was taken in its design to ensure absolute safety against fire risk. The spindle of the push button is not directly connected with the spindle of the valve and allows a small amount of free movement before contact is made. This ensures that if the push button is damaged or even completely disembodied from the mounting, the valve, which is situated well within the tank itself, cannot open to allow any liquid to escape. To open this valve by any other means than the push button it would be necessary to puncture the tank itself.

Between them, the "Lightweight" "Quickmount" and "Marine" provide Liquid Level Sight Gauge for all possible installations with absolute safety and ease of operation and maintenance.

SEETRU RELIEF VALVES

This range of relief valves employ new valving principles which set a completely new standard of endurance and reliability for a wide range of pressures and applications. The most important characteristic



of these valves is that they will remain absolutely leak-proof and stable, however often they may have blown off in service.

It is a common failing of relief valves, that whilst they seal satisfactorily when newly assembled, the valve seats get damaged and pitted when the valves lift and reseal violently, and as a result of this, after a period, the seal of the valve is impaired and leaks continuously with great detriment to the installation as a whole.

The Seetru Relief Valves employ a taper plunger mating with a stainless steel seat. In addition, it has a special rubber ring on the plunger. This provides an additional positive seal, but it is not required to take the seating pressure and thus is not subjected to any deformation, wear, or abrasion. This special patented ring called a "Lipped D-Ring" automatically performs a sealing operation, whenever the valve is seated, and will do so however often the valve is blown off previously, even if the valve seat and the valve plunger are some what worn as a result of long service.

The Seetru Lipped D-Ring exhibits the outstanding and reliable self-sealing properties of the rubber 'O' Ring. However, it has long been known that the rubber O'Ring cannot be used satisfactorily in taper seating relief valves, as they become dislodged by fluid pressure when the valve opens. The special design of the lipped D-Ring and the valve plunger on which it is fitted, ensures that the ring never becomes dislodged during operations and gives long reliable service.

Where temperatures or solvent conditions cause some deterioration of the rubber, in the cause of long service, it is possible in a matter of a few minutes and at the cost of a few pence to replace the lipped D-Ring with a new one.

For conditions where liquids or gases would be harmful to rubber, rings made of special compounds are available. This enables valves, especially those fitted with side connections and used on pump by-pass lines, to be used in chemical plant or fuel refinery applications that would otherwise be prohibitive.

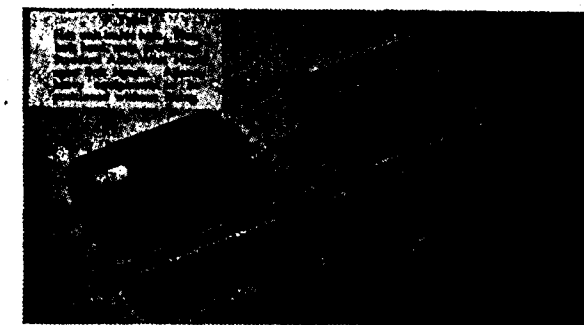
All Seetru Relief Valves are set and tested at the works before dispatch but some models can be readily adjusted in service to any modified blow off pressure desired. They are manufactured to suit a large range of B. S. P. fittings of both male and female.

Seetru Relief Valves have proved their value during long tests in laboratories and in long service and thousands are in use in a very wide range of industries. Here are some of the better known applications :—

Air cushioned water storage pressure tanks.
Pneumatic starting systems for oil engines.
Mobile and stationery compressor plants.
Pump by-pass valves for water, fuels, etc.

RESILIENT GRIP MOUNTING BOLTS

Many different types of anchoring methods have been developed in recent years, but few have been so



successful as Resilient Grip Mounting Bolts. These bolts have a moulded rubber sleeve which when compressed axially will expand laterally and grip the side of the hole in which it is placed.

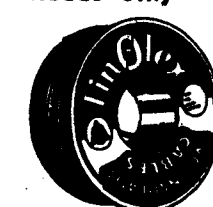


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formers, triple-phase selenium cell welding transformers provided with rectifiers, welding generators, point and line welding machinery, further pointless and pointless wire welding machinery. In addition to the above machinery a high quality and reliable ignitrone control equipment eliminating faulty welding has appeared on the market, which connected to point, line and pointless welding machines will ensure a current and time regulation set in advance.

The present high standard of our welding industry is ensured by the production of machinery and transformers having the following technical characteristics:

With the NGH 2 type single-phase welding transformers clear and even seams can be made. The lifetime of the transformer is long, since apart from the choking regulator it has no moving part. It is reliable even under hard working conditions. As regards its technical characteristics it should be pointed out that while the VDE specifies a 55% exploitation factor for the rated welding current, the NGK 2 is dimensioned for 70% at a rated current of 250 Amperes.

The HE type triple-phase arc-welding transformer with dry selene cell rectifier will load evenly the triple-phase alternating current net-work and is suitable for direct current arc-welding. The working lifetime of the built in selene rectifiers is 8—10,000 hours that is practically limitless. Moreover the reception of impulse like over-currents does not affect the lifetime. It is made in two sizes. The output of the type HE 160 is 9 kVA, its idle running voltage: 50 V, control range of current 30—160 Amperes, maximum welding current: 160 Amperes. The output of the HE 200 type is 15 kVA, its idle running voltage: 50 Volts, control range of current 40—250 Amperes, maximum welding current 250 Amperes.

In addition to the above types the 3/1 phase, alternating current arc-welding transformer is being

developed at the moment.

The DSG 92/12 type welding machine is composed of a special direct current welding generator and a triple-phase—short circuited—induction motor. The machine unit corresponds to the VDE 0540 specifications. Its rated current is 280 Amperes. The current value can be adjusted between 20—400 Amperes.

This group of machines meets world market requirements up to 100%, both as regards design and working safety.

At the moment a combined point and line welding machine with ignitrone tube automatic control is in the stage of production, for an output of 25 kVA. For the resistance welding technology the Hungarian welding industry is producing today the following machinery:

P 8 and P 25 type point welding machines, with a rated output of a 8 and 25 kVA respectively.

VH 25 type seam welding machine with a rated output of 25 kVA.

The T 30 type pointless welding machine has an output of 30 kVA, maximum cross-section to be welded is 500 mm².

In the series of wire welding machines two types are mostly in use: the TH 5 and the TH 30. Their connection output is 5 and 30 kVA respectively. With the type TH 5 steel wires of 1.5—6 mm diameters, copper wires of 1.5—3 mm diameters or aluminium and brass wires of the same diameters can be welded together.

Today the further development of welding in Hungary is ensured and supported by scientific work and in addition to the regular types the research workers and designers are in a position to create individual types, the so-called single purpose machinery as well. The machines are marketed by the TRANSELEKTRO Hungarian Foreign Trade Company for Electrical Equipment and Supplies.

Steel for Wagon Manufacture—Railways to Import One Lakh Tons

Railways are meeting the full demands of the coal transport almost from the beginning of September and 5,000 wagons a day are being moved to the Bengal-Bihar coal area. This was disclosed by a spokesman of the Railway Board who said that in the first six months the wagon allotment was 4,150 a day as against 4,550 indicated country. The railways would be importing one lakh tons of steel from abroad for various purposes, including the manufacture of wagons, with the resources available from the World Bank and Development Loan Fund. It was the aim of the railways to build 24,000 wagons in a year as against the present production of 15,000 to 20,000 wagons in a year.

NEW HUNGARIAN ELECTRONIC INSTRUMENTS

By A Technical Correspondent

THE rapid technical development of our days calls for an increasing number of electronic measuring instruments to be employed not only in research work and laboratories but in industrial plants and workshops.

Take for instance a radio and television factory or a microwave reporting chain installation or a wire communication network in general, and it will be clear that neither of them can do without an adequate number of electronic instruments. It is beside our point to enumerate all the various industrial branches which avail themselves of such instruments during their daily work, yet a hint at the regulation and control of automatic production devices or at the industrial testing of materials will perhaps be helpful to gauge the scope of their practically unlimited application.

At present Hungary is the leading manufacturer of electronic instruments in Central Europe, producing as it does a great variety of such instruments on a very high technical level. Here follows a sketchy description of some more recent additions to that extensive range.

The Workshop Signal Generator type 1166 is an indispensable piece of equipment wherever there is need for a signal of predetermined frequency and amplitude in a high-frequency range from 100 kc/s to



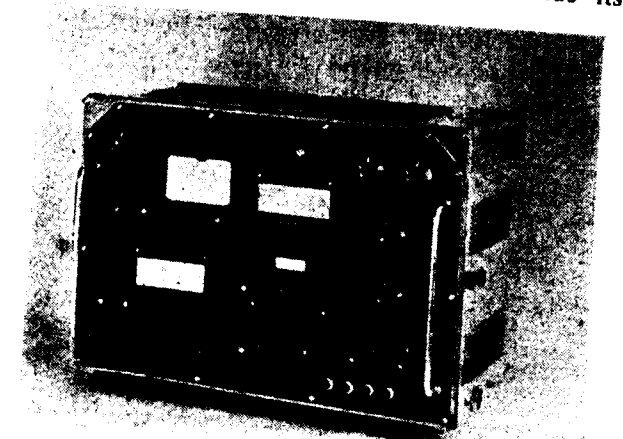
30 Mc/s. Its design is an entirely new concept. The frequency scale is much greater than usual and a push-button commutator system is provided to control such

processes as frequency change, service system selection and other switching actions between the circuits.

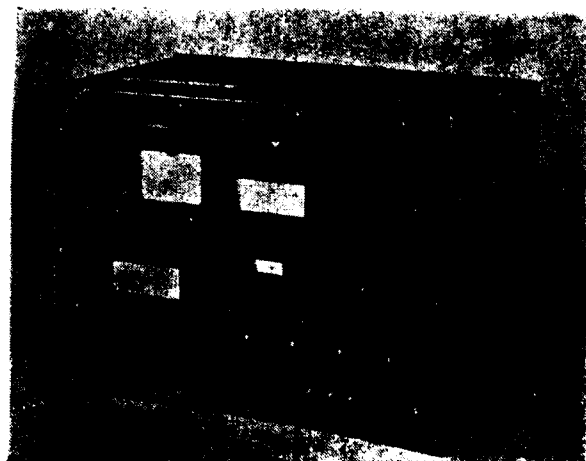
The recording of selectivity curves is made possible by means of a special 4 Mc/s oscillator incorporated to increase the accuracy of setting the basic frequency.

In addition to the well-known applications of ordinary signal generators, the apparatus can be used as a heterodyne wave-meter operating within specified frequency range. Apart from the 4 Mc/s oscillator referred to above, there is an oscillator of 1 Mc/s frequency to calibrate the oscillator built up of LC circuits. In that way the output frequency approximates in precision that of a crystal oscillator.

The Signal Generator type 1177 which operates in the frequency range of from 3500 to 7500 Mc/s, can be used as a supply unit for low-power microwave measurement. With its 1 mW output level it lends itself



to determining the sensitivity, the noise factor, the intermediate and full band width of radio receivers, the resonance frequency, resonance curve and quality factor of cavities, etc. Its various modulation facilities, such as internal and external pulse, internal square-wave, internal and external frequency modulation, add to the versatility of the apparatus.



frequency ranges as high as this. It incorporates many a technical feature that will satisfy the most exacting demands.

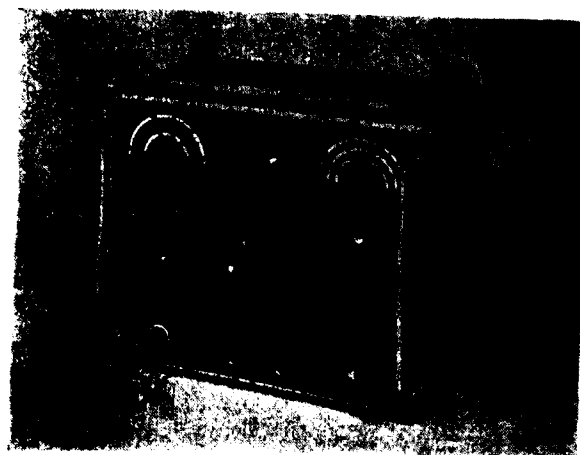
A fully transistorized model is the *Audio-Frequency Generator type TH 11* which covers the frequency range 20 c/s to 100 kc/s in four bands and has a frequency accuracy of 2 per mille. Output power 4 mW at 600 Ohms. Distortion between 20 c/s and 50 kc/s less than 1%, between 50 c/s and 20 kc/s less than 0.5%. Level fluctuation between 20 c/s and 20 kc/s remains within ± 0.5 db. The apparatus which embodies in its design a Hungarian patent, can be operated in spite of its transistorized circuits both from the mains or, in want of that, from three torchlight batteries of 4.5 V each.

The *Frequency Spectrum Generator type 1181* is a crystal-controlled unit for producing precision frequencies from the audio range up to 10 Mc/s. It is of equal use to laboratories and workshops, wherever high frequencies accuracy is essential.

Functioning as an active generator, it produces sinusoidal signals on three frequency bands, sharply peaked pulses on another three bands and wide frequency-spectrum signals on four bands with accuracies corresponding to the built-in quartz crystal $/1.10^{-5}/$. There are two crystal oscillator stages, one to supply an 1 Mc/s frequency which can be reduced through four multivibrator frequency dividers to 100, 10, 1 and 0.1 kc/s; the other to supply a 10 Mc/s frequency. A built-in mixer stage permits unknown frequencies to be compared and determined.

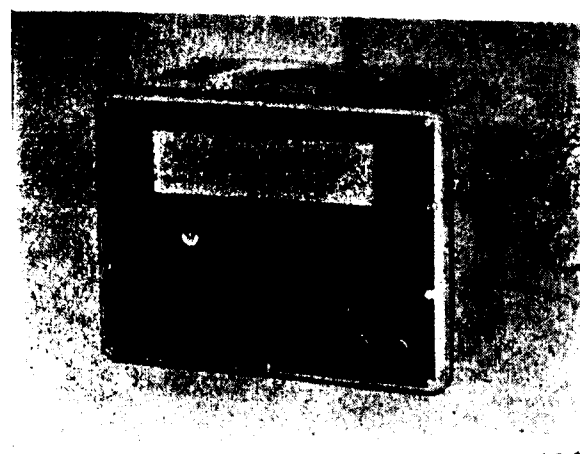
The *TV Signal and Pattern Generator type 1193* allows the receiver set to be tuned and adjusted independently of the TV transmitter. It furnishes all test signals and patterns specified by international

standards for use in TV engineering. The testing facilities it offers cover such details as the picture size and situation, its sharpness and linearity, the various intermediate frequency stages of the receiver, etc. The furnished patterns allow the scanning and the gradation of the video unit to be tested. The high-



frequency unit is tuned to 12 fixed frequencies which can be selected by means of a drum commutator. These frequencies, unless it is explicitly desired that they should follow CCIR regulations, are made consistent with the TV picture-carrier frequency channels specified in OIR recommendations.

The *Sweep Generator type 1194* is used both in laboratories and in workshops for setting and checking the high-frequency, intermediate frequency and video frequency stages of TV receivers. The curves of the tested amplifiers and filter circuits can be demonstrated on an oscilloscope attached to the apparatus.



It can be put to the examination of dipoles and quadripoles ranging from 100 kc/s to 230 Mc/s. The frequency deviation is variable from 0 to 10 Mc. The marker signals which are produced by a crystal-controlled generator at frequencies of 10 Mc and 2 Mc.

become apparent on the oscilloscope screen in the form of extinguishing dots interrupting the luminous curve. Stabilized power supply units energize the various parts of the apparatus, retaining as much as 3 V as reserve for the attached oscilloscope, if any, to be fed with. This voltage is utilized by the oscilloscope as phase shifter for horizontal deflection so that, on proper adjustment, a nearly rectangular figure will be seen on the cathode-ray screen.

The *High-Frequency Oscilloscope type 1546* which operates in 0—25 Mc/s frequency range meets the widest laboratory demands. Features like the transmission of pulses in true shape, the possibility to stretch the figure appearing on the screen or the incorporated voltage calibrating circuit, make the apparatus suitable for all current measuring procedures encountered either in TV engineering or in pulse transmission technics.

The electric design and circuit arrangement of the *TV and Pulse Oscillator type 1543* offer many an advantage that the user will only become gradually



aware of during use. Though its frequency range /20 c/s to 10 Mc/s/ is narrower than that of the former, the apparatus will lend itself to all measurements which do not require signals to be examined, beginning from D. C. ones.

Type 1316 is a high-sensitivity *Vacuum-Tube Voltmeter and Selective Amplifier* with wide frequency range /8 c/s to 600 kc/s/. It gives appreciable service in measuring or checking the voltage and gain conditions of low-frequency amplifier and transmission equipments.

The widely extended scale which covers the full range in 12 bands, gives convenient voltage readings from values as little as 30 μ V up to 100 V. The apparatus when used as a selective amplifier, provides gains of 2000 and 0.0063 in the first and the last band, characterized by μ V and 100 V full scale deflection values respectively. The linear distortion of the amplifier up to 300 kc/s amounts to a mere ± 0.5 db and does not exceed ± 3 db at a higher frequencies.

The *Audio-Frequency Millivoltmeter type TH 21* takes voltage measurements in the 20 c/s to 20,000 c/s range.

To facilitate readings, the entire range extending from 1 mV to 300 V is split up into 12 bands, so that voltages as little as 30 μ V will produce clearly discernible deflections. The apparatus is of a fully transistorized design, the incorporated batteries being sufficient for about 300 hours of service.

The *SHF Frequency Meters type 1616/2 and 1616/3* cover the ranges of 3500—7500 Mc/s and 7000—10,500 Mc/s respectively. These frequency meters which operate in the same ranges as the 1177 and 1178 type signal generators, offer their users the advantage of accomplishing measurements which have hitherto been hardly performable, if at all. They excel among comparable instruments by their straightforward design combined with convenient handling and remarkable measuring accuracy $/\pm 0.3\%/$.

Their construction makes use of the absorption system. Adjustment of the resonance point is by tuning a microwave cavity. There is a built-in indicator instrument and a potentiometer for sensitivity adjustment. For low-power frequency measurement an amplifier of higher sensitivity can be connected to the terminal point of the separately led-out diode. The apparatus is fitted with 50 Ohms international BNC outlets.

The *Stabilized Power Supply Unit type 1833* is a high-capacity laboratory instrument suitable to furnish simultaneous independent d. c. voltages, e. g. an anode and an auxiliary-grid bias voltage or two different negative grid bias voltages.

Not being grounded, the various independent units can be connected in series. With each unit supplying 300 V, the total obtainable voltage is 900 V. There are four incorporated instruments which can be switched over to act either as voltmeters or as ammeters. Two of the high-voltage units can be loaded with 100 mA, the third with 50 mA. The unit supplying the grid bias voltage can be loaded up to 1 mA. Variable voltages are obtainable between 0 and 100 V from the unit and between 0 and 10 V from the other. Apart from the stabilized voltage values already mentioned, the apparatus can be put to supplying filament voltages, complying in value to current tube types.

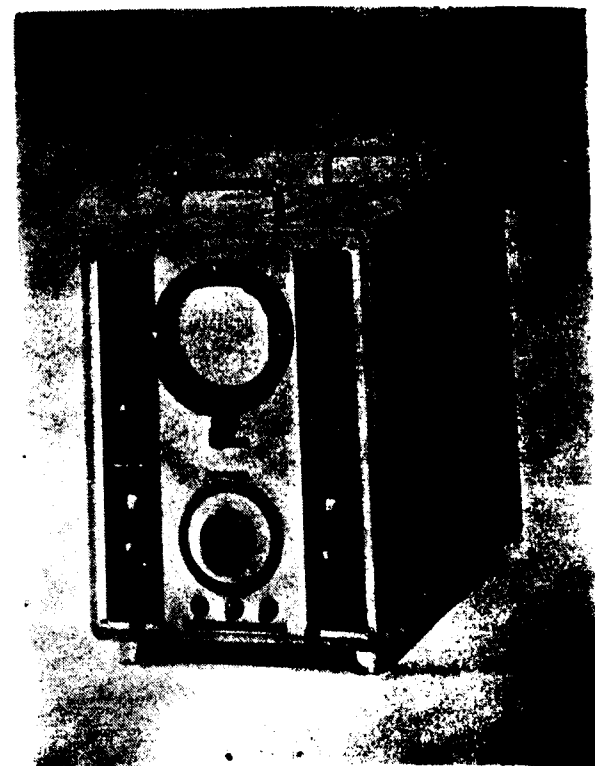
The Transistorized Power Supply Unit type TH 51 is a stabilized equipment to furnish high current intensities at low voltages. Its main application is in connection with apparatuses using transistors. A highly developed circuit arrangement which renders the output voltage independent of main voltage fluctuation, electric load and ambient temperature, makes the equipment nearly equal to the best electron-tube stabilizers.

The control parameters, owing to the considerable error signal gain and the special circuit design, fall little short of the ideal over the entire range. The output resistance, being practically zero at currents from 0.25 to 1.5 A, does not exceed ± 0.005 Ohm on the entire range. Fluctuations of ± 1 per mille to either side of the rated main voltage do not involve changes in excess of 0.003% at 20 V output voltage.

The Pulse-Fault Locator type 1158/S is used on both telecommunication and power transmission lines /cables, overhead lines/ for the rapid determination of defects as well as their sites and types. Considering its principle of operation, the equipment can be likened to a wired radar system with the difference that the time, needed by the pulses to cover the distance till the defective point of the line and back, is used for the site of the fault to be determined. The entire process appears on the oscilloscope screen and can be photographed there.

Its extraordinary speed of operation makes the apparatus suitable for the continual or periodical supervision of the line during service. The method offered by the use of this apparatus

is indeed the only one that permits an occasional fault / say a poor contact / of the line to be observed and located. Even complex line defects are



clearly discernible as to their types and sites, no matter if they are lying as far apart as 150 m and 150 km. The measurement is extremely simple, quick and precise to carry out. Heading of the result requires no expert skill and is taken direct off the instrument scale.

This was a cursory review of some representative items from the wide range of electronic instruments manufactured in Hungary. A complete list covering all the different types would require many times the extent of this report, their total number amounting to some hundred and fifty or more.

With any enquiries concerning details or models not dealt with above please turn to

METRIMPEX Hungarian Trading Company for Instruments,
Budapest V. Nador u. 21.

or to its agencies abroad.

Process Scheme of an Electrolytic Zinc Refining Plant

By An Overseas Technical Correspondent

THROUGH the versatile activity of the HUMBOLDT Works in ore dressing, it was only a few years after the firm was established that special attention was also paid to the related field of ore smelting. It, therefore, seems logical that the construction of smelting works for non-ferrous metals should ultimately find its way into the production programme.

Zinc occupies a leading position among the important non-ferrous metals. Its production calls for the application of procedures and furnaces that are entirely different from those usual in non-ferrous metallurgy. However, zinc is most suitable for electrolysis as no zinc anodes are required as starting material, the zinc sulphate solution obtained direct from the ores being used.

Unlike the dry process, high grade zinc with up to 99.995% Zn can be recovered in a single operation, both from high-grade and low-grade ores.

Let us, with the aid of the flowsheet reproduced above follow the procedure adopted in an electrolytic zinc plant designed and constructed by HUMBOLDT.

FOUR PROCESS STAGES

The electrolytic production of zinc is divided into four process stages:—

1. Roasting the zinc blende with subsequent recovery of contact sulphuric acid
2. Leaching the roasted blende with sulphuric or cell acid and subsequent chemical purification of the electrolytes
3. Production of cathode zinc by electrolysis, from the zinc sulphate solutions
4. Remelting the cathode zinc into commercial slab zinc, having a 99.99% zinc content.

1. ROASTING PLANT

On its arrival at the roasting plant from the ore yard the flotation blende is first dried. A steam-jacketed disc dryer (1) can be used to advantage for

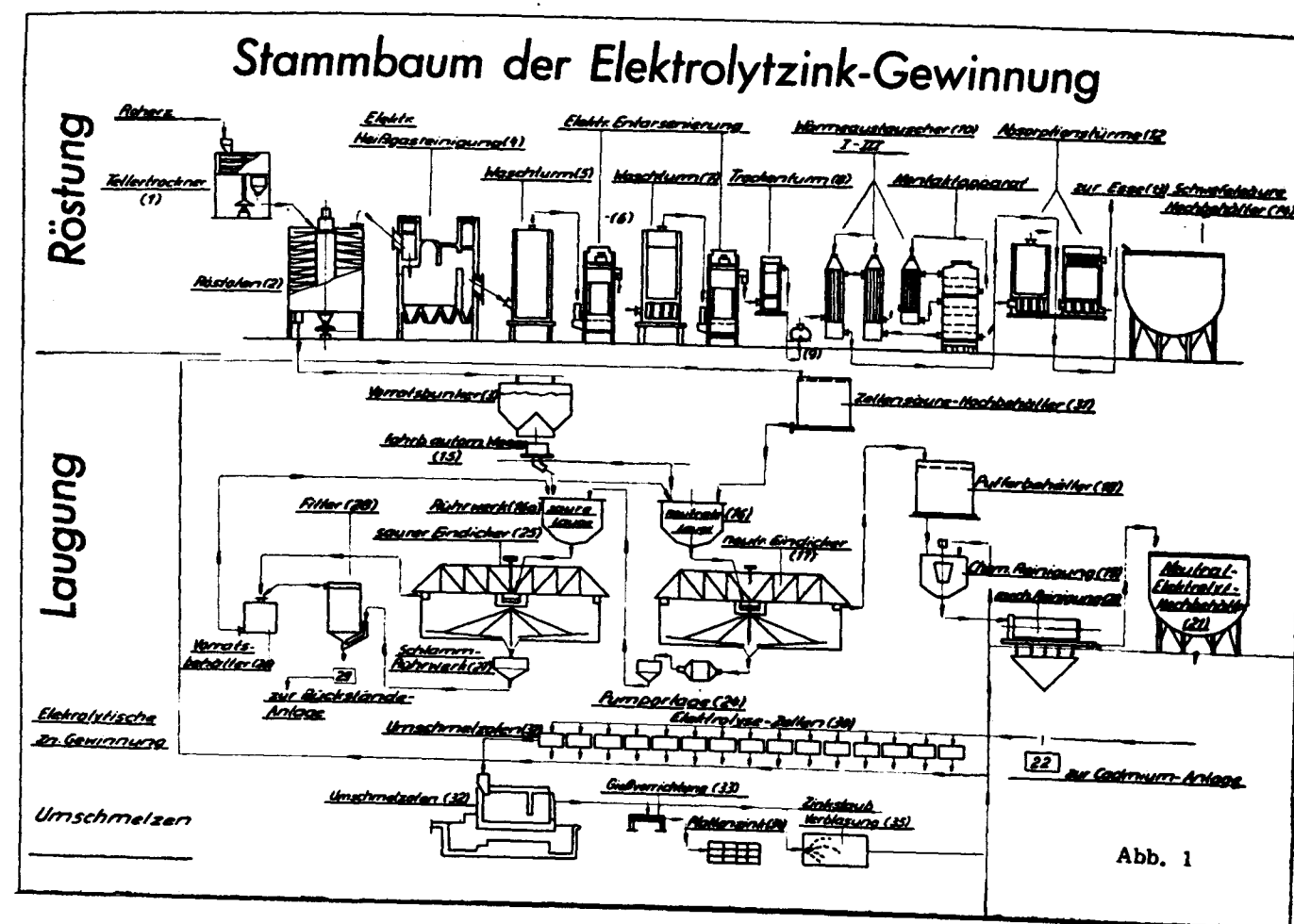
this purpose because, in addition to having a low steam consumption, it operates almost free from dust and without ore losses.

The dried ore has to be roasted in mechanical or flash roasting furnaces. The selection of the most suitable type of furnace will depend on the individual application and local conditions. If multiple-hearth roasting furnaces (2)—as shown in the flowsheet—are used the blende has only to be pre-dried until its water content is reduced to about 4%. Multiple-hearth furnaces have much in their favour for capacities up to 100 tons a day; as they are absolutely dependable and simple to operate they have the advantage over flash roasting furnaces. The heat from the roaster gases can also be utilized when operating with multiple-hearth furnaces; this is done by installing a suitable waste heat boiler.

HUMBOLDT also build flash roasting furnaces in units having capacities of 150 tons and more blende a day, where large throughputs are required and to special order. In any case flash roasting furnaces are provided with a waste heat boiler.

Upon leaving the furnace the roasted blende is transported through a screening and grinding plant to the storage bins of the leaching plant (3). (For clarity sake the handling equipment needed for this has not been included in the flowsheet; and to simplify matters the entire pipe system for the roaster gases has not been indicated.) A contact sulphuric acid plant has been provided for processing the blende roaster gases. As will be seen in the flowsheet, the gases must be thoroughly dedusted. The standard plants are equipped with an electrostatic precipitator of the Cottrell type (4) for this purpose. In the past few years HUMBOLDT have developed their own hot-gas cyclone dust collectors which exhibit practically the same efficiency as the Cottrell precipitators. HUMBOLDT thus build roasters with mechanical dust collectors attached, the operating costs for which are lower than those for a combination of furnaces and electrostatic cleaning plants for the roaster gas.

After the dust has been eliminated from the roaster



Flowsheet of an Electrolytic Zinc Refining Plant

- | | |
|----------------------------------|-----------------------------------|
| 1. Disc dryer | 18. Surge tank |
| 2. Roasting furnace | 19. Chemical cleaning |
| 3. Storage bin | 20. Mechanical cleaning |
| 4. Electrical hot gas cleaning | 21. Neutral electrolyte head tank |
| 5. Scrubber tower | 22. To the cadmium plant |
| 6. Electrical dearsenization | 23. Mill |
| 7. Scrubber tower | 24. Pump condenser |
| 8. Drying tower | 25. Acid thickener |
| 9. Exhauster | 26. Storage tank |
| 10. Heat exchangers I—III | 27. Slimes agitator |
| 11. Catalytic reactor | 28. Filter |
| 12. Absorption towers | 29. To the residues plant |
| 13. To the stack | 30. Electrolytic cells |
| 14. Sulphuric acid head tank | 31. Cell acid head tank |
| 15. Travelling automatic weigher | 32. Remelting furnace |
| 16. Agitator (Neutral solution) | 33. Casting unit |
| 16a. Agitator (Acid solution) | 34. Slab zinc |
| 17. Neutral thickener | 35. Zinc dust blowing equipment |

gas, the metals volatilized through roasting, such as arsenic, selenium, lead and cadmium, must be separated in a roaster gas cooling and scrubbing plant. For this purpose the roaster gas is washed with diluted sulphuric acid in two scrubber towers (5) in sequence. In addition to the metal oxides referred to, any chlorine and fluorine contained in the roaster gas are also removed by the scrubbing process; special subsequent operations are provided for eliminating them from the scrubbing acid.

The requisite fine cleaning of the roaster gases for the production of contact acid is done in a dearsenization plant, consisting of two electrostatic precipitators (6) and an intermediate tower (7). In this equipment the roaster gas is completely freed of moisture, that is, even the final traces of volatilised metals and SO_3 are separated in the form of condensate through the action of high-tension electric currents.

The cleaned but still damp roaster gas is then dried in a drying tower (8) by means of concentrated sulphuric acid. An exhauster (9) installed at the back of the drying tower sucks the roaster gas from the furnaces through all the aforementioned equipment and forces it through three heat exchangers (10) into the catalytic reactor (11). Here, through vanadium catalysts, the desired conversion to sulphuric anhydride is effected. To dissipate the reaction heat the converted SO_3 gases are first forced through the heat exchangers of the catalytic reactor and then through the absorption towers (12). It is in these that the desired commercial acid of oleum (fuming sulphuric acid) of various concentrations is formed. The commercial acid is stored in high-level tanks (14), whereas the residual gas is forced through the stack (13) into the open air.

2. LEACHING THE ROASTED BLENDE

Depending on the origin of the blende, its zinc content will fluctuate within a wide margin. In order to achieve a high electrolyte yield the percentages of sulphate-sulphur and sulphide-sulphur in the blende should, to keep constant the electrolyte stock, not exceed 1/2% and 1% respectively. High contents of cobalts, tin, arsenic and trace elements, such as germanium, greatly complicate the electrolytic process. Foreign metal impurities in the roasted blende, such as lead, copper, nickel, cadmium and noble metals, do not have a disturbing influence; they are separated as reclaimable by-products during the course of the process.

As will be seen in the flowsheet, the roasted blende is discharged from the storage bin (3) and by means of a travelling automatic weigher (15) it is accurately batched and fed into the neutral agitator (16). The agitator tanks are filled with a mixture of cell acid, acid electrolyte and, if necessary, fresh, diluted sulphuric acid. The leaching itself is done with special agitators, which stir the electrolyte-ore mixture from top to bottom at specific temperatures. As a general rule, 90 to 92% of the zinc content are extracted in a single operation, so that the solution is completely neutral.

The leaching process is carried out intermittently and lasts about four hours for a batch. If the test carried out during the leaching process shows that the entire iron has oxidised, the electrolyte is neutral and a good settling rate has been attained, then the charge is discharged into the neutral thickener (17). The clear overflow of the thickener runs off into a storage tank (18). From here it is pumped into the zinc dust precipitating vessels (19). There the cadmium and, at the same time, the copper and nickel contained in the electrolyte are precipitated by stirring in added zinc dust. Should the electrolyte contain cobalt, this must be separated in a special operation. The deposit produced in the zinc dust precipitating vessels is separated in filter presses (20) and transferred by car for special processing (cadmium extraction) (22).

After careful testing, and following the extraction of the alkali salts, the neutral electrolyte is forced into the high-level tank (21) and cooled down.

The slimes introduced into the neutral thickener (17) are once again acid leached to increase the zinc yield. For this purpose they are ground in a mill (23), collected in a pump condenser (24), whence they are forced into the acid agitators (16a). Here, by means of cell acid, the residual zinc is lixiviated to the greatest possible extent. After having reached a certain pH value, the acid electrolyte is drained into the acid thickener (25). The clarified overflow is collected in the storage tank (26) and fed in batches for neutral leaching into the agitator (16). The leaching circuit is thereby completed. The thickened acid slimes are accumulated in the slimes agitator (27), separated in filters (28), and transferred by car (29) to the residues plant.

3. ELECTROLYTIC TANK HOUSE

The neutral electrolyte flows by gravity from the high-level tank (21) into the electrolytic tank system. The electrolytic cells (30) are arranged in double rows.

In the middle of each row there is a distributor launder with the electrolytes. By means of Vinidur siphons the requisite quantity of neutral electrolyte is fed from this launder to each cell. When applied with about 10,000 amps. per cell the zinc is electrolytically deposited on the aluminium cathodes. The cell acid produced by the electrolysis flows from the cells through Vinidur pipes into a lower-level tank, from which it is forced at intervals into the cell acid head tank (31). The cathodes are lifted out of the cells by means of special hoisting gear and carried on runway rails to a stripper bench where the zinc is removed from the starting sheet cathodes.

4. REMELTING THE CATHODE ZINC

The cathode zinc is transported by special cars to

the remelting plant. Here there are low-frequency induction furnaces (32) in which the cathode zinc is melted down. The molten zinc is poured by hand into moulds (33) to produce commercial slabs weighing about 25 kilos. These are then stacked in the store (34) ready for dispatch.

Part of the molten zinc is blown into extremely fine zinc dust in a special zinc dust blowing plant (35), which is used for cleaning the solutions.

When the zinc is remelted a certain amount of zinc ash is produced. This contains a high percentage of metallic zinc. The metallic part of the ash is screened off in a screening ball mill and returned to the remelting furnace. The remaining zinc ash can be processed in the roasting plant.

FULLY INSTRUMENTED EXPERIMENTAL FORGE FURNACE

A new fully instrumented experimental forge furnace has just been completed in the Energy Section of the British Iron and Steel Research Association, Battersea, London. The furnace will be used to investigate the thermal efficiencies attainable in batch type heating processes. It is designed so that the material of construction can be varied, as can the heating schedule, type of fuel and furnace load, re-circulation and waste heat recovery techniques.

The heat capacity of the chamber can be altered by the provision of two alternative roofs, one of fire brick and the other of high temperature insulating brick. Oil or gas firing is provided for by means of three burners firing tangentially above the ingot and two below. The effects of convection and radiant heating can be studied. Comprehensive instrumentation allows calculation of complete heat balances at short intervals throughout the heating cycles.

REDUCTION OF STRAY RADIATION IN X-RAY TUBES

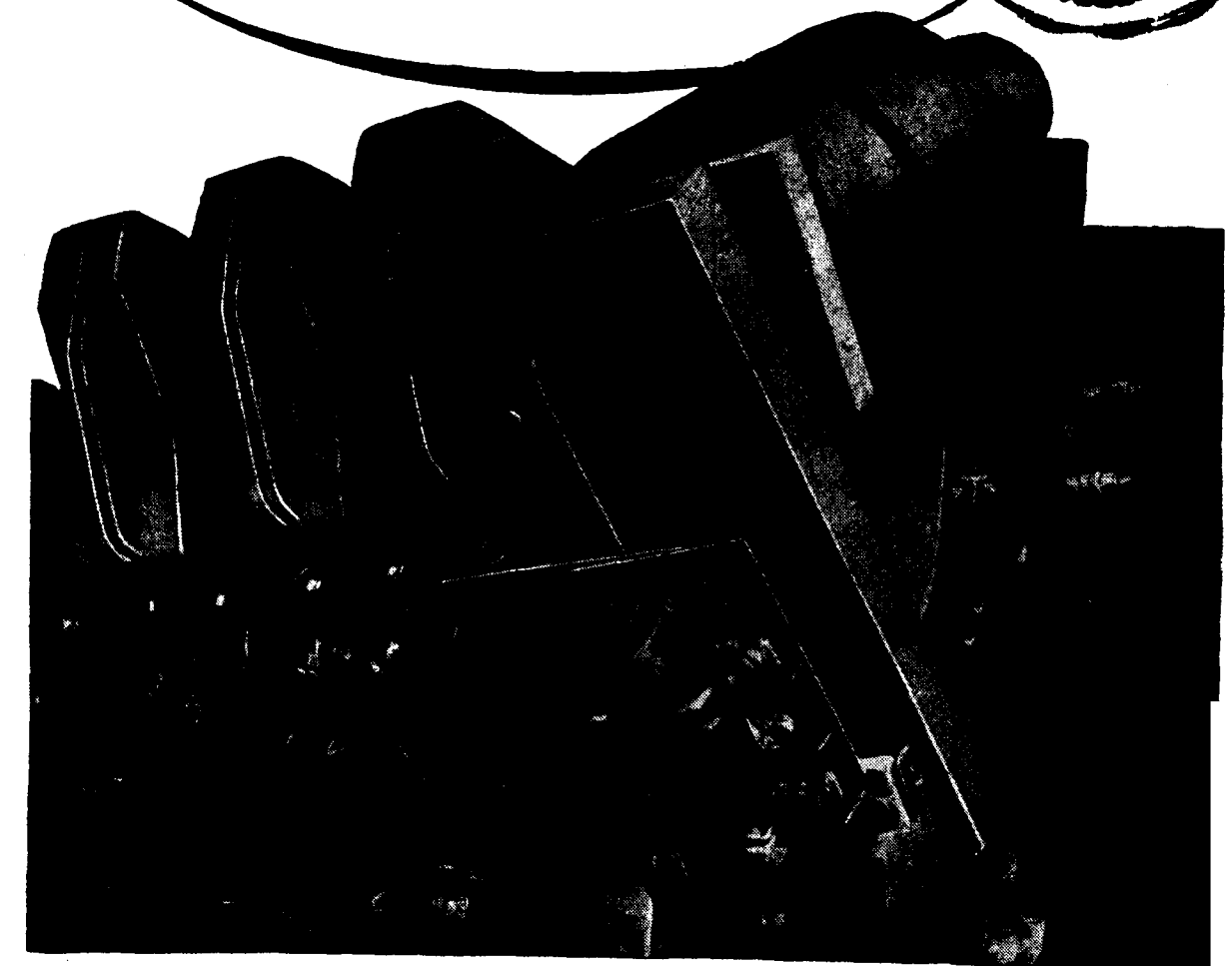
An essential and obvious requirement of any X-ray apparatus, whether for diagnostic or therapeutic purposes, is to stray, or "off-beam", radiation to be lowest possible level, in the interests of both patients and operating staff. In two diagnostic X-ray tubes recently developed by a U.K. firm the level of stray radiation has been reduced below that of previous

tubes: it is, in fact, so low as to be quite insignificant, the firm claims, in the assessment of the total X-ray dosage received by patients or staff.

These tubes, which have been named "Guardian", are rated at 150 kV and 125 kV respectively. When used at their maximum ratings the stray radiation is only one-tenth on the maximum acceptable level of 100 milli-rontgens an hour quoted in the Recommendations of the International Commission on Radiological Protection; and at the lower rating of 100 kV. 3 mA commonly used for screening (that is, direct radiographic observation on a fluorescent screen) it is less than one-thirtieth of the maximum permissible level.

The reduction of stray radiation is due to a newly-designed shielding in which the disposition of the X-ray absorbing materials has been carefully calculated to give maximum protection, and has been achieved with no significant increase in weight over previous tubes. The larger tube, the Guardian 150 will cater for the increasing use of radiographic techniques at voltages up to 150 kV. Its large, heavy target is designed for the shorter, heavy exposures demanded by modern radiological practice, and its very large thermal capacity—about 15 per cent. greater than in other large tubes in common use—makes it particularly suitable for angiography and cine-radiography where long series of heavy exposures are called for. The Guardian 125 is designed for general purpose radiography at voltages up to 125kV.

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MY IMPRESSIONS OF THE BRNO INTERNATIONAL TRADE FAIR 1960

By T. S. N. Rao

Managing Editor, Journal of Industrial Engineering

I recently visited the Brno Trade Fair in Czechoslovakia at the invitation of the Fair Administration Authorities and I have summarised my impressions in a brief manner.

THIS year's International Trade Fair in Brno, Czechoslovakia, was held between September 11th and 25th. Fifteen Czechoslovak Foreign Trade Organisations as well as numerous foreign firms from several countries of the world participated. In the Czechoslovak Engineering Works several thousands and thousands of Exhibits were displayed, the largest being those of STROJEXPORT, STROJIMPORT (MACHINE TOOLS INDUSTRY OF CZECHOSLOVAKIA) KOVO, MOTOKOV & TECHNOEXPORT which occupied approximately more than one half of the Exhibition allotted to Czechoslovak Exhibitors. Others of the Czechoslovak Industries who participated included OMNIPOL, FERROMET, METALIMEX, CHEMA-POL, CZECHOSLOVAK CERAMICS, GLASS-EXPORT, CENTROTEX, PRAGOEXPORT, OMNIA & UNICOOP.

The Czechoslovak foreign trade corporation of Strojexport displayed metal forming and die-casting machines, diesel engines, welding equipments, electrical machines, food-processing and ceramic machines, valves and fittings, pumps and compressors and transport equipments employed in Industrial undertakings.

STROJIMPORT exhibited machine tools of various types, all beautiful specimens of the Czechoslovak famous technical and engineering precision which highlighted the year's Fair. There were brisk and fruitful discussions and negotiations at the Pavillion of STROJIMPORT between the Officers of the Organisation and various foreign Industrialists & Businessmen.

TECHNOEXPORT displayed products and equipments in the sphere of Steam and Water Power Engineering, Rail-mounted Steam power plants, Equipments and machineries for Cement works, Water-Treatment and Airconditioning equipments, Equipments and Plants for Gasworks, Rolling Mills,

Woodworking Machine and various kinds of machineries for the Plastics, Rubber-processing Industries and some small complete Industrial Plants.

KOVO Foreign Trading Corporation, displayed Textile machineries, Leather/Rubber Machineries, Polygraphic machines, Photo-Cine Optical Equipments, Telecommunication equipments/apparatuses, Measuring & Control Instruments in Industries, TV Sets, Sanitary equipments, Laboratory Equipments, all of a very high order from the point of view of International Standards.

OMNIPOL displayed a wide range of Sport goods Firearms, Hunting arms, Sporting Planes and Trainer Planes.

DISPLAY BY FOREIGN COUNTRIES

A wide range of Engineering products were exhibited at the Fair by several hundreds of firms in Europe and Overseas, the number of such foreign firms having much increased than during the 1959 Fair. The SOVIET UNION was the biggest exhibitor of various types of Industrial Plants, Equipments, machineries at the Fair and its Pavillion was the centre of attraction for several Overseas and Foreign visitors.

The Soviet Pavillion occupied about 6500 sq. m. of both covered and open air space and the decorations at each stand were very attractive particularly during nights illuminated by hundreds of fluorescent and neon lights.

Other Socialist countries who participated in the 1960 Fair were China, Hungary, German Democratic Republic, Bulgaria, Poland etc.

From the Western world, who participated in this year's Fair, were exhibits of France, Federal Republic

of Germany, Belgium, Holland, Italy, Switzerland, Great Britain, Sweden, Denmark, Austria, Japan, Spain and Canada.

The Republics of Iraq, Morocco and Argentina had only official information stands at the Fair.

The well-known motor firms of Renault and Simca of France, Fiat of Italy, Rootes Group of British Motor Industries, A. C. E. C. and Electromecanique of Belgium, Philips of Holland, etc., displayed their products/equipments at this year's Brno Fair in good strength.

An important feature of this year's Fair, as it appeared to an overseas visitor, was the emphasis it laid upon modern technology; there were several technical meetings, scientific symposia and talks on technical precision and new technology in Industries, the main themes which preoccupied these participants in the discussions were :—

1. Fatigue of large machine parts.
2. Variable speed drives
3. The latest technological trends in the engineering industry
4. Bulk Yarns
5. Sanitary equipments.

My impression after visiting various pavillions at the Brno Fair was that Czechoslovakia has made a positive contribution to the development of International standards in the production of Industrial Plants and Machineries of various types of a high order and precision. Moreover the Brno Fair 1960 has surpassed all other similar Fairs held in Europe in the past years for its high quality, the methods of display of equipments, number of visitors from all over the world, volume of trade transacted, and above all the courteous hospitality and help rendered by all those in charge of the Fair Administration to the visiting tourists.

This has no doubt been due to Czechoslovakia's national characteristics, as a "nation of technicians" of a high order and precision and in my view this year's Brno Fair will lead to still higher success in the years to come with the result that Czechoslovakia will carve out for herself a place in the world as a key centre for trade between the East and the West.

The site of the Fair has been very well chosen, situated amidst trees, spacious grounds, the delightful

architecture of the pavillions, technique of illuminations and the layout of roads within the Fair Grounds to cope with such vast crowds of local and overseas visitors, interspersed with attractive lawns, decorative ponds, and ultra-modern exhibition halls of spacious types, all these lead to an impression that Czechoslovakia has probably the most modern fair grounds in EUROPE.

The Fair Administration has established a separate Press Centre under the guidance of Dr. Frantisek Kulovany and his able deputies who look after all the foreign Journalists arriving at the Fair. The Press Centre is a place of attraction for all the foreign visitors where one comes across several Journalists, Commercial Editors, Engineering Correspondents, News Editors of World Press and it is a thrilling experience to speak to them through several Interpreters and exchange opinions/ideas on various topics.

The Press Centre held several receptions in honour of visiting Journalists, press conferences addressed by high-ranking Officers of various Czechoslovak Commercial and Engineering Enterprises and film shows to demonstrate the advancement and progress of Czechoslovakia not only in the Engineering and Technological fields but also in other directions.

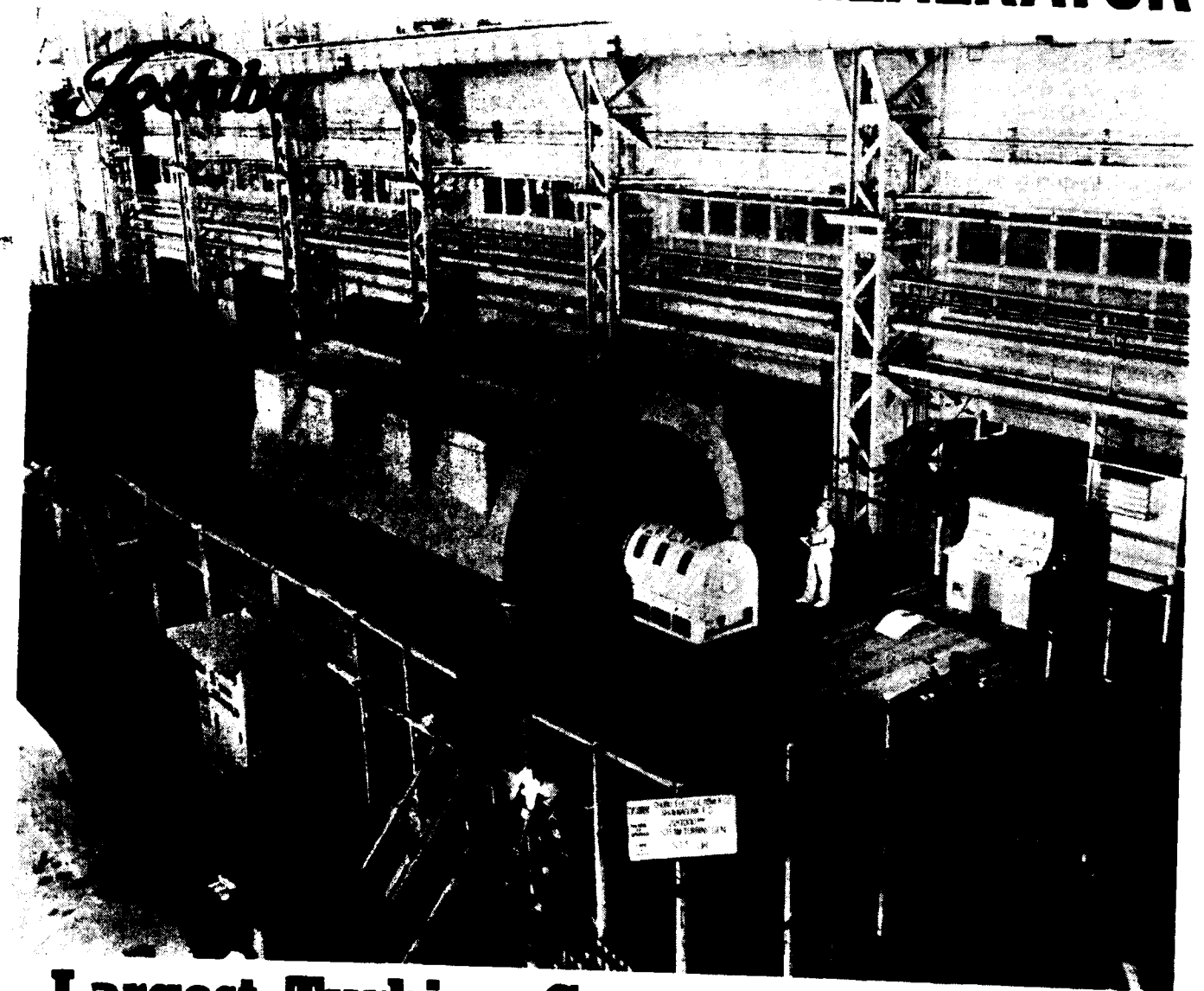
The one important aspect which strikes anyone, especially to a visitor from India and Far East, is the order and discipline in the daily life of the people of Czechoslovakia. In spite of the huge crowds which visited the Brno Fair every day, there were no stampedes, traffic jams, and the movement of visitors was rendered very easy by judicious planning of the entire Fair grounds and layout of Pavillions and Stands and roads leading to them. No policemen were to be found inside the Fair grounds excepting at the entrance and in one or two corners & excepting for the fire-fighting personnel, here and there.

The "social gathering" event at the PRESS CENTRE, in Brno Fair was remarkable, when all the visiting Journalists of the world witnessed various programmes. The Czechoslovak Folk Dances in their colourful traditional costumes was striking.

The visiting Journalists were taken round important cities of Czechoslovakia and places of historic and cultural interest.

The presidential palace in Prague is beautiful for its architecture and it is the official residence of

220,000KW TURBINE GENERATOR

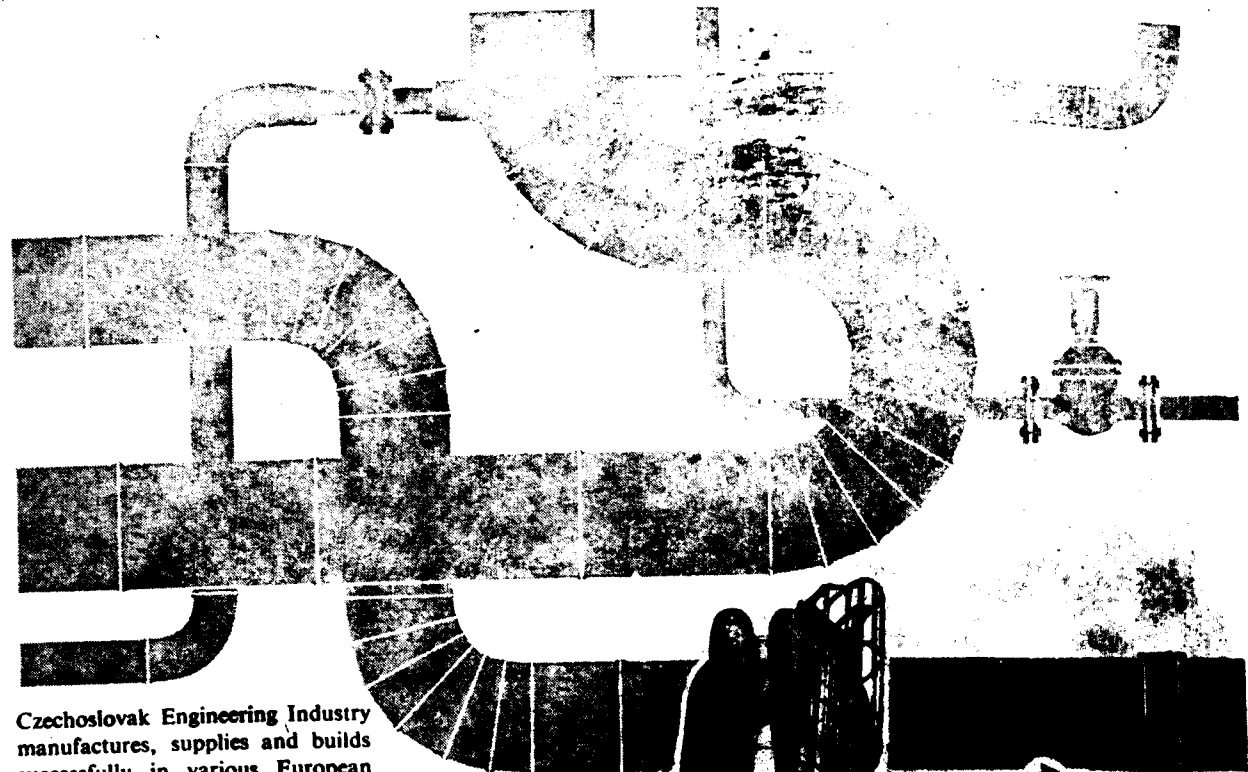


Largest Turbine Generator in Asia Produced by Toshiba

The 220,000 kW tandem compound type Toshiba turbine generator installed at the Shin-Nagoya Thermal Power Station of the Chubu Electric Power Company is rated 281,600 kVA at 2 kg/cm² hydrogen pressure. The largest in Asia and one of the largest in the world, this superior generator is the latest of many record-establishing turbine generators, 355 units totalling 6,180,000 kVA (4,890,000 kW), built by Toshiba since 1923. These turbine generators, as is the case with all Toshiba electric equipment and machinery, are outstandingly superior in design, dependability, durability, performance and efficiency. A catalogue of superior Toshiba products will be sent promptly upon request.

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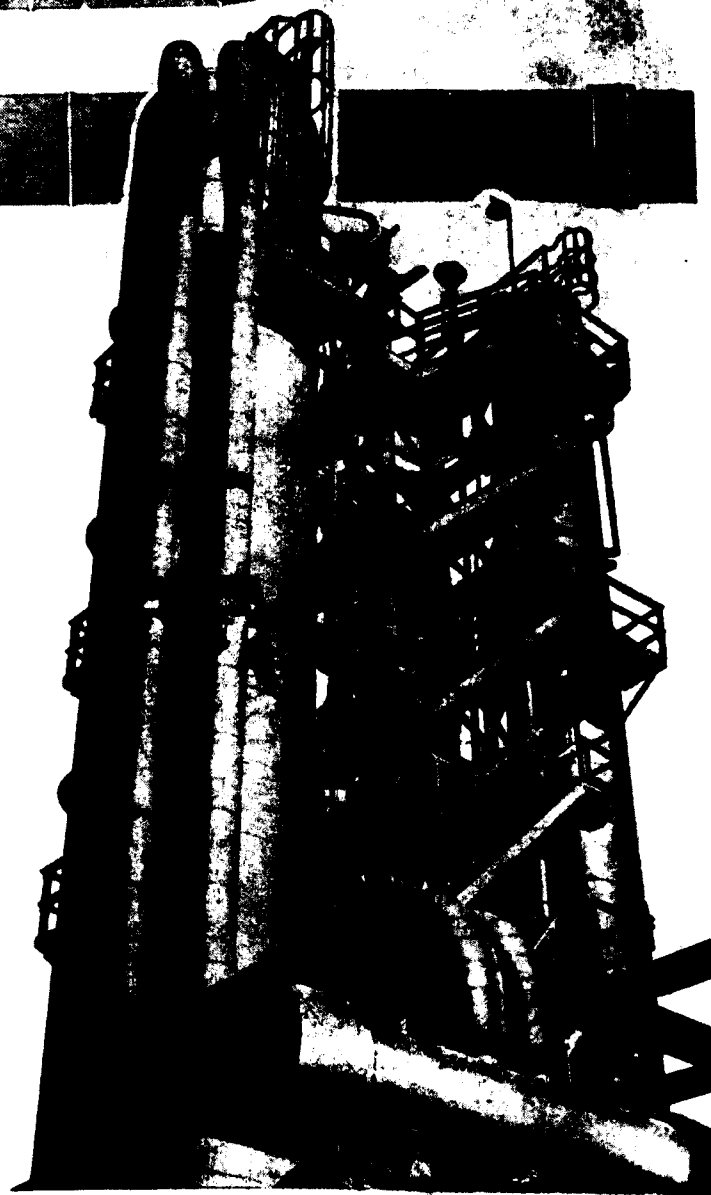
The oil refinery at Homs, in the Syrian region of the United Arab Republic has been completely equipped with machinery of Czechoslovak production.

We have the pleasure of inviting you to visit our exhibition at the Brno International Trade Fair, from 11th to the 25th September, 1960.

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