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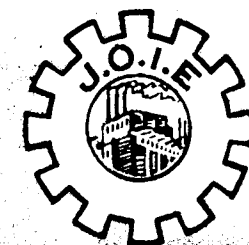
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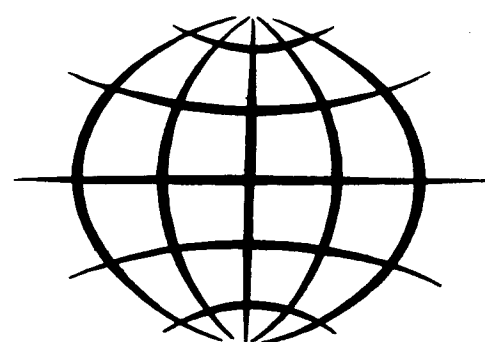
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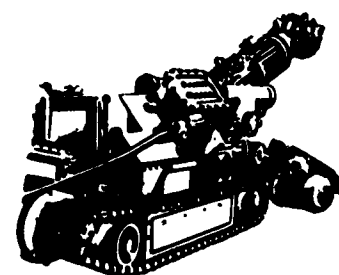
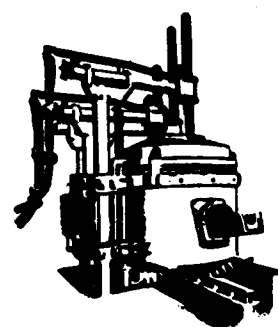
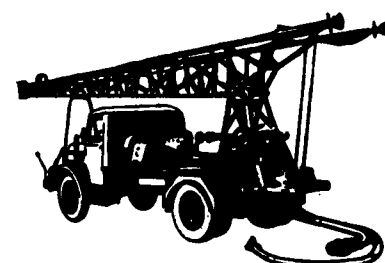
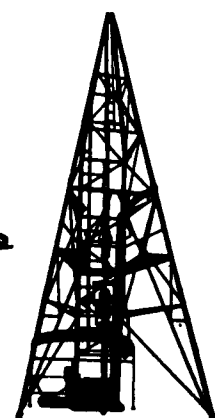
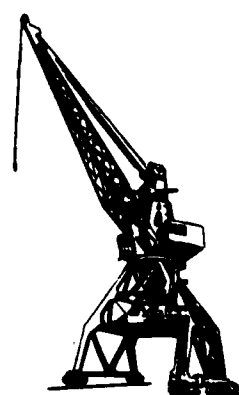




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JOURNAL OF INDUSTRIAL ENGINEERING

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Surplus Pig Iron in Bhilai—Export to Japan and Pakistan

Orders for the export of 58,400 tons of pig iron have been received by the Bhilai steel project. Of this 45,000 tons will be exported to Japan and 13,400 tons to Pakistan.

The total output of pig iron from the Bhilai project up to the end of August 1959 is 1,87,677 tons. About 9,000 tons of pig iron have already left Bhilai steel works for exports out of India.

It may be pointed out that the Union Minister for Steel, Mines and Fuel, Sardar Swaran Singh, announced in the Lok Sabha last session that though the maximum quantity of pig iron produced by the Bhilai and Rourkela plants would be utilised for the manufacture of steel, yet by the end of the year there would be a marginal surplus of pig iron for exports as new blast furnaces go into production. Most of the pig iron, the Minister announced, would be exported to Japan.

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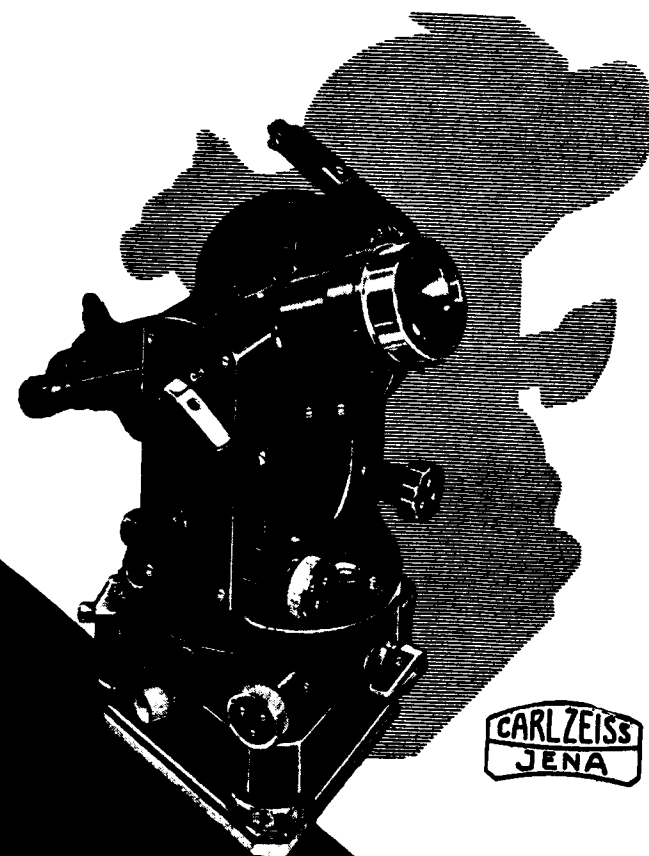
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PLANT LAYOUT

INDUSTRY Constitutes the mainspring of nation's endeavour. Industrialisation is an all-embracing function. Its benefits radiate to reach almost every aspect of our life and living. It has no limit in the creation of new wealth, new employment and new values for better living. This creative function of industry is however dependent on several factors, one of which is certainly a satisfactory plant layout.

The term "layout" means the relative positions of departments, machines, benches, stores etc. A careful arrangement of workplaces, equipment and stores eliminates unnecessary handling, and so reduces costs and increases productivity.

In the modern age, plant layout and its many complex problems have virtually become a science. An important principle to be followed, wherever possible, is that the basic layout should be planned for simplicity of work-flow with material entering one end and leaving at the other. This applies to the factory as a whole, to departments or to sections, although it is difficult to evolve general rules, as variations may have to be made, particularly in jobbing work.

In general, manufacturing industries can be divided into three groups, continuous, intermittent and jobbing. In plants operating on the continuous production of identical products, the raw materials flows consecutively through a series of machines or processes that are set up to operate as one complete unit. These continuous process may take a natural product, such as oil, salt or mineral ore and transform it into finished product. In modern automobile plants, we generally find a layout also similar to that of a continuous process industry.

With continuous production, plant layout does not present a difficult problem since with a standard product and a definite output to be achieved per unit of time, the necessary synchronization of effort lends itself to reasonably accurate calculation. The plant layout in this case can be tailored to fit the job. The factors to be considered in this case are: (a) the production operation to be housed, (b) estimates of immediate and projected output, and the production flow chart. Costs and efficiency, although not precedent, are the guide of the plant engineer.

The second type of industry, based on the intermittent process, is not so simple. In this type a flexible plant is employed to produce a range of similar products in economic batches. Such a plant may use many raw materials instead of just a few, and may often take as its raw materials the finished products of other plants. In such plants there is a continual change occurring which may in itself change the nature of operation.

The plant layout in such cases may be in terms of process or product control or a combination of the two. In plants set up on a process control basis, several or many products are moved through the various process points. There will be for example a general machining department, a forge shop, a general punch press department, a fitting shop and an assembly department.

The advantages in process or functional method are: specialisation from repetition of one or a few operations which naturally tends to increase efficiency; and reduction in the number of machines in that it is easier to keep a group of similar machines in operation and under full scheduled load than to do so where each machine is the only one in a group of widely varying operations. Such items as maintenance and repair, spare machines and parts, physical layout with the department, and power transmission are much simpler to handle.

On the other hand, the plant set up for product control, has the advantage of simplification of handling, elimination of inter-department transfer of work and the paper transaction involved in it, and the installation of a group incentive plan of wage. The extent to which any plant can move in one direction or the other is necessarily dictated by the nature of its manufacturing problems and every effort should be made to analyse all operations with the thought that what would be picture with the adoption of the other method before finalising the type of the layout contemplated.

The third type, the jobbing plant, where a continually varying amount of work will be coming through and which is the opposite extreme to continuous production, a reasonably satisfactory layout will be in grouping the departments and machines. Machines should be general purpose and capable of accommodating the variety of work that the differing products will demand.

In all types of plant layouts, it is advisable, wherever possible to allow for future expansion. Problems which have to be faced are the best position of stores, the location of the maintenance departments and other departments which provide a common service to a number of production shops or processes. The aim should be to eliminate unnecessary movement both of men and of materials.

"Design to fit the process" need not mean rigidity. The economies of designing plant layouts with a view toward flexibility of use, are more than recognised to-day. Another important point worth remembering in this context is that functions such as inspection and store keeping should be arranged in such way that they may be utilised as vehicles to progress the work so as to keep the work on the move instead of creating a sidetrack where it will be held up.

When a new factory is planned, both the type of building and the location of the plant and machinery, stores and offices should be determined according to the type of processes. For example, while the modern trend favours straightline operation in a one-storey plant, there are advantages in multi-storied gravity operated layout where the raw materials may be hoisted to the top of the plant and then, by chutes, conveyors and elevators the materials will move down floor by floor under their own weight, ending up as finished goods.

In planning a new layout, a number of devices may be used but the best method is by way of illustration as for example the template layout. This means making a small cut-out to scale of paper or cardboard to indicate each machine or bench to go into the layout. These templates can be moved around on a plan of

the factory until the best positions are found. For obvious advantages such templates should be cut from various coloured cards or papers to indicate machine groupings, equipment, benches etc.

Materials handling is intimately connected with the layout. "Handling adds cost but no value to the product" — is a slogan worth remembering in designing a plant layout. Wherever handling is required, ways and means must be found out to do it in the most economical and efficient way.

The first essential to efficiency is the elimination of waste of time, effort and materials and to ensure that each is used effectively. On the factory floor the most common instances of wastage are in the use of floor space and the use of labour in handling materials.

In dealing with the three main causes of waste, handling time, floor space and labour, the following three golden rules are very significant.

- (i) Nothing should be placed on the floor if it can be avoided.
- (ii) If it must be put down, it should be placed where it will next be required.
- (iii) Make use of "vehicles" of all kinds."

Application of such simple rules need not entail the use of costly equipment, as a simple roller conveyor or even a chute can be just as effective over a short distance as the more elaborate belt and chain conveyors are for greater distances.

For all its efficiency a well laid-out plant must cater for the employees welfare to foster their contentment and efficiency. Ventilation, adequate lighting, drinking water facilities, rest rooms, first aid centres, Canteen facilities, etc., are the factors to be kept in mind while deciding about the layout of a plant, as they have much to do in enlisting the worker's support in exploiting production facilities to their utmost.

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Progress of Bharat Electronics since Last Year's Independence Day Celebrations

BHARAT Electronics Limited was set up by Government in the public sector to make the country self-sufficient in electronic equipment in the shortest possible time. Although we started production only by the end of 1956, we have kept up a steady progress since then and it is considered worth-while giving a review of our activities during the last year.

Our major achievement during the year was the development of a Twin Channel VHF Trans-receiver for air to ground communication for the Indian Air Force. This set is primarily meant for fitment in the HT-2 Trainer aircraft and will satisfy a long felt need of the Air Force, as the aircraft has been without communication equipment all these years. The set was subjected to stringent tests and has been approved by I. A. F. It will shortly go into production. Modified version of the set for Single and Ten Channel operation are under development in our factory.

A Transistorised hearing aid has been constructed and tested in our factory. It has been found to be quite satisfactory, its performance being comparable to any imported equipment and cheaper in price. After further trials this will be put into mass production.

We have also developed a transistorised Loudhailer called "BELHAILER" during the current year. Large demand exists for this popular item throughout the country. It is an electronic megaphone with self-contained power supply and is required by Police, Fire Departments, Defence Establishments, Rail and Dock-yards and a host of others as a handy public address system. When we shortly go into production, our output will completely meet the country's requirements.

For the India Meteorological Department we manufactured 10,000 "BELWIN" Transmitters during the year for upper air observation. Efforts are being made to find foreign market for this equipment.

An agreement has been signed with PYE Telecom-

munications of Cambridge for the manufacture of their Wireless Set type 62 which is a high frequency mobile Trans-receiver for the Defence Services, who have been importing this set for the last several years. Our production of this set will completely meet the requirements of the services.

Another important agreement signed was with PHILIPS of Holland for the manufacture of Valves. The Valves standardized by the Radio and Cable Board and accepted by the Radio Manufacturers' Association in India will be taken up for manufacture in the initial stages. The capacity of the plant will be 1.8 million Valves of the miniature type which can be substantially increased by double shift working, if the demands warrant such a step. The annual turnover will be in the order of Rs. 40—50 lakhs when full production is reached. It is expected that the Valves will be available for sale by January 1961.

An agreement is shortly to be signed with M/s. SIEMENS and HALSKE of Germany for the manufacture of high power Transmitters which will help to conserve our country's foreign exchange as there is an urgent need for such Transmitters in the Defence Services and other Government Departments.

Our Crystal Division now completely manufacture Piezo Electric Crystals which are critical components required to stabilize the frequency for all types of electronic equipment.

The Transformer section is well equipped for the design and manufacture of a wide range of high quality Transformers and Chokes including power transformers smoothing Chokes (sealed and oil filled types) suitable for a wide variety of electronic applications. All Transformers and Chokes required for our equipments are produced in our factory.

There has been a steady increase in production during the year under review which amounted to Rupees 65 lakhs as against Rupees 26 lakhs during the preceeding year. For the year 1959-60, we have plans to produce equipment valued at over a crore of rupees.

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MANUFACTURE OF RADIO RECEIVING VALVES IN BHARAT ELECTRONICS (P) LIMITED, BANGALORE

In the production of modern electronic equipment, the valve forms an essential and vital component part on which depends its efficient functioning and performance. It is the heart of all communication and radar equipment; and of broadcast and television receivers.

Valves are required in large numbers for domestic broadcast receivers and for professional communication equipments. At present nearly 200,000 broadcast receivers are being produced in the country annually; and the valve complement required for these receivers will exceed 1.2 million. In addition, there are the requirements of valves for normal replacements and for special equipments.

To meet these demands the manufacture of valves was therefore envisaged as an integral part of the BEL Project.

An Agreement has been signed with Messrs. Philips of Holland on 11.5.1959 for securing the necessary technical assistance and collaboration for the production of valves. Philips of Holland and their Associated Companies are one of the leading producers of radio valves in Europe and their organization is backed by extensive research and development facilities. The Agreement is a comprehensive one covering the manufacture of all types of receiving valves required not only for the broadcast receiver industry, but also for the special requirements of the communication services. The manufacture of special quality valves (ruggedised valves) used in the Defence electronic equipment also forms part of the Agreement. Philips will render necessary technical assistance for establishing production in BEL and for training Indian personnel in their Works in Holland.

THE DETAILS OF THE PROJECT

Philips will supply all the necessary equipment and machinery for establishing production according to the latest techniques adapted to suit Indian conditions. The capacity of the installed plant will be 1.8 million valves of the miniature type which can be substan-



Sitting :

Left — Mr. F. C. Beunke, Philips.
Right — Mr. B. V. Baliga, Managing Director, BEL.

Standing :

from left — Dr. P. K. Kapre, Philips.
Mr. C. R. Subramanian, Jt./Chief Inspector, BEL.
Mr. T. T. Joseph, Commercial Manager, BEL.
Mr. J. P. Kacker, Controller of Finance, BEL.

tially increased by double shift working if the demands warrant such a step. The Agreement also provides for the manufacture of subminiature valves required for man-pack and ultra portable communication sets.

The annual turnover will be of the order of Rs. 40—50 Lakhs when full production is reached. It is expected that the production cost of valves in BEL will not be appreciably higher than the imported cost when the Plant goes into full production.

PROGRAMME OF MANUFACTURE

A beginning will be made with the manufacture of a range of standardised valves for domestic broadcast receivers. The Radio & Cable Board and the Broadcast Receiver Industry have formulated a standard series of 18 valves for which there is a substantial demand.

They are :	EF	89	UF	89	DK	92
	ECH	81	UCH	81	DF	96
	EBC	81	UBC	81	DL	96
	EL	84	UL	84	DAF	96
	EZ	81	UY	85	DM	71
	EM	80	UM	80	DCC	90

This series will be taken up for production in the initial stages; and new types will be gradually added as and when the demand justifies economical production.

According to the delivery schedule promised by Messrs. Philips, production is expected to commence within 20 months from the date of signing the Agree-

ment. Production will be undertaken in gradual stages to enable training of Indian staff and gaining of experience in the techniques of valve production.

Self-sufficiency in respect of the valve requirements of the country will be the main aim and every effort will be made to achieve it in the shortest time possible. It is expected that with the production of valves in the country, the retail price of valves will also come down.

Foreign exchange savings will gradually increase from year to year after the production has commenced. When full production is reached, it is estimated that nearly Rs. 30 Lakhs of foreign exchange will be saved annually.

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The Angle Division Tester and the Automatic Control - Tolerance Indicator, two new precision measuring instruments made in Jena

By Dipl. Ing. H. Zill
Jena, Germany

UNTIL now there has been no easy to handle, reliable and accurate testing instrument available for inspecting mechanical dividing heads, the accuracy of which is impaired in the course of time especially on the areas most used, due to the wear of the worm drive. Such an instrument is now provided by the *Angle Division Tester* (Figure 1) made by the optical Works Jena. In addition to this application, it can also be used for testing rotary stages, gear wheels, star wheels and polygons, as well as for adjusting the size of the angles when machining graduated plates and star wheels, gear and worm wheels, by the single dividing method and for divided circles of any type. A short description of its design follows. A graduated circle made of glass and divided into 360° is fixed in a casing. This circle as

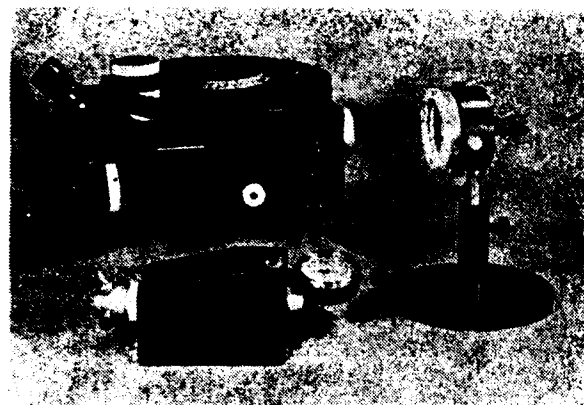


Fig. 1. Angle Division Tester.

well as the rough scale let into the outer wall of the casing are firmly connected to the take-up bush (length 120 mm., bore 45 H 6). Furthermore, the casing contains an auto-collimating telescope which can be aligned with a double-division mark on to a mirror placed close to the instrument in a fixed position free from vibration. To facilitate adjustment, a sighting device is attached to the outside of the casing and an auxiliary telescope to the mirror. Reading of the set values is carried out, as with the theodolite, at two diametrically opposite places (coincidence reading) (Figure 2) to eliminate eccentricity errors of the graduated circle. Two images of the graduated

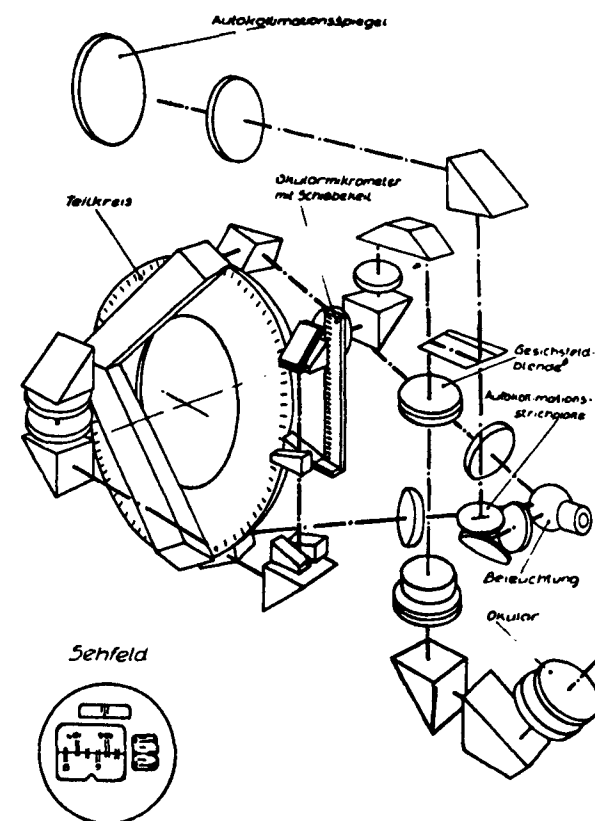


Fig. 2. Path of rays.

Auto-collimation mirror - Eyepiece micrometer with sliding wedge - Graduated Circle - field stop - Auto-collimation graticule - Illumination Eyepiece - Visual field.

scale appear therefore in the field of vision of the eyepiece and are made to coincide by means of an optical micrometer. The angle is read off the base scale to 10 minutes, whilst units of minutes and seconds can be read in a special window. The parallel path of the rays between the collimating telescope and the mirror permits, within certain limits, a parallel shift of the instrument towards or away from the mirror without affecting the measuring process detrimentally. For the measurement of star wheels and gear wheels a swing-out ball stop with precision indicator is also supplied, ensuring constant fitting. The maximum measuring uncertainty of the instrument is 3 seconds. Yet a further advantage of the instrument should be noted, i. e. that the Angle

Division Tester can be used with equal accuracy in a horizontal or vertical position. In its application to such tasks it therefore is superior to the Theodolite with collimator limited to the horizontal position.

The *Automatic Control-Tolerance Indicator* (Figure 3) has a different application. The ever progressing automation of mass production requires measuring instruments by means of which it is possible to control the manufacturing processes. In addition to checking the dimensions, e. g. in assembly lines, or the feeding of grinding discs in grinding machines up to the point where a pre-determined dimension is achieved, it is

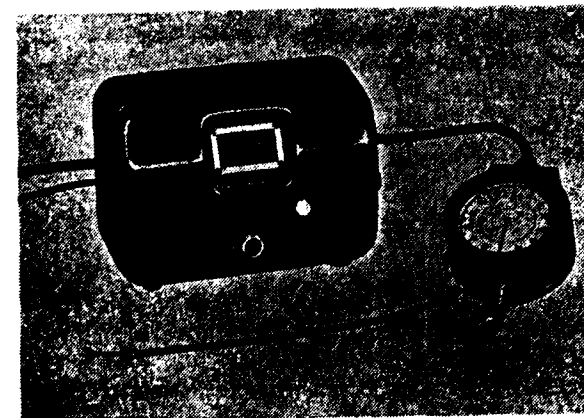


Fig. 3. Automatic Control - Tolerance Indicator.

also of interest to measure the manufactured products at as many places as possible at the same time in so-called multi-point testing instruments. For these components contact instruments are usually employed. The measuring limits of these are defined by adjustable contacts through which a circuit is closed or interrupted. To add yet another instrument of this kind to those already on the market was justified only if it were possible to attain advantages over the hitherto used instruments. The Automatic Control-Tolerance Indicator has therefore special features which make it outstanding compared to other instruments. To start with, the indicator over the entire measuring range of $\pm 60 \mu$ is equally reliable in any position of the contacts to within $\pm 0.1 \mu$. The accuracy of contact, i. e. the maximum deviation between tolerance mark adjustment and contact is 0.8μ , in the range of $\pm 60 \mu$

and remains constant for hundreds of thousands of operations. This has been proved by extensive and prolonged tests. This achievement is due to special design measures which eliminate the flow of material at the contacts or changes in the mechanical stresses.

A special advantage, however, is the adjustments of the contacts by means of curves which simultaneously also displace the tolerance marks. Starting with a certain value, the nominal value for instance, the tolerance can be adjusted without slip gauges and this considerably more accurately than is possible with threaded spindles. The tolerance mark and contact being coupled, the correct position can be maintained at any time by visual control. This is important because an unintentional change of contact can be immediately noticed, whilst with other measuring instruments of this kind there is no structural relation between contact and tolerance mark. With such instruments therefore, it is quite feasible that the contact has changed without this becoming noticeable on the position of the tolerance marks. Visual indication is shown—as well as by the position of the pointers on the scale—on a switch box placed in any suitable position containing in addition to a relay, the bridge circuit and the light signals. Simple relay circuits can thus be directly made, as the contact pressure is sufficient to execute switching operations with 100 Volt and 10 ma. For very short switching times and high switching sequences, which can no longer be controlled by relays, an electronic amplifier must be connected to ensure inertia-free transmission of the signals given by the Automatic Control-Tolerance Indicator. This amplifier can be obtained from the VEB Werk für industrielle Elektronik, Leipzig 0 27, Sommerfelder Str. 26. This electronic unit can be adapted to any requirements occurring in practice. With regard to the measuring head it should be mentioned that with its diameter of 82 mm. and a casing of 37.5 mm. thickness, its size is only slightly larger than that of a dial gauge. For safety reasons the voltage is provided with a 12 k6 tension shaft diameter. It is sealed against spray water, and any water of condensation which may form is rendered harmless by a hygroscopic element in the casing.

MANUFACTURE OF SMALL CARS

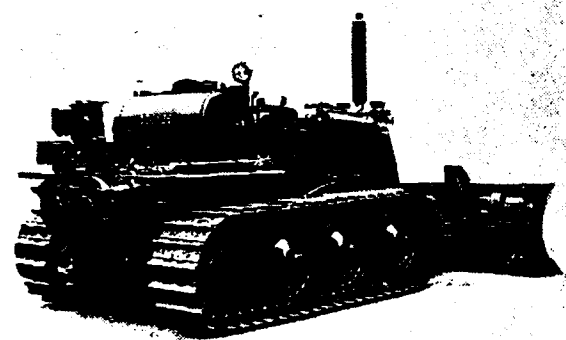
Replying to a question by Shri S. A. Mehdi on the manufacture of small cars, Shri Manubhai Shah, Minister for Industry, said in the Lok Sabha that 4,311 small cars were produced in the country during the first six months of 1959. The Minister added that the production in the latter half of the year was expected to improve considerably as sufficient foreign exchange for the import of components and raw materials needed for indigenous manufacture had been released. It was estimated that the production for the whole year might reach 12,000 numbers, the Minister said.

CRAWLER TRACTORS

British tractor production includes an increasing number of wheeled machines for agricultural work and for a variety of tasks in industry. But it includes also many tracklaying or crawler tractors of medium and high horsepower rating to meet the requirements of public works contracting, land reclamation, forestry and "pioneer" work in all parts of the world. This article is concerned with two recent additions to British crawler tractors, the Vickers "Vigor" and the Albion Cuthbertson "Water Buffalo."—Editor.

RECENTLY we visited the Scotswood Works, at Newcastle upon Tyne, where Vickers-Armstrongs (Tractors), Ltd., builds the "Vigor" and "Vikon" tractors. During this visit, the company announced the receipt of a contract from the Ministry of Supply for sixty "Vigor" tractors, with their associated equipment, which will be used by the Royal Engineers. Some of these tractors are already at work in difficult terrain overseas, as, for example, in the Malayan jungle, where the Royal Engineers are building a 64-mile length of road. Our title illustration shows a tractor fitted with overhead cable dozing equipment being used on a bank cutting job for this road.

The Vickers "Vigor" is powered by a Rolls-Royce six-cylinder, supercharged diesel engine, with dry-sump lubrication, which develops 180 belt horsepower at a governed speed of 1800 r. p. m. The crankcase and cylinder block are integral and are made of cast iron. The wet surface cylinder liners are removable and the twin cast iron cylinder heads serve three cylinders each; the fuel injectors are located in the tops of the cylinder heads. The tractor's main frame is built of $\frac{3}{8}$ in. steel plate; it carries the front suspension unit, the engine and cooling system and



"Vigor" tractor powered by six-cylinder Rolls-Royce engine, which develops 180 belt horsepower. This tractor is fitted with a hydraulic dozer blade and a rear control unit.

completely encloses the dry sump and oil reservoir. Machined faces are provided for the attachment of dozer equipment and the drawbar is anchored to a pivot bracket on the underside of the main frame.

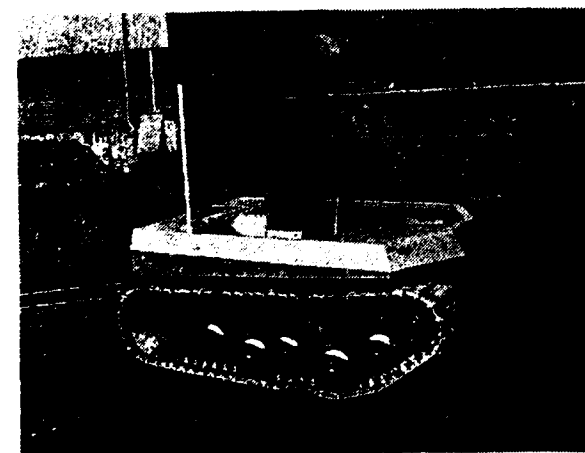
The suspension system has been designed to enable the full bottom-run of the tracks to be kept in constant contact with the ground. The system consists of eight large-diameter wheels which are linked in pairs, each pair oscillating on an individual pivot. The two front pivots are interconnected through a cross beam oscillating transversely beneath the main frame, while the two rear pivots have their centres on the reduction gear output shafts. By this arrangement, it is claimed, the weight of the hull is distributed evenly between the middle of the cross beam and the two rear track wheel and sprocket assemblies, thereby eliminating stresses. Excessive track tension is automatically countered by buffers which are attached to the track adjusters and act independently on the front wheels. The rear track wheel and sprocket assemblies incorporate the final drives. The gear train of each drive is arranged so that the reacting torque, which tends to turn the whole housing round its central pivot, is exactly equal and opposite to the torque reaction exerted by the track on the sprocket. The rear suspension units are thus free to mould the tracks to the surface of the ground. Each wheel, it should be added, is insulated by two rubber rings separating the rim from the hub. The object of these mountings, which allow a deflection of up to $\frac{1}{8}$ in. under load, is, of course, to damp out the high-frequency vibrations which would otherwise be transmitted through the body of the tractor. In the sprocket wheels there are four rubber rings to separate the outer wheel from the hub.

The length of the tracks on the ground is 8 ft. 8 in. the area of ground contact (with standard 22 in. wide track shoes) being 4756 square inches, and the ground bearing pressure 7.4 lb. per square inch. Each pair of links in the track assembly is pressed on to a sleeve and interlocked with the preceding pair of links by a pin which is passed through the sleeve and pressed into

the preceding link bosses. Rubber seals, situated at each end of the sleeves, imprison the lubricating oil which is forced round the pins during the initial assembly of the tracks. The tread-plates are bolted to the links. Two removable master pins are provided in each track so that, should it be necessary to take a track off the machine, one master pin is always accessible.

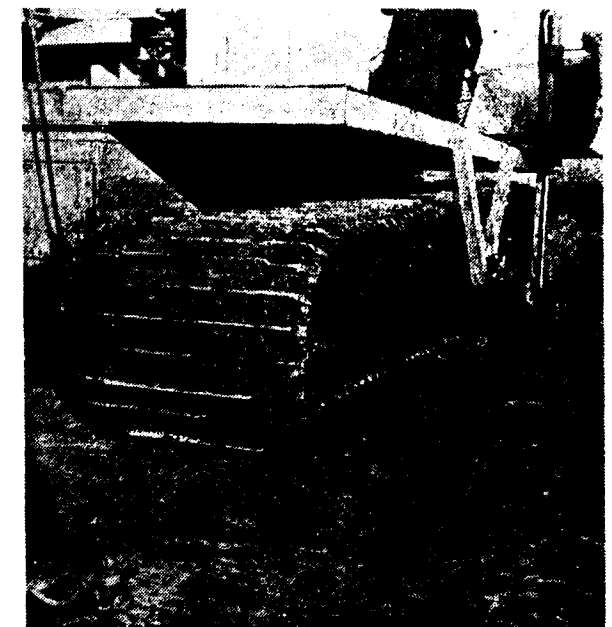
The tractor's six-speed gearbox is in principle two gearboxes built into one. The upper layer provides high, low and reverse-gear ratios, and the lower set gives three relative speeds for each particular ratio. This combination permits six forward speeds between 2.18 and 9.73 m. p. h. and two reverse speeds. In the full-torque transmission unit, which is the tractor's standard equipment, each final drive comprises two large gear wheels, of identical size, which mesh with an idler gear. These gears maintain a constant balance between the torque on the drive and that exerted by the track on the sprocket. The steering clutches convey the drive through a series of toothed friction discs; when a clutch is released, its discs separate instantly and, when engaged, the pressure of thirty springs ensures immediate take-up. Clutch-release is actuated by an automatic, hydraulic servo system controlled by the steering levers: a seven-cylinder pump, driven from the gearbox, gives constant oil pressure throughout the system. The steering brakes are operated independently by the steering levers, there being also an over-riding foot pedal which allows both brakes to be applied simultaneously.

As an alternative to the six-speed gear-box, a Rolls-Royce Twin Disc torque converter and a Vickers



A standard "Water Buffalo" for work on soft and marsh lands. The power unit of this tractor is a 75 b.h.p. Albion diesel engine.

three-speed gearbox can be installed in the "Vigor" tractor. This unit provides an infinitely-variable torque-ratio transmission train. The gearbox provides



The track of the new "Water Buffalo" is 48 in. wide, exerting a ground pressure of not more than 2 lb per square inch.

three forward speeds of 4.66, 6.4 and 8.8 m.p.h., and a reverse speed of 5.15 m.p.h. The hydraulic torque converter comprises three principal parts, namely, a housing which is integral with the engine-clutch housing, an impeller and a turbine wheel. The impeller, which is driven by the engine through a pedal-operated, single disc clutch, gives a circular motion to the fluid in the converter, while the fluid, in turn, rotates the turbine wheel. The turbine wheel is connected to the gearbox by a coupling shaft.

Several items of associated equipment for operation by the "Vigor" tractor are produced by Vickers-Armstrongs (Tractors) Ltd. They include scrapers, dozers, rippers, winches and compaction rollers. An accompanying illustration shows the tractor fitted with a dozer and equipped with a rear control unit. This assembly comprises twin spur-gear-driven drums, each having a capacity of 220 ft. by $\frac{1}{2}$ in. cable. The drums are controlled by a combined clutch and brake mechanism, the brakes being automatically applied when the clutches are released. The drive is taken from the rear end of the gearbox.

THE "WATER BUFFALO"

For work in swamps and similar terrain where

conventional crawler tractors could not be expected to operate successfully, the "Water Buffalo" was designed a few years ago by James A. Cuthbertson, Ltd., Biggar, Scotland, in conjunction with Albion



Opposed by the dust, the heat, and thick vegetation, men of the 410 Independent Plant Troop, Royal Engineers, are using Vickers equipment to construct a new, 64-mile-long road through dense jungle in Kedah State, Malaya. Here the Vickers VIGOR with overhead cable dozing equipment is engaged in bank cutting.

Motors, Ltd. Reclamation and drainage work on Scottish hill lands which was undertaken by the designer, Mr. J. A. Cuthbertson, emphasised the need for a machine capable of traversing swamps and at the same time hauling heavy loads of equipment. Two important design factors of the "Water Buffalo" are its flexible rubber track and its watertight steel hull which keeps the engine, transmission and steering dry even in a 4 ft. depth of water and, additionally, prevents the tractor from sinking when stationary. The track fitted to the standard "Water Buffalo" is 36 in. wide; it gives exceptional adhesion by "enveloping" the ground surface instead of riding the high spots, the ground pressure obtained being about 2½ lb. per square inch. One of our illustrations shows a standard "Water Buffalo" (THE ENGINEER, July 13, 1956) which is fitted with a four-cylinder, 75 b.h.p. Albion diesel engine.

Recently, we were present at the trials of the latest "Water Buffalo." This is a much bigger machine which has been designed for the Shell-B. P. Petroleum Development Company of Nigeria, Ltd. The tractor is required mainly for the transport of heavy oil drilling equipment and materials into the heart of the Niger Delta swamp lands. The new "Water Buffalo," which is illustrated herewith, is just over 23 ft. long and weighs about 24 tons. It is powered by a six-

cylinder Leyland engine, which develops 150 b.h.p. at 2000 r.p.m., the maximum torque being 450 lb.-ft. at 1100 r.p.m. The engine is fitted with a five-speed "Pneumo-cyclic" gearbox (see THE ENGINEER, November 20, 1953) and centrifugal clutch.

The watertight hull of the new tractor is built of sheet steel, there being removable covers for inspection and servicing of the engine. An amphibian body can be fitted to the hull to enable the tractor to float in free water. The tractor is supported on two large

GIANT SWAMP TRACTOR TO BE USED IN OIL SEARCH IN NIGERIA



A giant amphibious crawler tractor, known as the Albion-Cuthbertson "Water Buffalo", will shortly be shipped from the United Kingdom to Nigeria to transport heavy drilling equipment and materials into the heart of the Niger Delta swamp lands.

The tractor, ordered by The Shell-BP Petroleum Development Company of Nigeria Ltd., from Albion Motors Ltd., is designed to penetrate areas impassable to vehicles a fraction of its weight, has a tread far lighter than a man, exerting a ground pressure of 1½ to 2-lbs. per square inch as against the 6.5-lbs per square inch exerted by a man. It will be shipped with two amphibious slipes, or trailers, one a 28-tonner, the other a 10-tonner and a powerful capstan winch, mounted on the front of the machine, will be used for hauling.

Picture Shows:— The trailer travelling through extremely heavy peat bog during acceptance trials. The tractor is shown with only the front portion of its upper body in position and is designed to operate in free water towing the special slipe trailer.

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unsprung idler wheels at the rear and ten idler wheels (five on each side) on sprung crank axle assemblies. These axle assemblies are able to move vertically under the weight of the tractor on the tracks, and thus keep the tracks in contact with the ground. The forward moving part of the track, between the rear idler wheel and the front driving sprocket, is supported by four small idler wheels. Power from the engine is taken through the gearbox to a cardan shaft which transmits it to a distribution gearbox, where the drive divides into two parts. The power is then controlled by two independently operated clutch and brake mechanisms, each driving one track only, through a worm drive to a spur gear final drive.

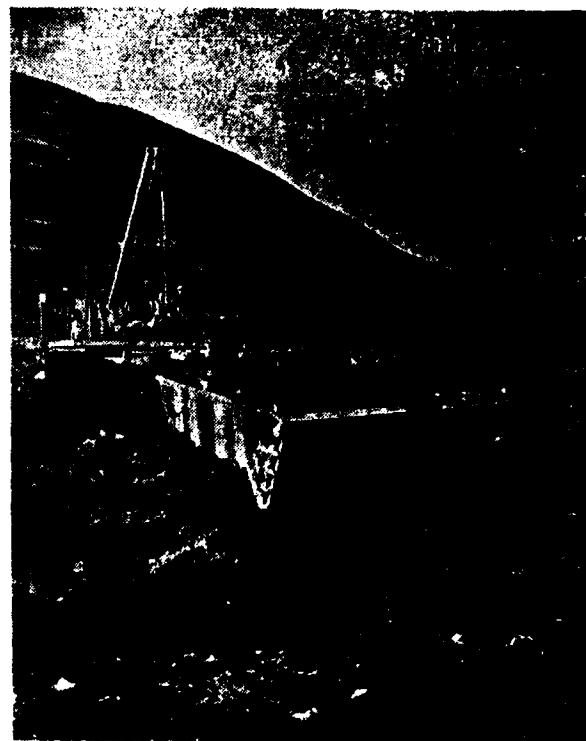
The most important part of the "Water Buffalo" is the 48 in. wide tracks which, like the tracks of the smaller machine, have no conventional link pins and bushes. The track links are joined by flexible rubber pads which are moulded round a series of wire linked ferrules to take the track bolts. The drive sprocket is at the front so that the track top is in tension and the bottom run is therefore free to mould itself closely to the ground undulations. An accompanying illustration shows the track arrangement. For these 48 in. wide tracks, it is claimed that they have a tread "far lighter than a man," exerting a ground pressure of only about 2 lb. per square inch.

A hydraulically operated dozer blade has been fitted to the tractor to enable it to make its way through virgin country, forest land and swamps. But, of course, this dozing equipment is for making preliminary roads in normally inaccessible areas; the machine is not primarily designed as an earth mover to compete with conventional crawler tractors.

To enable the "Water Buffalo" to perform various operations required in oil exploration surveys, as well as the erection and transport of drilling rigs, an oil field winch and gin pole assembly have been fitted at the rear. With this winch and gin pole, a lifting capacity of up to 10 tons can be obtained. The winch is specially geared to enable the lifting and transport of drilling rig components, and has a sufficiently low operating speed to assist in the erection of these components when being used as a crane. Another interesting point about the new tractor is that it can be fitted with a capstan winch, designed to run at track speed in all gears. This means that in land conditions, where the surface of the land is unable to transmit the drawbar pull exerted by the tractor, the winch can be used as an additional means to gain the necessary tractive effort. By a special arrangement on

the winch, the tractor can run on a permanent cable, when, for example, a section of free water is encountered, where the tracks of the tractor cannot assist in propulsion. Furthermore, for exceptionally high drawbar pulls in soft conditions, the winch and tracks are operated together to pull any implements or loads. In order that the machine can be handled satisfactorily by semi-skilled labour, all the controls, including steering, braking and operating the capstan winch and gin pole winch are by compressed air.

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Picture Shows:— A rear view of the tractor and 10-ton slipe trailer travelling through extremely heavy peat bog during acceptance trials.

The new "Water Buffalo" is being shipped to Nigeria with two amphibious trailers or "slipes," one having a payload of 28 tons and the other of 10 tons. It has been found that the most satisfactory method of transporting loads by the "Water Buffalo" is by these slipes, which are pulled behind the machine. The slipes can be fully amphibian when loaded, so that the loads can be transported by water as well as

land, and all of them are fitted with large aircraft wheels, which protrude approximately 9 in. below the base. When on hard ground, the slipe runs on wheels, and when on soft ground the wheels penetrate 9 in. into the surface so that the base of the slipe takes up and spreads the load to give a very low ground pressure.

(Courtesy—"Engineer")

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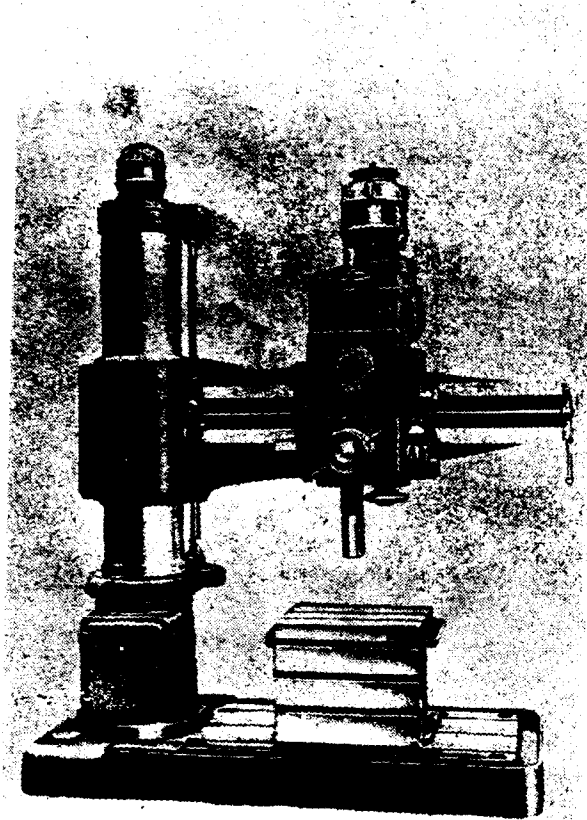
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Hindustan Machine Tools - Bangalore

By A Special Correspondent

THE wide range of machines that are currently manufactured in the Hindustan Machine Tools represent the rapid progress India is making in the production of Machine Tools. These machines include the H-22 high speed precision lathe in two types; six types of Milling Machines—Vertical, Horizontal and Universal in two sizes each and the latest addition to the production lines of the plant—Radial Drill in ten types. It may be added that steps have been taken to further diversify the production of lathes and in addition to the two types in varying sizes, the plant is also turning out lathes with varying bed lengths upto 5,000 mm. and with higher centre height upto 10" and lower speed ranges. The factory will also make available smaller Production and Universal lathes soon as the production of the same has been taken up recently.



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HMT turns out 10 types of Radial Drills for precision work.

The Machine Tool Industry is a 'must' for the industrial growth of a country. It is this industry which in a sense provides the key to the country's industrial growth by enabling it to produce all the plant and machinery needed for its factories. In the absence of a well-planned machine tool industry, India had necessarily to depend upon foreign sources for such plant and equipment. This can be well evidenced from the fact that most of the heavy plant and equipment which has gone to build India's industries has so far been obtained from foreign sources.

With the advent of planning after Independence, India has been rapidly industrialising itself and engineering and industrial goods until recently imported are now being increasingly manufactured in the country. The country today is producing its own bicycles, automobiles, electric motors, aeroplanes, etc. Obviously, its requirements in terms of Machine Tools have been on the increase as can be seen from the following statistics:

Year	Annual Imports (in Lakhs) Rs.	Annual Prodn. (in Lakhs) Rs.	Total (in Lakhs) Rs.
1950	249	28.59	277.59
1951	250	47.31	297.31
1952	221	44.37	265.37
1953	312	44.08	356.08
1954	385	47.30	432.30
1955	528	67.13	595.13
1956	837	108.18	945.18
1957	1,464	201.00	1,665.00
1958	1,531	375.00	approx. 1,906.00

In the present context of the goal for rapid industrialisation of India, and the consequent foreign exchange crisis the Machine Tool Industry thus assumes added significance.

HMT has during the year 1956—57 and 1958—59 accounted for 66% of Machine Tools in India.

Statistics of Production At Hmt	
1956—57	Rs. 53 lakhs
1957—58	Rs. 155 ..
1958—59	Rs. 220 ..

Central Fuel Research Institution's contribution to the development of Coal Washing Work in India

By

G. G. Sarkar & A. Lahiri

Central Fuel Research Institute, Jealgora

(Special to J.O.I.E.)

INTRODUCTION

AS far back as 1947, a detailed study of the washability characteristic of Indian Coals was made by Forrester and Majumdar under the auspices of the Fuel Research Committee, sponsored by the Council of Scientific and Industrial Research. Since then, the Central Fuel Research Institute and its Coal Survey Stations have been actively engaged in carrying out a systematic survey of the cleaning characteristics of Indian coals and in conducting extensive researches on the problems of coal washing. Directly or indirectly the Institute has helped in the planning and development of most of the existing coal washeries in India. Thus, all the relevant washability data required for the planning of the washeries at Jamadoba, West Bokaro (owned by M/s. Tata Iron & Steel Company Ltd.), and Lodna (belonging to M/s. Turner Morrison and Co.) and the washery under construction at Nowrazabad by M/s. Associated Cement Company were supplied by the Central Fuel Research Institute.

As for the central washeries in the public sector, the Institute has been entrusted with the entire responsibility of studying the washability characteristic of coal to be fed to these washeries scrutinizing results, drawing up plans and specifications and conducting the guarantee and performance tests after the washeries go into operation.

In planning a washery, the results of washability investigations are required for computing the recovery and ash content of various washed products for choosing the washing process or bath most suitable for the raw coal to be treated as well as for designing ancillaries like crushers, screens, conveyors, bunkers etc. The other factors requiring careful consideration are a knowledge of the extent of reserves, production trends and costs, mining conditions and

methods, transport facilities and freight rates, degradation of coal during handling and transport, the desired specifications of the washed products as well as a thorough study of the duty ranges and efficiency of coal cleaning units.

With reference to the selection of a proper washing unit, it is to be realized that no single washing unit can treat raw materials of variable size or type to any degree of refinement. Each of the washing processes has some limitation. For this purpose, large-scale washing tests in semi-pilot or pilot plants, which simulate the conditions obtaining in a commercial washery is often recommended. Moreover, washed products obtained in bulk from these pilot plants can be tested for their carbonisation, combustion and gasification characteristics and an evaluation of these characteristics is essential for integrated planning as this can go a long way in solving the important problems of disposing large quantities of middlings and rejects produced from the commercial washeries. With this in view, the Institute is conducting valuable studies in semi-pilot and pilot coal washing plants. Attendant coal washing problems like dewatering of washed products, up-grading, treatment and recovery of slurry, upgrading of middlings and rejects after crushing, preparation and reclamation of heavy media are also being actively investigated by this Institute.

The Institute has made some useful contributions in fundamental researches relating to the various problems of coal washing. To mention a few, are the development of an ash unit curve and middlings curves for better representation of washability results, the formulation of a new index for defining the sharpness of separation of commercial coal washing units and the evaluation of a new graphical method to determine the optimum conditions for operating a composite or unit washery for the purpose of recovering maximum yield of clean coal. Investigations, which need

special reference in this connection, are the studies on the fundamentals of coal flotation, flocculation of coal slurries and dewatering of fine coal as well as studies on the properties of dense medium suspensions, available in India.

In recognition of the valuable work done by the Institute, the Commonwealth Specialist Committee (London) on Fuel Research entrusted the Director, Central Fuel Research Institute (India) to act as Chief Co-ordinator for compiling review of work in the field of coal washing and preparation for the period from 1950 to 1955.

The report of the Coal Washeries Committee of the Production Ministry was largely based on C. F. R. I.'s findings and the draft report was prepared at this Institute. The Institute has so far published or prepared more than 70 research and review papers including reports pertaining to the work on coal washing.

A short review of the work, carried out by the Institute in the field of coal washing is outlined below under the following sections.

- I. Washability investigations.
- II. Planning of central washeries for the Public sector.
- III. Guarantee and performance tests of commercial washeries.
- IV. Studies on semi-pilot and pilot-plants.
- V. Studies on upgrading of coal by froth flotation.
- VI. Studies on special problems.
- VII. Studies on miscellaneous problems related to coal washing.
- VIII. Study and review of coal cleaning practice and developments.

I. WASHABILITY INVESTIGATIONS

The only way to assess the cleaning potentialities of coals, prior to the installation of coal washing plants is to carry out float and sink tests on properly representative samples and study carefully the washability results and curves. In the light of the results of float and sink tests, the ash content and recovery of washed products expected to be obtained from a commercial washery are computed. Even for the day-to-day control of any washery or for regulating the quality of

its products, such tests are considered to be of utmost importance. Moreover, in evaluating the performance of any washing unit, the coal preparation engineer has to depend on washability results and curves.

In any full scale washability study, the coal sample initially crushed to some optimum size, is screened to different size fractions and each of these screened sizes is subjected to float and sink tests using inorganic or organic solutions of varying specific gravities. Each of the fractions, so separated is weighed and its ash content determined. Thus, in one complete washability test, at least 30 to 40 ash determinations are to be carried out. The results are then combined for various size compositions and series of washability curves are constructed. One full scale washability test including all calculations, normally takes about two to three weeks to complete.

In the report¹ published by Forrester and Majumdar, the cleaning characteristics of over 140 samples of coals, collected from various coalfields of India, are presented. This work involved the completion of nearly 200 full-scale washability tests carried out during the period January 1944 to September 1947. Since then this Institute and its various coal survey laboratories have carried out more than 500 complete washability tests. Many such samples have been tested as a part of the programme of normal survey work as taken up by this Institute for a systematic study of our coal resources. The results of survey work are included in the annual reports issued by each coal survey station. Results of washability investigations also appear in several other important publications²⁻¹⁰ of this Institute.

In connection with the preparation of reports and specifications of central washeries for Hindustan Steel, N. C. D. C. and the Railways, a large number of washability tests have already been carried out. With the rising demand for coal and increasing deterioration of the quality of our coal resources, a major part of our coal will require upgrading before use.

II. PLANNING OF CENTRAL WASHERIES FOR THE PUBLIC SECTOR

In view of the projected production of 6 million tons of iron and steel at the end of the Second Five Year Plan and 11 million tons of iron and steel at the end of third five year plan, 10-12 m. tons and 17-20 m.

tons respectively of good quality of coking coal will be needed. Similarly, to cope with the rapid pace of industrialisation as well as with eventual diversion of all good quality coking coals to the steel plants, the railways which are at present the major consumer of coal will seek additional quantities of good quality non-coking coal suitable for combustion in the steam locomotives. Then again, to help the growth of various chemical and electro-chemical industries the production of low ash coals at least to a limited extent has also to be considered.

Without recourse to washing it is not possible to meet this ever increasing demand for both coking and non-coking coals. With the gradual depletion of good quality coal reserves in India and with the phased introduction of machine-mining practice, it is becoming imperative to resort to coal washing for ensuring the supply of the requisite amount of coal of specified quality as envisaged above.

Thus for supplying coal to the steel plants, five central washeries with a total rated (normal) capacity of 2000 tons per hour, are being erected. Of these five central washeries the erection of one at Kargali (465 tph) has already been completed and the washery has started production since November last. The erection of the washery at Dugda (600 tph) and Durgapur (360 tph) have also been taken in hand. The contract for the Bhojudih Washery (250 tph) is due to be finalised within the next two or three months. Global tenders for the Patherdih Washery (400 tph) will also be issued very soon. The Central Fuel Research Institute has not only conducted all the washability investigations in connection with the planning of these washeries but has also drawn up the specifications¹¹⁻¹⁶ and layouts of these plants.

For the purpose of upgrading non-caking and semi-caking coals, the railways have provisionally decided to install five central washeries of capacities varying between 300 tph to 600 tph depending on the availability of raw coal in different regions. Two of them will be located in Madhya Pradesh, one in Hyderabad, one in Bihar and the other in West Bengal. The work relating to the planning of these washeries is being actively pursued in different coal survey laboratories. As the washing scheme to be followed in all these washeries will be more or less similar, involving the treatment of only 6"—1" or 4"—1" coal, a tentative layout¹⁷ of such a washery has already been prepared by C. F. R. I. and submitted to the railways.

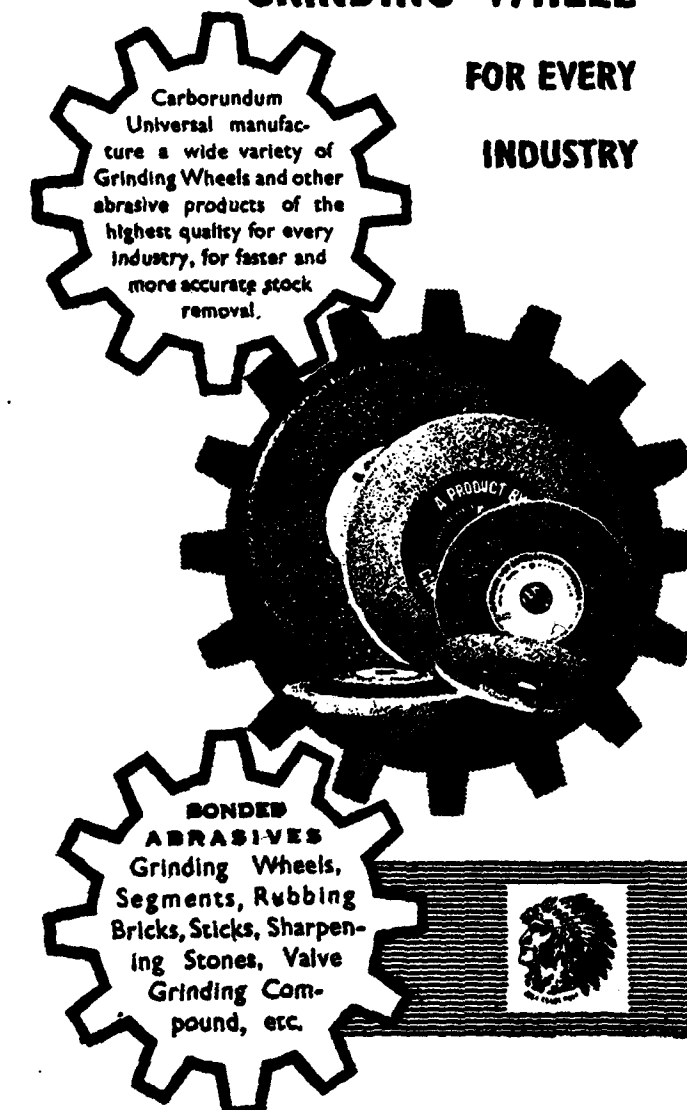
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On the basis of the results and scheme submitted by C. F. R. I., the Associated Cement Company has started erecting a washery of their own at Nowrazabad to ensure a supply of a consistent quality of fuel to their cement works and to keep down the pyrites content within reasonable limits. Our researches on recovery of iron pyrites from the washery rejects at Nowrazabad show that the cost of the washery can be paid back in a few years from the sale of pyrites if a suitable consumer could be found. A report⁶ on the washability tests and washing possibilities of Jatraj seam in Korba Coalfield (Madhya Pradesh) has been compiled and a scheme has been forwarded to prepare this coal to suit its special marketing problems. It is expected that 2 million tons of coal will be raised from the Korba thick seam (Jatraj Seam) by the end of the Second Five Year plan period. The Russian Government has agreed to include this washery project, as a part of their technical aid programme to India and the Russian

experts have started designing the washery on the basis of exhaustive results and technical data submitted by C. F. R. I.

III. GUARANTEE AND PERFORMANCE TESTS OF COMMERCIAL WASHERIES

The Institute has carried out complete efficiency tests of the small coal feldspar jig at Lodna belonging to M/s. Turner Morrison & Co. extending over a period of six months and has made available to the country detailed data on the performance of the type of washer with respect to the type of coal being fed to the washery^{10, 11}. C. F. R. I.'s test results also indicated some of the best conditions of operating this washery.

Similarly, the performance of each individual section of the Kargali washery is being closely studied and followed by C. F. R. I. At the request of N. C. D. C.,

C. F. R. I. collected samples from the washery at different periods and evaluated the efficiency of each component unit, like screens, crushers, washing units, centrifuges, drum filters etc. On the firm recommendations of C. F. R. I. certain modifications have been incorporated in the plant in order to counteract size degradation of raw coal prior to feeding to the washery.

IV. STUDIES IN SEMI-PILOT AND PILOT PLANTS

For efficient planning of washeries, laboratory float and sink tests are not adequate. It is necessary to carry out semi-pilot or pilot plant investigations with coals of different characteristics and find out the system, which is most suited to the coal or coals, both from the point of view of efficiency and economy. A study in such pilot plants is considered to be essential also in deciding the optimum screening and crushing sizes, particularly in relation to the difficult cleaning coals of India and in assessing the possible size-degradation the coal is likely to suffer in course of handling or transport from the mine or at different transfer points inside the washery. In addition, the installation of pilot plants helps to recover different washed products in bulk, which for the sake of integrated planning often need evaluation of their carbonisation, combustion and gasification characteristics long before the commercial washery came into operation.

SEMI-PILOT PLANTS

During the last few years, small capacity pilot plants have been designed, fabricated and installed at the Central Fuel Research Institute and preliminary investigations were carried out with the help of these plants¹²⁻¹⁴. All these units were entirely made and/or fabricated by the Institute. The following semi-pilot plants have been installed at the Institute.

- (I) A heavy medium cone separator having a capacity of 0.2 tons per hour.
- (II) A drum type heavy medium washer (Hardinge counter current type) of capacity 2.0 tons per hour.
- (III) A 6" diameter cyclone washer having a capacity of 2.5 tons per hour.
- (IV) An Acco flotation cell of about 170 lbs. (1.5 cwt) per hour capacity.

Special reference may be made to important investigations carried out with the cyclone washer. It is to be noted that cyclone washers hold out good potentialities for upgrading coals of poor cleaning characteristics and it is the latter type of coal, which constitutes a substantial reserve of our future supply of coking coal. It will be necessary to crush such coals at least to minus 1/4" or 1/8" for recovering reasonable yields of clean coal. A study on the working of 6" diameter cyclone washer, operated at low pressure (4.5 to 6 lb/sq. in.) using an overhead tank has revealed that better separation can be obtained by inclining the cyclone at 20° to the vertical.

The 2 tph drum washer has been utilised to supply washed fractions in bulk from Kargali coal for large-scale carbonisation tests and also low ash clean coal from Giridih slack for making coke suitable for use in calcium carbide manufacture.

PILOT PLANTS

The erection of the 40 tph coal washing pilot plant, has been completed¹⁵. It comprises of a 20 tph heavy medium drum type washer, a 20 tph Baum jig and includes all essential and auxiliary units, required for the full scale operation of a commercial plant. This pilot plant is the largest coal washing pilot plant in the world.

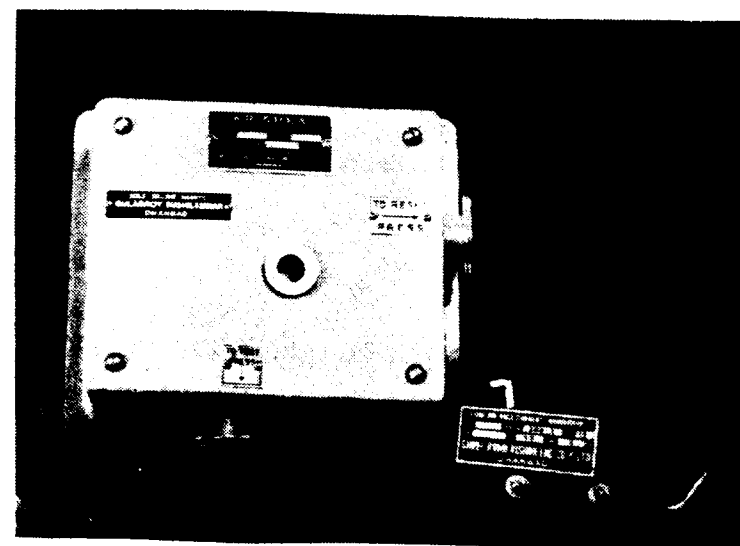
The most outstanding feature of this pilot plant is that it incorporates adequate flexibility of operation and at least 6 to 8 different washing schemes can be followed with this single plant. Test trials of this plant have already been taken and arrangements are now being made to undertake large-scale washing tests of coal for Hindustan Steel, N. C. D. C., the Railways and for several other private concerns including M/s. Birla Brothers Ltd.

Besides the above, tenders have been issued for the installation of a composite fine coal washing plant incorporating a heavy medium small coal washer, a small coal (feldspar) jig washer and a flotation unit and including a centrifuge and a drum filter in the circuit. The plant will have a capacity of 7 tons per hour and will be located by the side of the existing composite course coal washery.

V. STUDIES ON UPGRADING OF COAL BY FROTH FLOTATION

The industrial application of froth flotation as a technique of cleaning coal is becoming more popular.

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As coal is friable, coal fines are invariably produced during mining, transport, screening, crushing, washing etc. Froth flotation process affords the best solution for the cleaning of fine coal. The ash content of such coal fines is increasing, as a result of increased mechanisation, and progressive adoption of sand stowing. The quality of slurry is likely to deteriorate as more and more inferior seams are worked to meet the ever-growing demand of coking coals. The position will worsen still further, when the coals difficult to wash will need crushing to finer sizes prior to washing, thereby producing larger quantities of fines of high ash content. The same applies to the slurry of middlings, which may eventually have to be crushed and washed for recovering reasonable amounts of coking coals before they are consumed for generation of thermal power. Investigations have therefore been taken up at C. F. R. I. to study the possibilities of applying this technique for upgrading our coal fines and choose the most effective and/or cheap reagents that give fairly high efficiency of washing. The results of investigations have been indicated in a number of papers published or prepared by this Institute³¹⁻³⁶. Studies on the fundamentals of coal flotation have also been taken up³⁶ and are being actively pursued.

VI. STUDIES ON SPECIAL PROBLEMS

(a) Removal of water from wet (washed) coal by natural drainage

With the stress inevitably on wet-washing and wet-screening operations, the question of drainage and dewatering of washed and/or screened products, has to be seriously considered, as any excess of water beyond a specified limit (5 to 7 percent) is undesirable not only on the score of excess freight for transport but also from the point of view of its adverse effect on the efficiency of utilisation. The possibilities of removal of water from wet coal of various size consists have been studied at this Institute³⁷. It has been found that the drainage of surface moisture has apparently no relation with the rank of coal. It was also been observed that the addition of certain wetting agents can influence drainage quite appreciably. This study is being extended to coals of small and fine sizes.

(b) Recovery of iron pyrites from V. P. coals

Coals from Nowrazabad top and bottom seams contain over 2 per cent iron pyrites. Float and sink studies showed that about 80 per cent of pyrites went with rejects at 1.58 sp. gr. Economic recovery of

pyrites from the washery rejects was not possible by froth flotation. However tabling of the rejects crushed to a suitable size (below 25 mesh) led to a recovery of 62 per cent of the pyrites present in the washery rejects (corresponding to 52 per cent pyrites in the raw coal) with less than 9 per cent carbon and containing 42 per cent pyritic sulphur³⁸.

(c) Effect of washing on sulphur and phosphorus in Indian Coal

The main coals of Bengal and Bihar are low in sulphur and comparatively high in phosphorus content, while Assam coals are highly sulphurous but low in phosphorus content. Investigations at C. F. R. I. has revealed that most of the sulphur being in organic form is carried along with the cleaned product. In case of phosphorus, it has been observed that a part of it is certainly reduced with washing because of elimination of high-ash rejects but this reduction is not pro-rata with ash reduction^{39,40}.

(d) Properties of some suspensions used in dense media coal washing

The properties (viscosity and stability) of heavy medium suspensions for coal washing as are available in India have been studied⁴¹. These include shale, baryte, mill-scale, magnetite and hematite. Among many interesting inferences, it has been revealed that the presence of clay or coal slurries to the extent of 5 to 10 per cent, helps to stabilise the coarser size grind of magnetite suspension without affecting its viscosity to any great extent.

(e) Flocculation tests of coal slurries by using different reagents (flocculants)

In order to recover fairly low-ash coal fines from washery effluent water as well as to avoid stream pollution with dirty water, it is necessary to clarify it substantially before discharge into stream. The effect of different flocculants on the settling rates of coal slurries, collected from various commercial coal washing plants is being studied by this Institute.

VII. STUDIES ON MISCELLANEOUS PROBLEMS RELATED TO COAL WASHING

A series of "studies on coal washability" starting from the elementary principles of float and sink tests to the implications of the different criteria used to evaluate the performance of coal washing plants have been conducted by this Institute. The findings have

been discussed and published in different parts⁴²⁻⁴⁴ as mentioned below :

- (1) The meaning of coal washability
- (2) The ash units curve
- (3) Washability, sizing and breakage
- (4) The middlings curve
- (5) Washing before and after hand-picking
- (6) Variation in the ash of a washed coal
- (7) ± 0.10 specific gravity distribution curve
- (8) The tromp distribution curve and the error area
- (9) Efficiency and washing plant performance

It may be observed that these studies have led to the development of "ash unit" curve and "middlings" curves^{43,45} which can be used for better representation and interpretation of washability results.

The Institute has worked on and evolved a new approach to specify the sharpness of separation of a washing plant⁴⁶. The new factor called 'sharpness index' or 'Sarkar index' is expressed on a percentage basis and is independent of the quantity of feed and/or the density of separation.

A new graphical method has also been developed in this Institute which permits determination of the optimum separation density and size gradings of raw coal fed to a composite washery or the optimum ash level, at which two or more seams should be washed to give maximum yield of clean coal⁴⁷. This method will serve as a very valuable guide to coal preparation engineers before and after the washery is installed in so far as recovering the maximum yield of clean coal is concerned.

Investigations⁴⁸ have been carried out at this Institute to assess the exact nature of the impairment in efficiency of dense media coal washing units particularly in relation to the increasing amounts of near-gravity materials in a coal and at the same time to indicate how the efficiency figures, evaluated by different formulae, are affected by increased difficultness of coal.

To study the relation between the reduction in ash per cent and the reduction in yield per cent at

different sq. gravities of separation, a statistical analysis of extensive data obtained from the washability tests of Jharia coals has also been conducted.⁴⁹

The technique for the petrographic analysis of raw and washed coals has been used to investigate how far the gravity fractions of a particular coal influence the petrographic composition⁵⁰. This knowledge of the quantitative petrographic composition has a direct bearing on the process of coal carbonisation and allied problems of coal utilisation.

Various possibilities for the proper beneficiation of high ash slurries⁵¹ (a) middlings and rejects which are expected to be produced in large quantities from the different central washeries as planned, are also being actively investigated by the Institute staff.

VIII. STUDY AND REVIEW OF COAL CLEANING PRACTICE AND DEVELOPMENT

C. F. R. I. has studied the progress and development in coal washing techniques and researches of other advanced countries and has been following up closely the recent trends in coal cleaning practice in the world. The Commonwealth Committee on Fuel Research has afforded good opportunity for maintaining proper co-ordination in such work with regular exchange of reports and reviews⁵², and study tours by experts and workers have been or are being frequently arranged in order to make them conversant with latest developments in coal washing abroad. A few reports of such visits have already been published by this Institute⁵³⁻⁵⁵. Comprehensive reviews of modern coal washing have been compiled⁵⁶⁻⁵⁸. The Institute has also brought out several general papers on coal washing⁵⁹⁻⁶². The report of the Coal Washerries Committee, most of which was prepared by this Institute has dealt with many such problems and/or developments.

For an understanding of and for discussing the various problems and aspects of coal washing, the Central Fuel Research Institute organised a symposium on Coal Washing in September, 1953. In this symposium about 22 papers were presented, a large number of which were contributed by the Institute staff⁶³. Many papers on coal washing have also been presented at several other symposia held⁶⁴⁻⁷⁰.

Lectures by foreign experts have also been arranged from time to time. Special reference in this connection may be made to the lectures delivered by Dr. F. W. Mayer (West Germany), one of the leading coal

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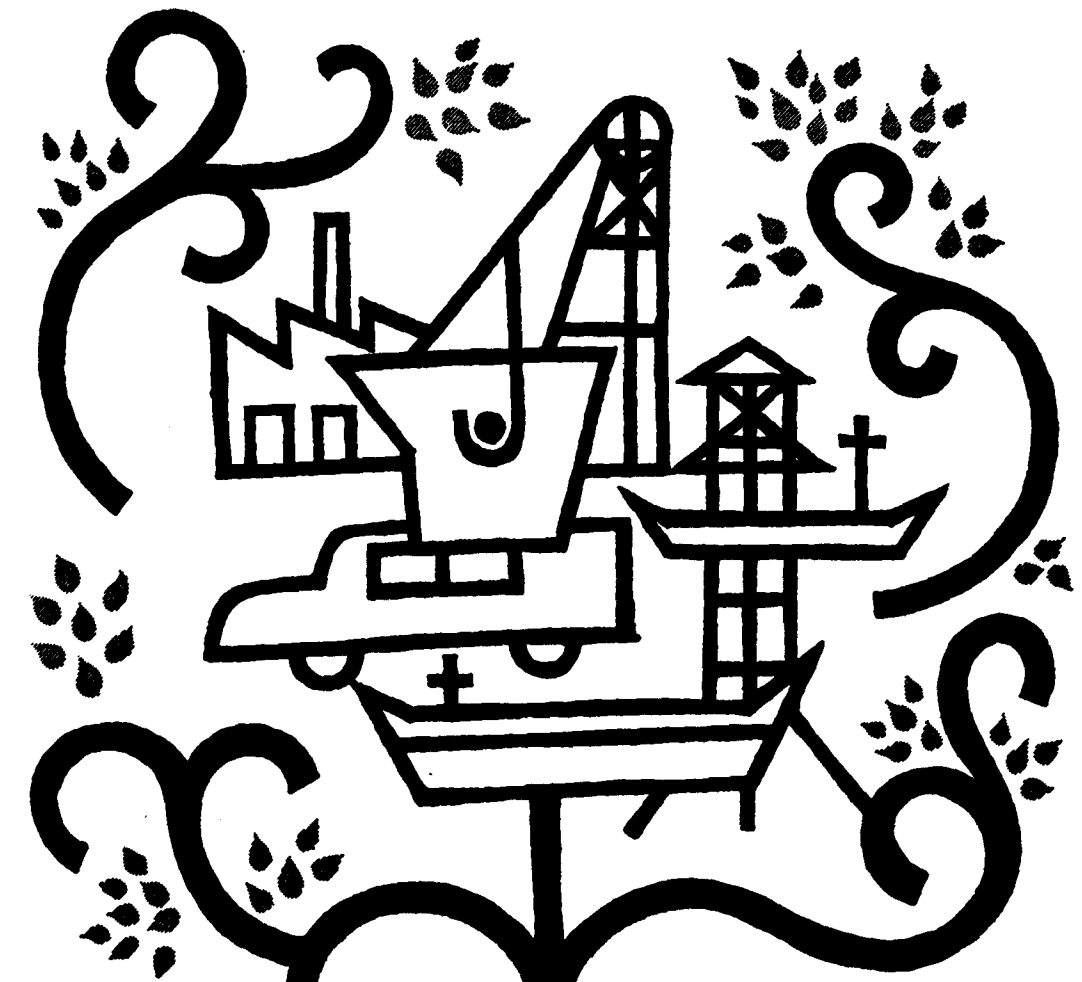
CONCLUSION

This short review covers some of the main activities of the Central Fuel Research Institute in the field of Coal Washing and preparation and relates to the work done here during the last 10 to 12 years. While the Institute takes legitimate pride in its modest achievements within a short span of time, it realises none-the-less that there is much harder task ahead. When all the central washeries come into operation, a number of problems including day-to-day control of quality, drainage and dewatering of washed products, upgrading and disposal of slurry, middlings and rejects are likely to be encountered and it will not be possible to investigate these problems at the individual washery. It is also envisaged that the future supply of metallurgical coal to the Iron & Steel Industry will be drawn more and more from the lower seam coals of Jharia and Bokaro fields and the only way to treat these coals will be to reduce them to fine sizes. In such cases, completely different types of washing schemes will have to be adopted using more of cyclone washers and flotation plants in the circuits. This will also necessitate the incorporation of elaborate systems for treatment and upgrading of slurry and arrangements for dewatering and drying of washed products. In the years to come the Institute will have to be busy to work on all such problems and follow them up closely both with laboratory study as well as pilot plant investigations.

The Institute is also playing an important role in the training of coal preparation engineers and technologists. With more of coal washing plants coming into existence in this country, the dearth of such trained personnel is being strongly felt. It is worth noting that a number of young scientists and engineers are now being trained by this Institute for carrying out coal washing investigations and for planning, designing and operation of coal washing plants.

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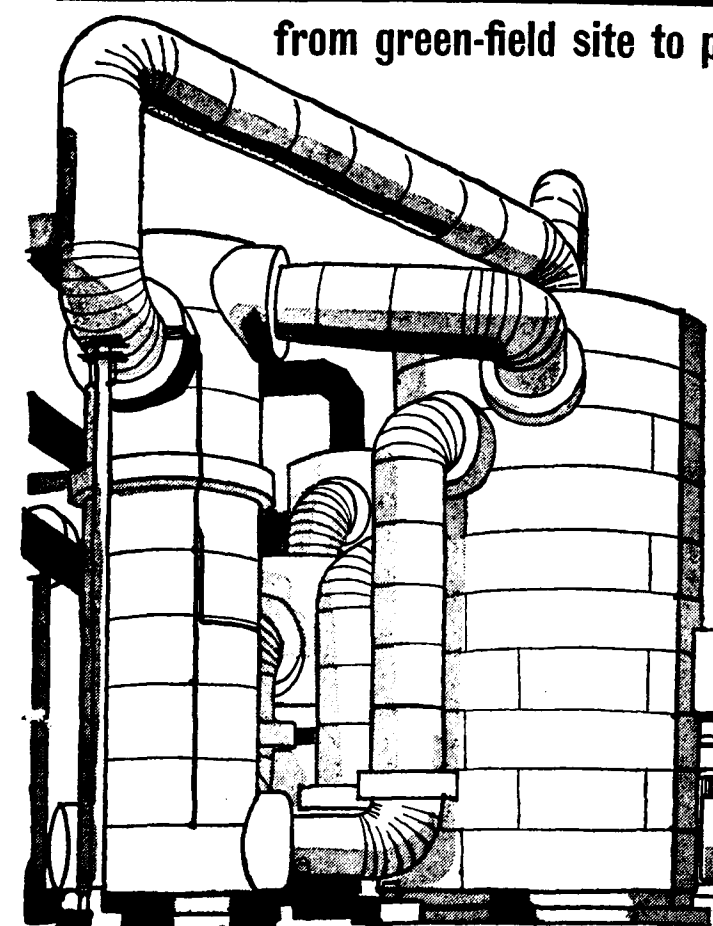
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The Indian Standards Institution has granted one more licence for the use of ISI Certification Mark in respect of tea-chest plywood panels to M/s Taj Plywood Products, Calcutta. With this, 52 licences have been so far granted to the manufacturers of tea-chest plywood panels.

The presence of the ISI Certification Mark on the panels is an independent third-party guarantee that the plywood panels have been manufactured under controlled conditions and conform to the requirements as laid down in (IS: 10-1953) the Indian standard specification for plywood tea-chests (revised).

The Standard Mark is stamped on the plywood panels under the supervision of the Development Wing, Ministry of Commerce & Industry, Government of India. Any complaint regarding the quality of tea-chest plywood panels bearing the Standard Mark may immediately be brought to the notice of the licensee, Development Wing and this Institution.

* * * * *

IMPORT OF CARS BY TOURISTS

The Government of India have decided to exempt cars, jeeps and station wagons imported by tourists under the 'Triptyque' system from Import Trade Control restrictions. This is subject to the condition that the vehicles shall be re-exported within the period stipulated in the 'Triptyque' or 'Carnet De Passage'.

This decision follows representations that considerable difficulty had often been felt in securing customs clearance permits in advance for import of vehicles through the automobile associations.

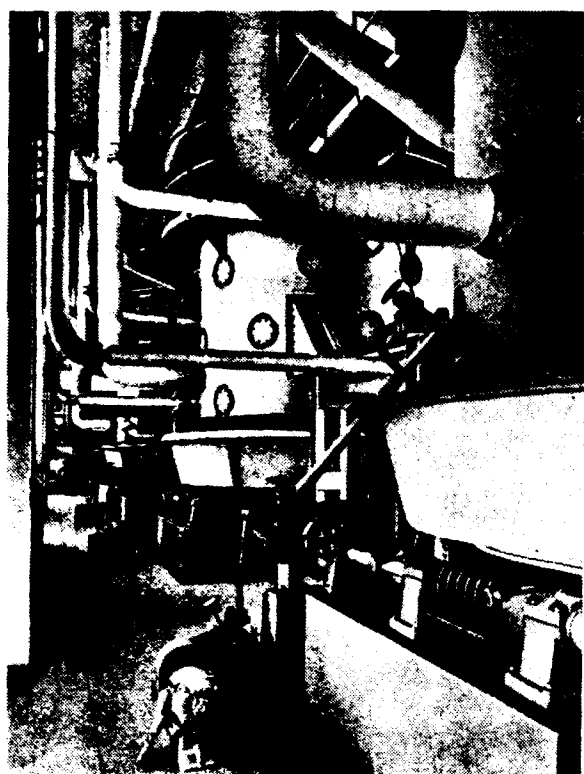
Announcing the Government decision, an Import Trade Control Public Notice, published in a Gazette of India Extraordinary, says that sale or retention of such vehicles in India in violation of the stipulated condition will entail penal action. Vehicles registered in the names of tourists will also not be allowed to be transferred to other parties in India.

UP-TO-DATE GAS-HEATING

From An Overseas Engineer

THE technology of modern thermal energy production has shown, especially in the past ten years, a definite trend towards gas heating. Both practical and scientific experiences prove that the thermal energy of solid fuels is utilised much better in the form of producer gas than if being burnt on grate. The advantages of gas heating are, besides a more economic efficiency, the simpler and easier manageability and a considerably simpler adjustability.

As a result of these recognitions and their scientific proofs, in case of using solid fuels, it is almost



Lower level of gas generators as seen from the side of the gear. This equipment rotates the slag-pan through which the slug produced during gasification leaves the generator.

exclusively producer gas that is used for modern furnacer heating and for solving other problems of thermal energy.



Upper level of gas generators with fuel bunkers, semi-automatic feeder and boiler.

In the field of gas producing equipments Hungarian industry is rich in experiences and traditions, especially as concerning generators and producer gas plants. The gas producer plants of the "Gabor Aron" Foundry and Engineering Works of rich past have been operated in home and foreign plants with excellent result.

The Hungarian gas generators are of the world known and widespread KOLLER-type, running on ball bearings of the central rotary grate system. They are supplied in six different sizes.

Performance of the KOLLER-type gas generators:

Shaft Ø mm	1200, 1600, 2000, 2600, 3000, 3200
------------	------------------------------------

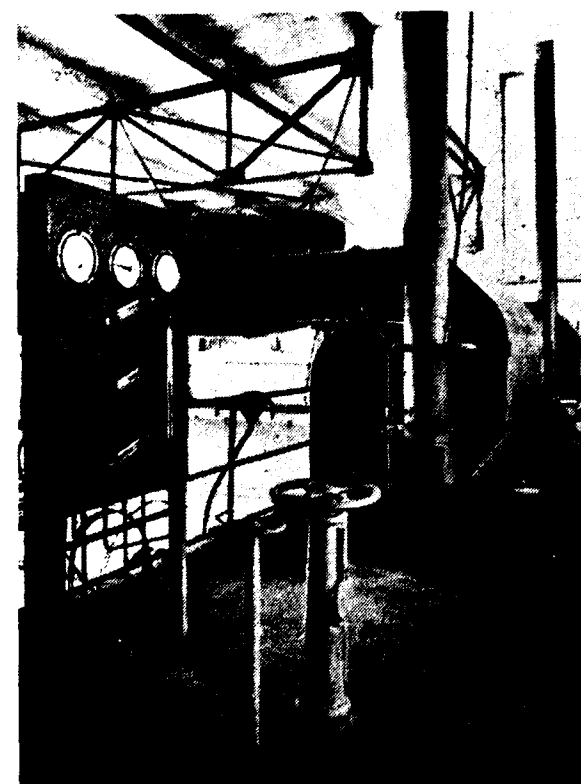
Performance Nm ³ /h	550, 1000, 1600, 3000, 4250, 5000
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All the six types are suitable first of all for the economic gasification of lignites. A fact of great importance when dealing with the problems of the economic application of low calory coals. In certain cases a thermic efficiency of as much as 75 per cent can be achieved. With careful handling the produced quality of gas is constant and uniform. Following

consumption their performance is automatically adjustable. All the six types are equipped with adequate safety devices excluding accidents and the danger of explosion.

ing works the temperature of gas leaving the plant may be adjusted, by means of suitable coolers, hot or cold, as desired.

The cleaning and redusting of gas is done in electrostatic detarrers. Tar and oil content of the gas water is reduced in sedimentation basins.

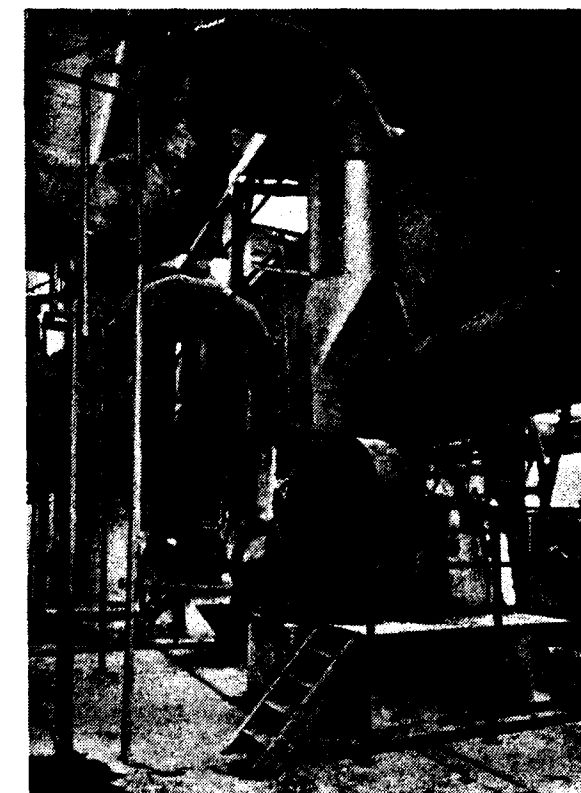


The picture shows the individual instrument panel along with upper level of the generator and the wet bottom master gas-valve. Instruments needed in the control of operation, thermometers and manometers, are placed on the panel.

When coal of medium calorific value is used /:3200—3500 cal :/ besides the guaranteed performance given in above table the heating value of the produced gas is 1450—1500 calory/Nm³.

Generators of smaller type are produced for hand feed, the bigger ones /: above 2600 mm. Ø:/ are equipped with semi-automatic or automatic feeders.

Hungarian industry supplies complete gas producer plants for the production of raw or refined gas. Depending upon the requirements of the gas consum-



Pressure intensifying device: top view of the pipeline system. The gas produced is transported through this system of pipelines to the consumers by the pressure intensifying ventilators.

The designers of the "Gabor Aron" Foundry and Engineering Works have been constantly experimenting to discover new possibilities in modern thermal energy. Recent experiments have brought along many an interesting and useful experience to be applied in the process of production.

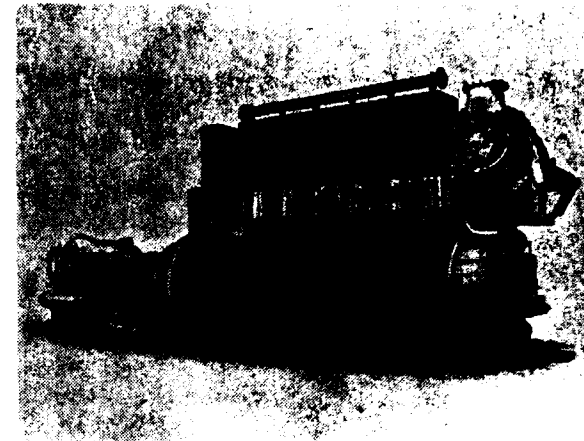
Hungarian industry has delivered this type of equipment to the Soviet Union, Czechoslovakia, Poland and other countries.

Diesel Engines Designed From First Principles Using Computers

By A Special Engineer

THE AT series of diesel engines that have been added to the range made by Ruston and Hornsby Limited of Lincoln, are the result of five years of design work starting from first principles. Every point of construction was questioned and the final choice was based on both performance and market considerations, not forgetting the question of servicing. Powers range from 600 to 1,645 b.h.p., with speeds up to 520 r.p.m. Bore and stroke are 12½ in. by 14½ in. All engines are turbocharged, and intercooling is used to obtain the higher range of power.

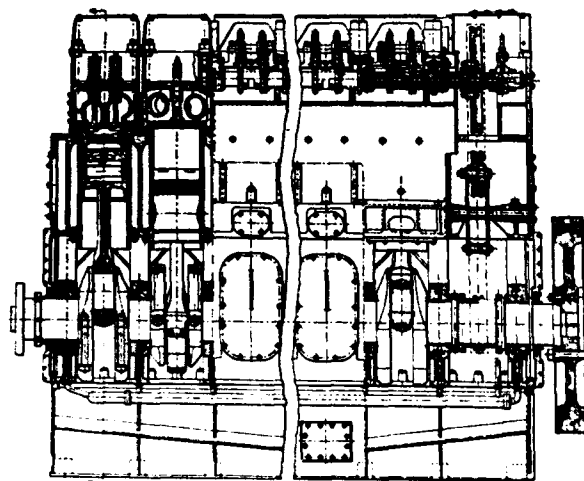
The operating cycle was first considered, and the optimum chosen by the use of computers at the IBM centre. Over 6,300 calculations were made leading to the production of three-dimensional graphs using boost pressure, cylinder pressure, compression and expansion ratios and intercooler temperatures as some of the variables. As a result, a high efficiency has been obtained, the first engines being able to give a fuel consumption of 0.339 lb. per b.h.p. hr. under service conditions, a figure which it is expected will be bettered in later models. The engines have been run with b.m.e.p.'s up to 180 lb. per sq. in. but the normal rating is 160, the figure at which the above results were obtained, when an intercooler was fitted.



Marine version of the Ruston AT diesel engine range.

Stress flow tests on a single cylinder test engine showed that by proper design the head could be fixed by four long bolts instead of the seven used in other models. Pressure tests showed that with four 1½ in. diameter bolts sealing could be maintained at cylinder pressures up to 3,000 lb. per sq. in. and over, whereas with the earlier design using seven 1½ in. bolts it had been difficult to seal at 1,200 lb. per sq. in. The four bolts allowed a symmetrical head casting with the four valves that had been shown to be the best arrangement for breathing, and with the inlet and exhaust passages opening on opposite sides of the head. It also became simpler to place the injector in the stream of the cooling water.

The fact that the inlet and exhaust are on opposite sides results in one side being relatively cool, so that a high level camshaft can be used without running into cooling difficulties. This has allowed a further simplification in that push rods are no longer needed and the rockers can bear directly on the cams. The cam assemblies are made in the form of sleeves held on the shaft by cotters. The rocker bracket is used as a load spreader for the head bolts which have rolled threads and are all proof tested before use. Their length gives them a considerable amount of elasticity, enough to work in conjunction with the stiff construction of the rest of the framework.





EXTENSOMETER
Type ORION-EMG 2353

The apparatus features a double Wheatstone bridge which measures the resistance variation of the strain gauge fixed to the machine element under test.

STEELSORTER
Type ORION-KTS 2733/S

The apparatus is easy to handle and serves for the quick classification of iron and steel workpieces and for the establishment of their technological identity.

FERROTESTER
Type ORION-KTS 2738/S

The apparatus is used for the quick direct measurement of ferromagnetic materials as to their magnetic properties, including magnetic saturation remanence, coercitive force and permeability.

ORISTROB STROBOSCOPE
Type ORION-EMG 2371/B

The unit serves for measuring the revolution or vibration speed of mechanism in motion. Measuring range with basic frequency: 600 to 15,000 r.p.m.

PIEZO-ELECTRIC DOUBLE-BEAM PRESSURE INDICATOR
Type ORION-KTS 2780/S

The apparatus is particularly suitable for determining the pressure prevailing in the cylinders of high-speed motors, Diesel motors, Switches and air compression tools as well as for testing their operations.



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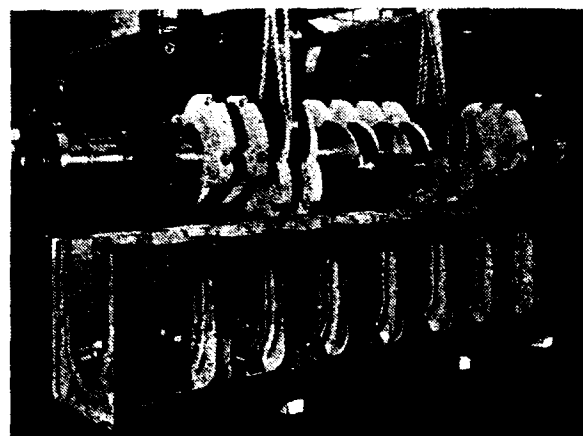
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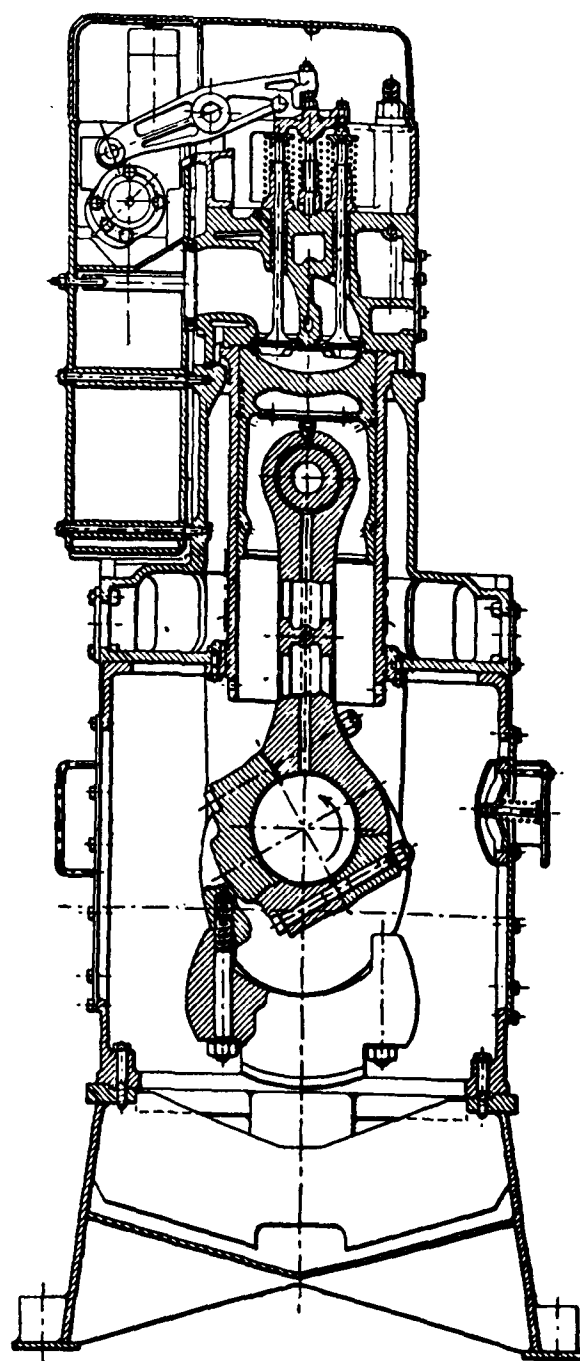
Both crankcase and shaft are extremely stiff: the shaft is 97.5 per cent balanced, and does not normally need a torsional damper.



Perspex and silicone-rubber models used in investigation into deflections under load of main bearings of Ruston AT engine.

Using the single cylinder mock-up, tests were made to determine the deflection of the crankcase under load. Although the case had been planned to be very rigid it was found that the deflection caused by applying the equivalent of the maximum cylinder pressure (1,200 lb. per sq. in.) was sufficient to nip the crankshaft in the main bearings, the whole of an experimental clearance of 0.015 in. being taken up. As a result, further tests were made using silicone rubber and Perspex models to determine the best shape; some of the models are shown in the illustration above.

The silicone rubber models which were made very exactly from wooden moulds gave the qualitative deflections, and the Perspex models were then used to give quantitative figures photoelastically. The type in



SECTION IN DIRECTION OF ARROW

the bottom right hand corner is the nearest to the final design, as can be seen from the other illustration, which shows the crankshaft and crankcase during assembly. It is interesting to note that the final form is simpler than some of the earlier attempts—a result that leads to further savings both in time and labour in the moulding shop and by reducing the number of faulty castings to be expected. Quantitatively, the deflections were reduced by a factor of five as a result of the new design.

The steel crankshaft is made by the "constant grain flow" forging technique developed by the English Steel Corporation, and is one of the very few parts not made by Rustons. Balance weights account for 97.5 per cent of the out-of-balance forces. The shafts have been made so rigid that torsional vibration dampers are not needed for the majority of applications. Prefit bearings on thin steel shells are used for both the main and the big-ends and oversize bearings are available for re-ground crankshafts. Lubricating oil is fed copiously to all bearings, sufficient to cool as well as lubricate. The connecting rod is also a solid forging with integral large end bores. The caps are secured by four bolts, the joint faces being serrated and angled, so that the rods can be removed through the bores.

Placing the camshaft at head level involved redesigning the fuel pump if the overall height of the engine was to be kept down. A short stubby pump was therefore produced to suit, which can be mounted wholly within the valve gear chamber and which is driven directly from the camshaft. These pumps are

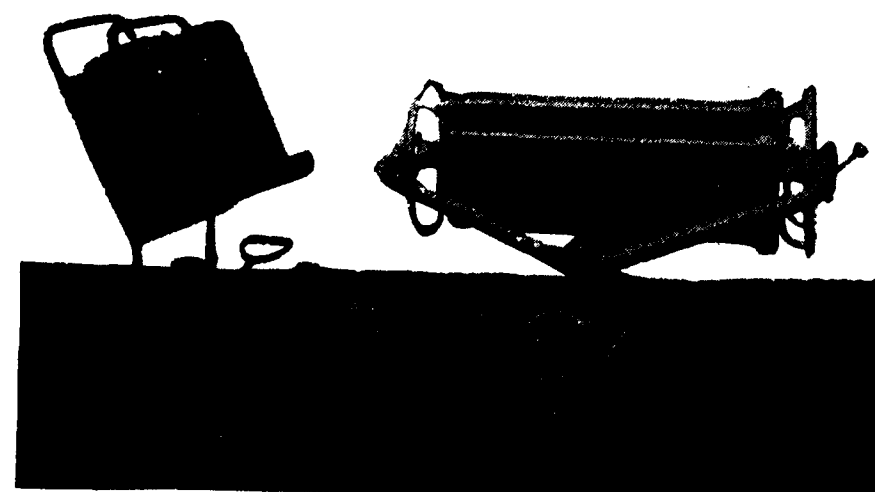
capable of handling all fuels in the class A and B ranges. Although the present engines are designed for unidirectional running (the speed would in any case require a gearbox for marine use) the direction can be chosen by changing the camshaft. Camshaft adaptations could probably also be made if there was any demand for a direct reversing version.

The camshaft is driven from the crankshaft by a duplex roller chain which has provision for adjustment. To prevent timing variations as a result of taking up any slack, the adjustment has two wheels, one acting on each leg of the chain. The camshaft is also used to drive a rotary distributor for feeding starting air to the cylinders in turn; this arrangement will allow for single wheel operational control of the engine.

The design allows for wide variations in installation. Since the cylinder components are symmetrical, "handed" engines can be built, and, as has already been mentioned, either direction of rotation is possible simply by changing the camshaft. Full power can be



Seifert Eresco Industrial X-Ray Unit

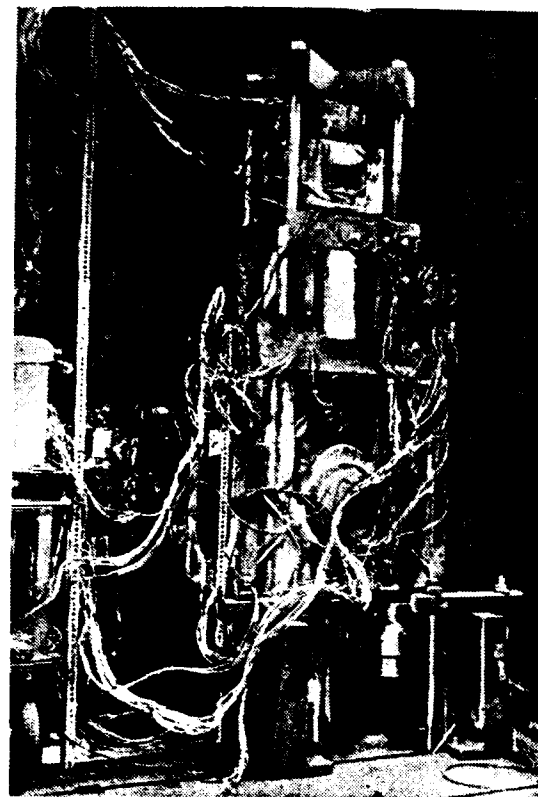


SEIFERT X-ray Units are being used by engineers and scientists in Bridge—and Steel hall building, Locomotive Building, Boiler shop, Pipe-lines and Vessels Foundry, Light-metal industry, Motor car Factories, Shipbuilding, Laboratories of various branches in industry and Scientific, Research work, for testing iron and non-ferrous metals, as well as any other kind of material, welding seams and castings.

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Single-cylinder mock-up of Ruston AT engine in form used for investigation of main bearing deflections, and for strain gauge investigations of structural stresses throughout the assembly.

taken from either end of the engine and the crankshaft has identical flanges at both ends for this purpose. Auxiliary drives can be taken from five positions: right or left-hand side at the fly-wheel end by chain drive; right or left-hand side of the free end, also by chain drive; or from the front of the engine from a resiliently mounted gear drive. This last can be seen in the illustration; it consists of a gear wheel mounted on the crankshaft, which has a resilient construction and round which are placed up to six pinions each driving an item of auxiliary equipment. This arrangement will probably appeal particularly to the marine user, as four of the drives can be for normal service requirements such as oil, scavenging, and fresh and sea water circulation, and the remaining two for bilge pump, fuel lift pump or a standby pump for some particular service.

Apart from performance, reliability has been a main

feature of the new design. The makers' recommended life between overhauls is 4,000 hours running (on Class A fuels), a figure which may well be increased to 5,000 hours, as development proceeds. Throughout the

design split pins have been avoided as far as possible, their place being taken by Nylock nuts or Circlips.

(Courtesy: " Engineering")

Distribution of Petroleum Products in India

OIL COMPANIES' REPRESENTATIVES MEET GOVERNMENT

Shri K. D. Malaviya, Union Minister for Mines and Oil, laid the following statement on the table of the Rajya Sabha in reply to a question by Shri Harihar Patel, who wanted to know whether the representatives of the Government of India and oil companies in the country met in New Delhi recently to discuss matters connected with the distribution of oil :

The General Managers of Burmah-Shell, Standard Vacuum and Caltex Oil Companies had jointly requested for having the opportunity of a general discussion with this Department, and such discussion was held on April 7, 1959. One of the points raised in the discussion was about distribution of oil. They referred to their earlier proposal that an industry-cum-Government committee should be set up to go into the various common problems that would arise consequent to the setting up of the two public sector refineries.

In this connection it was finally arranged that the General Managers would send in writing their detailed suggestions as to what should be the terms of reference of the committee they had in mind. The companies have jointly suggested that a Government-cum-industry committee should be set up (1) to examine the pattern which will emerge, and recommend necessary transport arrangements for the movement of refined petroleum products throughout India following the commissioning of the Government refineries at Gauhati and Barauni, and (2) to examine ways and means of resolving imbalance between production of refined products in the refineries in India (including Gauhati and Barauni) and the consumption requirements of the country.

The likely production pattern of the Barauni refinery will be known only after the discussion currently in progress with representatives of the U. S. S. R. Government are concluded. It would then be possible to decide whether it will be necessary to have such a committee and if so, what should be its composition and terms of reference.

SULPHURIC ACID PLANT AT BHILAI

The sulphuric acid plant at Bhilai, which will produce about 12,000 tons of acid per year, is expected to be ready soon.

The acid will be used for producing ammonium sulphate from the ammonia recovered as a by-product from the coke-oven gases. The plant for the conversion of ammonia into ammonium sulphate is also included for competition and commissioning in the programme for the next few months.

The first coke-oven battery and the blast furnace were commissioned in February, 1959. The coke-oven battery is daily producing about 1100 tons of coke, while the blast furnace is producing about 900 to 1000 tons of pig iron per day valued at over Rs. two lakhs.

With the commissioning of the second battery of coke ovens and the second blast furnace the output will be doubled.

The open hearth furnace will enable the production of steel ingots which will be rolled in the blooming mill and the billet mill.

* * *

CENTRAL BOARD OF RAILWAY RESEARCH

The Deputy Minister for Railways, Shri S. V. Ramaswamy, confirmed in the Lok Sabha during Question Hour that a high-powered Central Board of Railway Research was to be set up shortly. The functions of the Board, the Deputy Minister added, would be to direct and co-ordinate research on railways and secure co-operation of other institutions such as national laboratories.

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AFTER TWELVE YEARS OF CONSTANT EFFORTS, THE FRENCH STEEL INDUSTRY
HOLDS AN IMPORTANT PLACE ON 90 FOREIGN MARKETS

The French pig iron and crude steel output regularly increased since the war.

Such a constant production rise did not exclude of course some temporary pauses which characterize the normal development of any heavy industry; the following figures let appear the upward strength shown by the French steel industry during the last twelve years: 4,4 million tons of crude steel produced in 1946 immediately after the French plants had been heavily war-damaged; 8,6 million tons in 1950; 10,6 million tons in 1954, and 14,6 million tons in 1958.

By the latter output figure, France ranks fifth among the steel producing countries in the world.

THE FRENCH STEEL PRODUCING AREAS

Ranking first among the French pig iron and steel producing areas, the industrial progress of Lorraine, in the East of France, is based on the discovery, by the end of the last century, in 1878, of the basic Bessemer process (Thomas process) allowing a wide use of phosphorus ores for the steel making; as a matter of fact, the Lorraine underground contains large reserves of such ores reaching approximately 6 milliard tons.

Owing to the Lorraine ore fields, the French eastern steel industry disposes of over 2/3 of the French blast-furnaces, and provides 66% of the national steel production; it is all the more important as it mainly produces basic Bessemer steel (Thomas steel)—83%—and pig iron—75%—the greatest part of which is used for the making of this quality of steel.

The French northern steel industry ranks second and provides 22% of the total national steel output; the plants are located on the wide northern coal field and near some important steel manufacturing plants which supply the district with scrap, but are however distant from ore deposits. The northern steel plants mainly produce openhearth steel—40% of the French steel of this quality—but do not exceed 7% of the Thomas steel production and 15% of the electric steel production.

A third steel producing area, being the oldest one, covers half the southern part of France, and is therefore called "Centre-Midi"; coal reserves of this area are dropping off, electric power is now used as substitute and will be probably soon complemented with the natural gas of Lacq. The Centre-Midi is specialized in the production of high-quality openhearth steel and electric steel corresponding to approximately 7% of the French total output, but provides, alone, 60% of the French special steels produced as a whole.

Finally, the western area, on both sides of Normandy and Brittany, disposes of rich ore-deposits, the iron content of which is higher than Lorraine ore, but their reserves estimated to 2 milliard tons are less important than in Lorraine. The western area provides 5% of the French crude steel output, this percentage being equally shared out among Thomas and open-hearth quality of steels.

Owing to a considerable and constant endeavour for investments, the French steel industry could progressively reach its present level of production. According to the third equipment and Modernization plan of the French industry, the yearly productive capacity of crude steel will reach approximately 18,5 million tons in 1961. The construction and modernization of the necessary facilities — coking plants, power stations, blast-furnaces, steelworks, rolling mills—together with the social achievements for improving the standard of living of workers, will have reached the approximate cost of 1.200 milliard francs. But that is not all. In addition to these expenditures should be mentioned the continuous technical improvement whatever be for the increasing development of the phosphorus ores in Lorraine, or to spare raw materials such as cokes and coking coals which France always had to import. In this field, the Institut de Recherches de la Siderurgie Francaise (French Iron and Steel Research Institute)—I R S I D—in co-operation with the Laboratories and Research Departments of the plants, widely contributed to make the French steels well-known all over the world, thereby more and more inducing the foreign countries to follow up researches and applied researches works carried out by the French steel

industry, or even to use in their own plants the new processes settled by IRSID.

EXPORT: The case of India

Owing to the achievements of such plans and the settlement of such techniques, the French steel industry could successfully face the international competition made even harder after E.S.C.C.'s Treaty came into force.

Thus, in 1958, French exports, to which Saar exports are to be added, since France and Saar customs union is still in force this year, exceeded 4 million tons. During the first half of the year, however, a decreased demand could be observed on some export markets; this decline was compensated by a particular and successful endeavour of French producers at the end of 1958; during the last three

months of the year, French-Saar exports reached again a yearly rate of over 5 million tons, thus exceeding the peak export figure obtained in 1955 with 4.857.000 tons.

This important tonnage of exports is widely shared out among 90 countries. Roughly, 35% of French-Saar exports are delivered to the E.S.C.C. countries, 25% to the western and eastern European countries, 12% to Middle and Far-Eastern countries, 10% to North and South America, and 15% to the French Community countries.

As far as India is concerned, the two following tables show the recent development of French-Saar exports of steel products, the value of which exports correspond, according to different years concerned, to 30 up to 50% of the French-Saar products sold in this country:

FRENCH-SAAR STEEL PRODUCTS EXPORTED TO INDIA

	1955 Tons	1956 Tons	1957 Tons	1958 Tons
Semi-products	3.967	2.866	2.348	488
Wire rod	—	1.002	298	—
I and U-sections of 80 mm and over	17.554	17.922	4.940	6.855
Other sections	49.488	13.645	18.106	15.850
Steel pilings	205	610	1.111	—
Rolled bars	748	28.273	11.540	1.434
Hoops	5.268	3.428	43	—
Universals	17	146	—	483
Hot rolled plates	872	1.287	5.264	2.377
Hot rolled medium plates	949	2.121	4.167	2.680
Hot rolled sheets	1.771	13.385	3.557	1.035
Cold rolled sheets	692	12.116	480	94
Tin plate	—	3.741	38	4.715
Galvanized sheets and lead coated sheets	258	23.961	4.251	924
Railway material : rails	9.519	2.185	6.638	43.820
Railway material : sleepers	756	8.734	51.284	46.639
Railway material : fish plates	—	868	936	—
Tyres, wheel discs	310	596	2.836	62
Special steels	193	501	202	58
	92.567	137.387	118.039	127.514

IRON AND STEEL EXPORTS VALUE COMPARED WITH FRENCH - SAAR EXPORTS TO INDIA

	TOTAL (million francs)	IRON and STEEL (million francs)	%
1955	15.425	4.680	30,34
1956	17.068	8.270	48,45
1957	19.787	6.574	33,22
1958 (10 first months only)	21.123	7.049	33,37

SUCCESS OF THE RAILWAY MATERIAL MADE OF BASIC BESSEMER SEEL

From the first above statistical table, it appears that, among the exported steel products, the part of railway material, rails and sleepers, is becoming very important; the total figure of 9.000 tons in 1955 reached 90.000 tons in 1958. This considerable increase results from the high quality of rails made of basic Bessemer steel, which the Indian Railways could appreciate in France; as a matter of fact, the French Railways network, among the longest and most severely experienced ones in the world, has a traffic comparable with those of the largest Railways networks abroad. In this respect, the opinion expressed by one of the French chief engineers of the Societe Nationale des Chemins de Fer Francais, M. J. PALME, some years ago, on the occasion of a conference at the Iron and Steel Congress, in Bogota, is the highest praise for the

Thomas Steel: "Most of the rails used by the Societe Nationale des Chemins de Fer Francais, one of the most important net works in the world, as far as length and traffic are concerned, are made of basic Bessemer steel. The hard standard specifications of the French Railways, their great number of tests and their narrow margins, make this network one of the most efficient ones in the world. I take the liberty to make this comparison because French steelworks know it from experience, having supplied many foreign countries with rails, all over the continents and in all climatic conditions, according to the most various specifications. Such hard specifications require a first-class making as well as precautionary measures which the making of basic Bessemer steel rails comply with, to secure the quality desired.

But the confidence India placed in the French Railways material made of basic Bessemer steel, as well as the consideration shown for the technical achievements and researches works carried out by the French steelmen, are not, in a way, unilateral. It is compensated by increasing imports from India, particularly concerning the manganese ore as a raw material. French producers are directly interested in. In 1957, French-Saar manganese ore imports reached 322.369 tons compared with 169.546 tons in 1956.

These few information let appear that both France and India can develop their trade in their mutual interest, but, in a wider field, it should be noted that once again, iron and steel play an often unappreciated part in the rise of the standard of living and comfort for all of us in our everyday life.

HYDRAULIC RESEARCH CONGRESS AT MONTREAL— INDIA TO SEND THREE-MAN DELEGATION

India will participate in the 8th Congress of the International Association for Hydraulic Research, to be held at Montreal, Canada, from August 24 to 28, 1959.

The Indian delegation consists of Shri D. V. Joglekar, Adviser on Basic & Fundamental Research, Central Board of Irrigation and Power; Shri C. V. Gole, Chief Research Officer, Central Water and Power Research Station, Poona; and Shri S. P. Garg, Research Officer (Hydraulic), Irrigation Research Institute, Roorkee, who is already in the U. S. A. these days.

The subjects for discussion are density currents,

fundamental hydraulics of shiplocks, and transportation of material in water. Other subjects are air entrainment and air vents, ice problems in hydraulic structures, and hydraulics of gates and valves.

A study tour to some of the hydro-electric development projects and hydraulic laboratories in Canada has also been arranged for the delegates.

In view of India's comprehensive programme for fundamental and applied research in hydraulic engineering, at present being conducted at the Central Water and Power Research Station, Poona, the Congress is of vital interest to Indian engineers, who have contributed five papers to it.

JENA Instruments for Incident Light Microscopy

Dipl. phys. W. Oettel, Jena
German Democratic Republic

THE ever increasing demands of present-day engineering have brought about the introduction and extension of incident light microscopy and its allied fields into factories and there is every prospect of this expansion being a continuous one. Thus, for example, metal microscopy and ore—and coal microscopy have for a long time ceased to be only the domain of mining, metallography, mineralogy, geology or science of mineralogical deposits, but have won an assured place in almost all problems connected with mining, ore dressing, metal production and processing. These two principal applications for incident light microscopy have been joined in recent years by a new one, i.e., the microscopic testing of surface quality of finished parts, which is very often of decisive importance in precision technology and modern engineering. With a view to this enormous expansion of incident light microscopy, it appears desirable to provide laboratory workers from time to time with a short survey about the instruments that are available for their work.

Foremost amongst the Jena microscope products is the large inverted incident-light camera microscope "Neophot", which due to its excellent imaging quality, its versatile applications and rugged design has become a household word in professional quarters all over the world. It permits microscopic observations in bright field with normal, oblique or conical illumination, in dark field with polarised light and in

a stricter phase-contrast method than hitherto used, within a magnification range of 20 to 1600 times. For this purpose either apochromats or planachromats and plane-field eyepieces with extended image fields can be used. Furthermore, the Neophot can be used for close-ups with an imaging scale from 1:2 up, as well as for low-power magnifications and for photomicrographs up to a magnification of 1600:1. In conjunction with the Hanemann Micro-Hardness Tester (Fig. 1), which is equipped with an Apochromat 32x/0.65 . . . 0.30, hardness tests of very small structural components down to approx. 0.01 mm. diameter are possible.

For routine metallographic investigations in bright field the "Epitype" with its sliding stage (Fig. 2) is very suitable. It is equipped with the new Planachro-

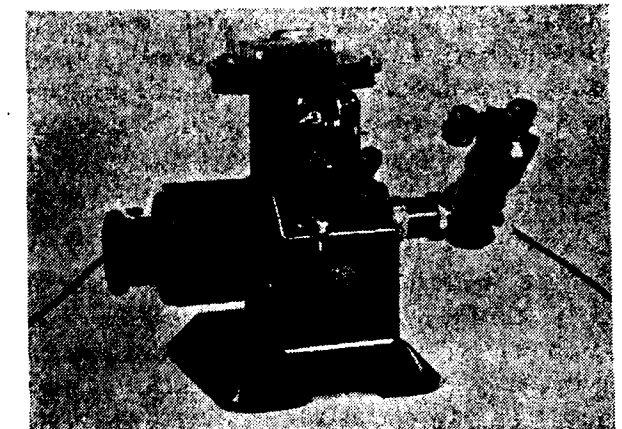


Fig. 2. "Epitype" with test-strip attachment.



Fig. 1. Inserting the Hanemann Micro-Hardness Tester in the "Neophot" illuminator.

mats which are parfocalized for the same stage position. Their large plane image field is fully utilised here for the first time in the straight monocular tube of 300 mm. internal dia. in conjunction with the wide-angle eyepieces especially designed for this purpose. The standard optical equipment permits a continuous variation of magnification, according to the standard series R 10, between 40 and 1000 times, a cylindrical turret permitting easy and quick change of the objectives without actuating the coarse motion. Moreover, to take into account the comparative methods gaining ever increasing ground in metallography, a so-called test-strip attachment (Fig. 2) has

been designed which permits a side-by-side comparison of five test-strip photographs to be made with the 24×24 mm. microscopic image of the specimen. In doing so all images are being additionally magnified

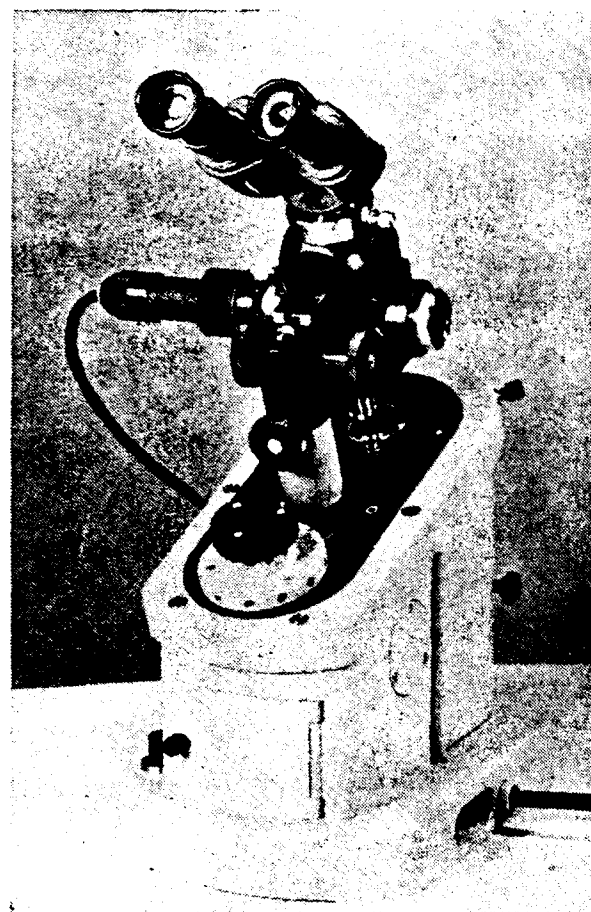


Fig. 3. Electrolytic Polishing Instrument "Elypovist".

three times by a magnifying lens. In this matter it is easily possible to classify the specimens in question during the material inspection either according to reference series compiled by oneself or to existing references without having to take extra proof photographs. The Epityp also of course permits photographs to be taken. For this purpose the test-strip attachment is replaced by the focusing device of the Universal Camera Attachment "MF" and this then used either with a 6.5×9 cm. plate camera or with the Multi-Exposure Attachment permitting three 24×36 mm. exposures on a 6.5×9 cm. plate, or with an ordinary miniature camera.

Metallographic investigation methods call for the use of the conventional plane ground, polished and frequently also of etched specimen surfaces. Because of the grinding dust and etching vapours caused by the preparation of the specimen, these should not be

prepared in the same room where the expensive metallurgical microscopes are installed, we designed the small Incident Light Microscope "Epignost" for testing the individual working processes required in preparing the sections. Equipped with a coarse adjustment only, the Epignost is available for observations up to 300 times magnification in bright and dark field. The Epignost can be supplemented with filter polarisers as well as with a simplified, attachable object traverser; furthermore with a spherical stage inclinable in all directions and with a transillumination base if investigations are to be made in transmitted or in mixed light. The result can be photographically recorded with the same ancillary attachments as used for the Epityp. Hence, the Epignost is also suitable for microscopic observation of specimens with natural surfaces.

Recently the Epignost has also been used in conjunction with the Electrolytic Polishing Equipment "Elypovist". Fig. 3 illustrates the complete equipment, consisting of the electrolytic polishing cell, of the small Incident Light Microscope "Epignost" and the 200 V. A. c. power aggregate. As the polishing process can be observed with the Apochromat

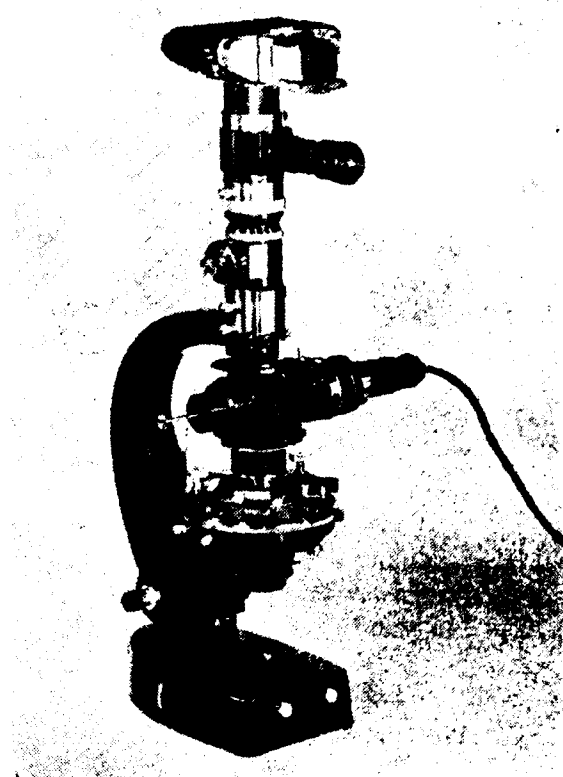


Fig. 4. Incident-light Polarizing Microscope with miniature camera.

15x/030 in bright field incident light there is no need to adhere and also in polarised light, if necessary, to any prescribed formula, so that the best possible processing of the specimen can be achieved, whereby the polishing potential and speed of flow of the electrolyte may be adapted to the prevailing requirements by means of the power pack. As quoted in the literature, the electrolytical polishing process is applicable to carbon, highspeed and stainless tool steels, aluminium, magnesium, zinc, tin and their alloys, also lead, silver, molybdenum, titanium, zirconium, vanadium, tungsten, germanium, uranium and cobalt.

However, when using ores as specimens, it is preferable to use the Incident Light Polarising Microscope illustrated in Fig. 4. Such an ore microscope permits not only qualitative but also quantitative observations in polarised light. The stand is the same as that of the Transmitted-Light Polarising Microscope "Polmi A", except that a diaphragm is inserted into the 360°-rotary stage and an incident-light condenser for polarised light in place of the analyzer intermediate tube. Since there is no need to adjust the stage for this purpose, so that the transmitted-light substage remains in position, work can be simultaneously carried out in incident and transmitted light, which may be of advantage for the observation of thin polished sections. In the discussed design of the Incident-Light Condenser the polariser filter is attached to the bright field support with adjustable iris diaphragm, whilst the filter analyser is fitted underneath the slide way. With the aid of a slide it can be moved in or out of the optical path and turned through 90° by means of a lever. Into a recess below the analyser the compensations Red I and $\lambda/4$ can be inserted. For this ore microscope planachromats with a minimum of strain are used. Finally, it is also possible to complement this instrument for photomicrographic purposes, same as the "Epityp".

With an ordinary Incident Light Condenser, to which planachromats as well as apochromats may be fitted, any large type transmitted-light microscope, having a removable condenser pinion box, and a vertically adjustable stage support, can be converted into an incident-light type of microscope, as the new stand "Nf" (Fig. 5), for instance. The coarse motion, in this case, actuates the tube by way of the tube carrier and thus reacts on the incident light condenser and on the fine motion of the stage (in the Figure on the sliding stage H). In this arrangement of incident-light condenser it is only possible to carry

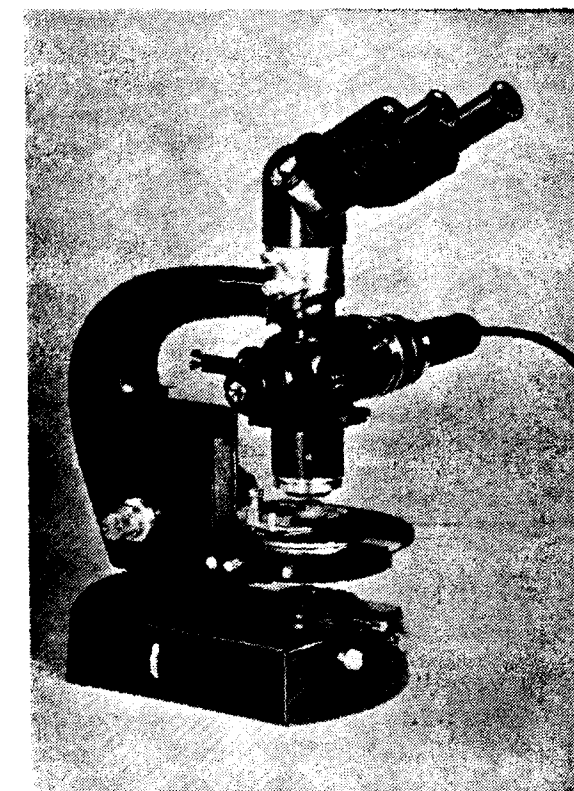


Fig. 5. Stand "Nf H" with incident-light condenser.

out observations in normal bright field with a plano-mirror or with a prism in dark field. Such an incident-light microscope is indicated if with the same instrument investigations in transmitted light are also to be made.

Finally, if it be required to examine natural surfaces also of larger specimens and damaged parts of technical products, etc., or to observe under the microscope preparations or other working processes, stereoscopic microscopes may be used to great advantage. They permit with a free working distance of 100 mm. the three dimensional observation at 4 to 100 times magnification: in some instances this magnification may be either larger or smaller. If a definite magnification is employed, it is recommended that the Stereomicroscope SM XIV be used; i. e., the Greenough type, in which two complete microscopes are joined so that the optical axes of the objectives are at an acute angle to each other. Yet, if it be required or desirable to change the magnification, the use of a "SM XX" stereomicroscope is to be preferred. Here a switch-cylinder with two telescopic systems of the Galilean type, and with an open aperture is fitted between the infinitely corrected objective and the two tube-telescopes. As these

telescopic systems may be used both for magnification or for reduction the required alteration in magnification can be achieved in this manner by turning the switch-cylinder whilst preserving the focused plane. Fig. 6 illustrates the "SM XX" in a multi-purpose stand permitting the observation of large specimens

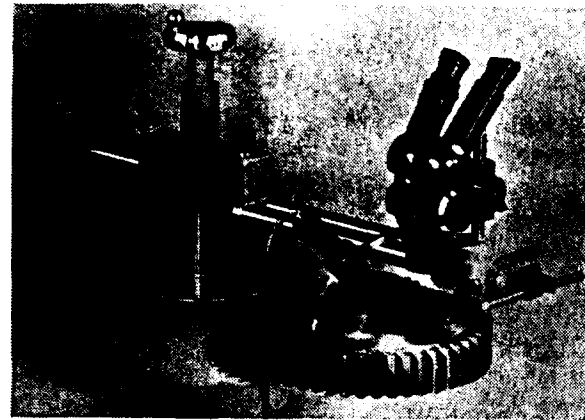


Fig. 6. Stereomicroscope "SM XX" on the multi-purpose stand.

without changing the microscope. With a horizontally adjusted microscope an area of 300×120 mm. can be completely explored and with a vertically standing microscope an area of 300×250 mm. The double bar carrying the microscope permits in addition to the horizontal and vertical positions also intermediate positions at intervals of 7.5° . The multi-purpose stand can, of course, also be used with the "SM XVI" or with the "Epignost".

In conclusion a few remarks should still be made about instruments for the microscopic examination of the surface quality of finished parts. Prof. Schmaltz's Surface Finish Tester deserves special mention in this respect. It is suitable for the determination of roughness-depths from 50 to 0.5 microns according to the light sectioning method. In this method a thin beam of light at less than 45° is intersected with the horizontal surface under test and the resultant profile curve evaluated with a microscope also at an angle of 45° to the surface under test. If, however, roughness—depths of less than 1 micron are to be ascertained, the large Interference Microscope (Fig. 7) must be used. It operates according to the multi-beam method of Tolanski and permits not only the testing of convex surfaces as with the small

Interference Microscope, but also the investigation of flat surfaces. The illustrated microscope allows magnifications of 70, 140, 170 or 340 times for subjective observation, whereas with the photomicrographic

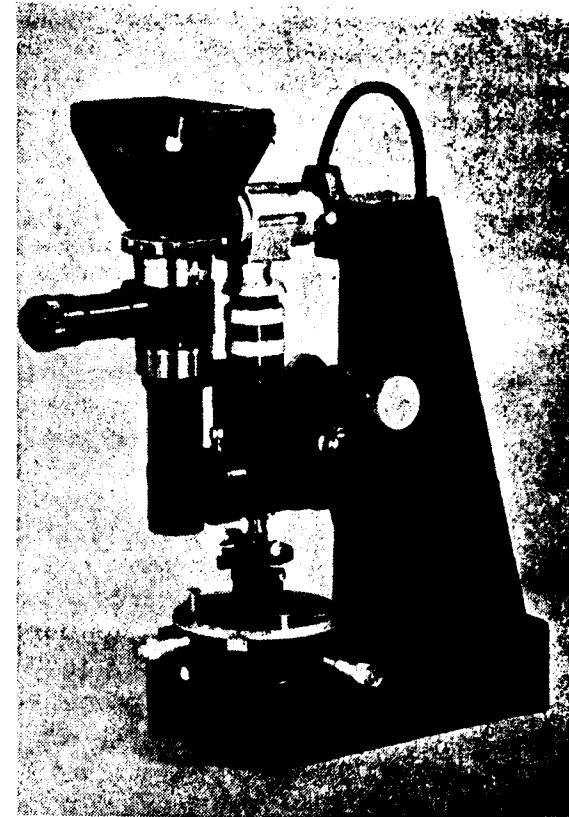


Fig. 7. Large Interference Microscope with photomicrographic attachment "MF".

attachment "MF" magnifications of 63 or 126 : 1 can be obtained. As light sources either a thallium lamp which provides strictly monochromatic light of wavelength 546 microns or a 15 W projection lamp with interference filter is used. This instrument is supplied with reference plates of different reflection powers, as well as with an interference head which permits movement of the reference plate relative to the flat surface to be tested. Thus the position or the separation of the interference bands can be varied.

The reader will accordingly find that there are at his disposal suitable instruments for all three principal applications of incident-light microscopy, i. e. metal, ore and coal microscopy.

ELECTRONICS IN INDUSTRY

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

THE spread of electrical energy and techniques amongst the people of the World, has contributed to the increased well-being by relieving Man of the most mundane of his tasks.

There are few human activities that do not owe decisive progresses to Electricity, Electronics and Nuclear Sciences. Electronics amongst these has, however, of late become important as it is difficult to mention any branch of science which has not experienced its influence. Electronic devices cover a very wide field of applications and have brought to light many new aspects of science and technology which would otherwise still be in the dark.

To many engineers, electronics is still only a simple extension of the domestic radio or television set. This may have been true to a limited extent, perhaps twenty or twentyfive years ago, but to-day, electronic engineering is a science in its own right and electronic devices are engineered to the highest possible standards for precision, efficiency and reliability. Since the out-break of the last war, electronic engineering has made its greatest strides. Development of electronics continues at great speed and, properly used in industry, it serves the purpose of improving quality, of being economical, and of creating better working conditions for the operators.

HISTORY

Electronic engineering has as its background the discovery of the electron by J. J. Thomson in 1897. This epoch-making discovery gave a tremendous impetus to the progress of physics. The invention of thermionic valve by Sir Ambrose Fleming in 1902, gave rise to remarkable developments in the field of radio; and in more recent years it has made possible television, radar and a bewildering assortment of closely related developments.

The real impetus to the development of electronic devices came when Lee de Forrest put the grid in the thermionic valve, and the immediate application of this to communication led to the creation of broadcasting, with its momentous influence on society.

WHAT IS ELECTRONICS ?

Electronics looks a mysterious word. As a scientific term it is somewhat vague. It may be loosely defined as the science which deals with the behaviour of free electrons moving in a vacuum or gas. That is to say, it uses an electronic valve.

With the advent of semi-conducting devices such as transistors, germanium and silicone diodes, the above definition has become limited. Electronics therefore not only involves all phenomena relating to the motion of free electrons, such as thermionic valves, photo-electric tubes, gas rectifiers, cathode-ray and X-ray tubes, but also embraces devices employing equipments such as transistors, in a circuit using combinations of capacitors, resistors and inductances which generally follow the conventions of electronic engineering.

ELECTRONIC VALVE

The heart of electronics is the electronic valve in which electronic conduction takes place by means of free electrons either in an evacuated enclosure or in an enclosure filled with some gas.

The following are the fundamental properties of electronic valve which are taken advantage of in its industrial application.

- (i) It can be made to operate as a switch, hence the term "valve" and the switching operations can be controlled with very great precision and it is in this aspect that it differs from most other types of switching system.
- (ii) In a different circuit it can be made to amplify in voltage and power small signals which are impressed upon its input and repeat them faithfully at its output.
- (iii) Electronic circuits can also be arranged so that they convert variables from one function to another.

The types of valve generally found in electronic circuits for industrial use are broadly classified as follows:—

- (a) Vacuum valves in which electronic conduction takes place by means of free electrons in an evacuated enclosure;
- (b) Gas-filled valves, where the enclosure is filled with some gas.

Another method of classifying electronic valves is in terms of the number of electrodes that have an essential part in the operation of the valve. Thus a valve containing two electrodes—a cathode and an anode or plate—is termed a diode; and a valve containing three electrodes—a cathode, a grid and a plate—is known as triode. In a similar manner, valves containing a cathode, a plate and more than one grid are known as multi-grid valves or more precisely as tetrodes, pentodes, hexodes, heptodes and so on in accordance with the total number of electrodes

DIODE

Representing the simplest form of valve, the diode consists of a filament and an anode or plate. The filament when heated by an electric current, emits electrons. The positive anode attracts these electrons which return to the filament through the battery. The conventional anode or plate current flows from anode to filament. This increases with the increase of anode voltage. But above a certain anode voltage the anode current remains constant and is independent of anode voltage.

With the application of alternating current between the anode and the cathode, the anode becomes positive during one half cycle and negative during another half cycle. When the anode becomes negative no electrons are attracted and there is no conduction during the negative half-cycle. Only that half of the cycle in which anode is positive with respect to the cathode will cause conduction. A device, known as rectifier for converting AC into DC, is thus obtained.

The difference between a vacuum diode and a gas-filled diode lies in the fact that introduction of an inert gas results in much larger currents to pass through and that a glow discharge is visible.

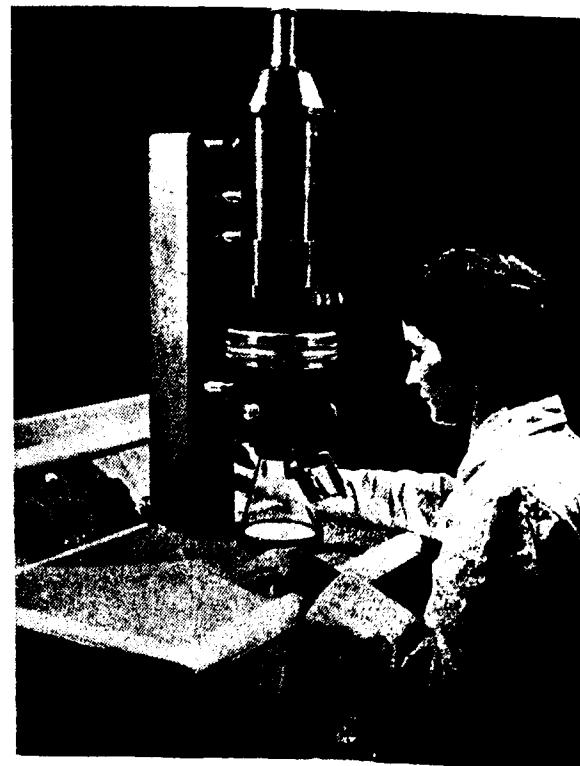
DEVELOPMENT OF TRIODE

The development of the triode, by the introduction of a grid in the space between the cathode and anode

for the purpose of controlling the anode current, by Lee de Forrest in 1907, is of great importance to science and engineering.

A negative voltage with respect to the cathode is applied to this grid so that it attracts very few electrons. There is therefore very little power dissipation in the grid. It has been found that with small variations of grid potential there is relatively a large variation in the anode current and consequently a large variation in the anode power. Its introduction has helped to obtain a higher degree of amplification and control.

In the gas-filled triode, after the valve has started to conduct, the grid loses its control altogether and to all intents and purposes, the valve behaves as a gas-filled diode. The current can then be cut off only



The Philips 75 KV Electron Microscope.

by removing the anode voltage or by greatly reducing it. With this type of valve it is possible to develop an electronic relay capable of operating at very great speed. The valve is usually referred to as a thyratron, which has become a vital element in speed-control systems, servo-mechanisms and high-speed timers.

THE IGNITRON

The ignitron is a gas-filled valve in which the cathode is not heated, but consists of a pool of mercury. A specially designed igniter is used to make the valve conductive and much higher currents can be handled by these valves. On some types water cooling is used to remove the heat generated inside the valve. The major use for ignitrons is in welding circuits, for the precise control of current and voltage, when power demand is not too high.

THE KENOTRON

Improved vacuum techniques resulted in the production of a high-vacuum rectifier, known as the Kenotron, in the year 1915. This is a simple diode with a filamentary cathode, usually made of pure tungsten. Its use is now largely confined to supplying D. C. power whenever importance is placed on high voltages rather than on high currents, such as is the case with X-ray tubes.

ELECTRONICS IN INDUSTRY

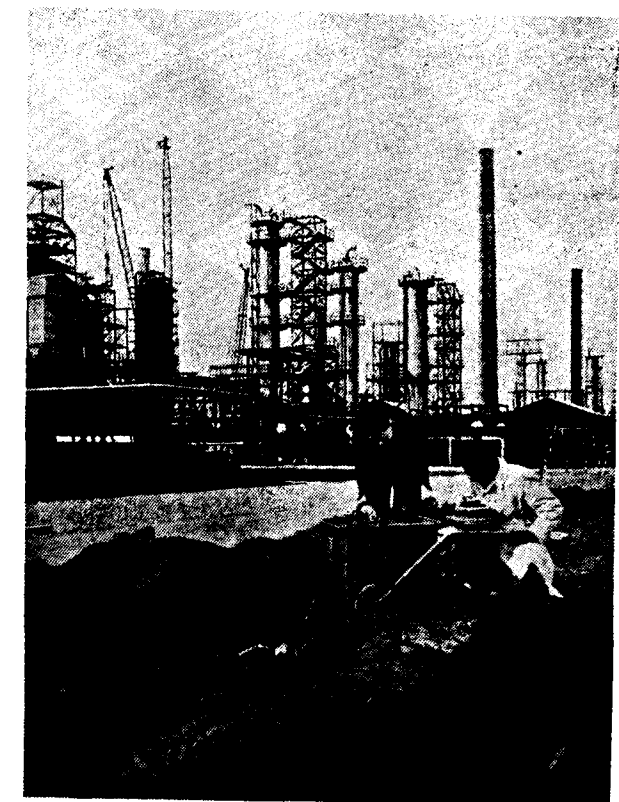
In its industrial application, electronics is used either as an energy converter or to provide it with almost perfect senses and intellect.

In this field the measurement of temperature, speed and light intensity, servo-mechanism, the industrial control of welding, the accurate speed control of electric motors, safety and alarm mechanism, industrial radiography, industrial television, high frequency heating, ultrasonics, electronic instruments for production control, process control, radio-active tracer technique, digital computation are but a few of the many applications where electronics are successfully used. It is proposed to discuss in this article some of the most interesting applications from amongst them.

INDUSTRIAL TELEVISION

One of the most interesting uses of electronics is in closed circuit television. Until a few years ago, television was confined to the field of entertainment alone, but of late it is finding important applications in industry where it is used to view at a distance many industrial processes where close-viewing would be hazardous to life.

The television equipment can be usefully employed on time and motion study. The time and motion study man can make close-up, unobtrusive observation



The PHILIPS 50 kV generator and measuring bridge for cable testing and localisation of defects used at an oil refinery.

and analysis of a particular machine operation or production method from a centrally located production control office.

The equipment essentially consists of two units, a camera containing a super-iconoscope type of tube, which gives high definition with a very great sensitivity, and a monitor display unit which also supplies the necessary voltages for the camera. The camera is connected to the monitor by means of a cable, which can be up to 300 ft. long without correction circuits, and up to 800 ft. long with correction.

A normal type of lens such as is used on a standard 16 mm, cine-camera can be employed, but usually three lenses are supplied, viz. :—

1. a wide angle lens — 1 : 1.5, $f = 2.5$ cms.
2. a normal angle lens — 1 : 2, $f = 5.0$ cms
3. a telephoto lens — 1 : 2.5, $f = 7.5$ cms.

These lenses are easily interchangeable, the focussing and adjustment of the diaphragm being made on the lenses.

Frame frequency is 50 c/s and is synchronised with the mains frequency. The line frequency is 15,625 c/s. No interlacing is applied. The horizontal scanning is free running. The scanning frequency is equivalent to 312½ lines. The high voltage required for operating the cathode ray tube in the monitor unit is obtained by rectification of the fly-back time base pulses.

HIGH-FREQUENCY HEATING

The high-frequency heating of conductors and non-conductors is another interesting applications of electronics in industry.

There are two forms of this heating, induction heating as applied to electric conductors of metals, such as iron, brass, aluminium, etc., and dielectric heating confined to the so-called non-conducting materials such as plastics, wood, oils, fats and foodstuffs.

Induction heating consists in surrounding the materials by a coil carrying the high-frequency alternating current. The heat is produced by the eddy currents induced in the metal by the alternating magnetic field. The frequency used depends on the physical properties and dimensions of the piece to be heated.

Dielectric heating consists in heating the materials by placing them between high-voltage plates to form the dielectric of a capacitor. The heat is generated by molecular friction resulting from the displacement current induced in the material.

The principal uses of induction heating are for the localised heat treatment—surface hardening, annealing, soldering and brazing. Dielectric heating has so far found its main uses in drying, glueing timber, pre-heating plastic pallets, foundry core drying, welding plastic sheets, curing rubber and plastics, cooking (including bread baking), chemical processes (catalysis and heating), and annealing (rayon and nylon treating).

The advantages derived by the use of electronic valves which convert ordinary current into high frequency unit, are : high concentration of power, precisely localised heating, large variety of applications and stable electrical characteristics over long periods.

ELECTRONIC WELDING CONTROL

Electronics has opened up a great many possibilities of controlling resistance welding machines in a better way and to a degree of precision which in earlier days was hardly believed possible.

In combination with electronic valves, numerous circuits have been developed for different purposes and characteristics and wide use is made of time control in the operation of welding control circuits.

With electronic valve it has been possible to speed up operations with greater precision and obtain first quality welds.



OBSERVATION OF DANGEROUS SCIENTIFIC TESTS WITH PHILIPS TELEVISION EQUIPMENT

In the case shown experiments were carried out with liquid acetylene. Because of certain risks of explosion the measuring instruments had to be read at a distance.

The measuring equipment itself could not be set up outside the danger zone, since otherwise the connections, including those of the manometers, would give rise to inaccurate indications.



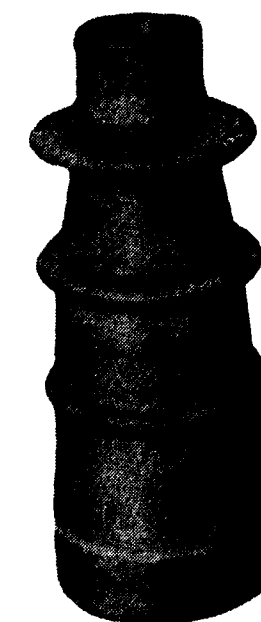
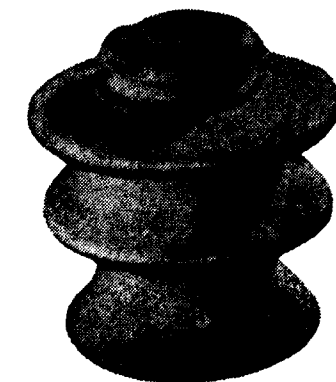
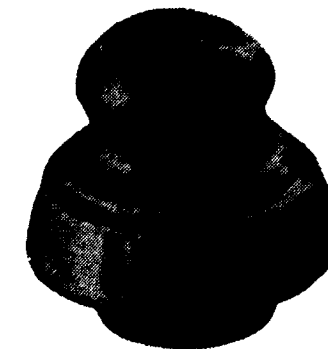
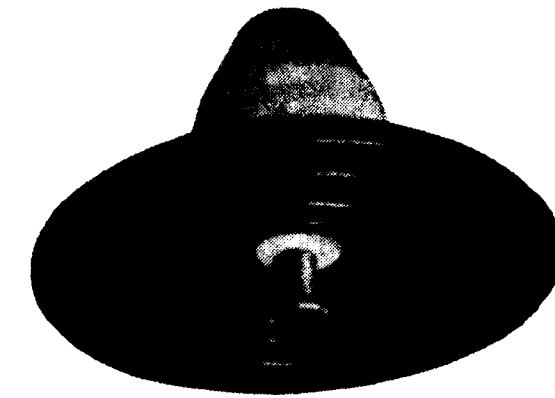
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ELECTRONIC CONTROL OF MOTORS

Electronic motor control has simplified many machine operations, making the machines more versatile. The use of electronic circuits in a motor control system offers many advantages for example, greater adaptability, i. e. units can be built into the actual machines, and a wide choice of characteristics, such as very low power consumption, silent and instantaneous operation, small space, the possibility of adapting the control for individual requirements, and changes in motor speed according to the desired characteristics.

Facilities such as changing speed smoothly and continuously whilst cutting, commencing each cut at low speed and then accelerating the same to the advantage of increased tool life, saving time on planing operations by increasing the table speed while cutting air, etc., can easily be incorporated in or added to machines having electronically—controlled drive. With electronic motor controls it is possible to limit motor current, and hence motor torque to a safe maximum value. This feature is particularly useful on planer drives, as it ensures that the table reverses smoothly and as rapidly as possible.

ELECTRONIC INSTRUMENTS

Many electronic instruments for highly accurate measurements are at present available for use in laboratories and research departments.

Oscilloscope, for example, has become a mass measuring-apparatus in industrial laboratory and workshop equipment specially for the measurement of processes of short duration. Electronic iron-detectors protect machines and products from damage which iron particles may cause.

Electronic instruments are now being extensively used for the measurement of thickness and gauge control. Known as the thickness meter, the instrument consists of a spherical scanning probe with lifting device and the inductive pick-up which comprises the supplementary ridge circuit to the measuring apparatus. Electronic hardness meters are now available for measuring the hardness.

For measuring D. C. and A. C. Voltages, electronic voltmeters have been developed and as industrial instruments, readings with an accuracy up to 5% can be taken. The advantages of electronic voltmeters are: (a) very great resistance to overloads, (b) fast

indication, and (c) suitable for a wide frequency-range and for a great divergency of voltages.

Generally three types of electronic voltmeters are available, viz.: (i) Amplifier-Voltmeters, suitable for measuring low voltages, (ii) Diode-voltmeters, suitable for measuring voltages with very high frequencies, and (iii) Selective voltmeters for measuring very low voltages of the magnitude of microvolts. There is still another type known as the D. C. millivoltmeter where values can be read with an accuracy of 1% or even better.

ELECTRON MICROSCOPE

The idea of evolving the electron microscope originated from the fact that the optical microscope had reached its limit of magnification and the short waves associated with electrons appeared to hold out promise for a new magnifying tool.

To-day electron microscopes are made either with electrostatic or with electromagnetic lenses, although the instrument giving the maximum resolution uses the latter type of lenses.

The electron microscope has become an indispensable tool in industries for particle identification, and study of surface details, structure and physical characteristics. Another attractive field of application is the metal ceramique.

Magnification of the order of 50,000 are obtainable in commercial instruments and much greater than this in experimental work. Even the dullest imagination must be impressed by the advance in knowledge which this instrument makes possible in numerous fields.

X-RAYS IN INDUSTRY

One of the earlier and more familiar products of electronic technique, the X-Ray is being used to-day in industry for inspection and checking, and for identifying materials.

The advantages of X-Ray examination lies in the fact that the methods are non-destructive and are capable of making quantitative and qualitative measurements of elements and compounds in a matter of minutes.

There are two different systems of X-Ray examination, viz.: "Fluoroscopy" and "Radiography".

The first system employs a screen coated with zinc sulphide on which the image of the object becomes visible when X-radiation impinges on it and in the second one, a record of the object is taken on a photographic film. Depending on the material and the kind of information required, fluoroscopy or radiography is employed.

Metallurgy, corrosion studies, internal combustion engines, petroleum refining, paints and other protective coatings are some of the fields where X-Ray analysis is widely used to-day. A large variety of material can be examined by this method of which some are given below:—Castings of aluminium, magnesium and steel, moulded products of hard rubber, wood and plastics, rubber tyres, aircraft and automobile parts, and insulating material, electrical condensers and cables.

The use of transverse supersonic wave probes in conjunction with a supersonic flaw detector, another instrument derived from electronics, is a well established system which can be applied with equal facility to routine testing or individual inspection work, as a complementary to the X-Ray technique.

ELECTRONIC INTELLECT

Various electronic equipments are now available to carry out the most fantastic intellectual activities such as counting, sorting, weighing, computing, etc., and also to perform mathematical tasks impossible to achieve by any other known method. These are also helping to reduce the risk of fire in industrial plants and mines by giving the alarm only and in certain cases by alarm plus reaction where fire extinguishing equipments are added to the alarm and they are put into operation automatically.

The high-speed electronic digital computer has brought about a revolution in engineering analysis and design.

Digital Computers are designed around a central arithmetic processing unit, usually called the arithmetic unit, and have three other basic supporting units, an input—output unit (which may be a multiplicity of

separate things) for communicating between the computer and the outside world, a memory unit for storing the instructions to be followed and the quantities to be worked with, and a control unit to supervise the proper sequencing of the many operations to be carried out. Although all computing systems have a general design based on these four units, they differ markedly from one another in details.

The important characteristics that the digital computer has, may briefly be stated as follows:—

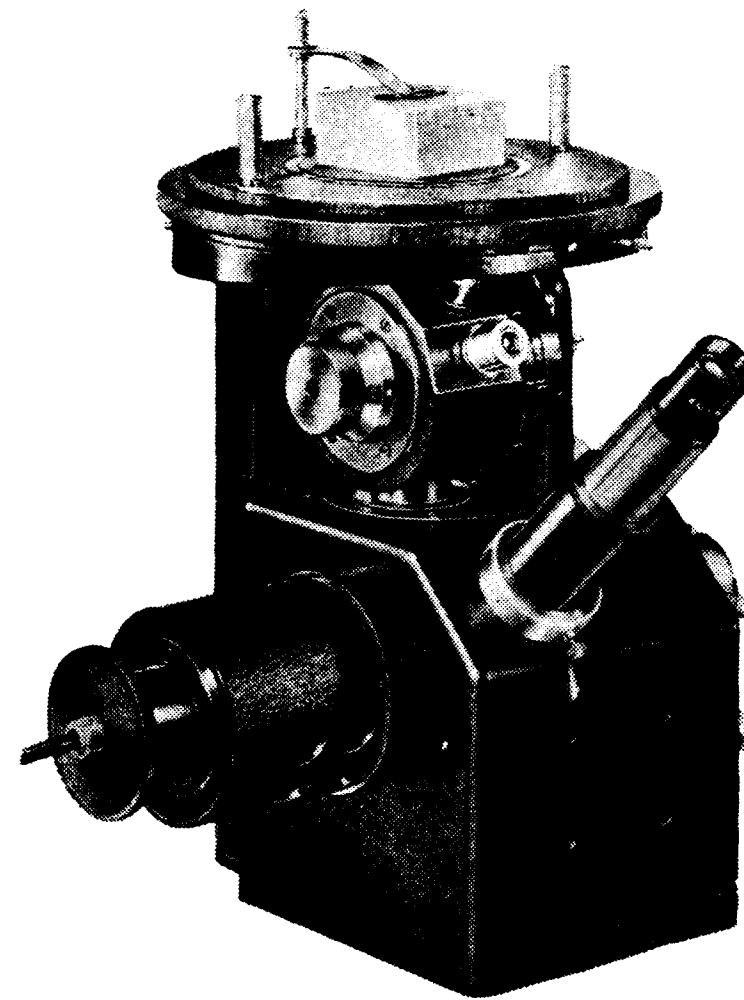
- (i) It can perform involved computations at a very high rate of speed.
- (ii) It can be programmed to follow a very long and involved series of computations.
- (iii) It can store the results of each separate computation for use in a later step.
- (iv) It can make a comparison of intermediate results with pre-determined quantities or with other intermediate results and alter its course of action or programme accordingly.

In conclusion, it may be stated, that conditions to-day are such that modern scientific methods must be employed to an increasing extent in industry, and one of the most important of these is the use of electronic devices. With development comes complexity, and to-day the technique of industrial methods and processes demand a knowledge and skill far greater than were needed in the days gone by.

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INCIDENT-LIGHT MICROSCOPES



Stereomicroscope "SM XVI"

Stereomicroscope "SM XX"

"Epignost"

"Epityp"

Incident Light Condenser
"Neophot"Electrolytical Polishing
EquipmentPolarisation Routine
Microscope "Polmi A"

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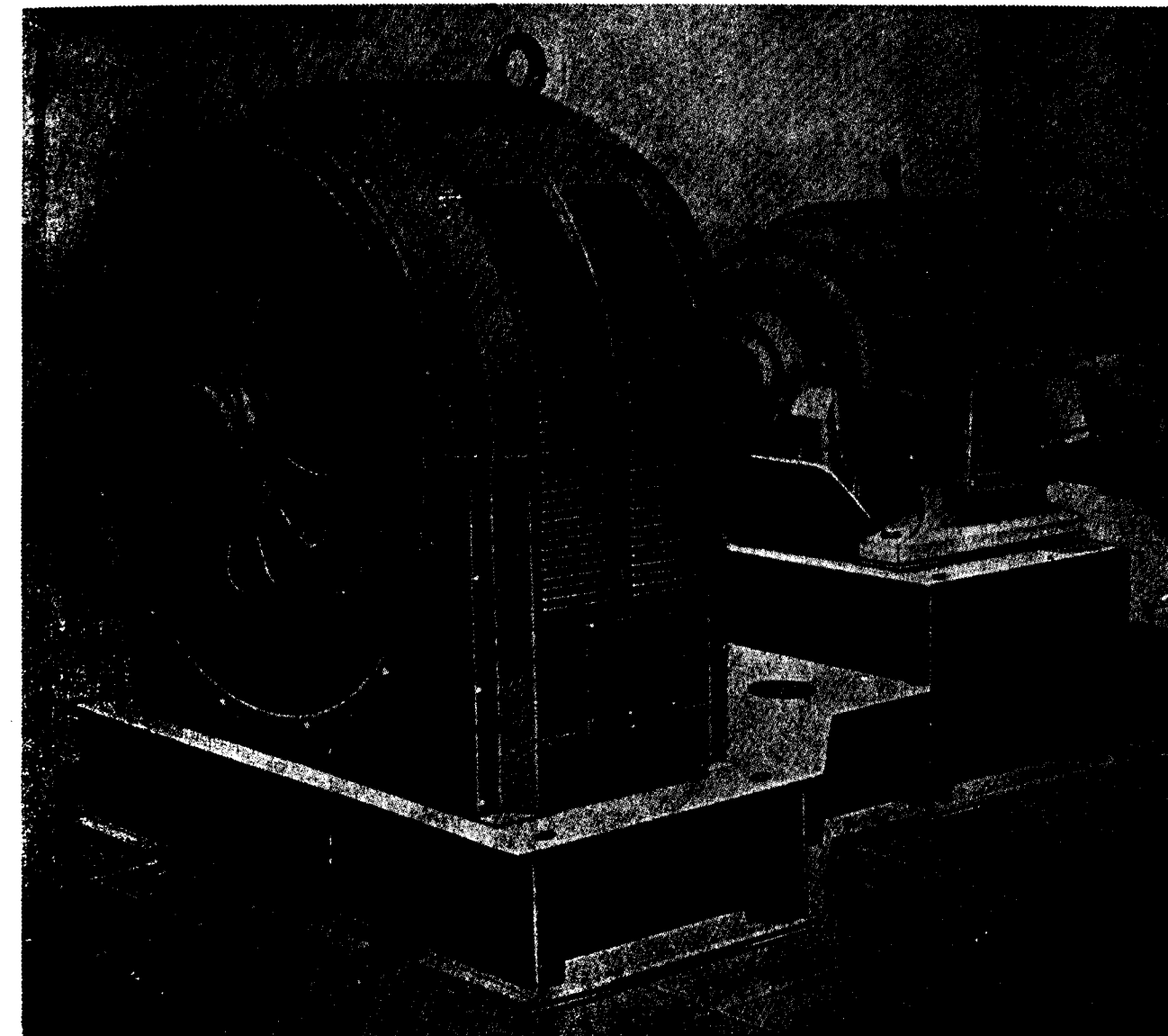
SMALL ELECTRIC MOTORS AND MOTOR PRODUCTION IN HUNGARY

By A Technical Correspondent

THE production of electric rotating machinery in Hungary has shown a tremendous development during the past 6 years. In consequence of the sudden growth in the requirements of foreign markets and our correspondingly increased exports, we have developed in succession the production of up-to-date motor series and of certain special motor types as well. Of course, in developing these motor series, we have made use of experiences gained in Hungary and abroad in regard both construction and

manufacturing technology, and utilized what proved to be the most advanced. Hence, today we find ourselves in the fortunate position of having no design older than 5 years within the range of our fractional horsepower and small motor types.

In the following we wish to give a brief survey of the various direct-current and alternating-current fractional horsepower and small motor series produced by the Hungarian electrical industry:



One type of the generators exported by Transelektro, Budapest.

- 1. D. C. motor range
- 2. A. C. motor range
- 3. Universal motors
- 4. Special motors.

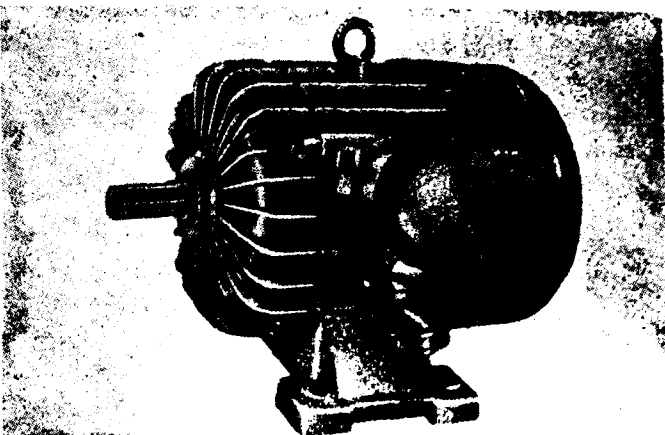
1. DIRECT-CURRENT MOTOR RANGE

The output range of the new direct-current motor series, calculated on the basis of 1500 r. p. m., extends from 0.6 to 75 KW. The outward appearance of the motors gives the impression of a quiet, smooth line as well as of a solid mechanical construction. The motors are of the drip-proof and totally enclosed designs with natural cooling. In addition, we manufacture motors with enclosures suitable for deck duty, which conform completely to the strict regulations laid down for motors employed on ships.

When designing these motors, we did not fail to pay full attention to the specifications of the various shipping registers (Lloyd's Shipping Register, the Soviet Shipping Register, etc.) The machines may be supplied in flanged or foot-mounted designs as desired by the customer, in the forms of generators or motors. The designs of the motors meet up-to-date requirements in every respect. The frame is made of welded sheet steel, this ensuring a mechanically rigid construction, free of vibration when in full operation. The bearing shields are made from excellent quality cast-iron. The terminal box, similarly of a welded design, offers plenty of space for the connection, eliminating thereby one of the main sources of



Single and Three-Phase Squirrel-Cage Fractional-Horse-Power Motor, Type VT in two-pole and four pole designs, output up to 450 and 350 W respectively.



Three-Phase Squirrel-Cage Small Motor, Typ: VZ, totally enclosed, externally fan-cooled, manufactured in designs of 2, 4, 6 or 8 poles. Output from 0.6 to 7 kW.

troubles which may be met with electric machinery. As a rule the motors are of parallel excitation, provided with a stabilizing compound windings. For special duty, however, they may be manufactured in the series or compound wound design, with self or separate excitation.

Owing to their proper dimensioning the motors may in practice be run between no-load and full load, as well as in both directions of rotation without any sparking on the brushes.

The enclosed design with natural cooling is made for the following basic speed and voltage :

basic speed : 750 1000 1500 2000 3000 r. p. m.
basic voltage : 110 220 440 Volts.

The direct-current basic series is suitable for the development of derivations serving the upmost variety of special purposes.

2. ALTERNATING-CURRENT MOTOR SERIES

The output-range of the new alternating-current motor series extends from 0.050 to 100 kW.

The fractional horsepower motors with outputs extending up to 0.6 kW, are made from light metal castings by the most up-to-date mass production process, that is by pressure die casting. These motors are of the totally enclosed design with natural cooling, made in 2 and 4-pole designs, the single-phase types for 110/220 V voltage, and the three-phase types for 380/220, 220/127, 190/110 V voltage.

The motors of the 0.6—100 kW output range are made in open and enclosed designs. The open design is drip-proof, its cooling being of the drawn through ventilation type. The intake of cooling air is effected on the side opposite to the drive, while the warm air is blown out on the drive side. The motor frame and the bearing shields are made from cast-iron. The motors have aluminium cast squirrel cage rotors. The design of the terminal box is such, that the cable outlet may be swivelled around in 90° steps to facilitate easy assembly and connection. The totally enclosed design is made with a ribbed cast-iron frame of robust construction. Cooling is provided by a ventilator accommodated under the cowl on the end opposite to the drive. The cooling air is drawn in by the ventilator on the end opposite to the drive and then blown along the outer surface and between the cooling ribs of the stator frame, ensuring intensive cooling in this manner.

Members of the series are made in 2, 4, 6, and 8 pole designs with squirrel cage rotors, and from 10 kW upwards with slip-ring rotors as well.

These output sizes between 0.6—100 kW are the following :

0.6	2.2	7.0	40.0
0.75	2.8	10.0	55.0
1.0	3.6	14.0	75.0
1.3	4.5	20.0	100.0
1.7	5.6	28.0	

The motor series with the output sizes proposed by the I. E. C. (International Electrotechnical Commission) will also be completed shortly. Its values will be as follows :

0.6	3.6	13.0	75.0
0.8	4.0	17.0	100.0
1.1	5.5	22.0	
1.5	7.5	40.0	
2.2	10.0	55.0	

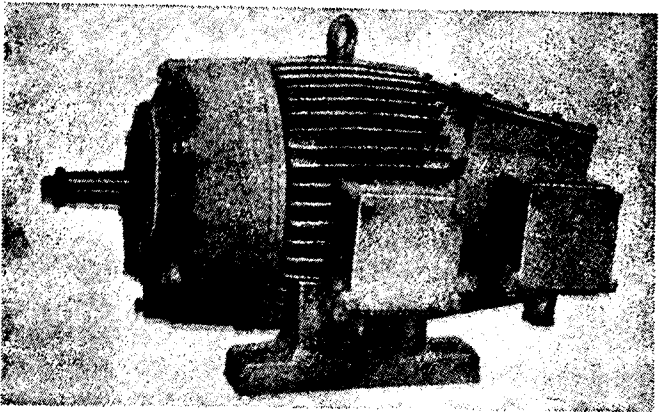
When dimensioning the motors, particular attention must be paid to the utilization of parts and materials, hence in order to obtain satisfactory efficiencies and power factors, the active materials are exploited only up to their limit of economy. The advantages of this principle will be realized in the course of servicing the motor.

We also manufacture double speed motors with a speed ratio of 1 : 2 most frequently up to 10 kW, in output (the Dahlander motors), which have been

designed for synchronous speeds of 3000/1500 and 1500/750.

3. UNIVERSAL MOTORS

The universal motor series are similarly made from light metal by pressure die casting. These motors are



Heavy-Duty Crane Motor with slip-ring Rotors, Type hORs, manufactured in 4, 6, 8 and 10 pole designs. Output from 3 to 64 kW.

made in the output range of 10—350 W. Similarly to the previously mentioned models, these are also available in totally enclosed designs, as well as in open designs to be built into machines for rated speeds of 3000—4500—6000 r. p. m., for direct and alternating—currents of 24—110—220 V. Apart from utilization in the industry, these motors are principally employed in household appliances. There is a special range of motors, however, designed for the various household appliances (vacuum cleaners, floor polishing machines, washing machines, etc.)

4. SPECIAL MOTORS

In addition to the mentioned types and designs, the Hungarian electrical engineering industry developed a number of other special small motor types in the course of the last few years, these being, for example, the following :

- domestic and industrial sewing machine motors
- ringing machines for telephone exchanges
- tachometer dynamos
- reluctance motors
- schrage motors
- galvanic dynamos
- flame-proof motors
- rotary converters

All the above mentioned machine types are exported by the *Transelektro Hungarian Trading Company* For Electrical Equipment and Supplies.

First Indian as Managing Director of Indian Oxygen Ltd.

Bengal Chamber President welcomes Indianisation of staff

 R. J. D. K. Brown, President, Bengal Chamber of Commerce and Industry, and Chairman, Indian Oxygen Ltd., Calcutta, introduced at a Press Conference on 1—9—59, Mr. A. K. Sen, as the new Managing Director of Indian Oxygen. Welcoming Mr. Sen's appointment, Mr. Brown declared that Indianisation of staff in foreign firms was inevitable.

Mr. Brown also announced another important in Indian Oxygen—that of Mr. P. C. Kavanagh who until recently was the Company's Western District Manager in Bombay.

Speaking at length, Mr. Brown explained the Company's progressive plans with regard to indigenous manufacture of welding and cutting equipment. Not only, said Mr. Brown, is Indian Oxygen the principal manufacturer of industrial and medical gases but is also the main supplier of India's requirements of equipment for welding (both Arc and Oxy-acetylene), cutting and various other processes.

Indian Oxygen he further declared was not only training its own employees but was also training technicians for other industrial organisations and the Government steel plants.

Indian Oxygen Limited, a subsidiary of The British Oxygen Company Limited, is to have as its top executive an Indian national for the first time through the appointment of Mr. A. K. Sen as Managing Director w. e. f. 1st June, 1959. Another important appointment from the same date is that of Mr. P. C. Kavanagh as Assistant Managing Director. Mr. Kavanagh was formerly the Manager of the Company's Western District in Bombay. These appointments have just received the consent of the Government of India.

Mr. Sen's association with the Company goes back 21 years when he joined as the Accountant on 1st September, 1938. An Honours Graduate from the Calcutta University and a B. Sc. (Econs.) of the London School of Economics, Mr. Sen qualified as a Chartered Accountant and is a member of the Institute of Chartered Accountants in England and Wales. He

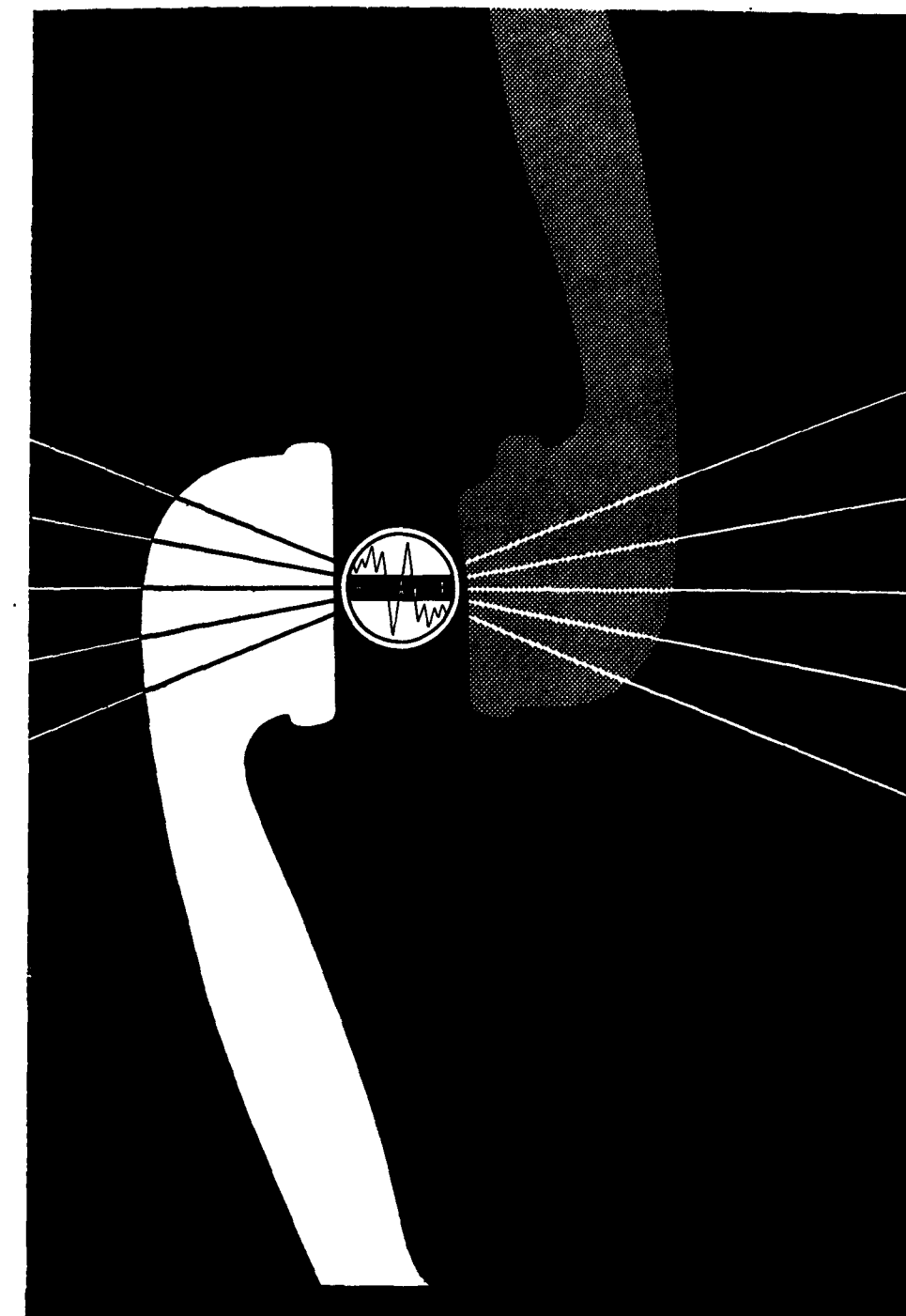


Mr. A. K. Sen, Managing Director, Indian Oxygen Ltd.

became the Chief Accountant in 1943 and was later made the Secretary and Chief Accountant in 1947. In 1953, he was appointed Finance Director. Mr. Sen succeeds Mr. R. G. C. Stephenson, till recently the Managing Director of the Company, who left for Australia at the end of May, 1959, to take up a similar position with an associated company—The Commonwealth Industrial Gases Ltd.

Mr. Sen's appointment, which takes place in the 25th year of Indian Oxygen's existence, is a striking example of the Company's progressive policy of promoting Indian nationals to the highest position of responsibility.

Indian Oxygen Limited was incorporated and registered in West Bengal on the 24th of January 1935 as a Private Limited Company under the name of 'The Indian Oxygen and Acetylene Co. Ltd.' The



BUDAVOX
 Budapest Telecommunication Company
 Budapest VII. Tanács Korut 3/a

Letters: BUDAPEST 62 P.O.B. 267

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Company was converted into a Public Company on the 15th day of January 1958 and, at the same time, its name was altered to 'Indian Oxygen Limited'. Today, there are nearly 17,000 shareholders amongst the public in India.

The Company's present business consists of the manufacture and sale of industrial and medical gases (including Oxygen, Acetylene, Nitrous-Oxide and Dry Breathing Oxygen) and electrodes and in the manufacture, assembly and sale of welding and cutting apparatus and equipment and other similar articles.

The business is carried on in India at the Company's Head Office and factories in Calcutta and at 13 branch factories and offices and through 21 distribution centres, dotted all over the country.

Since its incorporation, the Company has progressively expanded both its volume of production and its range of products and it is now the main supplier of India's requirements of industrial and medical gases and equipment for welding and various other processes, involving the use of industrial gases.

In order to meet the increasing demand for its products, the Company has throughout adopted a progressive policy, both as regards expansion of its factories and as regards replacement of old plant and machinery by modern equipment.

The industrial development plans initiated by the Government of India and, in particular, the expansion in steel production envisaged by the Second Five Year

Plan, are expected to give rise to a further very substantial increase in the demand for the Company's products. The Company has initiated a replacement and expansion programme which involves the setting up of new factories and expansion and modernisation of existing factories and includes provision for the progressive manufacture in this country of certain equipment and accessories used in the process of welding and cutting which presently have to be imported from abroad.

Over the last 20 years, extensive research has been carried out in the U. K. and other Western countries, giving rise to major developments of new processes and in welding and cutting techniques, which have led to considerable expansion in the use of the products of this Company. Research is vital to an industry of the type of Indian Oxygen and the British Oxygen Company, through its establishments in the U. K., has made significant contributions in this respect. Indian Oxygen Limited, through its association with the British Oxygen Company, is in the fortunate position of having access of the results of this research, which have been made available to industry in India. An Agreement will shortly be signed between the British Oxygen Co. Ltd and Indian Oxygen Ltd., which will ensure the continuance of these benefits to industry in this country.

Indian Oxygen Limited is fully conscious of its responsibilities and has a proud record of service to industry throughout the years. With the increasing industrialisation in India, it looks forward to playing an even greater part in the future development of the country.

WORLD'S MOST ACCURATE CLOCKS

The atomic clock, or, more correctly, the atomic frequency standard, is the world's most precise measuring instrument, enabling intervals of time to be defined and measured with an accuracy of one part in ten thousand million (one second in three hundred years). It is possible to achieve this degree of precision because of the extreme stability of the fundamental properties of the atom which are independent of all external influences, with the exception of magnetic field.

The world's first atomic clock has now been working at Britain's National Physical Laboratory at Teddington, near London, for three-and-a-half years. Now, a new and much larger one is being built there which will be ten times more accurate and will keep

the right time to one second in 3,000 years.

The main uses of these clocks is for checking the accuracy of radio equipment. Checks that used to take months now take minutes. Another important use is the determining of the variations in the rate of rotation of the earth, itself an extremely unreliable time-keeper since its period of revolution varies measurably at different times of the year.

The atomic clock also plays a vital role in checking the "standard frequency equipment", a collection of rather ordinary-looking grey boxes in vertical racks, many of which have been ordered from the National Physical Laboratory for use overseas. Among the countries now using these British time-checkers are Canada, the United States and Switzerland.

SPACE-TO-EARTH RADIO SIGNALS

By

Dipl. Ing. W. Vesper, Telefunken

GERMANY

SPACE-TO-EARTH radio signals are those signals transmitted to earth from rockets launched into space, some of which circle as satellites the earth for a certain period whilst others as, for example, the American rocket to the moon fly into space too far for the radio signals to be received by stations on the earth.

One of the chief problems in connection with the space-to-earth transmissions is the range of the radio transmitters carried by the rockets. Here it must be admitted that wireless technique is still behind the present stage of rocket engineering. This may seem strange to the layman because for quite some time already we have been accustomed to using transmitters which on all possible wavelengths span the earth, whereby, much to the regret of the communications technician, the waves (echoes) travel even several times around the earth. The maximum distance of our artificial earth-satellites from the earth ranges from 2000 to 4000 km. However, ground transmitters which can cover such ranges are very extensive and weighty installations. Furthermore, when considering that each gram payload in a rocket requires many times its weight in propellant charges in order to carry the rocket out of the gravitational field of the earth, it is understandable that an effort must be made to reduce as far as possible the dimensions of a space-rocket transmitter and, at the same time, to render its operation as reliable as possible.

A further distinction exists in the antenna system. For radio communications over great distances the expenditure required for transmitter and antenna is divided into about equal proportions.

By means of directional antennas the transmitter energy is radiated only in the desired direction. Such directional antennas have large dimensions and, therefore, cannot be considered for rockets. Consequently, a gain of the radiated energy is not possible on the transmitter side. For example, the lamp of a motor-car headlight behaves in a similar manner: if the parabolic reflector of a headlight

were removed the range of sight would be limited and the surroundings would be illuminated only by the lamp (transmitter).

A third restriction on the transmitter power is the power supply. When increasing the power it would even be unnecessary to increase proportionally the size of the transmitter components. Unfortunately, this is not the case with the battery which supplies the necessary power to the transmitter. For transmitters on the earth, the energy for the power can be provided by the uninterrupted supply of hydraulic power, coal or oil. However, in a rocket such supplies can be stored only in limited quantities. Although silver-zinc or mercury batteries are used, which with minimum weight produce a maximum amount of current or a certain current intensity over a maximum period, this storage capacity is limited. Although solar radiation provides a source of energy of unlimited duration, solar batteries of sufficient power are also not of small size. Solar batteries operate according to the principle that silicon or selenium cells deliver current when being struck by light. One of the best known applications is probably the electric exposure meter. Up to now, only the "1958 Beta" (Vanguard I, launched on March 17, 1958) of the American satellites was equipped with a silicon solar battery for the 5-mw transmitter. The second, more powerful transmitter was fed by a mercury battery.

Considering these restrictive conditions, the transmitter power and frequency must be so selected that the fieldstrength produced on the earth's surface by rocket transmitters lies sufficiently high above the interfering fieldstrength on the earth's surface. It will then be possible to identify and evaluate the radio signals within this noise level.

The noise level which originates from all possible discharge phenomena in the atmosphere and from interstellar space decreases at shorter wavelengths. Also the components and, consequently, the equipments as well as the antennas become smaller. However, this has also the disadvantage that very

short waves are propagated only as light rays and that the transmitter can be heard only as long as it can be "seen" on its path around the earth beyond the horizon. By international agreement, the frequencies of 108.0 and 108.03 Mc/s have been set aside for satellite transmitters. These frequencies are slightly above our VHF broadcasting band. On the other hand, the Soviet Union operates its satellite transmitters on frequencies of the upper shortwave range, namely on 20 and 40 Mc/s. Possibly, the wish of the Soviets to depend for their observations as little as possible on other sources of information was decisive for selecting both these frequencies. Although the required power is higher, observations can be made "below the horizon". This is due to that the electromagnetic waves are conducted, as in a waveguide, in a reflecting layer (Heaviside layer) which surrounds the earth. The waves of the satellite transmitter penetrate at sufficiently steep angles into the waveguide.

By making expenditures of optional amount it is possible, in all cases, to compensate in the receivers that what could not be carried out in the transmitters due to the restrictive conditions. We can use the most sensitive receivers and focus the received energy. The interferences which inside from all directions are gradually eliminated and the signal-to-noise ratio is improved. Sharply focussing antennas must be directed on the transmitter and, during the reception, must follow the position of the transmitter. At shorter waves the focussing is easier because the antennas are smaller.

The nature of the intelligence which the satellite's radio equipment beams back to earth will not be discussed here in detail. The instruments contained in the satellite measure temperatures, cosmic radiation, size and number of the meteorites flying through space, the magnetic field of the earth.

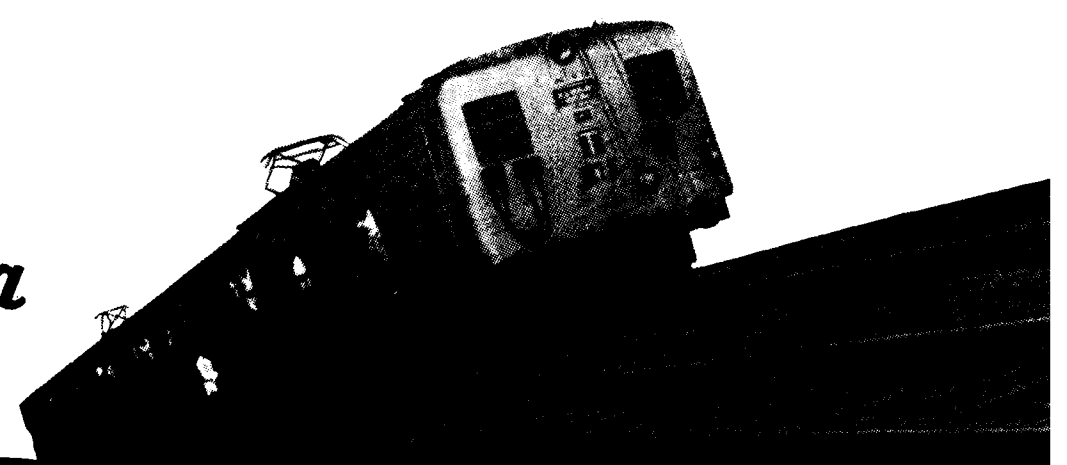
These measurements can be transmitted in different manners, namely, by amplitude modulation, phase modulation, pulse-length or pulse-phase modulations. Their reception requires a sufficient signal-to-noise ratio. However, in such instances where this condition is not fulfilled it is possible to obtain valuable data by determining the propagation direction of the incident waves according to their fluctuating strength (fading) and direction (bearing) as well as by observing the change in the frequency (Doppler shift effect). The evaluation of all these data will provide the physicist with important information about the nature of the earth's surroundings. Thus, for example, the first American satellite "1958 Alpha" was received by

Telefunken engineers by means of a series-produced commercial VHF receiver, Type E 149, and an antenna that did not exceed the cost of a medium-sized television antenna. During the observation of the Soviet satellites "Sputnik I" and "Sputnik II", the Instantaneous Reading Direction Finder of Telefunken supplied an abundance of data whose evaluation by the Max Planck Institute in Weissenau near Ravensburg has already brought forth valuable results.

Development is continuing its progress and one day—by the direct transmission from a television camera installed in a satellite or space station—the earth inhabitants will see on a television screen the earth as a planet in space. Then the ranges covered by space transmitters will no longer be a problem and radio technique will again keep pace with rocket engineering.



Shri M. V. Arunachalam (Extreme Right), Managing Director, Carborundum Universal Ltd. left Bombay by Air-India International for a study tour of West Germany, U.K. and U.S.A. as a Member of the National Productivity Council Team on Top Management and Organisation. He was seen off at the Madras Airport by Shri A. M. M. Murugappa Chettiar and Shri A.M.M. Arunachalam.



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Rumania Exports Complete Industrial Outfits

By

Engineer Nicolae Pricop "Industrialexport" State Company

SUCH has been the development of Rumania's engineering industry that it has been able in the last years, to manufacture complete outfits for various branches of industry—outfits which were being imported until quite recently.

Designed and executed by Rumanian specialists in accordance with the latest gains of science and technique, these outfits—considering the results obtained over several years of operation—are proof of the high standards of Rumanian industry and the progress it has achieved.

Indeed, the experience accumulated by the engineering industry and its steadily increasing capacities have brought Rumania to the point where, besides meeting her own requirements, she is able to design and manufacture complete outfits for export.

Following the demand of various foreign clients, Rumania has sent over a number of specialists, who after investigations on raw material resources and their characteristics, as well as on local conditions of exploitation, etc., put at the disposal of those concerned technical-economic schemes permitting them to make most suitable decision regarding the development of the respective industry.

Such schemes have been worked out for India, for instance, in the oil refining and carbon black manufacture sectors; for the Indonesian Republic in cement manufacture; for the Korean P. D. R. in the drug manufacture sector, etc.

Rumania's industry has great possibilities of designing and supplying complete outfits for most industrial sectors.

The following are supplied for the metallurgical industry:

- Blast furnaces upto 1000 m³;
- Open-hearth steel works with stationary furnaces up to 250 tons;

- Rolling mills for 0.2—0.4 mm sheet-metal;
- Pig-iron foundries;
- Steel foundries;

The following are supplied in the electrotechnical sector:

- Thermo—and hydro-electric power stations;
- Diesel-driven power stations;
- Transformer Stations;
- Power cables, etc.

Rumania's natural riches and the concern bestowed on the problems raised by their turning to account have led to wide specialisation in the designing and manufacture of outfits for the extraction and processing of crude oil and gas as well as in the manufacture of plant for the basic and process chemistry sectors.

Thus, in the petroleum sector, all outfits necessary for the drilling and extraction, transport and storage of crude oil are being turned out, as well as refineries and outfits for the transport, storage and distributing of oil products.

Outfits for drilling, collecting, transporting and distributing natural gas are likewise manufactured.

After its remarkable development in recent years, the Rumanian chemical industry is today in a position to meet most of the home requirements and foreign demands in the sectors producing a number of products that enjoy high prestige in the world market. Such development calls for great specialisation in designing and manufacturing outfits in this sector, and today the installations required for the manufacture of a great number of chemical products can be turned out in the country.

Rumania is able to design and supply factories producing sulphuric acid, soda ash, caustic soda,

(Continued on page 70)

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Improved Applications of PYE'S Telecommunications Equipments for various purposes

By
An Overseas Technical Correspondent

PYE ON HOVERCRAFT

PYE two-way radiotelephone equipment was installed in the Saunders-Roe Hovercraft and in its attendant launch so that "on the spot" performance reports could be obtained.

PYE AND WATER SPEED RECORD

A Pye 6-channel "Reporter" was built into a special compartment of Donald Campbell's Bluebird and other Pye mobiles were in attendant launches and at base. After Donald Campbell had broken his own World Water Speed Record he said the Pye "Reporters" were a boon and worked perfectly.

PYE AND THE MOTORWAYS

The contractors building the London-Birmingham motorway and the Preston By-pass find that Pye radiotelephones can save them immeasurable time. Calling up materials, re-grouping labour gangs, controlling transport... the v. h. f. control station is the focal point of all activities and nothing is "lost by the wayside".

PYE AND READY-MIX CONCRETE

In the United Kingdom and Australia the Ready-Mix Concrete companies have proved the value of radio control to link up their factories, lorries and outlying sites. No more delays are experienced over changes of specification in material, breakdowns or re-siting... two-way radio contact keeps everyone informed of the next move.

PYE RADIOTELEPHONES FOR IRANIAN OIL FIELDS

Between Kharg Island in the Persian Gulf, the Oilfield at Gachsaran and the Aghi Jari Oilfield communications will be by means of Pye equipment. The chain of repeater and terminal stations will cross a total of 160 miles of sea, coastal plains and mountain ranges.

PYE IN HONG KONG

Pye "Ranger" frequency modulated equipment is in use by the police throughout Hong Kong. Last year the Hong Kong Government approved an expenditure of £80,000 to bring Police communications up-to-date.

PYE INSTRUMENT LANDING SYSTEM

The Russians have developed their own system of I. L. S. but it does not conform to I.C.A.O. recommendations and in readiness for the B.O.A.C. Comet and other Western services to Moscow, the Moscow Airport Authorities are fitting Pye I.L.S. The Indian Air Force are installing their first I.L.S., and since India is among the most air-minded countries of today, it is anticipated that other orders, both military and civil, will follow. Among the British aircraft manufacturers who have had long experience of Pye I.L.S. on their own flying grounds are de Havillands who installed it at Hatfield three years ago. Practically all the Comet landings there have been made with its help. English Electric have had an installation at their Warton airfield for over a year.

(Continued from page 68)

sodium bicarbonate, sodium silicate, sodium sulphide and thiosulphate; for the dyestuff industry factories turning out: gamma acid, H acid, benzidine, beta-naphthol, alpha naphthylamin, anilin, azotic dyes, sulphur dyes, lacquers and paints; factories manufacturing other chemical products such as: super phosphate, nitrocalcium, ammonium nitrate, oxalic acid, acetaldehyde; factories producing oils, tanning extracts from wood: wood distilleries, outfits for the production of polyvinyl chloride, etc.

Long use in Rumania and in the importing countries is a sound test for the outfits designed and supplied; while the convenient delivery terms and the competitive prices of Rumanian products and appreciated by all customers.

The "INDUSTRIALEXPORT" Foreign Trade State Company will supply any additional information regarding the export of any type of complete outfits of Rumanian make.

TEXTILES SECTION

ELECTRONICS IN THE TEXTILE INDUSTRIES

By W. E. Swale, M.I.E.E., A.M.I.C.E.

The author indicates some of the applications of electronics to automatic process control. These are included in the following processes: colour matching, bale breaking, fire detection, wool carding, moisture-content recording, fabric drying, warp sizing, spinning and weaving, and so on — Editor.

APPLICATIONS TO BATCH PROCESSES

THE term "electronics"—of recent coinage and still often misused—refers to a branch of electrical engineering which deals with the conduction of electricity in a vacuum, in gases and in semi-conductor materials. Its characteristic equipment includes gas discharge lamps and neon tubes, photo-cells, transistors, transducers (those ingenious devices by which tiny mechanical movements are converted into minute electrical currents) and nucleonic, i. e. radioactive materials, with their associated radiation detectors. Electronic devices operate with unequalled sensitivity and speed; they have therefore become indispensable factors in developing the forms of automatic control which are revolutionising production methods.

The textile industries, like many aspects of engineering, represent batch processes. There is still a large amount of intermediate handling by operatives. Although the nature of these processes has not, in general, lent itself to radical changes by electronic methods, the textile industries do offer some interesting examples of electronic applications and automatic process control.

Among the many varieties of fluorescent tube lamps available the one bearing the name "colour matching lamp" is used where a cheap and simple type of colour corrected light is required. The close matching of colours in dyeing and printing calls for a much more critical blend of light sources, such as is found in the new G. E. C. colour matching cabinet. This contains four 2 ft. light-blue fluorescent tubes, two special ultra-violet tubes of similar size and three 100/150 W incandescent filament lamps. The three different light sources are separately switched and the filament lamps have rheostatic control to compensate for voltage fluctuations. The ultra-violet light com-

ponent caters for the matching of materials containing dyes which respond to the u-v region of the spectrum and therefore show a colour effect in natural light which is unobtainable under most forms of artificial lighting. The setting of the unit to a known colour basis can be carried out by reference to a dichroic



6½ h.p. motor driving a hosiery knitting frame with Emotrol equipment.

ladder or any other standardising samples favoured by the industry concerned. The total load of the cabinet is 580 W and the illumination provided on the inspection table is 170-200 lumens per sq. ft.

Specially designed Hanovia fluorescent lamps, fitted with Wood's glass filters, find many applications in textile processing. These range from the classing and grading of natural and man-made fibres to the detection and identification of mineral and oil stains and the assessment of the efficacy of anti-mildew treatment. The lamps must be used with care as the rays are damaging to the sight.

In the initial stages of bale breaking and opening raw cotton, pieces of tramp iron, which are easily picked up in the cotton fields or during transit, can cause serious damage and fires in the blowing room machinery. These pieces can be effectively located by a Cintel metal detector. This embodies a search head in the form of a window through which the ribbon of loose cotton fibre passes. A coil system generates an electromagnetic field across the window; this field is normally in a state of balance. If any metal, ferrous or non-ferrous, enters it, the balanced state is disturbed and a signal is fed to an amplifier, where it is magnified and initiates the desired action.

An ingenious system of fire detection—the Minerva nuclear detector—has found wide application in textile mills because of its sensitivity to the products of combustion which arise during the smouldering stages of an incipient fire. The detecting element of this device is an open ionisation chamber in which the air is rendered conducting by the alpha particles emitted from a small quantity of radium. A similar but closed chamber is connected in series with the first to form a voltage divider. Smoke or other products of combustion entering the first chamber radically change its electrical characteristics and give rise to a discharge in the cathode/anode circuit of a cold cathode valve,

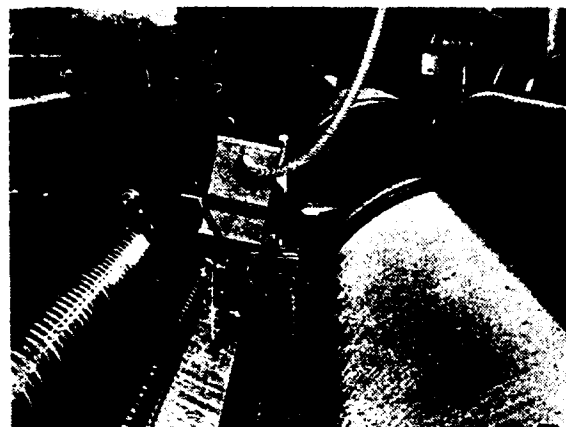


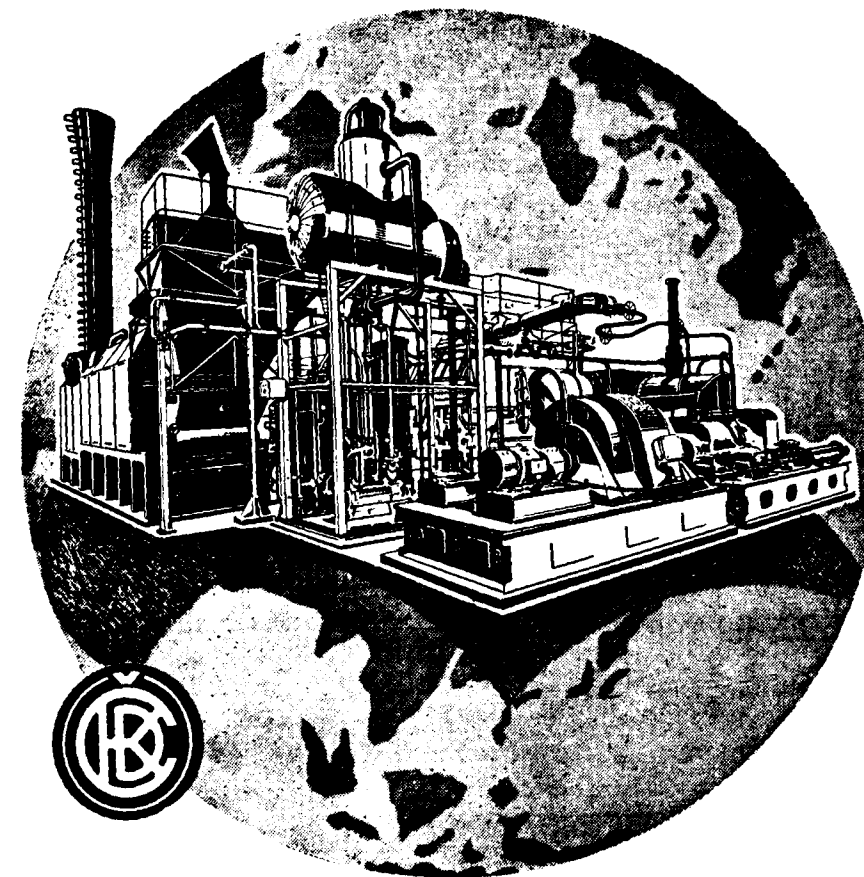
Photo-electric control unit mounted on a wool-carding machine.

so initiating an alarm signal before the fire actually breaks out. If alarm alone is considered insufficient for the protection of a given risk, then two-step protection may be afforded by arranging the detector in series with a conventional sprinkler or other automatic fire extinguishing system. In certain conditions, it may be noted, the surface of an electronic valve will get hot enough in service to ignite cotton "fly."

The use of electronic principles has greatly influenced and improved traditional methods of speed control of electric motors. Typical of many such systems is the B. T. H. "Emotrol" electronic control unit of which the basic components consist of: (a) a d. c. shunt-wound motor; (b) a control panel carrying thyratrons connected as a bi-phase or three-phase rectifier; (c) a transformer for supplying anode power to the rectifier circuits; and (d) a small control panel bearing pushbuttons and a motor speed adjustment knob. The standard speed range is 10 to 1, but ranges up to 100 to 1 can be supplied. The power range covered by this type of control is from $\frac{1}{4}$ h. p. up to about 600 h. p., the only difference being in the number and size of valves used. These range from single thyratrons to six water-cooled rectifier ignitrons. When fitted with "IR drop" compensation the regulation of this type of control is exceedingly close.

An interesting and promising electronic development is the "Autocount" wool carding control equipment which has been in use commercially for some years. This device is made by the Lancashire Dynamo Electronic Products, Ltd., in collaboration with the users, James C. Watkinson, Holmfirth, and the Wool Industries Research Association. Its object is to increase the uniformity of the woollen thread by controlling the density of the web passing from the carding machine. The principle depends on the use of a photocell and light source which are mounted over the web after it has left the doffer. The light is reflected back to the cell by means of a mirror placed below the web. The light, which is really the controlling medium, therefore passes twice through the web.

A rotating shutter in the head unit causes the photocell to observe alternately the light source directly and then the reflected light from the mirror. The ratio of these values remains constant as long as the density of the web is unchanged. The density of the web depends, amongst other factors, on the relative speed of the swift and of subsequent parts of the machine. The "Autocount" device provides indication and recording of the weight per unit length of the web. It can also be arranged to give closed-loop automatic control in such a manner as to maintain the web density constant, irrespective of variations in the rate of feed into the carding machine. The device has formed a valuable contribution in improving the carding process and intensive research is still being carried out on these lines.



PACKAGED POWER PLANT

The Czechoslovak Industry has developed a new type of steam power plant of an output 1,500 and 750 kW.—called "Packaged Power Plant".

The characteristic feature of the equipment is that it is delivered in blocks, ready assembled by the manufacturing works, the weight of the heaviest block being 18 tons. The Packaged Power Plant can be therefore transported by any means of transportation to the places where it is necessary to make the electric power available.

These Packaged Power Plants require minimum building investments,—a simple building with concrete slab, without vaulting. The erection on site requires minimum time, as only the interconnection of separate units is necessary.

The Packaged Power Plants can be used with advantage for large construction projects, for small factories and communities.

The good results achieved in operation and the experiences gained with these Packaged Power Plants present a good evidence of the high standards of the Czechoslovak steam power plants.

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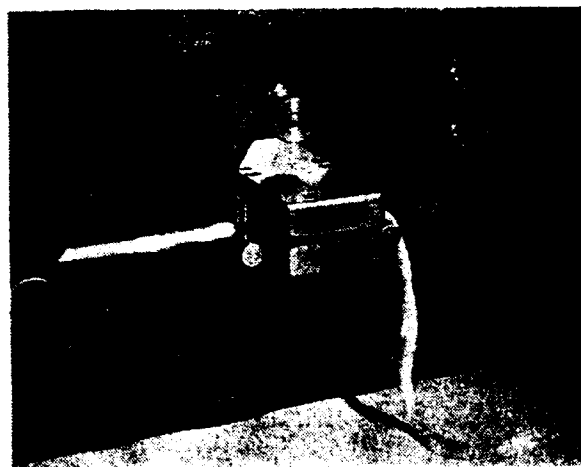
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MOISTURE MEASUREMENT

The recording of moisture in textile goods is important. Cotton yarn is sold on the basis of 8½ per cent regain (in other basic materials and forms of make-up slightly different values may be customary). For various reasons the seller and the buyer should ensure that the accepted values are closely maintained. Two well-known instruments illustrate different approaches to similar problems. The "Shirley" moisture meter (British Cotton Industry Research Association and



Electrode head of Fielden-Walker evenness recorder.

Record Electrical Co., Ltd.) is based on the fact that the electrical resistivity of a sample of textile fibres depends to a great extent on the amount of moisture which it has absorbed. The instrument consists of a simple mains operated electronic apparatus which has means for setting and checking to allow for changes in valve characteristics and voltage fluctuations. It normally has two hand-held electrodes, one being flat in shape for pressing on to raw cotton or cloth samples; the other is cone shaped for pressing into a cop of yarn. A separate pressure device is available by which a constant test force of 45 lb. can be applied. For cotton materials the dials cover a range of from 4.5 to 15 per cent. This meter can readily be adapted for testing most natural fibres, as well as wood pulp and materials in powder form. It cannot normally be used with natural silk, acetate rayon or nylon owing to the high resistivity of these materials.

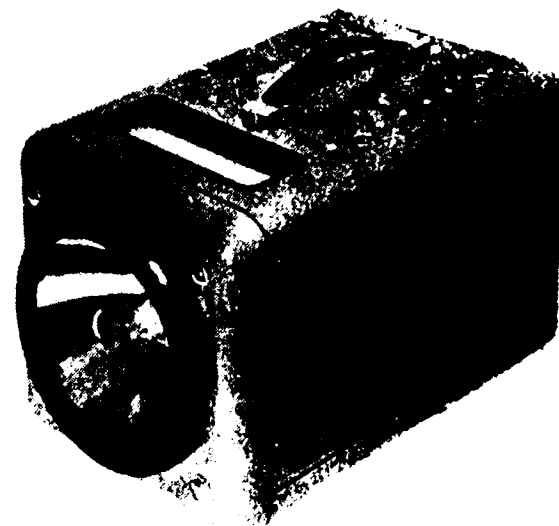
The "Drimeter" (Fielden Electronics, Ltd.) is intended for use mainly on any type of fabric drying or warp sizing machine. In these cases it indicates clearly the percentage moisture content of the finished product. The equipment consists of two circular condenser plates which are mounted on a "U"

shaped fitting so that the cloth or warp travels between the plates. The capacitance of the condenser is measured by using alternating current of radio frequency. The reading is given on a separately mounted meter. An automatic recorder-controller is available for keeping the machine speed at such a level that the material always has the desired moisture content. This means that the speed of travel of the cloth is reduced when the moisture rises and conversely. If the material is well woven and of constant thickness the control will usually operate within limits of plus or minus 1 per cent.

The stroboscope has many uses in spinning mills and weaving sheds, for example, in checking spindle speeds, in following the paths of fast-moving material such as yarn over guides, and in checking rollers for eccentricity or other mechanical faults.

CONTROL OF VARIATIONS

There are two devices from which much is expected in the perfection of spinning techniques. Both are based on variations in capacity of a condenser field in proportion to the weight of the cotton passing between the plates. The first is the "Uster" varimeter, in which a condenser field covers the entire width of the scutcher. The associated electronic unit converts these variations of capacity into sound frequency voltage variations. These signals operate an indicator or a recorder. The latter draws a diagram in which variations in weight of the lap-over lengths as short as



High power stroboscope of about 100,000 c.p. at 25 flashes per second; this permits direct reading of speeds from 200 to 6,000 r.p.m. and up to 48,000 r.p.m. by multiplication (E.M.I. Electronics)

one inch are clearly discernible. The second is the Fielden-Walker sliver to lap evenness recorder and integrator which is also based on the method of passing the material through a condenser head. Particular care is taken in this instrument to ensure a perfectly parallel electrical field.

The instrument weighs and records one centimetre lengths of material continuously at a speed of five feet per minute. At the same time it integrates the percentage mean deviation over ten-foot lengths. The instrument will cover all materials from the heaviest jute sliver to a single strand of 15 denier nylon filament, but different condenser heads must be used where wide variations are involved. A third instrument in this same class, the "Uster" spectrograph, may be looked upon as an advanced form of the Fielden-Walker device. Amongst other attachments is one which records the number of high or low levels of evenness above the mean. This information may be valuable for quality control. The instrument is expensive (approaching £2,000), but some progressive cotton spinners speak highly of it.

An electronic cotton grader is manufactured, apparently in Hungary, under the trade name "Orion EMG." It is claimed that a cotton maturity index, determining the quality factors of a cotton sample, can be obtained within minutes; that in the case of a known cotton variety both tensile strength and yarn count may be evaluated by reference to this maturity index; that the method of testing excludes subjective errors; and that it does not require special skill in use. The principle of operation is based on the bi-refringence of cotton fibres. A sample of fibres, placed in a beam of linear polarised light, will cause a varying intensity of light to pass, dependent on the cell-wall thickness. A correction is made for the indeterminate number of fibres in each specimen by subsequently viewing the sample in unpolarised light. The intensity of light, measured with the polariser inserted, then depends on the average wall thickness of the fibres only and not on their number. The apparatus weighs only 18 lb. and appears, from the description, to be easy to manipulate. If it fulfils its claims it should be very useful to cotton buyers and to spinners, although it would take some time to overcome the experienced cotton man's prejudice in favour

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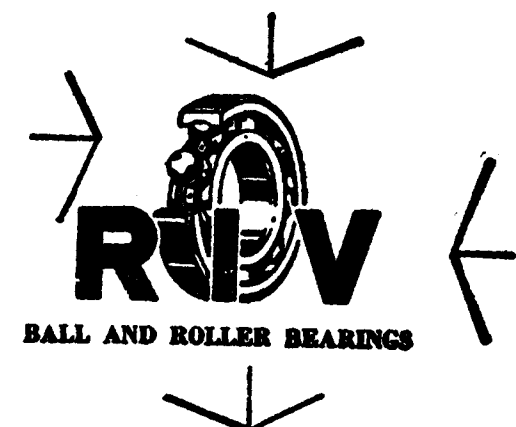
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STATIC CHARGES

An awkward problem in textile works may be the elimination of the "static" charges which tend to build up, particularly during the manufacture of acetate rayon or nylon. The presence of such charges is well known to the wearers of garments made of these materials. During the processing these charges not only cause the threads to balloon apart, but they also increase the attraction and fixing of objectionable dust particles. The "Shirley" static eliminator made by Record Electrical Co., Ltd., has proved successful when applied to warping and beaming frames. The principle lies in ionising a belt of air through which the yarn passes. Two sets of discharge rods, each fitted with a row of metal points, are supplied from a source of high-voltage d. c. (12,000 V) and produce a continuous output of positive and negative ions. An alternative system has been applied, particularly to



One end of a crimp twisting frame fitted with electric yarn heaters and an automatic temperature scanner.

looms on which "static-addicted" yarns are woven. This depends on the use of small round boxes which carry charges of a suitable radioactive isotope. These devices are hung in such a way that they produce a field of ionised air around the cloth as it is woven.

They are said to be effective, but the life of the capsules may be much less than was estimated and replacement costs are fairly heavy.

An interesting example of the application of electric heat is found in the crimp twisting machine made by Ernest Scragg & Sons, Ltd., and fitted with automatic temperature control by Fielden Electronics, Ltd. The machine is designed for the manufacture of "bulked" yarns. These are made by up-twisting synthetic fibre yarns, of about 2 denier filament, to the extent of about 120 turns per inch and heating the yarns to temperatures around 200 deg. C. in order to fix the crimping effect. The spinners are designed for minimum speeds of 30,000 r. p. m. and great care is taken to ensure uniform tension throughout the process. The numbered metal guards seen in the centre of the photograph protect the totally enclosed 9 in. long electric heaters which constitute the heat-setting units. A thermocouple is connected to each heater and by means of a motor-driven switch the temperature of each heater is measured every six seconds, the full cycle being completed in 15 minutes. If the temperature of any heater deviates by more than ± 1 deg. C. the scanner stops with the indicator needle at the appropriate heater position and gives a visual alarm. No yarn can be processed except in accordance with specified conditions. This combination of mechanical up-twisting and automatic electric heat treatment has proved highly successful. The latest model, type CS₃, has 240 spindles, mounted in pairs, each pair fed from a newly-designed twin-heater unit.

Textile laboratory devices also follow the present-day trends. A vibrascope, developed by the British Rayon Research Association, is used to determine the mass per unit length (denier) of a textile fibre. The principle depends on clamping an electrically charged sample between a vibrator and a tensioning system and causing it to vibrate at its natural frequency. Transverse movements of the centre of the sample induce a charge in a brass screw which acts as a transducer. The frequency of vibration, which is measured electronically, serves as a means of determining the denier. A range of deniers from 0.4 to 450 can be covered. The same Association has developed the "Manra" yarn filament counter, an instrument in which a sample of yarn is stretched under controlled tension and slowly cut. A stylus like a gramophone pick-up senses and records a signal every time a filament is severed. The desired data are obtained accurately and far more quickly than can be done by counting under a microscope.

The "Ferranti-Shirley" cone plate viscometer consists of a stationary flat plate and a slightly conical rotating disc, driven by a variable-speed motor at controlled speeds ranging from 1 to 1,000 r. p. m. The viscous traction on the cone exerts a torque on a precision electromechanical dynamometer and an electronic measuring system gives clear readings on a scale having an effective length of 25 inches. The instrument, which can be supplied with three different sizes of cones, gives readings in rate of shear (sec^{-1}) or shear stress (dyne/cm^2) and is applicable to a wide range of liquids in common industrial use.

The "Shirley" photo-electric stapler is an ingenious device which replaces the tedious and not very reliable method of "pulling" a fringe or thin layer of fibres from the bulk, arranging them in order of length and then estimating the average length of staple. The operator prepares a "fringe" (made up from 16 small pinches of cotton) and lays this on a pad, covered with black velvet. This is then gradually pushed through the instrument. The essential features of the stapler are the box which houses two photocells and lamps, connected in opposition to one another and a separate galvanometer. The fringe is brought into a position where two strips of light fall across the sample. The opposed cells pass a current which is proportional to the difference in intensity of the two illuminated strips of fibres and is therefore substantially proportional to the fibre density gradient mid-way between the strips. The distance moved between the two positions of maximum density gradient, which are indicated on the galvanometer, is termed the P. E. staple. The instrument is said to be simple to use, but the success of the method depends essentially on preparing the fringes according to a precisely fixed technique. The preparation and test of an individual fringe takes between two and three minutes.

In any process which involves the interaction of textile fibres with chemical solutions such as are used in scouring, bleaching and dyeing yarns and cloth, one criterion of efficiency can be said to be a function of the pH value of the bath. This should therefore be continuously metered. The same applies during the treatment of boiler feed water and of trade

effluents. The pH scale, in practice, ranges from 2—strongly acid, through 7—neutral, to 14—strongly alkaline. Smaller works will be served by a portable or bench type meter which allows routine tests to be made of samples taken on site. Many larger works have installed permanent automatic equipment for continuous process control. The principle of pH measurement depends on measuring the voltage across two specially prepared electrodes immersed in the liquid. The sensitivity of these industrial pH amplifiers is high (about 100 μ A/pH unit) so that recorders, indicators, control and alarm systems can all be operated from the same amplifier.

PHOTO-ELECTRIC SLUB DETECTOR

Slub catching, that is detecting and arresting knots and blemishes in spun yarn, has been a perpetual problem in the spinning industry. Mechanical slub catchers are effective up to a point, but do not achieve all that is desired. A photo-electric slub detector is comparatively simple to devise but is expensive when applied to every spindle on a 400 spindle frame. In this connection a recent development is likely to be of considerable interest. The apparatus is an automatic warp inspector, designed and manufactured by Bruce Peebles & Co., Ltd., in close collaboration with the British Nylon Spinners, Ltd. It is claimed that the device is fully automatic, reasonable in price, extremely reliable and that it will detect any faults, for example, breaks, neps, fly, broken filaments or slubs.

The principle consists in guiding a sheet of threads very accurately in the same plane. This is done by passing them over three ground ceramic guide rods. The sheet is illuminated from one end by a suitable light source which shines on to photocells at the opposite end. The shadow of the warp threads falls on the light-sensitive cells as the shadow of a single thread. This shadow is modified by the passage of any of the above-mentioned faults on any thread. The resulting electrical signals are amplified to operate a fault indication device. With the present design the warp speed is from 30 yd./min. upwards and the inspection width is 36 in.

(Courtesy: "Electrical Review")

PROF. JACK TO HEAD U.K. RURAL BUS SERVICES ENQUIRY

Professor D. T. Jack, a former Labour Adviser to the Government of India, has accepted an invitation to be chairman of the committee to study and report on rural bus services in Britain.

Prof. Jack is David Dale Professor of Economics at Durham University. He was Industrial Commissioner in the British Ministry of Labour in 1942, and in the following year became Labour Adviser to the Government of India. He was chairman of the U.K. enquiries into the shipbuilding and engineering pay claim in 1957, the Smithfield lorry drivers' strike in 1958, and the London Airport dispute in the same year.

NEW MACHINE FOR CARPET PRODUCTION

Original method of pile insertion into a pre-woven backing fabric

AN ingenious machine for producing pile carpet by an entirely new principle has recently been introduced by David Crabtree and Son Ltd. The machine, which has been invented by Mr. W. Felton, a director of the company, has been named the Needle Axminster loom, and is essentially a cut pile machine.

In principle, the production process resembles needle tufting in that the pile yarn is inserted into a pre-woven jute or hessian backing, but on the Crabtree machine, each individual tuft is secured by a cotton locking thread which passes through the loop of the tuft beneath the carpet. As a result of this method of securing the tufts, no latex backing of the kind which is essential in needle tufting is required, although a back sizing operation as applied to normal woven carpets is recommended.

Amongst the advantages claimed for the machine are that it is capable of processing yarns of all types (normal woollen spun wool carpet yarns have been used principally to date), that it runs at relatively high efficiencies (efficiencies of the order of 90 per cent upwards are suggested), that it will pass through reasonably well made knots without any difficulty whatever, and that it requires very little maintenance. The construction of the carpet is such that there is no long float of the pile yarn on the back, and thus, it is claimed effective use is made of practically all the pile yarn used.

The method of production is radically different from that on needle tufting machines. The needles operate upwards through the base of the fabric and each needle is threaded with a cotton binding cord. The needles are recessed near the eyes and the pile yarns are introduced into these spaces in between the needles and the locking cords by insertion tubes which move in a plane at right angles to that of the needles. The needles are subsequently withdrawn through the backing fabric and draw the loops of the pile yarn through also, the run of the loops of pile tufts being thus disposed across the carpet, and the binding cords running warp way along its length.

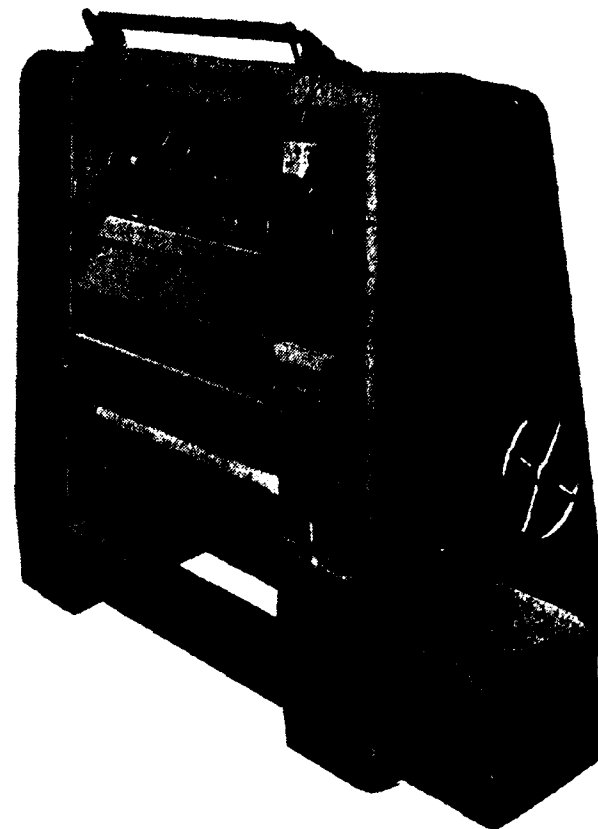


Fig. 1. Front view of 4/4 (36 in.) Crabtree Needle Axminster loom. In the foreground is the apron assembly which houses the cutter mechanisms.

PROVISION FOR HIGH PILE DENSITY

The construction of the machine provides a fixed pitch of five loop tufts per in. laterally giving 10 single tuft ends per in. across the machine, and up to 16 rows of tufts or shots per in. lengthways, the number of shots being controlled by the rate of movement of the fabric. With a construction of 10 shots per in., a fabric with a total pile density of 100 single tuft ends per sq. in. can be produced, equal to a 10-shot Wilton carpet construction.

The machine is at present capable of a production rate of 120 shots or rows of tufts per minute, which, with an insertion of 10 shots per in. and an assumed efficiency of 85 per cent, gives an output of about 165 linear yd. in 10 hours. Widths from 4/4 (36 in.) up to 20/4 (5 yd.) are available, and the pile height can

be varied between $\frac{1}{4}$ and $\frac{3}{4}$ in. Typical production particulars are 16 oz. per sq. yd. of jute backing fabric, 3/8s cotton count cotton locking thread, 2/50s woollen count hank-dyed Axminster pile yarn, and 10 to 12 shots per in. at a pile height of $\frac{1}{4}$ in.

OPERATIONAL MOVEMENTS

The sequence of operations is illustrated in Figs. 2 to 7. The needles first pierce the backing fabric from below as shown and then pass through individual slots in a guide plate above the fabric. Each needle is threaded with an end of cotton yarn taken from a warp beam and when the needles reach the upper

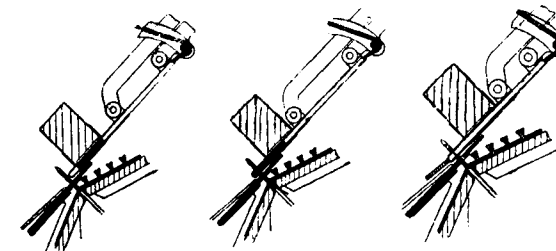


Fig. 2. The needles carrying the locking cords have penetrated through the backing fabric from below ready for the forward movement of the inserter mechanism.

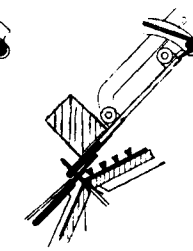


Fig. 3. The outer inserter tubes move forward passing between the needles and the locking cords. The needles are recessed and the outer inserters tapered.

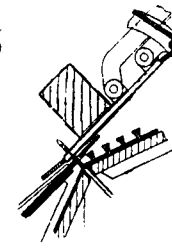


Fig. 4. The inner inserter tubes move forward independently causing pre-determined lengths of pile yarn to project from the inserter assemblies.

limit of their traverse, the pile inserter assembly carrying the inserter tubes moves forward passing each individual inserter between one of the needles and its locking cord. The individual inserters consist of two flattened tubes disposed one inside the other, the pile ends passing through and being controlled by the inner tubes which are fitted with non-return spring jaws. These inner tubes now move forward independently causing the free ends of pile yarn to project from the assembly; the inserter assemblies then start to retract and the needles to descend. The pile ends are caught between the needles and the cords and are drawn through the backing cloth as the needles continue to descend, the loops being turned through 90° in the process. The inserter assemblies continue to retract after the pile ends have been gripped and thus draw off a fresh length of pile yarn in preparation for the next stitch.

When the required length has been withdrawn, a flat cutter plate moving towards the rear of the machine shears the pile ends against the stationary base plate.

The mechanisms are arranged so that the inner tubes are retracted farther than the outers, with the result that after cutting, the loose ends of pile yarn are drawn completely within the outer tubes ready for the next insertion. Immediately after cutting, a tuft rake mechanism located beneath the base plate forces the tufts out of their respective holes in the plate carrying them to the rear and clear of the aperture prior to the next insertion; this action eliminates any danger of "sewing-in" of the loose pile tufts.

ARRANGEMENT OF THE MACHINE

The three major components of the carpet are introduced into the tufting zone independently. The hessian backing is fed into the machine from a batch roll at the front and passes underneath the operator's platform and is then taken round a series of straightening bars which are adjusted to remove any creases or folds. From here the backing fabric passes round a tension roller covered with card fillet which, at the end of the machine, is fitted with a friction brake through which the cloth tension can be increased or decreased as required, to secure effective needle penetration. The fabric then passes over a guide roller and across a front breast rail adjacent to the needle zone.

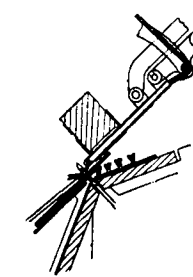


Fig. 5. The inserter assemblies retract and needles start to descend gripping the pile ends between the needle stems and the locking cords.

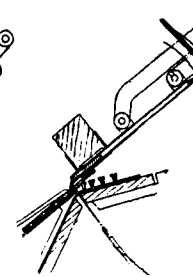


Fig. 6. The tufts are drawn through the backing cloth and turned through 90° by the locking cords which run warp way on the back of the fabric.

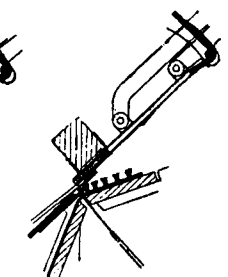


Fig. 7. The plate cutter moves forward shearing the pile ends against the stationary guide plate. Below the guide plate the tuft rake fingers push the cut tufts free.

Behind the pile inserter assembly is a further breast plate over which the completed pile fabric is passed before going to the take-up roller and out of the machine to a batching roller. The position of both breast plates is adjustable to control the pile height within the limits stated.

The front breast plate is inclined towards the

needle zone at an angle of 60°. The needles are mounted in a full-width control plate assembly coupled to the needle bar, a needle retaining bar locking the needles firmly in position. The needles can be very easily removed when required to simplify maintenance.

The cotton locking cords are supplied from a beam mounted at the base of the machine. The sheet of cords is taken over guide rollers at the rear of the machine, passes through lease rods and then round two full width feed rollers and tension bars controlled by springs at the side of the machine. The action of the feed and tension rollers is synchronized with the motion of the machine and the requirements of the take-up motion, change wheels being provided to vary the amount of let-off according to the tuft insertion which is controlled by the speed of take-up. The locking cord beam itself rotates freely and the feed rollers determine the amount of locking cord passing through the machine. A further adjustment is provided to vary the amount of cord left on the base of the hessian backing after pile insertion to produce a suitable finish for back-sizing.

PILE YARN DELIVERY

The pile yarn is taken from a cone, cheese or beam supply and passes across the top of the machine and through rubber covered nip rollers provided with a quick-release mechanism to facilitate threading. From the nip rollers the ends pass over a guide bar assembly and each end is then threaded individually into the pile inserters. The movement of the inserters, needles, cutters and both the pile and locking yarns is synchronised by interconnected levers and cams operated from the main driving shaft, the necessary mechanisms being housed at the sides of the machine.

The main drive to the machine is by triple Brammer belts and countershaft from a 2 h. p. motor. From the countershaft a chain drive connects, through

reduction gearing, to the main driving shaft underneath the machine on which are mounted four cams providing through connecting levers, the reciprocating movement for the needle-bar mechanism; adjustable connecting rods are provided to vary the stroke of the needles. Attached to the base of the needle-bar assembly are sliding bars connected to the pile yarn and locking cord tension rods to maintain uniform tension during the reciprocating movements of the tufting parts.

LOCATION OF MECHANISMS

At the driving end at the right hand side of the machine are located the cams, linkage and gearing for operating the tuft rake mechanisms, the pile yarn feed and the outer pile inserters. At the left hand side are the cutter cam which provides through connecting rods and linkage the forward and reverse movement for the cutter mechanism, and the cam for moving the inner pile inserter tubes.

The cutter arrangement is simple and effective; it comprises a stationary tungsten steel base plate provided with slots through which the needles pass, and a reciprocating top cutter plate built up in sections. This plate is flat and has an inclined cutting edge which slides across the base plate and shears the ends of pile yarn held by the inner pile inserters, the top cutter being self-sharpening.

INTERMITTENT TAKE-UP

The fabric take-up roller is located at the rear of the needle zone and is driven from the main shaft through gearing incorporating change wheels and a ratchet wheel and pawl mechanism. A manual take-up lever and slow motion control for checking adjustments is provided. The machine is fully guarded by covers which can be removed easily for inspection and maintenance.

(Courtesy: " Textile Recorder ")

The Central Board of Irrigation and Power of the Union Ministry of Irrigation and Power acts as the "liaison body" between the International Association for Hydraulic Research and India.

India had sent a five-member delegation to the 6th Congress, held in the Netherlands in 1955. The 7th Congress was held at Lisbon in 1957, but India did not send a delegation.

The participation of India in the forthcoming Congress will be useful, as the Central Water and Power Research Station, Poona, is currently engaged in conducting research on fundamental and applied problems in hydraulics.

PAINTS, PLASTICS AND CHEMICALS SECTION

Role of Safety Standards in Food Processing and Public Health Hazards

By

Dr. Indra Sanghi

(Central Electrochemical Research Institute, Karaikudi)

&

S. Ratnam

(Institute of Management, Tiruchirapalli)

[Brings out the nature and gravity of the problem and lays emphasis on positive approach to formulate essential safety and health standards. Recommends compulsory measures to check scandalous practices in vogue in preparing, packing, transporting and storing foods, drinks etc. Suggests laying down rigid standards for chemicals used in the preservation and sophistication of food and drugs and prohibiting their sale unless ISI is convinced of their harmlessness. Highlights common causes of household accidents and methods to be used to prevent them. Discusses role of the ISI and the necessity to make some standards compulsory—particularly those in the fields of national health and safety.]

NATURE AND GRAVITY OF THE PROBLEM

SOME of the recent outbreaks of food poisoning, epidemics and such other incidents in India have spotlighted and focussed the nation's attention towards problems of devising suitable standards and practices quickly and efficiently, in order to avoid such unfortunate occurrences and accidents. The task becomes even more pressing and important in view of the rapid industrialization and mechanisation of the country and urgency of achieving maximum productivity. In addition to such spectacular and sudden accidents that unfortunately recently came to pass, it must be admitted and realised that daily thousands of similar near-accidents occur which luckily do not result in such heavy losses and therefore never receive the attention that is due to them. Moreover, the public health hazards do not always show their effects quickly and clearly but go on silently but steadily undermining the health and happiness of the nation. A rough estimate of the cost of industrial accidents has already been given in an earlier paper¹. But the total costs and consequences of health hazards in homes, foods, cosmetics and such other factors have not so far been accurately estimated. However,

it is not difficult to understand that the cost of such hazards is indeed formidable.

POSITIVE APPROACH

There is no doubt that "safety first" is a sound motto and that proper consideration must be given to all the factors affecting public safety and health from the earliest stages of planning and development. Of course, legislation such as the Factory Act, Food and Drug Act, Notifiable Diseases Act etc., must be observed and enforced but simply a negative approach of legislation alone can never be adequate and sufficient to achieve the desired ends. There is great scope and need for more vigorous, more extensive and more organized positive efforts to formulate, lay down and educate the masses about proper and better techniques and standard processes and practices which would reduce such hazards. Industrialization and prosperity of a nation cannot be separated from its health and happiness and it is always better and more advisable to check and control health hazards through preventive measures rather than to apply the *post facto* curative measures.

In the last Indian Standards Institution Convention at Madras, we discussed that as far as possible the enforcement of Indian standards should be voluntary and through education and persuasion rather than by legislative control and police force. We also generally discussed the role of Consumers' Association and House-Wives Guilds in this connection. But recently there has been such a strong wave of public opinion against the scandalous practices in vogue in the preparation, packing, transport and storage of foods and drinks and the methods of handling and controlling the use of poisonous goods and infectious epidemics that it appears that much more drastic and compulsory measures may be required to enforce necessary standards in cases where public safety is concerned or where public health is likely to be affected. In the field of public hygiene, numerous outbreaks of epidemics such as cholera, typhoid, Asian flu, poliomyelitis and encephalitis etc., point towards the need for further precautions and stricter controls in such fields as drinking water, foods, cosmetics, medicines etc., some of which are considered below in further details.

SOPHISTICATION OF MODERN FOODS

The food industry in India is growing at a very fast rate as the tendency to use processed, preserved and packed foods is on the increase. Now this involves numerous problems of additive colours, preservatives, anti-oxidants, corrosions of packing tins etc. All these problems require most careful but immediate attention of the Indian Standards Institution for more than 700 chemicals at present are being used in the preservation and sophistication (i. e. deceptive alteration of properties or appearances) of food and drugs. As the British Medical Press pointed out 'while not all the operations of food technologists are needless or harmful or make for deterioration of the food supply, there is in the practical operation of food plants a good deal that is open to serious objection'. For example, the effect of roughly half of these 700 chemical additives has not so far been fully investigated and established as a result of scientific clinical researches. Thus, the slightest laxity on the part of Indian Standards Institution and the Parliament would greatly lure the unscrupulous to use these cheaper chemicals with unknown effects. Particularly susceptible to such use are substances like emulsifiers, delayers of staling or rancidity, fat extenders, bleaches, flavouring agents, sweetners, artificial aging materials etc., and it is imperative that the Indian Standards Institution lays down rigid standards about the quality and the quantity for the use of such chemicals.

It appears that we have embarked on a rake's progress of chemical manipulation that reaches from the soil whence our food derives to the finished product on our plates. Sir Edward Mellanby seems to correlate the increasing incidence of disease of alimentary tract, hyperpiesis and allergy with increased consumption of processed foods. To-day the food manufacturer is almost invariably given the benefit of doubt, i. e., he can use any additive which is hitherto not been proved to be harmful. It is felt that the shoe should be on the other foot and that no manufacturer should be allowed to use chemicals unless the Indian Standards Institution is convinced that it is absolutely harmless, for it must be realized, as Dr. Wilson, Secretary of the American Medical Associations' Council of Foods and Nutritives, once declared that one chemical can create more problems than 10 toxicologists could solve.

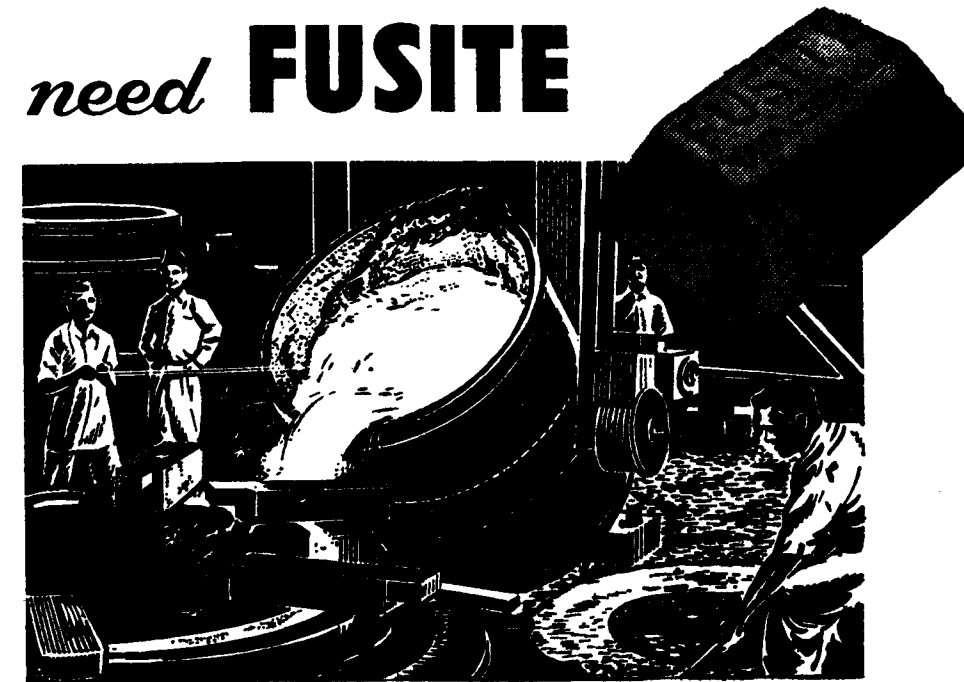
FOOD WRAPPERS AND PACKINGS

A new problem connected with processing of food lies in the increasing use of plastic materials for wrapping, storing and handling of foods. So far there are not specific standards or regulations regarding the composition of such materials, some of which contain substances likely to cause toxic hazard e. g., plasticisers, lubricants colorants, fillers etc. The Indian Standards Institution may go into tests for extractability under the most adverse condition and evolve standards for plastics which may be safely used as food wrappers. Some initial work in this connection is being done by the Toxicity Sub-committee in co-operation with the British Plastics Federation.

INGREDIENTS USED IN COSMETICS, TOOTH PASTES, ETC.

The use of cosmetics face lotions, lipsticks, tooth pastes etc, is rapidly increasing in India. These goods are heavily advertised and are brought into general fashion, although large numbers of such preparations have still to prove their worth and usefulness. On the other hand, quite a few of such substances may be positively harmful to the skin, teeth, hair etc., and may cause in the long run dermatitis or other troubles. It is, therefore, essential and imperative that the Indian Standards Institution lays down standard specifications for admissible compositions and performances. This was also brought out in the hearings of U. S. house of representatives Committee to investigate the use of chemicals in foods and cosmetics. For example, although there are about 150 brands of

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tooth pastes and powders in the market for which high pressure advertising and extravagantly wonderful claims have been made, the American Dental Association, after a thorough investigation, has come to the conclusion that it is the tooth-brush rather than the dentrifice that accomplishes the desired performance of keeping the teeth somewhat clean and in good shape. They concluded that all commercial dentrifices on the market had no proof of therapeutic value. Well, as long as they do not harm the teeth, the Indian Standards Institution may let the consumer, if he so desires, pay his price and take his choice but the Standards Institution must watch that no products harmful in the long run can be offered in the market.

Similarly, the extravagant and untruthful claims made for some soaps incurred the censor of Federal Trade Commission in the U. S. which found that often too frequent use of soaps is positively harmful for the skin. This harm may be intensified by certain chemicals which have been avoided under American Standard Specifications. Similarly, the Research Association in the U. S. found that quite a few of the deodorizers offered in the market were undesirable and a few of them even contained chemicals which were toxic, deadening or irritating to the nasal membranes. In view of the foregoing considerations, it is essential that the Indian Standards Institution should exercise similar vigilance, carry out investigations and formulate minimum standard specifications for all such substances.

AGRICULTURAL HAZARDS

The increasing, intense and indiscriminate use of artificial fertilizers, pesticides and crop-improvers and controllers has created great dangers and potential hazards to public health. This must be carefully looked into by the Indian Standards Institution and specific standards formulated and distributed for the use, storage and handling of all such chemicals in order to avoid agricultural accidents. A safety code may be devised and published as has been done in a booklet published by the Institute of British Agricultural Engineers. The illiterate farmers must be educated and provided necessary safety goggles, masks, gloves and attire for spraying and using poisonous insecticides. Here, there is need not only for standardisation of equipment and materials but also for evolving standardised techniques and procedures. In other countries, attention has been concentrated towards some of these problems also and we can usefully learn from their efforts and achievements. Up-to-date list

of dangerous substances may also be prepared and maintained and the instructions for the use of antidotes for each should be prescribed and presented in a standardized format on the containers themselves.

ATMOSPHERIC POLLUTION

Another great hazard to public health arises from atmospheric pollution and the indiscriminate release of all sorts of smokes, obnoxious gases, fumes etc., in the air. For example, all sorts of diesel engine fumes, petrol fumes, railway smoke etc., have been proved to be poisonous. The gravity of the problem can be judged by the facts that in a recent research it was reported that 2 tons of dust and soot are deposited daily per sq. mile of Calcutta due to the dirty atmosphere. In Britain also, recent researches have correlated the increase of cancer with the increase in atmospheric pollution. Generally speaking, the danger from dust particles increases inversely with the particle size. Two types of procedures can be standardized, one for dust separation and the other for dust control, e. g., (a) elimination of hazardous equipment, process or materials, (b) personal protection, general ventilation, local exhaust systems and wetting periodically by water spray systems which would cause the dust particles to settle down. Some of the examples of machinery designed to minimise the dust nuisance are pedestal grinder exhaust, swing frame grinders and integral exhaust systems as recommended by BSCRA ETC. The dust collected from a steel plant showed on analysis 63 percent of Fe_2O_3 and 0.6 percent SiO_2 . Also, various types of respirators and masks have been designed and standardised for the safety of workers in those operations where it is not possible to keep the atmosphere clean, for example, in mines, fogs etc. However, as far as possible, the designer should try to achieve maximum ventilation before resorting to individual respirators.

POLLUTION OF WATER

With the increasing industrialization in early stages it took several decades for Britain to realise the fact that some of the outbreaks of epidemics were directly due to the pollution of river waters and due to the discharge of burnt fuels and oils by the ships in the Thames Estuary. It took some more time to realize the harmful effects of the then common procedure of discharging waste effluents and liquids from factories and chemical plants into the various sources of water and particularly the rivers. In some countries, it has now been made compulsory by legislation that no such



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effluents can be discharged into rivers unless and until they have been properly treated and rendered harmless. In more recent time, elaborate precautions and arrangements have been made to discharge the waste products resulting from the atomic plants. In the Asian countries, in India particularly, the standard of public health and average diet is still quite low and we have been faced by recurring epidemics and widespread diseases, particularly due to pollution of municipal water supply in the bigger towns. It is, therefore, essential that Indian Standards Institution devotes some attention to these problems and curbs and controls the pollution of water resources and sets down stringent tests and strict standards for any water that is released to the supply pipes.

HOUSEHOLD ACCIDENTS

It may be a bit surprising to learn that more people are killed in the home than on the road. But all the same this is very often true. Three major causes for household accidents are (a) burns and fires (b) falls and slipping, (c) food poisoning or swallowing things that one should not. Burning accidents are often due to cloth, textiles, furnishings etc., catching fire. In India particularly, there are numerous accidents of women being burnt to death while cooking the meals and lighting the fire. In this connection, it is necessary to evolve standardized flame-resisting fabrics. Most of the fabrics can easily be made flame-proof by simple treatments. Fabrics which take more than 150 seconds to burn 100 inches in a vertical direction may be labeled as flame-resistant and given a rating of 150. The various cookers, fire places, chimneys etc., can also be standardized and so designed as to reduce the fire hazards. Special attention is necessary for specifying adequate and suitable safety precautions and fuses in all household appliances such as washing machines, electric irons, sewing machines, radios, electric fittings, batteries etc. In this connection, it may be worthwhile even to use the special plugs with step-down transformers incorporated therein to bring down the voltages from 240 V to 25-50 V only so that at least all the necessary household gadgets are designed and used only at low voltages, eliminating the hazards of electrocution.

Danger from falling and tripping can also be minimized by suitable designs of stairs, ladders, ledges, sharp projections and corners etc. For example, various non-skid flooring materials may be standardized. Similarly, the preferred slopes for stairs and

inclines and dimensions for hard-rails may be specified e. g., it has been found that 30-38° is the optimum incline for stairs. Similarly, all acids, poisonous and harmful chemicals can be provided with such stop-cocks and stored in such places as would generally be out of reach of the children.

VOLUNTARY VS COMPULSORY STANDARDS

In the end it is worthwhile to consider briefly the problem of voluntary vs compulsory safety standards. Although it is realized and generally agreed that, as far as possible, standards should be by persuasion and mutual consent, yet where safety to life and property is concerned, it becomes a public duty to see that the necessary precautions are effectively and efficiently taken without further delay. Thus, the government through legislation and the Indian Standard Institution through specialized services can do much to make life reasonably free of hazards. In this connection, the role of other organizations similar to those in Britain e. g., the Royal Society for Prevention of Accidents, the various Industrial Safety Groups and the Medical and Dental Associations is also very imperative and important and it is high time that in India also such organizations are set up and arrangements for proper co-ordination made to constantly keep the public health and safety hazards under review and suggest suitable precautions and standards from time to time.

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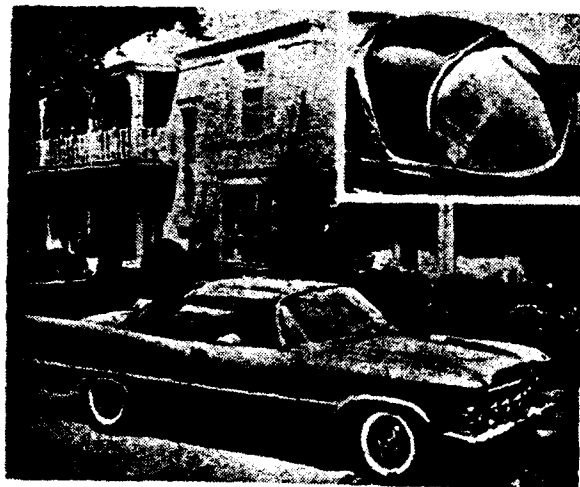
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Textured Plastic Coating Features Union Carbide Vinyl Resins

AS new as 1960, but available in 1959, a new textured plastic coating is gracing the exterior of the roof of the Imperial, an automobile manufactured by the Chrysler Corporation, U. S. A. Made from Union Carbide vinyl resins, the coating combines the elegance of leather with the durability of steel.

Hardtop landau models of the all-new Imperial Southampton line offer the last word in prestige from the Chrysler Corporation. To conform with the finest custom made standards, the roof is highlighted by the plastic coating that lends a black, grained-leather appearance to the landau area. It provides contrast to the brushed stainless steel forward section.



Union Carbide is exhibiting at "Plastics, 1959", Dusseldorf, Germany.

The finish offers the advantages of customizing the Southampton with the luxury appearance of leather or fabric, and the practical durability of a vinyl dispersion coating that resists cracking or peeling. Extreme exposure and use tests revealed that the coating did not fade, chip or blister and also offers high resistance to abrasion. Production savings were also realized by use of the Union Carbide vinyl based material. Lapping, joining, trimming and other costly and time consuming operations necessary with leather or fabric have been eliminated.

POLYETHYLENE FILM LINED CONTAINER REDUCES SHIPPING COSTS 67 PER CENT

Containers lined with film made of Union Carbide polyethylene, now being used to package fruit juice concentrates, have resulted in a 67 per cent shipping cost reduction over the metal pail method formerly employed, according to a leading juice concentrate producer in the United States.

Concentrates are packaged and shipped in five gallon (18.9 litres) corrugated boxes having disposable film bag liners. Disposable metal pails were formerly used for the same packaging job. The heavy metal pails were considerably more expensive from both their cost and shipping weight aspects. Now in



Two years of experience with a juice concentrate package incorporating low-cost polyethylene film has indicated more profit per shipment than the use of metal pails, the method previously employed. In addition, the polyethylene-lined package has reduced shipping costs 67 per cent, according to the packer.

polyethylene-lined boxes, the same volume of juice concentrate can be shipped at one-third the cost. Other savings result from the greatly reduced amount of space required by the easy-to-handle film-lined package in storage and in transit.

The use of three mil (0.003 inches), pinhole-free polyethylene film allows for lightweight, leakproof containers, according to the concentrate producer. Sealing of the polyethylene liner is a simple matter—the liner is gathered at the top, twisted and bound with a piece of paper-covered wire making a complete package.

Union Carbide is exhibiting at "Plastics, 1959", Dusseldorf, Germany, October 17-25.

POWDER GIVES CUTTING FLAMES A FLYING START

A unique and highly effective flame-cutting machine has resulted in a boost of output and a slash in production costs. Key to the efficiency of this machine is the addition of special Oxweld iron powder to the oxygen cutting flame which gets cuts off to a flying start.

Operation of this unusual machine is entirely automatic and more than 1000 billets can be cut in an average eight-hour shift. Billets 3 1/2 to 7 1/2 in. (8.9 to 19.1 cm.) in diameter are sliced into lengths ranging from 4 to 12 feet (1.2 to 3.7 m.). Materials cut vary from mild steel, through tough high carbon, to 4 to 6 per cent chromium alloy. Cuts are made fast, clean, and sharp and require no finishing. After the billets are cut, they are fed into seamless tube hot mills to be made into tubing which varies from 2 3/8 to 8 1/4 in. (6.1 to 20.9 cm) outside diameter.

Powder-cutting replaces the use of shears for this work. In addition to increasing the overall speed of the operation, powder-cutting also prevents elliptical shaped ends which are a problem with shearing. Shearing also has a tendency—especially in harder steels—to produce cracks that show up as open seams in finished tubing. This problem is also eliminated with powder-cutting.

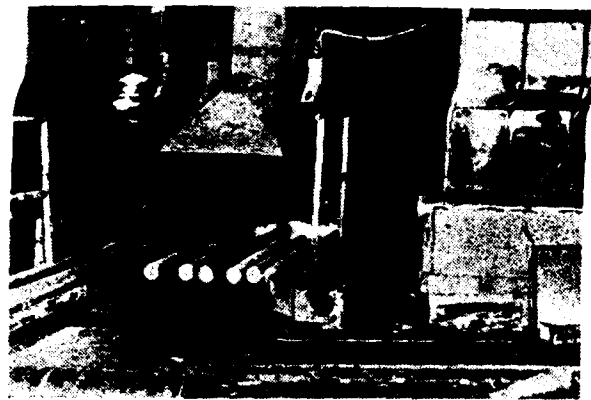
Service engineers from Union Carbide assisted in the design and construction of the automatic cutting machine. Two Oxweld C-39 cutting torches with powder-cutting attachments are mounted on an

Oxweld CM-37 machine carriage that automatically controls the cutting speed. Cams ride on the surface of the billets and raise and lower the torches to follow the round surface. Oxweld No. 200 iron powder is fed into the cutting oxygen stream from an Oxweld D-9 pneumatic powder dispenser. The addition of powder produces the intense reaction that quickly starts the cuts on the round surfaces. Use of powder also allows the operator to quickly restart the cut if for any reason the machine should be stopped at any point in its cycle.

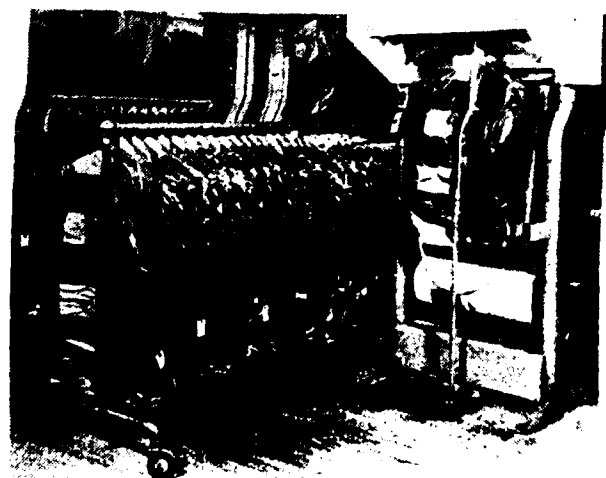
An operator easily and accurately controls the machine from a booth containing all necessary controls. Push button control makes it possible to automatically raise or lower the track for different size billets, position the torches at any place in the cycle, and restart the cut if lost. Billets are delivered by a crane to the cut-off dock where an operator rolls them onto the loading table and sets the stop for the required length. Sections are rolled from the cutting machine onto a platform where a skip car picks them up and transfers them to bins. The crane delivers them to the preheat furnaces and then to the hot tube mills.



Closeup shows two Oxweld C-39 torches cutting quickly and cleanly through several billets. More than 1000 billets can be cut in an average eight-hour shift.



Overall view of the automatic billet cutting installation shows the loading dock, feed rolls, cutting table, and the control booth on the right. Oxweld iron powder is fed into the flames from the Oxweld D-9 injector on the platform to the upper left of the machine.



Suit covers made of Union Carbide polyethylene film have successfully overcome wrinkling problems that accompanied the use of paper garment bags. The suits are protected during transit and display by the plastic bags which are inherently waterproof, flexible and resistant to tearing.

POLYETHYLENE TEXTILE PACKAGING OFFERS PROTECTION, CUSTOMER SATISFACTION

Tough, transparent film made of Union Carbide polyethylene has shown itself as the most desirable material yet in which to package men's suits for shipment. The new covering eliminates inadequacies found in conventional paper wrappings.

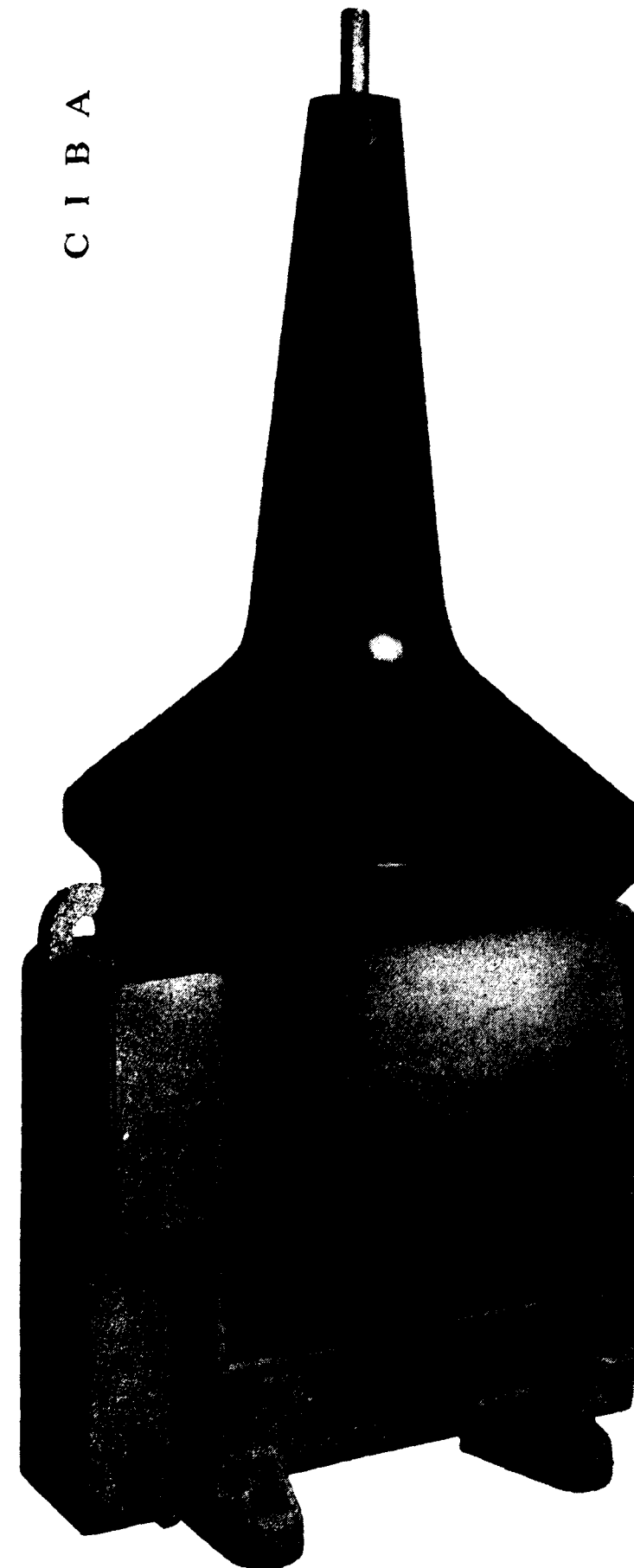
Suits are quickly and easily put into individual covers of polyethylene film in order to protect them in transit. Dust, stains and tearing are greatly reduced. The garments arrive in better shape for display—they have fewer wrinkles, and definitely improve consumer-retailer acceptance of the packaged garment.

Previously wrapped in paper, men's suits arrived at retail outlets badly wrinkled and had to be repressed before they could be displayed and sold. This was an added cost to the retailer. With the polyethylene wrap, however, the garments do not have to be pressed again by the retailer, even when shipped great distances. Complaints from retailers are substantially lower since the introduction of the new polyethylene package. In addition, the suits can be placed on racks without removal of the polyethylene wrap, while the previously used paper had to be removed for customer inspection of the garments.



Union carbide polyethylene film used to protect men's suits during shipping and display, is shown here being fitted over one of approximately 800 garments covered each day. The packaging machine dispenses a tubular film that has substantially reduced the problem of garment wrinkling, prevalent with the paper containers formerly used.

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Consumers, too, prefer the fresh appearance of clothing packaged in polyethylene film. Moreover, the polyethylene film cover may be re-used by the purchaser to store and protect other clothing at home.

While providing a protective, transparent package

for each suit, polyethylene resists tearing under normal usage, is inherently waterproof and does not absorb marks or stains from handling.

Union Carbide is exhibiting at "Plastics, 1959", Dusseldorf, Germany, Oct. 17-25

Steel Bars and Wire for Concrete Reinforcement

The Indian Standards Institution has issued a draft specification for mild steel and medium tensile steel bars and hard-drawn steel wire for concrete reinforcement.

The draft covers the requirements and the methods of test for rolled mild steel and medium tensile steel bars, in round and square sections, and hard-drawn steel wire of medium strength used for reinforcement in concrete.

The draft standard is a revision of the earlier standard on the same subject, published in 1953.

The draft revision incorporates two important changes. Firstly the so-called untested steel has been brought under a separate grade, having a lower ultimate tensile strength.

Secondly, steels having an ultimate tensile strength less than 40 tons, has been categorized under the name 'medium tensile steel' as compared to the originally adopted name of 'high tensile steel', which covers steels of strength in a very much higher range. Such a step is considered to pave the way towards better utilization of the available supplies of concrete reinforcement.

Further, to provide for proper changeover to the metric system, the bar diameter in the metric system has been given with near equivalents in inches to facilitate ready conversion.

Comments on the draft standard may be sent before October 3, 1959 to the office of the Indian Standards Institution 'Manak Bhavan' 9 Mathura Road, New Delhi.

TRAINING FACILITIES IN PETROLEUM TECHNOLOGY

A first degree course in petroleum technology with

20 annual admissions has been started at the Indian School of Mines and Applied Geology, Dhanbad. This was stated by Shri Humayun Kabir, Union Minister of Scientific Research and Cultural Affairs, in a written reply to a question by Shri Ram Krishan Gupta and three others in the Lok Sabha.

The Minister added that the Council of Scientific and Industrial Research had recommended that a petroleum council be constituted for the rapid development of petroleum industry in the country. This recommendation was under consideration.

It had been suggested, the Minister further said, that the petroleum council should *inter alia* deal with the following:—

- (1) Training of personnel, research and investigations, documentation and information and marketing and economics in the whole field of petroleum and natural gas,
- (2) facilities in the existing and proposed institutions and the potential for expansion of such facilities, and
- (3) what additional facilities, including any new institution, should be created.

A low cost system for remote or automatic control of its HPL-C metal enclosed interrupter switches has been developed by R & IE Equipment Division, I-T-E Circuit Breaker Co. Greensburg, Pa. Employing positive pneumatic switch actuation, the new system can be incorporated on the line of HPL-C switches from 600 through 2,000 amp and 2.4 through 14.4 kv. The system consists of a double acting air motor, linkages, solenoid valve and air cylinder. Three principal types of operation are permitted: Remote pushbutton control, automatic throwover schemes; and circuit opening on overload with thermal or overload relay sensing.

POLISH MINING EXPLOSIVES

Poland as one of the biggest hard coal producers in the world and a country of highly developed ores as well as other minerals mining is consequently a very important consumer of mining explosives. Owing to this fact Polish chemical industry specialises since many years in the production of these materials.

Mining explosives are also exported from Poland since some scores of years. Their high quality, exceptional yield, especially careful packing and prompt delivery are fully recognized by our foreign customers.

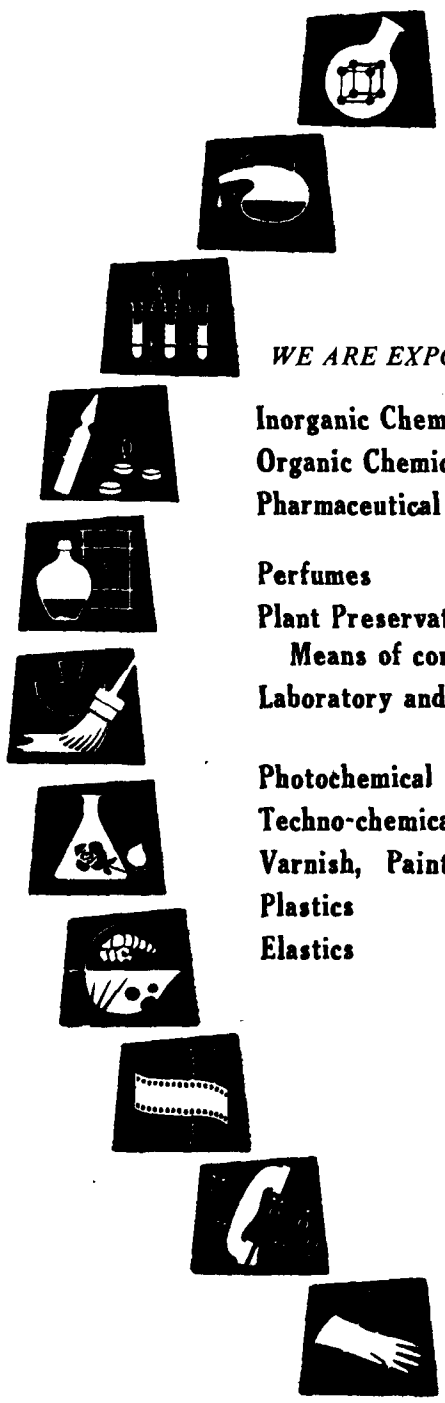
The assortment of Polish standard mining explosives includes:

- blasting gelatines i.e. the materials of practically highest strength used in hard rocky layers shooting, in subaqueous work etc.
- rock dynamites used in mining, in quarries, building of roads and tunnels etc.
- permitted dynamites applied to hard and soft rock beds in coal mines where exists the danger of methane /air or coal dust ignition/.

The above three groups represent together 35 standard sorts of polish made mining explosives —among them the sorts especially resistant to low temperatures, resistant to moisture etc. Such a wide assortment enables our customers to select the right material for any type of blasting work in any geological conditions, in any climate and in any season.

It goes without saying that we are always at our customers' disposal to study their individual needs and select the appropriate material in every specific case. In the practice of Polish mining explosives export we are often favoured by our customers' inquiries concerning technical advice from our part. We very appreciate those signs of confidence and are pleased to assist them with many years' experience of polish industry on this field.

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however recommending to use when only possible our standard size cartridges. Besides the mining explosives Poland supplies also complete assortment of igniting mediums like many sorts of fuses, mining detonating caps, electric detonators of instantaneous and delayed action.

Packing of mining explosives is always subject of our special attention — this factor being of course very important by the transport and storage of such materials.

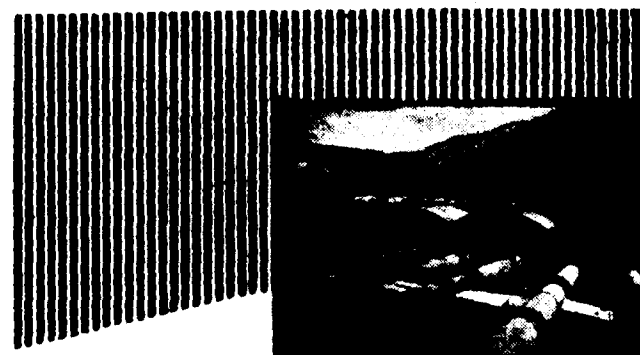
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PLASTIC BONDED TO STEEL

A motor ambulance is believed to be the first vehicle to have an interior lining of plastic-coated steel. The material was chosen because it proved to be easy to clean and hygienic, besides being simple to machine with conventional tools. This is but one example of the range of applications being evolved for Stelvetite, as John Summers and Sons, Ltd., has named its newly developed plastic-covered steel sheet.

Britain's Ministry of Works is introducing it for sorting tables in post offices: it is being used in buildings, as walls can be quickly erected with the large sheets and have an attractive appearance; it is suitable for laboratory bench tops; and because of its resistance to abrasion it is being used for lift panellings.

Details of the manufacturing process have not been revealed, but it is stated that coils of pre-treated steel are bonded to a specially formulated polyvinyl-chloride, without specifying the steel treatment or the adhesive. The product can be bent, formed, deep drawn, joined or welded.

The material can be supplied in a variety of colours and finishes, from smooth to embossed, and saves the user the trouble of painting his steelwork. The bond has been found to last the life of the material. Stelvetite is produced in widths up to 4 ft. and in lengths up to 12 ft., although theoretically any length is possible.

.. .. .

A Reading Machine that will scan "any document" even microfilm, checks and tally rolls—at the rate of 300 or more characters a second has been developed in Britain. It can even read smudged and blurred characters, its developer says, and makes it possible to feed information to a computer as fast as the machine can accept it.

The machine, built on the modular principle, features all-electronic scanning, can be tied in with computers, card-punchers, paper-handling devices. Primary output consists of pulses corresponding to the character being scanned—one pulse per wire. These pulses can be directly operate a keyboard, or sorter, or they can be stored in binary form. A joint company to be known as Rheem-Solartron Ltd., is being formed by Solartron, the original developer, and Rheem Manufacturing Co. of New York for further work on this and other electronic devices.

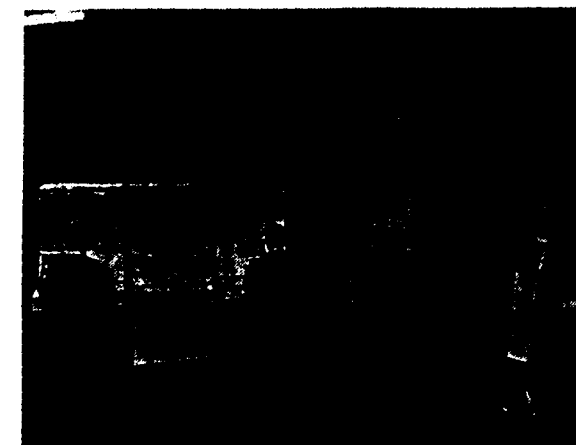
AIRCRAFT AND AUTOMOTIVE INDUSTRIES SECTION

FOR CO-OPERATIVE RESEARCH

The A.R.A.'s New Supersonic Wind-tunnel

AN important addition to the wind-tunnel facilities available to the aircraft industry in their co-operative research establishment on the outskirts of Bedford is now operational. This is the Aircraft Research Association's new supersonic ($M=1.4$ to 3.5) unit which has been constructed as an integral part of the original scheme for providing wind-tunnel facilities for the industry through a Mach number range from subsonic to just below hypersonic speeds. It has a working section $2\frac{1}{2}$ ft. high by $2\frac{1}{2}$ ft. wide. The following notes on the new tunnel have been prepared by the A. R. A. staff under Mr. R. Hills, the chief executive.

The axial compressor which drives it has eleven stages with a total power of 13,750 h. p. and is normally used as a suction plant on the Association's transonic tunnel to enable it to run above the speed of sound. The compressor circuit can, however, be



isolated from the transonic tunnel by motorized valves and then run on a separate circuit for the supersonic tunnel.

Both these tunnels can be run at the same time provided the transonic one is not required for speeds

above $M=1$. As in most model tests in the transonic tunnel, a considerable amount of work is done below $M=1$, there will be plenty of time available for running the compressor on the supersonic tunnel and the whole plant can be used to the best advantage. The changeover from one tunnel to the other by the motorized valves only takes a few minutes.

If a supersonic tunnel of constant working-section size is coupled directly to an axial compressor, the flow given by the compressor will not match that required by the tunnel over a range of Mach numbers. The working-section size must be chosen so that the compressor volume flow is sufficient to run it at the lowest Mach number required, and the compressor will then provide more volume flow than is necessary at the higher Mach numbers.

This characteristic can be utilised by providing an injector slot in the diffuser downstream of the working section and by passing the excess air from the compressor round the working section into this injector. In the new A. R. A. tunnel, where the working-section size is chosen to match the volume flow at $M=1.4$, the compressor gives an excess flow of about 120% of the flow required through the working section at $M=3.5$. This air is injected into the diffuser at a local Mach number of 1.7 and by its injector action considerably decreases the overall pressure drop between the entry to the working section and the exit from the diffuser.

Model tests made on a 4-in. square supersonic tunnel showed that with injection a pressure ratio of 3.6 was required for a Mach number of 3.4, compared with an estimated pressure ratio of about 5 without injection. As the pressure ratio on the compressor is limited to below about 4.2 because of surging, a speed of $M=3.4$ would not be obtainable without injection.

The new supersonic tunnel has, therefore, been designed for a Mach number range from 1.4 to 3.5, which the model tests showed can be achieved with the existing compressor. Model tests in the small tunnel could not be extended above $M=3.4$ and in the actual tunnel provision has been made for an extension of the Mach number to 4 if this proves possible.

Fig. 1 shows the tunnel circuit. The air from the compressor cooler passes through a 4-ft.-dia. motorized valve, which is one of the two isolating valves for the supersonic tunnel circuit. It then passes through a banjo-type junction, where the by-pass air is fed to the injector.

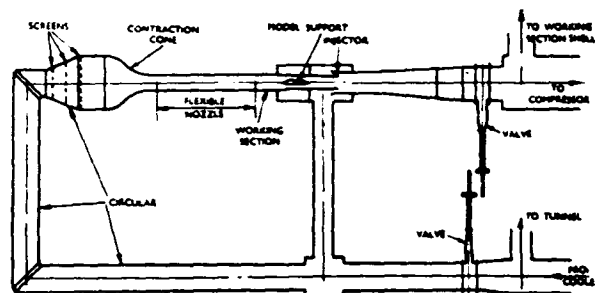


Fig. 1. The tunnel circuit.

Just upstream of the contraction cone the tunnel section expands rapidly (50° total cone angle), using three spaced gauze screens which prevent separation in the wide-angle diffuser. A fixed contraction is followed by the nozzle section, which has flexible top and bottom walls with fixed parallel side walls.

These flexible walls are designed to give the exact nozzle shape for a Mach number range from 1.4 to 4, and they have been made so that they can be adjusted over this range when the tunnel is running.

The top and bottom flexible walls are supported from large beams running the whole length of this section and pivoted at their downstream ends. The upstream end of the flexible plate is permanently bent round a rigid former, which is held at its downstream end by a link on the beam and at its upstream end by a linkage to a roller moving in a cam. Downstream of this former, or throat block, the flexible plate is supported by a number of links whose vertical heights are fixed by rollers moving in cams mounted in horizontal slides on to the beam.

The upstream end of the beam can be moved up and down by a screw jack driven by a hydraulic motor. As it moves, a linkage system fixed to the tunnel structure causes the cams which adjust the



Mr. R. Hills (left) chief executive of the A.R.A. at the supersonic tunnel control panel.

flexible wall to move horizontally. By this means the heights of the links are altered relative to the beam and the shape of the flexible plate is changed. At the same time, movement of the roller in the front cam causes the former block to move to a new angle relative to the beam.

There is sufficient adjustment in this system to give the correct nozzle shapes for every Mach number in 0.1 steps over the range $M=1.4$ to 4.

The sides of the flexible plate, which slide over the side walls, are sealed by polythene strips fitted in a groove in the sides of the plates and pressed against the side walls by a soft rubber backing strip. The chamber behind the flexible plate is vented to working-section pressure, so that the pressures across the plate are small: a fairly thin ($\frac{3}{8}$ -in.) plate can, therefore,



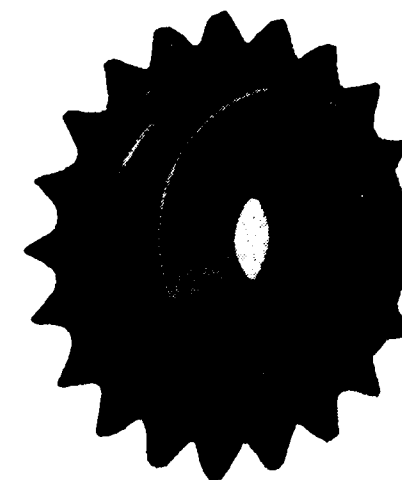
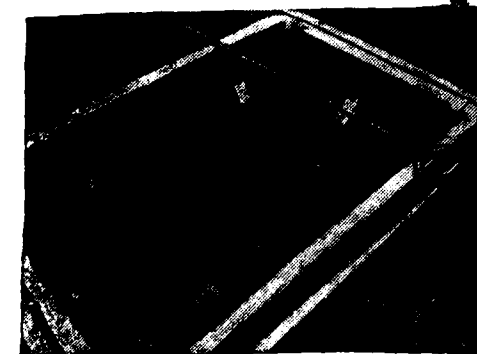
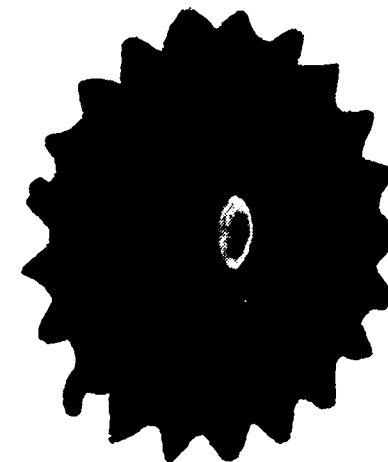
Another view of the main control console; the central indicator panel shows the flexible wall configuration.

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be used and the loads on the rollers and cams due to the bending of the plate and to air loads are, in consequence, small. This is the main reason why it was possible to use a design of this type instead of a more conventional one with individual screw jacks controlled by an expensive servo mechanism.

Mechanically the design has proved very satisfactory and control of the throat size can be obtained easily to less than ± 0.002 in., while the whole nozzle shape is within ± 0.005 in. of the theoretical for all Mach numbers. The movement over the whole range is obtained in $2\frac{1}{2}$ minutes.

From the limited calibration which has already been done the flow appears to be very uniform and the Mach number at the centre of the tunnel is within less than 0.01 of the design value. Some adjustment of nozzle shape could be made if required by altering link lengths, and if necessary new cams could be made, but it seems that this will not be required.

In the working section two 2-ft.-dia. windows with "Schlieren quality" glass enable flow photographs to be taken with a spark source and also allow continuous observation of Schlieren pictures and shahowgraph.



This special frame is used for the calibration of the strain-gauge balances used in the supersonic tunnel.

Support for the model consists of a quadrant and sting with the angle of incidence variation being obtained by hydraulic rams over a range from -10° to $+45^\circ$. The whole incidence range can be traversed in 25 seconds and a stepping device is provided which automatically alters the incidence by a predetermined number of degrees each time a button is pressed. Roll over the range 0° to 360° is provided on the model by a rolling unit fitted between the sting and quadrant.

Downstream of the working section, the top and bottom walls of the diffuser are fixed and approximately parallel but, as indicated in Fig. 2, the side walls are divided into a number of hinged sections, each

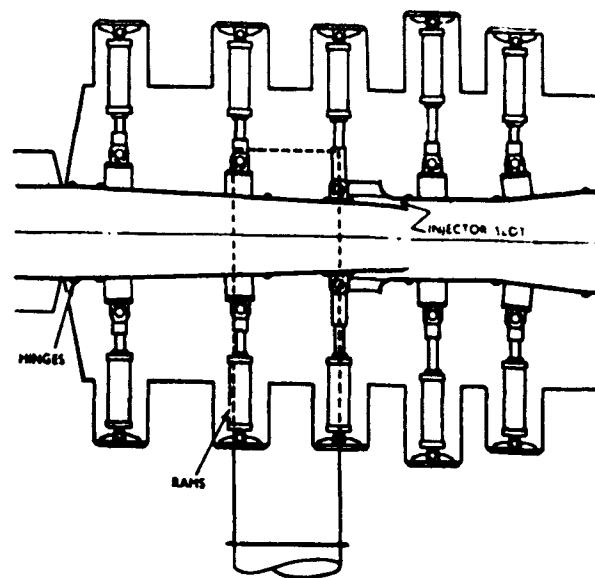


Fig. 2. The side walls of the diffuser have a number of hinged sections adjusted by hydraulic rams.

section being held in position by a hydraulic ram. These hydraulic rams can be adjusted while the tunnel is running to give the best possible diffuser configuration for any Mach number. The injector slot is fitted as part of this system and the amount of air injection can be changed by adjustment of the hydraulic rams to alter the slot width.

At the end of a further section of the fixed diffuser there is a 5-ft.-dia. valve, which is the other main isolating valve in the supersonic tunnel circuit. Downstream of this, the section expands to an 8-ft. dia. collecting chamber immediately ahead of the compressor. In this section a metal honeycomb, backed by a gauze screen, has been built to provide a safeguard against any parts of a model flying into the compressor.

The tunnel can be run over a stagnation pressure range from $\frac{1}{2}$ to $1\frac{1}{2}$ atmospheres and it is normally started at low pressure to avoid a large shock load on the model. Dry air is stored in a separate tank at 10 atmospheres pressure to raise the pressure in the tunnel circuit. This dry air is supplied by compressing air to 10 atmospheres, cooling, removing the water and then passing through a drier. Under running conditions sufficient air is bled into the tunnel circuit from the dry-air store to maintain dry air in it.

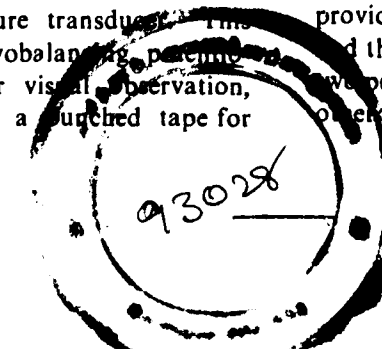
Measurements of the aerodynamic forces on models are made by strain-gauge balances mounted either inside the model or on the attachment sting. Signals from these strain gauges are fed to DC servo balancing potentiometers, which plot the resulting readings on a chart against incidence for visual inspection and feed a digitized voltage in binary form to a card punch.

Eight channels are normally provided, but these can be supplemented by further channels if required and up to a total of 20 quantities can be recorded on each card. These cards can then be fed directly into a computer, which corrects the results into the standard non-dimensional coefficient form.

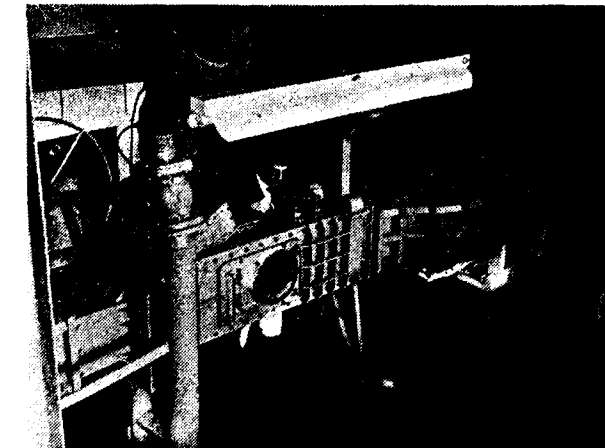
A calibration frame is provided for calibrating the strain-gauge balances. This uses a series of levers with dead weights so that forces and moments can be applied in three directions while the electrical signals are fed to the same servo-balancing potentiometers and card-punch system to record the readings, which can then be worked out directly on the computer.

In order to ensure that the directions of the forces which are applied are accurately known, the balance is mounted in a rig with means of adjusting its level in the horizontal and vertical planes under different loads. The measurements of level are made by using standard workshop dial indicators reading to 0.001 in. Using this equipment, a balance measuring three components of force and three moments can be calibrated and all linear interactions measured in a few hours.

Pressure measurements can be made by photographic records of normal manometers or by using several Scanivalve pressure switches, which switch a number of pressure points to a single pressure transducer. This transducer records on a DC servobalancing potentiometer, giving a chart record for visual observation, and also feeds the results on to a punched tape for transfer to the computer.



The A. R. A.'s transonic tunnel started model testing for the industry in February, 1957—though for one period of six months since then running was very limited due to a fatigue failure of the blades of the axial compressor. Some 35 tests on 18 different models have now been completed and the total fan running hours is over 1,300.



This 1/12-scale model of the A.R.A. transonic tunnel has a working section 8 in. x 9 in. and is used for small-scale pilot experiments.

Tests made have included normal force measurements on both complete and partial models of aircraft, and missiles and more extensive pressure measurements on jet intakes, and on a propeller turbine intake with a cropped propeller being driven by a hydraulic oil motor inside the model.

Development of methods for testing flutter models is under way, together with the installation of sufficient air storage at high pressure to enable jet efflux effects to be reproduced.

A small transonic tunnel—one-twelfth of the size of the large one (i. e., having a working section 8 in. by 9 in.)—has been built to provide a means of doing small-scale pilot experiments on any rigs which might be required in the large tunnel. This uses an injector drive from a compressor air supply and will run for up to 2 minutes. It covers a Mach number range from subsonic to $M=1.3$. A simple flexible nozzle is provided, adjusted in this case by one screw jack, and the working section itself can either be fitted with two perforated walls with two glass windows on the outer walls or with four perforated walls.

(Courtesy: Aeroplane)

How the Air We Breathe helps send Rockets out into space

A rocket poised for flight into space is a strange, silent symbol of things to come as it stands on its launching pad wreathed in plumes of vapor, its sides and nose cone glistening in the sunlight.

The long countdown continues. The seconds tick by. Zero!

Then slowly, almost ponderously the rocket begins to lift. Now it balances for a moment on a column of fire. Then, with a roar like that of a thousand giant waterfalls, it climbs skyward and in a matter of seconds is plunging into airless space lost to all vision save that of electronic tracking devices.

Watching a rocket launching, it is hard to grasp the fact that the tremendous thrust developed by the "bird's" engines owes its existence to a substance extracted from the very air we breathe—oxygen.

The reason for the oxygen is that in space, beyond the earth's atmosphere, there is no natural oxygen. A rocket, therefore, must carry its own supply of oxygen to keep its flaming engines from going out just as a match would if covered with a drinking glass.

However, oxygen in its natural gaseous state takes up a lot of room, a lot more than there is space for in a rocket. Therefore, liquid oxygen or "lox" as it is called by rocketmen, is used instead. In a liquid state, oxygen has 860 times the volume of gaseous oxygen. This means simply that a cubic foot of "lox" turns into 860 cubic feet of gas when it is changed back into a gaseous state. By squeezing so much oxygen into such a small space, engineers are able to insure that there will be enough on board the rocket to support combustion.

Oxygen, however, remains a liquid only at temperatures less than 297° F below zero. It must be stored, necessarily, in heavily insulated tanks. It is pumped through pipes swathed in layers of insulating material. In order to remain liquid, "lox" must also be kept under terrific pressure. This means that storage tanks, pumps, pipes, etc. must be absolutely free from leaks.

It is a little hard to comprehend just how cold this liquid oxygen is. Engineers use this analogy: if you were to plunge a finger into a tank of the liquid and then withdraw the finger and tap it lightly, it would

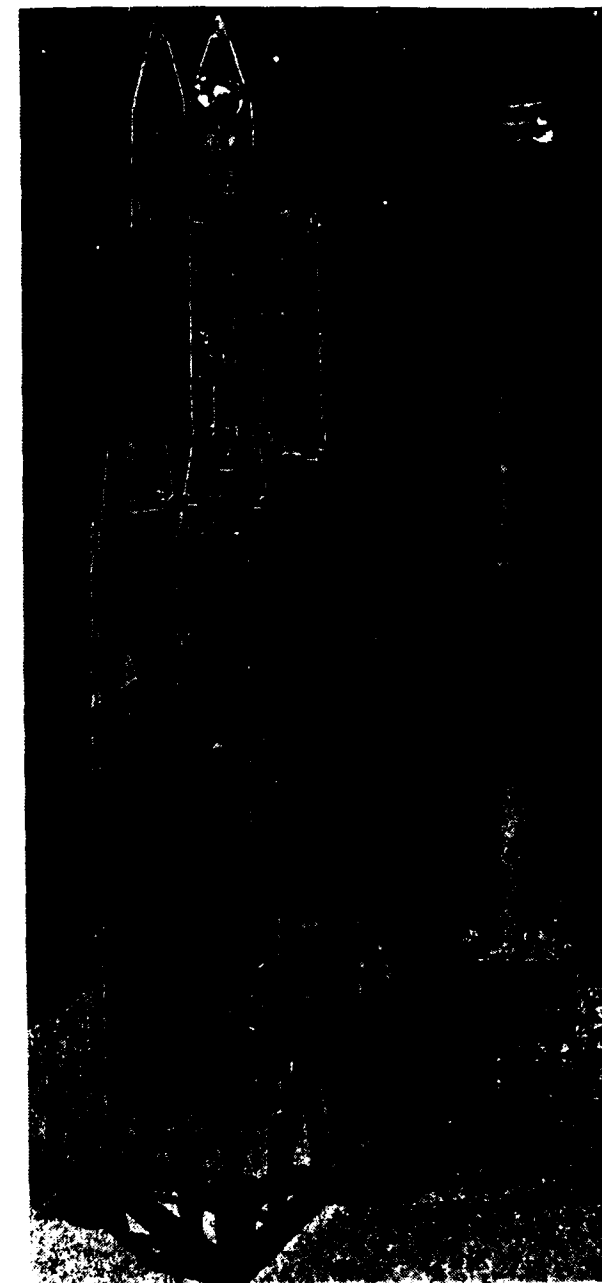


Photo of plastic model of Vanguard rocket shows location of various fuel tanks, guidance systems and other mechanisms. Tank containing liquified oxygen is indicated by arrow. Other major components are (from top to bottom): Vanguard satellite and third stage rocket, second stage fuel tanks and engine; liquid oxygen tank, first stage fuel tank, and first stage rocket engine. Blast-off scene is shown in background of drawing.

shatter into hundreds of pieces like glass under a hammer blow. It is the extreme cold of the "lox" in its storage tanks in the rocket that causes the

plumes of condensing water vapor that wreath the missile before flight time. The cold is so intense that it turns any moisture settling on the rocket's sides into snow.

Making liquid oxygen is almost as much of an engineering feat as is the flight of the rockets themselves. An outstanding example of the liquid oxygen making process at work is found at the Burdett Oxygen Company in Cleveland, Ohio. While the "lox" made in this (US) million dollar plant is used mainly for industrial purposes, the process by which it is made is similar to that used in making "lox" for rockets.

The first stage in the process is cleaning of the air from which the oxygen will be extracted in a filter which removes all dust particles. Following this, the air is compressed in the first two stages of a five-stage Worthington Corporation (U. S. A.) compressor. Between the second and third stages of the Worthington compressor, the air goes through a chamber where chemicals remove all its carbon dioxide content. From there it goes back into the compressor and passes through the remaining three stages. When it

finally emerges from the compressor, it is under a pressure of 2,850 pounds per square inch.

This pressure of nearly a ton-and-a-half is equal to that found in the ocean depths more than a mile below the surface. A human being subjected to such a pressure without special protection would be crushed into jelly in a second.

After it is compressed, the air is passed through an expansion mechanism which reduces the pressure to 65 pounds per square inch. This sharp pressure drop lowers the temperature of the still gaseous air to the point where it changes into a liquid. This part of the process is similar to the way dry ice is made in many commercial ice plants.

After being turned into a liquid, the air is passed through a "separation column" in which the oxygen is separated from the other gasses that make up atmospheric air—argon and nitrogen.

The finished liquid oxygen is then pumped into specially built, 18-wheel tank trucks painted red and white to warn motorists to keep their distance while the "lox" is being delivered.

for the Beginner in Aviation



HAL now offers the PUSHPAK, cheap to buy and operate.

Rugged in design and simple to maintain, this aircraft can operate from runways or small grass fields. It is offered to fulfil the immediate needs of flying clubs in India.

for Service and Civil Training

The HT-2, an all-metal aircraft of robust construction, stressed to 10G, makes it an ideal aerobatic trainer. A proven aircraft, both in performance and standard of workmanship the HT-2 is currently used by the Indian Air Force and the Indian Navy as a basic trainer.

The Civil Aviation Training Centre, the only government sponsored flying training school in the country, uses the HT-2 for training pilots upto commercial standards. It is also used by some flying clubs in India.

HT-2

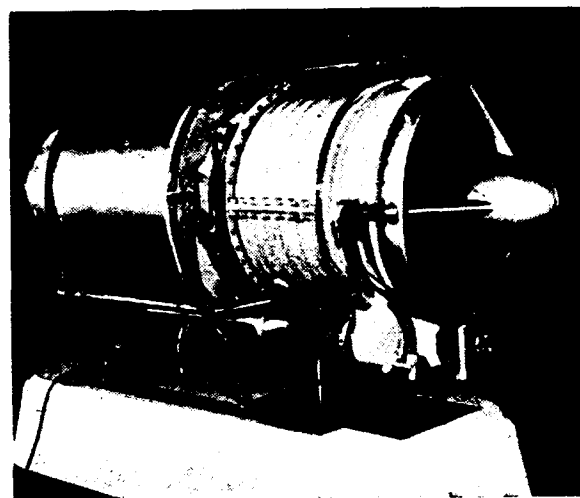
HINDUSTAN AIRCRAFT LTD.

BANGALORE, INDIA

HINDUSTAN AIRCRAFT LIMITED, BANGALORE

By Major M. V. Subrahmanyam
Publicity Officer

EIGHTEEN years after its inception, Hindustan Aircraft Ltd., today stands at the threshold of a new phase of expansion. In step with the latest trend in the aviation industry elsewhere, it is embarking on two new projects concurrently; the manufacture of the transonic, light weight jet fighter, the Gnat in collaboration with M/s. Folland of the U. K. and its power plant, the Orpheus Turbo Jet Engine, in collaboration with the Bristol Aero Engines Ltd., also of the U. K. The Gnat represents a new concept in light weight jet fighters and it has been so designed as to be powered by the Bristol Orpheus Turbo Jet Engine. This is the first time that Jet Engines are being manufactured in India.



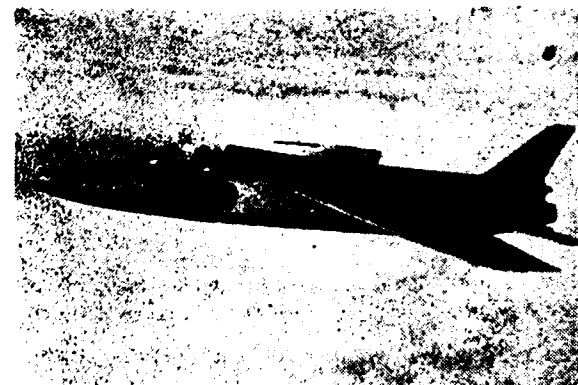
The Bristol "ORPHEUS" Turbojet engine.

In the field of light aircraft manufacture, Hindustan Aircraft Ltd., have put on the market an ultra-light two-seater aircraft, the Pushpak, primarily to fulfil the immediate needs of Flying Clubs in the country and to give an impetus to flying training. The Pushpak is probably one of the lowest priced aircraft in the world in its class. Also for the first time in India, a prototype of a suitable engine of the piston type to power this aircraft has been made at H. A. L. and this is now undergoing development trials. This engine will in due course power the Pushpak. These developments rest on the solid foundation of years of experience and achievements that have marked the growth of Hindustan Aircraft Ltd.

Before narrating the history of the growth of H. A. L., it is pertinent to observe that the growth of the aircraft industry in any country is dependent on several factors like the air-mindedness of the common man, the expansion of the Air Force, the growth of internal commercial air transport, the development of allied industries for manufacturing basic raw materials and a high precision instrument industry for the manufacture of aircraft instruments. Examined from these aspects, the growth of India's Aviation industry has naturally lagged behind the progress achieved in other industrially advanced countries but considerable leeway has been made up in recent years.

It was not until after the year 1910 that aircraft were seen in the Indian skies and it was not before 1928 that the first Flying Club in India was started. It was only in 1932 that a start was made in aviation in India by the formation of the Tata Airlines in Bombay and the Indian National Airways in Delhi for the carriage of mails between different cities in this country. Also it was only in 1933 that the 1st Squadron of the Indian Air Force was formed. It may be said that these helped to make the youth of the country air-minded and encouraged them to take up flying as a career. However, the manufacturing side of aviation was still a closed book to us while there as little if any, progress in the development of our Engineering Industries.

A big step forward was taken in 1940 by the well known Industrialist, Mr. Walchand Hirachand by the



The Transonic light weight jet fighter "The Gnat".

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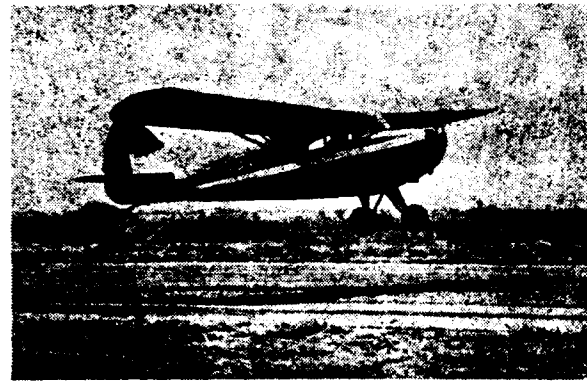
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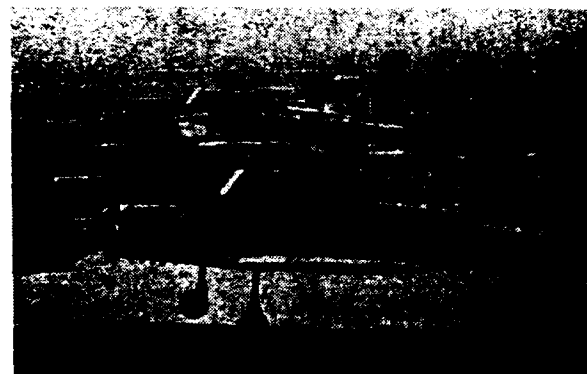
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The Ultra-light 2 seater "Pushpak" just taking off.

establishment of Hindustan Aircraft Factory at Bangalore for the manufacture of some types of American aircraft under licence, with the guidance of American technicians. But, even this endeavour was short-lived because about the time H. A. L. completed the manufacture and assembly of the 1st Curtiss Hawks, Vultee Bombers and Harlow Trainers, the second World War intervened and the factory was taken over by the Government of India for the establishment of a base to undertake the overhaul of fighters, light and heavy bombers, Flying boats, Aero-engines, instruments, accessories and allied equipment used in the Far-eastern theatres of war. At its peak period, the factory employed nearly 15,000 workmen and was the only organisation of its kind in East.

There was also another organisation called 'Tata Aircraft' established in Poona by Tata Sons Ltd., but this was a comparatively smaller factory and its job was mainly to assemble and repair a few British fighter aircraft. Immediately after the war, Tata aircraft in Poona was closed down. Hindustan Aircraft Ltd., however, continued, but with much reduced strength and by diversifying its activities. It



H. T. Aircraft in flight.

soon received a great fillip by being called upon to overhaul and convert several Dakota aircraft rendered surplus at the end of the war to form the nucleus of Civil Air-transport Companies in India.

Although no new aircraft were designed or built, Indian workers were able to gain much experience in the repair and re-building of modern all-metal aircraft, aero engines, instruments, etc.

In the early days of our Independence when we could not turn to foreign help, Hindustan Aircraft did a great job in rehabilitating old and broken up aircraft and making them airworthy. The value of this work to the country and the Indian Air Force at this critical period was considerable.

The Government of India decided in 1946 to utilise the existing capacity of equipment and skilled

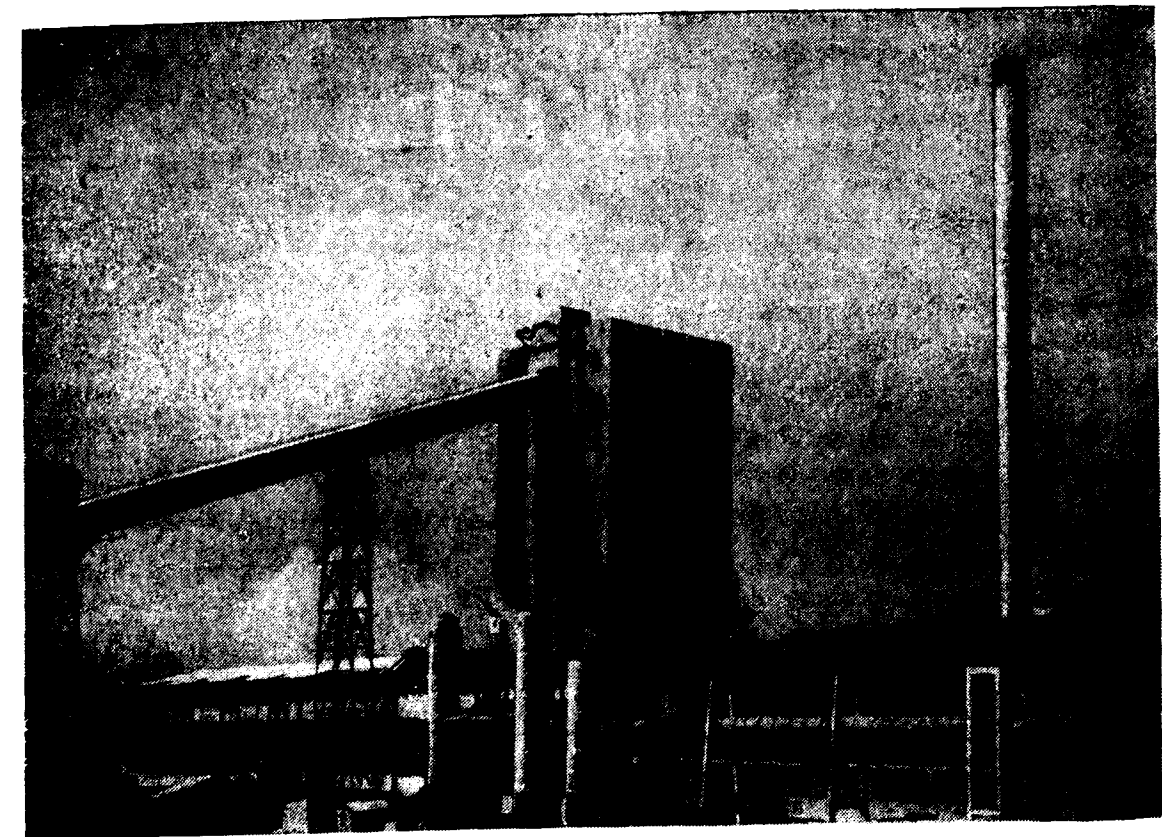


P.E.90 Piston type engine which will power future production models of the Pushpak.

personnel of the Hindustan Aircraft Factory at Bangalore, to undertake the manufacture of aircraft and engines and other components to cater to the needs of the Air Force and the requirements of Civil Aviation.

The authorised capital of the company is Rs. 18 crores. So far as the private holdings are concerned, the only two present members are the Government of India and the Government of Mysore.

A beginning on the side of production was made by the assembly and manufacture of Prentice trainers for the Indian Air Force under licence. Later a hundred tiger moths were erected and turned over to the Air Force. With the experience gained a more ambitious



The lighting-up of the Coke Oven battery No. 1 marks a new stage in the progress of the Durgapur steelworks

With the lighting-up of the Coke Oven battery No. 1 on 24th August, the Durgapur steelworks of Hindustan Steel Limited enters a new stage. ISCON is proud to announce that work on this battery has been completed nearly ten weeks ahead of schedule. When the process of gradually heating up the battery to operating temperature is completed, the Coke Ovens will be ready to supply coke for the first blast furnace to produce Durgapur's first pig iron.

ISCON

INDIAN STEELWORKS CONSTRUCTION CO. LTD.

Simon-Carves Ltd. Davy and United Engineering Company Limited. Head Wrightson & Company Ltd. The Wellman Smith Owen Eng. Corp. 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. The Cementation Company Ltd. Iscon Cable Group (Siemens Edison Swan Ltd. and Pirelli General Cable Works Ltd.)

BRITISH COMPANIES WORKING FOR INDIA

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programme for the manufacture of De Havilland Vampire Jet Fighters for the air-force was undertaken. Initially, this was done from imported components but later the factory attained self-sufficiency in regard to the manufacture of most of the parts and equipment required for this aircraft. In recent years hundreds of Vampire Fighters have been manufactured and turned over to the Air Force. By progressively reducing the cost of manufacture of these aircraft, H. A. L. has been instrumental in effecting a considerable saving in our foreign exchange expenditure. HAL recently took in hand the production of Vampire Duel Control Trainers and this project also will shortly be completed.

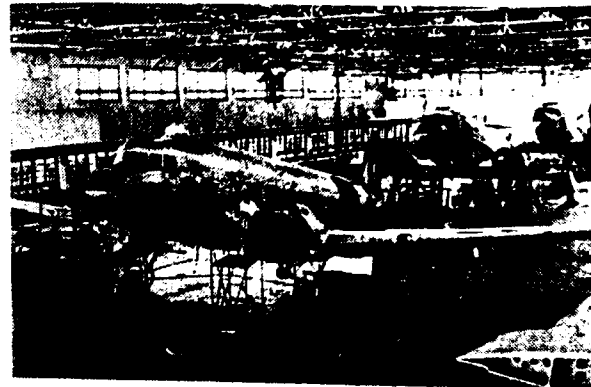
Simultaneously, HAL successfully designed and manufactured in quantity an all-metal two-seater trainer for replacement of the Tiger Moth. This aircraft designated HT-2 has been the basic trainer for the I. A. F., the Indian Navy and the Civil Aviation Training Centres.

And now, as briefly mentioned at the beginning of this article, the manufacture of the Orpheus Turbo Jet Engines and production of the Gnat aircraft are under way.

To this new two-fold project, H. A. L. brings a fund of technical know-how and experience accumulated since it embarked on the manufacturing programme of the Curtiss Hawk and the Harlow in the early days and the Percival Prentice, the HT-2 and the Vampire Jet fighters as well as the dual control Vampire trainers in recent years.

In the last few months H. A. L. made a new contribution to flying training within the country with its new ultra-light aircraft The "Pushpak". This aircraft which has gone into commercial production is

not only rugged in construction, easy to fly and maintain but above all economical to operate. It is specially suited for short field operations. The cruising speed of the aircraft is approximately 90 m. p. h. and its endurance just over three hours.



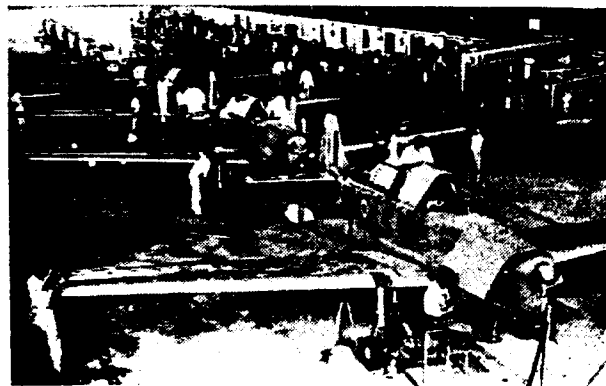
One of the airframe overhaul hangars.

A review of the civil market potential indicates that the aircraft is ideal for Flying Club operations, and for certain other roles.

Future production models of the Pushpak will be powered by an indigenously developed engine at HAL which is now undergoing its trials. The manufacture of this engine, the first ever to be produced in this country, will remove one of the greatest handicaps of the industry, namely the absence of indigenously made engines.

Thus, over the past 18 years, the Hindustan Aircraft Factory has developed into a comprehensively self-contained unit performing within its precincts the functions of repair, Overhaul and manufacture. It is equipped with all the ancillary workshops with the most up-to-date facilities and highly skilled technicians and executives.

Manufacturing processes cover a considerable field and a wide range. The factory makes its own special manufacturing tools and jigs. The Machine and Sheet Metal Shops are equipped with the modest modern machinery to manufacture practically all the aircraft components however complicated they may be. In the Carpentry section the most intricate wood work required for aircraft is carried out. H. A. L. is probably one of the few factories in the world which manufactures its own plastic canopies as well as batteries and other items of equipment. Normally such items are produced by manufacturers of accessories for aircraft.



H. T.2 Assembly Hangar.

METAL CUTTING TOOLS

twist drills, milling cutters, taps etc.

CUTTING TOOLS FOR WOOD

augers bits and gimlets, chisels and gouges, saws etc.

MEASURING TOOLS

caliper gauges, micrometers, snap gauges etc.

WORKSHOP TOOLS

spanners and wrenches, vices, pliers and nippers, machinist's tool kit etc.

PNEUMATIC TOOLS

GRINDING ARTICLES

glass paper and emery cloth, grinding wheels.



H. A. L. has also developed a well-equipped Foundry with a metallurgical and radiological laboratory attached to it. It is at present engaged in the production of highly stressed light alloy castings required for aircraft construction. The aluminium and magnesium alloys of the required specification and high duty bronze required for aircraft components are also being produced here. The Ferrous Foundry is undertaking the manufacture of high-grade cast iron castings for the Hindustan Machine Tools and Bharat Electronics Ltd. Another outstanding feature of this unit is the development of facilities for the forging of light alloys—the only source of supplies in the country of such items (which are urgently required for the manufacture of aircraft.)

Ever since it was established H. A. L., has been serving as the pivotal point in the East for the repair and overhaul of both airframes and engines not only of Indian Civil and Military aircraft but also of aircraft from overseas customers, Ethiopia, Saudi Arabia, Afghanistan, Iran, Ceylon, Burma, Indo-China, etc. As this phase of its activities tended to



A view of the modern machine shop.

grow, it was found necessary to establish a branch factory at Barrackpore near Calcutta as early as 1952. This was set up as the first step in the eventual bifurcation of the two main aircraft activities—Manufacture and Overhaul.

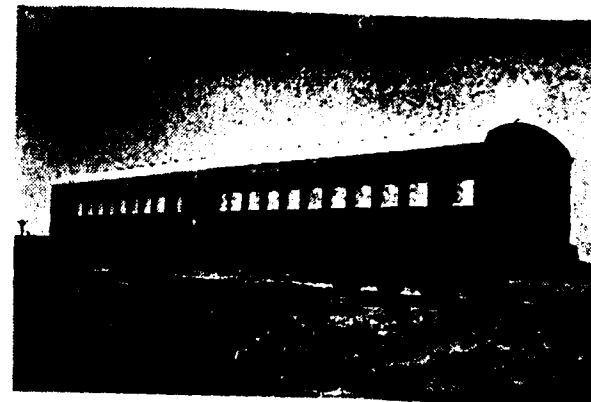
Lately the factory has started the overhaul of jet airframes and jet engines.

For the convenience of the overseas customers, H. A. L. has a scheme for the overhaul/exchange of aero engines, accessories, instruments and other

components and undertakes, all the transactions connected with Customs Clearance and other import and export formalities.

RAILCOACH MANUFACTURE

As in aircraft construction, so also in the realm of rail transport H. A. L. has blazed a new trail. Taking up railcoach manufacture as a major subsi-



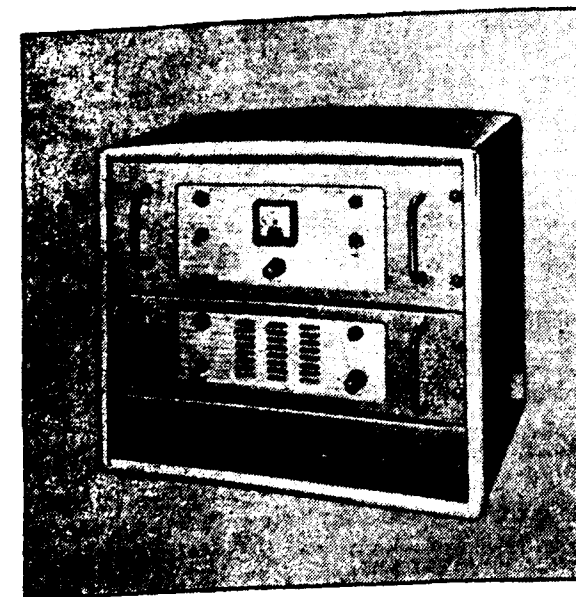
Picture of an integral coach being manufactured at HAL.

diary project in 1947 Hindustan Aircraft made a revolutionary contribution to the field of railcoach construction in India with its all-metal broad-gauge railcoaches. A novel feature of these coaches is that their construction was based upon aircraft construction techniques.

HAL-manufactured coaches inaugurated for the first time in the history of Indian Railways, an era of comfortable travel for the 3rd class passenger. Approximately, 1,300 all-metal coaches have so far been delivered by H. A. L. to the Indian Railways; this figure includes 60 military coaches of an improved design.

Recently HAL has launched on the construction of a more advanced type of Coach, viz., the all-steel Integral Coach. Production in due course is scheduled to reach the figure of 300 per year. The first integral coaches have already been accepted by the Railway Board.

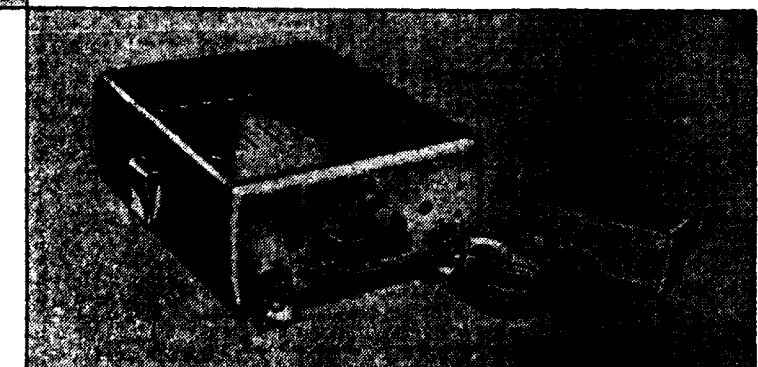
As in Rail Transport, so also in the field of Road Transport HAL has led the way with its Bus Body manufacturing project. With the growing nationalisation of the Road Transport services, the need arose for the standardization of Vehicles and Coach work.



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HAL has made a major contribution to this industry by producing until recently Single and Double Decker buses and pre-fabricated all-metal bus body kits. In view of the more important projects on hand, HAL has now given over this line to other firms under Licence agreements. Large numbers of HAL manufactured buses and pre-fabricated kits are now serving the major State Owned Road Transport Companies.

SPEEDING AIRLINER ENGINE OVERHAUL

To allow the quicker return after overhaul of Rolls-Royce "Dart" turbo-prop engines to service in its fleet of Vickers' "Viscounts", British European Airways has installed a complete engineering shop at its base at London Airport. Not only does this new method of handling cut out the minimum of six days' travel time necessary when the engines were sent to the Rolls-Royce factory at Derby, England, but it also eliminates a vast amount of paper work.

This is the first time that a British airline has undertaken responsibility for the complete overhaul of this intricate type of engine. So certain is B. E. A. that the new system will produce many effective economies, it already has in the course of construction five more test beds, which are expected to come into service at about the same time as the Corporation receives its new and bigger "Vanguard" airliner at the end of this year, or early in 1960.

With more than 250 "Darts" in service, B. E. A. now has more gas turbines in use than any other airline in the world, and the addition of the bigger "Tyne" engines, for the "Vanguards", will greatly increase the amount of work to be done in the overhaul shops.

When taken out of service for overhaul, the engines are completely stripped down, checked, repaired where necessary and then reassembled. When the overhauled engines are completely assembled they are subjected to a rigorous testing schedule, the engine test plant being one of the main features of the Overhaul Shop. To save space this has been placed in an underground cell and particular care has been taken to ensure that the absolute minimum of time is needed to change from one engine to another.

The method adopted by B. E. A., in close collaboration with the firm of Heenan and Froude, Ltd., which designed the entire test plant and was also responsible for its manufacture and installation, has been to provide two engine carts, one of which may be put to use on the test bed, while the other is in the

In conclusion, it may be stated that our aircraft industry has made commendable progress although we have still to develop supporting industries for the manufacture of basic raw materials, electrical equipment, instruments, etc. But, this is only a matter of time as during the 10 years and more of our independence, our industrial activity has increased enormously bringing the goal of self-sufficiency nearer.

overhaul shop above having an engine fitted to it. By this means the necessary electrical harness, piping, adaptors and the like can be fitted to an engine before it enters the test cell itself, and while the plant below is testing another engine.

These test carts have been designed so that they exactly resemble the positioning of an engine in its nacelle in the wing of an aircraft. By fitting the engine into a cart above ground, an average of two hours and ten minutes are saved in the time needed for the engine on its test bed. Since the test run lasts approximately six hours, this means that nearly 40 per cent. greater usage of the test bed is possible.

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COMPUTER SPEEDS STEEL

CONSTRUCTIONS BY FIFTY TIMES

To make the maximum possible use of its "Pegasus" computer, United Steel Companies, Ltd., asked all subsidiary companies to suggest ways in which they might employ it, when it was not required for ordinary statistical or financial calculations. One of the first practical uses for the computer, which was made by Ferranti, Ltd., came from the United Steel Structural Company. From it has been developed a revolutionary new method in the structural engineering field. With the use of the computer, the design of steel floor structures is now carried out 50 times faster than by the conventional manual computation.

This new method, which has been evolved in collaboration with the company's operational research and cybernetics department, now means that the design of a floor framework can be completed within two days of receiving floor plans. In turn, subsequent changes in design—even up to the fabrication stage—can be re-calculated with equal speed. One example of this speed-up was given with the detailed design calculations for a power station floor structure, which took two hours of computer time. A design engineer would have taken several weeks to complete the same task.

MARINE ENGINEERING SECTION

Vosper Ltd. of U.K. Build First of an All-Turbine Patrol Boat Class

Speed in Excess of 50 Knots : "H.M.S. Brave Borderer"

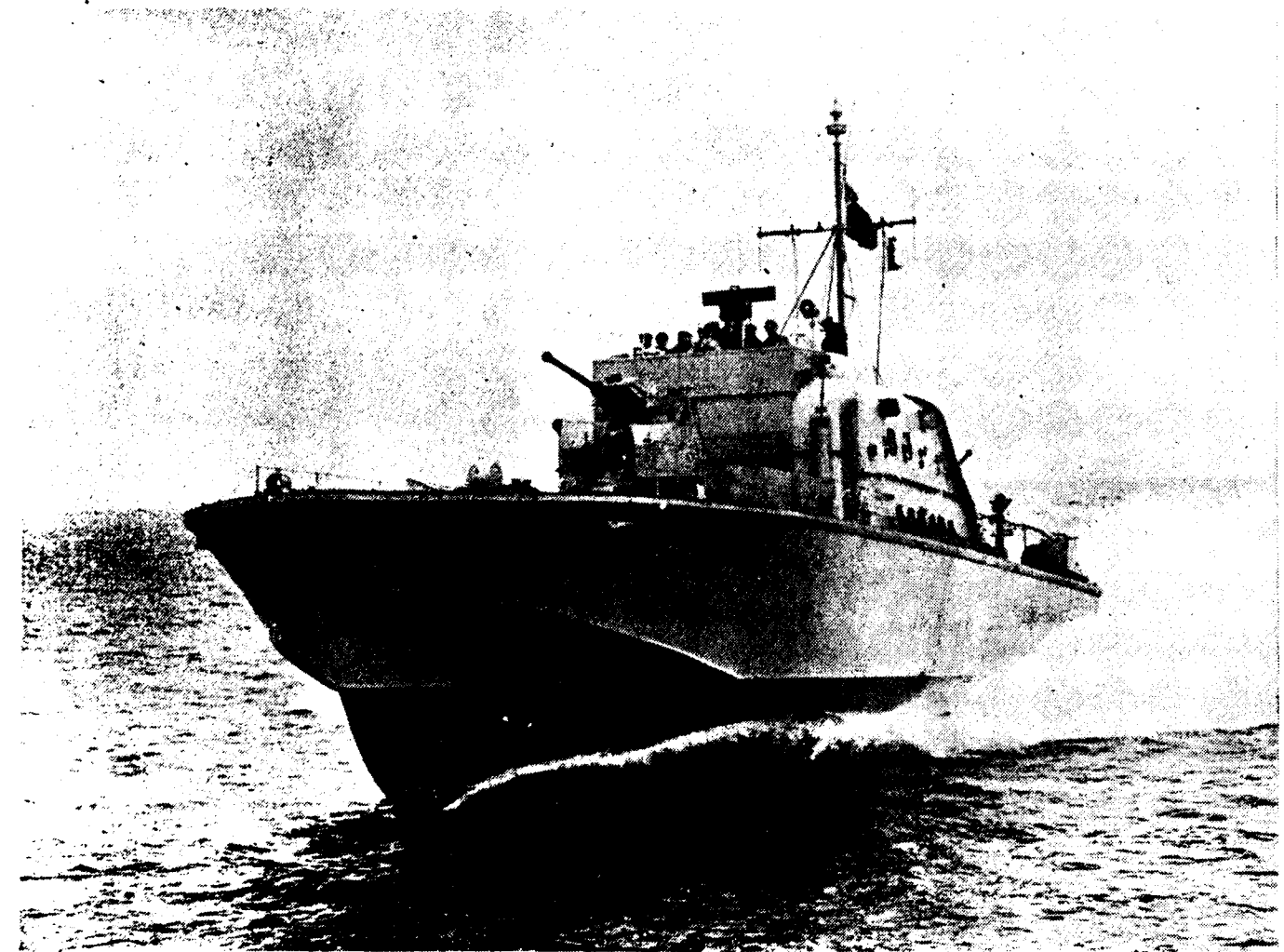
The first of two Brave class fast patrol boats which will help to keep alive coastal forces techniques in the Royal Navy. She is currently undergoing trials from the Yard of Messrs. Vosper Ltd., Portsmouth, her Builders. This new warship of joint Admiralty / Vosper design is powered by three marine Proteus gas turbines, designed and manufactured by Bristol Aero-Engines Ltd. During preliminary trials the craft has exceeded 50 knots.

SPECIFICATION

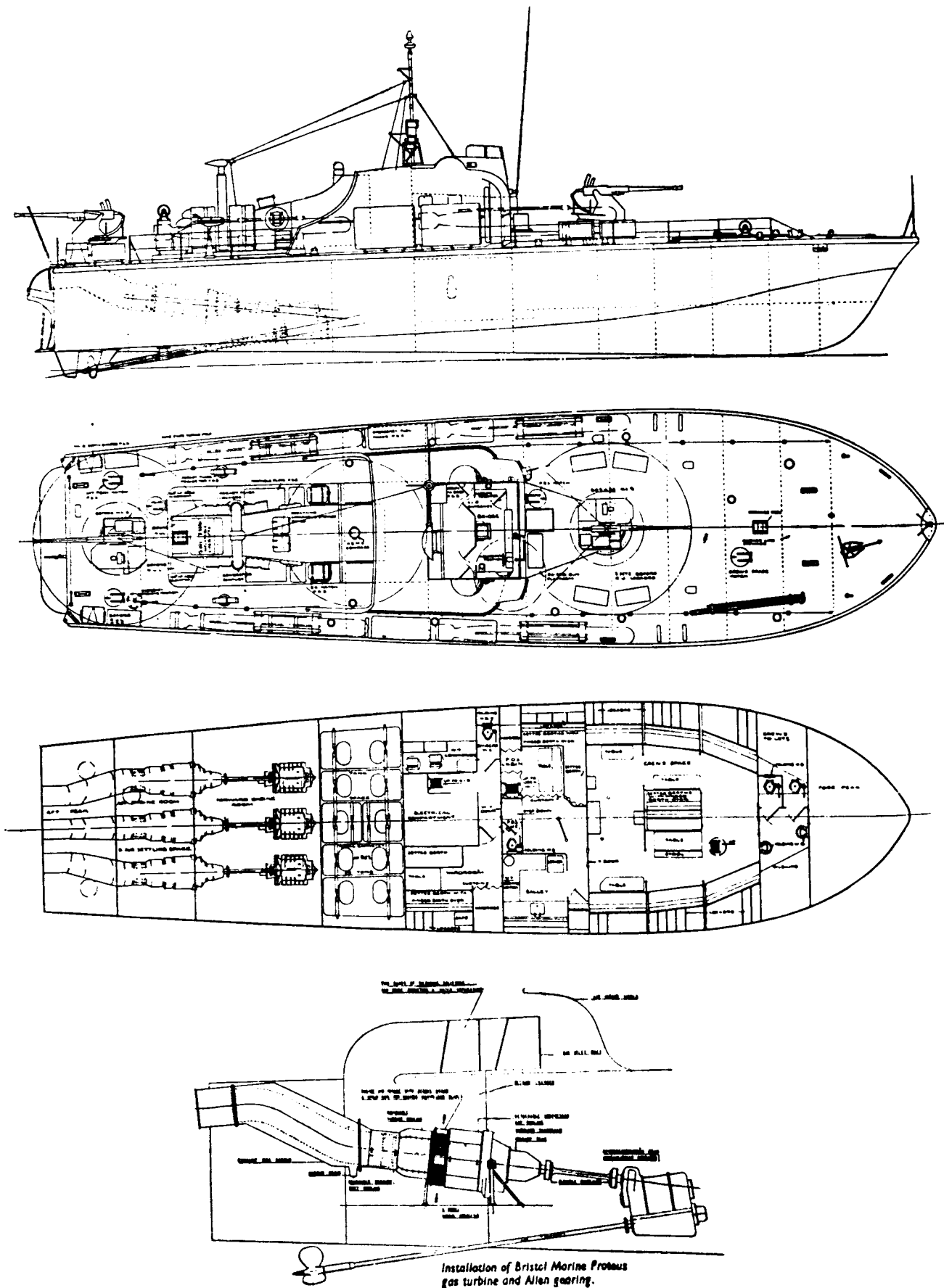
Speed : Exceeding 50 knots at 10,500 total B. H. P.

Principal Dimensions : 96 ft. length.
25 ft. beam.
95-100 tons average displacement.

Main Propulsion Units. Three Bristol Proteus marine gas turbines each of 3500 maximum B. H. P. and continuous rating of 2800 B. H. P.



H.M.S. Brave Borderer on preliminary trials at Vosper Ltd. Portsmouth. Powered by 3 Bristol Proteus marine gas turbines, each of 3,500 maximum B.H.P. Speed in excess of 50 knots.



Generator Units. Two Rover gas turbines of 40 kW each. All propulsion and generating is effected by gas turbines, there are no reciprocating engines installed.

Gearing. Gearings linking the turbines to the propellers and for manoeuvring result from a special design by Messrs. W. H. Allen Sons Ltd. of Bedford.

Special Features. The construction is basically all-welded aluminium members as far as the load-bearing structure is concerned. Planked in mahogany, sheathed in fibre-glass below the water line.

Air intakes of moulded fibre-glass construction.

Shafting of monel metal with propellers shrunk on without making use of the usual key, which tends to reduce strength in the shaft. In this way a smaller shaft for given torque can be used.

Propellers are relatively small and high speed. This is a novel and unusual feature resulting from joint research carried out by the Admiralty and Vosper Ltd. at the Cavitation tunnel in Vosper's Portsmouth Shipyard.

Exhaust is through upper portion of transom, protected by a shelf and adjustable hinged flaps to protect the exhaust outlet in the event of one turbine being stopped.

Lightweight electrical fittings throughout were specially developed by Vosper Ltd. in conjunction with the Admiralty.

A very high degree of manoeuvrability is achieved by Vosper designed electric hydraulic

steering gear in conjunction with three rudders. The helm can be put hard over at full speed.

Design. This was carried out under Admiralty orders by Vosper Ltd. as a joint effort with Admiralty departments, the whole co-ordinated by Director of Naval Construction (now Director General of Ships).

This proved an excellent arrangement as exhaustive design study was initiated and Admiralty research facilities were available at all stages. More particularly the Admiralty Experiment Works Haslar, with their experiment tank; Naval Construction Research Establishment at Rosyth; and Admiralty Engineering Laboratory at West Drayton.

Considerable research, more particularly as regards water exclusion in the air intakes and possible effect of salt-laden atmosphere on blading material, was carried out by Bristol Aero-Engines Ltd. under Admiralty Contracts.

Armament. Four 21 in. torpedoes and one 40 mm Bofors.
or two 21 in. torpedoes and two 40 mm Bofors.

Complement: Three officers and 17 ratings.

Role. These craft are designed for offensive operations in enemy coastal waters and for a defensive role protecting our own coastal waters, particularly against similar types of craft. M. T. B.'s and M. G. B.'s played a large role in the 1939-45 war in the North Sea, Channel and Mediterranean.

It is believed that this craft will be the first warship of any Navy in the world to have a service speed in excess of 50 knots.

Production of Pig Iron at Bhilai

The Bhilai Steelworks produced 28,708 tons of pig iron during July, 1959. The production since the first blast furnace was commissioned in February, 1959 thus totalled 1,56,306 tons till the end of July, 1959. Nearly 19,758 tons of pig iron valued at about Rs. 42,48,000 were despatched to various places in the country, during the month, bringing the total despatches to 1,15,934 tons valued at about Rs. 2,49,25,000.

The coke production during July was 39,565 tons. The total quantity of coke produced at Bhilai till the end of July was 2,03,784 tons. The quantity of coal tar recovered during the month was 1,426 tons. The coal tar despatches during the month were 703 tons, bringing the total despatches to 2,356 tons. During the month, 53,306 tons of coal were received at Bhilai from the mines. The coal consumption here during the month was 52,884 tons.

SPACE-SAVING MARINE POWER UNIT

First Sea-Going Ship with Exhaust-gas Turbines

By P. C. Secretan

Technical Editor of "The Shipping World", London

THE first British ship to be powered by exhaust-gas turbine machinery has now been completed and has carried out extensive sea trials on the River Clyde. It is the turbine vessel *Morar*, an ore carrying ship of 9,250 tons deadweight, with an overall length of 427 ft. and beam of 57 ft. 3 ins.

The ship was built by Lithgows Ltd., for Scottish Ore Carriers Ltd. The gas turbine has been built by Rankin and Blackmore Ltd., to the designs and with the technical assistance of the Consultancy Department of Power Jets (Research and Development) Ltd. The three gasifiers have been supplied by the Free Piston Engine Company Ltd., of London.

INCREASED CARGO CAPACITY

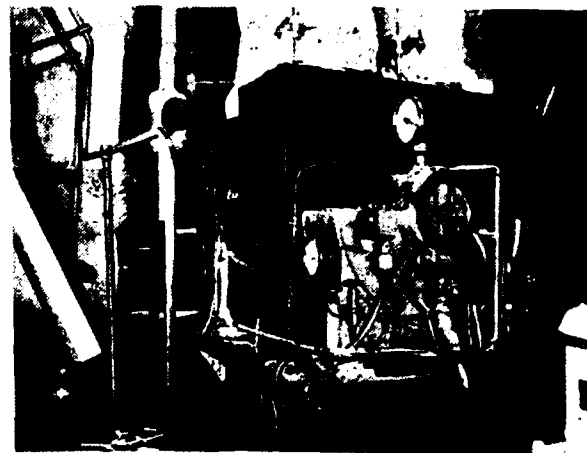
Though the maximum possible length of the engine room could be 10 frame spaces, in the case of the *Morar*, which is an ore carrier, this type of propulsion made it unnecessary to use more than five. The remaining five frame spaces give an increase of about 12,411 c. ft. bale capacity, as well as allowing an increase of about 309 tons in water ballast capacity. It is of interest to note that the estimated weight of the entire machinery installation is 220 tons less than the weight of the machinery in her sister ship, which is powered by conventional diesel machinery.

The propelling machinery in the *Morar* consists of three GS. 34 free-piston gasifiers supplying gas to an exhaust-gas turbine geared through normal reduction gearing to the propeller shaft. The gearing has been supplied by the Fairfield Shipbuilding and Engineering Company Ltd., of Glasgow, and is of the double-reduction, articulated, locked-train type, reducing the speed of the gas turbine from 5,250 to 115 r. p. m. Each gasifier is rated at 1,230 gas h. p., or about 1,000 shaft h. p., and there is, therefore, a reserve of power, as the propelling machinery has been designed to provide only 2,500 s. h. p. in service. The speed of the *Morar* is 11 knots in service but on trials she has attained a speed of 12½ knots.

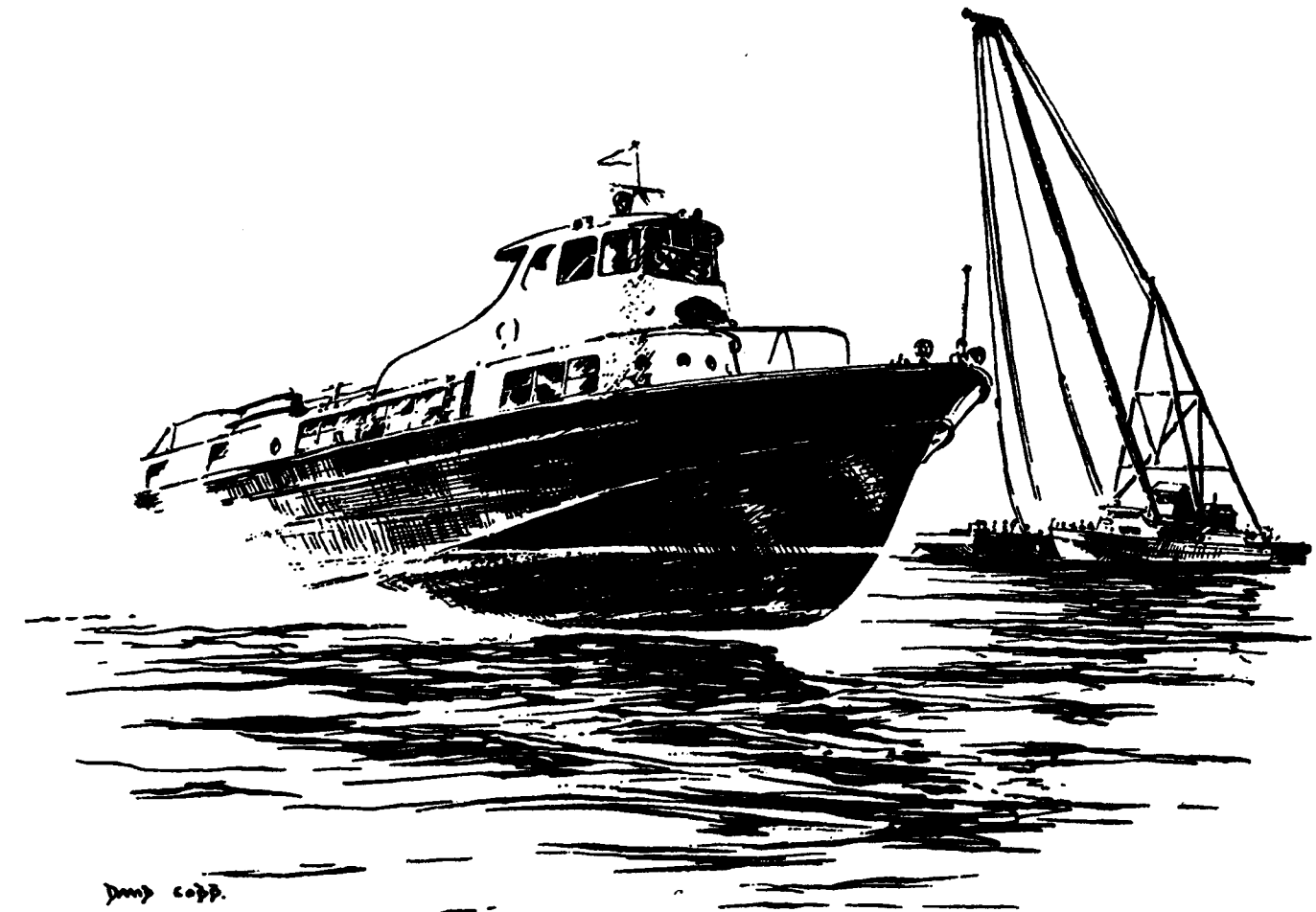
A SIMPLE UNIT

The exhaust-gas turbine, which first ran trials on the test bed in April 1958, is a simple two-bearing unit having ahead and astern turbines on the same shaft, with separate inlets and a common exhaust. Manoeuvring control is effected by means of special valves which direct the gases to the ahead or astern sections of the turbine. The turbine is stopped by sharing the gases in such proportion that the torques produced by the two turbines are balanced against each other. Control is hydraulic and the handwheel and instruments are housed in a neat console in the engine room.

It was announced, during a demonstration run, that the turbine at present installed in the *Morar* is a prototype and has been designed mainly to prove mechanical efficiency. A replacement turbine is now in hand which embodies lessons learned from the prototype, and it is anticipated that the change-over will be effected in about 12 months.



This view of the engine-room of the new ore carrier the *Morar* built by Lithgows Ltd., Port Glasgow, Scotland, shows the gas turbine power unit built by Rankin and Blackmore Ltd., Greenock, Scotland, to the designs and with the technical assistance of the Consultancy Department of Power Jets (Research and Development) Ltd., 25, Green Street, London, W. 1.



80 ft. EXPRESS PASSENGER LAUNCH recently delivered to SHELL TANKERS Ltd. for use on Lake Maracaibo Venezuela



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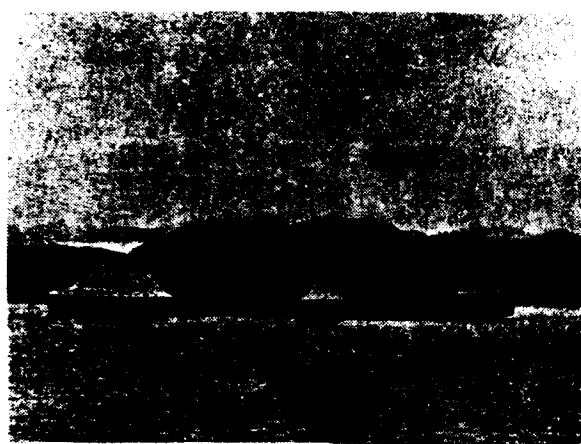
While the turbine was on test, results showed a blading efficiency of 86 to 87 per cent. for the ahead stages, but as this is a reversing turbine the overall efficiency is reduced on account of windage losses in the astern blading. Causes of further losses in efficiency have been discovered since, the two major faults being the swallowing capacity and the outlet volume

The first fault has been rectified, but there still remains a residual loss on this score. On the other hand, the outlet volume is too restricted because of the too close proximity of the astern blading, with the result that, in addition to impeding the flow of the exhaust gases, a complicated parasitic gas flow has been introduced. Although this has been largely overcome by the fitting of a movable mask, the constriction of exhaust is still present.

Because of these faults, which are now known and understood, the turbine efficiency is reduced, resulting in a fuel consumption of 0.49 lb./s. h. p./hour on a gasifier consumption of 0.335 lb./g. h. p./hour. The consumption of the new turbine now in hand will be about 0.42 lb./s. h. p./hour, and although this is somewhat higher than the conventional diesel engine, it is confidently expected that this will be reduced with further development.

EASY TO MANOEUVRE

The direct-reversing turbine is simple and highly manoeuvrable. Due to the fact that the design



The exhaust-gas turbine vessel Morar, the first new ocean-going ship to have this type of propulsion, was built by Lithgows Ltd., Port Glasgow, Scotland, for Scottish Ore Carriers Ltd. She is here seen on her sea trials on the river Clyde.



Here are the three free-piston gasifiers installed in the new ore carrier the Morar, built by Lithgows Ltd., Port Glasgow, Scotland. The gasifiers were supplied by the Free Piston Engine Company Ltd., 37 to 41, Bedford Row, London. W.C. 1.

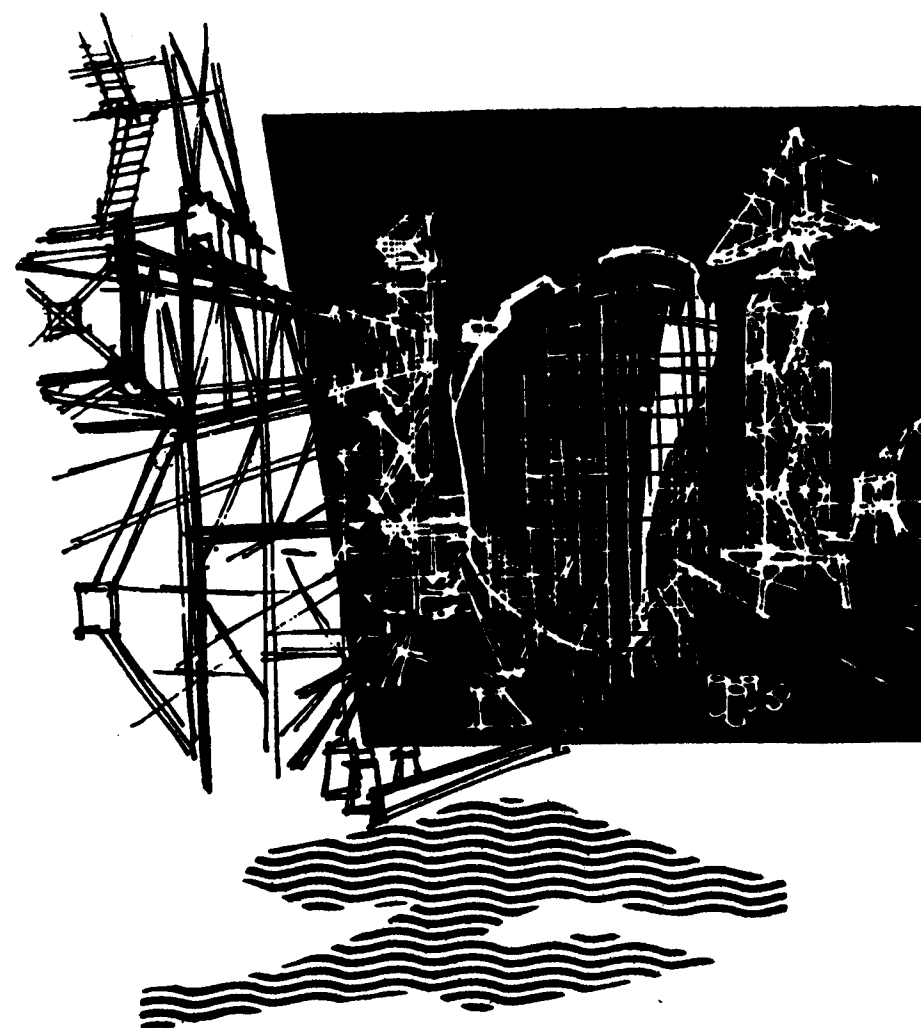
temperature is no more than 900° F., there are no metallurgical problems connected with the blading. Still further reductions in fuel consumption can be obtained by the introduction of a non-reversing turbine and separate astern section. The Morar is operating on heavy fuel up to 1,500 seconds viscosity, but gasifiers can operate, and have operated, without trouble on oil having a viscosity of 3,000 seconds.

Contrary to expectation the machinery in the Morar is not unduly noisy; in fact it is comparatively quiet and free from pulsation. The inlet trunking has been sheathed and is brought into the engine room from funnel height. In the next ship to be built by Lithgows Ltd., which has an installation of about 7,000 s. h. p., the air intakes may be taken from either side of the superstructure.

SEVERAL ATTRACTIVE FEATURES

Considerable interest has been shown in the Morar, which is not only the first British ship to be fitted with exhaust-gas turbine machinery, but also the first new ocean-going vessel to have this type of propulsion. It has several attractive features to offer apart from the reduction in engine room space, such as reduced time spent on maintenance and the fact that if a gasifier should break down while the ship is at sea it is still possible to proceed with two gasifiers in service while repairs are being carried out. Other similar type marine installations are being carried out by British ship-yards and it will be interesting to note what progress is made during the next 12 or 18 months, by which time other exhaust-gas turbine ships should be at sea.

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Modern and Safe Oil Terminal at Los Angeles

The enlarged marine oil terminal at the Port of Los Angeles is one of the world's most modern and safest from fire hazards.

A \$ 2,250,000 modernization program has almost doubled the capacity of Union Oil of California's operations at this busy harbour.

Electronically-controlled gauges automatically alert the pump control house and trigger a high-level alarm system before tanks can overflow. Up-to-the minute fire-fighting equipment includes automatic fog system installations over the entire pumping area, plus five special type monitors covering both wharves.

In a recent two-year period, for example, the Union Oil marine terminal has processed 1,329 ships, representing almost every nation in the world, in loading and unloading more than 44 million barrels of petroleum products.

Additions to the oil company's facilities include a 600-foot concrete wharf. This, together with its previously existing wharf, permits two super-tankers to dock simultaneously.

Both wharves are so designed that they can also accommodate barges and other type vessels.

Expanded storage facilities in eight modern double-deck floating roof tanks raised this terminal's storage capacity to 800,000 barrels. In addition, direct pipe

lines to the big Union Oil Refinery, less than five miles away, provide large storage areas there for the loading and unloading of tankers.

Multiple lines and pumping systems permit the handling of 35,000 barrels of oil products per hour through the expanded terminal. Twenty risers and 19 inter-connecting lines on the two wharves of the oil dock are operated by 14 special-type pumps. Nine



Airview of world's first protected supertanker terminal at Los Angeles Harbour with SS TORREY CANYON, first tanker to visit the new facility, alongside. Located midway on the wharf are five hydraulically-operated loading arms which are attached to the piping system of the ship. Outboard dolphins at either end of 960-foot long reinforced concrete wharf bring over-all tying-up length to 1,160 feet.

pumps are designed to handle fuel oil only—seven of them having capacities of 5,000 barrels per hour, two having capacities of 10,000 bph. Two pumps are reserved for kerosene and solvents at 1,000 bph; two carry refined oils at a rate of 4,000 bph; and one connects to crude oil lines and pumps at the rate of 2,500 bph.

The 14 oil lines connect the pump area with the docks, providing facilities for either loading or unloading. Lines range in size from six to 12 inches in diameter.

PROTECTED TERMINAL FOR SUPERTANKERS DEDICATED

The first protected supertanker terminal in the world was dedicated at Los Angeles Harbour recently with the push of a button on a control board which enables

one man to unload 35,000 barrels of crude oil an hour.

Lloyd A. Menveg, president of the Board of Harbour Commissioners, then officially turned over the huge facility to A. C. Rubel, president of the Union Oil Company of California which will operate it under a 30-year preferential assignment. This agreement stipulates that any company bringing supertankers into the municipal port may use the new terminal.

One hundred civic officials and shipping and oil company executives attended the dedication ceremonies on the wharf and the reception which followed aboard the first supertanker to visit the new terminal, the SS TORREY CANYON.

Los Angeles Harbour's General Manager Bernard J. Caughlin said the completion of this unique facility means that Los Angeles Harbour is the first port in the world to catch up with the recent tremendous increase in the size of tankships. Normally, these maritime giants have to take the pounding of the open sea while

discharging their cargoes either by lighterage or by long, expensive pontooned pipelines.

Located in the San Pedro area of Los Angeles Harbour, the terminal stands on an 18-acre man-made peninsula which was constructed with earth dredged up from the floor of Outer Harbour. The dredging created a fairway—500 feet wide, 46 feet deep and 1 3/4 miles long—from the breakwater entrance to the terminal site. This special channel was so dredged that it can later be deepened to 55 feet if the draft of supertankers yet to be built requires it.

The reinforced concrete wharf is 960 feet long and 60 feet wide. Outboard dolphins at either end provide an over-all tying-up length of 1,160 feet, according to Admiral Edward V. Dockweiler, chief harbour engineer.

Five hydraulically-operated loading arms and a control house are installed on the wharf. The loading arms swing out to be attached to the piping on the ship at the push of a button.

One man in the control house controls the massive

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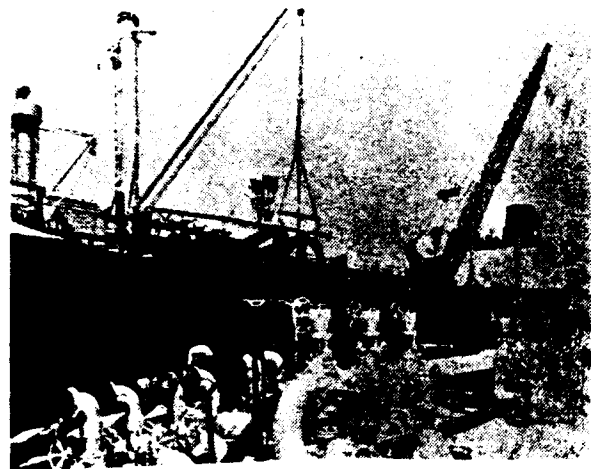


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FOUNDRY & ENGINEERING WORKS

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Dock side pump facilities and risers at the expanded \$ 2,250,000 facilities of Union Oil Company's marine terminal in Los Angeles harbour.

flow of oil. From this vantage point, he can get instantaneous temperature and level readings from the five storage tanks located a short distance away.

This recently completed tank farm has a total capacity of 875,000 barrels. The four pipelines serving the terminal include one 30-inch line to transmit crude oil from ship to tank farm to refinery; two 12-inch fuel lines from refinery to farm to ship; and one 12-inch reversible fuel or crude line from tank farm to refinery.

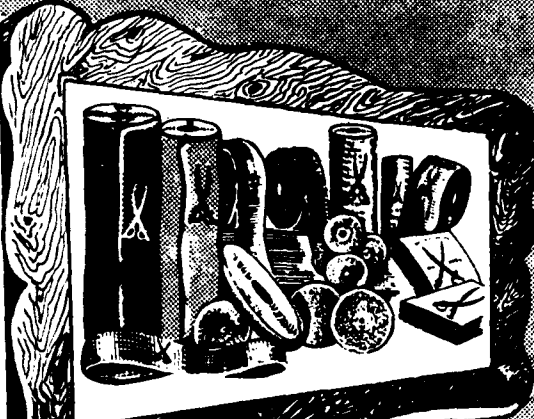
The Harbour Department spent \$ 4,000,000 for the fairway, dike and fill of the man-made peninsula, and the wharf. The new facility, Dockweiler explained,

will accommodate the largest ships afloat today—vessels of 75,000 tons.

The SS TORREY CANYON, scene of the dedicatory reception, is a supertanker but not the largest of those expected to call at this port. She is 810 feet long, 104 feet wide and 92 feet high—about the height of a 10-story building. Her maximum capacity is 478,000 barrels.

In his dedication speech, Menveg said: "This terminal marks another milestone in Los Angeles Harbour's accelerated progress program aimed to provide overseas shippers with the finest facilities to be found anywhere in the world."

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India

Telemetering and Radiotelephony for plant supervision

By An Overseas Engineer

CONSIDERABLE demands are made on public utilities departments with regard to the reliability of the generation and distribution of power. The adaptation of the operating installations to the considerable load variations calls for a reliable plant supervision. In a single service area the supervisory equipments are frequently located at a distance of several hundred kilometres from the control station. In order to ensure a reliable supply to the consumers, many public utilities departments are to-day already using radio installations, which operate in the v-h-f and u-h-f ranges, for the rapid transmission of communications and also for telemetering and remote control.

For similar supervisory purposes Telefunken has supplied the gas-works Niederösterreichische Gasvertriebs-AG ("NIOGAS") with the necessary installations for telemetering, alarm-signalling by radio and also for radiotelephony. These installations differ from the technique generally employed by German electricity-supply enterprises in that the interrogation of the metering stations is completely automatic. It is remarkable that the radio operations are performed only over 4 frequency pairs (2 pairs in the 160-megacycle band for the radio metering and 2 pairs in the 80-megacycle band for radiotelephony and alarm signalling by radio although a total of 4 relay stations are required for the coverage of the entire service area. The entire radio system operates with

frequency modulation. The system comprises a feeder line with two terminal stations of the "SHF Radio Link of 7000 Mc/s" (maximum: 6 speech channels and 1 service channel; transmitter output 100 mW; range: 50 km), a 12-W pilot station, two 12-W repeater stations and, for the time being, six 12-W metering stations in the 160-megacycle band as well as two 15-W pilot stations, two 15-W repeater stations, seven 1.5-W alarm stations 15 mobile radio equipments of 15 W and 4 portable sets (1.5 W) in the 80-megacycle band. It is possible to enlarge the supervisory equipments. The automatic interrogator in the central station is provided for handling 50 orders for the metering, remote control and for checking the radio stations. The AEG pulse-rate system is used for the telemetering. Transmission disturbances are signalled automatically. An alarm is recorded and signalled by acoustic and optical indicators which show the place of the alarm and its cause. A wall panel with mimic connection diagram contains the recording devices for the remote indication and, by pilot lamps, symbolizes the interrogation of the measured values. Radio conversations from the servicing stations or vehicles can be extended into the telephone network.

The supervisory equipments correspond to the newest state of technology and are reliable communications transmitters which improve the economy of operation.

Model of a coke oven plant presented to the Museum

The model of a coke oven plant was presented at an informal function on September 19, 1959, by Mr. H. Pratt, Chief Engineer for India, Simon-Carves Limited (U.K.) and taken charge of by Dr. R. L. Thakur, Planning Officer of the museum. The model has been housed near the model of a Blast Furnace for producing iron.

In the gallery on metallurgy, the Museum has a large-scale model of Blast Furnace and it is therefore particularly befitting that model of a coke oven battery has now been added. The coke produced in coke oven is used in the Blast Furnace along with iron ore and other ingredients to procure pig iron.

This industrial museum which is the first of its kind

in India was opened on May 2, of this year. In the words of Prof. Humayun Kabir, who performed the formal opening, the Museum could rightly be called a modern university which would help developing scientific outlook and temperament.

The museum galleries as constituted at present deal with the following subjects: metallurgy, petroleum, electricity, nuclear physics, electronics, television, optics and miscellaneous. The museum is opened to the public from 2 p.m. to 7 p.m. on Tuesdays to Sundays excepting notified holidays. Parties from schools, colleges and other institutions are particularly welcomed and are provided with guides to conduct the parties around the museum.

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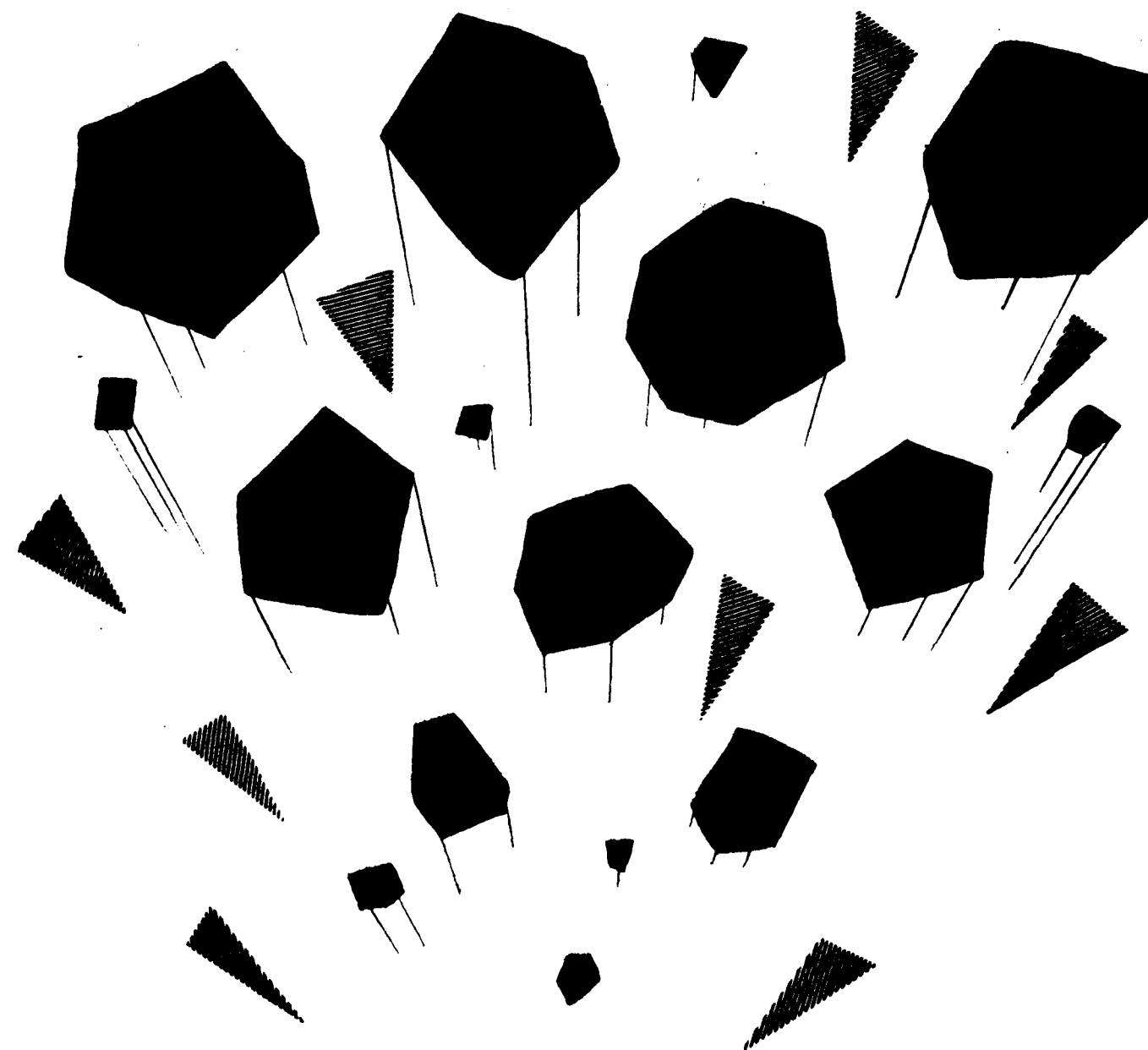
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