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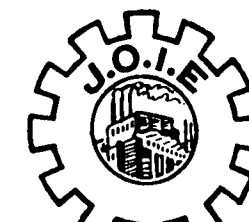
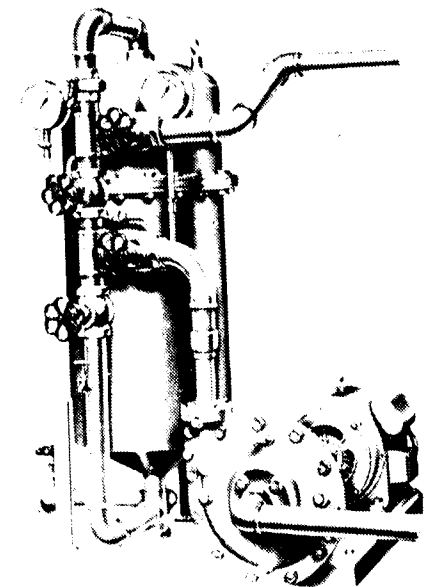
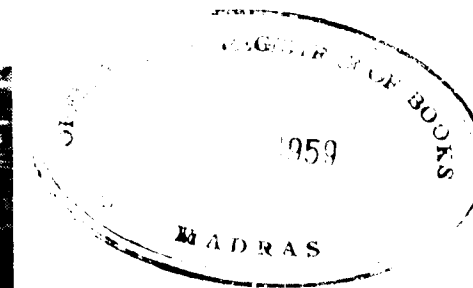
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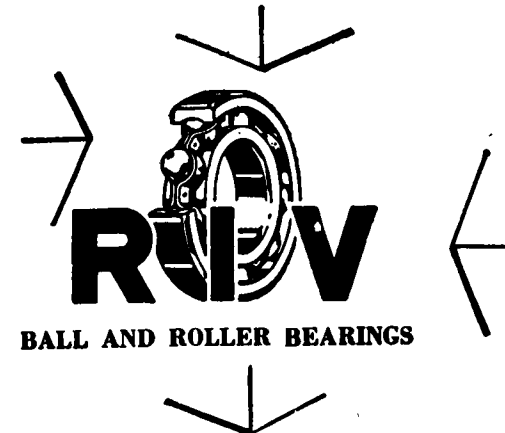
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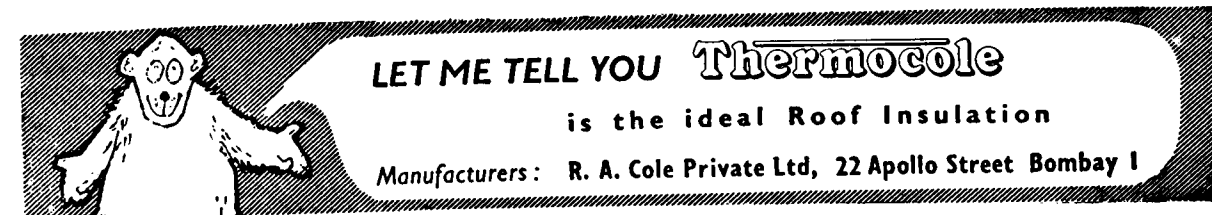
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SONIC TESTING FOR INTERNAL SOUNDNESS

THE importance of sonic test in modern engineering to meet the serious problem of determining the internal soundness of both raw, semifinished and finished materials, has been amply proved in recent years. The external inspection of a product can be of little value if internal defects resulting from faulty forging or casting, incorrect heat treatment, excessive high speed grinding, from stresses, fatigues, etc., which cause it to fail in service, remain undetected.

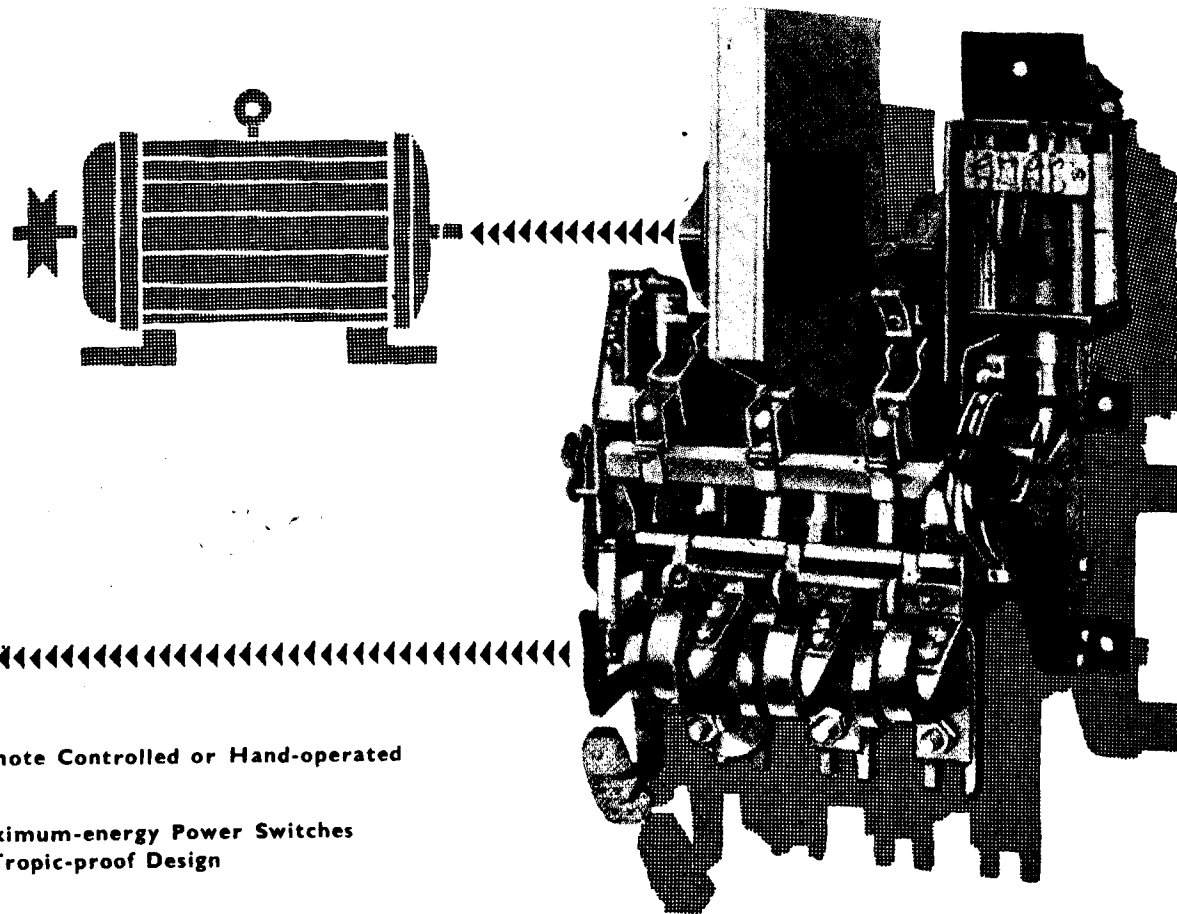
The present state of Automation forces the industrial enterprises more and more to use, for manufacturing purposes, as far as possible only flawless raw materials, in their production shops for the purpose of free cutting machinability as well as for the chipless shaping of sheet iron and all sorts of strips and bands.

From the aspect of safety and prevention of accidents, the importance of subjecting the numerous finished products, particularly highly loaded parts and components of machines, vehicles and so on, to a rigorous inspection, cannot also be too strongly emphasized.

In all these cases, extensive use is now being made of sonic testing. Various testing apparatus and devices according to the sonic method are now available in the market; with their help it is easy to find out doublings in sheet iron, cracks, flaws, fissures, scratches, shrink holes, contraction cavities, piping, welding faults, etc., on form parts of all kinds.

Sonic testing has done not only a remarkable job in the discovery of internal defects which are too deep to be located by any other known method, but it has also been of considerable value in overall *quality control* throughout the plant. In many instances the sonic test has brought about complete changes in the manufacturing techniques due to the discovery of internal defects which were not known to be present and were found to be due to fundamentally wrong manufacturing methods. Above all this method represents one of the most effective non-destructive testing procedures available to the engineers in a very handy way.

The principle involved in the method consists of transmitting a beam of high frequency sound waves into the material under test by means of a searching unit which contains an X-cut quartz crystal. These sound waves are directional. The higher the frequency the straighter the beam. These waves are reflected from the opposite end of the piece and are picked up electrically at the point where they start. The movement of the waves from the point of origin and the point where they are reflected is shown on a ground glass screen. If any crack, sub-surface defect or any other flaw is present which interferes with the passage of the waves through the piece, the location of this defect is immediately shown as a new indication on the screen.



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The depth to which the sonic beam will penetrate effectively is determined by a number of variable factors like uniformity of grain structure, grain size, surface condition, wave length and frequency, size of searching unit used and the amount of sound generated. The operation of the device is quite simple. It can be used at any location where electric current is available since it is the electrical pulses which are transformed into sonic vibrations and transmitted into material.

Materials that can be tested by sonic method are varied and many. The list includes aluminium and its alloys, brass and bronze ceramics, copper, magnesium, molybdenum, monel, nickel, plastics, steel and its alloys and tungsten.

Among the typical applications are included axles, bar stock, bearings, billets and blooms, welds, castings, die blocks, extrusions, forgings, ingots, gear blanks, piston rods, shafts, pressure vessels, wheels, ship frames, press cylinders, tubing, plate stock, fan blades, etc.

Sonic testing is relatively new. As a means of meeting the necessity for thorough inspection as far as the internal soundness is considered, the method is relatively cheap when compared with other methods, easily operated and speedy. The successful use of the sonic testing is largely dependent on the operator as well. For this reason the development of competent operators needs a close attention.

As a real contribution to all manufacturers of products as listed earlier, the sonic testing does not only save many man and machine hours of wasted effort on material that is defective but is also useful in preventing accidents responsible for the loss of many a human life.

THE USE OF SILICONES IN THE SHELL MOLDING INDUSTRY DESCRIBED IN BOOKLET

A new four-page data sheet on the use of Union Carbide silicones in the shell molding industry has recently been made available. It describes the properties, advantages, and effective working concentrations of three silicone parting agents.

LE-460 Silicone Emulsion is described as the best parting agent now available for the shell mold process. When applied in diluted form, it produces excellent parting with minimum build-up on the pattern and, consequently, long runs between cleanings. "Hundreds of users have proven", a Union Carbide executive said, "not only that LE-460 is most effective, but also that it is by far the most stable and economical emulsion type parting agent obtainable. The economy

of use of this product is a direct result of the low concentration of silicone required."

Another parting agent described in this data sheet, LS-46 Silicone Solution, is a ready-to-use solution of 5% silicone in mineral spirits. Up to 15 or more pattern releases can be obtained from a single application. Although LE-460 emulsion is the recommended parting agent, there are instances when a solution is preferred.

L-46 Silicone Oil is available to those who wish to produce their own parting agents. A solution similar to LS-46 can be made by using 5% by weight L-46 in a solvent such as mineral spirits.

Know Stainless Steels When Selecting for Equipment

By W. E. McFee

Armco Steel Corp., Middletown, Ohio.

SURFACE of stainless steel presents a unique phenomenon in that it normally is corrosion resistant to a wide variety of corrosive environments. Some authorities have attributed this property to the presence of a thin transparent film of oxides which serves to retard corrosive action. Since this film may re-form after it has been damaged, it fortifies the entire surface of metal against attack by corrosive agents. If the corrosive agents are reducing in nature the film may not re-form and corrosion will proceed.

There are four basic groups of stainless alloys:

Group I. Magnetic martensitic grades hardenable by heat treatment.

Group II. Magnetic ferritic grades not significantly hardenable by heat treatment and only slightly hardenable by cold work.

Group III. Non-magnetic austenitic grades which are not hardenable by heat treatment but hardenable by cold work.

Group I-A. Precipitation-hardening alloys which may be austenitic initially but are transformed in the course of heat treatment to a martensitic structure and then precipitation hardened by low temperature aging treatments.

The development of these groups and the relative corrosion resistance of many standard grades are shown in Figure 1. There is a marked difference in the corrosion resistance of alloys containing 11% chromium and alloys containing less chromium. Figure 2, developed from an investigation conducted in 1925, shows that the e. m. f. potential of chromium alloys is reversed when the chromium content is between 10 and 11%.

More recent investigations have shown that this also is the point where the alloys will air passivate and become corrosion resistant. Therefore, chromium-iron alloys usually are considered to be true stainless steels when their chromium content is over 11%. Increasing the hardness of stainless alloys by cold

work or carbon additions may reduce corrosion resistance.

With Type 410 (a 12% chromium alloy) as a starting point (Figure 1), there are several modifications. Type 403 has a restricted analysis range. Type 405 has from 0.10 to 0.30% aluminum added to minimize hardening at weld seams. Type 416 has sulfur or selenium added to improve machinability.

Type 414 has 2% nickel added to improve its corrosion resistance, particularly to mild reducing acids. The additional chromium in Type 431 increases its corrosion resistance; it has better corrosion resistance than any of the Group I alloys. In

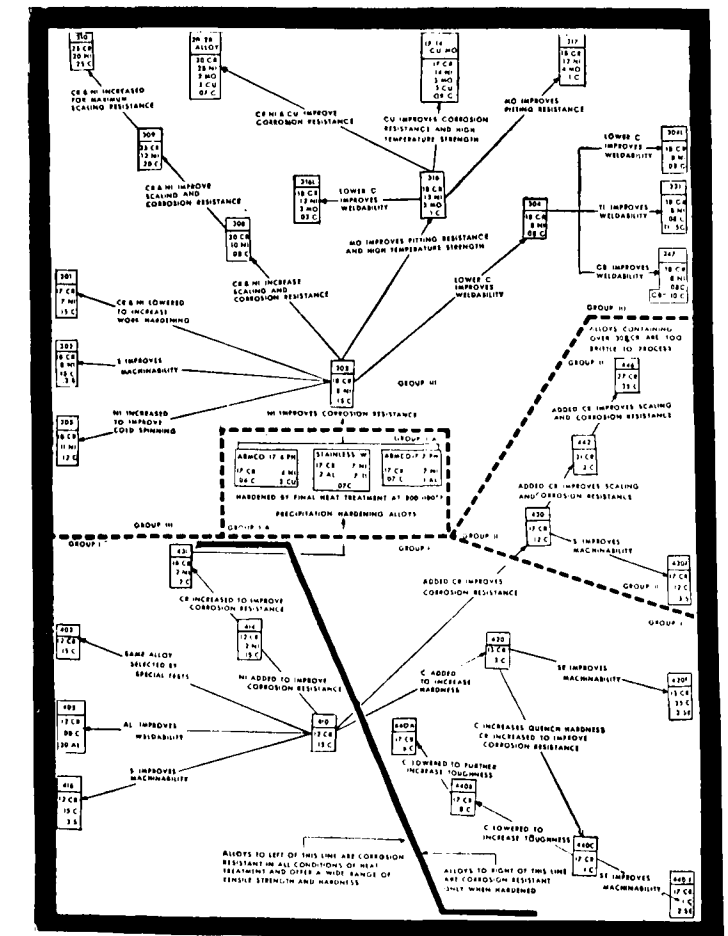


Fig. 1. Relative Corrosion Resistance of Standard Grades of Stainless Steel.

Figure 1 these alloys are to the left of a line separating other alloys in the group. They are corrosion resistant in all conditions of heat treatment and offer a wide range of useful hardness and tensile strength. Of these alloys, only Types 410 and 405 are available in sheet form. Type 410 sheet is not used in the hardened condition except of special applications where abrasion resistance is required.

On the other side of the line are the alloys, bar and wire only, that are high in carbon content and are corrosion resistant only in the hardened condition. The carbon in Type 410 is increased from 0.15% maximum to about 0.35% maximum in Type 420 and the result is an increase in hardness from about 370 to about 500 Brinell in the hardened and stress-relieved condition. This change does not lower the corrosion resistance materially compared to that of hardened Type 410. Type 420F has an addition of sulfur or selenium to improve its machinability. Increasing the carbon content of Type 420 to about 1% results in Type 440C, which has a Brinell hardness of about 600. Although this alloy contains about 4% more chromium, it has lower corrosion resistance than Type 420 but better abrasion resistance. Alloys 440B and 440A contain less carbon than Type 440C. They have better corrosion resistance and less brittleness. Type 440F, with an addition of sulfur or selenium, has better machining properties.

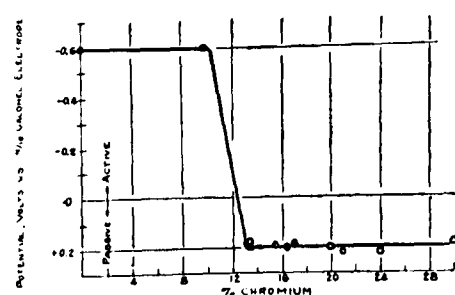


Fig. 2. Chromium content of chromium alloys versus EMF Potentials.

The Group II magnetic ferritic alloys are not hardenable by heat treatment and are only slightly hardenable by cold work. Type 430 with 17% chromium is the basic alloy. Its corrosion resistance and scaling resistance are better than those of Type 410. Sulfur is added to Type 430F to improve its machinability. Increasing the chromium content to 21%, as in Type 442, and to 27%, as in Type 446, further improves scaling and corrosion resistance. Type 446 has scaling resistance equal to that of Type

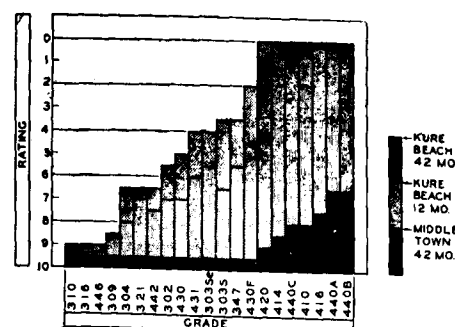


Fig. 3. Appearance ratings of 21 standard grades of stainless steel after 42 months' exposure in a severe marine atmosphere at Kure Beach, N. C., and a mild industrial atmosphere at Middletown, Ohio.

Rating: 10 = Original appearance, no discoloration.
0 = 100% discolored by rust or adherent soil.

309 at 1000°F, and its corrosion resistance in marine atmosphere is equal to that of the better austenitic grades. The alloy has low high temperature tensile strength and poor welding qualities and, under some conditions, may exhibit poor ductility. All these alloys, except type 430F, are available as sheet, bar, and wire.

The non-magnetic austenitic grades (Group III) have better corrosion resistance than the other grades. The basic alloy is Type 302, or an 18% chromium-8% nickel alloy with a maximum of 0.15% carbon. A characteristic of these austenitic grades is that the corrosion resistance may be lowered when the alloy is cooled slowly through the range 900° to 1400° F. Under these conditions the carbon combines with the chromium and is precipitated as chromium carbide in the grain boundaries, depleting them of chromium. This takes place rapidly in the range 1200° to 1300° F. There are four alloys that have been developed to minimize this condition. In two of these, Type 304 with 0.08% maximum carbon and Type 304L with 0.03% maximum carbon, carbon content is lowered so there is less carbon available to form chromium carbide. Types 347 and 321 contain stabilizers that preferentially tie up the carbon so that it cannot form chromium carbide. The stabilizer in Type 347 is tantalum and columbium and in Type 321 is titanium. These four alloys generally are used for welding applications, and Types 347 and 321 are used when they are subjected to long exposure at the sensitizing temperature. Their corrosion resistance is about the

same as Type 302 except that Type 321 has lower corrosion resistance to boiling 65% nitric acid.

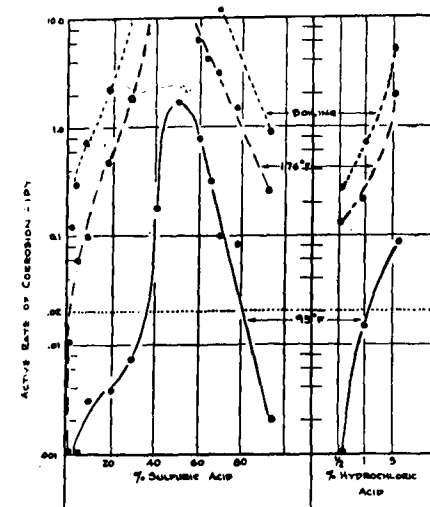


Fig. 4. Effect of temperature and concentration of sulfuric and hydrochloric acids on the corrosion rate of Type 316 stainless steel.

At the left of the chart of Figure 1 is a group of 18-8 alloys with slight alloy changes for specific applications. The 18-10 alloy, Type 305, is used for cold heading and cold spinning applications. Additional nickel reduces work hardening. Type 301 has slightly less nickel and chromium to increase the work hardening effect where stiffness and high tensile strength are required. The general corrosion resistance of these two alloys is about the same as that of Type 302. Type 303 has about 0.3% sulfur or selenium added to improve its machinability.

Another group consists of alloys with higher nickel and chromium contents, which are used for applications requiring scaling resistance as well as corrosion resistance. Type 309 has a safe maximum working temperature of 2000° F and Type 310 somewhat higher. The corrosion resistance of these alloys is often equal to or better than that of Type 316. Type 308, the 20-10 alloy, is used mostly in welding rods for welding 18-8 grades.

A group of alloys is based on Type 316 to which 2 to 3% molybdenum has been added to improve corrosion resistance, high temperature tensile strength, and pitting resistance. Type 316L, with 0.03% maximum carbon for resistance to sensitization during welding, has the same general corrosion resistance as Type 316. The addition of 1% more molybdenum, as in Type 317, further improves the alloy's corrosion resistance.

There are two new alloys that probably offer the best all-around corrosion resistance of the wrought stainless steels. The 20% chromium-28% nickel alloys with copper and molybdenum demonstrate better resistance to sulfuric acid in concentrations between 20 and 80% at 80° C. than can be obtained in any other standard wrought stainless alloy. Armco 17-14 copper-molybdenum alloy has exceptional high temperature and creep strength properties and has been used for blades in high temperature fans and for high temperature bolting.

A new group of alloys, known as the precipitation-hardening alloys, has been introduced since World War II. Their corrosion resistance generally is better than that of the best hardenable standard grades and in some media is equal to that of 18-8. They may be fabricated to final size and then hardened at temperatures low enough to avoid scaling, distortion, or cracking. Corrosion resistance of Armco 17-7 PH is somewhat dependent upon the condition of final hardening, and precipitation hardening at 1050° F provides better corrosion resistance. Wet grit blasting or surface grinding are the preferred methods of removing scale. Pickling reduces the corrosion resistance.

ATMOSPHERIC AND CHEMICAL CORROSION

The simplest method of corrosion classification is that in which visible forms of corrosion are used to indicate certain types of corrosion. These include atmospheric, general chemical, pitting, galvanic, crevice, and intergranular corrosion, and stress corrosion cracking.

An illustration of the wide range of corrosion resistance of stainless steels is their resistance to atmospheric corrosion. In Figure 3 the appearance ratings of 21 standard grades exposed in bar form for 42 months in a marine atmosphere are compared with similar samples exposed in a mild inland industrial atmosphere. With the exception of the 12% chromium and high carbon-17% chromium samples,

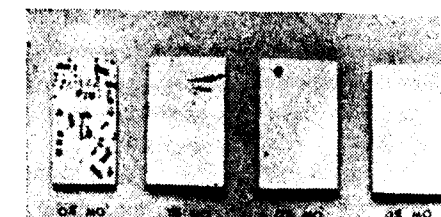


Fig. 5. Effectiveness of molybdenum to minimize pitting in stainless steel.

there was no significant attack in the mild industrial atmosphere. At Kure Beach (North Carolina, U. S. A.) there was considerable rusting of all grades except Types 309, 310, 316, and 446.

There are a large number of chemical reactions in which the metal is uniformly corroded by the environment. The rate is determined by such factors as temperature, concentration, the type of reacting media, aeration, and solution velocity. In this type of corrosion, and especially in borderline cases, a slight change over the critical temperature may result in extremely high corrosion rates. This is illustrated by Figure 4, which shows the effect of temperature and concentration of sulfuric and hydrochloric acids on Type 316 stainless steel. If an arbitrary figure of 0.020 inch per year is selected as a maximum rate for satisfactory corrosion resistance, at 95° F, Type 316 is resistant to sulfuric acid concentrations less than 35% and greater than 85%. The corrosion rate increases rapidly in low concentrations of sulfuric acid at 176° F and very rapidly in a boiling solution. The rate for 20% acid at 176° F is many times greater than the rate for the same concentration at 95° F. Effect of temperature on corrosion by hydrochloric acid is similar; 1% acid is much more corrosive at 176° F than at 96° F.

An example of the effect of temperature was found in a Type 316 petroleum derivative still. Corrosion tests had shown Type 316 alloy to be resistant to the hot liquid and vapors. However, one still failed after 2 years of service, and another revealed considerable corrosion after only 9 months. All failures were on the inside of the still bottom in an area nearest the burner flame. Investigation showed that the burner had been moved closer to the still bottom to increase production, which increased by 50° F the temperature of a tarry residue accumulated at the bottom of the still. The tarry residue contained 0.5% sea water, which apparently was not critical when the still was

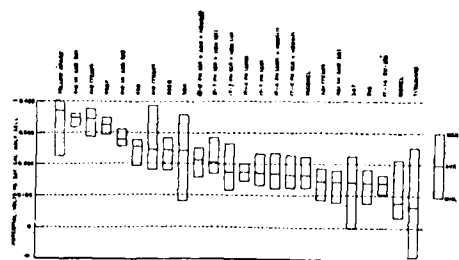


Fig. 6. Galvanic potentials of stainless steels in flowing sea water.
Flow 13 ft. / second at 18° C.

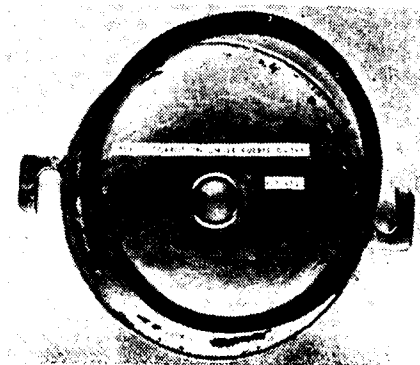


Fig. 7. Crevice attack between rubber gasket and Type 304 Stainless steel syringe head after 1 year's service.

operated at the lower temperature. The increased temperature caused by changing the burner resulted in a very rapid corrosion rate.

If corrosion information on a chemical solution is not readily available, laboratory corrosion tests in accordance with the ASTM Recommended Procedure for Conducting Plant (American Society for Testing Materials) Corrosion Tests are helpful in screening corrosion-resistant alloys. Conditions should be as near operating conditions as practical. Yet these tests can be misleading if all factors are not considered. For example, specimens suspended in a solution will not indicate the effect of external heat on a vessel designed to heat the solution.

A small percentage of a contaminant in a process solution that is not carried over in the final product may cause more corrosion than would be shown in tests made with the final product. Conversely, a low concentration of a contaminant may be beneficial. An example of this is a 0.3% addition of copper sulfate to hot sulfuric acid. This is used in pickling solutions for copper alloys, to inhibit the attack of sulfuric acid on Type 316 stainless steel.

Designs for control of chemical corrosion should take into consideration the alloy, corroding media, concentration, temperature, solution velocity, aeration, and process impurities on each side of the vessel.

PITTING

The effectiveness of molybdenum in Type 316 in minimizing pitting attack in stainless steels is illustrated in Figure 5. The samples were immersed for 72 hours at room temperature in an aerated 10% solution of ferric chloride acidified with hydrochloric

acid. The sample with 2% molybdenum corresponds to Type 316, and with 3% molybdenum corresponds to Type 317 stainless steel. Pitting generally is associated with halogens, and chlorides are the most common offenders.

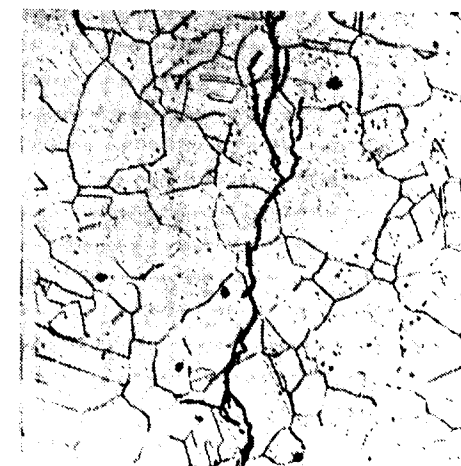


Fig. 8. Photomicrograph of stress corrosion crack. (Etchant 60% HNO₃. 250x before reproduction).

Two experimental pieces of equipment for filling jars of pickles with a salt-sugar-vinegar sirup were fabricated from Type 316 stainless steel. Serious pitting was observed on one bowl after a year's service. It did not develop on the other bowl. The sirup in the pitted bowl had a lower salt concentration and was cold. The sirup in the other vessel had a higher salt content and was hot, conditions which normally would promote pitting. It was reported that the pitted bowl had been cleaned after each day's operation. However, inspection showed streaks of sirup on the sides, and the original bright reflective surface was cloudy and dull. The other bowl had been carefully cleaned after each day of operation, so that the sirup was entirely removed from the bowl. It was taken apart once each week and cleaned with an alkaline solution to restore the original bright surface. This illustrates a necessary precaution—the surface of stainless steel must be given every possible chance to air passivate in order to heal any damage to the passive film.

GALVANIC ATTACK

Galvanic corrosion occurs when two dissimilar metals joined in an electrolyte generate a current high enough to accelerate corrosion of one metal. It is important when stainless steels are used because

they are often more noble than other common metals. They may accelerate attack on such metals as magnesium, zinc, aluminum, steel, brass, and bronze when coupled with them.

“The galvanic series of metals in flowing sea water as determined by LaQue (Corrosion Testing, Edgar Marburg Lecture, 1951 Proceedings of the ASTM Vol. 51, 1951) has been useful in predicting the galvanic effect of dissimilar metals. A galvanic series of stainless steels determined with the same equipment is shown in Figure 6 [from “Some Observations of the Potentials of Stainless Steels in Flowing Sea Water”, K. M. Huston and R. B. Teel CORROSION Vol. 8, pp. 251–256 (1956)]. Yellow brass, Inconel and Monel have been included to show the relation of stainless steels to alloys in LaQue's galvanic series. This chart indicates that composition and heat treatment have a definite effect on the average potentials of stainless steels in flowing aerated sea water. While the potentials may change with different electrolytes under different conditions of flow, aeration, temperature and concentration, the relation of one alloy to another in any electrolyte should follow this pattern. Also, some conditions will exist where the maximum or minimum potential values will control. Under

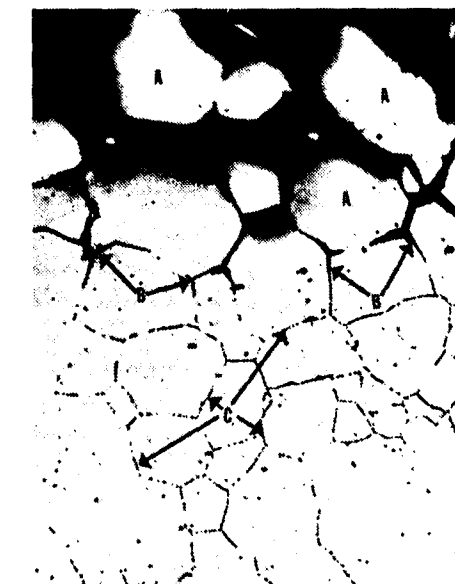


Fig. 9. Photomicrograph shows effect of nitric acid on sensitized Type 316 stainless steel.

- (A) Grains detached by intergranular corrosion.
- (B) Intergranular corrosion progressing along grain boundaries.
- (C) Carbides precipitated in grain boundaries.

these conditions galvanic corrosion will be accelerated or retarded.

The table showing Sea Water Corrosion of Galvanic Couples (CORROSION HANDBOOK, pp. 420-426, Wiley, New York, 1948) is helpful in predicting the area effect on coupling dissimilar metals."

The report of ASTM Committee B-3 (1948) on galvanic and electrolytic corrosion of Types 304 and 316 stainless steels coupled to aluminum, bronze, lead, zinc, Monel, copper and mild steel is useful in predicting the galvanic effect of coupling stainless steel to dissimilar metals in atmospheric exposure.

Another type galvanic corrosion not generally recognized is associated with graphited packing used with stainless steel valve stems and pump shafts. Graphite has a potential in the e. m. f. series close to silver, so it is electro-negative or more noble than most metals with which it comes in contact. It will accelerate pitting attack on stainless steel in humid conditions. This is of particular concern to valve and pump manufacturers in designing equipment to meet the increasingly higher pressure and temperature requirements of the chemical, oil, and power generating industries. Some gasket manufacturers have added inhibitors to protect the stainless steel during storage life.

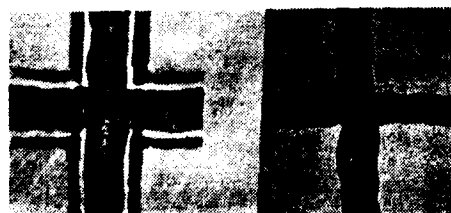


Fig. 10. Effect of low carbon in preventing carbide precipitation in heat affected zone of weld.

After 12 hours in 10% HNO_3 - 3% HF at 80°C ., 1/8-inch sheet.

Galvanic corrosion may be prevented by insulating the components, by the use of a corrosion barrier, by cathodic protection, or by choosing metals close together in galvanic series. Plating one part to reduce the galvanic difference also has been done.

CREVICE CORROSION

Crevice corrosion is considered a form of concentration cell corrosion. It may occur where two materials, one of which may be a non-conductor of electricity, are joined in such a way that a crevice is left between them. Anaerobic conditions may develop when the crevice is filled with a salt solution or even with fresh water. A concentration cell may result and the normally passive film of the stainless steel is broken. Localized attack at the crevice takes place.

An example of crevice attack between a rubber gasket and the head of a Type 304 sirup holder used in a soft drink bottling plant is shown in Figure 7. The initial corroding medium was a low concentration of chloride-containing bactericide, some of which was trapped between the gasket and head. After the vessel was dried, the bactericide that remained behind the gasket formed a nucleus for an extremely corrosive solution. When the area was remoistened during the next sterilization operation, a very active concentration cell developed. The attack was stopped by separation of the rubber gasket and the stainless steel part during rinsing and drying after sterilization.

A still head was subjected to a low concentration of hot sulfuric acid. Crevice corrosion in the flange proceeded at a much faster rate than on other surfaces of the head. Corrosion of this type can be overcome only by redesign to eliminate the crevice. This still head also provided a good illustration of the improper choice of a stainless steel. Type 347 was used because of its welding characteristics. The designer selected it for this property but overlooked the fact that it has poor corrosion resistance to hot sulfuric acid. Although the corrosion rates of Type 316L would be high, it would have been a better choice for this application.

Crevice corrosion may be minimized by coating or insulating contacting surfaces with a corrosion barrier. The barrier should be a non-corrosive material that will adhere to the stainless steel surface and not be dissolved by the media. Alkyd resin zinc chromate primers and some rubber-base adhesives are useful in minimizing crevice corrosion where the coatings are not soluble in the media.

STRESS CORROSION CRACKING

Stress corrosion cracking is not peculiar to stainless steel. It is found in some aluminum alloys and in

copper-base alloys, where it is referred to as season cracking; it also is found in silver-platinum alloys, magnesium alloys, lead alloys and mild steel. In general, stress corrosion cracking depends upon the three factors—stress, concentration and nature of the corrosive media, and temperature. The path of a stress corrosion crack in austenitic grades is essentially transgranular, although it may proceed along some of the grain boundaries. A micrograph of a typical stress corrosion crack is shown in Figure 8.

Preventive measures begin with design to eliminate stress raisers. Stress raisers which may start stress corrosion cracking are numbers stamped in the surface, square shoulders in pressure equipment, and stresses locked in by welding. In some cases, residual stresses resulting from fabrication procedures may be relieved by annealing.

The corrosive environment may be changed—for example, a sulfate substituted for a chloride. Halogens should be avoided when practicable.

When stress corrosion cracking is found in the austenitic or chromium-nickel grades of stainless steel, the use of the ferritic stainless steels, where they offer adequate corrosion resistance, will minimize the tendency to this type of failure, except at welds.

An article on stress corrosion cracking of hardenable stainless steel [F. T. Bloom, *Corrosion*, pp. 39-49 (August 1955)] states that all the hardenable grades of stainless steels are susceptible to cracking under the combined influence of tensile stress and corrosion. This depends on the severity of the stress, the nature of the media, and, to a large extent, on hardness of the steels. Most severe conditions are acid-sulfide solutions, which promote entry of hydrogen into the steel, and where chlorides are present to promote pitting. In such media cracking may occur in the standard grades under stress at hardnesses of Rockwell C 24, in a severe marine atmosphere at Rockwell C 40, and in industrial atmospheres at Rockwell C 45. Most resistant of all alloys tested were Type 422 (a modified 12% chromium alloy tempered at 1200°F to Rockwell C 30), Armco 17-4 PH, and Armco 17-7 PH overaged to the same hardness level.

Careful study of the factors—stress, corrosive media, and temperature—related to a specific stress corrosion failure may indicate corrective measures. More specific information on the extent of stress

corrosion cracking and the conditions under which it occurs in industrial applications is needed. Committee A-10, Subcommittee IV, of the ASTM and Unit Committee T-5E of the NACE have assigned task groups to survey industry in order (National Assn. of Corrosion Engineers) to obtain this information.

CARBIDE PRECIPITATION

Carbide precipitation occurs when chromium and carbon in the approximate ratio of 16 to 1 combine as chromium carbide and rapidly separate out at the grain boundary in the temperature range of 1200° to 1300°F . This leaves a network along the boundaries impoverished in chromium, the protective element, which is subject to rapid attack in some media. A photomicrograph of precipitated carbides, intergranular attack, and grains dropping away from the surface is shown in Figure 9. Austenitic stainless steels when heated in the sensitizing range of 900° to 1600°F and allowed to cool slowly are susceptible to attack. Exceptions are the maximum 0.03% carbon grades, grades during welding, and the stabilized types.

In stainless steel welds a narrow strip is heated to about 1200° to 1300°F on each side of the weld bead. The metal is susceptible to intergranular attack along these strips, even though the time of

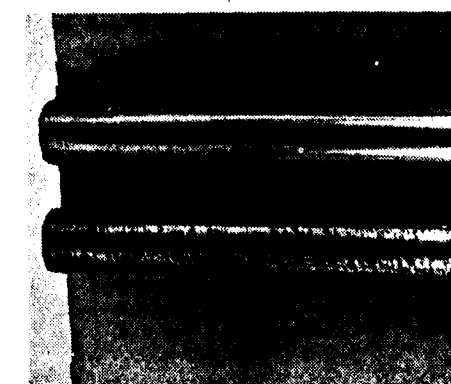


Fig. 11. Effect of passivation on appearance of stainless steel parts with contaminated surface.

Top: Passivated in 20% HNO_3 - 2% $\text{Na}_2\text{Cr}_2\text{O}_7$ at 110° - 120°F for 30 minutes.

Bottom: Not Passivated

After 32 hours exposure at 122°F and 100% relative humidity.

heating is short. This narrow strip is known as the heat-affected zone. With welding grades of stainless steel the heat-affected zone has been almost eliminated, as illustrated in Figure 10. A similar weld, free of the heat affected zone, could be obtained by using the titanium or columbium stabilized grades of stainless steel. Annealing after welding also will eliminate the effects of carbide precipitation.

CLEANING AND PASSIVATION

Cleaning and passivation also are important in the application of stainless steel. Usually methods employed in cleaning ordinary steel may be used for stainless steel. Mineral and vegetable oils, paraffin, lard, or straw oil may be removed with proprietary detergents, alkaline cleaners, or organic solvents. Phosphoric acid base cleaners are effective for removing rust and light weld stains, but not weld scale. Metallic lubricants such as copper, lead, or cadmium are easily removed by a warm solution of 20% nitric acid.

Stainless steel wool, with or without household cleaners, may be used on the duller finishes. Ordinary steel wool or steel wire brushes should not be used because they will imbed iron particles in the surface and cause rusting in a short time. Weld or heat treating scale should be removed by one of the procedures recommended in the ASTM Recommended Procedure for Descaling and Cleaning Stainless Steel (A 380-54 T). Soldered joints should be washed thoroughly after the soldering operation to eliminate all solder flux. These fluxes often have a hydrochloric acid base and will cause rusting if they are not removed before the equipment is placed in

service. Fumes from soldering flux should be exhausted to the atmosphere to prevent their condensation on stainless steel.

Passivation is a form of cleaning. The chief purpose of this cleaning treatment is to remove free iron picked up by the surface during processing and fabrication. Of less importance is the possible reinforcement of the passive film, because a clean stainless steel surface will air passivate in a relatively short time. It is not necessary to use the nitric acid passivating solution after acid pickling when the pickling operation has been thorough and the surface has been rinsed free of the acid. The addition of 5% sodium dichromate to the passivating solution is recommended for the passivating treatment of highly polished parts of all types of stainless steel. The effects of passivating severely contaminated tumbled Type 304 parts are shown in Figure 11.

Occasionally, the surface of free-machining stainless steels will assume a gray discoloration during passivation. This is referred to as flash attack and is observed most often with Type 416. The mechanism of this attack has not been determined, but the tendency to flash attack may be minimized by increasing the dichromate from 2 to 6% in a 20% nitric acid solution and by extending the immersion time from 15 to 30 minutes to 30 to 45 minutes.

ACKNOWLEDGMENT

The author acknowledges with appreciation the co-operation of K. M. Huston in the preparation of this article.

NEW COMPUTER TO SPEED SEA RESCUES

The U. S. Coast Guard has put into operation an electronic computer specially designed to expedite sea search and rescue operations. The machine is used to compute and keep up to date on a daily basis the positions of all merchant vessels in the North Atlantic Ocean, the Caribbean Sea and the Gulf of Mexico.

The computer is operated by the Coast Guard, with the voluntary co-operation of shipping companies, which have instructed their ships to radio their position, course and speed to the Coast Guard at specified times.

A constant check is thus maintained on all ships, regardless of nationality.

The daily position of the ships are shown on a special display board. In the event of trouble on a specified ship, the display board shows at once what other ships are nearest and best adapted for search and rescue operations.

The computer can process and store the course, location, speed, destination and other important data on about 3,000 vessels.

DESIGN is more than Nuts and Bolts

By Morris P. Taylor

Mechanical Engineering Department, California State Polytechnic College.

Too much emphasis on details often blinds designers to the more basic requirements. Here's a checklist - lest we forget what design is really about.

DESIGN is a lot more than stress, deflection and function. Text-books and college courses rightly emphasise these fundamentals, but industry needs men with a broader viewpoint.

Stop for a moment and look at your current design project from a distance. Many of the requirements to be listed here you have met automatically—without conscious thought. Others may have been overlooked at the risk of major redesign later or complete product failure.

Design requirements are of two types: absolute requirements that must be met by any design, and relative requirements that apply to certain products—depending on use, function, customer demand and similar changeable factors.

1. Absolute Requirements.

These are of general nature. They apply uncompromisingly to any design.

NORMAL FUNCTION

The machine must do its job and do it reliably. Gun must shoot, ship must float, automobile must run, typewriter must write.

An established product will meet these requirements almost automatically. With a totally new design, however, workability may be and often is, the most difficult problem. Early automotive engineers and airplane designers like the pioneers in any field—all had to solve this problem first. It is now the greatest problem in missile design. It is the most basic design requirement.

LEGALITY

Engineering design and construction is often regulated by law. The design of civilian aircraft, railway equipment, certain components of automotive equipment (such as brakes and lights) and some phases of ship design are regulated by Federal codes.

Pressure vessel design is governed by state laws, usually based on ASME Codes. There are also state industrial accident codes covering safety guards and devices and the requirements of insurance companies and underwriter's associations.

SPECIFICATIONS

In design projects carried out for technical customers (governmental bodies, utility and manufacturing concerns etc.) the product must meet a number of specifications set up by the purchase contract. These may specify performance (output, for example, and efficiency) or enter into phases of detail design, allowable stresses, and other such matters. However, there is a growing feeling among engineers both buyers and sellers, that such specifications should be limited to ultimate performance only, that tying down detail design requirements interferes with engineering progress.

SAFETY

A design must be safe against any reasonable abnormal condition. It must not be delicate and fragile. It must also be safe from the standpoint of industrial accident or hazard to user or operator. Guards should be provided for all moving parts. Motions should be interlocked in sequence so that accidental operation is automatically prevented. As examples: artillery pieces have "salvo latches" to prevent firing if the breech block is not fully locked and other parts are not in correct position; high-speed punch presses have photo-electric or other cut out switches so they will not move if the operator's arm is in a dangerous position; automobiles have switches so the engine cannot be started if the car is in gear.

VIBRATION

Every effort should be made to reduce or eliminate vibration. Entirely apart from its effect on peak stresses, which may be very serious, vibration is annoying and tiring to operators, and even to occupants of nearby buildings.

NOISE AND FUMES

Noise, obnoxious fumes and contamination of discharge water should be reduced as far as possible, in all products except in some sorts of military apparatus. In civilian life, no one has a right to commit a nuisance, and such action is subject to law suits.

CONVENIENCE OF OPERATION

Controls, gages, operating handles and warning lights should be conveniently and logically located. This makes satisfied customers and users and contributes to safety of operation.

LUBRICATION

Any parts that cannot be expected to last the normal life of the unit (such as spark plugs and tires on automobiles) must be easily replaceable.

TRANSPORTABILITY

For certain very large products, such as central station apparatus for power companies, mining machinery, large irrigation valves, the designer must be sure the largest individual or factory-assembled part can be moved to the site by rail, water, truck, or whatever transportation medium is available.

BALANCED DESIGN

Although this is not strictly an absolute physical requirement any good design should be balanced. Parts should be reasonably uniform in strength, apart from intentional weak links meant to fail before other more valuable parts are injured. Except for such weak links, parts should be equitably proportioned; "don't tie up a row boat with a three-inch hawser".

II. RELATIVE REQUIREMENTS

Here are the requirements that apply to a specific product, depending on its nature, use, customer demand and such. Some of these factors, such as light weight and low cost, or efficiency and performance, may be conflicting. Certain of these requirements are obvious—such as light weight for aircraft components and long life for central electric power stations. However, their relative importance is often debatable.

INITIAL COST AND EFFICIENCY

These two factors are considered together, as they are often related inversely—a more efficient machine is usually more expensive. This is not an absolute rule; in several instances, such as development of the high compression internal combustion engine, efficiency was increased and cost reduced. But the more efficient design is often more expensive so the engineer must decide how much he is justified in increasing first cost to get increased efficiency.

The connecting variable is the load factor—actual work output divided by the potential maximum output, the final criterion being that over-all cost per unit of output (operating cost, interest on investment and depreciation) shall be a minimum. Where reasonably accurate data can be obtained the computation is relatively simple but with many machines such as passenger automobiles, household mechanical devices, private aircraft, and outboard motors, the load factor is not only low but extremely variable among different users. For commercial users, such as public utility, manufacturing plants and transportation systems, the load factor is more definite.

When machinery is worked at or near full load much of the time, efficiency is extremely important and a more efficient machine can usually justify its additional first cost. With equipment run occasionally and at light loads, first cost should be as low as possible. As a homely example, a household washing machine costing twice as much, even though using half the electric power would not be saleable.

OVERLOAD CAPACITY

Certain machines must have capacity to work short periods at loads over normal rating. Overload capacity is usually zero for most machines driving fans, blowers, marine propellers, centrifugal pumps and such apparatus. In other machines, such as diesel locomotives, overloads are prevented automatically by both the electrical control and the limit of adhesion. However, in aircraft engines and equipment, a definite short time overload capacity is required for take-off. In powered excavating and earth-moving machines, overload capacity is needed to loosen and cut into solid material and handle harder material met unexpectedly during a cut. Hydraulic couplings or converters are used in such machinery to limit and control shock overloads.

The question—how much overload capacity? is often difficult to decide. Should an automotive cooling system be able to handle an engine pulling the heaviest house trailer over the toughest highway grade on the hottest day?

CAPACITY TO ABSORB UNUSUAL SHOCKS

This is usually a matter of judgment. Obviously, such capacity cannot be infinite. An airplane cannot be designed to run into mountains—nor can automobiles crash head-on at high speed without injury or damage. However, an airplane should not be damaged by a rough handling, nor should an automobile frame be buckled by a minor traffic accident.

In certain cases, such as commercial aircraft, ships and railway equipment arbitrary accidental shock factors for design have been set up by legal groups. It is then only necessary to design for the hypothetical conditions.

WEIGHT

The importance of weight varies with the product. In aircraft it is extremely important. In rail and road vehicles it is also important especially in highway transport where, with legal limitations on gross weight, any savings in truck weight means just so much more payload. Portable equipment of any kind should be weight-controlled.

In stationary machinery, weight is important only as it affects cost: unnecessary and excessive weight is usually expensive. Although it is not good practice to use high strength alloy steels throughout over-all design cost can often be greatly reduced by these alloys in certain key parts. For instance, in a complicated mechanism involving a gear drive, alloy gears and shafts permit smaller gears, shaft centers can be placed closer, and the size and weight of the entire assembly is reduced.

Good design always aims at small size and low weight. Use direct stresses, avoid overhung and curved beam supports where possible. Use material for as many loads as possible and avoid needing a separate frame or bracket for each part. In this connection, internal gears will often save money—reducing bulk and weight by bringing shaft centres closer.

LONGEVITY

The designed life of a product should be reasonable and suitable to its use and desires of the user. Many designs are for limited life. Military products should not be designed, often cannot be, to run forever. Aircraft equipment must be designed for limited life under extreme take off loads. Automotive transmissions for passenger cars are not designed for continuous operation at full load and speed in the lower gears, which are seldom used. However pumps, blowers, central station power plants and marine propulsion plants must be designed for long operation at full load.

The modern tendency is to design for more output per unit of material. With continuous improvement and resulting rapid rate of obsolescence, and with more accurate stress analysis, designing with low stresses to last forever is poor practice. Good material should not be pampered by calling for unnecessarily high factors of safety.

PRODUCIBILITY

A good design must be such that it can be manufactured and, as far as possible, with standard tools and facilities. But when developing new machinery or designing machines to be produced in large volume the designer must not be too bound by existing tools. Many of the important "break-through" designs—those that have opened up new horizons—involved new and unique tooling problems. The steam turbine the ball bearing, the radial aircraft engine, the gas turbine, the hydraulic torque converter—all involved special manufacturing and material problems. However, the designer should not require special tooling or unusual precision, unless these are unavoidable or some very definite gain is made.

Standard materials and standard parts—fastenings, bearings, oil seals and such should be used wherever possible. With so wide a range of standard parts available, both in size and quality, the designer must be prepared to fully justify a decision to specify special parts.

MAINTAINABILITY

Easy lubrication should be possible. Accessibility for easy repair and overhaul is also important, but can be overemphasized. Accessibility was important to early cars, which required frequent repairs. In modern

cars, which stay out of the shop for long periods, it is much less so. However, machines should not be made unnecessarily difficult to work on by careless design — when a little forethought would improve conditions at no extra cost.

The question of designing for special wrenches, repair jigs and such devices is one for applied intelligence. Often, large savings in weight and bulk can be made with special tools. In large volume machinery for technical users, such as diesel locomotives, there is no objection to special jigs for overhaul. In fact the users are themselves quite ingenious in developing such devices. With machines such as the farm machinery, to be used in remote locations by non-technicians accessibility for ease of repairs with a minimum of standard tools is very important.

APPEARANCE

Products purchased by the general public — such as automobiles and household devices — must have eye appeal. The question of just what is pleasing appearance is one of psychology and esthetics. Producers maintain industrial design and style departments to handle such problems. Even with such help it is not always possible to guess the public reaction.

With products for commercial and technical users, such as trucks farm machinery, pumps, steam generators, turbines and military aircraft, appearance is less important. Here the designer is not justified in spending much time on good looks, except that cover plates, housings etc., should be made smooth and pleasing in appearance when complications won't result. A minor point—avoid inaccessible corners and crannies that are hard to clean.

Fortunately, a straightforward and successful design generally looks good to the technical user.

A LAST WORD OF ADVICE

Most new products proceed through a series of mockups, prototypes and test models before release for production. In the mockup and prototype stages, it is probable that certain needed improvements, changes and corrections — not caught on the original lay-out—will show up. Without in any way approving careless lay-out work the designer should not let himself be mentally “thrown” by such occurrences. Very few new devices work perfectly the first time.

(Courtesy: *Product Engineering*, U. S. A.)

PREHEATER & DRIER

A portable hopper dryer has a capacity of 5 cu. ft. and can supply dried moulding powder to injection machines up to the 12-oz. size. A built-in humidity controller makes the dryer useful for nylon processing. This device loads through a large covered opening in the top, discharges from a gate valve at the bottom and requires no compressed air or chemicals. Sight glass shows level of powder inside. Large units are also available from Thermomat Co. 300, Maple Avenue, Trenton. 8. N. J. U. S. A.

* * * * *

ATOM MAY HELP MAKE LONG-LASTING PAPER

By using radioactive carbon, a peaceful product of atomic energy, the life span of books, newspapers, magazines and other printed matter could be extended to as much as 20,000 years, according to

Dr. Willard F. Libby of the U. S. Atomic Energy Commission.

Dr. Libby says that in recent experiments it was found that when a small fraction of radioactive carbon was added to alanine, an amino acid containing carbon that enters into plant structure, the extremely slow rate at which the alanine decomposes could be measured—about one part in 5,000,000 days.

“We could do much the same experiment with a sheet of book paper,” Dr. Libby explained. “The technique would be to place a sheet of the paper in a closed container and collect the carbon dioxide liberated by oxidation due to the attack by air, and compare this with similar tests on other sheets of paper treated with different additives.

“By these techniques it probably would be possible to prepare a paper which would last however long one wanted, perhaps 20,000 years.”

COVENTRY 1/4" STYLE 'XT' SELF-OPENING DIEHEAD

THIS new-type Coventry Diehead has been specially designed for use on Single-Spindle Automatics such as the Brown & Sharpe No. 00G, B. S. A. No. 48 and C. V. A. No. 8 Machines.

Besides having the notable features which have contributed for so long to the success of the well-known Coventry Diehead, the Style 'XT' Diehead is also equipped with external tripping mechanism. This eliminates the possibility of the diehead's opening due to centrifugal force produced by the very rapid indexing of the turret on these high speed machines.

A particular advantage is its ability to cut short threads; the diehead can be set to trip almost immediately the dies commence cutting. The diehead is fitted with a spring-cushioned shank which provides lateral movement in both directions to compensate for the slight difference which may exist between the pitch of the thread and the forward motion provided by the feed cam. This cushion-action ensures a good start to the thread and also, with the substantial sliding dogs, provides an easy sliding movement ensuring long die life. The spring pressure can be varied.

The Coventry 1/4" Style 'XT' Diehead will cut threads from 12 BA to 1/4" Whitworth with appropriate dies, and as the shank is hollow, screws of any length can be cut.

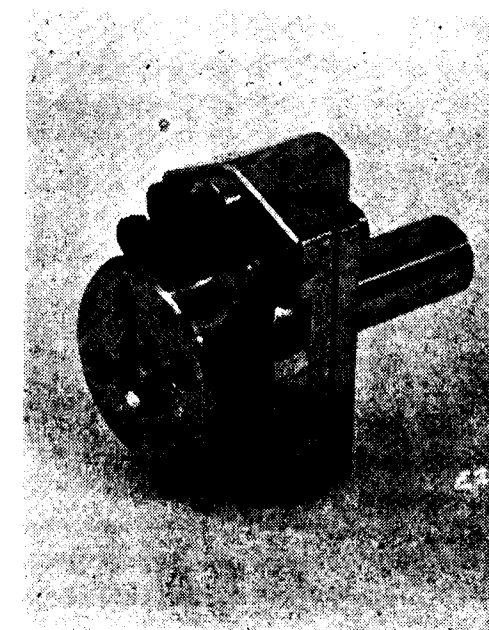
1,500 Asbestos Fibres are Finer than One Human Hair

Asbestos fibre, which has many important industrial uses, is the finest, or thinnest of all natural mineral fibres, according to the Johns-Manville Company in the United States, which processes asbestos fibres for industrial use.

The extraordinary fineness of asbestos fibres can be realised, the company says, by comparing them with glass fibres. While 4,000 glass fibres may be contained

in one linear inch, as many as 1,000,000 asbestos fibres may be placed side by side in the same space. If 1,500 asbestos fibres are twisted together, the resulting thread is thinner than a human hair.

Asbestos fibre is familiar as an ingredient in textiles, building materials, insulations, pipe, brake linings, friction materials and packings and gaskets. It is also used in plastics, paints, adhesives and putties.



The diehead uses the same dies as fitted to all 1/4" size Coventry Dieheads which enables the standard Die Grinding Fixture and Height Gauge to be used for regrounding.

The Coventry Style 'XT' Dieheads can be used on small Capstan and Centre Lathes for which the external tripping mechanism would be ideal for cutting short threads.

WHAT'S NEW IN CERAMICS? AND WHAT'S COMING?

Ceramic Industry Survey Spotlights Research in Physical and Chemical Structure of Ceramics, Points out Processing Developments with Far Reaching consequences

Just what is new in ceramics and what are scientists thinking in the future for ceramics?

This question is being posed to our editors so frequently by government representatives, bankers, investors, educators and just hard-headed businessmen that we will answer it to the best of our ability for general consumption.

In general, it can be said that the scientist is taking over when it comes to application. No longer are the physical properties the only consideration for ceramic application, but chemical composition and structure are coming into their own.

Processing, too, is receiving great attention. The need for changes in processing arises from the need for greater productivity, practice of more automation, and, through processing, the development of newer ceramic properties. Some of the newer raw materials cannot be handled in the same old way, and, of course are getting special processing attention.

Following are described some of the noteworthy research projects which will affect the future of the industry.

NEW GLASSES AND ENAMELS

The need for porcelain enamelling wire has long been realised, but a proper glass was needed. Now that research work is under way.

We can also report here some very revealing developments, for instance:

1. The discovery of silica-free antimonate glasses
2. The discovery of $\text{Sb}_2\text{S}_3\text{-K}_2\text{O-Sb}_2\text{O}_3$ glasses.
3. Discovery of V_2O_5 opacified white enamels.
4. The discovery that enamel adherence is a chemical phenomenon and the discovery of the conditions under which it occurs.

EXTRUDING NON-PLASTICS

Of very significant importance is the development of a method of preparing non-porous ceramics of BeO , MgO , UO_2 or ThO_2 , formed by extrusion or dry pressing at normal pressures and fired at temperatures below 2900°F ., through the use of special powders of the respective oxides.

It might be added here that we are all having very much trouble keeping up with the progress in electro-ceramics. The ceramic magnets thermistors and other products based on piezoelectric properties are being developed so rapidly that one can hardly keep up with them.

ARCHITECTURAL USE OF PORCELAIN ENAMEL

The greatest expansion in the porcelain enamel industry will undoubtedly result in the growth of its use for architectural purposes. With lower temperature enamels, this area is becoming more and more promising. Perhaps a most interesting porcelain enamel is the ceramic smokestack which is being manufactured at the A. O. Smith Corporation.

PYROMETRIC CONES FOR ALL PURPOSES

ALMOST completed is the development of a new cone series for use in the firing of all kinds of porcelain (aluminum, steel and cast iron) and decorated china etc. The series begins somewhat below the existing one. Also the series would have smaller temperature increments between successive cone numbers and have a new-unique scheme of numbering so as to distinguish the cones from the present series.

The cones will be formulated and processed so that a cone reading can be obtained in a few minutes i. e., cold cone plaques can be pushed into an operating box-type enamel furnace with a load of ware and the cone will deform and give an indication of the time-temperature conditions of its position

in the furnace in the few minutes used to fire the enamel.

Cones of this type should be ideal for fast firing conditions in hobby potter kilns, decorating kilns and enamel furnaces. They can be used to determine whether the same end point of firing is being obtained, or with several pairs of cones a rather complete picture of heat distribution throughout the furnace chamber can be obtained.

At this time, sample cones are being tried out in laboratories and plants. All reports are not in, but considerable favourable interest has been developed.

GLASS LUBRICANT FOR TITANIUM

The newer titanium alloys which are being used increasingly by air, frame manufacturers must be formed at elevated temperatures because of their lack of ductility at room temperatures. As a result, sheet metal titanium parts are being formed at temperatures as high as 1700°F . Aside from the obvious problem of heating the blanks and the dies, the lack of satisfactory forming lubricants has been a major obstacle in these processes.

Since titanium tends to gall and seize severely at these temperatures resulting in scored parts and dies, the problem is serious. Conventional organic lubricants have been unusable above 600°F . and although colloidal graphite has been of some help on open structured die alloys such as mechanite, parts free of galling have not been obtained above 800°F .

Therefore, the Seattle division Processes Unit of the Boeing Airplane Co., initiated a study of the feasibility of using molten glasses as lubricants for sheet metal forming operations between 800°F and 1700°F . Certain enamel frits were evaluated first and were found to provide good lubrication but were not readily removed from parts and dies. The division developed a series of glasses for different temperature ranges which have low enough chemical reactivity to enable their removal from parts and dies. The glasses are made up in organic suspensions and are applied by dipping and spraying.

Glass lubricants have been developed to cover the range of 800°F . to 1700°F ., and in production tests have been found to provide lubrication, prevent galling, and to provide oxidation protection to the titanium alloys at the higher forming temperatures. The

lubricants have been used successfully in drawing with heated parts and dies, in deep hammer forming with hot parts and both hot and cold dies and in brake forming with heated parts and dies. Tests are also planned for draw bench forming and yoder roll forming.

It is believed that this type of lubrication will eventually find widespread usage in forming a wide variety of alloys of magnesium, zirconium and titanium which require elevated temperature forming.

PLATINUM COATED REFRACTORIES

There is a new emphasis on modern cast refractories. Cermets are a comer, but at present are still too brittle for structural use. Toughness is needed to stand up in service in the next family of turbine engines. Work must be started to make them ductile.

The problem of coating carbon or graphite to allow its use as a heating element without burning up has not been completely resolved but is continually challenged. The problem of putting a thin coating of platinum on refractory backing to prevent its solution in molten glass has never been solved, but platinum linings are successfully used inside of refractory backing.

CONTINUE STUDIES ON STRUCTURAL CLAY PRODUCTS

A continuous drying method for structural clay products is being researched. Terra sigillata as a coating for clay products has been developed and is of great interest as to the colouring possibilities.

Light weighting these building products is now assured. Brick will weigh two pounds, clay pipe less than half. Even sanitary-ware, tile and clay roofing will be very light in the near future.

Prestressing is a foregone conclusion in the development of clay products for construction.

PROCESSING METHODS TO INCREASE PRODUCTIVITY

Two companies are spending much time and effort on trying to devise new ways of doing things, that is, the use of fritted materials, new schemes of pressing or forming etc., to overcome the high labour cost, especially in the home table-ware field.

For instance, colloid mills are used in the preparation of glazes. Increased excess air at burners is used for firing of ware. New hot press techniques are in the making.

Just recently we reported a method of spraying a body against a metal mold which is heated and spinning. Process is rapid and produces a denser ware with no shrinkage.

If all raw materials for whitewares were prefired and then sintered with frit, burning time would be in minutes instead of hours, without shrink. Today a body is formed of raw clays. In the fire it twists, turns, shrinks, bends and finally levels off to a predicted shape. The hazards are great. By firing out the twists, turns, shrink etc. losses would be reduced almost entirely and accuracy would be assured, time would be saved.

Why not develop plasticity in whitewares with a chemical rather than water? Then, just prior to forming add a setting agent which would set the entire formed piece very hard and ready for decorating and glazing.

Another idea in the experimental stage is the forming of ware with a liquid medium other than water at subfreezing temperatures. The liquid is volatile at higher room temperatures and eliminates a drying process.

GAS OBTAINED DIRECTLY FROM OIL SHALE

Oil shale can be converted directly into heating and fuel gas by an efficient new process that has been laboratory tested, an announcement by the Institute of Gas Technology in the United States discloses.

The process is described as one in which crushed oil shale is treated with hydrogen at high temperature and pressure. It produces gas that is about as efficient and economical as natural gas, and more efficient and economical than most manufactured gases, the Institute says.

An important advantage of the new process is that it by-passes the step of first converting the oil shale into liquid oil. In addition, the process converts between 90 and 100 per cent of the active matter in oil shale into fuel. Existing oil extraction processes utilise only about 80 per cent of the active organic matter in the shale, the Institute points out.

* * * * *

NEW REFRACTORIES IN OFFING

Electrically cast refractories are not new and aluminum silicate compounds are common. But now, a chrome-magnesium material is electrically cast and already is used in open hearth linings. This opens up an entirely new approach to forming ceramic products and certainly develops entirely different properties from the material.

VARIETY OF COATINGS USE ELECTROPHORETIC DEPOSITION

A wide variety of coatings is now being prepared starting with electrophoretic deposition techniques. The coating process, developed by Vitro Laboratories includes these four steps:— 1. Preparation of coating dispersion. 2. Electrophoretic deposition. 3. Densification where necessary. 4. Firing.

Other coatings of interest include special ceramic coatings bonded to a metal substrate. Since this application was developed under classified government contracts, details cannot be published at this time. Other examples of Vitro's electrophoretic coating process, of possible interest to the ceramic industry include the deposition of various cements on metal substrates, and protective coatings on graphite.

(Courtesy: Ceramic Industry)

DIAMETER GAUGE

An electronic instrument that detects changes in diameter of round stock and coated wire operates by picking up changes in the shadow cast by the passing round stock. The gauge is accurate to within 2 mils. and is intended for control of diameters 3/8 in. and above. Gauge signal is displayed on a meter, recorded on a strip chart, and may be used to control operating variables. Since no part of the instrument touches the product, it will measure diameter of wire coatings etc. that are still in the molten state. It would seem that this instrument could also be used in measuring critical dimensions of certain non-round extrudates. The gauges are manufactured by Industrial Gauges Corporation, West Englewood, N. J. U. S. A.

* * * * *

Induced Draught Cooling Towers

By F & D. Brownlie

London W-5

AN important part of modern factory design is the provision of a means of water cooling which is efficient, economical to operate and which occupies the smallest possible space. A type of cooling plant which combines these requirements and which is becoming increasingly popular is the Mechanical Cooling Tower of the induced draught type.

In this type of structure the fans are situated at the top and cause the air to enter the base of the tower at a relatively slow speed and to leave from the top at high velocity. The advantages of this method are that the incoming air is circulated more evenly through the packing and that recirculation is not likely to occur. Recirculation is a difficulty which sometimes occurs with mechanical towers of the forced draught type, as in these structures the air is forced into the base of the tower at high velocity causing a depression into which the saturated vapour emerging relatively slowly from the top is sometimes drawn and recirculated through the tower, thus greatly lowering its cooling efficiency.

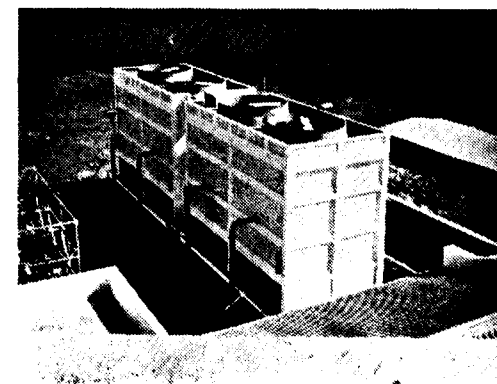
One of the leading British designers of this type of plant, Film Cooling Towers (1925) Limited, has developed a system of packing for induced draught cooling towers which provides the greatest possible degree of heat transference with a low capital outlay. This system, known as "Film Flow", distributes the liquid evenly over the packed area of the tower and gives the cooling air unimpeded access to all parts of the packing.

The water is led to the tower either in a closed pipe or in an open culvert from which it is discharged into secondary troughs through orifices specially designed to prevent splashing. From the secondary troughs it is fed into weir type spreader troughs running the entire length or breadth of the tower at a pitch of 6 inches. The spreader troughs, which have specially shaped notches at 2 or 4 inch intervals, rest on the top layer of the tower filling. The filling is composed of a number of horizontal trays of parallel laths, the direction of each layer of laths being at right angles to the trays above and below it. The effect in plan view is of a grid composed of 2-inch square network and the water upon being discharged through the trough walls

flows down the grid packing in an even film changing direction through 90° in every 2 inches down the whole depth of the stack.

This method of distribution ensures that the entire surface of the packing is evenly wetted, providing a very high heat exchange co-efficient, which together with the fact that the cooling air has a relatively unimpeded flow throughout, effects an economy in the cost of the power to drive the fans. Also, by completely avoiding the formation of water drops there is a smaller loss of water by entrainment and the use of baffle plates and drift eliminators is unnecessary.

The salient feature of the Film Flow system, however, is the saving in space, as the Packing depth can be reduced in some cases by as much as 50% of the space required by the normal drip bar packing system. This is reflected in both lower capital costs and in considerable saving of the power required to obtain the pumping head.



Film Cooling Towers (1925) Ltd.
Induced Draught Cooling Tower at Shahpur
Power Station, India.

Induced Draught Towers incorporating the Film Flow packing system can be constructed with shells of reinforced concrete, asbestos cement tile, steel or timber according to clients' requirements and local conditions.

The system is entirely of British design and further details may be obtained from the manufacturers at Kew Bridge, Brentford, Middlesex, England.

THE BRUNING COPYFLEX PROCESS

By A. Special Correspondent

The advanced, fumeless, easy-to-use diazotype reproduction process that makes clean, sharp, low-cost, direct-positive prints in a matter of seconds.

WHAT COPYFLEX IS....

THE Bruning Copyflex process is an extremely versatile and flexible method of making low-cost, direct positive reproduction of anything drawn, written, typed, or printed on translucent material. An advanced diazotype whiteprinting process, Copyflex produces black-on-white, black-on-colour, colour-on-white, colour-on-colour, or multi-colour prints of drawings, tracings, plats, maps, specification sheets and other originals easily, quickly and conveniently.

In engineering, drafting, and architectural work, Copyflex is preferred because it provides an on-the-spot reproduction service that's fast, economical, simple to use, easy to maintain fumeless, clean, quiet, odorless and dependable. More than just a reproduction process, Copyflex is also preferred because of its ability to reduce time and costs in a number of drafting applications, including the making of design changes.

HOW COPYFLEX WORKS....

The underlying principles of the Copyflex process parallel those of photography. They involve exposure of a sensitized copying material (Copyflex paper, cloth, or film) to light and subsequent development of the latent image resulting from the exposure. But with Copyflex, the copying is done entirely inside a Copyflex machine—without the fuss and mess the time, and the expense that accompany conventional photographic processes. And with Copyflex, you can make any number of direct dry, positive copies without the need for negatives or other intermediates.

HOW TO MAKE A COPYFLEX PRINT....

Copyflex machines are the ultimate in operational simplicity—no special operating skills or experience are required, no critical adjustments are necessary.

To make a direct-positive copy of a tracing or other translucent original, you merely set the machine's single master control knob to the proper exposure speed, and feed your original and a sheet of Copyflex paper, cloth or film into the machine for exposure.

On Copyflex machines equipped with automatic separation devices, the exposure, the separation of the prints from the original, the development, and the delivery of the print are accomplished automatically in one continuous process. On Copyflex machines, not equipped with automatic separation devices, the process is the same, except that prints are returned to the operator after exposure and are reinserted manually of development.

Printing development and drying of the print are all completed in a matter of seconds; and while prints are running through the machine, the production of new copies of the same or different originals can be started. From insertion to finished print, the entire operation is as simple as modern reproduction engineering can make it.



Copyflex Model 250

WIDE CHOICE OF MACHINES AND MATERIALS....

Bruning produces a full line of Copyflex machines, accessories and sensitized materials to meet every engineering drafting and architectural need. All Copyflex products are backed by years of research, product development, and rigidly controlled manufacturing standards—important reasons why Bruning has been a leading name in reproduction since 1897.

BASIC PRINCIPLE OF THE COPYFLEX PROCESS

Copyflex is a low-cost photosensitive reproduction process. It utilizes a light-sensitive material which, after exposure to ultraviolet light through a translucent original, and after subsequent development, yields a positive copy of the original. The exposure (printing) and development operations are combined in Copyflex machines, enabling the fast, efficient production of finished prints.

THE CHEMICAL PRINCIPLE

Copyflex papers, cloths, and films bear a thin, dry coating of a diazo emulsion. This diazo emulsion possesses two major properties: (1) it is highly sensitive to actinic light—that is, light in the ultraviolet region of the spectrum; and (2) it has a strong chemical affinity for Copyflex developer solutions with which it combines to form a dense, inert, black or colour-line dye. Wherever the diazo emulsion is exposed to actinic light, it decomposes and loses its ability to form a dye line. Wherever the emulsion is not exposed to actinic light, or wherever an image obstructs the transmission of actinic light to the emulsion, the diazo coating retains its ability to form a dye line.

THE PRINCIPLE IN ACTION

When a translucent original is placed upon a sheet of Copyflex sensitized material and the two are inserted into a Copyflex machine, a revolving glass cylinder conveys them around a powerful mercury arc lamp emitting actinic light. The lamp's rays pass through the translucent original everywhere except where they are blocked by the opaque lines drawn, written, typed, or printed on the original. When the rays reach the diazo coating on the Copyflex material, they destroy the ability of the emulsion to form a dye line in those areas.

After exposure, the sensitized Copyflex material passes between rollers which apply a tin film of metered copyflex developer. The developer combines or "couples" with the active diazo emulsion still remaining on the material, thus forming a black or colour-line image which is an exact, positive, highly legible copy of the original.

SPECIFIC REASONS WHY COPYFLEX IS THE PREFERRED REPRODUCTION PROCESS IN ENGINEERING DRAFTING AND ARCHITECTURE....

Direct, Dry, Positive Reproductions—in seconds.. Right when you need them. In a matter of seconds, Copyflex gives you clean, dry direct positive reproductions of anything drawn, written, typed or printed on ordinary translucent materials, such as tracing



Copyflex Model 35.

paper, cloth, or film. You handle only the original itself and the sensitized Copyflex materials—no negatives or other intermediates are required. Instead of waiting for hours or days for facsimile reproductions, you get them almost immediately with the Copyflex process—right on the spot when you need them.

ECONOMICAL—SMALL PRINTS COST AS LITTLE AS 1 C. EACH—LARGE PRINTS ONLY PENNIES

Copyflex prints are inexpensive to make—you can enjoy the advantages of sharp, clean Copyflex reproductions at a remarkably low material cost. Small prints cost as little as 1 c apiece for materials.. large prints only pennies each. Copyflex saves you

money in other ways too. Copyflex eliminates the costly delays often involved in obtaining prints by other means. Copyflex requires no highly skilled, highly paid operator. Because of the consistently high quality of Copyflex materials, print waste is reduced to a minimum. And, with your own Copyflex machine, you can take advantage of many money-saving drafting room and office shortcuts made possible by the versatility and flexibility of the Copyflex process.

SHARP CLEAR INTENSE LINES AND IMAGES

Copyflex prints are flat, durable and easy to read—with clean, sharp, permanent lines of uniform density and contrast. Every detail is faithfully reproduced exactly as drawn. Because of their durability and permanence, Copyflex reproductions are more convenient to use than the original, and because of their high line contrast, are often easier to read. Copyflex image lines are waterproof, smudgeproof, and smearproof—are erasable with special Copyflex eradicators. The surface of most Copyflex materials permits the entry of notations, design alterations and other data on prints with pencil, ink or typewriter.

AUTOMATIC CAPILLARY TYPE DEVELOPER SYSTEM ASSURES POSITIVE PRINT DEVELOPMENT AT ALL SPEEDS

In the Copyflex process, developer solution is applied in metered amounts to exposed prints by direct capillary action, assuring you of complete developer coverage at all printing speeds and on all types of materials—paper, cloth, and film. Because the proper amount of developer is applied to each print automatically, you never have to worry about adjusting manual developer controls or feed levers. Copyflex developer chemicals and Copyflex sensitized coatings are perfectly balanced to provide positive, 100% development of the image every time.



Copyflex Model 300.

COPYFLEX IS CLEAN, QUIET, AND ODORLESS EMITS NO NOXIOUS FUMES, REQUIRES NO MESSY INKS, MASTERS, OR NEGATIVES

The Copyflex process is clean, quiet, and odorless. There are no noxious fumes to bother the operator or others in the vicinity and there no messy inks,



Copyflex Model 505.

masters, stencils or negatives for the operator to handle. Copyflex prints, whether made today or years ago, emit no disagreeable odor—an important consideration to those who must use the prints as well as to those who make them. Because Copyflex machines are virtually noiseless, you can place them near personnel without fear of work disturbance or interference.

COPYFLEX MACHINES ARE EASY TO OPERATE—NO SKILL OR EXPERIENCE REQUIRED

Anyone can learn to operate a Copyflex machine with just a few minutes' explanation and demonstration. One simple knob controls the synchronized exposure and development of Copyflex prints—no separate, bothersome developer feed controls are necessary. Because no special feed adjustment is required for running different size originals, you don't have to worry about machine "make-ready" every time you want to make Copyflex prints.

COPYFLEX MACHINES REQUIRE NO PERMANENT INSTALLATION—NEED ONLY AN ELECTRICAL CONNECTION

Installation of a Copyflex machine requires only an electrical connection. Exhaust ducts or vents are not necessary because Copyflex emits no fumes or vapours. Nor are plumbing connections or special lighting conditions required. Copyflex thus offers unsurpassed

mobility, economy, and convenience of installation—you can locate your machine anywhere to meet present requirements and relocate or reposition it at any time without excessive reinstallation expense.

COPYFLEX MACHINES REQUIRE ONLY ROUTINE CARE AND MAINTENANCE

Just a few minutes' routine care per day is all that is required to maintain a Copyflex machine in excellent working order. There are no complicated adjustments, no critical controls to forget about, no complex mechanical attachments to remove, replace or regulate.

USES OF COPYFLEX INTERMEDIATES HOW THEY SAVE TIME, EXPENSE, AND WORK IN ENGINEERING, DRAFTING AND REPRODUCTION

Copyflex "intermediates" are direct-positive, sepia-line prints made on sensitized translucent paper, cloth, matte film, clear film. They are called "intermediates" because they can be used in exactly the same way as originals from which they were made: They are translucent, they have a highly reproducible image, their image lines are eradicable and all except the clear films can be drawn on with pen or pencil. Here are some of the ways these top-quality materials can be used to save time and money and increase productivity in your engineering, drafting and reproduction departments—additional examples of Copyflex versatility and flexibility.

PROTECT YOUR VALUABLE ORIGINALS AGAINST DAMAGE

Using Copyflex translucent materials, make reproducible prints of your original tracings and drawings. Use these reproducible prints as your "working originals," and keep the actual original drawings in the files, where they will be safe from the wear and tear of constant handling.

GET QUALITY PRINTS FROM FADED OR WORN ORIGINALS

If your original is weak, torn or faded make a reproducible print of the original on Copyflex translucent material. Use this translucent print in place of the original to get sharp, black-lined subsequent prints in the Copyflex machine.

MAKE DESIGN CHANGES EASILY AND QUICKLY

To make design changes without altering or tracing the original, make a reproducible print of the original on Copyflex translucent material, make the design changes on the print with pencil or ink and/or

Copyflex eradicator, and make as many Copyflex prints of the design change as needed.

SPEED THE MAKING OF DRAWINGS CONTAINING COMMON BASIC ELEMENTS

When two or more drawings are to contain certain basic elements which are common to all, Copyflex intermediates eliminate the need for tracing or redrawing the "constant" elements each time. Simply make a drawing containing only the constant elements, make as many copyflex translucent prints of the original as there are different drawings required, and complete the individual drawings on the drafting board by adding their respective design variations to the translucent prints.

MAKE COMPOSITE PRINTS OF TWO OR MORE DRAWINGS

Composite prints of two or more originals can be made by (1) reproducing each original on Copyflex translucent material (blocking out or later eradicating any unwanted portions of the original designs); (2) superimposing the prints or placing them next to each other in desired registration; (3) running them through the Copyflex machine just as you would a single original.



Copyflex Model 110.

SPEED PRODUCTION OF PRINTS

Make several reproducible prints of your original on Copyflex translucent material. Use these reproducible prints as multiple "duplicate originals" in your Copyflex machine, and speed the production of final prints proportionately.

STREAMLINE PRINT DISTRIBUTION

Send single reproducible Copyflex prints of your originals to other offices equipped with Copyflex machines. There final prints can be made from the reproducible prints as needed resulting in savings of time, materials and postage.

Liberty's 3-Point Programme Increases Container Life

Flame Polishing—Thermal Shock Proof Testing—Protective Filming

CONTAINER manufacturers are more concerned with the trips a bottle makes before it breaks than ever before. Much effort has been put forth to coating the outside surfaces of bottles with various materials in order to increase the number of fillings a bottle can take.

Plants like Liberty Glass in Sapulpa, Okla. have gone a step further and installed an integrated set up to minimize bottle breakage. The three steps are: (1) Flame polishing (2) Thermal shock-proof testing (3) protective filming.

FLAWS AND THEIR CAUSES

Glass breaks as a result of tensile forces acting on its surfaces, as a result of stresses developed by impact, thermal shock and internal pressure, to name a few. These stresses are usually concentrated at flaws, microscopic and macroscopic, on the glass surface. The various causes of these flaws on the outside surfaces are:

(a) Contact of the bottle with the iron mold which is patterned with a network of microscopic cracks or discontinuities (b) Bottle contact with the dead plate, the hot ware conveyor belt and the annealinglehr belt—these contacts give rise to additional microscopic cracks and visible checks. (c) The accidental touching of the glass surface against other objects during its transfer from the forming mold to the annealinglehr likewise produces surface flaws and checks. (d) The accidental bottle-to-bottle contact during transfer to thelehr or in thelehr also gives rise to flaws and checks. (e) Handling by the selectors during selection and packing further exposes the fresh virgin surface to abrasion, bruises, impact marks and other flaws (f) During all subsequent handling of the bottle, its outside surfaces are subject to the development of handling flaws.

FLAME POLISHING FIRST

The 3-step protection programme at Liberty Glass begins with flame polishing just as soon as the ware

from the forming machine enters thelehr. The bottles pass through a bath of flame just long enough to glaze the outside surface skin. The path of the flame is adjusted to that it covers the entire bottle.

The thermal shock treatment is built right into the annealinglehr. The equivalent of an 80°F. water thermal shock is given by a 150°F. air thermal differential. This thermal shock treatment is designed to develop high tensile forces in the outside surfaces of the bottles from their base areas for a distance of two inches or more (the so-called Murgatroyd belt area)

Sufficient tensile forces are developed to cause flaws such as microscopic checks, re-entrant or "V" angles which are present in the bottom and lower sidewalls to develop into full sized cracks and such bottles are thereby completely fractured. As these broken bottles reach the selectors, they are immediately culled. These units insure that the bottler will have no first filling breakage in his washer or filler from these particular causes.

PROTECTIVE FILMING

The warm ware, as it leaves the tunnel of the annealinglehr and before it reaches the selectors, passes into a spray booth where a thin film of stearate is deposited on the outer surfaces of the ware. The spray of stearate is applied as a very fine mist so as to reach all portions of the outer surfaces of the bottles.

This film of stearate possesses good lubricating qualities to prevent glass-to-glass seizure during the hand selection, 100% choke gauging and the packing into the cartons.

Handling bruises and abrasions are thereby prevented and the original virgin surface of the flame polished and thermal shock proof tested bottle is preserved and kept in that condition during all subsequent movements up to the bottle user's washer.

(Continued on page 31)

What Should An Engineer Learn and Unlearn To Become A Good Manager?

By R. E. Pattison

U. S. A.

"WHEN an engineer becomes a manager two specific and dramatic changes must take place in his thinking; he must think in terms of the direction of the efforts of people rather than the completion of engineering projects; he must realise that his progress as a manager is dependent upon the number of people whom he can successfully motivate rather than the number of projects which he personally can complete satisfactorily and on schedule.

The engineer starts his life work as a specialist and he receives his promotions in accordance with his expertness in his specialty. When he becomes a manager, this whole situation changes. He is now a generalist. He is now appraised on this ability to identify and supervise specialists.

To be a manager, the engineer must acquire a new set of principles, skills and tools—those of management. These principles, skills, and tools do exist; a considerable body of management know-how has been accumulated and more is being added to it every day.

There are some things which an engineer must forget when becomes a manager—the most important of which is the exactness and accurateness with which he has appraised the results of his work. He must

now realise that he is dealing with human beings. Human qualities, potentials and relationships are anything but exact and are constantly changing. Very broad and flexible allowances must be made. On the other hand, much more is to be expected of human beings than of material things, and the life of the manager is full of many more surprises than that of the engineer". Mr. Lawrence A. Appley, President, American Management Association.

* * * * *

"There is no science of business. . . . All business decisions are based upon the interpretation of quantitative data, intuitive appraisals of unquantified information, consideration of the limitations imposed by law and by the action of human beings in co-operative, productive effort. The good engineer brings to the management process two enviable qualities: (1) an understanding of science and engineering upon which the application of industry rests; (2) a training in rigorous, analytical thinking which is often helpful in the solution of management problems. On the other hand, the engineer's interest in things and processes and his search for reasonable certainties are handicaps in the effective performance of management responsibilities in our present world.

Thus I would argue that the engineer must acquire a

(Continued from page 30)

SILICONE FILMS APPLIED

The same spray booth is sometimes used for the application of silicone and other types of films. Silicone films are applied to the outside surfaces of the bottles if the customer specifies that such coating should be done.

Liberty Glass programme takes into account those flaws that existed prior to the filming treatment. The flame polish treatment erases those surface flaws

resulting from mold contact; the thermal shock proof test treatment changes mold contact, conveyor belt contact and other contact flaws into actual cracks and destroys such ware in thelehr instead of during the first and subsequent fillings, and the protective filming treatment minimizes flaws in surfaces which result from handling in the critical period, that is, when the glass surfaces are in a warm, virgin condition, and also during subsequent handling unit the ware reaches the washer of the ultimate user.

knowledge of the methods of production, distribution and finance. He should understand as much as possible about himself, the nature of other human beings and the environment—economic and political—in which he lives. In addition, a successful manager should possess the intellectual skill and resilience to deal with the novel situations presented to him by changes in the economic, social and technological circumstances”—Mr. Eli Shapiro, Professor of Finance, School of Industrial Management, Massachusetts Institute of Technology.

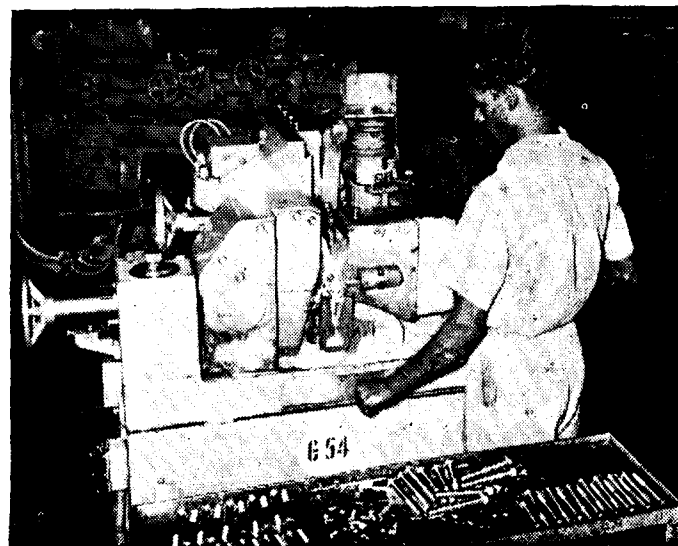
“There are three broad areas..... of knowledge and skill which an effective engineering manager must possess; an understanding of people a knowledge of the operational functions of company and skill in administering his engineering project.

A manager must accomplish his project objectives through other individuals. It is therefore imperative that he understand basic human psychology and methods of stimulating desired responses in other individuals.

The quality of the engineering which goes into a new product greatly affects the future profits of the company. In order to ensure maximum profit, the engineering manager must have a clear understanding of the functions of the pertinent areas of the company, such as manufacturing, sales and service, and of his tremendous influence on this future operations.

The engineering manager must also possess skill in administering his particular project. He must have skill in planning both the technical and non-technical phases of his project, as well as organising an effective work force to achieve the technical objectives. He must apply all of his knowledge and understanding of people in the face-to-face direction of his project and insure that co-ordination with other functions of the company is accomplished at the proper time.

Engineers, because of their training and experience, are well prepared to assimilate knowledge of the company organization and of the technical phases of administering the engineering project. They probably will, however, have to exert considerably more effort to comprehend the polyhedron we call ‘man’ and to thoughtfully and continually apply understanding of his daily activities”.



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New Can-Filling Machine for frothing liquids

By J. A. McIntyre
London

DESIGNED primarily for the rapid dispensing of highly frothing liquids with extreme accuracy, the Waddington-Duval Can-Filling Machine can equally well be used for non-frothing liquids. Being made of stainless steel (unless otherwise specified) it can be used with most liquids and one Machine can dispense any number of different products.

In operation the container to be filled is placed on the scale, which is set to the quantity required to an accuracy of half of one per cent. The supply is cut off instantly when the balance arm of the scale rises and interrupts a photo-electric cell.

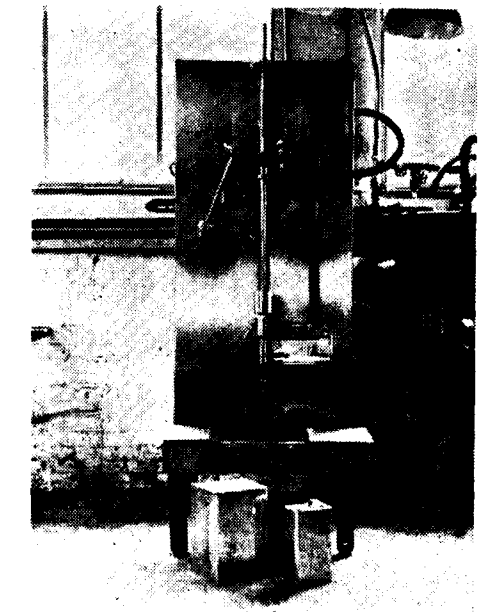
The avoidance of frothing is ensured by the patented filling lance being lowered to the bottom of the can before any liquid flows and by automatically controlling the rate of flow in such a way that filling starts very quietly and continues evenly, thus effectively eliminating turbulence.

For non-foaming liquids the operation can be adjusted for full-flow filling from the start, thus cutting down the operating time.

Measuring 3' x 3' x 6' high the machine fills 1, 2, 3, 4, 5 and 10 gallon containers. Changeover from one size to another takes approximately ten seconds and a by-pass is incorporated to permit filling 45 gallon containers.

One unskilled operator only is required for the machine which will handle up to 60 tons of foaming liquid into sealed containers per week.

Thanks to the prevention of foam and the effective non-drip design of the Machine, spillage is nil: the Machine has been proved in operation to save from 1 to 1.5 tons for every 100 tons of foaming liquid handled. It also ensures that the outside of the



container and also premises are kept dry and entirely free of contamination by the product, which is itself safeguarded from pollution during dispensing. Tin wiping is entirely avoided.

This machine is available from:
LIQUID SYSTEMS LIMITED,
NORWICH UNION HOUSE,
WELLESLEY ROAD, CROYDON

Special Note:

This well tested but new Can-Filling Machine can be seen on Liquid Systems Limited's Stand at the Chemical and Petroleum Engineering Exhibition, No. 10, Inner Row, Grand Hall Gallery, Olympia, London, W. 1 from 18th—28th June, 1958.

Engineers will be available to give full technical details and demonstrations will take place daily.

TWO-RANGE SURFACE PYROMETER

Claimed to be the first of its kind, the Pyro Model DR35 surface pyrometer has two measuring ranges, with appropriate scales from 0 to 500°F. and 0 to 1500°F. Selection of range also changes room temperature compensator. Low range is marked off in 5° subdivisions; high range divisions are 20°F. Accuracy is 1.5% of maximum scale reading, on both ranges.

California Institute of Technology—Jet Propulsion Laboratory

By An Overseas Correspondent

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

AN ingenious miniature tape recorder—the size of a king-size cigarette package—gives the third United States IGY earth satellite launched by the Army, Explorer III, the ability to provide five times the information on cosmic ray intensities as was furnished by Explorer I, it was revealed today by Dr. William H. Pickering, Director of the California Institute of Technology Jet Propulsion Laboratory.

JPL and the Army Ballistic Missile Agency, Huntsville, Ala., the latter under command of Major General John B. Medaris, joined in launching the second U. S. Army satellite as part of the International Geophysical Year activities, which are sponsored by the National Academy of Sciences.

The third satellite—similar in size and weight to the first Explorer but different in instrumentation—followed the launching of Explorer I the night of January 31 by JPL and ABMA. Explorer II was launched March 5, but did not achieve an orbit.

Dr. Pickering described the instrumentation in Explorer III as “more sophisticated” than the instruments in the Explorer I.

Explorer I contained two radio transmitters which continuously sent to earth stations information on three experiments: cosmic rays, micrometeorites, and interior and external temperatures.

Explorer I was essentially a space experiment designed to provide preliminary information on the environment and conditions it meets in space as it whirls around the earth in its orbit.

In effect, it sampled three items of information—cosmic rays, micrometeorites, and temperature levels—and sent these data to earth receiving stations. In doing this, it provided information of incalculable value to scientists not only in this country but also to those in nations taking part in the International Geophysical Year activities.

The “more sophisticated” instruments in Explorer III, Dr. Pickering explained, include a magnetic tape



Hold for release—Explorer II, U.S. Army's Second Satellite.

recorder which will receive total omnidirectional cosmic ray incidences and intensities throughout the satellite orbit.

Then, as the satellite swings over the Minitrack ground network along the 75th meridian in South and North America, it will be interrogated by a radio command signal from the ground which will tell it to report what it has found in its orbit.

In some five seconds, the playback head of the miniature recorder will cascade down to ground stations a veritable torrent of information that was picked up during the two hours or more of its flight.

The tape recorder contains some 55 inches of magnetic tape on which the cosmic ray levels will be imprinted. This is the equivalent of some two and a quarter hours of flight time.

But when it is interrogated by ground stations—which will use a special radio signal coded as to frequency and duration—the information collected in the orbit will be sent in five seconds to special ground equipment.

After the reception of this rapid-fire signal on the ground, it will be passed through special filters to reduce the background noise. Then, it will be translated in the form of visual lines on an oscilloscope to sort out the information in its code.

The tape recorder to give 100 percent information on the cosmic rays was proposed to the U. S. IGY Committee for use in a satellite by Dr. James A. Van Allen, head of the physics department at the State University of Iowa.

It was this Van Allen experiment, modified to eliminate the tape recorder, that was contained in Explorer I.

Thus, the third Army satellite contains the true Van Allen package, including the tape recorder, which was designed by Dr. Van Allen and slightly modified by the Jet Propulsion Laboratory.

George Ludwig, a graduate physics student at SUI and an assistant to Dr. Van Allen now assigned to JPL, helped design the tape recorder package and modify it for installation in the cylindrical shell case of Explorer III which contains the instrumentation. He explained the difference between the two Army satellites in this way:

“Explorer I was a preliminary probe of space to find cosmic ray incidences and intensities in order to construct a preliminary idea of the cosmic ray pattern. With that knowledge now in hand, Explorer III will give us more precise information of intensities throughout its entire orbit.”

Ludwig explained that the tape recorder is contained in an encapsulated unit which also holds the high-power transmitter that radiates 60 milliwatts of radio frequency energy. (One milliwatt is one thousandth of a watt.)

In Explorer I, the high-power unit had a design life expectancy of two weeks, but this relatively short life span was caused by the fact that the high-power transmitter was continuously on the air.

In Explorer III, the high-power transmitter will be on the air only during the time that it is relaying the coded information on the magnetic tape to the ground. This conservation of the chemical batteries is expected to prolong the life of the high-power transmitter to two months.

The high-power transmitter will send only information on cosmic ray activity.

The low-power transmitter in Explorer III, like the low-power transmitter in Explorer I, radiates 10 milliwatts of energy and has a life expectancy of two months.

The low-power transmitter in the third Army satellite will send continuous transmissions to ground stations on the external and internal temperatures of the satellite, cosmic ray counts, and micrometeorite impact.

The micrometeorite experiment is under the responsibility of Dr. Edward Manring of the Air Force Cambridge Research Center.

The micrometeorite experiment will give figures on the density and relative momentum of the tiny, dust-like cosmic particles as they hit a 12-wire grid erosion gauge mounted near the aft end of the satellite.

These wires are connected in parallel to operate a subcarrier of the low-power transmitter. As each wire grid is severed, the subcarrier will experience a small step change in frequency, indicating a high-velocity impact with a micrometeorite five microns or larger.

This wire grid experiment also is on board the first Explorer, along with another micrometeorite experiment which involves a spring impact microphone that catches the impact as micrometeorites hit the steel shell of Explorer I.

The spring impact microphone, however, was not installed on Explorer III.

In the encapsulated package which contains the high-power transmitter and the magnetic tape recorder, there is an ingenious system of coding the time so that it will be possible, on receipt of the signal on the ground, to tell where the satellite was at that time in its orbit when it received specific cosmic ray information.

The capsule has a tuning fork which gives an internal time standard. This standard is used to relate the incidences and intensities of cosmic rays to points where they occurred in the orbit.

In recording cosmic rays in flight, the tape recorder

(Continued on page 36)

Acetylene Gas for Welding and Cutting

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

THE importance of using pure Acetylene in Oxy-Acetylene welding and cutting, because of the numerous advantages that accompany it, cannot be too strongly emphasised. The fact that it is almost impossible to weld certain metals and alloys with impure gas, and that the mechanical and physical properties of other metals and alloys are seriously affected by the use of crude acetylene in the blowpipe, is sufficient justification for directing attention to this important question.

Impure gas is not a very serious fault in scrap cutting, but in ordinary hand cutting, where a degree of neatness and correctness is required, and specially in machine cutting, impure gas is absolutely unsuitable. In addition to producing an unsatisfactory cutting job, impure acetylene gas causes the consumption of excessive volumes of oxygen.

For welding, brazing, etc., a flame composed of oxygen and impure acetylene gas is definitely unsatisfactory and cannot produce welds comparable in strength with the parent metal.

IMPURITIES IN ACETYLENE

Compounds of Phosphorus and Sulphur, Ammonia,

Water vapour and finely sub-divided lime constitute the principal impurities in crude Acetylene. The detrimental effects of Phosphorus and Sulphur on metals are well known. Besides the same, the crusting of blow-pipe nozzles and the pollution of the atmosphere of the workshop are also due to these undesirable constituents of impure gas.

Free nitrogen and water vapour, which bring down the temperature of the flame with consequent increase in the cost of welding, are produced from Ammonia present in the impure gas. Ammonia also attacks the fittings, blowpipes, etc., and causes them to deteriorate.

Apart from reducing the temperature of the flame, water vapour retards the speed of welding and produces defective welds due to oxidation of the metal taking place during welding.

Finely sub-divided lime or lime dust, as it is called, is carried with the gas and passes freely through water. Its presence is a common cause of weak welds and backfire in the blow-pipe. In addition, assisted by the moisture present, it tends to choke up the tubes and to obstruct the small orifices in blowpipes, etc.

(Continued from page 35)

moves at a snail's pace—5/1000th of an inch per second.

After it is interrogated and sends its information to the ground Minitrack stations, the tape recorder runs the tape over an erase magnet which wipes it clean. Then, by a system of cams and electric solenoids, it resets itself to the slow recording speed and collects new information that it will send to earth again on the next pass over the ground stations.

Because it will thus give complete information on cosmic ray levels during its entire orbit, Explorer III is expected to produce some new scientific evidence relating to the geomagnetic fields of the earth.

It is known, for example, that cosmic rays are more

intense at the North and South Poles of the earth, where there is also a greater concentration of magnetic lines which influence the cosmic rays.

Whether or not this phenomenon is related exclusively to the magnetic core of the earth, or is influenced by some outside factor, is a question that is now in dispute.

There is one theory that a belt of ionized particles is traveling in a ring outside the earth's atmosphere to form a current and induce a magnetic field that is independent of the earth's magnetic field.

Some preliminary evidence as to the validity of this theory may be furnished by the cosmic ray data that the third Army satellite gathers.

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REMOVAL OF IMPURITIES

The quality of the gas obtained from an Acetylene generator varies considerably and depends mainly upon :—

- (a) The quality of the carbide used.
- (b) The efficiency of the Generator.
- (c) The speed at which the gas is generated.
- (d) The loading of the generator.
- (e) The proper care, cleaning and maintenance of the generator.

Even when all these factors are satisfactory, the gas will always contain considerable quantities of impurities to affect either the quality of weld or the cost thereof. It is obvious therefore that the removal of these impurities is absolutely essential, if economy and efficiency in the numerous applications of Acetylene in industry are required.

Only washing and filtering the gas by passing it through a vessel containing such materials as cotton wadding, charcoal, pumice, coke, wood shavings, etc., are not considered sufficient, as a result of which the process of purification by using a chemical purifier has come to stay.

Among the best known purifying materials are Heratol, Catalysol, and Suder. The last two items are distinguished by their regenerative properties—that is they recover their chemical activity by simple exposure to the atmosphere and without external assistance, and thus can be used over and over again until the accumulation of impurities render them inefficient.

For efficient purification of the gas, the care and maintenance of the purifying chamber is very important apart from using the best purifying material. The Cross-sectional area of the purifier should be ample, and the depth of purifying material should not exceed that specified by the makers, otherwise loss of pressure and overheating of the gas will take place. The simplest and quickest method of testing the gas is to use a white absorbant paper, saturated with a 10 per cent solution of silver nitrate, and expose it to the gas. Should the paper turns black after a few seconds' exposure, the gas is unsuitable for welding purposes.

In such cases of failures, action to be taken may be stated as follows :

- (i) Change, regenerate or renew the purifying material.
- (ii) Check for the pressure at which the gas reaches the purifier. If it is found to be low, the gasholder should be adjusted to throw an increased pressure.
- (iii) Look for any obstruction in tubes, valves and cocks or too small a cross-section for these details and take appropriate action to remove or change them.
- (iv) Check up for the size of the purifier, if it is too small for the quantity of gas required, it should be changed.
- (v) Ensure that the instructions indicated by the makers of the purifying material have been correctly followed.
- (vi) Make sure that the unions or joints connecting the purifier to the generating plant and piping are leakproof.

DISSOLVED ACETYLENE

Because of the numerous advantages obtainable by the use of dissolved acetylene, the practice of generating acetylene in a generator is fast falling into disuse.

The acetylene in this case is obtained compressed in cylinders filled with a porous mass, the pores of which hold a film of acetone in suspension. Before the gas is compressed into cylinders it is freed entirely from any injurious impurities and dried. The gas is naturally cool (a point of very considerable importance in acetylene applications) and is freed from cylinders at steady pressures and volumes, these pressures and volumes being conveniently ganged to meet the user's immediate requirements. The volume of gas on tap is governed only by the number of cylinders put into use, and, by the employment of a pipe line fed from a battery or by the employment of a multi-cylinder connector, gas to an unlimited volume, is on tap.

In most cases generators are too small to permit conveniently the use of a purifier that can function correctly, and, in any case, even where a suitable purifier has been fixed, this purifier is subject to serious neglect. Also the hydraulic back pressure valve which is the operator's guarantee of personal safety is, in 99% cases, completely ignored by careless operators.

Whilst 1 cwt. of carbide is reckoned to generate

approximately 500 cu. ft. of acetylene, and whilst it is the habit, therefore, to reckon that the cost of 2 cwt. of carbide represents the cost of 1000 cu. ft. of acetylene, this is very far from being the case in effect when small generators are employed. As it is impossible for an operator to reckon the exact footage of gas that will be required for a certain job, it is impossible for him to know exactly how much carbide to put into the generator. Whether too little or too much carbide is put in the generator, there is loss from over-generation and after generation. This loss is generally estimated to be not less than 50%, based on numerous tests carried out in different factories.

Whilst dissolved acetylene is available merely by the opening of one valve, the procuring of acetylene from a generator necessitates a considerable amount of pre-work, and the continued procuring of acetylene from that generator involves sustained work which is not directly applied to weld or cut production. The time loss is fairly considerable. On the operation of one welding or cutting plant, using dissolved acetylene, one man is required. With a small generator, in addition to the actual blow-pipe operator, the services of at least one other man are required.

Owing to irregular generation of acetylene on a small generator, pressure and delivery fluctuate and automatically an irregular mixture of gases is obtained in the blow-pipe. As it is essential for good work that the blow-pipe oxy-acetylene flame be of a certain composition and form, this fluctuation directly results in the continual taking away of the blow-pipe from the job in order that flame adjustment may be made. During this period of flame adjustment two things happen. Both oxygen and acetylene are being consumed to no productive purpose and the job to which the blowpipe has been applied loses heat. In order that the original heat condition may again be obtained, oxygen and acetylene must be used. This means that every stoppage for flame adjustment or for generator attention, results in a double loss, and, not in all cases, but certainly in the majority of cases, this loss represents anything up to 25% of the acetylene reckoned to have been produced by the carbide used.

In conclusion it may be stated that dissolved acetylene will produce better work and will ensure that unnecessary volumes of oxygen shall not be used; by its portability it will speed up work and provide an added convenience; by its safety it will provide a guarantee to life and property.

Two-colour injection machines

An Italian maker offers a small injection machine designed to do away with the costly transfer of two-colour moldings between shots. (Business machine key tabs are probably the most important use for this type of moulding today). The machine consists mainly of a clamping system with an apparatus rotating about it on a crankshaft. The moulds are successively set in five different positions, in two of which the moulding of the two colours is carried out: trimming and ejection operations are done in the others. About 3000 pieces an hour can be turned out in this machine which are manufactured by Messrs. A. Triulzi S. A. S., Via G. Procida 8, Milan. Italy.

RELEASE PAPER

Especially difficult releasing problems encountered in the production and utilization of products having tacky surfaces can reportedly be overcome with a release paper introduced by Daubert Chemical Co., 333 N. Michigan Avenue, Chicago 1. ILL. USA.

The chemically-treated paper has found use as a backing for pressure-sensitive adhesive coated plastics, fabrics, paper, rubber etc. It also performs a useful function in the production of foamed products or sponge. The material is available with one or both sides coated.

All-Plastic Ball Valve. A relatively inexpensive rigid Koroseal PVC self-lubricating ball valve with Teflon seals has been announced by the Plastics Division of B.F. Goodrich Industrial Products Co., Marietta OHIO. The product is said to be lighter in weight and more compact than other PVC valves, and the ball valve provides easy take-up to compensate for wear. Replacement parts are reported to be easy to install. The quick-opening valve has no metal parts and is said to have chemical resistance equal to high impact rigid Koroseal Grade 300. Recommended working pressures for sizes $\frac{1}{4}$ through $1\frac{1}{2}$ in. are: 140 p.s.i. at 100°F.; 70 p.s.i. at 130°F. and for 2 and 3-in. sizes, 100 p.s.i. at 100°F. and 50 p.s.i. at 130°F.

Private Enterprise Must Further Social Ends

CHIEF MINISTER'S CALL TO BUSINESS MEN

Mr. Y. B. Chavan, Chief Minister of Bombay, assured a large and distinguished gathering of the mercantile community in Bombay that he would do his best to make the State prosper within the objectives and policies which the country had adopted for building up a welfare State.

All suggestions for improvement in the economy and difficulties experienced by the trade and industry in the actual enforcement of legislative and other measures affecting them in day-to-day matters would be examined carefully and acted upon on merits, he added.

The Chief Minister was inaugurating the Bombay State Business Men's Convention. Representatives of more than 150 trade associations in the State participated in the convention. Mr. Chavan, therefore, aptly remarked that "for the first time the representatives of trade and industry in the State were meeting together to work as partners in the economic progress of the country in a co-operative and constructive spirit."

Mr. Chavan, however, asked the business community to bear in mind that "a Socialist society had to be built up not solely on monetary incentives but on ideas of service to society." The basic criterion for determining the lines of advance, he said, had to be not private gain but social gain. Private enterprise, free pricing and private management were, according to him, devices only to further what were truly social ends. They could only be justified in terms of gains accruing to society as a whole.

PRIVATE SECTOR VITAL

The Chief Minister justified the existence of public sector. "In a growing economy" he said, "where conditions are diversified, there is scope for both public and private sectors to expand simultaneously. However, if development is to proceed at the pace envisaged and to contribute effectively to the attainment of the larger social ends in view, it is inevitable that the public sector has to grow in its own sphere and also relatively to the private sector."

The total outlay of Bombay State's Second Five-

Year Plan which is an integral part of the National Plan, is of the order of Rs. 350 crores. A recent review of the resources indicates that the State Government will be able to find about Rs. 228 crores from its own sources for financing the Plan. The balance is expected to be received from the Centre by way of assistance. The Chief Minister pointed out that for the co-ordinated development of agriculture and power, nearly, 39 percent, of the total Plan allocation of Rs. 350.28 crores was earmarked for irrigation and power.

KOYNA POWER

Mr. Chavan tried to remove doubts unnecessarily created in certain sections regarding the utilisation of Koyna electricity in the surrounding areas of Maharashtra. He assured those in doubt that such utilisation was being planned. High priority had been given to the completion of the major and medium irrigation works carried over from the First Plan and also to the construction of road links for connecting the regions which had merged in the new Bombay State. The State would require 70,000 miles of roads, of which about 43,000 miles of roads were expected to be ready by the end of the Second Plan, he added.

Earlier, Mr. G. P. Kapadia, President of the convention, pleaded for a natural growth of the private sector in the developmental economy of the country. The existing arrangement under the industrial policy statement demarcating spheres of industrial activity as between the private and public sector, he said, had to be reviewed in the light of actual performances in the two spheres so far and the requirements and possibilities in the future. He suggested that the working of the Capital Issues (Control) Act be examined more critically.

The new Companies Act, Mr. Kapadia said, was not conducive to either promotion of corporate enterprise or its proper functioning.

Mr. Kapadia vehemently opposed the decision of the Central Government in directing the states to take over the wholesale trade in food grains. This was the most unwarranted intrusion by the State. He suggested that no hasty steps should be taken.

INDUSTRIAL SNIPPETS

DURGAPUR "ENCOURAGING EXAMPLE" OF INDO-U.K. CO-OPERATION

Lord Simon's Letter to "Guardian"

"A remarkable and encouraging example of friendly and effective co-operation between Britain and India" is how Lord Simon of Wythenshawe describes the steelworks being set up at Durgapur, West Bengal. In a letter to the *Manchester Guardian* he writes:

"May I congratulate you on the excellent article in your issue of November 12 on the Indian steelworks which is being erected by a British group; and may I, as president of one of the firms closely concerned with it, add one or two points which I hope may be of general interest? May I, at the same time, draw attention to Walter Lippmann's article in today's issue (November 14) in which he argues that one of the great questions before the world today is whether the Communists or the West are to be the leaders in helping Asia and Africa to carry through the reforms they desire, and suggests that this depends largely on leadership in the economic field?"

"May I suggest that the British order for the Indian steel-works is a good example of co-operation by the West which is accepted by India as being helpful and valuable?"

"I should like to add that the success which this great plant is so far achieving is due to the co-operation of three groups: first, the industrialists who built up a special organization and who are carrying the work through; secondly, the British Government and the British banks whose very willing, generous, and efficient help has been so important a factor that it is fair to say the contract could not have been carried through without it; and thirdly, the Indian Government, who have given us at all stages every help in their power, and perhaps I ought to add the hundreds of Indian members of the Government, the civil servants, the officials in and around Calcutta, and the Indian engineers and workmen on the plant.

"The contract is, I believe, the largest single export contract which this country has ever received. I suggest that it has been a remarkable and encourag-

ing example of friendly and effective co-operation between Britain and India".

* * * * *

SPECIAL COURSE IN LONDON FOR TRAINEES

Sixteen Indian engineering graduates, members of a party of 19 who have just arrived in the United Kingdom for training for supervisory posts in the Durgapur steelworks, are now undergoing in London a special introductory course arranged by the British Council. They leave London on November 21 for the steel companies with which they will work. They are the fourth party out of a total of 300 Indian engineers who are being trained for Durgapur posts in the United Kingdom.

The London course includes lectures by leading educational authorities on the British Government and the welfare of the working classes in Britain. Prominent industrialists are addressing the trainees on British industry, with particular reference to steel, and the course includes a lecture on Durgapur by the chief engineer of the Indian Steelworks Construction Co., Mr. W. H. Hindson.

The trainees, with the steel companies to which they are being assigned indicated in brackets, are: M. S. Gauba, Delhi Polytechnic (John Summers & Sons, Chester); S. N. Mukherjee, College of Engineering & Technology, Jadavpur, Calcutta (Steel Company of Wales); N. G. Paul, College of Engineering & Technology, Jadavpur (Stewarts & Lloyds); A. R. Ganguli, Asutosh College, Calcutta (Appleby-Frodingham Steel Co., Scunthorpe); P.G.P. Pillai, V. C. College, Alwaye (Park Gate Iron & Steel Co., Rotherham); M. B. Nagarajan, Indian Institute of Science, Bangalore (Skinningrove Iron & Steel Works, Saltburn); G. S. Raiker, College of Engineering, Poona (Lancashire Steel Corp., Manchester); V. V. Rao, Indian Institute of Science, Bangalore (British Oxygen Linde Co., London); S. N. Pramanik, College of Engineering & Technology, Calcutta (Steel Company of Wales); Y. H. Gharpure, Laxminarayan Institute of Technology, Nagpur (Simon-Carves Ltd.); B. K. Adak, Jadavpur University, Calcutta (Consett Iron Co. Ltd., Durham);

N. K. Ohri, Delhi Polytechnic (Appleby-Frodingham Steel Co.); S. Pereira, College of Engineering, Guindy, Madras (Richard Thomas & Baldwins, Ebbw Vale); C. K. Malhan, Birla College of Engineering, Pilani (Steel, Peech & Tozer, Sheffield); S. Ramakrishnan, Government College of Technology, Coimbatore (Steel, Peech & Tozer); and D. L. N. Rao, Indian Institute of Science, Bangalore (Park Gate Iron & Steel Co.).

* * * * *

INDO-BRITISH INDUSTRIAL ENTERPRISE EXPANDS

Manufacture of Electric Tools

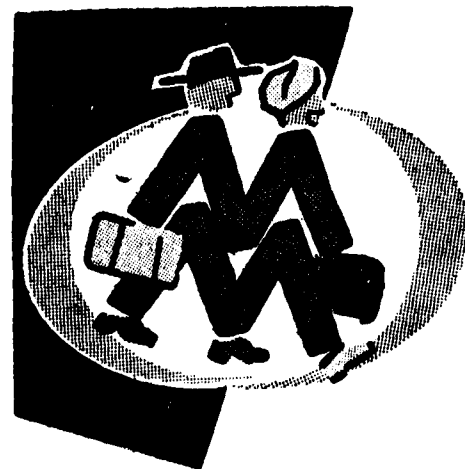
Further expansion in the range of Wolf electric tools manufactured in India is promised by the joint Wolf Electric Tools Ltd. - Rallis India Ltd. enterprise at Mulund, near Bombay.

The present range of Indian-produced tools, states the London office of the new firm—Ralliwolf Private Ltd.—will be extended to cover more specialized types. These will include portable grinders, sanders, flexible shaft grinders, lathe grinders, blowers, and valve seat grinders.

The new industry was started in India two years ago, when Wolf Electric Tools Ltd. joined forces with Rallis Ltd. to assemble a limited range of electric tools, partly from components sent from England but using, wherever possible, local sources for other materials.

Now, Ralliwolf announces, the stage is set for progressive expansion. With building operations for the Mulund factory under way and scheduled to be completed by the middle of 1959, manufacturing processes will be extended progressively, and the existing range of tools extended.

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TEXTILES SECTION

World's Most Modern Spinning Frame — The Whitin Model K

By An American Correspondent

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

The Spinning Frame of the present and the Spinning Frame for the future

THE Whitin Machine Works is proud to introduce and present the world's most modern spinning frame—the MODEL K. An entirely different machine from any of its famous whitin predecessors and a product of one of the world's largest textile research centers, the Whitin MODEL K Spinning frame has every advanced element in textile engineering and spinning technology, including many new features never available before. At the same time, this new machine has been designed in its entirety to embody the most modern concepts in machine design as well as to utilize the products of the latest type high precision machine tools.

Lines, coloring and style of the MODEL K were executed by Raymond Loewy Associates, world famous industrial designing firm, achieving an exceptional combination of form and function. The machine's performance, productivity and operational efficiency will make it attractive to manufacturing executives whose goals are specific and based on costs; its pleasing appearance will be a source of pride to all those who work with it.

The Whitin MODEL K is the frame which, because of its new design and features broadens the horizons of the textile industry to new areas in quality and productivity with lower productive costs, beyond those now known.

NEW FEATURES

The MODEL K features include: 27" overall width, covered individual spindle drive from side drive shafts, straight line spinning, traverses up to 12", and

scientific balloon control ring application. All gearing is enclosed in the head end, as is the new builder. The pneumatic waste removal unit is integrated into the machine design and a new arrangement is provided to disperse heat generated by the motor enclosed in the foot end. The MODEL K uses the latest type Whitin SUPERDRAFT two-apron drafting system and UNITROL top arm weighting. Available in either 3½" or 4" gauge, the machines can be made up to 312 spindles for 3½" gauge, or 264 spindles for 4" gauge in increments of 24 spindles. Minimum difference between ring diameter and gauge is 1".

TESTED OPERATION

Testing of the machine and all its components has been carried out over a long period of time not only in the large Whitin Research Department under mill conditions, but also in mills in the broad range of production spinning from carded coarse counts to combed fine counts. The operational and test results more than substantiate the goals and objectives set up by its designers, based on the company's century and more experience in building spinning frames known through the industry for their productivity, quality performance and profit making capacity.

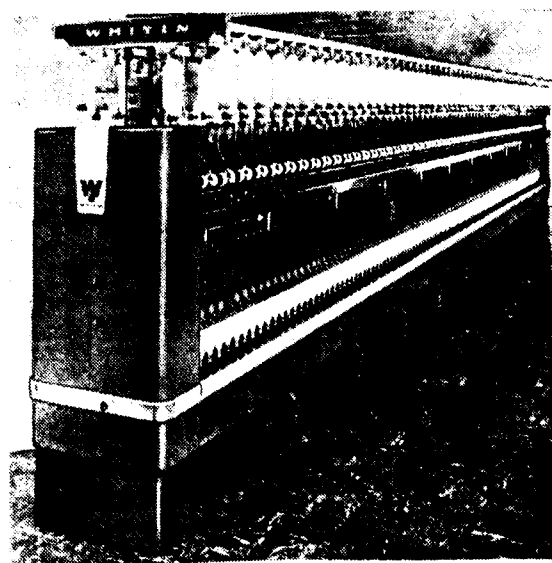
BASIC DESIGN

In the design of its new MODEL K Spinning frame, Whitin considered all the possibilities. A gradually growing industry desire for a frame occupying less floor space was recognized, and a frame width of 27" adopted. Rather than mechanically and physically compress the present frame components into this

reduced width or alternatively, to compromise by partial design modifications and add only these new features which could be superimposed on such a narrowed chassis, the MODEL K design results in a markedly different frame in which several important operating and mechanical advantages were secured. Chief among these are: reduced floor space; elimination of the cylinder, cross shafts and under-frame pulleys; improved performance, better spinning conditions, and improved yarn quality; greater frame cleanliness, and decreased operating, production and maintenance costs. Forward placement of the roll stands puts the bite of the rolls over the spindle, and the balloon control rings and yarn guides are ideally positioned and their motion most efficiently and accurately controlled. Of special importance is the sharp reduction in air currents, turbulence and windage in, under, and beside the machine. An ingenious arrangement removes the heat generated by the motor away from the frame immediately, contributing to more even relative humidity conditions in the immediate vicinity of the spindle, yarn and drafting areas.

GENERAL FRAME CONSTRUCTION

In the basic frame and chassis details, particular attention has been given to securing structural rigidity and capacity for absorption of vibration. The head end, which contains all the operating assemblies, is cast iron. Cast iron side rails, steel ring rails and roller beam are all supported by sampsons spaced every twelve spindles. Additional roller beam supports



Only 27" wide, the Model K features increased production from less floor space, improved quality yarns and beautiful styling.

and frame rigidity are provided by ring rail and balloon control ring guide sampsons and top sampson bridges. In addition, single piece roll stands extend across the frame, connecting both sides. A spindle drive shaft is mounted outside each spindle rail with belt, guide and tension pulleys at each spindle position. The drive shafts are mounted in sealed antifriction self-aligning bearings and consist of short sections connected together by reinforced split couplings.

A distinct feature of the frame is its precision construction with parts machined to close tolerances, to provide the operational stability so necessary for high speeds and optimum performance.

NARROW WIDTH

The overall 27" width of the MODEL K allows the maximum use of floor space. Floor space occupation by this new machine ranges from 25 to 35 per cent less than the standard 39" frame, which with bumper rods, requires 42". The architecture of present mill building erected with construction techniques requiring 24, 25 or 26 foot bays between supporting columns restricts the number of spinning frames and spindles that can be accommodated in a given area.

The total number of spindles which can be placed in a given area is influenced by many factors such as: mill managerial, manufacturing and processing policies and practices. Relative humidity, temperature and cleaning equipment used and many other physical factors relevant to the spinning department also have a bearing on the maximum utilization of floor space and spindle containment.

The smaller space requirement for the MODEL K will result in more spindles in the same area, and increased production per square foot of floor space. The MODEL K design eliminates two disadvantages commonly encountered when placing five narrow frames in the space now occupied by four machines. The first of these is "wind tunneling". This term describes the concentrated air streams and turbulence found in the alleys and around the spinning and drafting areas, the effects of which cause an increase in ends down, one end down too frequently affecting one or more adjacent spindles. The second is described as "snowstorming" and also caused by excessive windage and air currents beside and around the frames. This situation is evident by excessive deposit of lint everywhere on the frame and in the atmosphere. High speed revolution of a small cylinder in a confined area

and exposed, long, spindle tapes moving at high linear velocities are recognized as the principal cause of some of these excessive air eddies and rapidly moving air streams. The absence of the cylinder and exposed spindle driving elements in the MODEL K eliminates this cause of the turbulence.

SINGLE SPINDLE DRIVE

To drive the spindles, an entirely new arrangement is used on the Whitin MODEL K spinning frame. Each spindle is driven by a $\frac{1}{4} \times 20$ " strong, one piece belt. With 180° contact on the $1\frac{1}{8}$ " spindle whorl, this belt drive provides uniform spindle speeds and uniform twist generation. The belt passes over 120° of the shaft driving pulley, under a tension pulley and over an idler pulley, all mounted on sealed-for-life anti-friction bearings. The ratio of spindle drive shaft speed to spindle speed is 2.50. This single spindle drive eliminates the cylinder, cylinder bearings, tape tension pulleys and tapes and, of course, all the maintenance required for them.

Since the spindles are independently driven, the starting, stoppage or operation of one spindle in no way affects the operation of any other spindle. Only one spindle is involved when a spindle is stopped to piece up an end or to change spindle drive belt.

Replacement of the spindle driving belts is the essence of simplicity and requires less than ten seconds, whether the frame is running or stopped. The belt is removed by slipping it off the pulleys and drawing it up through the ring, up and over the spindle, or just by cutting, if it is to be discarded.

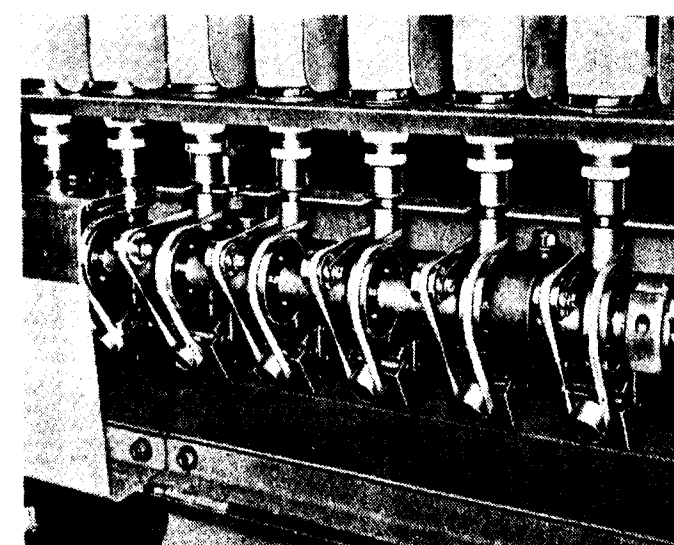
Replacement is done by dropping the belt around and down the spindle, through the ring, around the whorl, over the shaft pulley, under the tension and on the idler pulleys. Since all elements are completely accessible and conveniently located, the operation can be performed as a single continuous motion.

STRAIGHT LINE SPINNING

A straight line for the yarn path between the drafting apparatus and the spindle is neither new nor revolutionary. In fact, it is as old as the spinner's art, even dating into pre-history. It was used in hand spinning with spindle and stone whorl, the Saxony spinning wheel and the wool spinning wheel. A departure from straight line spinning was made on the mule by the angulation of the spindle, and a still different angular yarn path was utilized on the ring

spinning frame for manufacturing and spinning convenience. In practice, the modification served extremely well, becoming a useful factor favorably influencing broad developments in the design of spinning frame creels, drafting systems, spindle drive and other frame elements.

Interest in the straight line for the yarn was renewed in the past several decades by the activity of several investigators and inventors and has been given serious continuing study. However, the industry trend to traverses longer than 9", high spindle speeds, and large rings, and the search for improving spinning conditions to reduce labor factors in productivity brought this topic once more to the foreground to meet the necessities imposed by these conditions. These conditions today involve other factors not considered critical until recently i. e., very large roving packages that must be accommodated in a creel, systems with higher drafting capacity, and speeds of high order.



Spindles are individually driven by narrow, easily applied, endless long wearing belts.

But, successful straight line spinning at high speeds with long traverses is closely related to reduction and control of the increased yarn tension developed by the longer balloon formed.

An advantage of straight line spinning from the front rolls to the spindle is that the twist can run unimpeded from the traveler into the bite of the front rolls. This fairly even distribution of the twist up to that point gives increased strength to the yarn just as it emerges from the front rolls. It is at this point, according to the evidence, that the largest percentage of end breaks occur.

By improving the twist distribution and extension, the physical result is the improvement of the spinning condition. In practice, this can be translated into a lower twist multiple to meet present break standards, increased front roll speed and higher production of more even yarns. The straight line spinning and improved twist distribution is complemented nicely by the new MODEL K single spindle drive which provides very uniform spindle speeds, the combination being significant in reducing ends down.

BALLOON CONTROL RINGS

As package lengths increase above 9" and as speed increases, tension and control of the balloon become critical. Analysis of the whole problem and the uses of balloon control devices for the minimization of tension are far from simple. There are more than 25 variable factors involved, including ring diameter, spindle speed, count and yarn diameter, angle of yarn pull, bobbin diameter, air drag, centrifugal force, traveler weight and shape, traverse, length of yarn, yarn speed, balloon dimensions, and several frictional forces, naming the most obvious.

In spinning, with a constant balloon diameter, yarn tension is proportional to the square of the spindle speed, and also to the square of the height of the balloon formed. The ballooning yarn at any given instant occupies a position which constitutes a complex curve, identified as a segment of a helicoidal sinusoid.

To provide proper control of the yarn in its helicoidal or spiral path from the front rolls to the traveler and to reduce the yarn tension, the Whitin MODEL K has a special combination of two balloon control rings slightly larger than the spinning ring. A very small thread guide is also used. The balloon control rings and the thread guide all move simultaneously the same distance, maintaining a fixed distance relationship with each other. The two balloon control rings are located above the center of the traverse. In operation, the balloon control rings act to divide the balloon into three balloons having small diameters and short lengths, resulting in most satisfactory control of all the variables.

The special combination of size, shape, position, motion and operation of the balloon control rings on the Whitin MODEL K Spinning frame was adopted after lengthy experiment, mathematical analysis and consultation with world recognized authorities in the scientific fields involved. In operation, the balloon

control rings are so placed during the building of the bobbin that the length of the three balloon segments formed is such that the yarn tension is reduced to a low order and confined to a narrow range all through the whole traverse cycle from bottom of bobbin to the top.

Reduction of yarn tension makes its greatest contribution to betterment of the spinning condition and reducing the number of ends down. Experience to date on the MODEL K indicates that this improvement is marked and significant. Since piecing up ends constitutes approximately 25—40% of an operator's duties, hence reduction in ends down affects the operator assignments and reduces spinning costs.

Selection of the correct traveler with the balloon control arrangement used on the MODEL K is made far easier than would be thought possible. Inspection of the yarn path as it passes by the control rings reveals instantly whether the traveler is too light, too heavy, or approximately correct for the yarn count and spinning condition.

More uniform yarn tension, longer distance for twist distribution, and fewer ends down all contribute to more uniform, more even and stronger yarn. The cost benefits here are obvious: better quality finished yarn and fabrics, fewer seconds, reduced burling, weaving, winding, slashing, warping, and spooling costs. Test and mill operation have indicated that the special combination of balloon control rings for tension control and the straight line spinning condition on the Whitin MODEL K permit greater production from higher front roll speeds with no increase in ends down.

A panel supports the two balloon control rings and thread guide. Prior to doffing, all three are raised and folded back against the panel entirely out of the way allowing the bobbin to be removed from the spindle without interference. This is an important factor in reducing time required for doffing. A crank is inserted in the head end to operate the mechanism for raising the panels, balloon control rings and thread guides on both sides of the frames simultaneously and for returning these parts to their operative position. Five seconds or less is required in each operation. So small is the force required, any doffer can operate the motion easily and quickly.

For piecing up, the balloon control rings are self-threading; the pigtail shaped thread guide is threaded as usual.

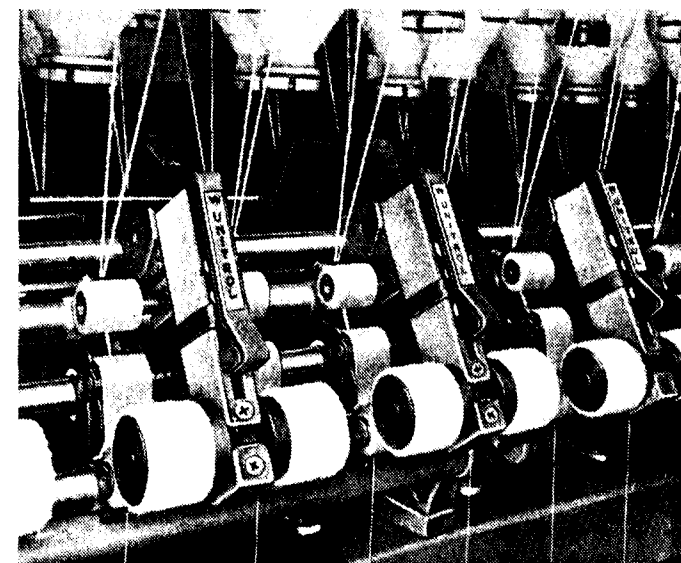
SPINDLES AND BRAKE

The Whitin MODEL K PIONEER center-base spindle is the latest antifriction type, equipped with a new positive-action hand brake. The center base spindle design utilizes multiple and compound sliding features which result in strong self-centering characteristics and excellent absorption of vibration. A substantial range of spindle bobbin fits is available to create the optimum angle of yarn pull. Each spindle is mounted on the precision machined spindle rail and held in position by a bolster case nut. One of the most important elements in the spinning frame, Whitin PIONEER spindles are recognized as being not only remarkably strong and stable in running performance at high speeds, but having the lowest maintenance, lubrication, and operational costs.

The new brake is actuated by a hand lever conveniently mounted on top of the spindle drive enclosure. It has two arms, cam operated, which exert a balanced pressure on the spindle and stops it instantly. Only a slight effort is required to operate the brake.

SEPARATORS

Full length separators are mounted on tiltable brackets, preventing interference with adjacent ends when one end breaks. The separators are handled by the doffer in the usual manner.



Latest type Unitrol top roll weighting arrangement is accurate and positive. Release of weighting is made very easy by lifting arm cover. Whitin Super-Draft two-apron drafting system handles fibers up to 3".

ENTIRELY NEW HEAD END—NEW GEARING ARRANGEMENT—NEW BUILDER

The sleek, streamlined head end contains the main drive reduction gearing, all the draft and roll gearing, the cam complete builder mechanism and the actuating mechanisms for the chains and springs moving the ring rail and balloon control ring panel. Identification and location of all these components and assemblies are illustrated in Fig. 00.

A major objective was to reduce the gearing and builder components to their simplest possible form, making instructional and operational procedures common-sense and virtually foolproof. All gears used are case-hardened steel or of a special alloy and precisely cut. All change gears have the same bore, face and pitch, permitting interchangeability of draft, twist, and lay gears. Only one wrench is required for gear changing. Lubrication of head end gearing is reduced to greasing eight bearings in the builder once in six months, an item requiring less than five minutes. All other bearings in the head end are sealed antifriction type, lubricated for their life.

Also contained in the head end are the three manually operated winding mechanisms for a.) the balloon control rings, b.) the ring rails and c.) the builder. The doffer controls the position of the three during the doffing procedure from the same position by inserting a crank into the ends of shafts by which these mechanisms are operated.

Securing maximum utilization of space, simplification of gear arrangement, easy accessibility of all change gearing and minimum gear requirements in inventory, are provided by the completely new gearing arrangement in the head end. With the frame stopped and after opening the safety-lock doors, all the gears for changing twist, drafts and lay are unobstructed. Gearing for changing break-draft, twist constant, twist direction and draft are also easy to reach, remove or replace.

DRAFT AND TWIST GEARING

Four draft constants are available on any PIED-MONT frame by changing two gears, the total range of drafts being from 5—75.

A two-gear combination secures any one of these four constants: 1.33, 2.00, 4.00 and 8.00. In normal practice the frames would be used with one of these constants, unless a very substantial change in the

range of yarn counts run was undertaken. Determination of the proper draft change gear is very simple, in fact the simplest procedure available on any spinning frame. To find the number of teeth required in the single draft gear, the draft is multiplied by the particular constant used on that frame.

It should be noted that each of these range con-

stants provides a very wide range of drafts and twist and that any of these four constants can be secured on any MODEL K frame in a moment simply by changing two accessible gears. The range constants of 2.00 and 4.00 will cover nearly every spinning requirement encountered in all but the very finest and coarsest counts. The following table illustrates how the teeth in the draft gear can be found easily for any of the range constants being used on the frame.

TEETH IN DRAFT CHANGE GEAR = DRAFT* DESIRED × RANGE CONSTANT				
For Draft* of	60	30	18	10
with Gear Combination and Draft Constant	Gears 90/30 = 1.33	Gears 80/40 = 2.00	Gears 60/60 = 4.00	Gears 40/80 = 8.00
Draft Change Gear Has	60 × 1.33 = 80T	30 × 2 = 60T	18 × 4 = 72T	10 × 8 = 80T

* Including contraction

With five gear sizes: 30T, 40T, 60T, 80T and 90T, all ranges of drafts from 5—75 and twist turns from 5—50 are instantly available. The complete flexibility of the drafting arrangement requires the stocking of only a minimum number of draft change gears and the use of most practical and economical gear sizes. For the spinning overseer and section man, their ability to check the draft or twist instantly by looking at the draft or twist change gear will be distinctly appreciated.

Calculation of twist change gear teeth is likewise as easy and follows the same procedure. The number of teeth in the twist gear equals the number of turns per inch desired multiplied by the twist constant used.

For example :

TEETH IN TWIST CHANGE GEAR = TPI DESIRED × RANGE CONSTANT				
For Turns per Inch	22	16	6	
with Twist Constant	Gears 80/40 = 2.00	Gears 60/60 = 4.00	Gears 40/80 = 8.00	
Then Twist Change Gear Has	22 × 2 = 44T	16 × 4 = 64T	6 × 8 = 48T	

A broad range of lay selection is available for flexibility and accuracy; in normal practice, the combination of gears used would be limited to two.

The simplification of the gearing and easy selection of the proper gear size eliminates the calculations and formulas formerly required. This feature of the MODEL K will appeal strongly to supervisors and fixers as will the other elements on the frame which perform the same function they always did but with mechanisms that are simpler and easier to adjust and more efficient.

DRIVE PATH

From the motor in the foot end, power is transmitted to a jack shaft from which the spindle drive shafts on each side of the frame are driven. Drive for the head end elements is taken from the left side spindle shaft by means of a timing belt and gear reduction box. The latter supplies power through intermediate gears to the drafting rolls on both sides of the frame and then through a connecting shaft to the cam gear, cam, builder and control ring mechanism. The gearing arrangement permits the entire machine to be turned over by hand, even with the roll weighting applied.

NEW BUILDER

Another important and significant improvement is obtained by the new builder design and an entirely

different arrangement for transmitting the cam action into precisely controlled motions for the ring rails and balloon control rings. Simplified adjustments and operation of the builder for these motions and for precise pick selection are some of its distinguishing features.

The movement of the cam actuates a pivoted arm which transfers its motion to another arm and a sliding member that is connected by a chain to a cross shaft. The latter is given an oscillating motion to reciprocate the ring rails and balloon control rings.

Uniform counterbalance of the ring rails and the balloon control rings, thread guides and their supporting panels is obtained by springs having a cable connection with a compensating cam on the cross shaft referred to.

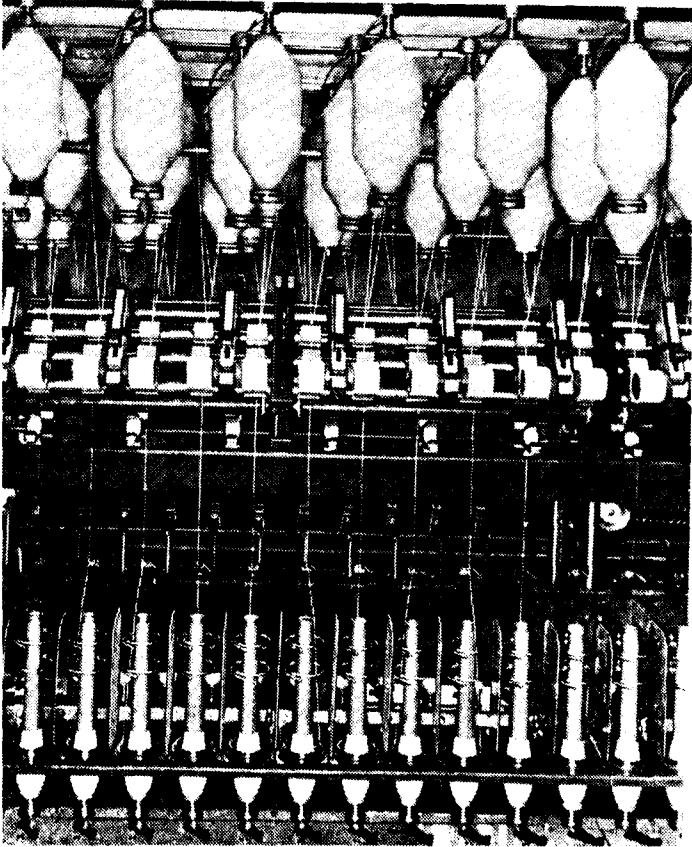
The basic design principles of this builder have been thoroughly tested over a long period of time. Because of its functional operation, it provides that precise control of ring rail motion, so vitally important to: good bobbin tapers, bobbin formation, wind yarn lay and high speed wind-off characteristics of the yarn. Warp, filling or combination winds can be used.

Excellent winding-off characteristics are secured with the filling cam provided and with this new builder, without sloughing at high winding-off speeds—a very much desired objective—enabling mills to reduce winding costs. The function of the bobbin building mechanisms is such that this smooth wind-off is secured with that desirable spinning condition obtained with a faster ring rail upward motion and a slower downward motion. Utilization of this rail motion speed combination reduces traveler wear, rate of yarn tension change, and results in fewer ends down.

Since winding-on, or bobbin building is one of the three major functions of a spinning frame—the other two being drafting and twist insertion—the advanced performance of the MODEL K Spinning frame in this regard is one of the very attractive operating features of the frame. In many mills loss from tangled or poorly built bobbins multiply small losses from waste or from inadequate yardage on the bobbin to quite substantial yearly sums.

LIFTING CHAINS

The chain mechanism for the rail motion insures



Frame side showing new balloon control ring arrangement.

continuous smooth rail movements. The chains are connected to ring rail brackets. Sliding brackets to which the ring rails are secured are provided with antifriction rolls and are traversed on fixed posts by chains actuated by the builder motion.

The possibility of lint interfering with the motion of the rails is, for all practical purposes, eliminated. The same fixed posts also serve to guide the motion of the balloon ring panels. The steady motion of the rails and balloon control rings insures accurately wound bobbins.

Compensation for slight stretch and wear of the chains is made by take-up bolts.

WHITIN SUPER-DRAFT AND UNITROL

The drafting system used on the Whitin MODEL K Spinning frame is the Whitin SUPER-DRAFT System. The fact that this system has been installed as new equipment or as a changeover of older Whitin and other frames on more than 5,000,000 spindles in the past few years alone, is evidence of its value in the minds of the managers of leading mills.

Adopted in the U. S. in 1929 by Whitin, the original Casablancas two-apron drafting technique has been modified and improved by Whitin research. The Super-Draft two-apron system provides accurate control of the fibers, flexibility in handling cotton and spun synthetic fibers in lengths up to 3', and excellent all-round performance on the full range of drafts and on all counts from the coarsest to the finest. Roll stands are adjustable for the varying fiber lengths.

Bottom rolls are casehardened and screw jointed, carefully manufactured to close standards of concentricity. Top rolls are antifriction type in the front line. Non-lubricated rolls are used in the middle and back lines. Hence, except for several-year cycle lubrication of the front roll bearings, no lubrication is required. Covered, wood-type reservoir inserts shield the bottom roll bearings, serving the double duty of protecting the bearing from lint and providing oil in the amount required.

The latest type Whitin UNITROL top arm weighting arrangement is used on the MODEL K. This smooth clean-lined self-contained unit encloses pre-calibrated springs which can provide any desired weighting for the rolls. Roll weighting is easily applied and released by moving the top cover. A single line of clearers is used, leaving the remainder of the drafting area open to the cleaning action of the overhead cleaners now extensively used. The advantages of this type of top roll and weighting by its elimination of backbars and gudgeons is well recognized.

PIECING UP

Piecing up broken ends can be accomplished either by the usual method or by piecing up behind the front roll.

WASTE REMOVAL AND CLEANLINESS

Incorporated integrally into the basic frame design, the ducting and orifices of the pneumatic waste removal and broken end collectors enhance the general frame cleanliness, while requiring the minimum use of space. Because of the streamlined design and enclosure of operating units formerly exposed to lint, dirt, and grease, the absence of cylinder, cross shafts, tape tension pulleys, builders and other elements formerly contained under the frame, the MODEL K will require far less cleaning attention than conventional or other narrow frames. In fact, its design brings the spinning frame a long stride forward toward the goal of automation in spinning insofar as cleaning is concerned.

MOTOR HEAT REMOVAL

A new arrangement is provided for dispersing motor heat from the motor enclosed in the foot end. Cleaned air from the waste removal system passes over the motor and is then blown upwards, or directionally if desired. Removal of motor heat prevents concentration of heat near the end of the frame and the reduction in relative humidity in such heated areas. This Pneumakool* system for removing motor heat is a product of The Pneumafil Corporation.

CREEL

A new umbrella creel has been designed for the MODEL K providing optimum roving bobbin placement and permits better cleaning. Casablancas bobbin holders are employed. A two post creel support increases rigidity of the unit.

PIEDMONT AND FUTURE INDUSTRY NEEDS

Consideration of future industry needs was a special objective in the design of the Whitin MODEL K Spinning frame. As the industry proceeds towards higher and higher speeds, longer traverses, increased operator productivity and increased poundage per square foot of floor space, and decreased maintenance and cleaning, the MODEL K has every feature that will permit maximum utilization of the advantages offered by these practices. As the shuttle-less loom becomes widely used, the MODEL K will be pre-eminently adapted to industry needs for large package production of filling yarns from the same area now housing narrow gauge standard filling frames. Never before has the industry been offered a single machine so ideally suited to the needs of its time yet incorporating in its design so many advanced features to augment its value in the future.

SUMMARY

Features of the Whitin MODEL K Spinning frame, each individually important, in sum, make a powerful, impressive total. Some contribute to higher speeds, greater production, improved yarn quality and fewer ends down, others to reduced space use, decreased operating, maintenance and production costs. The open construction, clean under-chassis, and streamlined housings invite maximum use of air cleaning and minimize hand cleaning.

All together they provide the textile industry with the newest frame in the world—The Whitin MODEL K

The Spinning Frame of the PRESENT
and THE Spinning Frame of the FUTURE!

* Trademark — Pneumafil Corporation

Progress in the Dyeing of Textile Materials

By L. S. Thompson

Manager, Special Projects General Dyestuff Company,
General Aniline & Film Corp. New York, N.Y.

COMBINING production with top quality is the foremost thought of any good management. We are all aware that these are vital points: unfortunately not every plant has the equipment or personnel to obtain the standards desired.

It has been proven that a combination of modern equipment and know-how usually keeps a plant busy and in a position to compete price-wise with properly finished goods.

In the presentation of this paper, it is our intention to illustrate and explain some of the latest types of equipment and methods that are employed for the preparation, dyeing, and finishing of cotton and some of the synthetic fibers.

COTTON PREPARE

Fabric preparation: The first and very important part of successful handling is started by laying out and sewing in the grey room, run through gas-fired singers, immediately into a desizing pad which acts as quench as well as saturation for the enzyme. Excessively high speeds are employed and it has been found that by steeping 3 to 6 hours prior to saturating with a weak solution of sulfuric acid followed by slosh washing, residual impurities are removed in a simple manner.

Before discussing the newer types of continuous bleach, I believe it is most fitting that we emphasize the importance of the oldest work-house which is still the backbone of good cotton prepare, namely, the kier. Production-wise, a five-ton kier will produce 50—60,000 yards per day depending on the weight of the fabric. Many plants keep this type of equipment for specialties although their newer type ranges produce more yards per hour.

Continuous peroxide bleaching is now firmly established for ease of handling and control and it is adaptable to the processing of cloth either in rope form or in the open width.

In a typical BECCO two-stage continuous rope peroxide bleaching operation grey goods that have

been sewn, singed, and desized enter the washer at one end, pass through a squeezer and on to the caustic saturator where they pick up a $\frac{3}{4}$ per cent solution of caustic soda. In the caustic J-box they steam for one to 1½ hours to purify the cotton fibres making them more receptive to further treatments.

Leaving the caustic J-box they are washed, saturated with a solution of hydrogen peroxide, sodium silicate, and a very small amount of caustic soda; and passed on to the peroxide J-box. Here in one hour's time steam and chemicals combine to bleach to the desired whiteness and goods are passed on through another washing and final squeeze to the white bin.

Depending on the size of production, there are many variations of this range. For example, it is possible to use only one-half of the range first for alkali prepare, washing, and then to re-run using the saturator and J-box for peroxide bleach.

Recently we had the opportunity of viewing another continuous bleach range which is designed for open width known as the *Benteler Continuous Open-Width Bleach Range*.

As its name implies, this range can be used both for desizing and bleaching in open-width at speeds of 44 to 87 yards per minute. A brief description of this machine shows the fabric coming from a truck and entering a steam chamber to be aired and to obtain its maximum absorption.

"The steeping or softening effect of the steam is not concentrated entirely on the size in the fabric but also on any seed. The fabric passes from the steaming chamber into the impregnating chamber in a complete vacuum. As it goes through this latter part, which contains desizing agents, the fabric goes through three light nips and then through a heavier one at the exit which pads in the impregnating fluid deeply; this last pressure mechanism can be easily adjusted so that it is possible to regulate the degree of absorption.

"As the next stage of the process, the fabric passes through the very heart of the machine, namely, the

continuous batch box in which it remains for a period varying between 30 and 80 minutes according to requirements. These periods of time are made possible without interrupting the continuity of the process by a system of batching on and batching off, in which, by virtue of a completely new construction, two lengths of fabric can be batched one upon top of the other. In batching off only the bottom layer is pulled of either the lower or upper batch and then carried into the following steamer.

"The object of this steamer is to bring the size which has already been dissolved by the desizing agent into a free state, so that it may be readily removed in the enclosed steam or hot water washing compartment through which it passes. A special improvement in the construction of these enclosed wash-boxes is the method of carrying the fabric vertically to a high point. This fact, combined with the powerful built-in-spray tubes and guide rollers, insures intensification of the washing to a degree not previously possible. It is reported that the degree of washing and rinsing achieved in a single wash-box of this type is equivalent to that of two or three of the smaller open type."

So far we have explained only the desizing, and will now described the bleaching operation. For this, another range similar to the one described is run in tandem and has proved to be most effective for the reason that the desized fabric has already passed through 2 or 3 steam processes and that a fresh passage through steam within the range insures that the fabric has an exceptional capacity to absorb chlorine or peroxide from the liquor.

"These are concentrated in the fabric, as already described, by frequent passages through nips. The period of time necessary inside the batch-box already described depends firstly upon the seed content, secondly upon the degree of adulteration by non-cellulosic particles, thirdly on the necessary concentration, and finally on the necessary temperature. There are two advantages in bleaching inside the subsequent steamer, firstly that residual peroxide (free oxygen) can at that point complete its work, and secondly that the nature of its construction permits processing at temperatures in the region of approximately 195°F to 215°F. Washing off follows as already described for desizing in precisely the same manner."

Continuous peroxide bleaching is noted for its uniformity for subsequent processes of finishing such as dyeing or printing. Other values are time, space, labor, and cost of materials. The short history of

continuous bleaching has proven its value in the textile industry.

Recently U. S. Patent No. 2,790,699 issued to Imperial Chemical Industries, Great Britain, which gives in detail a new solvent-based bleaching process followed by a sodium peroxide bleach, both with a saving in time and chemicals that is practically unbelievable while producing well-bottomed and absorbent goods, should be of interest. We have had no practical experience with this process, but the patent as it reads is of extreme interest.

DYEING

The Williams Unit and Pad-Steam methods of dyeing are well established as the types of equipment used for continuous application; so we do not believe it necessary to describe these operations.

There are, however, other continuous methods which I believe should be explained, namely, the standfast Patent Molten Metal Continuous Piece Dyeing Process and the latest — The bond Dyeing Machine.

STANFAST PATENT MOLTEN METAL CONTINUOUS PIECE DYEING PROCESS

This process has been devised and developed for the purpose of applying vat dyes in continuous form to cotton, viscose rayon and linen fabrics. There are two systems of operation in piece dyeing. No. 1 System is applicable to the less tightly spun or woven fabrics such as towels and the lighter qualities of poplins and drills when the natural affinity of dyestuff and fiber achieve the desired dye penetration into the fabric when the dry fabric, after pre-heating over cylinders, picks up the requisite leuco dyestuff content from the dyebath where it is floating upon the surface of the molten metal. Dyeing is completed within the molten metal bath and the cloth emerges through the Glauber salt bath on the exit side of the metal bath and is subsequently rinsed, oxidized, soaped, rinsed, and dried.

No. 2 System has been devised to deal with the heavier cloths which, by virtue of being tightly spun or densely woven provide difficulties in achieving satisfactory penetration of the dyestuff throughout the fabric. In this case, the cloth, after preheating, is impregnated with dispersed dyestuff in the unreduced condition in the dye trough of a padding mangle and is subsequently passed through a bath of caustic and

hydro floating upon the surface of the molten metal in the dyeing machine. Full reduction and fixation is achieved in its passage through the metal bath and the cloth is subsequently aftertreated in a similar manner to that in No. 1 System.

Directly coupled to the molten metal dyebath is a four compartment dye supply tank. At any given time, the dye may be supplied to the machine, through any one compartment of this tank by means of a pipe line in which is inserted a centrifugal pump and then through a steam-heated heat exchanger in which the dye is heated and attains the full reduced condition, prior to delivery to the dyebath the content of which is a little over one gallon. The dye temperature is automatically controlled as also is the level of the dye within the bath. Another of the four compartments will contain a cleaning liquor, and a third compartment the dye liquor transferred from one of the dye mixing tanks.

In changing shades, a length of leader is sewn on to the end of the cloth which is being dyed and when this arrives at the dyebath a valve is operated on the four in one tank, which switches the feed to the dyebath from the dye in use to the cleaning liquor and as the cloth, which has already passed through the metal machine, is aftertreated and deposited on the delivery truck, the dye system on the metal machine is being thoroughly cleaned. The end leader is sufficiently long to fill the soaping unit and to the end of this leader is sewn the next batch of cloth to be dyed. On arrival of the new cloth to the dyeing machine, the machine is stopped while the cleaning operation is completed, after which the cleaning liquor is evacuated from the machine. The valve control is switched to the third compartment and the new dye is fed through the dye heater to the dyebath when the machine is re-started operating on the new shade. This operation is accomplished within five to seven minutes.

It has been found that by pigment padding, followed by drying and then running by the No. 1 System exceptional results have been obtained. Heavy weight sateens and drills are being dyed by this method on short as well as long runs with excellent results. End to end shading is at a minimum with good penetration and coverage.

THE BOND DYEING MACHINE

This continuous dyeing range, as mentioned, is one of the latest to be introduced for the dyeing of woven materials.

The heart of the machine is the slotted metal plates between which the fabric passes. A circulating pump forces the processing liquor into header units which are so baffled that the liquor is uniformly distributed to the slotted plates and passes through the slots at high velocity, thus creating an area of intense turbulence. Hence, liquid velocity and turbulence, rather than mechanical pressure are used in processing. Distance between the plates can be adjusted to adapt the machine to carpeting or other high pile fabrics.

The number of units depends on the type of dyeing such as in the use of vats, two units would suffice, one for pigmentation followed by drying, then through a second unit containing caustic and hydro followed by conventional washing, oxidizing, washing, and soaping.

THE PAD ROLL* DYEING SYSTEM

We have described the newer continuous open-width methods of application using fast colors and it has been more or less proven that when using this equipment for direct dye-stuffs, although penetration is relatively good, the fixation is not of the best.

The Pad-roll Dyeing System, a new production method for open-width dyeing with substantive dye-stuffs, is proving to be the answer for fixation and penetration with this class of dye-stuff without the prolonged boiling normally used in kettle or winch dyeing.

**This machine consists of a padder, a heated channel followed by a roll winding chamber.

"The pretreated dried goods are impregnated continuously on the padder. Due to low temperature of the bath and small capacity of the padder trough, as well as high speed passage (normally 55—65 yds. per minute) substantivity effects are eliminated, thus insuring uniform dyeing from beginning to end.

"Impregnation is immediately followed by a passage of the goods through a heat zone for the purpose of giving the goods the temperature required for dyeing. The heat is imparted by means of infra red rays, whereby it is possible to obtain a maximum of 100°C (312°F.). The degrees of heat required depend on the kind of material, the temperature being adjusted by means of a variable transformer. It is, therefore,

* Registered Trademark

** Rydboholm System—Swedish Pat. No. 134, 441 — Foreign Patents.

possible to give each kind of fabric and speed of padder the proper amount of heat.

"Immediately after heating, the goods are fed into a roll winder chamber and rolled up under a minimum of tension. This will insure maximum yield of dyestuff, as well as a satisfactory dyeing retaining its feel and character. The roll winder chamber is a well-insulated cabinet connected to the heating channel. By injecting steam in a suitable manner a moisture saturated atmosphere will be maintained within the heating channel and adjoining chamber. The temperature and humidity of the wound cloth will, therefore, remain constant during dyeing. The cloth winder, which runs on ball bearings, is mounted on a portable platform equipped with casters. The rear wall of the winder chamber serves as a tightly closing door swinging on hinges. The platform can be rolled through this door on tracks. When rolled into proper position, the cloth winder shaft couples automatically with the drive shaft.

"After the cloth is wound on the beam, the equipment is stopped for a short time. The door is opened, the seam at the end between back cloth and fabric cut, and the impregnated goods are attached to the beam. Doors and slot opening for the goods are closed. The chamber now is a fully closed room in which the beam is allowed to rotate until dyeing is completed."

HIGH TEMPERATURE PACKAGE MACHINES

In the dyeing of yarn, high temperatures are becoming popular and the use of these high temperatures has been a challenge to the manufacturers of package dyeing equipment.

This equipment is installed in one of the larger yarn dye houses and includes a battery of 25 machines of various sizes. The particular carrier is loaded with Davidson spring-wound packages. These machines are fabricated of Type 316 stainless steel and the installation is so designed that no drippings will go through the floor to the basement. Note the special skirt which seals the floor opening around the kier. All of the operating equipment such as pumps, levers, valves, and piping is located in the full-depth basement below the machine. This provides for very easy access for maintenance purposes. Another interesting features of this piece of equipment is the use of heat exchangers for heating and cooling the dyebath without having any of the steam injected into the bath. The use of heat exchangers eliminates contamination of the dye liquor and furthermore

prevents dilution of the bath. The automatic control system in this case automatically controls both the heating and cooling. Furthermore, they have automatic control for the return of the condensate from the heat exchanger to the boiler, thereby reclaiming this heat. Furthermore, automatic return of the cooling waters to the cooling tower system enables the re-use of this water. Thus, none of this water or available heat coming out of the exchanger is wasted. These machines are smaller capacity units of the high-temperature, high-pressure type. When referring to high temperature, these machines are rated at 325°F, and for pressure of 81 P. S. I. (lbs. per square inch). These same units are complete with heat exchangers for heating and cooling and, of course, will duplicate all operations that can be performed on the larger equipment which we have just discussed.

These machines will process four identical beams and have installations where two of these machines are interconnected, thereby enabling the dyeing of 8 dye beams or 8 carrier loads in a common dye-liquor bath. This is accomplished by use of the Smith Drum interconnecting system providing for uniform results in the total number of kiers interconnected.

OTHER ADVANCES

Many important advances have benefited the textile industry recently. Some of the more noteworthy are:

MAGNETIC FLOW METER

The Magnetic Flow Meter, without any restriction in the line whatsoever, is now able to measure flows in pipes from 1/10 inch in diameter up to approximately 6 feet in diameter. An electro-magnetic field surrounds the pipe section and the liquid passing through generates an EMF which can be calibrated directly in flow units. It completely ignores such metering problems as turbulence, suspended solids, variations in conductivity, density and viscosity. Currently, one of a smaller size is being used on metering dye pigments to synthetic fiber solutions before the fiber is spun.

O-R POTENTIAL

O-R Potential measurements are used to determine the end points of oxidation-reduction reactions; to measure the intensity of oxidizing or reducing agents in solution. An outstanding application in the textile

industry is where O-R Potential measurements enable exact control of vat dyeing by measuring the reducing ability of the dyebath Redox measurement.

O-R Potential instrumentation consists of an EMF Dynalog indicator, recorder or controller connected directly to a reference electrode and a platinum electrode. No intermediate amplifier is required.

Standard electrodes are used with leads up to 20 feet in length. For greater distances — up to 200 feet between electrodes and instrument — leads are available through the manufacturer.

FLUID BED DRYER

The first textile drying machine to use the fluid bed principle of heat transference by the use of fine glass beads (Ballotini) has been introduced by British Tufting Machinery, Ltd., Blackburn, England. It is termed suitable for any process where controlled heat has to be applied to fabric for drying or any finishing process which involves the use of heat, such as heat-setting or resin curing.

It is reported that satisfactory drying trials have been concluded on the machine with cloths ranging in weight from 6 to 12 ounces a square yard. However, a lot more evaluation work has still to be done on different types of fabric and different processes.

SCREEN PRINTING

Attempts are constantly being made to mechanize the screen-printing operation partly or completely, so as to enable the screen printer to handle roller-machine quantities without the initial capital outlay for a roller machine and without the expense of engraving copper shells and chromium plating. Several types of machines are at present in use.

NEW FIBERS, DYES, AND FINISHES

Space does not permit an individual discussion of all the new synthetic fibres, but it might be of interest to mention briefly those that are slated for production within the very near future.

CRESLAN

An acrylic fiber manufactured by the American Cyanamid Company — is reported to have excellent affinity for premetallized, chrome, direct, acid, acetate and basic dyes; limited affinity for vats, sulfurs, and naphthols.

DARVAN

Described as a dinitrile fiber, is manufactured by B. F. Goodrich Chemical Company. This fiber has

affinity for azoic, disperse, and cationic dyes. However, the absorption and diffusion into the fiber is rather slow so that carriers or high temperatures are recommended. This is of particular importance when dyeing medium to heavy shades.

ZEFRAN

The nitrile alloy manufactured by Dow Chemical Company can be dyed with a wide range of colors, namely, vats, soluble vats, sulfurs, naphthols, after-treated direct and neutral premetallized dyes.

NEW DYES

The development of the reactive dyes, the first really new class of dyes to be discovered in the last 25 years, shows a new range of bright colors fast to washing and employs a new concept. The reactive dyes form a chemical bond between dyestuff and cellulose and are usually applied cold to get the maximum amount of dye fixed on the fiber. Fixation is accomplished with alkali. However, each dye must be studied for best balance between temperature and pH.

FINISHING

Wash and Wear, a combination of fast colors and durable resins, is well established with the consumer. Ease of handling with little or no ironing has made this article extremely popular. The success of this development is in the selection of proper resins and technique of application.

Discoloration, tendering, and odor contributed to the difficulties in both cotton and/or rayon fabrics with thousands of dollars spent on research to overcome these complaints. Excellent progress has been made by the resin manufacturers together with the know-how of proper application by the finishing plants.

Wash and Wear is a symbol of this achievement showing the efficiency of a combination of resins and color that will withstand household machine washers or drip-dry washings.

CONCLUSION

We have attempted in this presentation to describe developments that are currently being used for coloring and finishing of textile fabrics. Some are well-established, making it possible for certain companies and their personnel, who are faced with competition, to operate in the most efficient manner.

As to the future, let us all gain as much knowledge as possible with these and future developments realizing that those who think and look ahead will go ahead.

NEEDLE FELTING—

The Modern Concept of An Ancient Material

By E. F. Didier

General Works Manager, Needle Division
The Torrington Company

Felt is reputed to be one of the earliest non-woven fabrics produced by man. And, as so frequently happens, it resulted from an accidental—and incidental—necessity, rather than from a carefully planned effort to fill a need. The legend is that felt first “occurred” when Arab camel drivers placed camel hair in their sandals for protection against the burning sands of the desert; the material was fulled by the pressure and friction of the foot, assisted by the moisture generated by the body.

RECORDED history notes that felt was used by the very earliest civilizations as clothing and tenting material because of its inherent strength. Felted materials are used today for much the same reasons; however, the many refinements and improvements that have been developed over the years further enhance its qualities and enlarge its useful applications. Felt uses have broadened from a homely beginning as a crude protective padding in footwear to include such things as rugs and rug cushions, bed blankets, pads for mattresses and upholstered furniture and automobiles, filters, sound deadening and insulating pads, gymnasium mats, paper making felt, padding for clothing, wadding for shotgun shells, cement pipe, and many others.

Felt is defined as a fabric built up by the interlocking of fibers by a suitable combination of mechanical work, chemical action, moisture, and heat. Felt may consist of one or more classes of fibers: wool, reprocessed wool, and reused wool with or without admixture with animal, vegetable and synthetic fibers, including sisal, jute, and glass fiber. Cotton felts are similarly made in the many combinations of materials.

Needle felt, whether made from natural or synthetic fibers, begins as a continuous batt (lap) of specified thickness and width fed to a machine which performs a needle felting operation by punching barbed needles into the batt (lap); the barbs on the needle engage the fibers and push them through the mass material to interlock the individual fiber strands with each other. The thickness and density of the finished product is a factor of the initial thickness of the batt (lap) and subsequent layer build up, as related to the

number of needle punches per linear unit of movement. To increase either thickness or density the felt may be re-run to concentrate the number of needle punches or to “weave”—in additional layers of fiber material. No other operation follows the needle felting of the batt (lap) except for whatever finished product processing may be necessary.

When the batt (lap) is superimposed on a woven fabric and both are needle felted together, elongation under tension is less than for the simple mechanical interlock structure. Woven inserts give increased strength for the same weight or thickness.

Looms used for needle felting are essentially punch presses in which the batt (lap) is carried over grid bars and stopped, momentarily, while the needle board descends to punch the needles into the batt (lap). The motion pattern is intermittent, with the actual forward linear motion of the batt (lap) related to the speed of the reciprocating motion of the needle board to produce the desired characteristics in the felt. That is, the batt (lap) moves forward a fixed and pre-determined distance each time the needle board descends to punch the material.

The needle board, attached to the reciprocating beam, usually is made of very fine grade, selected mahogany because of its uniform grain structure and dimensional stability. Some success has been attained with magnesium needle boards. The length of the needle board is, of course, a function of the machine size, designated in widths from 36 in. to 250 in. Development work is now under way by one prominent loom manufacturer to build a 450 in. machine.

A concerted effort also is being made to increase the operating speed of needle looms to meet increased production demands as well as production cost considerations. Loom speed has been increased from 125 r. p. m. to 1,000 r. p. m. Improved design concepts have provided more symmetrical balance, less weight in reciprocating parts, and smoother, quieter operation. The number of needles per board has been increased (approximately 9,000 per board for the 250-in. machine and approximately 16,000 per board for the 450-in. machine) to produce more concentrated penetration and higher production. Still other improvements intended to increase production rates are in the development stage.

Obviously, a critical component of the needle loom is the needle board and the thousands of needles that must be placed by hand. The needles are not lined up in straight, symmetrical rows, but rather in arrangement patterns that have been figured out mathematically and checked by actual usage results. One of the latest formations is a modified herring-bone placement that produces the most advantageous punching design and resultant interlocking of fibers.

The thousands of small holes that must be drilled in each needle board, into which the needles are inserted, present a real problem for the loom builder. The holes must be absolutely true and straight and drills of this small size are easily deflected in many directions by the grain in the wood. Naturally a needle inserted in an off-true hole is, likewise off-true and must be straightened by hand after insertion so that the needle will enter the proper guide hole in the bed of the loom.

The magnesium alloy needle boards developed by the loom builder reduced the problem of straight holes, but did not completely eliminate it because even metal contains a certain amount of “grain”. Other problems also are apparent with the metal board. For example, when using the normal single blade felting needle the triangled and barbed portion of the needle fits into a hole that is approximately the same size as the shank of the needle. If the needle blade varies slightly to the large size because of high barbs, it cannot readily be inserted into the magnesium board holes. If the needle is forced into the hole the barb scores the hole itself, making it difficult to remove the needle when worn out or broken. The single blade needle can be used in wood boards with less difficulty but protruding barbs eventually will wear the holes so that the boards will become useless due to the excessively loose fit of

the needle. The worn board can be redrilled for a larger size needle.

The needles themselves are available in many sizes to satisfy the requirements of the finished product, the kind of raw material used, the thickness and density of the felt, etc. The Torrington Company manufactures needles ranging from the smallest, $20 \times 40 \times 4 \frac{1}{16}$ in., made from 0.037 in. diameter wire, to the largest size, $9 \times 11 \times 3 \frac{1}{16}$ in., made from 0.140 in. diameter wire. The largest size is a crankless type of needle, used in a converted Fales machine for making cushion padding for automobile seats.

The double blade needle was developed by The Torrington Company, in collaboration with leading manufacturers of looms, to overcome the difficulties experienced with single blade needles. The part of the shank that is anchored in the needle board is of larger diameter than the “working end” of the needle. The larger size hole in the board allows the use of a larger, stronger drill which makes a straighter hole. With a larger clearance hole through the board there is no difficulty inserting the barbed portion of the double blade needle. A single blade needle made with a large diameter wire could be inserted and removed as easily, but would not be acceptable for some kinds of felting. It is not unusual to “needle” a board with size $17 \times 19 \times 3 \frac{1}{2}$ in. needles and then change to size $16 \times 19 \times 3 \frac{1}{2}$ in. when the board holes have become worn. The only adverse effect of this practice may be the holes left in the felted product resulting from the needle penetrating beyond the triangle portion as far as the larger diameter shank.

Felting needles are made in two types with respect to the spacing of the barbs. Regular barbs are spaced $\frac{1}{4}$ in. apart in each row, while close barbs are spaced $\frac{1}{8}$ in. apart in each row. For special purposes high or low barbs can be made on any type of felting needle. Barb depths have been standardized for general purpose needles as a compromise between wear life and breakage. Even a slight increase in the depth of a barb can cause excessive breakage, while a barb that is too shallow will not felt properly. Excessively high barbs also have a tendency to tear material, seriously affecting the tensile strength of the felted product.

Many felting mills have a regular schedule for replacing worn and broken needles in the boards. All needles are removed from the first third of the

board and replaced by new ones. The good needles removed from this section, which are only partially worn, are placed in the center section. Those taken from the center section are inserted in the last third section. This method of re-needling boards greatly lengthens the use life of the needles while producing a smoother, more uniform felted product. Another economy practice that is possible with many kinds of felting is to adjust the bed of the loom to such height that only the end barbs of the needle penetrate the worked material. As these barbs become worn off the bed is raised sufficiently to utilize the next row of barbs, and so on until the needle becomes worn throughout its length.

The life of felting needles depend upon many factors, i. e., type of material being felted, thickness and density of the finished product, amount of needle hole wear in the boards, straightness of the holes, needle straightness, construction and temper of the needles. Chrome plated needles wear considerably longer than a standard steel needle, although the added cost of chrome plating can seldom be justified unless the wear factor greatly exceeds the breakage factor.

Chrome plating will neither increase nor decrease the incidence of breakage.

Needles are classified by gauge sizes—gauge numbers being used for the diameters of the shank, blades, and triangular blade section. The first number in the gauge size of the needle is the wire size from which the needle is made.

Gauge	Wire Size	Gauge	Wire Size
9	0.140"	15	0.072"
10½	0.121"	15½	0.068"
11	0.110"	16	0.064"
12	0.105"	17	0.055"
13	0.0925"	17½	0.052"
13½	0.085"	18	0.0475"
14	0.080"	20	0.037"

Improved techniques, new fibres, greater knowledge of needle felt manufacture and use will produce tailor-made felts that fit close requirement specifications. The manufacturers of felting needles naturally will keep pace with future requirements.

New Foam-Killers for Industrial Use

SAG Antifoams, new fast-acting and highly effective foam killers for industrial use have been made available by the Silicones Department, Union Carbide International Company, Division of Union Carbide Corporation.

The new products are available in two forms—SAG 47 Silicone Antifoam Fluid for non-aqueous systems and SAG 470 Silicone Antifoam Emulsion for aqueous foaming systems. Handy eight-ounce (227 gm.) samples in polyethylene squeeze bottles are being distributed to industries desiring to evaluate the newest, most effective of the silicone anti-foams.

Fighting or preventing foam is a costly problem in many manufacturing processes, in the loading of tank cars and other equipment, or in public works facilities. Only small quantities of anti-foam are required; often 10 to 200 parts per million is all that is needed.

SAG 47 Silicone Antifoam Fluid is a 100% solids solution which can be used at full strength, as a solvent solution, or blended with other materials. It is available in a one-pint (0.47 liters) wide mouth jar containing one pound (0.454 kg.); in a one gallon (3.785 liters) open top can containing eight pounds (3.63 kg.); and in a five gallon (18.93 liters) open top can containing 40 pounds (18.14 kg.).

SAG 470 Silicone Antifoam Emulsion contains 10% silicone solids by weight, and is ready for use, but can be further diluted if desired. It is available in one gallon (3.785 liters) and five gallon (18.93 liters) cans and in drums of 55 gallons (208 liters).

There are many applications where SAG Antifoams are effective, including the manufacture of adhesives and glues; synthetic resins and polymers; cleaners, solvents, soaps and detergents; dyes, inks, and pigments; drawing compounds, distillations, vegetable oils; paints, varnishes and lacquers; and paper making.

SAG Antifoams are also used in making rubber; in tanning; in finishes for textiles; in wire drawing solutions; in waxes, emulsions and antifreeze; in galvanizing and pickling; with paper sizes and finishes; in plating solutions; asphalts; in evaporation and dehydration; in rendering; with cutting, cooling and lubricating oils; in sewage disposal; in gas absorption units; in making tallow and in hydraulic fluids.

These anti-foams are chemically inert and resist oxidation over long periods. Although their order of toxicity is extremely low, SAG Antifoams are not presently recommended for use in food manufacture or in the manufacture of drugs to be taken internally.

PAINTS, PLASTICS & CHEMICALS SECTION

DETERMINATION OF THE FRICTIONAL CHARACTERISTICS OF PLASTIC FILMS AND LAMINATES USING THE MOVING FILM—STATIONARY SLED METHOD

By An Overseas Correspondent

TODAY'S packaging operations demand high speed over-wrap and bag making machines and, of course, packaging materials that provide the necessary protection plus fabricating ease. In investigating the desirable qualities of plastic films for such packaging uses, a thorough study of the "slip" of film or the ability of one film to slide over an identical type film or over another surface should be one of the first properties to be evaluated. In establishing the "slip" or frictional characteristics standard test methods are necessary.

Two standard methods of evaluating slip have been investigated by the Packaging Department of UNION CARBIDE'S Development Laboratories, (1) the Inclined Plane method, which is described in Technical Release No. 1, and (2) the Moving Film-Stationary Sled method, with which this release is concerned. Both appear to have general applicability and, under properly specified conditions of testing, the results obtained by both methods are similar.

The coefficient of friction is defined as the ratio of the frictional resistance to the normal pressure acting on two surfaces in contact. This coefficient of friction is a measure of the relative ease with which the surface of one material will slide over the surface of another material. The frictional resistance between two materials before sliding takes place may be expressed by the static coefficient of friction (m_s), and the frictional resistance during sliding may be expressed by the kinetic coefficient of friction (m_k). The latter depends to some extent on the relative motion of the materials.

TEST METHOD

In setting up the Moving Film-Stationary Sled method the following apparatus is used. (See schematic Fig. No. 1.)

- (1) a pair of motor driven rubber rolls with a speed of 0.5 ft./min. to 200 ft./min. is used in the experimental work. Any type rolls that will give a constant pull may be used.
- (2) a push-pull gauge (similar to Chatillon and Sons model 154-3). The capacity of the gauge needed will depend on the range of values to be measured. For most polyethylene films being tested, a 1000 gram capacity gauge with 10 gram subdivisions will be the most useful. This will measure a coefficient of friction up to and including 1.0.

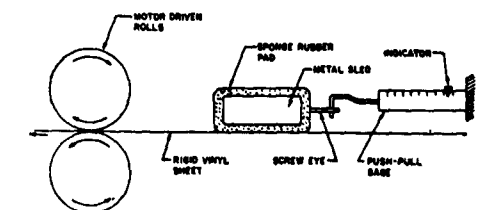


Fig. 1. Schematic Diagram of Apparatus for Moving Film, Stationary Sled Test Method.

For more tacky films, gauges having a capacity of 10 pounds or 20 pounds will be required. These gauges are marked in gram divisions and will measure the coefficients of friction up to and including 4.5 and 9.0 respectively.

- (3) a steel block, 2-1/2 in. X 4 in. X approximately 0.75 in. with a suitable screw eye fastened in one end. The block which is referred to as the sled, is wrapped with 1/8 in. thick sponge rubber (medium density sponge). The rubber is fitted snugly around the metal sled and taped in place. (See Fig. No. 2.) Since uniform

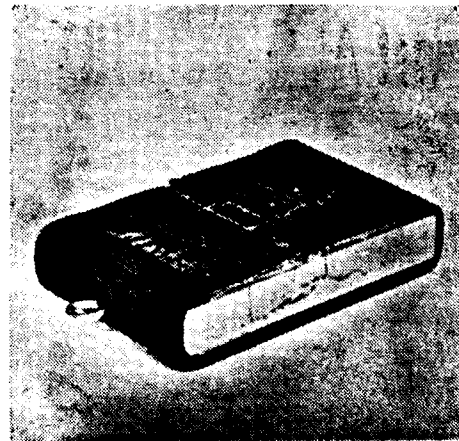


Fig. 2. Sponge-rubber covered Metal Sled used in Moving Film-Stationary Sled Method.

intimate contact cannot be obtained between the test samples by the bare metal surface alone, the sponge rubber is used. This rubber distributes the load of the steel block evenly to the test sample and ensures intimate contact between the test surfaces. The entire assemblage should weigh 1000 grams.

- (4) a timing device to measure seconds.
- (5) a rigid vinyl sheet 8 in. $\times$ 28 in. $\times$ 0.04 in. or some other rigid and smooth carrier to which the sample is attached.
- (6) cellophane tape and double-faced adhesive tape similar to 02 "Permacel" tape. (Permacel Tape Corp., New Brunswick, N. J.)

TEST SPECIMENS

Test specimens of two different sizes are prepared. One sample is cut approximately 24 inches in the machine direction by approximately 8 inches in the transverse direction. The other sample is cut approximately 12 inches in the machine direction by 2-3/4 inches in the transverse direction.

Extreme care must be taken in handling of the samples. The test surface must be kept clear of dust, lint or fingerprints or any foreign matter which might change the surface characteristics of the film.

PROCEDURE

- (1) Lay down two strips of the double-faced adhesive tape along the length of the

rigid vinyl sheet so that they are 6 inches apart and parallel to each other.

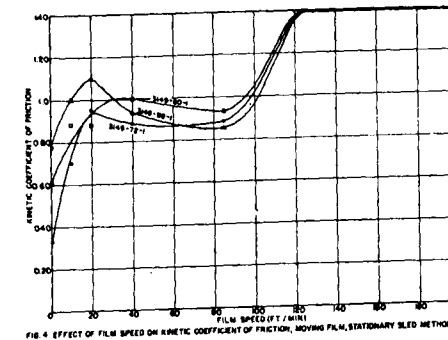
- (2) Having cleaned the surface of the vinyl sheet thoroughly, tape the 8 in. $\times$ 24 in. sample to the vinyl sheet with the machine direction of the film corresponding to the length of the vinyl sheets. Stretch the film just enough to eliminate wrinkles but not enough to elongate the film.
- (3) Tape the 12 in. $\times$ 2-3/4 in. sample to the sponge rubber-covered metal sled pulling tightly to eliminate wrinkles without stretching the film. Here again keep the machine direction of the film parallel to the length of the sled. (See Fig. // 3).



Fig. 3. Applying Plastic Film to the Sled used in Moving Film-Stationary Sled Method.

- (4) With the rigid vinyl sheet in the bite of the draw rolls, turn on the motor and adjust the speed of the rolls to give a linear rate of travel of 0.5 ft./min. for the vinyl sheet. This rate may be obtained by marking off a one-foot length and determining the time (in minutes) for the vinyl sheet to travel one foot. Then if not at the desired rate change the speed of the rolls until the rate of 0.5 ft./min. is attained.

The rate of one half foot per minute is chosen because at this rate there is a greater difference in coefficient of friction for different films than at higher speeds. (See Fig. No. 4) As the speed of the carrier is increased the values for coefficient of friction of various films began to converge until at 120 ft. per minute the values became coincident.



It can be noted here that, though a variable control unit is used to vary the speed of the rolls for experimental work, this would not be absolutely necessary. Constant speed rolls which would pull the carrier at a rate of 0.5 ft./min. would be adequate. Do not allow the test area of the film to pass through the nip rolls at any time while adjusting the speed of the rolls.

- (5) Set the vinyl sheet in the nip of the rolls and place the film-covered sled on the film-covered vinyl sheet attaching the sled to the push-pull gauge by means of the screw eye in the sled. (See Fig. No. 5.) Turn on

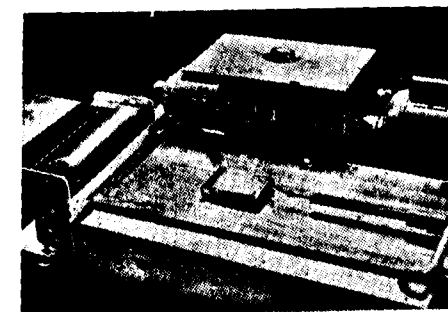


Fig. 5. Moving Film-Stationary Sled Apparatus used in determining coefficient of friction of plastic films.

the motor. As a result of the frictional force between the contact surfaces, no relative motion will take place between the test films until the frictional forces acting at the interface of the film is exactly counterbalanced by the force exerted on the sled by the spring gauge.

DETERMINING STATIC COEFFICIENT OF FRICTION

To determine the coefficient of friction, which is the ratio of the frictional force to the normal force (or weight of sled), read the frictional force directly

from the push-pull gauge and take the normal force as 1000 grams, the weight of the sled. The gauge reading taken is the one that occurs when slippage between the test films take place. The indicator will move along the gauge as the sled is carried along with the vinyl sheet. When the frictional force between the surfaces of the sample is overcome by the pull of the spring in the gauge, the sled will stop moving though the rigid vinyl sheet continues. At this point the indicator will also stop and the reading will be the frictional force for that film. This reading will give the *static coefficient of friction* using the following formula :

$$\text{Coefficient } (m_s) = \frac{\text{gauge reading}}{\text{sled wt.}}$$

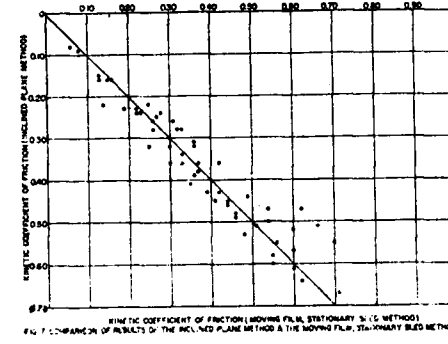
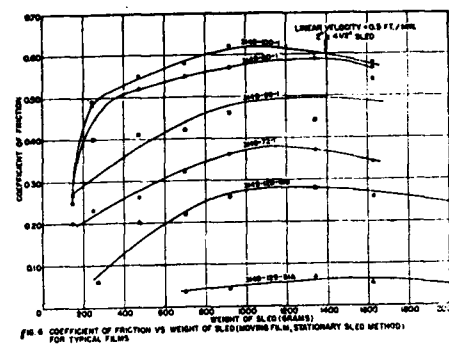
DETERMINING KINETIC COEFFICIENT OF FRICTION

Now note the gauge reading during a run of approximately 20 seconds. This is equivalent to the force required to sustain slippage and may or may not be lower than the force required to initiate slippage. By inserting this reading in the formula given above the *kinetic coefficient of friction* (m_k) can be obtained.

One type of film is tested several times and an average value taken. Each individual test necessitates the use of new pieces of film on both the sled and vinyl sheet.

CONTACT PRESSURE

The effect of contact pressure between the two samples on the coefficient of friction has been determined to a limited extent for the Moving Film-Stationary Sled method. Contact pressures from 17 gram/sq. in. to 230 gram/sq. in. were used for this test. The contact area was held constant (the size of the sled) while the weight of the loading medium was varied. The test was made on various materials having coefficients of friction of approximately 0.10 to 0.60 when measured using 1000 grams and at a speed of one half ft. per minute. Results of these investigations have been plotted in the graph, (Fig. No. 6) as coefficient of friction versus sled weight. In general an increase in the weight of the sled first increases the kinetic coefficient of friction up to a maximum and then the use of heavier sleds decreases the coefficient of friction obtained. The maximum coefficient of friction appears to be obtained when using a sled weight from 1000 to 1400 grams.



CLASSIFICATION OF POLYETHYLENE FILM ACCORDING TO SLIP

The following scheme of classifying polyethylene films according to slip has been developed. No single scale of classifications can be expected to describe the behavior of polyethylene film for all of its varied uses. However, the description of the slip of polyethylene film as shown in Table 1 is considered to be a fair one for current commercial purposes.

TABLE 1

Classification of Polyethylene Film According to Slip

Classification	Coefficient of Friction
Good	under — 0.40
Fair	0.40 — 0.50
Poor	0.50 — 0.80
Very Poor	0.80 — and over

Some users have expressed 0.40 to 0.50 as an acceptable range while others prefer film below 0.40. It has been found that film can have too much slip. Such film may telescope on the rolls, slide excessively on the machines, or it may be impossible to stack bags made from such film. Therefore it may be necessary to impose a limit of approximately 0.25 on the "good" slip range.

COMPARISON OF THE INCLINED PLANE METHOD AND THE MOVING FILM-STATIONARY SLED METHOD

Under properly specified conditions of testing, results of the two methods, the Inclined Plane method and the Moving Film-Stationary Sled method, compare very well. The graph, (Fig. No. 7) correlates the results obtained by the two methods on various samples of polyethylene, cast vinyl, and polyethylene coated cellophane. For the Inclined Plane

method the coefficients of friction were determined at a reciprocal rate of sliding of 30 sec./in. using a 1000 gram block. By the Moving Film-Stationary Sled method, the coefficients were obtained at a linear speed of 0.5 ft./min. using a 1000 gram sled.

In the graph, the coefficient obtained by one method is plotted against the coefficient obtained for the same film by the other method. The solid line represents what the average relationship between the two values should be while the plotted points indicate the actual relationship. The points are not too widely scattered and it is felt that good agreement between the test can be obtained under these conditions of testing.

The reproducibility of both tests has been demonstrated on a number of occasions. Samples from the same rolls of film have been tested by both methods at various time intervals and by different operators and results have checked to within several hundredths of a coefficient of friction unit. Exact reproducibility may be complicated by indeterminate surface variability.

The Inclined Plane method is suitable for film to film measurements of coefficient of friction in the range 0 to 2.8 while the Moving Film-Stationary Sled method is readily adaptable to the measurement of coefficient of friction in the range 0.0 to 9.0. The latter test is also particularly suited for measuring materials having high static coefficient of friction and in which it is impossible to obtain kinetic coefficients of friction. The Moving Film-Stationary Sled method requires heavier and more costly equipment than the Inclined Plane method. The time required to run the former is not as great as for the latter, and for quality control purposes the higher initial cost may be overbalanced by the labor saving.

If it is only necessary to define a range of coefficient of friction for the material under consideration, the Inclined Plane method may be used on a "go-no go"

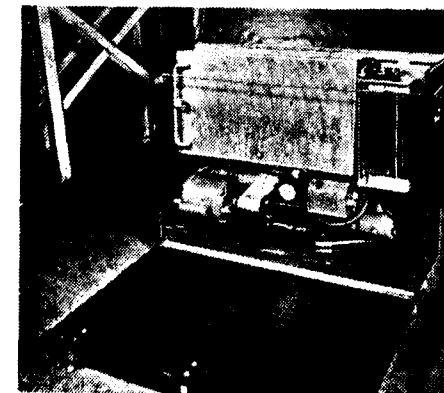


Fig. 8. Moving Film-Stationary Sled Apparatus in portable case for convenient transportation.

basis. Any films that do not fall within this range can be immediately identified. The Moving Film-

Stationary Sled method will provide an exact value for the film and it may also be used to evaluate the coefficient of friction of film or coated stock against various metals. This may be useful in determining how a particular material will handle during bag making. For these measurements, a polished metal plate is used in place of the moving film and the same film covered sled is used as in the film to film measurements. The Inclined Plane method could be used for testing film to metal but the speed of testing using the moving film method more closely simulates conditions of film on machines.

The equipment for these tests need not be kept in a controlled atmosphere and may be made portable for testing at various locations. (See Fig. 8) Both methods are adaptable to quality control and both yield similar and reproducible results.

New Aqueous Silicone Emulsion Textile Softener

A new silicone emulsion designed specifically for softening thermosetting textile finishes is now available from the Silicones Department, Union Carbide International Company, Division of Union Carbide Corporation. Designated Union Carbide XLE-48 Silicone Textile Softener, it offers the established advantages of durable softeners, such as high tear strength, abrasion resistance, and enhancement of sewing properties. In addition, its increased durability toward repeated dry cleaning and washing; its outstanding resistance to scorching, yellowing, and water spotting; and its complete resistance to chlorine damage provide a high quality, high performance softener. XLE-48 has outstanding product and bath stability; it is non-gassing and is compatible with other finishing materials. When used either alone or with other hand modifiers it makes available a full range of hand variations.

In addition, Union Carbide XLE-48 silicone possesses two important features not available in other durable softeners—outstanding resistance to wet soiling (redeposition of soil) and improved release of soil during laundering.

Other uses where the outstanding properties of XLE-48 are of importance are: yarn lubrication,

non-woven fabric softening, latex release and warp sizing.

Millions of housewives, the textile, laundry and dry cleaning industries for years have been troubled with the problem of soil redeposition, or wet-soiling.

Unfortunately, up until recently, softeners which were applied to fabrics at the mill adequately performed their proper task of recovering soft hand and mechanical properties after the application of resins, but did not provide resistance to wet soiling.

The chemical industry for years has been looking for a softener which did all these jobs at once. Now, it is felt that XLE-48 not only has the already established advantages of silicone softeners for cotton fabrics, but has the additional advantage of outstanding resistance to wet soiling.

Union Carbide XLE-48 Silicone Textile Softener has been extensively tested in independent laboratories and in cotton mills. It is expected that the outstanding properties of this softener will also benefit other natural, man-made and blended fabrics. Finishers have long been demanding a better softener—a demand which up until now could not be met.

How to fire Aluminum Enamels

By Dr. Paul A. Huppert

Director, Ceramic Coating Department,
Gulton Industries Inc., U.S.A.

Furnace Types—Firing Cycles—Avoiding Warpage—Evaluating Results

THE critical point in any porcelain enameling process lies in the firing operations and this is especially true for low melting glasses applied on light metal alloys. In general, when speaking of firing ranges, it is wrong to refer to temperatures only while it is correct to specify time and temperature cycles. Much too little work has been devoted to establishing a proper ratio of time and temperature which is characteristic for any given enamel composition.

INFLUENCE OF FLUXES

During recent years, a great deal has been learned from investigating the influence on firing cycles deriving from adding either to the smelter batch or to the mill, or to both, powerful fluxing media such as the typical lithium compounds or some other similarly active ingredients. It has been found in steel enamels as well as in refractory type ceramic coatings how much such additions can influence the firing ranges without adversely affecting properties of the importance of impact and thermal shock resistance, chemical resistance, surface hardness, elasticity, adherence, tensile and compression strength and other important factors.

It has been found that in almost all cases, lithia added to conventional ground coats could replace the expensive nickel flash process, the main importance of which consists in a reduction of the maturing temperature of a given ground coat by approximately 35° to 50° F.

In titania white cover coats such additions were liable to reduce the firing cycles, thereby improving colour shades. Similar effects were found in pastel type colours based upon the use of titania.

Analogous conditions prevail in the field of enameling aluminum where recently developed flux additions are leading to new burning ranges. Practical tests have proven that by maintaining the same metal gauges, a special enamel of this type showed the

same finish characteristics when fired over a range of

970° F.	for 10 minutes.
1050° F.	for 2 minutes.

These cycles will of course change with compositions and are characteristic for each individual enamel.

HOLD TEMPERATURE, CHANGE TIME

In many cases, it is possible to establish one fixed firing temperature for a particular enamel suitable for a medium aluminum metal gauge and to change simply the time up or down if heavier or lighter metal gauges are to be coated or if instead of solid aluminum the enameling of aluminized steel is required.

This method has its special merits where continuous operations are chosen. In such a case, the temperature of the furnace may be maintained rigidly while only the conveyor speed has to be altered or adjusted to the metal gauge to be enameled.

EVEN TEMPERATURES ESSENTIAL

The original developers of the process claim that even furnace temperatures with variations not exceeding plus or minus 5° F. are essential. This requirement means a terrific burden for both the furnace builder and the furnace operator. All efforts should therefore be directed towards improving the enamel compositions as well as operating conditions to ease this situation with, in many case has frightened off the enamellers from using aluminum as the base metal.

The use of three types of furnace equipment has been reported namely stationary box type furnaces, fully continuous and intermittent type constructions. The most common sources of fuel are gas, oil or electricity. The latter is the most pleasant; however, frequently depending upon localities—the most expensive source of fuel. In the case of liquid

give it a try—
it's a jolly



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fuels, it seems that the radiant tube furnace constructions are first choice.

The items to be fired and the fact that either both sides or only one side has to be enamelled dictate the type of suspension and furnace tooling. In the case of continuous operations, flat belt conveyors or conventional hanging chains are recommended, and both types have their advantages and drawbacks. The most important undesirable features are either hanging holes along the edges of flat sheets or marring of the back side when placed on flat conveyors. The occurrence of "chain marks" is also a frequent disadvantage of the latter method.

Very recently extensive studies have led to the belief that radiant heat should be replaced partially or fully by convection heat.

PYROMETER PROBLEMS

Often an extremely important point is being overlooked. It is almost impossible to co-ordinate temperature readings from one pyrometer to another. Even the most accurately calibrated instruments are liable to show differences because of location of the thermocouples, construction of the furnace, type of instruments, length and material of lead wire and various other conditions. Even in the same plant it is frequently difficult to correlate time/temperature cycles from one furnace to another.

Requirements of heat will change with the type of furnace, whether stationary or continuous; with the source of fuel; with the ratio between radiation and convection heat; with the fact whether the heat source derives from the top or bottom, from both or from the sides; with the type of tooling or conveyors etc. etc.

Any general indications by the suppliers of frit, mill additions etc., may thus only serve as a lead and have to be adjusted according to equipment, ware and all other circumstances.

Only the final appearance of the goods produced, and tests, such as adherence, accelerated spalling etc. may serve as criteria when comparing enamels from different sources.

Since the firing range of aluminum enamels is below 1000° F., i. e., before the furnace shows distinctive deviation from the black colour, a simple method of checking the degree of maturity of the burned enamels has often proven of considerable help. This consists of the use of a regular flash light. As soon as the light beam directed towards the fired goods shows sufficient degree of gloss, the enamel is

readily fired and the goods may be removed from the furnace.

MUST OVERCOME WARPAGE

Of great importance is overcoming warpage during the firing process. There is considerable difference in the coefficient of expansion between the base metal and the enamel. While aluminum metal has a cubical coefficient of expansion of approximately 600 to 660 $\times 10$, the low melting glasses used for coating-light metals are usually within the range of 400 to 450 $\times 10$, i. e., much below the metal.

Contrary to common belief, this is of minor importance as far as adherence of enamel to metal is concerned because of numerous influencing factors such as development of an adequately interlocking aluminum oxide interface layer, elasticity, improved flexibility due to thinness of coating, high tensile and compression strength.

However, the difference in expansion causes warpage of flat sheets and predominantly flat shapes and this is becoming more severe with purer aluminum alloys such as type 2-S or 3-S, even on heavier gauges. Thanks to the ability of aluminum enamels to be postformed within reason, such warpage may be flattened out after firing without damage.

WARPAGE CAN BE OVERCOME

Such warpage can, however be overcome or avoided by coating the back side also, thus counteracting the influence of the different co-efficients of expansion between metal and enamel. So far, this application of a backing seems also to be the only place where recuperated residue or scrap material may be used, thus helping to reduce the additional cost of the "backing" by limiting the cost practically to labour expenses only.

Many of the other frequently unavoidable flaws and mistakes causing rework or rejects are due to improper firing or inadequate burning equipment. It is, thus, dangerous to try to save an initial investment cost by installing inefficient furnaces since the difficulties deriving from such wrongly placed savings will often turn out to replace success with failure.

The results will depend however, not only on properly working furnaces but equally on metal preparation, handling of the ware, application techniques, type and degree of drying, thickness of coating and last, but not least, composition and preparation of the enamels.

(COURTESY: CERAMIC INDUSTRY, U. S. A.)

What is New in Chemical Products

Plastic Tooling Moves into Longer Runs

Of metal-fiber-laced epoxy, plastic tooling is no longer tied to short production runs.

Present plastic tooling is lighter, cheaper, quicker to make than standard metal dies. Now new metal-fiber-reinforced epoxy composition for tooling adds outstanding impact strength, thermal conductivity and machinability to advantages, plastics materials can offer tool and die makers.

Result is that plastic applications formerly limited to prototype and low-production metal forming dies now extend to medium production-run metal forming. Though the new reinforced epoxy will cost more than a simple casting of compounded epoxy, its unique properties will also extend the new reinforced epoxy's uses to those where conventional plastic materials are marginal.

Called Epoxy-Alloy, the term refers not only to new reinforced plastic material, but also to a method for effectively using this material. An Epoxy-Alloy tool or die is a mass casting, made by a pressure process, consisting of a heat-resistant epoxy system reinforced with metal or glass fibers. For best performance, a technique has been developed for surfacing the pressure-cast core of an Epoxy-Alloy die with an epoxy face coat reinforced with flocked chopped metal-fibers.

Depending on whether metal fiber or metal and glass fiber reinforcement are used, the identification of the new composition will vary as follows:—

Epoxy-Alloy ES—An epoxy mass casting reinforced with steel fiber and surfaced with an epoxy steel-fiber-flocked face coat. Epoxy-Alloy EG-SF—An epoxy mass casting reinforced with glass fiber and surfaced with an epoxy steel-fiber-flocked face coat.

Epoxy-Alloy EA—An epoxy mass casting reinforced with aluminum fiber and surfaced with an epoxy aluminum-fiber-flocked face coat. This Epoxy Alloy composition is designed for applications requiring high thermal conductivity, such as heated matched moulds, and the like.

To-date, approximately seventy Epoxy-Alloy dies

have been put into commercial operation. Thirty-five dies for a military project were built in 15 weeks at a cost of \$ 250,000. Conventional metal tools, it is reliably estimated would have required upto 18 months of tooling time at an approximate cost of \$ 2 million.

NITRILE RUBBER—*The first with ozone resistance.*

Compounds of new Hycar 1072 nitrile rubber are reported to be unaffected by ozone during extended test periods, even when the compounds are soaked in hot oil before exposure to ozone. The compound also has superior oil resistance, food flexibility, high strength and exceptional resistance to abrasion and oxidation. Suggested applications include electrical insulation, especially near ozone-producing spark discharges, and fabric coatings for both indoor and outdoor uses. Rubber parts which are under extension stress during use are more likely to be attacked by atmospheric ozone than are those which are not under stress. Therefore, Hycar 1072 should do well in finished parts which are likely to be under tension for long periods.

RESINOUS POLYOLS—*Intermediate for surface coatings.*

A new intermediate for surface coatings, resinous polyol X-450 is now being marketed in development quantities. A hard, colourless solid, it has an average of five to six primary hydroxyls per molecule. Ideally its chemical structure may be regarded as poly (1-phenyl, 3-hydroxymethyl butene).

Esterifications can be carried out readily with excellent retention of the original good polyol colour. Surface coatings made with the material are said to feature good resistance to caustic.

TRANSPARENT PLASTIC—*Unlike older thermosets, it holds shape in heats of supersonic aircraft.*

Sierracin 880 is a new high-temperature plastic developed for canopies, windows etc. in aircraft that are operating up around the heat distortion point of materials now in use. It is a cast, polyesterbase, transparent, thermosetting material that can be used

for aircraft enclosures that operate at surface temperatures as high as 280° to 300° F.

Unlike many of the other thermosetting plastics which retain a tendency to return to the shape in which they were cast when subjected to high temperatures, 880 is supplied in partially cured condition. Cured after final forming, it holds this shape until it chars.

Planes which might now use glass windows because plastics won't take the friction heat they generate would save 40 to 50 lb. if they used 880.

URETHANES—*Quartet of developments:*

New polyesters
polyethers
isocyanate
new foam manufacturer.

A new series of unique low cost polyester foaming resins are said to possess superior characteristics for the manufacturer of urethane foamed products.

The resins are known as Selectrofoam Resin 6207, for flexible foamed products, and Selectrofoam Resins 6004 and 6005 for rigid products. The flexible foaming resins provide, at reduced cost, excellent load-carrying capacity at low densities, higher resilience, good freeze resistance and a soft feel. Foam is manufactured by a one-shot process, no pre-polymer required.

The rigid resins 6004 and pre-polymer 6005 are said to provide a very tough, rigid foamed structure with unusually good adhesion for panel fabrication to other materials such as metals, some plastics and other construction materials.

Though first commercial urethane polymers were

based on the reaction of isocyanates and polyesters, low-cost polyethers are beginning to make a strong bid for the market. A new series has just been introduced which, according to manufacturer Union Carbide Chemicals makes it possible for urethane makers to prepare a broad range of prepolymers to meet the most exacting requirements for flexible foams.

These new intermediates are propylene oxide addition products of 1, 2, 6-hexanetriol, trademarked Niax. Four polyethers varying in hydroxyl number from 42 to 240 corresponding to molecular weights from 4,000 to 700 are available.

Niax triols can be used alone or in combination with a poly propylene glycol. Increasing the amount of triol in formulations increases rigidity of resultant foams. Highest molecular weight product will probably find use in softest foams, lowest molecular weight in semi-rigid foams. It is interesting to note that as Union Carbide Corp.'s chemical company division is introducing these new polyethers its Bakelite Co. division has announced its withdrawal from the manufacture and sale of polyester resins. Chemical company division does make polyester raw materials.

Development emphasis in the urethane field has been primarily on the resin rather than the isocyanate component of the polymers. Now Carwin Polymer Products has come up with an isocyanate variation said to improve the physical properties of foams at elevated temperatures.

It is polymethylene poly-phenylisocyanate, trademarked PAPI. PAPI-based rigid foams are said to retain 70% of their room-temperature strength at temperatures as high as 400 F. with a shrinkage of only 2%. Urethanes based on conventionally-used tolylene diisocyanates become unserviceable at 200 to 250 F.

HARD-WASTE OPENER

The RM 7/3 rag and hard-Waste opener announced by Oreste Rolando, Biella-Chiavazza, Italy has three cylinders to tear and open rags, clippings, knitwear, felts, hard ends and roving wastes. Materials of wool, cotton, silk, jute and man-made fibers can be processed. Separation is done on all three cylinders, and there is a patented apparatus for the extraction and conveyance of the pieces to the feed lattice. Other machines are made with one to seven cylinders.

Extrusion and Vacuum-Forming of Polyethylene Sheet

By A Chemical Engineer

INTRODUCTION

Potential market areas include

1. Products currently injection- or compression-molded from polyethylene. These items, such as dishpans and other housewares, have aroused the most interest to date. Extrusion and vacuum-forming may be more profitable for many such items, especially very large pieces, thin-walled pieces, short-runs and products for which production must be set up very quickly.

RECOMMENDED EQUIPMENT

Extruder

Electrically heated and controlled with at least a 15:1 length-to-diameter ratio. Cooling water must be circulated around the feed section of the barrel. If this section is kept neutral or heated, the surfaces of many particles will be melted. The particles will then tend to stick together and cause bridging at the hopper, slowing down the feed rate.

Screw

One designed to give high mixing action, such as a Dulmage or shallow-channel, and cored for circulating water.

Breaker Plate and Screen Pack

Increases pressure in extruder barrel and promotes good mixing as well as protecting die lips from unfluxed fragments. A 20-60-100 mesh screen pack should be sufficient.

Sheet Die

Horizontal, T-type, with several independently controlled heating sections and variable adjustments of the die opening across the die. Independent heating sections aid in evening out large thickness variations—a 48-inch (1.2 meters) die should have at least five. Very important is the internal construction of the die, which should be streamlined on the inside as much as possible. Stagnation places should be avoided, as molten polyethylene is soft, and cannot push out harder, partially decomposed material which has been

caught in corners. Such stagnated substance anywhere near the die land and lips will cause permanent die lines in the finished sheet. Polyethylene left in a hot non-streamlined die even for only 4-6 hours has caused the surface of subsequently extruded sheet to be covered with die lines.

Takeoff

Two or three highly polished rolls of chrome-plated steel, arranged vertically, and being fed over the middle roll. Water-quench systems are not recommended. For roll takeoff of sheet under 40 mils thick, feeding can be either over the middle roll or under the middle roll and around the top roll as is used in some impact styrene installations. However, for anything above 40 mils., it has been found necessary to extrude over the middle roll and around the bottom roll. This thicker sheet must be allowed to sag onto the roll it is to strike and carry around, rather than away from it. Differential speed control of the first two takeoff rolls is a useful feature. This allows the speed of the first roll, or of the first two rolls, to be changed independent of the rest of the takeoff. A fine adjustment is thus obtained on the tension or sag in the sheet between the various takeoff and pull rolls. The roll temperatures must be controllable to within a few degrees; closed-circuit circulation of hot water, controlled by thermostats, is an adequate method for which equipment is readily available.

Vacuum Former

A machine which can handle both female and male (drape) molds is recommended, as either may be preferred for any one object.

TECHNIQUES

Extrusion

There are three basic things which have been found to help appearance of the sheet surface: increased barrel temperatures, increased barrel pressures, and increased mechanical work input. The first has been proved effective in most commercial and laboratory equipment, and is often the simplest remedy. However, the resulting higher compound temperature may cause handling and takeoff difficulties.

The second quality-helper, increased pressure, is most easily accomplished with a given machine and die by increasing the screen pack. Along these lines, it follows that the die opening should be as small as possible – not much larger than the desired thickness. This will give maximum back pressure, and has the additional advantages of minimizing draw down, which can cause vacuum-forming troubles if excessive. If the die has a choker bar, lowering this will also increase barrel pressure—again improving quality at the expense of production rate.

The third suggestion for better quality is increased mechanical work put into the material. Devices for achieving this are: lower screw speed; screw designs which promote better mixing, such as shallow channels and Dulmage torpedoes; screw cooling, especially important at the front end of the extruder; longer barrels; preheating (which causes earlier fluxing and more intermixing of fluxed material); and the use of more viscous materials, which require more work to make them flow.

Good colored sheet can be made at moderate speeds with natural resin and a colored masterbatch. A high degree of mixing is necessary; as speed is increased, color streaks appear even before the flow marks. When applications are critical and high rates desired, or when mixing ability of equipment is poor, a colored compound is recommended for best results.

EXTRUSION CONDITIONS—
DFD-4400 and DFD-4030

Resin :	Preheated 1/2 hour at 170 deg. F. (77 deg.C.), fed to extruder at 150 – 170 deg. F. (66 – 77 deg. C.).
Screens :	20, 60, 100 mesh, or more
Screw Temperature :	Water-cooled at 125 deg. F. (50.5 deg. C.)
Barrel Temperatures :	Cold water around feed section to prevent clogging in throat. Heated zones held at 390 to 420 deg. F. (199 to 216 deg. C.)
Head and Die Temperatures :	400–410 deg. F. (204–210 deg. C.)
Compound Temperature at Die :	About 400 deg. F. (204 deg.C.)
Roll Temperatures :	180–185 deg. F. (82–85.5 deg. C.) (first roll). 150 deg. F. (66 deg. C.) (second roll)

PROPER TAKEOFF DESIGN AND CONDITIONS

A temperature-controlled roll system is definitely recommended. The desired solution is one where the extruded sheet strikes the top of a polished roll driven at a controlled speed, carries around and under this roll, and then passes around a second similar roll directly beneath the first. The sheet should stick completely to the first roll and always be above the clouding-crystallization point (about 100 deg. C.) while on this roll. It is desirable to run this roll as hot as will permit satisfactory takeoff, for maximum surface gloss. A roll temperature of 175 deg. –200 deg. F. (80–93 deg. C.) will usually fill all these requirements.

The second roll is best run cold enough (about 150 deg. F. [66 deg. C.]) so that the sheet clouds (crystallizes) between the two rolls and on first contact with the second roll. This roll has also been run so that the sheet sticks to it, as with Roll 1. Some improved gloss on the contact side is thus gotten; however, this introduces handling difficulties after leaving Roll 2, and requires a high roll temperature—probably above 210 deg. F. (99 deg. C.).

There are many factors which affect the proper roll temperatures. Consequently the range of possible roll temperatures is wide; however, for a given operation with given equipment, the roll temperatures are critical and often must be held to within a few degrees of their optimum temperature, especially on the first roll. Otherwise, the sheet will either stick too much (too hot) or not completely (too cold). Some of the variables, and their probable effect on optimum temperature of the first roll, are as follows :

Change	Heat to be Removed from Constant Roll Area	Roll Temp. Should Be
Greater roll area used	less	greater
Better heat transfer through rolls	same	greater
Faster extruder output—same takeoff speed	more	less
Faster output, same thickness, faster takeoff	same	same
Higher compound temperature	more	less
Thinner sheet, faster takeoff	less	greater

Several takeoff problems have been solved in laboratory and field extrusions of polyethylene sheet. These are now discussed.

Pockmarks can appear—tiny spots scattered all over the sheet. These can often be eliminated by changing roll temperatures. If the pocks are visible on the first roll, a higher temperature on this roll is called for. The effect of pocks on Roll 2 is much less noticeable on the finished sheet. Changing this roll's temperature in either direction should eliminate them; lowering this temperature is the preferable remedy.

The sheet may stick too strongly to Roll 1, and may carry around the roll too far before pulling off. Preferred solution, if equipment is so constructed, is to speed up Roll 2 slightly with respect to Roll 1. If this cannot be done, Roll 1's temperature must be lowered.

Clean rolls are very important. Dirt, dust or grease may get on the roll in such small amounts as to be invisible to the eye, and still cause pocks and other defects which stubbornly persist in spite of changing roll conditions.

Air can be trapped between the sheet and the middle roll, and result in blemished sheet. Often, the "trapped air" is merely incomplete sticking, and can be eliminated by raising roll temperature. However, air can be trapped if the roll is dirty, or if the takeoff system feeds under the middle roll and around the top roll. If this system is at fault, lowering the position of the rolls with respect to the die may help.

Many roll systems have third temperature-controlled roll that can be pressed with variable force on the sheet as it strikes the first roll. Such a roll will iron out some die lines, help keep uniform gauge, and help surface gloss if roll is polished. This roll must be surfaced with metal, teflon or other smooth heat-resistant material; rubber is unsuitable. It is often a very sensitive arrangement, and a small rolling bank of molten material can build up in the bite of the rolls, especially if the thickness at the die varies more than a few mils across the sheet. The sheet may then show glossy and dull spots, single wiggling lines in the machine direction, or possibly areas of many irregular parallel lines running across the sheet. Suggestions if such troubles occur: Either operate without the third roll, or try to eliminate the rolling bank by adjusting the die bolts to produce uniform gauge, or by adjusting third-roll pressure.

Polyethylene will take a reasonably high gloss from a polished roll without a third press-roll. In general, if the die is smooth-surfaced and frequently cleaned (hence, no die lines), the third roll is often unnecessary.

ary, and can easily be more trouble than it is worth. The exceptions to this statement are two: (a) when a very high gloss is desired on both sides, and (b) extrusion of light and medium gauges of natural sheet, where both surfaces affect final appearance; a polished press-roll improves this appearance.

With a two—or three-roll system as described above, sheet has been made both on commercial equipment and in the laboratories with a specular gloss value of over 90. This gloss does not disappear during vacuum forming.

Since polyethylene is much softer at extrusion temperatures than rubber-modified polystyrene, handling of the extruded sheet is more of a problem. Thus, a system with the second roll below the first roll is recommended—especially for thick sheet. With this arrangement the sheet is draped over the first roll, instead of sagging away from it under its own weight. With thick sheet, the sag may be very great, and production of good sheet may be impossible without this preferred arrangement.

GAUGE CONTROL

This can be very time-consuming, especially when starting up on a clean die. In this case, a feeler gauge which will not scratch the die surface is helpful. The outer edges should be set a few mils narrower to eliminate thick beads at the edges. When sheet is to be vacuum-formed, these edges should not be trimmed, as they will become the portions held by the forming frame, and will become scrap anyway. In fact, running these edges several mils thinner than the rest of the sheet will reduce the amount of vacuum-forming scrap, and thus improve product and/or reduce costs.

The remainder of the die width should be set a few mils larger than the desired sheet thickness. If high screw speeds are to be used, the center section can be set a little narrower than the rest of the die, as at these speeds more material is pushed out of the center.

Final adjustments must be made on a hot machine, with die-lip adjusting bolts, and die temperature settings. This last adjustment is the least desirable, as it takes longer to have its effect, and tends to produce varying compound temperatures across the sheet.

For some vacuum-forming applications, sheet could conceivably be run deliberately out of gauge, to achieve desired thicknesses in the vacuum-formed piece. This

further points up the advantages of extrusion and vacuum-forming at the same location—where the sheet thickness can be easily controlled and tailored to best fit the application.

TECHNIQUES—VACUUM-FORMING

Description of Operation in Former

The sheet is clamped in a frame held under a heater, and begins to show large wrinkles in all directions a few seconds after heat is applied. These then start to line up parallel to each other, in the machine direction of the sheet. The more oriented the sheet is, the greater is this tendency of the wrinkles to line up. In any case, the machine direction can be identified by watching the wrinkles. The sheet then begins to sag and the wrinkles start to disappear. About the time the wrinkles are all gone, the crystallization temperature is passed, and the natural sheet loses its cloudiness. At any time after the wrinkles are all gone (and, if natural, the sheet is all clear) the sheet is soft enough to form. Its temperature is then about 110–120 deg. C.

If heating is continued, the sheet temperature rises rapidly, as the specific heat of the molten polyethylene is appreciably less than that of the crystallized plastic. This extra heating may be necessary for the sheet to draw completely over some deeper or more complex molds. However, there are these disadvantages to the extra heat: the surface nearest the heater may lose its smoothness, and become pebbled; the sheet may sag low enough to touch the mold and become prematurely cool; the sag may be great enough to cause an appreciable temperature difference between the center (farther from the heater) and the edges (nearer the heater); and cycle time is increased, making fewer parts per hour and increasing the cost per part.

After the object is formed, it will cool very slowly in air. Auxiliary cooling is definitely desired to speed up the forming cycle. Such devices are external cooling fans, a water cooled mold, and compressed air blown back from the vacuum line under the formed sheet. This last device also aids in release of the formed part, but must not be applied too soon after forming, when the soft polyethylene may be distorted by air blast.

Mold release agents are unnecessary with polyethylene. Zinc stearate and silicone grease have been tried, and do nothing other than impair the smoothness of the surface in contact with them. Furthermore, silicones are stress-cracking agents for polyethylene. Since it will stick to almost nothing when crystallized, polyethylene forms should release easily from well-designed molds, with nothing more than a blast of air underneath the form.

APPEARANCE OF PRODUCT

If a glossy polyethylene sheet is fed to the former, this surface will be retained on the outside of the finished form, except in cases of severe overheating. On the inside—the surface in contact with the mold—the resultant surface depends upon the smoothness of the mold surface and on mold temperature. For a smooth surface, the mold must be very smooth and warm. A cold mold will chill the surface in the same way that a cold roll chills extruded sheet without putting on a glossy finish. Where this inner finish is important, a compromise with cooling cycle is necessary; warmer molds mean glossier surfaces but longer cooling times.

The thickness of the finished part will be greatest at flat horizontal surfaces and any other areas that the sheet strikes as it is draped, before vacuum is applied. Where the sheet is oriented, it will be thinner in areas drawn across the direction of orientation, than in areas drawn with this direction.

MOLD DESIGN

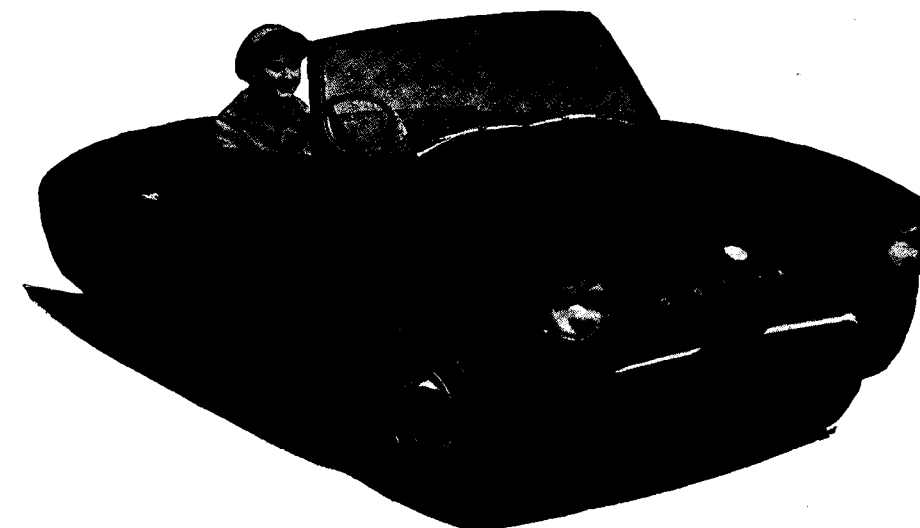
Among the special considerations in designing a mold for vacuum-forming polyethylene is this 2 to 5 per cent shrinkage in the formed part. Molds should be designed so that this shrinkage aids, rather than hinders, release.

Since polyethylene is soft when molten, it tends to be drawn into vacuum-holes easily. Thus, these holes should be as few as possible, and as small as possible at the surface. The use of a high vacuum with no leaks around the frame will make a minimum of holes necessary, as will relieving the under side of each hole almost to the surface, so that the holes are of tiny diameter only near the surface. Judicious placing of these holes, with a thought to the finished article, will also help to make them less conspicuous on the formed piece.

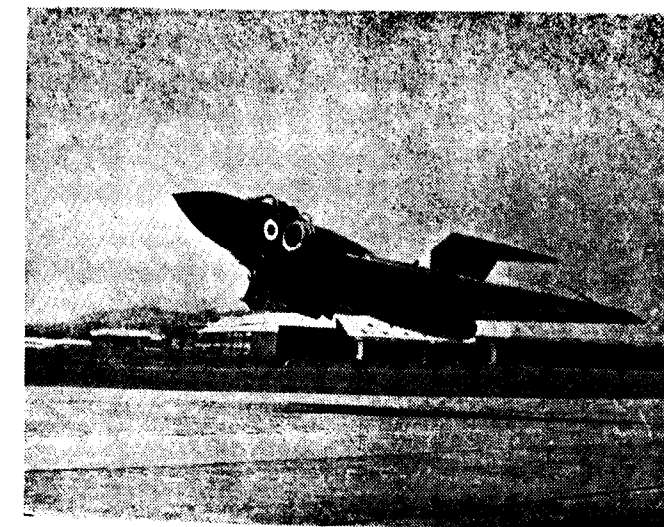
The soft sheet sometimes is drawn underneath the mold at its base, making release difficult or impossible. Most molds can be designed to remove this possibility.

When designing a vacuum-forming mold, it should be remembered that every ridge on one side is a valley on the other. This is especially important in housewares, where a sharp strengthening ridge around the base becomes a hard-to-clean valley inside the piece.

The possibility of rigid inserts should not be overlooked when designing molds for polyethylene, a flexible material. These inserts can be formed-in-place or added after forming, to further strengthen the piece.



AIRCRAFT AND AUTOMOTIVE INDUSTRIES SECTION



Doppler Navigators for Civil Airlines

By An Aviation Correspondent

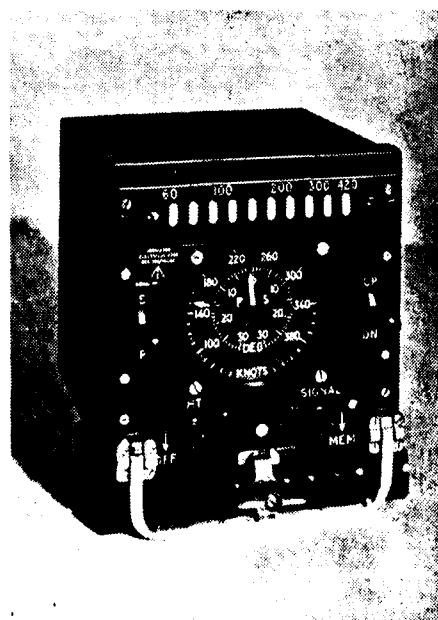
WITH the rapid increase in air traffic in post-war years there has been a growing awareness of the need for more accurate navigation on the trunk airways. Because of the limitations of present navigational aids, aircraft flying commercial air routes are so spaced out that each aircraft occupies a great deal of air space, which in theory, it has all to itself, to minimise the risk of aerial collision. With more and more aircraft flying these routes the time has come when saturation point is being reached in many parts of the world. Since the amount of space available cannot be stretched, the only alternative is decreased separation between aircraft on the airways. This brings in its train the problem of closer control of aircraft flying the routes. It will be of vital importance for Air Traffic Controllers to know the exact position of each aircraft; equally important will be the need for pilots to fly exactly on track and to have a precise knowledge of their aircraft's position and ground speed. With the recognised standard navigational equipment used at present in commercial aircraft such a degree of navigational accuracy cannot be guaranteed.

Some years ago, rumours began to circulate in aeronautical circles about the development of a revolutionary form of navigational aid, by means of which an aircraft could be accurately navigated from one point to another without the assistance of any ground based equipment. Such pseudonyms as "Green Satin" and "Blue Silk" were in circulation to cloak the identity of the equipments installed in aircraft of the Royal Air Force. In view of the obvious military value of such a device a blanket of security was imposed by military authorities on both sides of the Atlantic. It could not be expected, however, that a device of this kind, which would be of the utmost value to commercial flying, would be retained for the sole use of military flying indefinitely. Some two years ago the ban was partially lifted and some details were disclosed. Twelve months later the full story was released—the story of Doppler Navigators. At the same time British and U. S. manufacturers announced that special equipments for civil use were being developed.

The principles on which the operation of Doppler navigators is based was discovered by, and named

after the Austrian scientist, Christian Johann Doppler, who discovered some 115 years ago that sound waves emitted from an object in motion undergo a change in pitch when heard by a stationary observer. When the moving object is approaching the observer the pitch of the sound appears to be higher than it actually is, and drops to an apparently lower pitch when the object has passed and is receding. There are many everyday examples which illustrate this; two which come readily to mind are the whistle of a passing train and the noise of an aircraft passing at speed overhead.

It was soon discovered that light waves act in a similar fashion and the spectrum band of a source of light receding from an observer moves toward the lower, or red, frequencies. This discovery proved to be of value to astronomers in calculating the motions of heavenly bodies, since the degree of shift in the spectrum is a direct function of the speed of the object observed. The higher the speed the greater the shift. Radio waves and light waves, being both electromagnetic in character, have similar



S.B.A.C. 1957

The indicator unit of the Marconi Doppler Navigator Type AD2100. Direct indication of ground speed and drift angle is read off from the central dial.

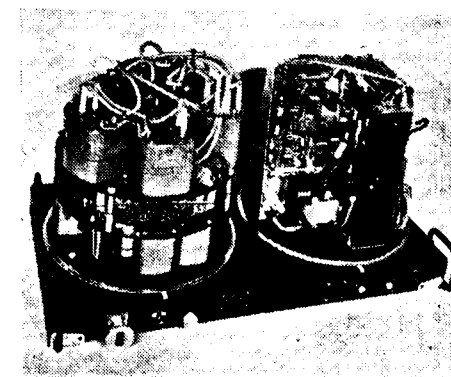
physical characteristics and are subject to the same fundamental physical laws, Q. E. D. the Doppler Effect applies equally to radio waves.

For over a century no other practical use was found for the Doppler Effect. It was not until World War II that scientists found other uses for it—in naval gun laying. Thus it was that what had been nothing but a scientific curiosity for more than a century was viewed with a more respectful eye, and it was not long before a further use was found for it, this time as a means for discriminating between moving and stationary objects in radar systems. Then, in 1947, scientists of the Ministry of Supply designed a simple experimental equipment for studying the value of the Doppler Effect in a navigational aid. It was from this that Marconi's Wireless Telegraph Company developed the first Doppler Navigator to be used operationally—the Type AD. 2000.

For a complete understanding of the operation of Doppler Navigators a knowledge of electromagnetic wave theory is necessary. In general terms, however, they operate in the following way:—

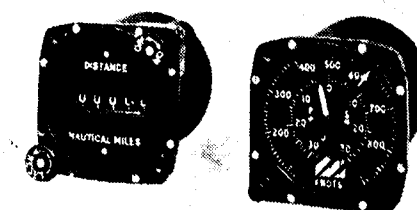
The transmitter in the aircraft feeds radio signals to the aerial system which shoots them towards the ground in two beams, one directed forwards and the

other backwards. These signals strike the ground and are reflected. A small proportion of the reflected waves find their way back to the aircraft, are picked up by the aerial and are fed to the receiver and computer. Because of the relative motion of the aircraft to the ground the frequency of the returned signals differs slightly from that of the transmitted ones, those received from the forward beam being



Marconi Doppler Navigator Type AD 2000

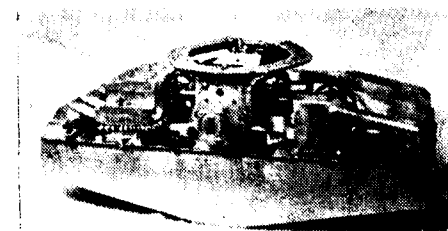
Picture shows Transmitter-Receiver with pressurised casings removed to show the arrangement of components and wiring.



Indicators of the new Marconi Type AD 2300 Doppler Navigator for Civil Aircraft.

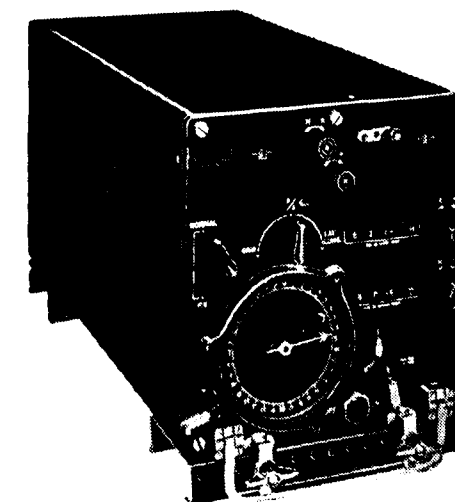
Left: 'Distance to run' indicator.

Right: 'Ground Speed' and 'Drift' indicator.



Unit of the new Marconi Type AD 2300 Doppler Navigator for Civil Aircraft.

View showing wave-guide connection.



Marconi Doppler Navigator Type AD 2000

Picture shows the Ground Position Indicator MKIV which provides automatic and continuous information of ground position from input information of heading, drift angle and ground speed.

Presentation is in any one of three forms, controllable by a switch, namely Grid presentation, A/A Set Track or Latitude and Longitude.

higher in frequency and those from the backwards beams lower in frequency. This difference is due to the operation of the Doppler Effect. By comparing the two returned frequencies a third one called the Doppler frequency is obtained. It is from this frequency that the speed of the aircraft over the ground is calculated. As the difference in frequency is a direct function of the relative motion of aircraft and ground, it follows that the greater the speed of the aircraft the greater the difference in frequency will be.

The drift angle is found by displacing one of the two beams to starboard and the other beam to port of the aircraft's track, the positions being rapidly switched from one side to the other. By comparing the difference in the two frequencies reflected back to the receiver the sideways motion of the aircraft over the ground, if any, can be found.

The Doppler Equipments have been found to be extremely accurate in use. A small margin of error is introduced into the system by the gyro compass, but it is likely that this margin will be reduced as more accurate compasses become available. In a series of tests carried out by the R. A. F. with a

Marconi equipment using a specially calibrated compass, a series of 300 nautical mile flights were made at a height of 5,000 ft. These showed that the resultant navigational errors along the route was nil, while at right angles to the route the average was 1.1 nautical miles.

A number of Doppler Navigators are currently being evaluated by airlines. The results so far prove that these equipments will be of great value to commercial aviation as an additional aid to accurate navigation and time saving in operations. Commercial airlines will probably begin using Doppler on passenger routes before very long. Although the travelling public are not likely to be aware of it these unique instruments will have a considerable effect on the efficiency of airlines service, in enabling flights to keep more closely to time-tables and flying the most favourable routes. It is probably not generally realised that aircraft seldom fly the most economical track because of the unpredictable factors of wind direction and speed. An aircraft equipped with Doppler will be able to keep to its selected course throughout and keep closely to its flight schedule. The irritating delays which sometimes occur because of aircraft arriving late will thus be substantially reduced.

The Story of the Vacuum Cleaner

FIRST THREE MACHINES ON SHOW IN LONDON

The Science Museum in Kensington, London, now has the first three vacuum cleaners ever made in the world. Surprising as it may seem, the Museum has not previously been able to show anything to do with this important side of domestic and industrial cleaning. Among the new acquisitions is one of the first models designed by the late H. Cecil Booth, the "father of vacuumation". It has been released to the Museum by Queen Elizabeth II after its many years of service at Osborne, Isle of Wight. Its history reveals that the Royal Family was the first in Britain to own one of the "new-fangled machines", as they were called in 1902.

King Edward VII had ordered its purchase, after it had been used to clean Westminster Abbey prior to his coronation. Soon after the coronation, Booth suggested to the Royal Mint in London that his machines could save a lot of time and money by gleaning all the scraps of precious metal that fell to the floor. He was invited to give a demonstration in

the Copper room and this was so successful that he was permitted to repeat his performance in the Silver Room. The Mint authorities were surprised at the large quantities of metal he was able to pick up.

For a final demonstration, he was taken to the Gold room. Then he packed up his machine and left. He was crossing London Bridge when his horse and cart were held up by a cordon of police. He had omitted to empty the bag of his vacuum cleaner and return the scraps of gold. It is not surprising that the world quickly got to hear of Booth's invention!

One of the other models now in the Science Museum is the original Goblin vacuum pump, also invented by Booth, which has the nickname of "Puffing Billy", while the third is the earliest domestic trolley type vacuum cleaner, complete with tube and fittings (circa 1906). Booth was the founder of the British Vacuum Cleaner and Engineering Company Ltd., which today has its headquarters at Goblin Works, Leatherhead, Surrey, England.

Teddington Aircraft Controls Ltd.

Cefn Cæd, Nr. Merthyr Tydfil,
Glamorgan, Gt. Britain.

TEDDINGTON Aircraft Controls Ltd. specialises in all forms of temperature and pressure control as applied to aircraft and their equipment is installed in the majority of the latest British aircraft both military and civil. Their products cover a wide range of temperature control valves, pressure switches, time switches, anti—and de-icing controls, fuel tank pressurisation controls, pressure regulators, potentiometers, pressure transducers and flexible metal bellows.

Among many interesting current T. A. C. projects is a pneumatic temperature control system. This temperature controller, which may be adapted to cabin temperature, radar equipment cooling, airframe/engine de-icing and weapon heating control systems makes use of a bi-metal element detector developed by the company. This element is exceedingly rugged and is insensitive to vibration—a condition which has always been a source of trouble in bi-metal thermostats.

The response of this element to changes in temperature is arranged to control a bleed on a pressurised bellows connected to one end of a beam; thus cabin temperature change signals are converted into pressure change signals. The other end of the beam is acted on by a second bellows which senses cabin pressure. The position of the beam controls a selector valve which opens and shuts ports to the pneumatic actuator of a butterfly valve. The bellow subjected to the sensing element bleed effect is pressurised to a fixed value above cabin pressure, thus, the system is unaffected by variations in the cabin pressure which is utilised as a datum.

The importance of the pneumatic temperature controller is significant due to the increasing ambient temperatures encountered in modern high-speed aircraft which make the use of electrical components difficult.

A development of this pneumatic servo has been designed as a pressure regulator. It differs in design from the temperature controller inasmuch as the control valve is connected to a balanced piston assembly, one side of which senses the downstream pressure which is to be controlled, and the other side, a pressure controlled by a relief valve/orifice

system set to give the specified control pressure. Variations in actual downstream pressure, which cause a differential across the piston, are compensated for by the movement of the piston which sets the main control valve at some new throttling position.

Among the many types of pressure switches in production is a variant designated 'Dual Pressure Switch', which meets the requirement for a switch capable of closing a set of contacts at different points on rising pressure and of adjustment over a wide range of settings. It is suitable for use with inflammable liquids and in ambient temperatures ranging from -50°C to $+150^{\circ}\text{C}$. The setting of a switch now in production is as follows:—

Operating pressures	80 p. s. i. and 1,000 p. s. i.
Max. overload pressure	2,500 p. s. i.

Teddington Aircraft Controls manufacture accelerometers, potentiometers and pressure transducers under agreement with Giannini Ltd., the British affiliate of G. M. Giannini & Co. Inc., of America. A recent addition to the range of pressure transducers is one giving a digital output and designed to measure atmospheric pressure from sea level to 70,000 ft.

The output is in the form of a coded signal (cyclic progressive, binary-coded-decimal) and the instrument may be used in conjunction with a pulse type telemetry system in the performance testing of guided missiles, or directly with an electrically operated digital recorder or typewriter.

An extensive range of hot air and gas control valves are in production and these range from 20 mm. carbon barrel valves to 4 in. three-way carbon gate valves and 5½ in. butterfly plate valves. The method of operation may be electro-mechanical, electro-pneumatic, mechanical or manual.

In the butterfly valve range, lightweight units are available for use, with suitable actuation, in ambient temperatures of up to 250°C and capable of handling air or gas at 250°C . An example of this type of valve is one with a bore of 4 in. weighing 4 lb. and designed to control air at 250°C in ambient temperatures up to 150°C . These valves are nickel plated to give high corrosion resistance by the Kanigen process.

Time switches, for turbine engine starting, camera gun operation, airframe/engine de-icing and turbine engine re-heat control are in quantity production by the company. A very interesting development of the range of time switches is one designed to meet the requirements of British Standard Specification G. 137 for aircraft navigation lights. This specification was issued as a result of a mandate by the International Civil Aircraft Organisation to make navigation lights intermittent for greater conspicuousness in air navigation signals. The requirements are that the fuselage and tail lights as one circuit and the wing tip lights as another should be lit alternately. The frequency specified is 40—60 cycles per minute with an 'on' period of each circuit equal to within 10% and an 'off' period of both circuits not exceeding .15 of the time for a complete cycle, a complete cycle being one 'on' period of each circuit.

The Teddington unit designed for this application has an approved life of 3,000 flying hours between overhaul.

TWO NEW STEEL PLANTS FOR BRITAIN

The British Prime Minister, Mr. Harold Macmillan, announced in the House of Commons on November 18 Government authorization of new projects which will greatly increase, over the next few years, Britain's capacity for the production of steel. Two new strip mill plants to be constructed will have an initial production capacity of 500,000 tons each, and will be capable of expansion to provide capacity for an annual production of 4,000,000 ingot tons. The total cost of this plan cannot yet be estimated, but it seems likely to be well over £100,000,000.

One of the new plants, for sheet and tinplate, will be constructed by Richard Thomas & Baldwins Ltd., at Newport, Monmouthshire (Wales). The other, for sheet and light plate, will be built by Colvilles Ltd. in Scotland.

The Colvilles project will make use of facilities already being provided by the company's existing plants, and the additional cost of the new plant is estimated at about £50,000,000. The Richard Thomas & Baldwins plant will be an entirely new works in a new site, and is likely to cost very much more than the other. Final details of this plant are still being discussed. To the extent that construction of the plants will require funds additional to the

The company have for many years conducted a continuous development programme aimed at the successful manufacture of flexible metal bellows and more recently have, to this end, operated in technical collaboration with the Solar Aircraft Company of America. Bellows are made in the non-ferrous metals including brass, alumbro, tungum and cupro-nickel in diameters ranging from $\frac{3}{4}$ in. to 7 in. and in ferrous metals in steels such as 18/8 stainless steel, the Nimonic series of alloy steels and Nilo K in diameters ranging from 1 in. to 7 ft.

The various types of bellows have a wide application in many branches of engineering, such as pressure sensing elements, shaft seals and packless glands, flexible and expansion joints, thermostats and transfer movements.

An extensive range of test equipment has been designed and developed in order that practical tests, to ensure design conditions have been met, may be carried out on bellows units.

resources of the two companies, the necessary funds will be advanced to them by the Government.

ADDITIONAL OUTPUT NEEDED

The Prime Minister told the House that the Government had accepted the conclusion of the Iron & Steel Board that additional capacity for the production of steel-mill products was required to meet the future needs of the national economy. It had been decided in principle, therefore, that this additional capacity should include two major strip-mill projects, each with the appropriate steel making and finishing capacity.

He described the Newport scheme as the first stage of a major expansion of strip-mill production in South Wales. He explained that the Scottish scheme would increase production of sheet in that country to more than was at present consumed by industries there, and should help to attract to Scotland new industries using sheet.

Both works will be capable of substantial expansion, particularly the one in South Wales. It is expected that work will start on the construction of both new plants next year, but it will be four or five years before they are likely to be in production.

FAIREY PHOTO-ELECTRIC SAFETY OHMMETER

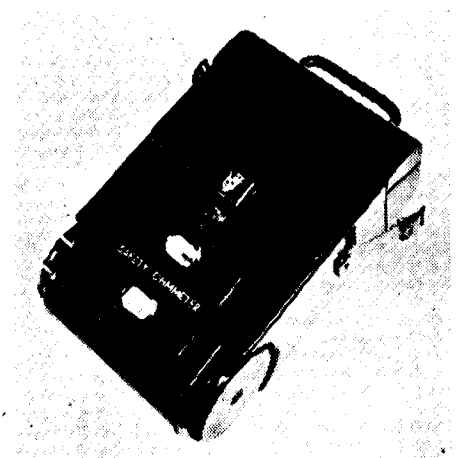
By an Aeronautical Engineer

THE use of a selenium photo-cell as the power source for a resistance bridge eliminates the normal hazards involved in the testing of firing circuits. Explosive component checks rely on a measurement of resistance, which necessarily implies the application of electrical energy to the circuit. To remove the possibility of accidental ignition, the energy applied during the test must be below the safety margin of the component under any condition of instrument failure, or misuse. In conventional methods this is achieved by including a current or voltage limiting device with the power source. In the event of a breakdown of this restraint, dangerously high currents can be introduced into the firing circuit, with a consequent risk of ignition. This danger is overcome by the use of a selenium barrier-layer photo-cell, the output of which, under any condition of light saturation or failure, cannot exceed a short-circuit current of 10 mA or an open-circuit voltage of 0.7 V.

Designed and developed by the Weapon Division of The Fairey Aviation Company Ltd., Heston, Middx, the instrument utilizes a Wheatstone bridge, providing a range of resistance measurement from 0—10K ohms in four switched ranges (0—10 ohms, 0—100 ohms, 0—1K ohms, 0—10K ohms). A "transit" position on the switch is arranged to place a short-circuit across the meter terminals for galvanometer damping. The power source for the bridge is a high sensitivity Infra-Red selenium photo-cell, the characteristics of which are modified in manufacture to limit the short-circuit current of the cell at light saturation, and yet maintain a high sensitivity at low illumination intensities. Null indication is provided by a sensitive centre-zero galvanometer, the pole pieces of which are shaped for off-balance insensitivity. To achieve a high accuracy and stability, $\pm 0.1\%$ wire-wound resistors, cast in an Araldite block, are used for the bridge ratio arms, and a wire-wound cam-corrected potentiometer of $\pm 0.1\%$ linearity for the variable element. To compensate for the $\pm 5\%$ overall resistance tolerance of this potentiometer, a 5 ohm variable wire-wound resistance is included in the fixed ratio arm. This is accurately adjusted on initial assembly and locked.

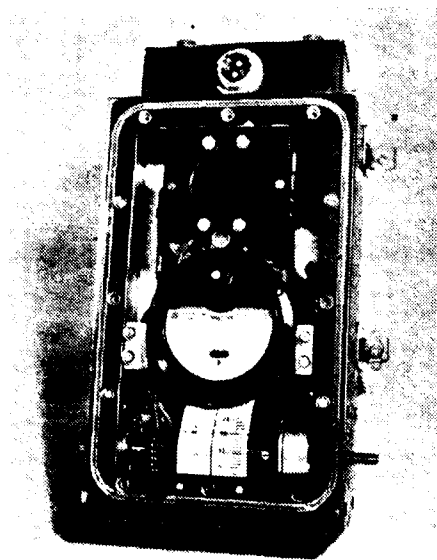
The instrument consists of an inner sealed case, enclosing the bridge components, contained in an

outer protective cover. The galvanometer and photo-cell are attached to the under-side of a perspex plate which forms the lid of the inner case, and is hermetically sealed to it by means of a Neoprene washer. Cut-outs in the outer cover provide viewing access to the range and scale information, meter and photo-cell. To remove the possibility of accidental earthing of a test circuit by the instrument, the outer case is flame-sprayed with a tough, durable coating of nylon. A connection to the instrument screen is provided for use if required. The range and scale drums are mounted adjacently and viewed through a single aperture. Control of the range switch and variable resistance is achieved by means of $3\frac{1}{2}$ inch diameter knobs, the peripheries of which are fluted for ease of operation with gloved hands. Sealing of spindles, fixing screws, etc., is achieved by means of banded seals.



Fairey Photo-electric Safety Ohmmeter.

The fundamental bridge accuracy (determined, by component tolerances) is of the order of $\pm 0.3\%$. The measurement accuracy, however, is dependent upon the sensitivity of measurement and the scale reading accuracy. At low illumination intensities (i. e. below 50 foot-candles), and under the load conditions presented by the bridge at any setting, the photo-cell is essentially a constant current generator. The current output, and therefore the sensitivity of the bridge, is directly proportional to the intensity of the light incident on the photo-cell. The illumination intensities required to produce a detectable galvano-



Fairey Photo-electric Safety Ohmmeter sealed inner case with components in position.

meter current for different range and scale settings are shown in Table 1. They are based on a $\pm 10\%$ incremental change of the variable element and are an indication of the *measurement sensitivity* of the instrument.

TABLE-1

Range	Percentage Scale Reading				Illumination intensities required to produce a detectable galvanometer current for a $\pm 10\%$ incremental change in resistance setting (foot candles)
	5%	10%	50%	100%	
0-10 ohms	9	5.5	3	2.7	
0-100 ohms	2	1.3	.8	.7	
0-1 K ohms	2.5	2	1.7	11.6	
0-10K ohms	13	12	12	12	

The Fairey Safety Ohmmeter

The Fairey Safety Ohmmeter, designed specifically for the testing of explosive circuits, sets a new high standard of safety, not only in the field of armaments, but whenever the testing of electrical circuits has to be performed in an environment of explosives or inflammable gases. The principal design feature is a Photo-Electric Cell, which is an inherently safe power source of indefinite life, with none of the hazards and inconvenience associated with batteries or hand generators.

The instrument also incorporates other features



Checking a firing circuit with the Fairey Safety Ohmmeter.

Using normal bridge-balancing techniques, an improvement of at least 2:1 in bridge setting accuracy can readily be achieved, since the figures quoted for measurement sensitivity relate to a detectable galvanometer deflection. Thus, the intensities given in Table 1 are sufficient to provide a *measurement accuracy* of approximately $\pm 5\%$. For higher accuracies, the illumination intensities should be increased proportionally. High scale reading accuracy is ensured by the use of a precision cam-corrected potentiometer, wired as a variable resistance, and an accurately graduated scale drum. This has an effective scale length of 6.5 inches for 100 divisions. The resistance angle of the potentiometer is held in manufacture to $300 \pm 0 - 0.25^\circ$, and the linearity to $\pm 0.1\%$. Backlash is eliminated by fixing the scale drum directly to the driving shaft of the potentiometer.

The overall dimensions of the instrument are $11\frac{1}{2}$ in. $\times$ 7 in. $\times$ 4 in. and its weight is approximately 8 $\frac{1}{2}$ lbs.

designed to ensure safety and reliability. The outer case is designed to provide robustness and ease of operation in the field. It also has a thick nylon coating as additional protection and insulation against voltage pick-up. The inner case is sealed as a protection against all climatic conditions, and the leads are screened against induced voltages from external sources. The instrument has been subjected to exhaustive environmental testing, including tests to Inter-Service Specification K. 114, and has gained full Ordnance Board Approval and the Ministry of Power's Certificate of Intrinsic Safety, and is supplied

to the Royal Air Force and guided weapon manufacturers.

Technical Description

The instrument provides resistance measurements from 0 to 10K ohms in four switched ranges, viz:—

0 to 10 ohms	} The scale drum common to all ranges is calibrated in 100 divisions.
0 to 100 ohms	
0 to 1K ohms	
0 to 10K ohms	

The maximum open circuit voltage of the cell is 0.7 V. and the maximum short circuit current 10 mA.

The instrument can be operated both in daylight and in artificial light of a reasonable working intensity, and provides a reading accuracy of within $\pm 5\%$. As the fundamental bridge accuracy is $\pm 0.3\%$ the reading accuracy with greater light intensity is better than $\pm 5\%$.

Dimensions	— $11\frac{1}{2}'' \times 7'' \times 4''$ 29 cms $\times$ 18 cms $\times$ 10 cms	} Exclusive of handles etc.
Weight	— Approximately 8 $\frac{1}{2}$ lb./4 Kgs.	
Price	— £ 95.	
Delivery	— Four weeks.	

INDIAN TRAINEE AT "NUCLEAR ENERGY" STEELWORKS

A Colombo Plan trainee from India, Mr. R. S. Karbelkar, has been gaining experience in Britain at the first steelworks in the world to use electric power generated by nuclear energy—the Workington Iron & Steel Co. in West Cumberland, a few miles from Calder Hall. (The Calder Hall nuclear power station feeds current into the national Grid, and when the Queen opened it two years ago she went to the steelworks and switched over the newly generated current.)

Mr. Karbelkar, of Dadar, Bombay, went to Britain just over a year ago. He spent three months at the Workington steelworks, one of the plants of the United Steel Companies Ltd. He also spent six months at the works of John Summers & Sons Ltd. at Shotton, near Chester, and two months with Dorman, Long (Steel) Ltd., Middlesbrough.

This was Mr. Karbelkar's first visit to Britain, and he said in an interview that his study of the different steelmaking methods had provided very useful experience. Mr. Karbelkar left for home with other Durgapur trainees on November 29.

The machine will sew across 10-ft-wide carpets in less than 10 secs.; and carpet backings, carpets with pile, tufted carpets and carpets with latex backing can be sewed. The machine sews a chain stitch, which is quickly removed after processing.

Carpets to be joined are fixed to the machine with suitable holders, and the sewing head traverses to give a straight seam. The machine with the motor drive is held in one hand, which also operates the starting button as the machine traverses. The machine is quickly returned to the starting point by pushing it along the rails on its own rollers. The sewing head can also be used as a portable machine by detaching it from the railway carriage and taking it to the carpets to be sewed.

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CARPET SEWING MACHINE

A railway sewing machine for joining carpets for continuous processing has been announced by Trumeter Co., 38 W., 32nd Street, New York 1, N.Y. The machine can be fixed to the machine as a unit for an individual process or it can be fitted with portable stands.

The new polyamide, nylon-11, offers excellent possibilities as a covering for metal sleeve bearings. It has a bearing surface that will take high loads, needs no lubrication, and can be produced at low cost. In addition it has low moisture absorption and is useful in the temperature range of 212°F. to 67°F. For high clearance sleeve bearings, fluidizing conditions can be controlled closely enough to give coatings that do not require subsequent machining, and that can take relatively heavy loads under both continuous and intermittent duty. Effectiveness as a bearing surface depends on the bond between the plastic film and the metal. Adhesion of nylon-11 to aluminum is aided by the oxide film on the metal, giving tensile adhesion up to 5000 p. s. i.

NEW AUSTIN HEALEY SPRITE

Sports Car With Many Outstanding Features

A completely new, small and inexpensive sports car, the Austin Healey Sprite is powered by a special 948 c. c. B. M. C. 'A'-type engine (developing 42.5 b. h. p. at 5,000 r. p. m.) and costs £455 plus £233 17 s. Purchase Tax in Great Britain.

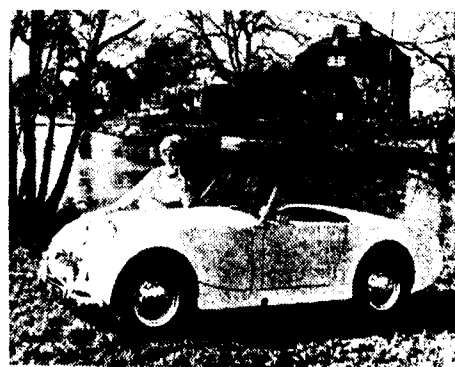
It is some 20 years since Austin made a small sports car but the "Sprite" lives up fully to the fine tradition established in the 1920's and 30's and more recently by the Austin Healey 100. It has a maximum speed in the eighties and rapid acceleration but with a fuel consumption ranging from 30-45 m. p. g.

POWER UNIT

The power unit is a tuned version of the well proven A 35 engine, fitted with twin S. U. carburettors, and special valve springs; compression ratio is 8.3 to 1. Mechanical specification includes a four speed gearbox, independent front wheel suspension by wish-bones and coil springs, quarter elliptic springing at rear with trailing arms (giving a low unsprung weight). A hypoid $\frac{3}{4}$ -floating rear axle, ratio 4.22 to 1, provides overall gear ratios of: First 15.31, second 10.02, third 5.96, and top 4.22 with 19.68 reverse. Steering is by rack-and-pinion, with $2\frac{1}{4}$ turns from lock to lock. Tyres are 5.20 x 13 in., tubeless. The Sprite has a two-seater body with all-weather equipment in the form of side-screens and a detachable P.V.C.-coated hood.

Ease of maintenance has been given considerable attention: the entire front of the body is hinged from the scuttle giving excellent access to engine, suspension and steering unit.

A selection of bright finishes for body exterior, trim and hood range from cherry red to primrose-



Austin Healey Sprite.

A wide range of extra equipment is available including heater and demister, windscreen washer, rev-counter, tonneau cover and laminated windscreen.

FAMOUS ANCESTORS

With the introduction of the Sprite, Austins are opening a new era in the sports car field, as not since 1938 has a small sports car been made by the Company. These early sports cars, ranging from the early "Ulsters" to the "Nippys" were all "off-shoots" of the 750 c. c. racers, which had so many outstanding successes, holding many international and speed records and attaining speeds in excess of 100 m. p. h.

Some of the original design points used on these pre-war Austin sports cars are used in a much more advanced and improved form on the present day Sprite. An example is the rear suspension which employs quarter-elliptic leaf springs and trailing arms.

The Sprite, now in production, is covered by the worldwide servicing facilities of the British Motor Corporation.

NEW DESIGN—TEST BED FOR JET-PROP ENGINES

A new aerodynamically designed, twin cell test bed capable of testing jet-prop engines of 10,000 e. s. h. p. with propellers of 20 ft. diameter passing up to 4,000 lbs. of air per second has been opened at the Nantgarw test site of B. O. A. C.'s repair factories at Treforest, South Wales.

The test bed is being used for testing the Proteus 705 jet-prop engines of the Corporation's 15 Britannia 102s and the Proteus 755 engines of its 18 Britannia 312s.

In designing the internal shape of the engine cells consideration had to be given to the possibility of vibration problems being caused by propeller excitation due to tip clearance in regard to the surrounding cell shape. Air re-circulation due to pressure difference also presented problems. Following investigation of a number of different shapes, the present circular test section, with a diameter of 28 ft. giving a propeller tip clearance of 4 ft. was decided upon.

The aerodynamic shape of the test section was specified by B. O. A. C. and it was constructed by British Reinforced Concrete in 8" thick pre-stressed concrete, which was cast in situ and post tensioned. An overall compression loading has been the aim, to reduce fatigue stress due to vibration.

All the test equipment was designed to B. O. A. C.'s specification by Heenan and Froude, who also supplied the equipment and were responsible for its installation.

In designing the structure for supporting the engine on test one of the main objectives was to present as little obstruction to air flow as possible, but at the same time the engine had to be readily accessible when idling.

This was achieved by carrying the engine on top of a control streamlined steel column. This column in conjunction with its steel underframe will take the full power, weight and thrust of the power unit. It is also arranged so that torque reaction measuring equipment can be added later if necessary. At each side of the column just below the engine are "swept back" service ducts extending to the cell walls. These also act as engine access platforms from the control room and cell floor.

An interesting feature is the handrailing along each side of these ducts. It is electrically operated and made to rise with the opening of the control room door. When the engine is ready to run the handrailing can be made to recede into the leading and trailing edges of the ducts by operating a push button on the control panel. The handrailing does not therefore interfere with the airflow.

A circular nacelle is mounted on top of the column and this carries the engine which is attached to a tubular mounting frame and backplate. Hinged swing bolts enable the engine assembly to be connected quickly.

For propeller handling a hydraulically operated platform is provided forward of the test stand. This stand has to be retracted to floor level, before the engine is started. An electrical interlock prevents the engine from starting until the platform is fully down.

The control room is alongside the cell and has an observation window just above and a little towards the rear of the engine. Around the window is built the main control panel and this houses engine instrumentation, controls, indicator lamps and starting and switch panels.

The throttle control for the Proteus is the Ultra type similar to that installed in Britannia aircraft. An alternative hand operated mechanical system is also included comprising levers, brackets and push/pull tubes. The de Havilland propeller control is of the hydraulic type.

At one end of the control room and forming an extension to the instrument panel, is the engine oil system cabinet. This houses two quite separate systems for different types of lubricating oils. Provision is made for heating, cooling and filtering the oils, the oil/water heat exchangers and filters being below in the plant room. An inhibiting oil system is also installed for use at the end of tests.

The fuel measuring instruments and associated items are contained in a separate ventilated cubicle beneath the control room. Flow indicating meters are remote reading with dials on the main control panel. Provision has been made for taking quick full specific gravity checks. In case of an emergency, there is a

push button switch which closes the magnetic valves in the fuel line, stops the extractor fans and cuts off all D. C. services into the Test Cell.

For fuel storage, six underground tanks each 9 (8" dia. x 32' 0") long are provided. The capacity of each one is 12,000 gallons. Fuel from these is pumped to the test houses, one pump serving each plant. Pump suction lines and tanks are interconnected however so that fuel from any tank can be delivered to either test cell. Adequate fuel filtering is provided. A separate high flow pump with filter and meter is installed for offloading fuel from supply vehicles into the tanks.

As a precaution against fire in the engine cell and fuel cubicle fixed CO₂ extinguishing plant is incorporated. The gas is contained in steel cylinders and can be released from several carefully placed operating points. In the event of gas being discharged interlocks automatically stop the engines, shut off ventilation, cut the fuel supply and operate an alarm device.

Electrical Carpets for Heating Rooms

Homes in mild climates can be heated uniformly and at low cost with "electric blankets" manufactured in the form of floor carpeting. For a penny per hour householders in Britain can heat an average living room to a comfortable temperature in mild winter weather. Floor temperature averages 70 to 75 degrees Fahrenheit and only 80 per cent. of the floor needs to be covered by the new electric carpet to achieve maximum comfort.

Because the electrical heating elements are distributed evenly over the floor, less heat is needed at the source to warm all the room air uniformly than is required by most conventional heating arrangements.

The carpet, consists of a high-strength steel element with hard plastic insulation, placed between two layers of felt bonded together by an adhesive. Thermalay engineers say the danger of fire has been eliminated by using a plastic insulation tough enough to withstand the normal movement of furniture over the carpet. They claim that even a hammered nail will glance off rather than penetrate the wire. At present, the new heater is designed for use under conventional carpets. It is not made in floor carpet patterns. (*Made by Thermalay Ltd., of Halifax, Yorkshire, England*).

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Engine starting is done electrically through a 112 volt rectifier set.

The silencing of the test bed has been completely successful. The Cullum Pier and Panel system has been used in the air intake and exhaust with a Cullum Dtuner for the engine jet exhaust.

On the Civil Engineering side the site required a completely new installation of all services, and was not merely an extension to the existing facilities at Hantgarw. In the final design (a reinforced concrete frame and brick panel construction) the cells were each made in three separate sections with separate foundations, and the workshop between is also completely independent of the cells. The test sections are on foundations of solid concrete 8 ft. deep. The walls are mainly 14" reinforced brickwork except at the working section where they are 18" thick.

Construction of the test bed was started in March 1957, and the first cell was completed and ready for use in March 1958.

Portable Unit for producing distilled water

Fix a hose from the kitchen tap to one end of a de-ionising cartridge and another from the other end of the cartridge leading to a car battery, turn on the tap, and purified (de-ionised or distilled) water will be produced as quickly as it leaves the tap. This new British device will be a boon to motorists and to garages, as it will do away with the necessity for storing distilled water in a bulky carboy. It has been developed from a laboratory portable de-ionising unit.

The de-ionising cartridge contains exchange resins which purify the tap water as it flows through them. The resins themselves act as an indicator of the life of the cartridge. When new, the resins are dark blue in colour; gradually, as they are exhausted, their colour changes to yellow, starting from the base. The cartridge is marked with an "exhausted" line near the top and when the yellow resins reach this mark it is the sign that the cartridge needs changing—a job that can be done in a few seconds by releasing two hand nuts and the outlet union.

A single cartridge of the junior model will give up to 150 gallons of de-ionised water, while a larger cartridge, designed for garages and operators of large fleets of petrol or electric vehicles, gives up to 300 gallons at a single charge. (*Developed by Elga Products Ltd., of Railway Place, Wimbledon, London, S. W. 19*).

MARINE ENGINEERING SECTION

Polish Shipbuilding Industry—Present Position and Development Prospects

Mgr inż. Zdzisław Nowakowski

Manager of Central Board of Shipbuilding Industry, Warsaw

SHIPBUILDING in Poland did not develop practically until after World War II, although a small shipyard was built at Gdynia in 1938 with one slipway on which the construction of a vessel was begun. Immediately after Poland regained its freedom the Polish authorities took measures to start production in the shipyards of Gdynia, Gdansk and Szczecin. The shipyards were completely deprived of all outfit and basic production equipment, their slipways and fitting shops destroyed and burned down during war activities.

Rehabilitation work was carried out intensively with the gradually regained production potential serving at first for repairs and maintenance of merchant ships in operation. At the same time conditions were being created for the production of new vessels; design offices were organized, work on plans of vessels and their equipment commenced, marine engineering and steel works were built up for the production of main engines, auxiliary mechanisms and shipbuilding steel.

All this enabled the shipyards to start the building of new vessels, the first two being completed in 1949. These first vessels, simple in construction, were coal-and-ore carriers of 2,540 tons d. w. capacity, steam engine driven, with wholly riveted hulls. The main engine and most auxiliary mechanisms were of Polish design and construction.

That year was the turning-point in Polish shipbuilding which henceforth developed rapidly, and its remarkable progress can in the first place be attributed to the outstanding aid received from the state, which gave the industry prominent support, seeing in it not only a basis for building up the home fleet, but the great export possibilities as well.

POST-WAR PRODUCTION

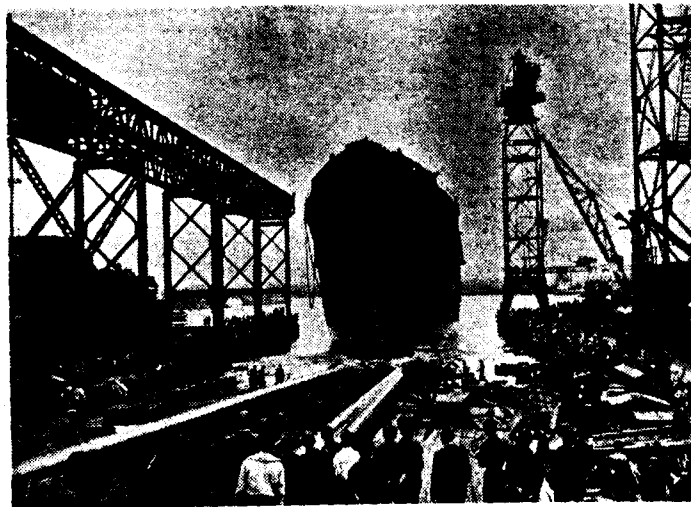
All these efforts resulted in a rapid expansion of the shipbuilding industry, and the following table shows its output and rate of progress.

TABLE I

Year	No. of vessels completed (over 100 t. d. w.)	Tonnage in d. w. completed	Index
1949	2	5,080	starting period
1950	3	7,620	" "
1951	4	4,790	" "
1952	36	42,610	100
1953	52	65,960	153
1954	44	77,810	183
1955	65	103,660	242
1956	59	119,770	280
1957	59	147,000	346

With this tonnage output Poland occupies the eleventh place in the table of world shipbuilders. Apart from the increase in tonnage output the range of ship types has been extended and ships of the following main types have been built and delivered: general cargo motor vessels: 10,000, 4,000, 820, 660 tons d. w.; steam colliers: 5,000 and 3,200 tons d. w.; steam coal-and-ore carriers 2,600 tons d. w.; steam fishing trawlers 450 and 500 tons d. w. At the same time a large number of smaller craft were constructed, such as drifter-trawlers and fishing boats, tugs and other units for special purposes.

Export production of vessels started in 1950 increasing rapidly to play a dominant part in the total production. The principal buyer of Polish-built ships is the USSR. Major contracts have been concluded



Launching of cargo — liner 10,000 TDW.

with the Chinese People's Republic, Brazil and Egypt, and a few smaller fishing craft were delivered to England and Denmark.

The percent of export in the total production is shown in the following table.

Year	1950	1951	1952	1953	1954	1955	1956	1957
% of export	33.4	46.4	84.5	84.5	77.5	91.8	84.9	62.4

Despite the remarkably quick headway made by the shipbuilding industry in the course of the past few years certain disproportions in quality were revealed.

On the one hand a high level was attained in the construction of fully welded hulls, with up to 60% automatic welding, using the section or block production methods with the sections and blocks fitted out to a considerable extent. This shortens the hull production cycle on the slip, which—for example—amounts to 3 months in the case of 5,000 tons d. w. vessels and 4,5 months in the case of 10,000 tons d. w. vessels. Moreover, the quality of hulls is high and can easily compete with the average standard achieved by the leading shipbuilding world industries.

On the other hand there are deficiencies in the outfitting branch due mainly to the insufficient development of auxiliary industries producing main engines, ships' mechanisms and outfit elements. In particular the lack of home-produced high-powered marine Diesel engines has made itself felt. It is no

wonder that most of the vessels were steamers based on the home-produced steam engines which can hardly be called modern. The quality of outfit elements is not always satisfactory and some of the mountings, installations and minor details still lack proper finish and are inferior to western standards.

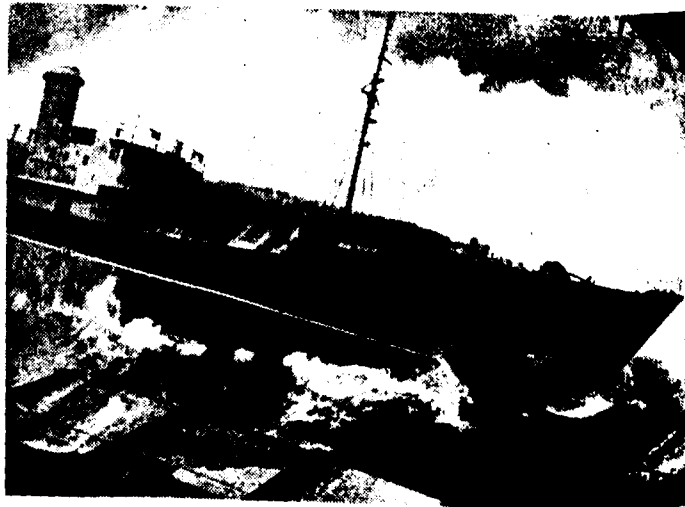
Steps are being taken to improve the situation in the near future and to ensure parallel development of high quality production of all ship equipment.

DEVELOPMENT PROSPECTS OF THE POLISH SHIPBUILDING INDUSTRY

To cover the increased demand for steel due to an increase in production of hulls, the output of ship steel has been considerably raised. Although all steel was imported in the first post war period, home production now covers 70% of the demand and is expected to supply the full quantity of steel materials within the next two years. Moreover, the production of marine Diesel engines is being started on Sulzer licence embracing several types of main and auxiliary engines of the RSAD, TD and BH groups. The main engines up to 10,000 HP and more will be built.

Apart from the licenced production, new Polish constructions have been developed of which the prototype of a 4,500 HP engine is nearing completion. The first engines of entirely Polish production will be completed in 1959 and the total power to be produced within the next 5 years will reach about 230,000 HP.

In addition we are planning the construction of marine steam turbines of 13,000 HP within 3 years



Side launching of the trawler

TABLE 2

Kind of vessel	Type	TDW Deadweight	BRT Tons Gross	Service speed	Machinery	(To be) built in the year
Tankers	Large	35 000	22 500	15	T lub s T, D	1961*)
	Medium	18 000	12 600 499—	16	T, D S	1960
	Coaster	500 do 1500	—1 200	12	D	1959
Gen. cargo carriers	Large	11 000 4 000—	6 600 3 000—	16	S D	1956
	Medium	—6 000	—5 000	14,5—15,5	S D	1952—1960
	Small	1 550	1 300	13,5	S D	1959
Tramps	Large	12 500 do 14 500	8 520	14,5	S D	1961
	Medium	2 600 do 5 000	2 000 do 1 200	11—12,5	P S	1949
	Coasters	460 do 1 100	299 do 760	10—11,5	S D	1359
Fishing vessels	Monther ship for herring fishing vessels	9 300	11 540	12	P S	1958
	Factory trawler	1 250	2 600	12,5	S D	1959
	Freezing trawler	1 000	2 400	11,5	S-E D-E	1959
	Motor trawler	550	600	13	S D	1960
	Steam trawler	450 do 500	600 do 660	11	P S	1951
	Motor drifter trawler	260	350	11	S D	1959
	Motor drifter trawler	100 do 140	150 do 175	9	S D	1952
	Fishing boats	20 do 45	35 do 83	8—9	S D	1948
	Tug boats, various	do 180 KM		8,5—11	P S D, S.	1957 1961

*) Tankers above 35,000 t d.w. to be built from 1962 onwards.

Abbreviations: T — turbine; D — Diesel engine; DE — Diesel Electric; S — steam engine.

time and preparatory work and research are being carried out on the use of gas turbines for main propulsion purposes. Constant studies are being made on the application of nuclear energy for ship propulsion.

The steadily decreasing share of vessels equipped with steam engines is to be eliminated by 1961 when main propulsion will be constituted by Diesel engines and steam turbines.

We aim at raising the potential, further investments and development of the shipyards. At present 2 large slipways at Stocznia Szczecinska, destroyed by war action, are being reconstructed, with a capacity for vessels up to 25,000 tons d. w. Two or three new slipways are intended for Stocznia Gdynska for vessels up to 50,000 tons d. w. with a possibility of enlarging them for vessels up to 100,000 tons d. w.

Apart from these plans a proportionate development of the auxiliary industries is foreseen comprising all branches like: marine and electrical engineering, refrigerating machinery, chemical materials etc.

The fulfilment of the above plans will mean a further steady increase of new-built tonnage. The development of the production basis will in its turn increase the number of types of vessels.

Another table will show the ships which have been

built up to now and going to be built in the years 1958—61.

In addition to these ships the production programme comprises a number of smaller craft for special purposes, such as: salvage boats, fire-fighting boats, hydrographic and training vessels, and the like.

The following classification societies are at present operating in Poland: Polish Register of Shipping, Register of USSR, Lloyd's Register of Shipping and det Norske Veritas. Any construction of ships is undertaken according to the requirements and under the supervision of the classification society requested by the owner.

The increased production of vessels is destined primarily to cover the demand of the home fleet, whose development is now planned at a more rapid rate than hitherto. Certain amounts of tonnage are planned for export—for the traditional and largest customer, the USSR, and other customers such as: People's China Republik, Brazil and Egypt. Further export orders are also expected from other countries with large fleets.

Poland is interested in establishing export contacts in shipbuilding with the largest possible number of buyers from many countries and is offering favourable terms of delivery.

WORLD'S BIGGEST ENGINEERING SHOW OPENS IN LONDON NEXT APRIL

The world-famous ENGINEERING, MARINE, WELDING & NUCLEAR ENERGY EXHIBITION traditionally held in the Autumn, has been rearranged to open in the Spring of 1959. It will occupy the three vast halls of Olympia, London, comprising more than a quarter-million sq. ft. of stand space, and already over 500 exhibitors have booked stands.

Engineers of every kind, users of diesel engines, operators of welding plant and equipment, and all those concerned with the harnessing of power—particularly nuclear power—should make a note that the Exhibition will be open from April 16th to April 30th, 1959.

There will be more than 1,000 categories of

engineering products and plant on show, including the latest developments in nuclear energy equipment. The exhibitors' stands will be staffed by technicians able and willing to offer visitors detailed advice on any problem.

Intending visitors from abroad can obtain all information regarding travel and accommodation from The American Express Company, or Thos. Cook & Sons Ltd., the official Travel Agents to the Exhibition. An interpreter staff will be available for those who require it. Details of the Exhibition itself can be obtained from the Organisers, F. W. Bridges & Sons Ltd., Grand Buildings, Trafalgar Square, London W. C. 2.

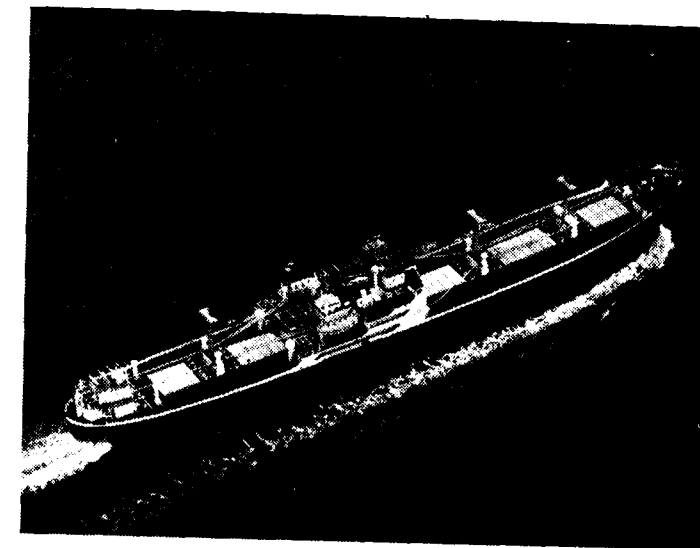
A Montreal Trader carries out successful trials

By A Technical Correspondent

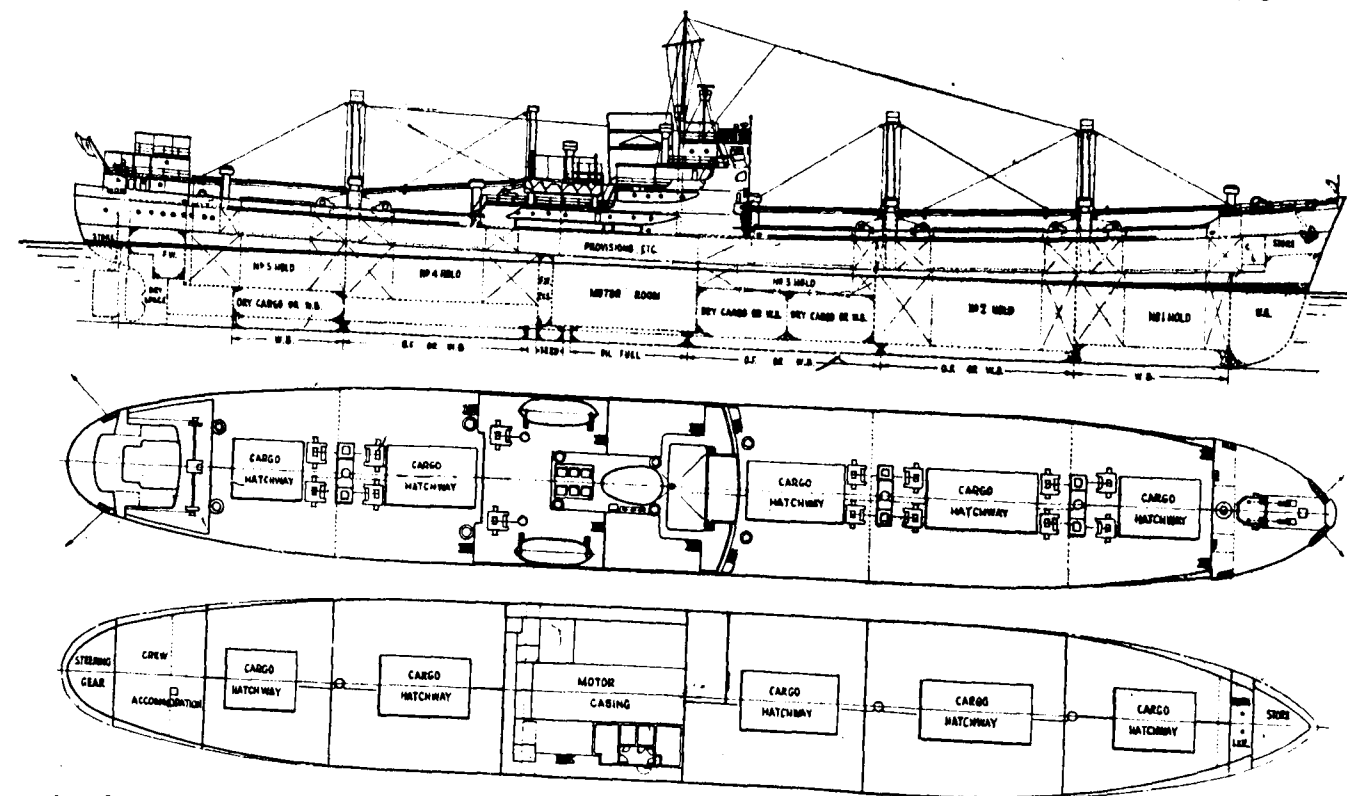
Closed Shelter Decker m. v. "CAIRNFORTH" leaves on her Maiden Voyage

ANY new tonnage destined for trading to the St. Lawrence, and particularly to Montreal, commands attention today in view of the forthcoming opening of the St. Lawrence Seaway, as a result of which a ship of the "CAIRNFORTH" type will be able, for the first time in history, to proceed to ports situated on the shores of the Great Lakes.

The "CAIRNFORTH"—latest production from The Burntisland Shipbuilding Co. Ltd.—was launched on August 15th and ran her trials on November 13th. Since she is the first new ship for this company for some time and one of their first motor ships, her delivery marks an important event in the history of Cairn Line of Steamships Ltd. She has been built to maintain a general cargo service between Newcastle-on-Tyne, Dundee and Leith, and Montreal during the



M. V. "CAIRNFORTH" on her maiden voyage.



months of May to November, and St. Johns, N. B., to April. For this reason the ship is ice-strengthened. She is a handsome vessel and measures 430 ft. between Halifax, N. S., and Portland, Maine, from December (Continued on page M.E.6)

Ship Repairs in Polish Yards

By Inz. Ryszard Erbel

Technical Manager of the Gdansk Repair Shipyard.

THE rapid development of the Polish mercantile marine and ports has necessitated the creation of industrial centres which would permit Polish and foreign ships to be repaired quickly and at reasonable prices.

By using up-to-date production methods the Polish Shipbuilding Industry now occupies the 11th place in world shipbuilding, especially in the serial production of ships. In order to ensure concentration on problems of new constructions and, on the other hand, to secure adequate technical materials for ship repairs, special ship repair yards at Gdynia, Gdansk and Szczecin were established in 1952. At present these ship repair yards repair nearly all Polish ships and since 1953—an increasing number of foreign ships also. At present any ship which calls at a Polish port can be served promptly and all necessary repairs can be carried out at competitive prices. In addition to the ship repair yards at Gdynia, Gdansk and Szczecin there are repair workshops in every Polish port. These workshops carry out minor repairs of the small and fishing craft.

The Ship Repair Yard in Gdansk is the greatest enterprise of this kind. It possesses 4 floating docks of which the largest one has a capacity of 8,200 t. The quay of the yard is 3,000 m long, 1,200 m of it being fully equipped with cranes, compressed air, acetylene, water, steam and alternating and direct

current for ship's service. In addition to the quay cranes the yard is equipped with floating cranes of 30 t, 60 t, and 100 t capacity. The floating docks are equipped with 10-ton cranes. The yard is fully equipped with machinery for metal treatment, foundry for non-ferrous metals, metallizing workshop, arrangements for heat treatment, chemical laboratories, technological and strength-test laboratories, compressed-air plant, acetylene plant, boiler plant for steam generating and 5 tugs.

The Ship Repair Yard in Gdynia has two floating docks of 1,200 and 1,000 t capacity and slips for fishing vessels up to 150 t and 32 m long. The total length of the fully equipped quays amounts to 360 m. The yard has separate Hull and Machinery Divisions and its production programme comprises the full range of hull repairs. The workshops of the yard specialize in the electric and electro-navigational repairs as well as being representatives of Messrs. Plath, Hamburg.

The Shipyard in Gdynia possesses 3 floating docks, the largest one identical to the one in Gdansk (8,200 t.) while quay facilities are similar. Besides the Shipyard in Gdynia possesses test-stands for cargo handling equipment as well as a bench testing set for Diesel engines. At present the overhaul of large tonnage vessels forms the main work of the yard.

(Continued from page M.E.5)

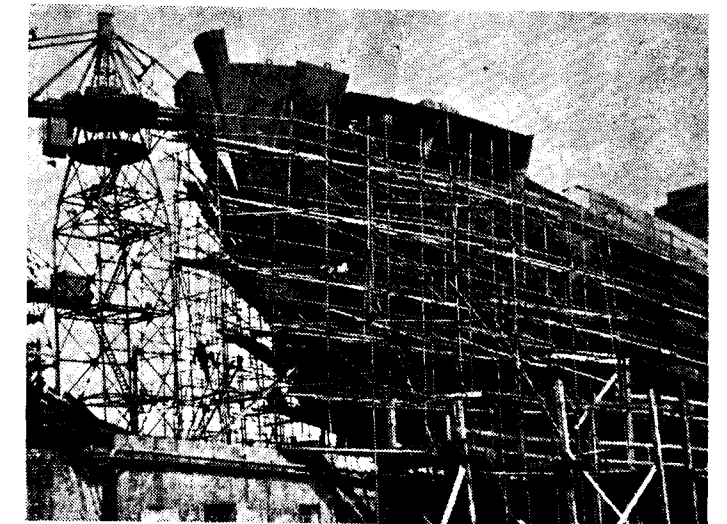
perpendiculars, with a beam moulded of 59 ft. 9½ inches, a depth moulded to the upper deck of 38 ft. 6 inches and to the second deck of 29 ft. 6 inches. The deadweight tonnage is 10,700 and the draft in load condition 27 ft. 6½ inches. There are five cargo holds with associated 'tween decks, three forward and two abaft the machinery space, all with mechanical ventilation. No. 3 hold contains two large deep tanks with a 'tween deck space between the ballast tank top and the second deck. The ship is capable of carrying iron ore and the deep tanks and tunnel side tanks are suitable for carrying water ballast or dry cargo. The fourteen cargo winches, warping winch and windlass are steam-operated but of

the most modern totally-enclosed splash lubricated type.

As for propulsion, the single screw is driven by a Hawthorn/Doxford opposed piston 2-cycle direct reversing engine, developing 4400 b. h. p. and burning heavy oil. Engine room auxiliaries are steam driven and electric current, 220 volts d.c., is from three 40 kW. generator sets. They take steam from two horizontal multitubular boilers at 120 lbs. per square inch. There is also a vertical exhaust gas silencer boiler in the uptakes. The entire installation has been carried out by the engineering department of the Shipbuilders.

The Ship Repair Yard in Szczecin has three floating docks for ships up to 3,000 t, 900 t and 600 t (respectively) and one slip. The total length of the quays amounts to abt. 2,500 m., 500 m of them being fully equipped with electric energy, water, steam, compressed air, acetylene and quay cranes. The Hull and Machinery Divisions of the shipyard are equipped with up-to-date machinery, laboratory and foundry for non-ferrous metals and cast iron.

The possibilities of the Polish yards in ship repairing are vast. Docking ability is illustrated in Table 1. The ship repair yards carry out various dock works as cleaning, de-scaling and painting of hulls, overhauling of rudders, propellers and kingstones, hull repairs, strengthening and elongation of hulls. Repairs are performed with high quality materials approved by the surveyors of the corresponding classification societies. The yards repair hulls both riveted and welded and, if required, the seams can be X-rayed. The programme comprises repairs of boilers, steam engines, steam turbines and Diesel main and auxiliary engines. Adequate measuring devices and machine tools guarantee high precision of machining. The yards are able to carry out ship outfitting jobs in the electric, deck and other branches. All repairs such as of radio equipment, telephones, echosounders, radars, logs etc. are performed by specialists.



Assemblage of the hull.

The equipment of the yards permits carrying out any current and general overhauls as well as reconstruction. Co-operation with the Mechanical Works in Elblag, Cegielski Works in Poznan, steel-works and marine engineering works in Silesia enables the yards to carry out any kind of repairs of ship engines and ship.

The repairs can be done under the survey of Polish Register of Shipping, Soviet Ship's Register,

TABLE 1
DOCKS, PONTOONS AND SLIPS OF THE POLISH SHIP REPAIR YARDS.

Ship Repair Yard	Facilities	Number	Capacity tons	Length o. a. m.	Length l m.	Breadth m.	Draught m.	Notes
Gdansk	big dock	1	8 200	156	143	26	7,5	self docking, 2 cranes 10/6 T
"	pontoons	3	1 700	92	92	16	5,5	for lifting dock
Gdynia	dock	1	1 200	76	69	13,2	5,4	new built
"	pontoon	1	1 000	92	92	16	5,5	
"	slip	1	150	—	30	6,5	3,5	dimensions given for craft — 16 posts
Gdynia — Stocznia im. Komuny Paryskiej	big dock	1	8 200	156	143	26	7,5	self docking — 2 cranes
"	pontoons	2	1 700	92	92	16	5,5	
Szczecin	big dock	1	3 000	93	83	24	6,0	self docking — 1 crane
"	dock	1	900	58	46,8	15	4,4	
"	small dock	1	650	46,8	31	14,7	4,0	works in conjunction with slip
"	slip	1	180	—	35	7	2,0	dimensions given for craft — 6 posts
Swinoujscie	dock	1	850	69	69	12,5	3,2	

Lloyd's Register of Shipping, Det Norske Veritas and Bureau Veritas, who have their representatives in Gdansk.

The yards have already performed thousands of repairs on Polish and foreign ships, from the smallest repairs made during the ship's stay in harbour to the most complicated repairs including reconstruction of ships.

For example the Ship Repair Yard in Gdansk carried out in 1957 the general overhaul of Polish ship "Warynski" 4,341 G. T. and "Kilinski" 7,697 G. T., comprising strengthening of hulls and reconstruction of decks. Owing to these changes both ships have gained an unlimited cruising range for iron ore carrying. In 1956 general overhaul of the Burmeister and Wain engine built in 1913 was carried out on the ship "R. Fraugutt". In 1957 the yard completed the construction of a floating dock for ships up to 1200 tons.

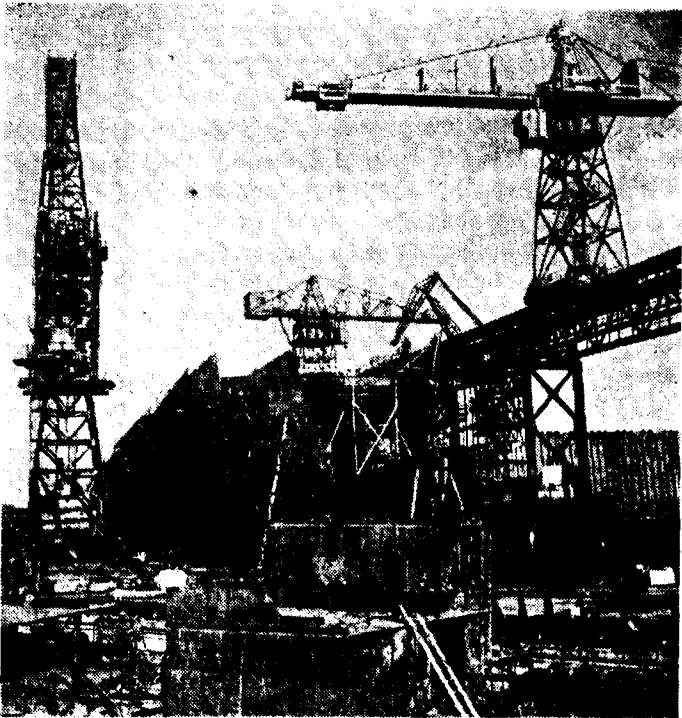
In 1957 the Shipyard at Gdynia finished the reconstruction of m/s "Dzierzynski" 12,000 G. T. which had been torpedoed and sunk in 1944, raised from sea in 1954 and on which the reconstruction work began in 1955.

Apart from numerous ship repairs the Ship Repair Yard in Szczecin has reconstructed 5 floating docks on two of which the steam-drive has been replaced by electric drive.

Besides the repair works the ship repair yards built in 1957 about a hundred vessels such as: wooden 25 m cutters type B-25, hydrographic cutters, steel 17 m cutters, floating hotels with up-to-date equipment for 50 persons, tugboats 180 HP for harbour service and cutter engines 100 HP (Puck).

Table 2 illustrates the number of repaired ships during their stay in the yards besides the repairs carried out in harbours. In 1956-1957 450 ships were repaired, total tonnage of them amounting to 527,500 G. T. including abt. 110 vessels of over 3,000 G. T. The Ship Repair Yard in Gdansk specializes in repairs and reconstruction of large tonnage ships.

In 1957 the yards also performed minor repairs on 829 ships during their stay in harbour, 227 of them being foreign flag. Dockings, repairs and class overhauls of 31 foreign ships and minor repairs on 92 ships in the harbour have been carried out by the Ship Repair Yard in Gdansk alone. Among foreign



Assemblage of hull 10,000 TDW cargo-liner at the slip-way of the Gdansk-yard.

TABLE 2
Docking, repairs and periodical overhauls

Repair Yards	Number of vessels		Gross tonnage	
	1956	1957	1956	1957
Ship Repair Yard at Gdansk	101	118	191,8	222,7
Ship Repair Yard at Gdynia	54	64	12,4	11,4
Ship Repair Yard at Szczecin	54	59	35,1	50,1
Total	209	241	239,3	287,2

ships most were Finnish, with Scandinavian, German and other West-European ships following.

The ship repair yards being economically and technically independent are united in the Central Board of the Repair Yards and their commercial representative is the Foreign Trade Central Office "Centromor", Warsaw. The Mechanical Works in Puck manufacturing Diesel engines and the Marine Radio Service (MORS) in Gdynia also belong to the Central Board mentioned above.

Polish ship repair yards are constantly improving their efficiency and standard by adding to their equipment, reducing repair time and prices.

The History of the development of the "Vosper" Roll Damping Fins

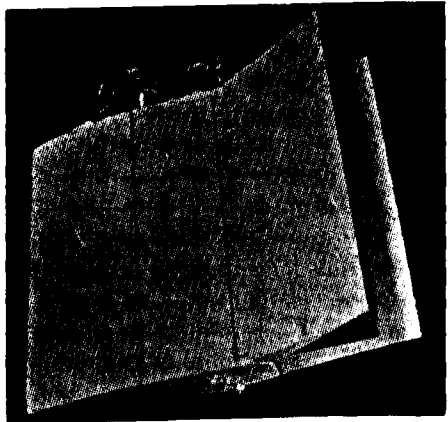
By a Marine Engineer

IN about 1949 Vosper were persuaded from a number of sources, including Service departments, and owners, that there was a requirement for a roll reducing apparatus which could be fitted relatively easily and cheaply either to small craft in the course of construction or as an addition to a ship already in service.

The well-known stabilizing systems already in use in the larger naval and passenger ships at that time appeared on the whole to be difficult, if not impossible, to apply to the smaller vessel for a number of reasons.

After consideration of the problem, we decided that a considerable simplification and saving in installation space and weight could result from the use of fixed, non-retracting fins. Furthermore, the use of modern technique as applied to hydraulic actuation in industrial and aircraft engineering seemed to offer the possibility of a further considerable saving in weight and space without noticeable detriment to reliability.

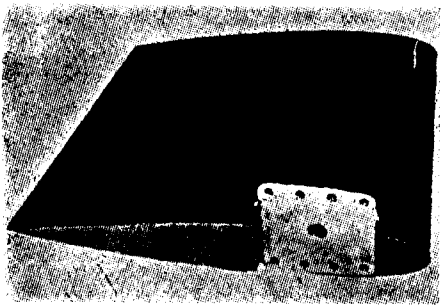
It was decided, therefore, that in the first instance, the practicability of such a scheme should be tested at sea in the "trial horse" yacht M. Y. *Sea Victory*,



A Fin with split flaps as fitted experimentally in M.Y. "Sea Victory". The Fin shown was on the port side and the angle of incidence at the time of taking the photograph was approximately 20 degrees.

a converted Fairmile "B" Class Motor Launch of 112 ft. length and 90 tons displacement.

An investigation was carried out by Mr. T. R. F. Nonweiler, B. Sc., an aerodynamicist, to decide upon the optimum configuration of lifting surface to be



An unflapped Fin assembly of N.A.C.A. symmetrical section of welded construction. This is the type normally supplied with Vosper Roll Damping Equipment.

employed in the fin, and from the point of view of obtaining maximum lift for a given area, it was decided to make use of a fin with split flaps at the trailing edge.

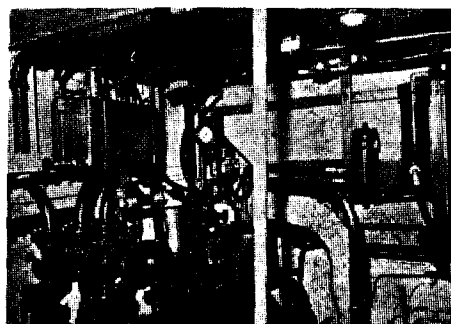
However, although quite successful when applied to the M. Y. *Sea Victory*, it was eventually decided that there was merit in the idea of using a simple, unflapped fin of symmetrical section, as, despite the known slight reduction in lifting efficiency of such a section, complicated mechanical linkages are avoided.

We have found this design of fin to function satisfactorily in all the cases we have met so far.

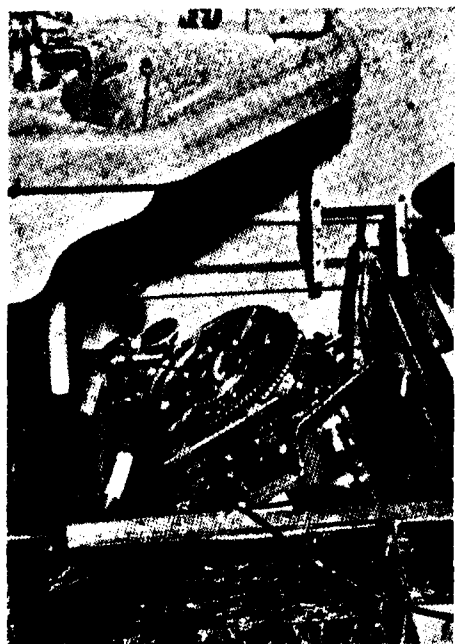
What has probably constituted the toughest problem of all to solve over the years of the development of the activated fin for roll reduction has been the method of control. This was solved for us by the much valued advice of Mr. James Bell, M. Sc., of Muirhead & Co., who has taken a lion's share in the development of the control apparatus for all British installations developed to date.

M.Y. "JOY"

110 ft. 0 in. converted Fairmile "B" of 95 tons displacement



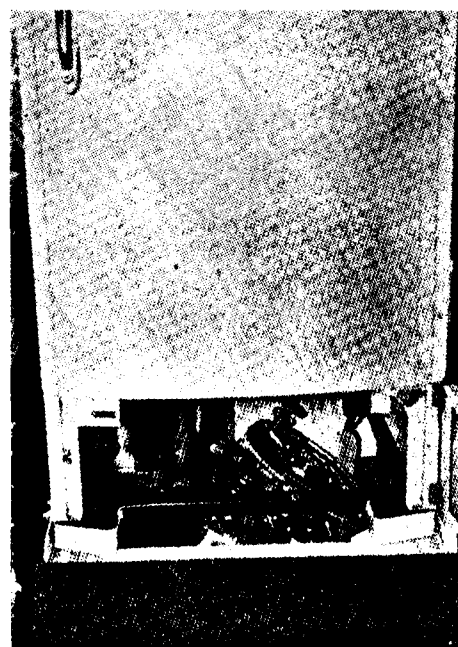
A general view of the engine room showing, left to right, the service oil tank, suction filter, pressure gauge, accumulator and pressure relief valve, oil cooler and micronic filter.



An inboard view of the port fin installation. This photograph illustrates the compactness of the installation inboard. This is of particular value when the fin seatings are installed in accommodation spaces.

By 1954, we felt the development had reached a stage where we would be justified in offering our equipment for sale. The first craft to be fitted was the M.Y. *Calisto*, R. Y. S. (350 tons), owned by Group-Captain Loel Guinness, O. B. E., who was throughout this development a valued source of inspiration and encouragement.

The whole of the installation was carried out at Antibes in the South of France, under the supervision



An inboard view of the starboard fin installation. In this case, the fin seating is in the galley beneath a refrigerator. Sufficient access is allowed to the assembly for maintenance purposes and yet the installation occupies the minimum of accommodation space. The brake assembly may be clearly seen in these photographs.

of our technicians. Owing to the limited size of the dry dock, it was necessary to fit the fins subsequent to undocking by making use of the services of a diver.

As evidence of the success achieved with this, our first commercial installation, extracts from a letter written by the owner to our Managing Director are reproduced herewith :—

"I feel that I should write and tell you that the stabilizing fins that you designed and had fitted to *Calisto* are an unqualified success.

"We have tried them out pretty thoroughly now under all sorts of varying conditions, and it is frankly astounding what they do. The other day, for instance, we steamed and found a heavy swell, with no wind. In these conditions, without the fins, we would have rolled in such a way as to make everyone in the ship thoroughly miserable, and the

cooking would have become difficult if not impossible, and everything would have had to be secured. As it was, we never moved, and one had the impression that we were steaming in a flat calm. I switched the fins off for about fifteen seconds, and that was quite long enough!

"On another occasion we had a big sea broad on our port bow, wind around force 5. This sea forced us to slow down for about one hour before arriving at our destination. I do not think we ever rolled more than 3 to 5 degrees, and anyway the roll was so negligible that it proved entirely unnecessary even to secure bottles. I did not risk switching the fins off on this occasion!

"We have purposely run the whole outfit more or less continuously, hoping to find and remove any 'bugs', but so far, you will be pleased to know, we have had little trouble with the installation; on hydraulic leak, and that is all....."

Many successful installations have been carried out since that date, including yachts and service craft.

The extent to which we have achieved our object, which was to produce a compact lay-out suitable for installation in existing or projected craft without the necessity for allocation of special compartments or the reduction of fuel storage capacity, can readily be seen from the photographs incorporated in this brochure.

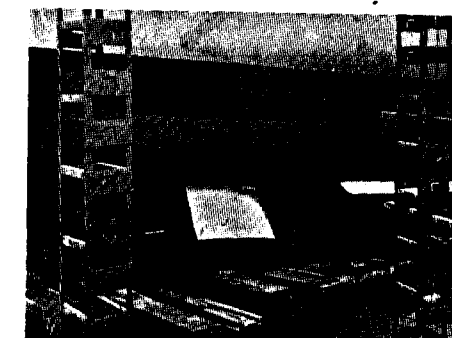
SOME OF THE ADVANTAGES TO BE GAINED BY THE INSTALLATION OF "VOSPER" ROLL DAMPING FINS

For many of us the reason for wishing to reduce the roll of a ship is fundamental, namely to increase personal comfort and to alleviate the tiring effect which excessive rolling has on the human system—even when we are acclimatised or have our "sea legs." Any sailor who, in World War II, served in the Atlantic convoys will recall the terrific strain imposed on him by the continuous rolling of the ship while trying to maintain station in convoy. It is not inconceivable that had the crew efficiency not been so impaired, our losses might not have been so great and the enemy losses would have been higher, resulting in a more speedy conclusion to the Battle of the Atlantic. There are, nevertheless, many other

reasons for reducing roll, of equal importance in peace as well as in war, of which the following are but a few :—

- (1) Excessive rolling can be dangerous, particularly in the smaller, round bilge craft, and especially when the period of encounter with the waves and the natural period of roll are synchronised.
- (2) A ship with Roll Damping Equipment installed is able to maintain its speed under adverse weather conditions, when without fins it would be forced to reduce speed, seek shelter or heave-to.

H.M.S. "CONISTON"
Length Overall : 152 ft. 0 in. Displacement : 430 tons



A view of the hull showing the starboard fin in its central position.



A view of the engine room with floor plate removed to expose the starboard fin top-plate assembly.

- (3) The means of maintaining speed assists in the navigation of the ship and its ability to maintain its course and time schedule.
- (4) It saves fuel, as the vessel is able to maintain its economical cruising speed.
- (5) Running repairs are more easily carried out on the ship or its machinery in heavy seas when Roll Damping Equipment is installed.
- (6) The care of patients on Hospital Ships and the comfort of passengers on liners or pleasure craft is greatly assisted if Roll Damping Fins are installed.
- (7) Crew efficiency is improved, and thus the safety of the ship is increased.
- (8) The safety of Merchant Ships and their cargoes is greatly increased, since the likelihood of cargoes shifting is minimised; especially is this true where deck cargoes are carried.
- (9) For certain cases where fishing trawlers habitually work their gear from one side of the ship, a Roll Damping Fin fitted on the opposite side should enable fishing to continue in worsening weather; also the improved conditions on deck will speed up and simplify the work of gutting and stowing the fish.

There are other advantages too, which apply particularly to warships:—

- (10) The production of a steady platform for the handling and launching of guided and ballistic missiles and the operation of guns and anti-submarine weapons.
- (11) It assists radar scanning in surface and aircraft detection and anti-aircraft defence.
- (12) It facilitates refuelling and replenishing at sea.

Realising the advantages that are to be gained by the installation into a vessel of Roll Damping Fins, it has been our aim to design the equipment with a view to:—

- (a) Achieving a high efficiency in roll reduction;

- (b) Simplicity of design;
- (c) Economy in internal space requirements;
- (d) Minimising the all-up weight of the installation;
- (e) Ease of installation into existing vessels;
- (f) Low cost of manufacture and installation;
- (g) Simplification of maintenance and replacement by standardisation of parts.

SOME CONSIDERATIONS OF THE DESIGN AND PERFORMANCE

It will be appreciated that a ship moves in axes other than roll, such, for instance, as pitch, heave, surge, sway and yaw. It is, however, primarily with rolling that we are concerned here, mainly because a relatively small energy input from the wave formation passing a ship can influence motion in the rolling plane to a considerable extent, in fact to a far greater extent than the ship can be influenced in any other plane.

Since the energy input required to make a ship roll is comparatively small, it follows that it is possible to reduce or "damp" these induced rolling motions by means of correspondingly small applications of energy.

Most theoretical studies of the ship rolling phenomenon assume—as a convenient simplification—a regular system of sine waves to act upon the ship. This, therefore, infers that the nature of the disturbing forces is sinusoidal in character, which, while simplifying the mathematical prediction of ship motion, does not in fact represent the randomly-distributed complex wave system such as is normally encountered in a seaway.

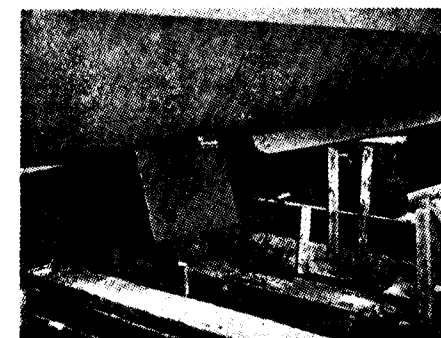
It is mainly for this reason that there is likely to be merit in making use of a controlling mechanism of a somewhat greater sophistication than the simple "rate" gyro developed by Messrs. Muirheads and which has until recently been used by us in all cases.

For those who are interested in obtaining a more detailed knowledge of this aspect of the subject, we would recommend a perusal of "Ship Stabilisation Controls & Computation" by J. Bell, M. Sc., an excellent paper read before the Institute of Naval Architects in July, 1957.

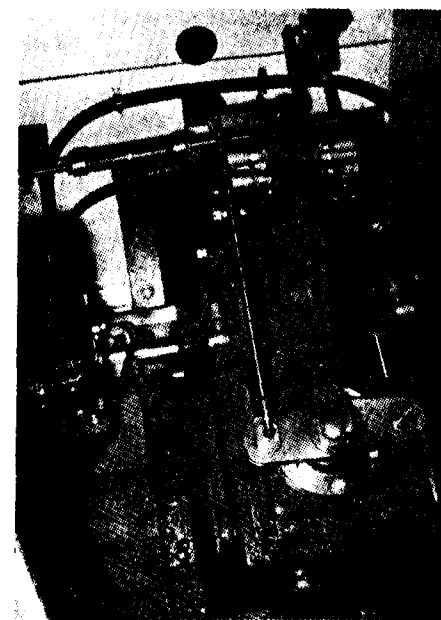
Ideally, in order to maintain the vertical position in a seaway, it is necessary to apply a moment to the ship which will exactly counteract the instantaneous disturbing moment supplied by the passing wave formation acting in the rolling plane. To achieve this would necessitate a control function such that the fins can be instructed in advance as to what position they should assume relative to the water flow in order to produce the necessary moment equal and opposite to that generated by the passing wave formations. Such a control has not as yet been

M.Y. "SILVER CLYDE"

Length Overall: 58 ft. 0 in. Displacement: 24 tons.



A view showing the fin on the starboard side of the hull.



A view of the fin top-plate assembly showing clearly the hydraulic rams and the Muirhead Gyro-controlled hydraulic relay and control rods. Due to the small size of this installation, the brake assembly was not required.

developed as a practical reality, so that it is in fact necessary for some motion of the ship to occur in the rolling plane before the fins can be ordered to reduce or "damp" the motion.

As a matter of perhaps only academic interest, the state of stabilisation described above, where the true vertical is maintained at all times, would be unlikely in practice to result in the greatest comfort for the passengers and crew of the ship. For reasons connected with the composition of the type of sea wave most frequently encountered, the maintenance of the true vertical would, in fact, involve some accelerations in the athwartships plane, which would be felt by passengers more than if the ship were allowed to maintain the "apparent" vertical, which involves the maintenance of an attitude at all times vertical to the wave slope. Incidentally, of course, much less energy is required to accomplish this latter state of affairs, and "stabilisation" to this degree becomes much more of a practical and economical proposition.

It may be understood from the above that full stabilisation in the sense of the world is not really a practical possibility, and this is certainly the case for the smaller ship. It is for this reason that we prefer the more scientifically correct term "roll damping fins" instead of "stabilisers." Such fins can and do produce critical damping which is a close approach to stabilisation.

However, the matter is not of outstanding importance as long as it is understood that **the function of the "VOSPER ROLL DAMPING FINS" is to minimise rolling by making use of an engineering technique which allows of simplicity, reliability, ease of installation and compactness.**

So effective and successful has this approach proved to date that we can see no reason why this arrangement should not be equally applicable to larger vessels.

With regard to the merits of the flapped versus the unflapped fin design, studies which are in progress in our research section, making use of an analogue computation technique specially developed for our purposes, indicate most definitely that, despite relative simplicity of the unflapped fin, the required lifting force can be developed by increasing slightly the fin area. If necessary, two sets of fins may be installed, located forward and aft, away from the area of maximum beam and the operating mechanism can

still be kept light and compact by virtue of the relatively low torque required to operate such fins which are usually of N. A. C. A.* symmetrical section. This section ensures freedom from stall for the fin at maximum incidence and delays the onset of cavitation in high speed cases.

The great virtue possessed by the unflapped fin is that the centre of pressure is more easily predicted and the movement of the centre of pressure away from the axis of the operation stock is almost negligible for a fin incidence of up to 25 degrees to 30 degrees either way.

Using a fin of low aspect ratio adds greatly to the simplicity of the installation since the fins do not require to be withdrawn into the hull—an immense advantage as regards internal space requirements.

AN OUTLINE OF THE METHOD OF OPERATION OF THE EQUIPMENT

The activation of the fins is accomplished by the integration of two systems, the hydraulically-operated power system which activates the fins, and the control system which feeds the correct sensory movement to the power system.

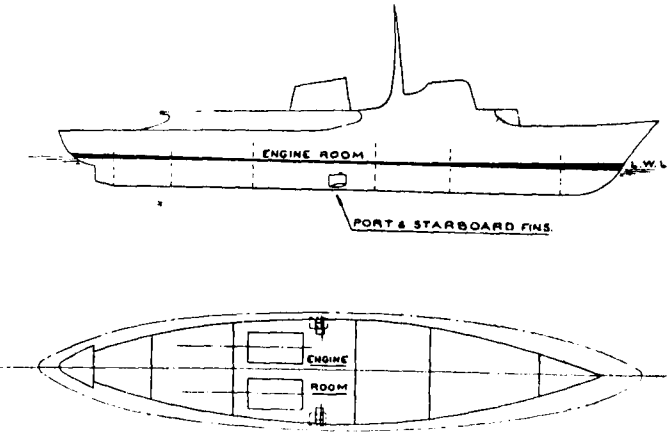
The Hydraulically-operated Power System

Oil passes from the service oil tank (1), through a valve (2) to a coarse type filter (3) and cooler (4), and to the hydraulic pump (5). The suction filter (3) removes any larger particles of foreign matter which may enter the circuit, thus eliminating any risk of damage to the pump. The oil cooler (4) is inserted in the circuit as a safety device, should overheating of the system result from faulty maintenance or accident to the equipment. The cooling supply is normally taken from the salt water cooling system for the main or auxiliary engines in the ship. If necessary, it can, of course, be fed from a separate supply, although the requirements are comparatively small and the temperature rise under normal conditions negligible; thus, little interference is anticipated with the remaining cooling arrangements.

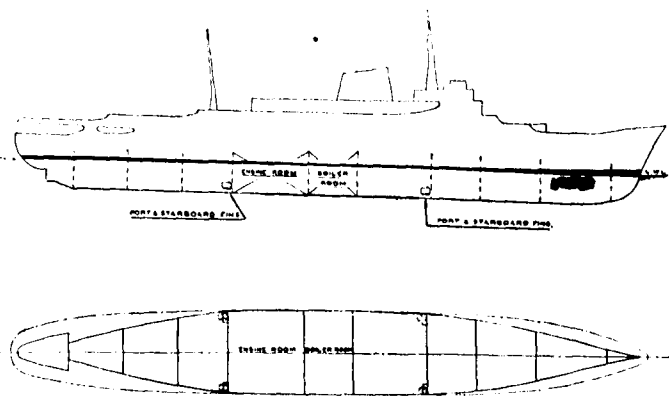
Oil under pressure from the pump is supplied to a micronic filter (6) which removes all remaining particles of foreign matter within the system and thus obviates risk of damage to the sensitive hydraulic rams and valve gear. A by-pass system also operates on the pressure side of the pump through a

* National Advisory Committee for Aeronautics.

A TYPICAL GENERAL ARRANGEMENT WHERE ONLY ONE PAIR OF FINS IS REQUIRED



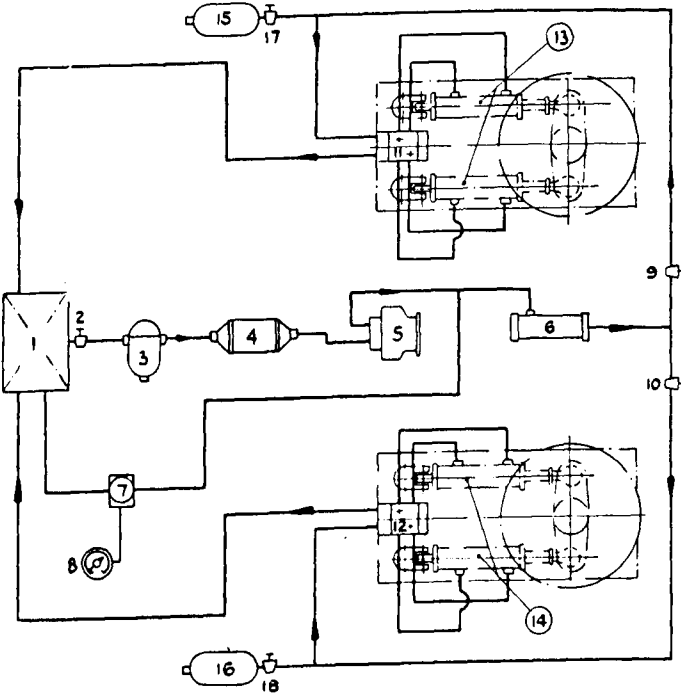
A TYPICAL GENERAL ARRANGEMENT WHERE TWO PAIRS OF FINS ARE REQUIRED



pressure relief valve (7) and back to the service oil tank. The pressure relief valve controls the maximum pressure in the system and may be adjusted to the recommended pressure in conjunction with the pressure gauge provided (8).

Oil from the micronic filter is supplied through valves (9) and (10) to the double-acting valve system (11) and (12) which supply the rams on each of the top-plate assemblies (13) and (14). The valves (9) and (10) are incorporated to enable parts of the system to be isolated when carrying out maintenance. Hydraulic accumulators (15) and (16) are also installed near the top-plate assemblies, and these provide a boost to the system should the oil requirement for the rams be greater than can be instantaneously supplied by the pump. The hydraulic accumulators therefore control the minimum pressure

DIAGRAM OF A TYPICAL HYDRAULICALLY-OPERATED POWER SYSTEM



- 1. Hydraulic Tank
- 2. Suction Valve
- 3. Suction Filter
- 4. Hydraulic Oil Cooler
- 5. Hydraulic Pump
- 6. Micronic Filter
- 7. Pressure Relief Valve
- 8. Pressure Gauge
- 9. Shut off Valve
- 10. Shut off Valve
- 11. Ram Operating Valve
- 12. Ram Operating Valve
- 13. Hydraulic Rams
- 14. Hydraulic Rams
- 15. Hydraulic Accumulator
- 16. Hydraulic Accumulator
- 17. Accumulator Isolating Valve
- 18. Accumulator Isolating Valve

within the system and are also provided with valves (17) and (18) so that they may be isolated when required.

The top-plate assemblies provide the upper bearing to the stock, which passes through the hull and to which the fin is bolted. The upper end of the stock is keyed to the cross head or tiller. A double-acting ram is attached to each end of the cross head, the other end of the ram being mounted on arms cast integral with the top-plate seating. Oil is supplied to each ram through the double-acting valve mechanism in such a way that oil enters one side of the ram under pressure at the same time that oil on the other side of the ram is expelled. The ram on the other side of the cross head is similarly arranged but in opposite sense. Control of the valve system supplying the rams is effected by the gyro-controlled hydraulic relay.

The control to the second top-plate assembly is so arranged that the fins are rotated in opposite sense.

Oil leaving the control valve system is returned to the service oil tank. A valve drain is also incorporated in the control valve, discharging into the service oil tanks.

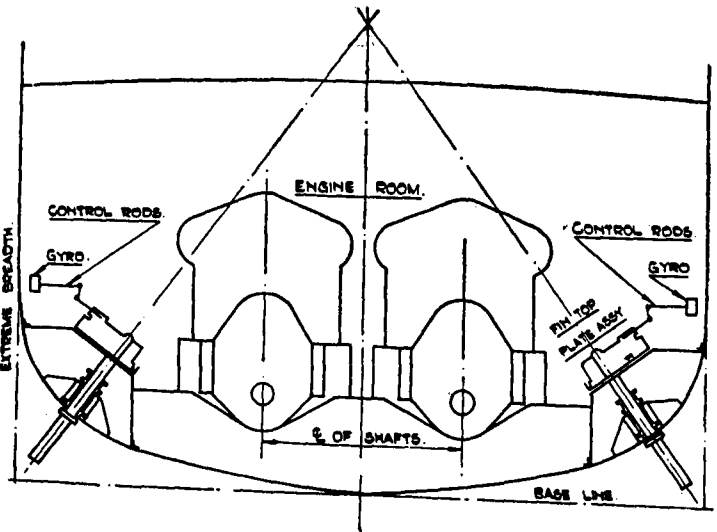
The control System

As has already been explained, the basis of the present control system is a gyro-controlled hydraulic relay, although it is possible that other systems could be applied to give the correct signals to the fins, such as, for example, an accelerometer.

The Muirhead Gyro-controlled Hydraulic Relay at present in use is so designed that it is sensitive to the velocity of roll of the vessel. Sensory movements due to precession of the Gyro unit are then amplified to the double-acting valve system (9) and (10) by means of control rods. This provides an accurate method of transferring the signal from the Gyro to the fins.

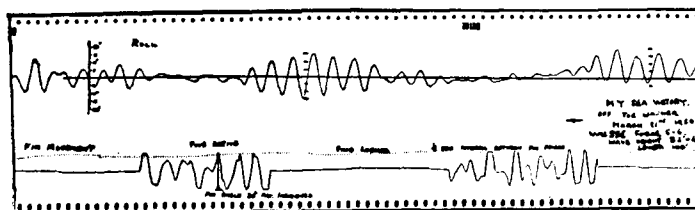
It is, of course, possible to transmit the signal to the fins by other arrangements; for example, a Magslip system can be employed. This has the advantage that connection between the Gyro unit and the top-plate assemblies can be effected by means of electrical wiring, thus obviating the necessity for careful alignment required where a rigid control rod system is installed. Such a system has particular advantages when installing the Roll Damping Equipment in an existing ship where space is at a premium, or where a total of four remotely-spaced fins have to be actuated from a centrally-placed Gyro.

A TYPICAL SECTION THROUGH THE ENGINE ROOM IN WAY OF THE ROLL DAMPING FIN INSTALLATION



Safety Arrangements

Should a fault occur in the power system which resulted in the fins assuming an attitude inclined to



the fore and aft line of the ship, they may be returned to their central position by means of the hand-operated brake gear provided. This latter consists of a brake drum which may be clamped to the fin stock. The periphery of the brake drum is coupled to a worm drive which may be rotated manually by a ratchet arm until the fins assume their fore and aft position, when the fins may be locked and the brake released.

Should the fins permanently adopt their maximum angle of incidence to the water flow, due to a fault in the power or control system, the resultant heel induced in the ship will only be a matter of 3 or 4 degrees, and this may be corrected immediately by means of the brake.

It is interesting to note that this has never happened to our knowledge, except when it was deliberately tested on the *Sea Victory* during the course of the development of the equipment.

WHAT THE ROLL DAMPING FINS ACHIEVE

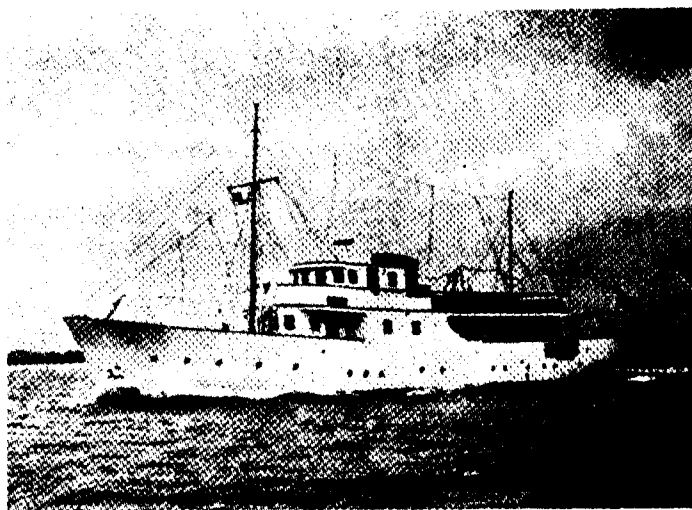
It will be found that the very substantial reduction of roll achieved by the use of the Vosper Roll Damping Fins can and does make all the difference to pleasure, comfort and efficiency aboard the smaller ship. The reduction in the amplitude of rolling is in fact very marked, and this point is borne out by the satisfaction expressed by owners and captains of vessels to which Roll Damping Fins have been fitted.

During the period of the development of this equipment, in order to gain information as to the performance of the fins under varying sea conditions, we have installed in M. Y. *Sea Victory* an apparatus whereby a running record of roll and fin movement can be obtained. A selection of these records is reproduced here so that it can be clearly seen that a very considerable reduction in rolling amplitude is

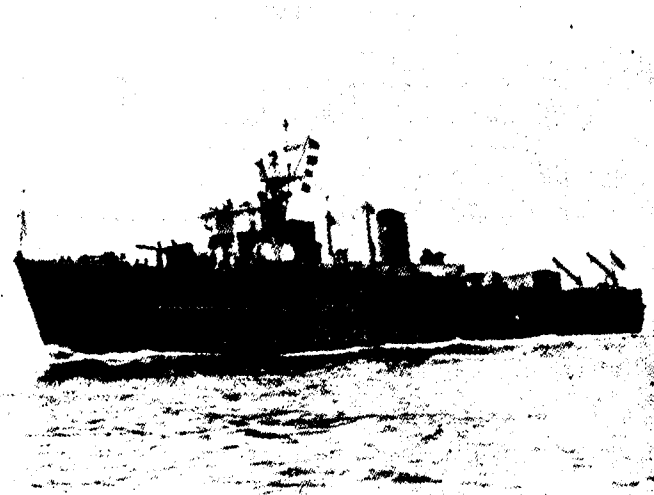
achieved with the fins in operation, as compared with the state of affairs when they are inoperative.

Analysis of the example of a roll recording shown above should be made from right to left, the upper trace representing the movement of the ship in the seaway, the lower trace representing the movement of the fin.

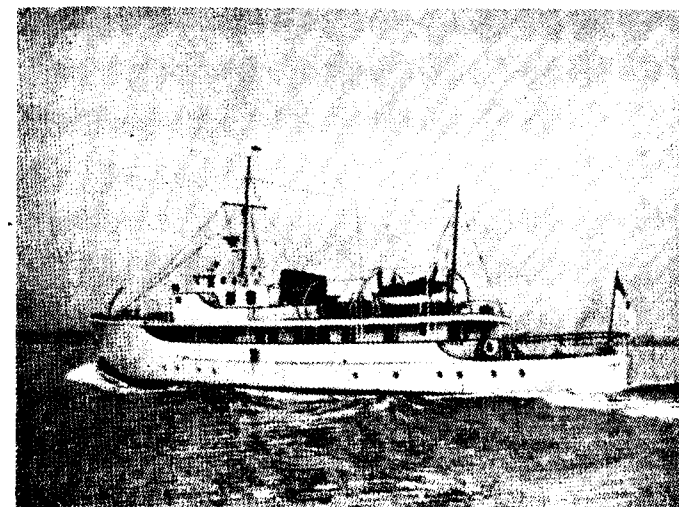
It will be noted that in the first portion of the record, the fins are locked in their midship position and are, therefore, offering no active resistance to the rolling motion of the ship. They will, of course, now tend to act in the same way as a bilge keel, so that it is true to say that the roll record of the same ship in the same seaway, but without fins installed,



M.Y. "DEIANEIRA," R.Y.S.
Displacement : 239 tons



H.M.S. "CONISTON"
Displacement : 430 tons



M.Y. "CALISTO"
Displacement : 350 tons

would have a slightly higher roll amplitude than that shown.

In the second section of the record, the fins are switched on, and it will be seen that there is immediate decay in the roll of the ship. The fins are again locked and the roll immediately builds up.

On switching on the fins for the second time, immediate decay of the rolling of the ship is apparent, and the roll remains damped out until the fins are again locked.

An overall analysis of roll recordings on the *Sea Victory* indicates, under normal conditions, a reduction in roll between fins locked and fins active of at least 80%.

In fact, a statistical analysis makes possible the assessment of a stabilisation "factor" which relates the sum of the angles rolled in a given time without the fins operating against the figure appropriate when they are in operation. This is of some value in arriving at an idea of how much improvement results from the use of the fins **at that particular time and in that particular "sea."**

It is not, however, by any means a completely reliable guide to performance since, even in the largest ships, conditions can arise in very heavy weather where a damping factor substantially less than two is achieved despite perhaps a damping factor of five or six being recorded in moderate sea conditions. This situation may further be influenced by the fact

that the effective period of encounter of the disturbing waves is at or near synchronism with the natural rolling period of the ship. This latter condition has a major influence on the potential build-up of rolling from only moderate but well-phased disturbances, and it is under these conditions that the Roll Damping Fins will show up to particular advantage.

It is frequently suggested that by virtue of the fact that a ship fitted with fins will roll much less, the passage of the wave system will be likely to cause the ship to shudder on impact, thereby increasing the structural stresses. In fact, the reverse is the case, since the racking stresses set up by the angular acceleration of the vessel in rolling will be minimised and the sometimes dangerous situation is avoided whereby a free-rolling ship may under certain sea conditions roll against the sea—it is in this latter condition that the waves appear to be striking the ship.

An important point when considering the installation of Roll Damping Fins is the installed weight of the equipment. While it is not, of course, possible to quote a formula for the calculation of weight in any particular case, it may be of interest to the reader to quote an example. In the case of a motor yacht having a displacement of some 100 tons, it is reasonable to assume that the total installed weight of the equipment would be under one ton.

With regard to speed losses due to the drag caused by the fins, extensive tests have been carried out which prove that even in fair weather conditions, these losses are negligible. The following are some figures resulting from tests :—

Overall length of ship : 110 ft. 0 ins. Displacement : 174 tons.

Reduction in speed, due to the installation of Roll Damping Fins, amounts to :—

2.0% at 12 knots, which is equivalent to	
a loss of speed of	0.24 knots.
1.2% at 13 knots, " " "	0.15 knots.
0.7% at 14 knots, " " "	0.10 knots.

In weather conditions where the fins will be required, a gain of speed may be anticipated due to the improved attitude of the ship in the seaway and the greatly reduced rolling losses. In more severe weather conditions the gain of speed will be further improved, as the ship will be able to maintain its speed where without fins it would have to reduce speed or, in the extreme, "heave-to."

Radio service and the production of radio equipment

By Inż. Jan Krzewiński,
Marine Radio Service, Gdansk.

RADIO equipment is of the utmost importance to both deep-sea and coasting vessels or river craft. High quality of radio equipment not only guarantees the safety of navigation but also is an invaluable aid for high standard of navigational efficiency and sea-to-shore communication.

In order to let the reader appreciate the achievements and the prospects of the Polish marine radio equipment industry as well as that of radio service on ships we want to present a few important facts from the past.

In the period between the two world wars the production of the marine radio equipment was practically non-existent in Poland. Ships were fitted with various types of imported equipment which was not always satisfactory.

In 1948 a small enterprise employing seven people was established under the name of Marine Radio Service (MORS). Its task was the maintenance and repair of radio equipment on board ships. Later on a company was developed for carrying out repairs, design and production.

In 1949 the state controlled Marine Radio Service Company, called M. O. R. S., was housed in three wooden barracks in Gdansk where in addition to radio service the construction of simple and later on more complex and modern radio devices was started. At the beginning the following equipment made by M. O. R. S. was installed on ships: alarm signal keyer, hum and noise filters, internal transmission sets, antenna change-over switches, receivers etc.

During that time future experts gained every month more and more practical experience both in design and production of radio equipment. At first the staff consisted of a few radio engineers and a score of workers.

In 1952 M. O. R. S. moved to their own offices at Gdynia, Zygmunt Augusta 3-5-7. Modern equipment and machines were purchased which made it possible to extend the range of equipment produced.

The number of designers grew and new techniques were worked out and put into practice.

M. O. R. S. became producers and suppliers of radio equipment for the Polish Merchant and Fishing Fleets. Mechanical workshops have been built and equipped with modern machine-tools; processes like: welding, galvanizing, paint spraying etc., are carried out by the latest methods. The assembly workshop is provided with excellent instruments which guarantee the proper finish of equipment. The design department and radio laboratory have the modern measurement instruments and are carrying out complex research work in radiotechnology. At present M. O. R. S. employs four hundred workers including professional engineers with long experience.

It is only recently that M. O. R. S. radio equipment has been brought up to European standards of quality and workmanship. M. O. R. S. is in a position not only to supply all Polish vessels with radio equipment but also to export it. Their achievements are great.

The marine communication receiver type OK-102 is of very high quality. It can also serve as a fishing radio-telephone receiver or as a direction finder receiver. It is made entirely of material resistant to sea-corrosion and in accordance with the rules of international conventions as well as with radio regulations. It is a five-valve 9 circuit superheterodyne receiver and can be supplied of 110 or 220 volt D. C. mains as well as from 24 volt battery. It works in the following ranges:

220 — 550 Kc/s	1.22 — 3.5 Mc/s
1220 — 3500 Kc/s	3.4 — 8.0 Mc/s
3.4 — 8 Mc/s	7.7 — 16.5 Mc/s
7.7 — 16.5 Mc/s	16.0 — 32.0 Mc/s

Emergency receiver type OA-101 is designed for installation on liners, cargo ships and other vessels and used when the main communication equipment cannot be used. It is a 4-valve 3 circuit directly amplified receiver designed for A-1, A-2, A-3 emission in the frequency range of 380-570 Kc/s.

SHIPYARDS IN POLAND

Stocznia Gdanska	— Gdansk
Stocznia Polnocna	— Gdansk
Stocznia Gdynska	— Gdynia
Stocznia Szczecinska	— Szczecin



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For further information please contact :—
THE POLISH COMMERCIAL COUNSELLOR'S OFFICE,
42-44, Sunder Nagar, New Delhi.
Tel: 43782

The emergency receiver OA-101 is supplied directly of a volt emergency battery without converter. The device conforms to the regulation of classification society.

Radiotelephone type NOMS-0015 can be installed on fishing and small vessels. The transmitter works with an antenna several meters long, output power 15 Watt in the frequency range of 1.6-2.6 Mc/s and 2.6-3.8 Mc/s. Receiver type OK-102 has been described above. This radiotelephone is used in the fishing fleet with excellent results.

The echo sounder type SPN-11 is used for navigational purposes especially on fishing vessels. This is a recording echo-sounder using dry paper, for sea-bed sounding and for the detection of density and characteristics of fish concentrations as well as of small fish shoals. Sounding range is up to 1250 in. It is made in sizes suitable for installation both on bigger and on smaller vessels. Housed in an aesthetically made casing it is entirely moisture-temperature—and vibration resistant.

Autoalarm receiver type AA-6 is designed for installation on ships of group I and II as a receiver of international alarm signals. The device consists of radio receiver, selector and alarm unit. It is designed in accordance with the rules of the International Convention for the Safety of Life at Sea 1948 and it conforms to CCIR (Documents of the VIII Plenary Assembly, Warsaw, volume I) and Polish Ship's Register.

Very high frequency radiotelephones with frequency modulation type FM-302 are available for installation on vessels, motor-cars, railway engines etc. Radiotelephones work in the range of over 30 km and can work on 4 crystal-stabilized frequencies in the ranges

of 35-43 Mc/s, 70-78 Mc/s, 100-108 Mc/s, 156-174 Mc/s. Selective calling can be made with these devices. These radiotelephones are made in small sizes and are of high quality workmanship.

In addition to the equipment described above M. O. R. S. produce other devices like: telephony alarm signal devices, internal transmission sets, antenna change-over switches, switch boards for battery charging and auxiliary radio equipment.

Experienced designers of the M. O. R. S. work on new devices taking into consideration the latest developments. This will enable them to supply the Polish fleet with the most up-to-date equipment.

The Company has three main branches of development: the production of echo-sounders, of marine radio receivers and of high frequency radiotelephones with frequency modulation. This will make M. O. R. S. independent of foreign producers and later on enable them to export their equipment. Moreover M. O. R. S. has a well organized and well equipped Service Department which ensures proper maintenance of radio equipment on vessels. A staff of highly qualified radio engineers and technicians carries out repairs of radio-communication, radiolocation and radionavigation equipment. The service is continuously available both to local and foreign ship-owners.

At the XXVII International Poznan Fair M. O. R. S. is exhibiting their equipment which compares favourably with that of foreign competitors. Modern engineering techniques, great possibilities of training technicians in the operation and production of equipment make possible a thorough analysis of the customer's needs, further improvement of design and a rapid growth of the Company.

ZIPPERED CABLE COVER

Combination of a slide fastener with an extruded vinyl plastic forms a unique, flexible housing for wire and cable. Compared to conventional sleeving the product makes it much easier to expose wiring trouble areas for all types of maintenance—substantial savings in time and labour are the result. The new housing offers excellent dielectric properties and is inherently waterproof. Manufacturers Alpha Wire Corporation, New York, U. S. A.

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PLASTIC LADDER

Designed especially for chemical industries, made of moulded glass-fiber plastic with a balsa wood core, a new chemically resistant ladder is claimed by the manufacturer to be the toughest and most durable ladder ever constructed from any material. For added safety, the aluminum rungs molded into the side pieces feature a non-slip grit-embedded neoprene covering. Since 120,000 v. applied between the rungs causes no breakdown the ladders are considered safe for electrical repair work. Manufacturers: Putnam Rolling Ladder Co., New York.

BRITISH SHIPPING AND SHIPBUILDING

By Peter Duff

Editor of the "Shipping World" London, and author of "British Ships and Shipping"

AT one period of time, about the turn of the century, thanks to their leadership and opportunities for the development of steam navigation and steel shipbuilding, British ship-owners carried as much as half of the world's seaborne trade. This is no longer the case today, because many other countries have developed merchant fleets of their own; and the fleets of owners who register under the so-called "flags of convenience", like Liberia and Panama,—countries which have no maritime traditions—have secured for themselves an ever increasing share of world trade. Nevertheless, the United Kingdom ship-owners still have the largest actively trading fleet of merchant ships in the world, and they can still claim to be the carriers of the world. The total volume of world trade has, of course, increased enormously at the same time.

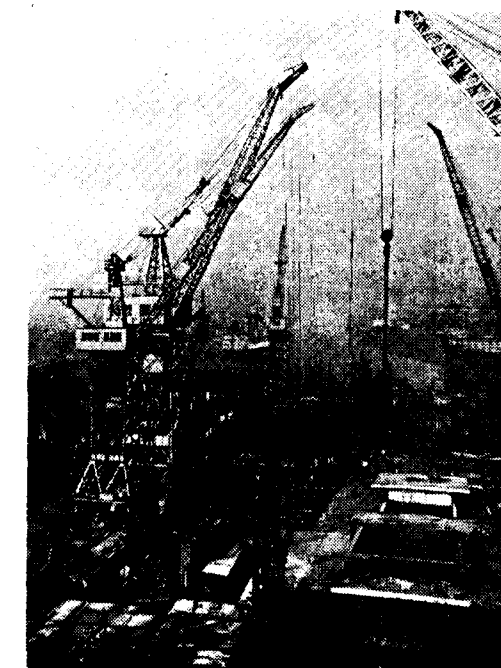
At the end of 1957 the world merchant fleet totalled some 106,000,000 tons gross, considerably more than the 61,000,000 tons gross which has in existence at the outbreak of the Second World War. Statistics for the principal maritime countries are given in the Table at the end of this article; it includes only merchant ships of 500 tons gross and over designed for commercial trading. It excludes lake and river tonnage, as well as non-trading vessels like tugs, dredgers, fishing vessels and so on. It will be seen from this table that United Kingdom vessels now account for 17.3 per cent. of the world total, compared with 27.5 per cent in 1939; but the proportion of the world total is increased to about 20 per cent. if the inactive war-built Liberty and other ships laid up in the United States National Defence Reserve Fleet are excluded (totalling nearly 14,000,000 tons gross).

POSTWAR EXPANSION

Much of the increase in the world merchant tonnage since the beginning of the Second World War is due to the expansion of oil tanker fleets, and the British tanker fleet has participated in this expansion. In 1939 United Kingdom tankers totalled about 3,000,000 tons gross, or about 26 per cent. of the world total. At the beginning of 1958 the U.K. tanker fleet had reached

about 5,600,000 tons, or some 17.8 per cent. of a world total of 31,500,000 tons gross.

Since Britain consists of a group of islands in the Atlantic Ocean off the mainland of Europe, it is naturally heavily dependent on the shipping industry for the transport of its imports and exports. The islands for many years have not been self-sufficient in raw materials such as fuel and metal ores and they are

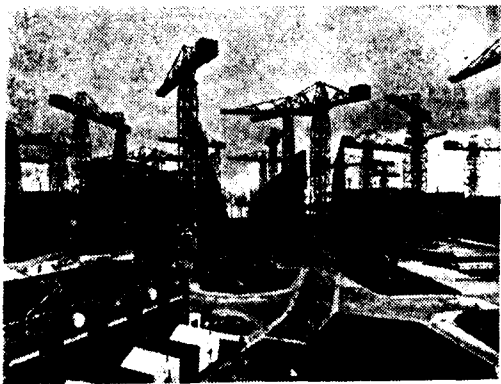


Clydeside, in Scotland, is one of the United Kingdom's largest ship-building areas. Here is a view of the assembly berth in the yards of Alexander Stephen and Sons, Ltd., of Glasgow, showing a cargo and passenger ship in course of construction.

incapable of growing foodstuffs enough to feed more than half their population. Huge volumes of materials and foodstuffs have to be imported from overseas, and by the same token large quantities of industrial exports of manufactured goods and equipment must be exported in order to pay for the essential imports. Thus Britain's overseas trade forms a high proportion of the world's total of seaborne trade.

NO STATE AID

None of this trade is reserved exclusively for British ships, nor has it been since the repeal of the Navigation Laws in 1849. In fact, there is not even any restriction of the purely coastal trade to the national flag, although foreign participation in the movement of cargoes between United Kingdom ports does not amount to more than about five per cent. at present. Nor does the Government subsidise the shipping industry or assist it in any way financially, except to the extent that shipowners who invest in the building of new tonnage may offset 40 per cent. of the cost of building against income and profits tax, in addition to the normal depreciation allowance of 5 per cent. per annum for 20 years. This concession has been made necessary because of the rapid advance in shipbuilding prices throughout the world in recent years. A ship

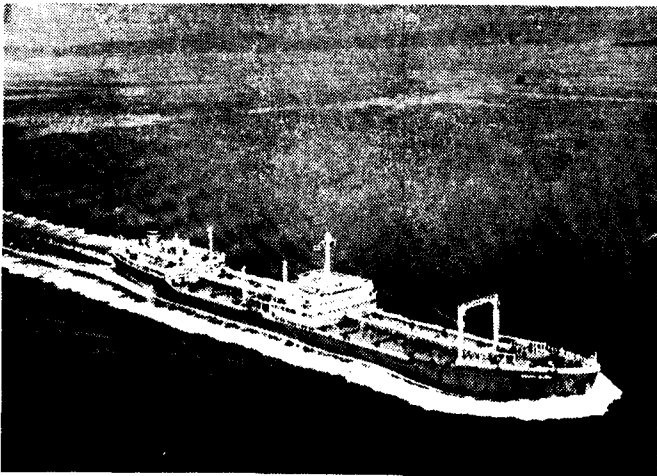


Here is a view of part of the shipyard of Harland and Wolff, Ltd., at Belfast, Northern Ireland, which employs more than 20,000 men. For many years since World War II it has topped the shipping output figures for the United Kingdom.

built today may cost four or five times the cost of the ship it is intended to replace.

PASSENGER LINERS

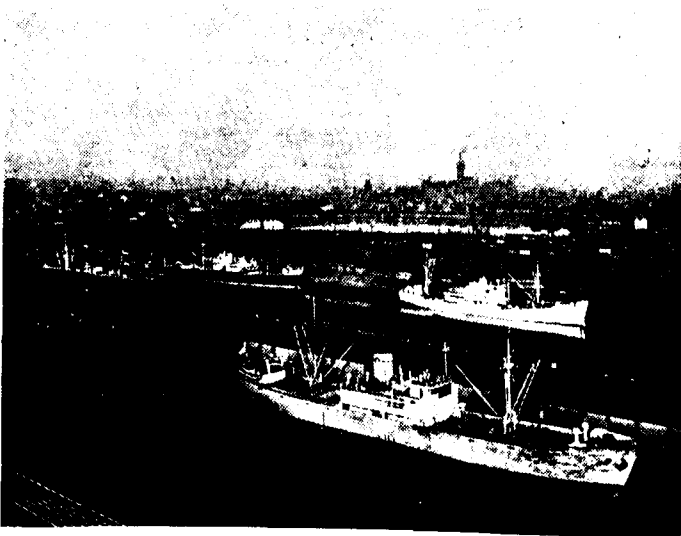
Despite the rapid expansion in air travel, Britain still has by far the largest fleet of passenger liners in the world. More than a million passengers cross the Atlantic Ocean every year by sea, most of them in British ships like the world's largest liners *Queen Mary* and *Queen Elizabeth*, and a greater number than travel by air. Then there are also the large passenger liner fleets which link the United Kingdom and the Continent of Europe with distant parts of the Commonwealth, such as Australia and New Zealand, South,



An aerial photograph of the oil tanker *British Glory* taken during her trials. The ship was built by Vickers-Armstrongs (Shipbuilders) Ltd. at their shipyard at Barrow-in-Furness, Lancashire, for the British Petroleum Tanker Company Ltd., and launched in 1957.

East and West Africa, and Pakistan, Ceylon, India, Malaya and Hong Kong, as well as other regions such as South America and the Far East.

The passenger and cargo liner section of the British mercantile marine accounts for about half of the total operational tonnage, and includes an exceptionally large number of specially designed fast refrigerated ships designed for the carriage of imports of cargoes like fruit, meat and dairy produce from all parts of the world.



Clydeside, in Scotland, is one of the United Kingdom's largest ship-building areas. This view of Glasgow, looking across the dock area, shows the University dominating the city.

TABLE

World Tonnage By Nationality As At 31st December, 1957 Steam And Motor Vessels of 500 G. T. and over excluding Lake and River Tonnage And Miscellaneous Craft, E. G. Tugs, Trawlers, Etc.

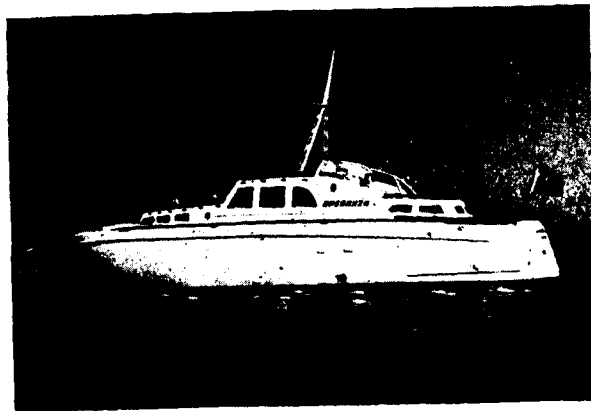
		NON-TANKERS		TANKERS		TOTAL	
		No.	Gross tons (000)	No.	Gross tons (000)	No.	Gross tons (000)
United Kingdom	..	2,331	12,725	634	5,638	2,965	18,363
Canada	..	151	697	31	138	182	835
Other British Countries	..	658	2,312	29	155	687	2,467
British Commonwealth	...	3,140	15,734	694	5,931	3,834	21,665
Argentina	..	148	625	51	342	199	967
Belgium	..	93	457	11	121	104	578
Brazil	..	216	666	35	166	251	832
Costa Rica	..	128	491	3	19	131	510
Denmark	..	329	1,197	57	647	386	1,844
Finland	..	254	624	19	164	273	788
France	..	524	2,521	149	1,414	673	3,935
Germany, West	..	950	3,053	78	371	1,028	3,424
Greece	..	284	1,377	27	192	311	1,569
Holland	..	688	2,986	142	1,164	830	4,150
Honduras	..	59	207	14	151	73	358
Italy	..	647	3,245	159	1,395	806	4,640
Japan	..	905	3,644	141	981	1,046	4,625
Liberia	..	555	4,056	337	5,131	892	9,187
Norway	..	855	3,566	448	4,931	1,303	8,497
Panama	..	407	2,068	194	2,225	601	4,293
Portugal	...	104	383	10	71	114	454
Russia	..	708	1,902	116	510	824	2,412
Spain	..	331	1,017	40	250	371	1,267
Sweden	..	554	2,042	100	991	654	3,033
United States +	..	2,680	19,738	352	3,730	3,032	23,468
Other Countries	..	1,137	3,256	150	664	1,287	3,920
Total	..	15,696	74,855	3,327	31,561	19,023	106,415

+ Vessels of 1,000 gross tons and over; provisional figures for 30th June, 1957.

The figures are based on estimates made by the Ministry of Transport on the latest information available. The figures for Russian tonnage are known to be incomplete. The United States figures exclude merchant-type tonnage owned by the U. S. Army and Navy but include vessels in the Reserve Fleet estimated at 13½mn. gross tons at the end of 1957. As in previous years, vessels owned in Canada, but registered in the United Kingdom under the 1950 arrangements, are included in this table as Canadian.

(From the Annual Report 1957-1958 of the Chamber of Shipping of the United Kingdom.)

SPERANZA



Speranza riding to her marks after launching.



Keel Assembly showing laminated frames in position.



Fibreglass Rudder and Propellerstrut Assembly showing propeller and shaft in position

The cabin cruiser, designed and built by AFCCO Private Ltd., Bombay, was launched on 21st December, 1956 from the builders' Lakri Bunder Yard. SPERANZA attained a speed of 22.3 knots on the measured mile in Bombay Harbour. Such a speed for a craft of this type with a teak hull, powered by only a total 200 b.h.p. reflects on the many weight saving refinements which were employed. A large portion of this saving in weight would not have been possible without the use of CIBA'S products such as :

AEROLITE, the versatile U. F. synthetic resin extensively used for constructional gluing of wooden structures, such as laminated frames and knees, engine bearers, etc.

ARALDITE LAMINATING RESIN, the epoxy resin used for fabricating light and strong glass reinforced laminated structures, such as rudder quadrant, tiller arm, ventilators, galley sink and drain board, rudders etc.

ARALDITE ADHESIVES used for bonding of metal to metal or to other materials.

The total saving in weight with the use of above mentioned products is estimated to be over 2,000 lbs. which has enabled the builders to instal aluminium fuel tanks bonded with **ARALDITE Adhesive**, giving the craft a range of over 800 miles.

May we send you more information about the use of the versatile synthetic resins marketed by us?

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Most of the cargo liner services link with the United Kingdom, but some of them do not touch the United Kingdom at all, operating for example from the United States to India and Pakistan, or across the Pacific from the United States to Australia, New Zealand and Japan. Similarly the large fleet of tramp ships is engaged in world-wide trading. In recent months, for example, British tramp ships have been engaged in carrying ore from Brazil to Poland and from Indo-China to France, as well as coal from the United States to Western Europe.

OVERSEA TRADE

The value of United Kingdom imports in 1957 is estimated at £4,049,000,000, while the value of exports is put at £3,325,000,000. This is some measure of the importance of shipping to the United Kingdom, although not all this trade is carried in British ships. In fact the proportion of foreign ships to British ships engaged in trading with United Kingdom ports has been rising gradually, from 30.1 per cent. in 1948 to 43.7 per cent. in 1957. The British shipping industry however, contributes handsomely towards the nations balance of payments in the form of its foreign-currency earnings in the service of other countries. A recent survey revealed that the net foreign-currency earnings of the industry—gross revenue less disbursements in foreign currency—amounted to more than £220,000,000 in one year.

BUILDING AND REPAIR FACILITIES

The maintenance of such a large fleet of merchant ships calls for extensive shipbuilding and repairing facilities. The United Kingdom shipbuilding industry

EQUIPMENT CAN NOW ON POLYETHYLENE COAT

You can now have your chemical equipment coated with low cost polyethylene. A recently developed technique produces a lining which is standing up very well to a variety of chemical corrodents in plant applications.

UNIQUE METHOD

Tank Lining Corporation, Pittsburg, Pa. has come up with a unique flame-spray method for high-pressure, high-density linear polyethylene. A significant point : the process (which will be licensed to other lining companies) doesn't change the properties of polyethylene. It has not been plasticized, inhabited or extended and the applied film looks a lot like extruded

has been established for over a hundred years as the world's leading shipbuilder. At mid-1957 it held orders for about 7,000,000 gross tons of merchant shipping worth £1,000,000,000. A measure of its contribution to the merchant fleets of the United Kingdom and the rest of the world in recent times is the fact that during the ten years 1947 to 1956 the industry has produced some 3,500 ships representing over 13,000,000 gross tons. This total includes 1,150 sea-going merchant ships of 4,500,000 gross tons, valued at over £38,000,000, that have been exported to overseas owners. The industry builds ships of all types and sizes : fast passenger liners whose name have become household words ; oil tankers and ore carriers ; cargo vessels to carry all kinds of merchandise and raw materials ; fishing vessels ; and tugs, coasters, river vessels, barges and lighters. In addition, the United Kingdom ship repair yards can maintain and repair every type and size of water-borne craft. Every week the United Kingdom ship repairing industry returns to service 1,500,000 gross tons of shipping.

In recent years the shipyards of the United Kingdom have launched annually some 1,400,000 tons gross of merchant ships, in addition to naval work. About two-thirds of the yearly output is normally for the replacement or expansion of the trading fleets of British shipowners, and the rest is devoted to specialised non-trading craft or for export to Commonwealth and other mercantile marines. Of the 9,948,000 tons gross of merchant ships at present under construction in the world's shipyards, some 2,345,000 tons gross are under construction in Britain ; and the total order book of the British ship building industry is valued at nearly £1,000,000,000. About one-fifth of this total is for export.

or molded polyethylene. As a plastic, polyethylene isn't a newcomer in chemical equipment applications : pipe is used extensively ; sheet and film polyethylene are popular as a linear for simple equipment such as drums and small tanks. But until now nobody had a satisfactory way to spray on polyethylene to get a bond between plastic and metal. Polyethylene has been dip coated, but this is impractical for large equipment.

Some companies have tried flame sprays before, but to get a good bond they incorporate such additives as butyl rubber or polyisobutylene. These agents change the physical characteristics and chemical resistance of polyethylene.

UNDERWATER EQUIPMENTS FOR MARINE ENGINEERS

SIEBE Gorman & Co., Ltd., of U. K., are manufacturers of all types of underwater equipment including deep diving suits with all ancillary equipment, shallow water suits and Aqualungs, de-compression chambers, diving belts, in fact, practically everything required for underwater operations from just below the surface to 300 ft. in depth.

There are three main types of diving apparatus currently in use and each has its particular application. These three types are:— Standard Diving Suit "Mistral" Compressed Air Aqualung, and the surface Demand Air-line Breathing Apparatus.

The Siebe, Gorman Standard Diving Suit as used today is substantially the same in principal as the suit originally invented by Augustus Siebe over a 100 years ago and is generally accepted the world over as being the most practical. This type of suit can be used for many underwater undertakings such as harbour building and development, inspection of underwater foundations in harbours, bridges etc., and it enables the diver to work for long periods underwater without discomfort in any climate. In cold areas the diver is insulated from the surrounding cold water by the air contained in his suit, while in hot climates it is possible to supply air which has first been passed through a cooler. A diver wearing the standard suit can carry out most jobs of work such as welding, cutting, inspection, tightening of bolts etc., so long as he remains in a reasonably upright position.

The Standard Suit, however, has certain disadvantages where speed, short duration underwater or the necessity to work at any angle, are required. The Compressed Air "Mistral" Aqualung is an ideal apparatus to use under these conditions as the diver is not hampered by air-lines, or heavy weights which enables him by using swimfins to cover a very wide

area, such as in the case of a search in clear water, in a very short space of time. The apparatus consists of a compressed air cylinder of 1100 litre capacity charged to a pressure of 1800 pounds per square inch and carried on the wearers' back. Air is supplied from the cylinder to a demand type reducing valve which is operated by the diver's lungs according to the amount of exertion he makes and the depth at which he operates. The set is carried in a Nylon harness which has been specially designed for strength, durability and comfort in wear.

The surface demand air-line apparatus comprises an air storage cylinder situated either on shore or in a boat, an air-line from the cylinder to a demand valve secured to a harness worn by the diver, and a mouthpiece and breathing tubes. This type of apparatus has many advantages some being the greater endurance of the air supply, not having to wear a cylinder it is possible for the diver to enter confined spaces, and the ability of the attendant to adjust the air supply pressure to suit the depth at which the diver is working.

Other types of apparatus of interest to shipbuilders and repairers include underwater Oxy—hydrogen or Oxy-acetylene welding or cutting apparatus, underwater lamps and television.

There are also many types of apparatus made by Siebe, Gorman for Marine use in connection with safety, such as the Marine Compressed Air Breathing Apparatus which can be worn by crew members when entering or cleaning holds or tanks where there is a deficiency of oxygen, or for fire-fighting and rescue. Equipment which can also be supplied for these purposes includes protective clothing safety helmets, safety harnesses and lifelines, smoke helmet apparatus and gas respirators.

LOOM ATTACHMENT

A loom attachment that will weave names into the cloth without the use of jacquard cards has been introduced by A. B. C. Textile Machinery Co., North Bergen N. J. The names to be woven can be set in an electrical plug board by the operator and the apparatus

will control the weaving of the name by an electro-magnetic system. With this loom attachment it is possible to personalize towels, table cloths, sheets, napkins and items with woven names in large or small lots on an economical basis.

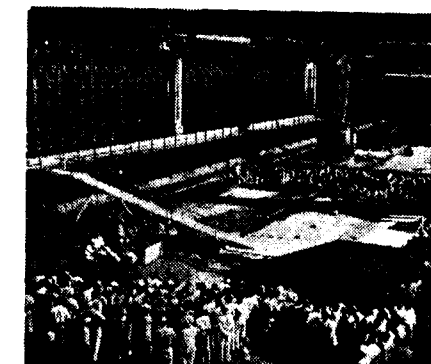
MACHINERIES SUPPLEMENT

Tata Coke Oven Battery Lit Up

By A Technical Correspondent

ANOTHER mile-stone was achieved on November 20th, when the last Coke Oven Battery at Jamshedpur was lit up by Sir Jehangir Ghandy, Director-in-Charge, Tata Iron & Steel Company Limited. The first oven of this battery was lit up jointly by Sir Jehangir Ghandy and Shri Rampadarath, Tata's oldest coke oven employee having served for 42 years in the Department. This battery is part of Tatas' 2-Million Ton Expansion Programme. The present battery, numbered 3, has been built by Simon-Carves Ltd., to replace the old Battery No. 3, also built by the same firm. It consists of 57 ovens, in two blocks of 28 and 29, thus incorporating 2 ovens more than in the old battery. These ovens, as well as those of the Simon-Carves' Batteries Nos. 1, 2 & 4, are all of the twin-flue compound under-jet type. With the completion of this battery, there are now a total of 230 Simon-Carves Coke Ovens in operation at Jamshedpur Steelworks

and these can carbonise approximately 5,500 tons of coal per day.



Lighting up of Tata Coke Oven Battery No. 3.

This photograph shows a general view of the Tata Coke Oven Battery No. 3. It also shows part of the gathering in connection with the lighting up ceremony.



Lighting up of Tata Coke Oven Battery No. 3

This photograph shows the joint lighting up by Sir Jehangir Ghandy and Sri Rampadarath of the Tata Rebuilt Battery No. 3 at Jamshedpur on November 20.

BATTERY COMPLETED IN RECORD TIME

The battery has been lit up in less than 9 months from the date of starting of the demolition of the old battery and this is the shortest time ever taken by the firm for rebuilding a battery of this size. The demolition of the old battery No. 3 started on February 25th this year and at one stage as much as 300 tons of scrap steel and bricks were being handled in one day. The laying of brick work for the rebuilt battery commenced on June 20th, and it was completed within 13 weeks, averaging 800 tons of refractory bricks per week. Approximately 1400 tons of steelwork, 1000 tons of castings and 2000 cu. yards of concrete were used in the construction of this rebuilt battery.

The work of this particular British Firm for the Tata Iron & Steel Company Limited has not been confined to the building and re-construction of coking plants. They have also been responsible for the building of some other parts of steel works, viz., Steel Melting Shop, Ore Bins, Soaking Pits, Calcining Plant and a Coal Handling Plant at Jamadoba. Altogether during the past 8 years, the firm have undertaken 9

major and many smaller contracts for the Tata Iron & Steel Company.

Simon-Carves Ltd., have also been responsible for building all the Coke Ovens at the Indian Iron & Steel Company's Steelworks at Burnpur. Six Coke Oven Batteries were built between 1922 and the second World War; the seventh was completed in 1950; the eighth was put to work in January this year, and the ninth started pushing coke on October 8th this year, one month ahead of schedule.

At the new Durgapur Steelworks the firm are responsible for the coal handling, washing, stocking and blending plant, the three coke-oven batteries and

by-product plant (the latter including a sulphuric acid plant, tar distillation plant and naphthalene plant, and an effluent treatment plant of the microbiological type) and the steam and electric power station as well as a substantial amount of work on inter-connecting services between various sections of the steelworks.

Thus the role of this firm in the development of the Indian Steel Industry is not an insignificant one, for out of the five large steelworks operating at the end of the present plant period, Simon-Carves Ltd., would have been closely associated with at least three of them, namely those at Jamshedpur, Burnpur and Durgapur.

UNION CARBIDE INTERNATIONAL COMPANY OFFERS NEW, STRONGER POLYETHYLENE PIPE COMPOUND

Polyethylene pipe with up to nearly one-third greater initial burst strength than obtainable with conventional pipe-grade resins will be introduced by Union Carbide at the Eighth National Plastics Exposition in Chicago, November 17-21 and will be available to visitors to the Union Carbide International Company exhibit.

The new material combines its high initial strength with proportionally longer service life as well as usual high-performance characteristics required in pipe applications. Development of the new resin stemmed from investigation of a great number of potential resins with wide ranges of densities and other properties.

Instantaneous burst strength is proportional to the density of the resin, the tests indicated. Both the density and the material's melt index determine the resistance to environmental stress cracking and the stress level maintained in long-term pressure testing.

Both results, the tests showed, could be obtained with an ideal resin that combined a high density with a low melt index. To satisfy these needs, the new resin—designated DHD-4022—was developed with a density of .929 and a melt index of 1.0 to 1.5.

The major strength advantages of this material over conventional first-grade pipe compounds include: a 10 to 30 percent increase in instantaneous burst strength,

10 to 15 percent higher long-term resistance to stress at room temperature, and significant improvement in resistance to environmental stress cracking.

Other features of the material include exceptional corrosion resistance, low temperature properties, flexibility for coiling, light-weight, non-toxicity and excellent surface gloss. When subject to hard water, the material resists build-up of mineral deposits.

Because of its higher strength, DHD-4022 can be extruded into thinner wall pipe than ordinarily formed from current high-grade materials, thus reducing the cost of finished pipe.

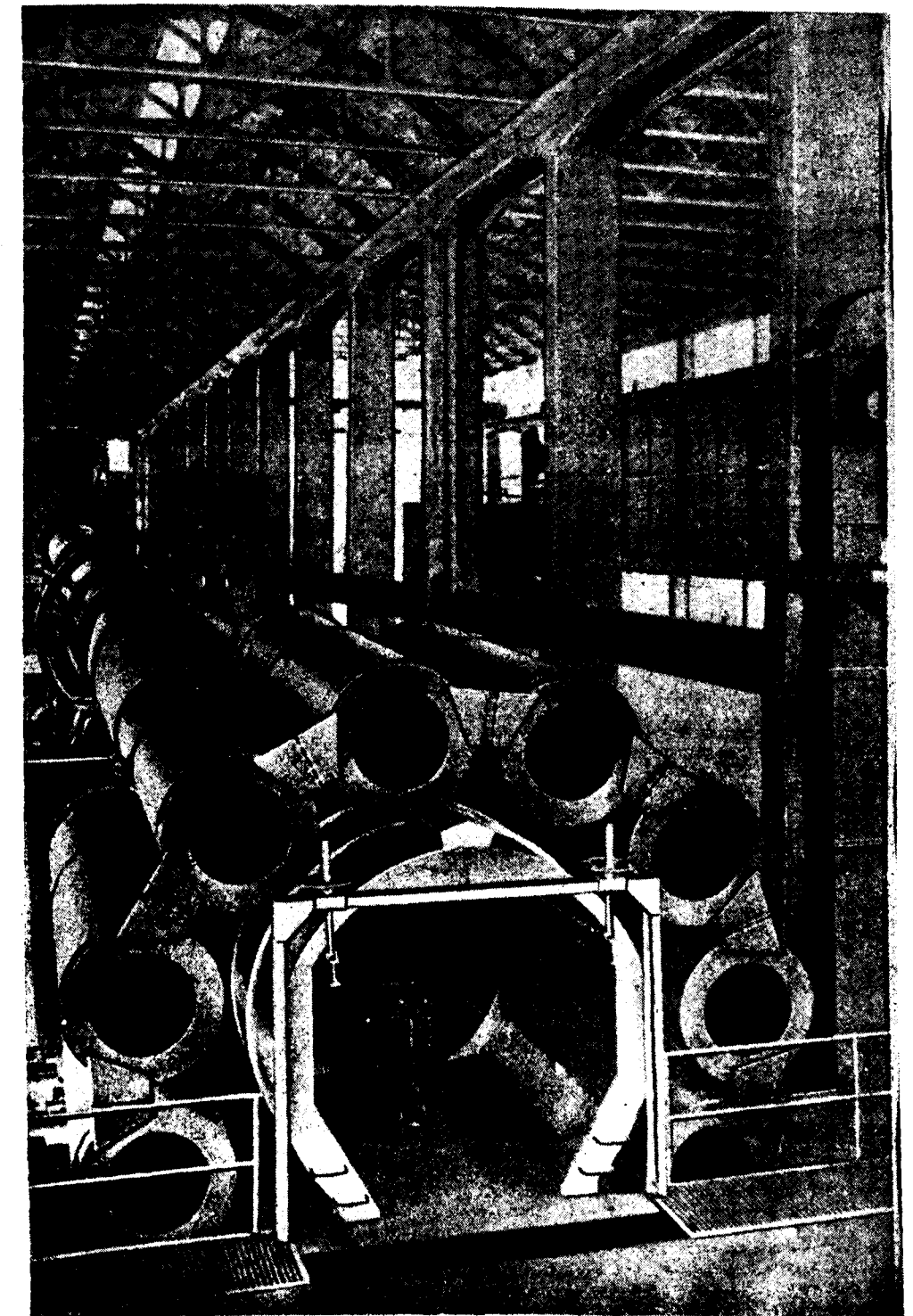
The new Union Carbide polyethylene is approved by the National Sanitation Foundation of the U.S.A. for transmission of drinking water. Tests conducted prior to the introduction of the material concluded that no toxic substances were extracted from the pipe by aggressive natural water. They verified that passage of water through the pipe has no effect on the appearance, odor or taste of the water.

The new material can be extruded on any standard extruder, employing material temperatures ranging from 160 to 180 deg.F. (71.1 to 82.2 deg.C.). Cylinder conditions will depend on both the type of screw and the screw speed.

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New Range of Industrial Power Sweepers

By An Overseas Correspondent

THE modern trend in industry towards more and more elimination of manual labour by mechanisation is being developed in up-to-date factories, warehouses, railways, bus and transport depots, hospitals and in fact any locations which require frequent cleaning; such non-productive duties as the sweeping and disposal of dust and debris are being carefully observed.

It is recognised that an efficient dust collection system prolongs the life of plant and equipment and reduces the risk of contamination to stocks and stores. By mechanising this operation not only is sweeping efficiency increased but costs are greatly reduced in some cases by as much as 80%.

A firm of well-known manufacturers of mechanical handling equipment in UK, have now added to their products a range of industrial power sweepers. These are known as the "Matling-Wilshire" Industrial Power Sweepers "800" Series. These machines are produced in three sizes for sweeping paths 24 inches, 36 inches and 48 inches wide, according to the width of the aisles and openings through which the sweeper must pass. Matling-Wilshire sweepers are powered by a 5 h. p. or 8 h. p. petrol engine which drives the road wheels through a clutch and differential assembly and also operates the brush units with a direct V-belt drive. The shaft extension at the other end of the engine drives the vacuum unit.

The brush reel is composed of twelve brushes in all which can be supplied in a variety of fillings to cater for any sweeping conditions. The brush pressure may be varied by raising or lowering the front wheel by means of an adjusting screw. Patented brush holders facilitate brush changes and allow bristles to be worn down to minimum length.

The patented "Duscon" control system filters the air and automatically separates the dust from the debris. This eliminates the necessity of laying the dust with a sprinkler system. The brushes rotate against the direction of travel throwing the debris into the hopper whilst the vacuum unit pulls the dust up into the dust bag. Heavy particles do not reach the bag

but are thrown out to the hopper by the cyclonic separator on the 836 and 848 models. The hopper is quickly detachable by tipping the sweeper and, being mounted on heavy rubber tyred castors, it can easily be wheeled away for emptying.



Matling-Wilshire.
Industrial Power Sweeper.

A side sweeper attachment fitted at the front of the machine on a two-way swivel head can be supplied as an optional extra. This enables the operator to sweep right up alongside walls or stacks of materials. A detachable sully is available to permit the operator to ride when sweeping large areas indoors and outdoors.

Matling-Wilshire sweepers are strongly constructed and simple to operate. A heavy front bumper protects the sweeping chamber. Finger tip controls are conveniently located. Three wheel suspension means effortless steering and correct weight distribution makes it easy to tilt the sweeper to clear obstructions.

New Distillation Unit for inflammable solvents

BY connecting to any steamline, saturated or superheated, and feeding the exhaust steam back to a heating system, washing plant or auxiliary machine, the running costs of a new distillation unit, marketed by Liquid Systems Ltd., Norwich Union House, Wellesley Road, Croydon, Surrey, is almost negligible.

Known as the Schlegel D. E. 200 it is of simple, robust construction, requiring little, if any, maintenance.

It comprises a well insulated distilling chamber of 44 gals. capacity with a water cooled condenser, and can be fitted with either a manual or automatic temperature regulator.

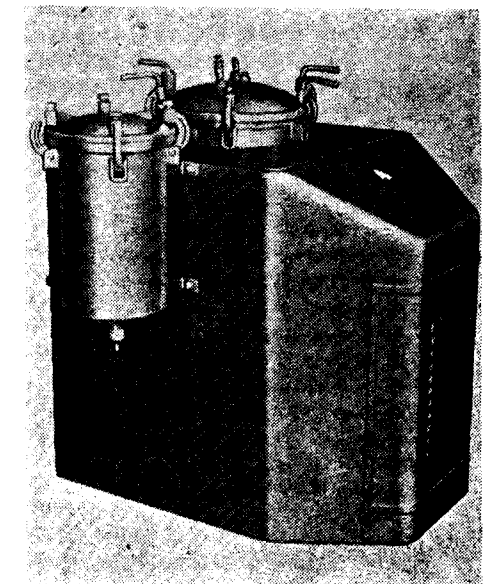
For the removal of oils, greases, pigments and other dissolved impurities from white spirits and solvents such as turpentine, wash kerosene, nitrosolvents, tri-chlorethylene etc. it is clean to handle and simple and safe to operate.

All solvents with a boiling point under 140 degrees C can be distilled by the use of saturated steam at 45 p. s. i. g. Liquids with a boiling point higher than 140 degrees C require superheated steam.

The D. E. 200 unit is also available fitted with electrical heating elements and automatic temperature control.

It is ideal for Paint Manufacturers, Dry cleaners, Chemical Manufacturers and other industries who wish to restore solvents and white spirit to their original clarity ready for re-use. The considerable savings effected rapidly repay the low capital cost involved.

A smaller model, the Schlegel D. E. 30, is electrically heated and has a capacity of 6½ gals. Suitable for



Schlegel Model D.E. 200 Distillation Unit.

liquids having a boiling point ranging from 40 degrees C to 200 degrees C, it incorporates a three-stage heating element and a thermostat which controls the heat and automatically switches off the supply when the spirit has been distilled.

TECHNICAL DATA

	D. E. 200	D. E. 30
Capacity:	45 gallons	6½ gallons
Heating Medium:	Steam or Electricity Three phase A.C. 6.8 Kw	Electricity, single phase A.C. 250 Volts.
Output per hour:	6½ — 9 gallons	1 — 1½ gallons.
Base dimensions:	2' 8" x 4' 3"	2' x 3'
Nett weight:	approx. 617 lbs.	approx. 177 lbs.
Gross weight:	approx. 816 lbs.	approx. 265 lbs.

POLYETHYLENE-BAG PACKAGER

The Model 111—11 bag packager, announced by Errich International Corporation 5E, 35th Street, New York 16, N. Y. can open flush-ended polyethylene bags at speeds up to 1,500 units per hour. Operators can learn to operate the

machine in 20 minutes and reach peak efficiency in an hour or two. Mirror-polished metal product guides are precisely balanced and can easily fill flimsy materials with no danger of damage or slowing of production.

Unique Multipoint Recorder Offers Unusual Flexibility

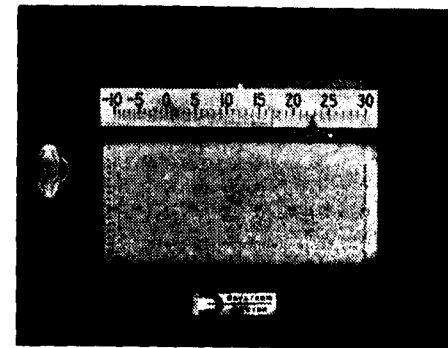
A new multipoint recording potentiometer, capable of handling from two to twenty-four points by means of simple plug-in adapter units has been designed and produced by Weston Instruments, Division of Daystrom Incorporated, Newark 12, N. J.

The Model 6702 Daystrom-Weston instrument is designed to measure any number of variables by means of a simple and inexpensive kit of change-over parts. Should the purchaser be measuring, for example, six points, and additional work load requires that twelve points be under scrutiny, the operator need only change a plug-in unit and replace a dial indicator and print wheel which are mechanically geared with the selector switch. No new selection switch is needed, no soldering is required, and no refitting of the components is necessary. The entire change-over operation can be completed in three minutes.

The new Daystrom-Weston Multipoint Recording Potentiometer is the biggest advance in recording instruments in twenty years, according to the company. It is expected to obsolete all other recording instruments which cannot be changed from one recording job to another without extensive refitting, resoldering, or rebuilding.



The problem of range changing on the Model 6702, the company states requires only the insertion of the proper range clip. A change in the type of thermocouple or transducer being used is easily accommodated by replacing a newly designed terminal block which has the cold junction compensation integrally wired into it. Inserting the matching range clip and scale



The New Daystrom-Weston Model 6702 Multipoint Recording Potentiometer.

plate, which are included in the thermocouple change kit, completes this simplified procedure. The instrument is also easily changed into a pen-dragging type for single-point recording.

* * *

The industry pattern in pricing recording potentiometers has traditionally followed a sliding scale, with the price of the instrument rising as the number of measurement points increase. By grouping related components in the simplest, most serviceable, and most efficient manner, Daystrom-Weston is able to offer this new model at one price, regardless of how many source inputs are required by the purchaser. This is the first time that a readily changeable instrument with a simple kit of interchangeable parts has been made available to industry, with further savings effected by the fact that all recorders, from two to 24 points, are offered at the same price, eliminating the necessity of purchasing a different recording potentiometer for each job.

The Model 6702 mounts in a standard 19-inch relay rack, and is available for panel or wall mounting. It can be used to measure any inputs from thermocouples or transducers, whether they be voltages, frequencies, temperatures, pressures, pH, etc. All change-overs can be simply effected in the field by screwdriver adjustment through the hinged front door which makes all the parts readily accessible, the manufacturer states.

The Daystrom division reports that added features include alarm switches, internal illumination, chart tear-off, high resistance to shock, vibration and corrosion, low spare parts inventory due to interchangeability of parts, and a built-in test

"Flocking Installation BFA 58"

By A Technical Consultant

"What are we talking about FLOCKING?"—one can hear it in all the countries where the textile industry is at home.

We wanted to have this question answered as we can imagine that readers interested in this line have already a concern in the development of the youngest invention of surface refinement.

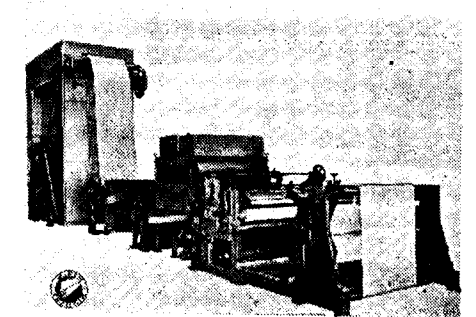
The answer is amazing concordant: One cannot imagine FLOCK PRINTING to be absent when ennobling textile surfaces. Authoritative firms who have still been a little sceptical against introduction of this method are now asking for efficient plants.

The reader experienced in this line partly knows from his own experience how important the use of a really durable adhesive is. Here the development has continued as well and one disposes now of a Dispersion-Adhesive which is not only boil-fast but also immune from chloric and other solvents used at a chemical cleaning on account of its duration.

On account of obtaining an objective and unprejudiced opinion we have contacted a German firm—manufacturers of machinery—. We received the news that they have occupied themselves with the construction of another efficient installation for flocking because of the increasing requirements, although the decision probably has been difficult, regarding the costs of development and research.

Eagerly one has given us exact information which we do not want to withhold from our readers who are generally interested in this line.

This continuously and fully automatically working flock printing installation is constructed as to curve



BREITBAND-BEFLOCKUNGSANLAGE FÜR TEXTIL- UND PVC-MATERIAL z. B.: 1,35 m Arbeitsbreite mit einer regelbaren Beflockungsgeschwindigkeit von 5 - 10 m/min. - vollautomatisch arbeitend, eingerichtet für vollflächige Beflockung oder Dessin-Flock.

the material when passing the different stations. With this arrangement a pleatless conduct is guaranteed. The transportation without strain between the different aggregates is done by means of 5 pneumatic tension tables wherewith an irregular and therefore disadvantageous flocking (formation of clouds) can be avoided. The flocking process itself is done twice in the electrostatic flocking zone while afterwards a mechanical flocking zone at the same time has the function of an effective pre-cleaning. In the drying mansard the material is dried in the spiral system where the flocked side of the material in no case gets into touch with the rollers to turn round. The volume of the mansard is approx. 60 running meters. The mansard is heated with steam, whereby an automatic regulator cares for a constant temperature up to 150° C. It also disposes of a fresh air feed and an air circulation whereby the separating of the solvent steam can be controlled by a throttle valve. A combined working cool-brush—and unwinding device finishes the flocking process.

FLOW AND LEVEL TRANSMITTER

Rate of flow and liquid levels of difficult materials such as jells, slurries, corrosive fluids and suspensions can be checked with a pressure-sensitive transmitter developed by Taylor Instrument Cos., 95 Ames St. Rochester 1. N. Y. U. S. A. The Taylor 205T

Volumetric Differential Pressure Transmitter consists of sensing units that may be mounted inside a conventional chemical tee or on a standard 3-in. flange. The transmitting portion of the level-control system is based on the Taylor 333R Transmitter.

New Type of Sieving & Straining Machinery for Ceramic Industry

RUSSELL Constructions Ltd., the well-known manufacturers of sieving and straining machinery, who pioneered and developed the application of gyratory vibration as the operating principle of this type of machinery, have recently produced a range of models which are particularly suitable for the requirements of the Ceramic industry.

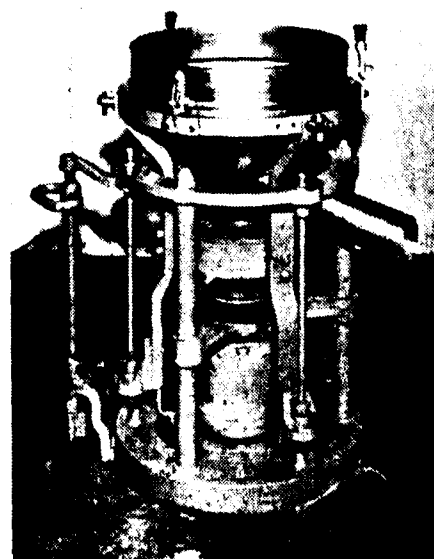
Their Stand Sieving and Straining machine, for example, is used for sieving colouring matter for the removal of oversize particles after grinding. Such substances as oxides, gold etc., can be passed through very fine mesh screens at high speeds and with a total absence of dust. A feature of this compact machine is the ease with which the sieving unit can be dismantled for cleaning, an important consideration when different materials are handled successively.

In the processing of body slip the Russell Separator can deal with throughputs of up to 10 tons per hour through mesh screens ranging from 100 to 140. This machine is virtually automatic in operation in that it provides continuous evacuation of oversize material. This material, having travelled slowly down the full length of the screen is delivered at the outlet in a comparatively dry state.

When sieving alumina, it is essential that the classification of the material should be completely accurate as the presence of any oversize particles in the finished product would produce blemishes after the firing of the ware. A special series of machines for both batch and automatic processing is available for this operation giving extreme accuracy and employing 40-60 mesh stainless steel screens.

A special sieving machine has also been developed by these manufacturers for the processing of tile dust. This material, having a relatively high moisture content, is liable to blind the ordinary sieving machine. The provision of an electrically heated screen in the Russell machine eliminates this difficulty and a very high throughput can be obtained. When passed through a 16 mesh screen the tile dust emerges as a uniform powder which packs well in the subsequent pressing process.

The vibrating unit of the machines described consists of a $\frac{3}{4}$ h.p. totally enclosed electric motor which, coupled to an out-of-balance flywheel, imparts a gyratory motion to the screen in such a manner that while the screen itself does not rotate,



Sieving & Straining machine. Stand model.
Russell Constructions Ltd.

every point in its surface describes a circle of minute diameter in a horizontal plane. This action entirely obviates the clogging and blinding tendency which most materials possess when being passed through machines operating on the shaker screen principle and in addition gives a very high throughput rate.

Russell machine can thus be fitted with screens of reduced dimensions which having a relatively small unsupported area, enable the operator to use textile meshes and to obtain greatly increased sieving efficiency with a long mesh life.

They also operate an advisory service to deal with all sieving and straining problems and provide demonstration facilities at their Head Office for testing the suitability of their equipment with manufacturers' own materials.

Molding Materials for Present and Future Molding Techniques

By R. W. Miler
U. S. A.

THE injection molding industry has for the past few years seen an increase in competition. This trend has caused molders throughout the country to reduce production expenses where possible. Two areas offered the greatest potential to increase the molders profit margin. First, automation to reduce the amount of labour required on each part produced. Second, reduction of material used in the molding process.

The trend toward greater economy has brought about the use and development of hot runner and runnerless molding. This type of molding has altered the moldability requirements of plastic materials. These requirements will vary somewhat with the application, type of equipment used, and the design of the product. The general purpose material of yesterday may not satisfy all of the present needs. Therefore, it is essential to produce a family of materials to satisfy the overall market. This is presently being done. Further material research and development may increase or decrease the number of materials required to satisfy the molding industry.

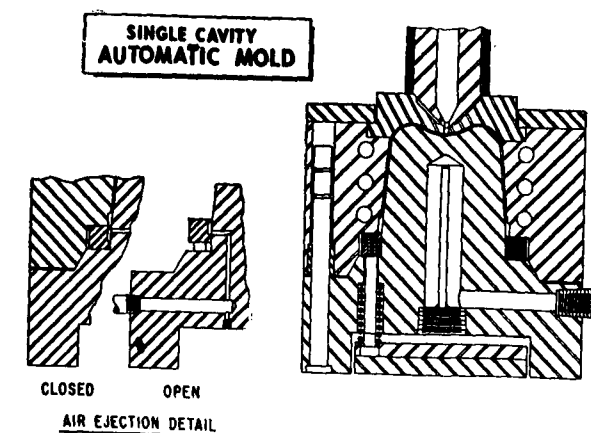


Fig. 1

The successful use of a material in the hot runner, or runnerless molding process is dependent on many factors. Some of these factors are: a wide softening temperature range, a high heat distortion temperature, greater ease of flow under pressure at low temperatures,

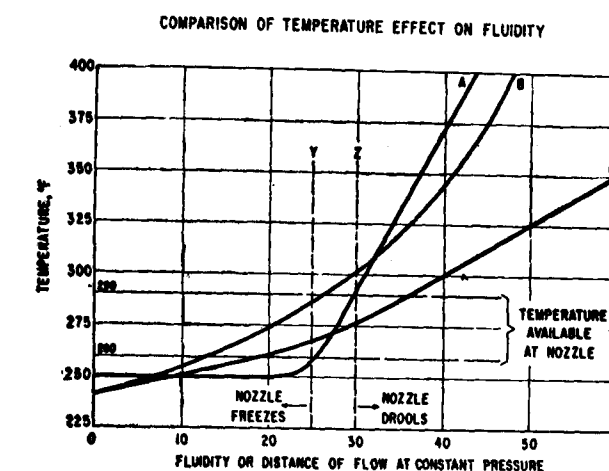


Fig. 2

rapid heat transfer and low specific heat. Unfortunately, no one material satisfies all of these desirable basic needs. Polyethylene has many of these desirable basic characteristics, however, the final physical properties of the application will determine the selection of the material.

The information contained in this discussion has been obtained from data on polystyrene and polyethylene materials. Polystyrene is widely used in the hot runner and runnerless molding process. Polyethylene is becoming more widely used and its performance characteristics are generally considered more suitable for this type of molding. These two materials were, therefore, selected for discussion in this talk. Graphs contained in this paper were taken from data procured in the Plastic Technical Service Laboratory. The trends shown by the curves are believed to be particularly significant to hot runner molding.

The softening temperature range should be wide, to prevent freezing or drooling of the secondary sprue, or nozzle. (Figure 1) In the nozzle or sprue area of the plastic flow system the material must be maintained at a high enough temperature to insure flow occurring when pressure is exerted through the injection cylinder. A material having the desired wide softening

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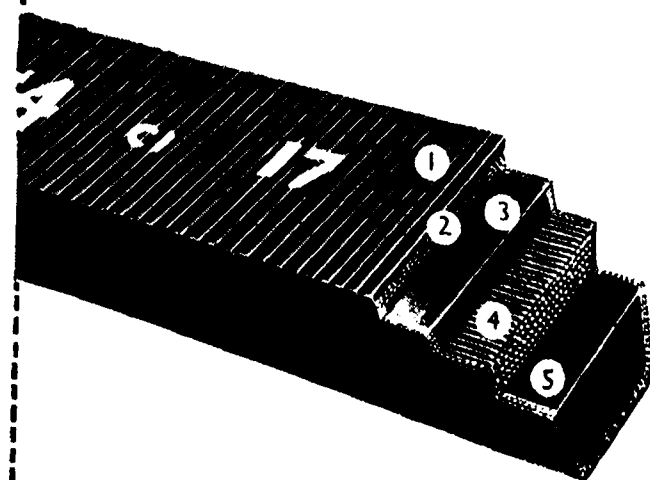


DRAC-52

1 TOPPING RUBBER
seals and protects the
jacket overlap.

2 JACKET of multilayer
rubber impregnated fabric
armours the belt against
surface wear.

3 FILLER RUBBER holds
the cords in correct place,
resists distortion and
cushions the cords against
sudden starting shocks.



4 REINFORCING MEMBER
of high strength rubber
impregnated synthetic textile
cords provides adequate
strength and resistance to
strain and fatigue.

5 BASE RUBBER specially
compounded to resist fric-
tional heat provides an ideal
foundation for the cords
and gives a large gripping
surface on the sides.

temperature range will be fluid enough to flow as pressure is exerted, but will not flow or drool after the pressure is released. This will occur although the temperature in the area of the nozzle or secondary sprue may vary. The degree of accuracy of temperature control required in this area may then be reduced. Nozzle valves have sometimes been used to control occurrence of nozzle drooling or freezing, with materials having a narrow softening temperature range. Their use may not be as necessary when using materials with wide softening temperature ranges.

(Figure II) The curves in Figure II show how typical materials change in fluidity as the plastic temperature increases. The materials shown have approximately the same heat distortion temperature. The material in the nozzle will range in temperature from 260°F. to 290°F. All molding conditions except temperature are held constant. The pressure is to be held at 16,000 psi. The material in the nozzle must have sufficient fluidity to flow under the given pressure, as indicated by the vertical line Y. A material having fluidity greater than 25 but less than 30 will flow under pressure, and does not drool as the pressure is released. If the plastic fluidity is greater than 30, drooling will occur.

The material shown by line A has a wide softening range and becomes very fluid as the temperature is increased from 245°F. to 255°F. The materials' fluidity increases at a much reduced rate above 255°F. Material A will neither freeze nor drool with the nozzle or secondary sprue operating at temperatures from 260°F. to 290°F.

Material B would appear stiff flowing and freeze in the nozzle until the temperature is increased above 290°F. The plastic would drool out of the nozzle if the

temperature is above 300°F. This is a much narrower range of temperature than was required for material A and closer nozzle temperature control would be required.

Material C would also require a narrower nozzle temperature operational range than does material A, because it is more temperature sensitive. With the

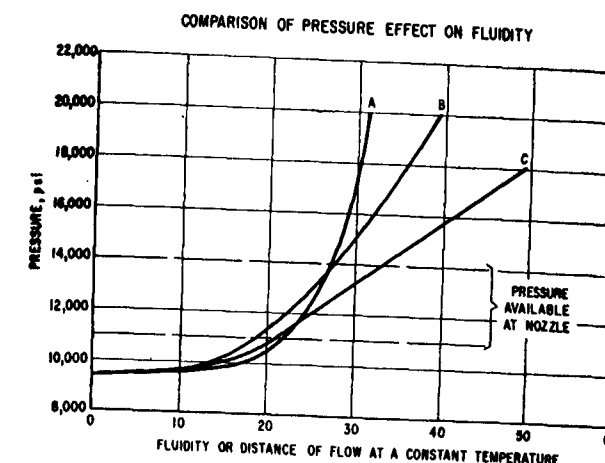


Fig. 4

nozzle varying in temperature within the indicated limits material C could either freeze or drool. The nozzle temperature control range would have to be very accurately controlled to operate from 270°F. to 275°F. to successfully run material C.

Material A should then be the easiest molding because it has less change in fluidity with small temperature changes.

High heat distortion materials often show advantage in hot runner or runnerless molding. Materials having high heat distortion temperatures will usually solidify rapidly. A material being injected into a mold cavity will cause an increase in the mold temperature. The temperature rise will be the greatest in the area around the gate. This is also the area where it is most difficult to place water lines. When a high heat distortion temperature material is used it solidifies at a higher temperature level, thus, the hot spots in the mold will have less tendency to wrinkle or distort. Less cooling time may then be required with these polymers. Therefore, parts may be produced on fast cycles without wrinkling occurring around the gate.

A high heat distortion temperature may prove a disadvantage when thin section, cold molds, and where long flow distances are involved. The material flowing into the mold will solidify rapidly, and may cause

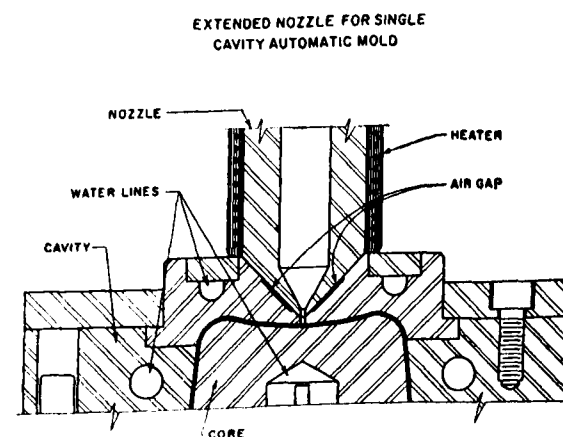


Fig. 3

excessively high pressure requirements and excessive unidirectional orientation. Where possible it would still be advantageous to use materials with high heat distortion temperatures. This may be partially or fully accomplished in practice by zone mold temperature control, (Figure III) and the use of high speed injection.

Pressure sensitive materials are desirable for hot runner or runnerless molding. The materials which flow easier as the pressure is increased will allow the nozzle or secondary sprues to be operated at lower temperatures. The temperature in this area is then closer to the temperature of the mold wall. This will aid in minimizing the wrinkling of the part around the gate, and the possibility of the material freezing in the nozzle, but may cause an increasing tendency for the material to drool.

Some pressure sensitive materials may drool if they are very easy flowing at low pressures. Drooling may occur if the residual pressure in the heating cylinder and the material temperature are both high enough to cause the material to flow. Although this may create difficulty in some cases, reduction of the nozzle, and cylinder temperatures should prevent this cause of drooling.

(Figure IV) The curves in Figure IV show the materials' increase in fluidity as the pressure is raised. They all have approximately the same practical heat distortion temperature. All moulding conditions are held constant except pressure. The cylinder temperature is to be maintained at 350°F., and the nozzle at 275°F. The pressure range available at the nozzle is from 11,000 psi to 14,000 psi.

Material A, B, and C will start to flow at approximately the same pressure, 9500 psi. Material C above this pressure exhibits a greater increase in fluidity than

THERMAL PROPERTIES

	POLYSTYRENE	POLYETHYLENE
SPECIFIC HEAT BT.U./LB./°F. or CAL./GR./°C.	0.32	0.60
THERMAL CONDUCTIVITY RANGE 20°C. to 80°C.	2-3 x 10 ⁻⁴	8-9 x 10 ⁻⁴
RANGE OF CYCLE TIME FOR GIVEN MOLD (SEC.)	24-30	23-30

Fig. 5

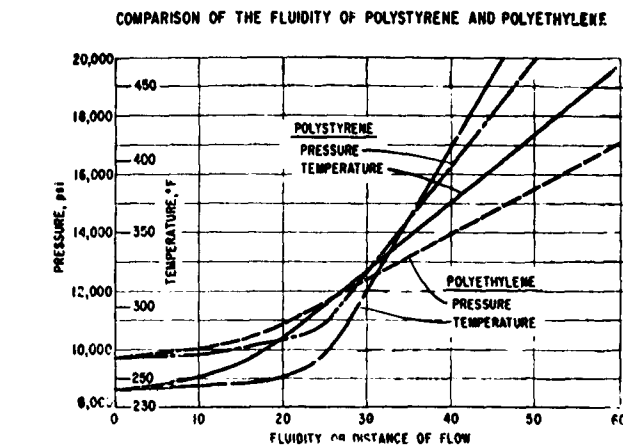


Fig. 6

the other polymers. The nozzle temperatures could then be less for material C than A or B.

In operating the nozzle closer to the mold temperature the possibility of the part wrinkling around the gate area would be minimized. Therefore, a more pressure sensitive material such as C would be preferred in hot runner or runnerless molding.

The thermal properties of a material other than heat distortion will also determine the success of a material in hot runner or runnerless molding. A material having a rapid rate of heat transfer and a low specific heat should perform well in this type of molding. Less wrinkling of the part around the gate should be encountered. Freezing of the material in the nozzle should be minimized as long as the small amount of heat required by the material is made available. Difficulties might be encountered if chilling in the mold is excessively rapid, requiring very high pressures to be used during the molding operation. The use of high speed injection may prevent excessive pressures and/or temperatures being required when a rapid chilling material is being molded. Rapid injection has been used successfully to overcome this difficulty especially when molding very thin section parts or flowing long distances.

A comparison of the specific heats, thermal conductivity and cycle times of polystyrene and polyethylene illustrates how these properties affect the moldability of a material. The specific heat of polystyrene (Figure V) is approximately one-half that of polyethylene. The rate of thermal conductivity of polystyrene is about one-third that of polyethylene. The cycle times shown are about the same for both materials.

Both materials, though they differ in basic thermal properties, can generally be molded within the same range of cycle time. This is mainly due to their differences in sensitivity to pressures and temperatures.

(Figure VI) The fluidity differences between polystyrene and polyethylene are as shown. Polyethylene is less temperature sensitive and more pressure sensitive than polystyrene. The flow properties and the rapid rate of heat transfer which are characteristic of polyethylene make it an excellent prospect for hot runner, and runnerless molding.

Polyethylene is generally considered to be a material which works well in this type of molding operation, and is usually used where the application permits.

Modifications of polystyrene materials to reduce the temperature sensitivity and increase the pressure sensitivity will provide improved performance characteristics for hot runner moldings. This is presently being accomplished by the use of easy flowing polystyrenes.

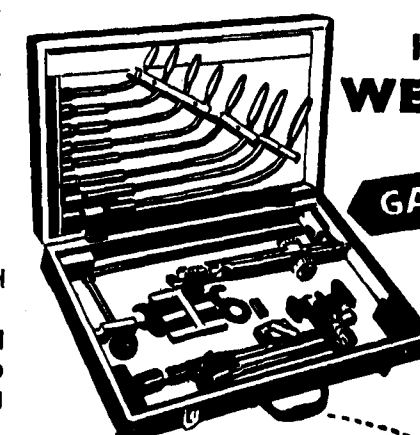
It may be well to conclude that no one material possesses all of the desired characteristics for all moldings. With the broadening of the plastic markets and the introduction of many new materials, the proper selection of a material to fit the specific job at hand will become increasingly complicated.

In trying to select a material for hot runner and runnerless molding the following basic properties might be the best overall combination. First: a material having low temperature sensitivity but which will flow easily at low temperatures. Second: a highly pressure sensitive material which flows easily at low pressures. Third: a material which has a high distortion temperature, thus, permitting quicker ejection from the mold. Fourth: a high rate of thermal conductivity is desirable to remove the heat rapidly from the material. Fifth: a material having a low specific heat, thus, requiring less time to solidify or become fluid.

Further study should afford a more complete understanding of the effect of a materials basic physical properties on the fabrication characteristics, and reduce the present complexity of material selection.

HINDUK

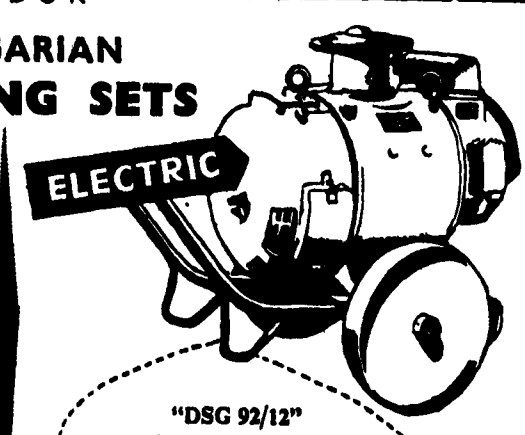
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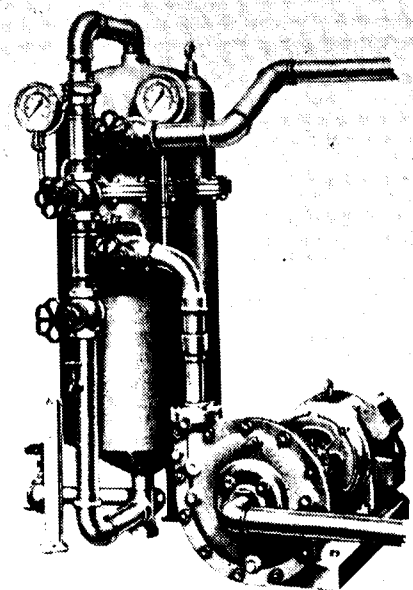
NEW TYPE OF FILTERS— For Chemical & Pharmaceutical Industries

THE Pulsometer Engineering Co., Ltd., have developed a filter for treating large quantities of fluids which, while giving a quicker rate of filtration than the conventional pressure filter, produces better results and occupies a smaller area.

This new filter employs elements coated with diatomaceous powder which will remove even the smallest suspended solids from water and by producing a sparkling clear effluent with an added "polish" greatly reduces the need for chemical treatment. Organisms such as amoebae and algae which are difficult to filter out by conventional methods are efficiently trapped by the filtering medium.

The Pulsometer Diatomaceous filter is very compact in comparison with the pressure sand models; a unit with a diameter of 1 foot for instance, when operating at 100 gallons per square foot of filtering area is equivalent to a sand filter of 4 foot diameter. Thus besides providing an improved performance it effects a considerable saving in capital installation costs and space. Operating costs are reduced to a minimum, as being of simple design and construction, the filter can be serviced by unskilled labour.

The equipment is available in four sizes ranging from a model fitted with nine pairs of elements having a capacity of 1,290 gallons per hour to one fitted with ninety pairs of elements with a capacity of 12,000 gallons per hour. The elements are durable and are resistant to most corrosive fluids.



Diatomaceous Filter Pump.
Pulsometer Engineering Co., Ltd.

Its efficient operation at continuously high rates of flow for long uninterrupted cycles makes it eminently suitable for use in the chemical, petroleum, pharmaceutical and beverage industries. In addition it is applicable to the treatment of municipal water supplies and to clarifying swimming pool water.

Further particulars may be obtained from the manufacturers at Nine Elms Iron Works, Reading.

INDIAN STUDIES ALUMINIUM PRODUCTION IN U. K.

Mr. A. Basu, a development engineer employed by the Aluminium Manufacturing Co. of Calcutta, will have the opportunity of studying all stages in the production of aluminium at the British Aluminium Co., where he is spending a year under the Colombo Plan training scheme.

The British Aluminium Co. makes aluminium sheeting, tubing, and extrusions. Its products are

used in buildings, in the construction of cars, lorries, milk churns, lighthouses, steeples, aircraft, and much else. Mr. Basu will spend some time at the firm's three alumina factories, at its big reduction works in Scotland, and its three rolling mills. Before returning to India he will also be given the opportunity to work at the company's research and experimental laboratories at Gerrard's Cross, Buckinghamshire.

Union Carbide Chemical-Loaded Molecular Sieves Latent Curing Aids in Rubber and Plastics

By a Chemical Engineer

MODERN rubber and plastics fabricators are continually searching for faster curing systems. The use of more active agents to obtain these rapid curing reactions has been restricted because their use generally results in formulations which are difficult to process and store. This problem is especially acute due to the high temperatures reached during the processing of rubber formulations. A novel series of latent curing aids, Union Carbide Chemical-Loaded Molecular Sieves, now makes it possible to use these active compounds to obtain faster, more effective curing systems, while still maintaining processing safety.

Chemical-Loaded Molecular Sieves are a combination of Union Carbide Molecular Sieves and curing aids, which are contained within the pore structure of the Molecular Sieves by strong absorptive forces. The active compounds, when loaded on Molecular Sieves, are effectively isolated from the rubber or resin formulation during the processing and storage steps. However, at curing temperatures, which are generally higher than processing temperatures, the active compound is released from the Molecular Sieve to accelerate the curing reaction.

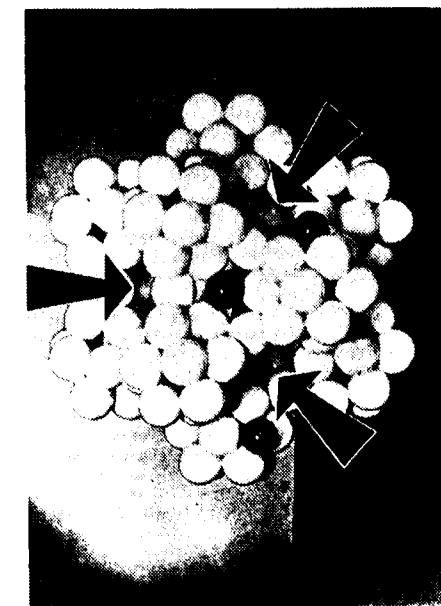
In this way, Loaded Sieves permit the use of highly active compounds to obtain fast cures, without sacrificing processing safety or pot life. Now, even vulcanization agents previously considered too active or volatile for practical use may be used with processing safety.

Chemical-Loaded Molecular Sieves can be used as latent accelerators and curing agents in a variety of rubber and plastics formulations including styrene-butadiene rubber, natural rubber, Neoprene, nitrile rubber, epoxy resins, rigid vinyl plastisols and others. Loaded Sieve CW-2015 (di-tertiary butyl peroxide) is being used commercially in the curing of rigid vinyl plastisols. Loaded Sieves are also being investigated by many processors in the rubber and plastics field, for use in such items as tires, mechanical goods, hose, belting, and footwear. These unique curing aids have aroused considerable interest and enthusiasm among those companies now evaluating them for these uses.

MOLECULAR SIEVES

The unique properties of Molecular Sieves have made this development possible. Molecular Sieves, a class of absorbents, are man-made crystalline aluminosilicate materials, chemically similar to many natural clays and feldspars and belonging to a class of minerals known as zeolites. The outstanding characteristic of these zeolite materials is their ability to undergo dehydration with little or no change in their crystal structure. The dehydrated crystals are interlaced with regularly spaced channels of molecular dimensions. This network of uniform pores comprise almost 50 per cent of the total volume of crystals.

The empty cavities in activated Molecular Sieve crystals have a strong tendency to recapture the water molecules that have been driven off. This tendency is so strong that if no water is present they will accept any material that can get into the cavity. However, only those molecules that are small enough to pass through the pores of the crystal can enter the cavities and be absorbed on the interior surface. Various types of Molecular Sieves are available to



absorb both large and small compounds. This sieving or screening action, which gives rise to the name Molecular Sieves, is only one of the unusual characteristics of these materials.

ABSORPTION OF POLAR MOLECULES

Molecular Sieves have a high affinity for polar molecules and will absorb them in preference to non-polar compounds. Generally speaking, the more polar the molecule, the stronger it is held within the crystal. These polar molecules are contained and can only be released from the Molecular Sieve by the application of heat or by displacement with a more strongly absorbed material, such as water.

Those materials which are used in the rapid curing of rubber and resins are generally very polar compounds. Therefore, the ability of Molecular Sieves to absorb these molecules, contain them within its pore system, and then release them when heat is applied, has led directly to the development of Chemical-Loaded Molecular Sieves as latent curing agents in rubber and plastics.

NEW VEHICLE SPEEDS CEMENT DELIVERIES

A new multi-purpose vehicle capable of carrying cement and other similar materials under a variety of conditions has been devised. It is capable of delivery in bulk where blown discharge is required either for elevation to a silo or discharge to a point some distance from the vehicle, of delivery in bulk where gravity discharge is required, of delivery in bags, or of any normal tipping work such as the cartage of sand, ballast or coal.

This British vehicle, basically a tipper, is provided with an entirely new type of detachable bulk container which can be removed quickly and easily whenever conversion to normal tipper usage is desired. The new vehicle is intended to permit the rapid conversion of a tipper from bulk to bagged carriage form and its "blowing" equipment enables bulk materials to be discharged rapidly to heights of up to 60 ft.

The bulk container, which can be lowered into position on a standard tipping body or tipping platform, is held in place by a system of male and female transacted pyramids secured by means of quick release pins. These take up all lateral and longitudinal movement.

The cement-carrying capacity of the container is eight tons, all of which, under normal conditions,

A large number of different compounds, including amines and peroxides, have been loaded on Molecular Sieves, and evaluated as latent curing aids in rubber and plastics. The products listed below are now available in commercial quantities. Other materials are being studied, and undoubtedly, new products will be added to this list in the near future.

Latent Secondary Accelerators

- Loaded Sieve CW-1015— Piperidine
- Loaded Sieve CW-1115— Di-n-butylamine

Latent Neoprene Accelerators

- Loaded Sieve CW-3010— Catechol
- Loaded Sieve CW-3120— Diethyl Thiourea

Latent Curing Aids in Rubber and Plastics

- Loaded Sieve CW-2015— Di-tertiary butyl peroxide

can be discharged into a silo 60 ft. above the ground in approximately 20 minutes. The containers can be of either light alloy or mild steel construction.

Designed by Bonallack and Sons, Ltd., of Basildon, Essex, England in collaboration with The Ketton Portland Cement Company Ltd.

* * *

INDIAN STEELWORKS TRAINEE COMPLETES U.K. STUDY

On his way home to India after spending 13 months studying the maintenance of open-hearth furnaces at steelworks in Scotland and England is 29-year-old Sant Kumar Govil, of Dankaur, Bulandshahr, U. P. He is due in Bombay on December 19.

Mr. Govil, who arrived in the United Kingdom on November 1, 1957, and whose training was provided under the Colombo Plan, went first to the Scottish firm of Colvilles in Lanarkshire, moving last February to Stewarts & Lloyds' works at Bilston, Staffordshire. On his return to India he will work for Hindustan Steel (Private) Ltd., whose works are at present under construction.

* * *

AUSTRALIAN TECHNOLOGICAL ITEMS

By Charles Lynch
Canberra, Australia

ELECTRONIC DEVICE FOR ASSESSING URANIUM ORE

AN electronic device, known as an ore grade discriminator, is an unusual piece of equipment at Australia's uranium mine at Mary Kathleen, in Queensland. Located between the mine and the acid treatment plant, the device assists in the bulk sorting of the uranium ore supplies.

The device is housed in an archway type of framework 16 ft. high, and consists of six geiger tubes. Trucks containing ore from the mine pass under the arch on their way to the treatment plant. Gamma rays from the radium content of the ore react on the Geiger tubes which feed a "count" into a junction box, and in turn to a ratemeter. In a matter of only two seconds the ratemeter converts the total gamma ray count of the truck load into an equivalent uranium oxide percentage. The truck is then directed to the appropriate stockpile of ore, depending on its grade. The device is operated by only one man.

It was invented by Mr. R. Sterrett, a Tasmanian geophysicist, in conjunction with Mary Kathleen Uranium Ltd.'s chief geologist, Mr. F. Hughes.

GERMAN PROCESS FOR WOOD PULP MOULDINGS IN AUSTRALIA

The Fibrat process of the Deutsche Fibrat Gesellschaft Company, of Germany, which enables manufacture of products from wood pulp, is to be exploited in Australia by Australian Paper Manufacturers Ltd.

The technique enables manufacture of units for automobiles, television sets, radios, cases for typewriters and film projectors, and similar articles.

These mouldings are usually covered with a plastic material to make an attractive finish. Their manufacture will bring the Australian wood pulp industry to new markets.

The company to exploit the process will have a nominal capital of £A 100,000, and will be wholly owned by Australian Paper Manufacturers Ltd. A

new factory is to be established at Fairfield, a Melbourne suburb, for the project.

STEEL BONDED TO PLYWOOD FOR REFRIGERATED RAIL CARS

A problem encountered by an Australian company, Commonwealth Engineering (Queensland) Pty. Ltd., in construction of 100 refrigerator cars for the New Zealand Railways was solved when a way was found to bond stainless steel with plywood.

New Zealand health regulations prohibit the use of any material containing zinc or lead where contact can be made with food.

Stainless steel in heavy gauge would have been self-supporting in installation, but its high cost rendered it uneconomical. It was therefore decided to use a veneer of the steel for the interior panels. These were made of marine-bonded, hardwood-faced plywood which was given a stainless steel face. The reverse side of the panels was then covered with galvanised iron. In both cases the metals were resin-bonded to the plywood.

The contractors also made use of plywood for the floors, ceiling and interior door panels of the refrigerator cars.

PARQUETRY FLOORING FOR THE HANDYMAN

Parquetry flooring has now been introduced into the home handyman's range of "do-it-yourself" activities in Australia.

A new type of wood parquetry called the Met-Foil Mosaic Parket Flooring introduced into New South Wales by George Hudson Pty. Ltd., of Sydney, combines the quality of economy, hard wear, and ease of laying with the traditional beauty of parquetry.

Panels 18 inches square made up of 80 small blocks are fixed to a perforated aluminium foil backing in the design. The panels are simply applied to the sub-floor with adhesive, and when laid achieve the usual parquetry effect.

New Network Analyser in use at Witton Works

By A Technical Correspondent

First of its type in World

THE first full-sized network analyser of its type in the world has recently been completed at the Witton Works, Birmingham, of The General Electric Co., Ltd. It differs in basic principle from all earlier large commercial analysers in that it operates on the transformer analogue principle as distinct from the more usual miniature component type of model network assembly used on the more conventional analysers. It can cover a far wider range of problems than the conventional analyser, since for many intricate system and machine design problems, the conventional analyser is not readily



A general view of the Witton network analyser.

capable of simulating the required type of physical component. In addition the transformer analogue analyser has a very high inherent accuracy of 0.1 per cent., and can readily simulate such items as "pure" inductance or capacitance with zero resistive component.

WINA, as the Witton Network Analyser has been named, has a total of 208 universal units, all of which are capable of simulating any type of positive or negative complex impedance, admittance, current or voltage injection quantity, or purely complex quantities in equations. Two units can also be switched together to represent a complex symmetrical or asymmetrical mutual or transformer coupling. This enormous versatility enables the analyser to deal with the most complex type of electrical or mathematical network problem; which is of particular

importance in the solving of intricate mechanical and thermodynamic problems by equivalent networks.

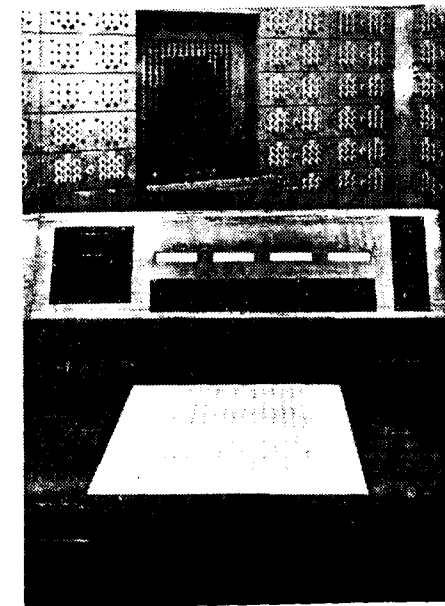
It was in 1937 that Mr. C. L. Blackburn, BA, MIEE, of the firm of Consulting Engineers, Merz and McLellan, first showed how two transformers with three windings on each could be used to assimilate complex quantities, and a small analyser was constructed on these lines at Newcastle in the same year. Some time later a second small analyser was built at the Imperial College of Science from a design by Sir Humphrey Davy.

An outstanding feature of the design of "WINA" is the centralized plug-board which enables the direct representation of power system studies. Additional plugging facilities enable full advantage to be taken of the analyser's versatility. The design provides facilities for the automatic checking of interconnecting and metering, and incorporates a metering system with a digital type of display. Facilities are also available for the direct printing of results.

CONSTRUCTION

The analyser is built in four individual sections, each section consisting of a central plug-board with 52 standard analyser units arranged in racks on either side. All 52 units in one section are connected to their plug-board by jumper leads so that the units can be connected together in any way desired. Front sockets are also included in the individual units so that interconnections can alternatively be made here, or a combination of plug-board plugging and front plugging can be used for special problems. The arrangement of four similar units enables four separate small studies to run in parallel. The plug-boards, however, can be inter-connected so that a large problem can be continued from one board to the other.

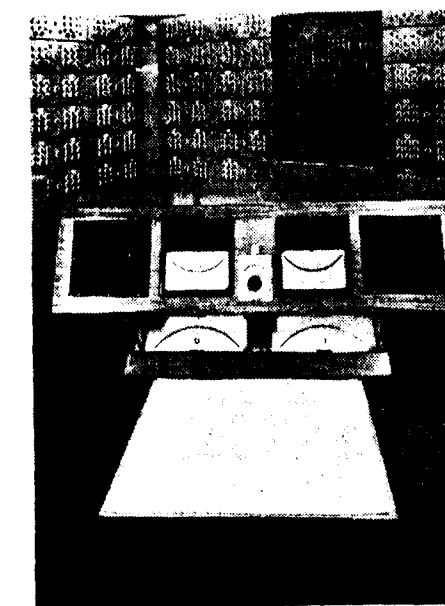
The most formidable task in the construction of the analyser was the great amount of interconnecting and complex switching that was required. Each analyser unit contains nine multi-position, multi-wafered switches, which, together with the compensat-



The bridge metering section of the control desk.

ing circuits and terminal sockets, resulted in a total of 700 soldered joints for each unit. Thus for the 208 units alone there were some 145,600 soldered joints. In addition the interconnecting plugs and plug-board metering selection plugs and general interconnecting leads to the control desk resulted in a further 50,000 soldered joints.

To facilitate wiring, use was made of a special bonded strip of ten different-coloured plastic covered wires. This has been used for all the leads to the



The direct metering section of the control desk

plug-boards, and the strips have been grouped together and run inside Bakelite tubes for neatness and to keep electrical interference down to a minimum. Control and indicating leads are run in standard 61-core telephone-type multicore cable, and the metering leads are channelled in separate screened cables.

The wooden control desk has been specially designed to accommodate all control facilities, recording instruments and metering arrangements to the maximum advantage. Carefully designed interlock and monitoring facilities are built into the desk to obviate the possibility of metering or recording errors. Particular care has been taken to group all continuous controls and meters within easy access of the operator, and to provide him with a clear view of the complete analyser. These features play an important part in minimizing operational fatigue when extensive system studies are being conducted.

TRANSFORMER COMPENSATING CIRCUITS

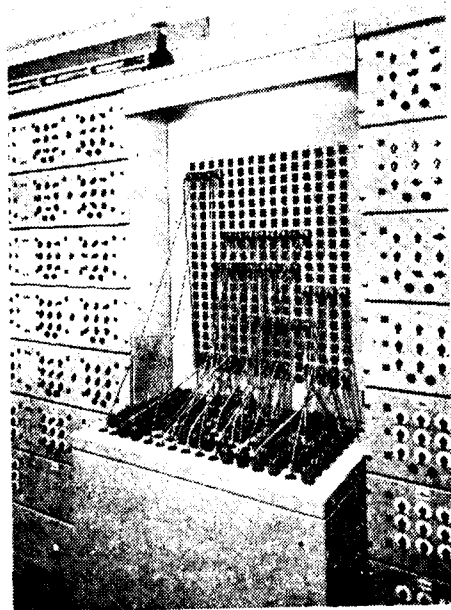
The ultimate accuracy of the analyser depends upon the degree to which the apparent magnetizing currents of the transformers can be reduced. An electronic circuit is incorporated for this purpose which continuously monitors the volts-per-turn on the transformer and injects into a special compensating winding the required magnetizing ampere-turns. The overall result is that the currents flowing in the actual transformer analogue network are reduced to a very small value. The electronic circuit is built on a printed circuit to give simple access, neatness and maximum reliability.

Two types of metering are employed.

Direct Metering: This equipment directly transforms the analogue voltages picked up from the analyser into the normal power system quantities of volts, amps, watts and vars. This is done by electronic computing and amplifying stages feeding four high-quality meters scaled directly in "per unit" quantities. A wide range of scales from 0.1 to 31.6 per unit on the $\sqrt{10}$ principle are available for the ammeter and voltmeter. The range of the wattmeter and var-meter is the product of these two, and is automatically computed and shown on an illuminated number display unit.

Self-balancing bridge metering: This equipment consists of four independent self-balancing bridge units metering the two cartesian co-ordinates of the

voltage and current at the required point, and gives an illuminated in-line number display of the results. These meters consist basically of automatically tapped reference transformers which run until their output voltages exactly balance the input voltages being metered. An electronic error-detector measures the unbalance voltage and send the required signal to the three switches which automatically tap the reference transformer. The average time for a balance is approximately two seconds and the equipment gives an accuracy of 0.1 per cent. or 0.001 per unit of base.



Close-up of the central plug-board.

CONTROL AND MONITORING

The control desk is arranged in two halves which house the direct metering and bridge metering respectively. Control switches make it possible to couple any of the four plug-boards to either metering system. Unit selection buttons are associated with

the units so that any unit can be metered. When metering a unit it is possible to select the voltage from either end of the unit to neutral, or the voltage across the unit.

Each half of the control desk has an illuminated plotting table which has a small square corresponding to each socket of the plug-board, and recording sheets are prepared to fit over these plotting tables. When a unit is selected for metering the square involved on the plotting table is illuminated, and the readings can be directly recorded in the correct place on the covering recording sheet.

For general circuit analysis any size of steady state R. L. C. circuit calculation can be very quickly solved up to a maximum of 208 complex impedance units. In general equation workings, any expected order of polynomial with real or complex roots, or large tedious equations needing repeated solutions can in general be accommodated. Solutions of 14×14 complex or 20×20 non-complex matrices are possible. A matrix inversion can be very quickly obtained. The steady state and stability behaviour of any large power system can be fully studied.

In the use of rotating machine design general machine equivalent circuits or the direct and quadrature axis equations can be used. Equivalent circuits can be arranged to allow the physical picture of the machine to be retained and to provide direct adjustment of any required machine parameter. The machine circuit can always be directly coupled to any external circuit to provide a general combined study. On closed-loop control systems frequency response curves can be obtained to determine the stability of the system. For non-electrical analogue problems any problem that can be represented by steady-state equations or circuits can be solved.

(Courtesy: "THE CONSULTING ENGINEER")

MANUFACTURE OF TRACTORS

The Minister for commerce and Industry, Mr. Lal Bahadur Sastri, told the Rajya Sabha that a scheme for the manufacture of bulldozer and scraper attachments had been licensed. The factory would be located in Bombay State. These attachments would be suitable for more than one make of tractors.

In a written reply to a question by Mr. N. S. Chauhan, Mr. Shastri said that approval was likely to be given, in addition, for the manufacture of spare parts of the "caterpillar" units which were already in the country. This unit would be set up in Calcutta. Another firm was likely to be licensed for the manufacture at Madras of "Allis Chalmers" tractors and other attachments.

The licences for all these schemes had been applied for by private parties, Mr. Shastri added. These schemes were in addition to the scheme of the ordnance factories.

New Concrete Hardening Material for Heavy Industrial Use

By F. D. Brownlie

THE importance of maintaining concrete flooring in a really hard condition cannot be too strongly emphasized. This is particularly the case where handling equipment having steel wheels is in use and also where products are being handled which are susceptible to the effects of dust.

A new concrete hardening material is now available which produces a surface which is non-slip and practically unwearable even with the heaviest industrial use. Produced by J. H. Sankey & Sons Ltd., the well-known building material specialists and known as "Emerytop", it is applied when the concrete is being laid which means a considerable saving in time. The fact that a screed is not required also effects a certain amount of economy.

After the concrete has been consolidated, trowed to level and the surface closed with a steel trowel, "Emerytop" is sprinkled at the rate of $4\frac{1}{2}$ lbs. per square yard. A steel float is then used to bring the moisture up through the material. Immediately after, a further application is made also at the rate of $4\frac{1}{2}$ lbs. per square yard and the moisture is again brought up

by means of the steel float. This surface is then smoothed off with a trowel. A final trowelling is given in order to obtain a hard and dense finish.

An important advantage which is gained from the use of this floor surfacing compound is that as it will only produce a smooth finely graded even finish on a low water ratio mix of the type which results in good quality concrete, the architect or engineer in charge can verify whether his instructions in respect of the concrete mix have been adhered to. If the material should be laid on a wet sloppy mix of the type that results in weak friable concrete, the rough uneven finish which the "Emerytop" will assume will betray this fact.

The compound is available in various colours. If an oil resistant floor should additionally be required this can be obtained by the subsequent application of "Sealtop" produced by the same manufacturers. With several applications of this latter finish the floor can be given a hard glassy surface $\frac{1}{8}$ " thick which is impervious to all except the most active oils and greases.

CLARKSON CARD FORMER

A machine that produces nylon tire cord from the manufacturer's beam in one operation has been developed by U. Rubber Co. at its Winnsboro S. C. plant. The machine produces a package of two-ply yarn weighing up to 40 lbs. that is ready for the loom creels. It is designed primarily for making nylon tire cord but can be used to make rayon tire cord as well. A wrapping action rather than actual twisting is used to produce the plied yarn.

The yarns from the supply beam are led into the cord former through a suitable tension device. Half of the ends are put through metering rolls and are led to an eye mounted at the edge of a rapidly rotating disk. Within the balloon formed by this yarn, another package of yarn is mounted. The free end of this package is fed through metering rolls and joined

to the end being fed from the beam. The ends pass through a hollow spindle in which the wrapping action takes place and are delivered to the creel package.

The other half of the ends from the beam are led to the top of the machine, where they are wound into packages that will be used to replace the package mounted on the hollow spindle.

The clarkson cord former produces a tire cord in which stresses in each ply are exactly balanced. U. S. Rubber Co. holds a patent on the machine and plans to license it for use by other manufacturers. Its own production installation of 1,120 spindles will probably be at its Shelbyville, Tenn. plant early in 1959.

New "MFS" Temperature Controller designed by Loewy

By Our Overseas Correspondent

A new mercury-actuated industrial temperature controller with a number of unique features and a modern design styling by Raymond Loewy Associates was introduced recently by the Partlow Corporation.

Designed to control temperatures to an accuracy of one-half percent of scale range over the extreme temperature application of -30 to 1100 degrees, the new instrument was tailor-made for the industrial heat process and food process markets, the company said.

Company officials predicted the control would, "set a new standard for the industry." It is the first time that the consumer styling for which the Loewy organization has become famous, has been applied to an industrial temperature control.

The result is a case made of attractive, gray, reinforced polyester plastic with a unique flange design.

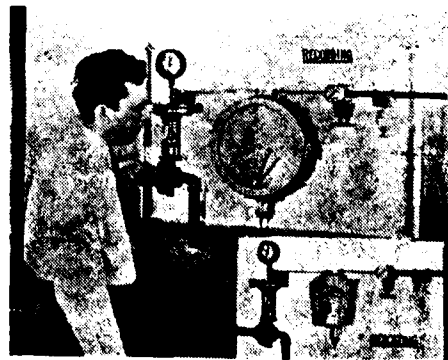


This design permits the instrument to be easily either flush or wall mounted just as it is shipped from the factory without additional hardware, or mounting brackets.

The case features a camera-type moisture seal which also makes it dust free. For greatly improved near and far readability and setting, the instrument incorporates an "Accu-vision" dial, features of which include optically contrasting color combination of the calibrations, pointer and background; a magnified setting pointer, hairlines for parallax sighting, and a much larger-than-normal dial area.

PARTLOW NEW PNEUMATIC INDICATING & RECORDING CONTROLS

The Partlow Corp. has introduced a new low-cost pneumatic recording controller and a pneumatic



indicating temperature controller. Both the recording and the indicating controls feature a readily adjustable throttling range of 3 to 20 per cent. Both controls also utilize an interchangeable mercury thermal element as the sensing medium.

The *recording* control, shown above in a typical application hook-up, is designed to utilize a 15 pound air line to actuate an air-operated device. It is available in any of 10 optional temperature ranges within the extremes of -30 to 1100 degrees F (-35 to 600 degrees C). The control has a built-in, fail-safe provision in its design. It features a 10-inch circular chart either electric or spring driven for 24 or 48-hour or 7-day periods. One of the features is a readily adjustable throttling range, 3-20%.

The *indicating* control, shown above in insert, is designed primarily for general industrial uses. Like the recorder, the indicating control, utilizes an inter-

(Continued on page M.S.23)

MODERN EQUIPMENT FOR CEMENT MAKING

By an Engineering Correspondent

FOR decades VEB Maschinenfabrik Polysius, Dessau (German Democratic Republic), has been leading in the planning and manufacture of complete cement mills on technically modern and economical lines. Alongside complete installations, the manufacturing programme of this factory also includes all kinds of single machines and apparatus for cement making such as breakers, decanting machines, rotary dryers, rotary kilns with cooling cylinders, solo rotary kilns with attached cooling zone or tubular radiator, Lepol rotary kilns, ball and tube mills, multi-chamber solo mills with different kinds of drives, air flow mills, kiln mills, wind sifters, dust collection plant, conveying plant of all kinds and modern packing and weighing installations. By combining kiln and cooling cylinder in one cylinder the rotary kiln has been further developed into a solo rotary kiln with a daily output of 600 tons. The combination mills feature rough and fine grinding processes in a single machine. The chief advantage of the Lepol kiln lies in a maximum

utilization of heat fed into the kiln in form of coal, oil or gas which is greatly superior to any other system of kilns so that, for example, for burning high-grade portland cement an amount of heat of 335,000, 400,000 BTU is required for 1 ton of clinker. In the course of this process the entire heat supplied by the furnace is utilized by the most intensive use of the heat of exhaust gases, by reducing the loss due to radiation and by the most effective transfer of the heat of the outgoing product to the furnace air within the kiln system. In addition to that all combinations complicating the sequence of operations such as coupling of kiln and waste-heat boiler or kiln and raw materials dryer have been avoided. The construction of all plant, which are electro-automatically controlled, has reached a high standard of development and is meeting all demands with regard to maximum safety of operation and greatest simplicity of attendance by operators needing only short training. The attendance staff for each shift is made up of one person each on the burner platform and at the nodulating pan.

X-RAY EQUIPMENT

The Government of India has approved three schemes in the large-scale sector and one in the small-scale sector for the setting up of factories to manufacture X-ray equipment in the country subject to the approval of the terms of their foreign collaboration. Giving this information to Mr. Nawab Singh Chauhan in the Rajya Sabha, Mr. Manubhai Shah, Minister of Industry, said that no foreign participation in the capital was envisaged in any of the schemes and in the case of one firm in the large-scale sector foreign collaboration was also not involved. The foreign collaboration terms in the other schemes were under examination. The factories in the large-scale sector would be located in Bombay, Calcutta and Delhi or Faridabad or Patiala. The factory in the small-scale sector would be located in Bombay. The capacity of the factories in the large-scale would be Rs. 30 lakhs worth of equipment per annum. Answering supplementaries, Mr. Shah assured the House that hospitals would not suffer for want of X-ray films.

(Continued from page M.S. 22)

changeable mercury thermal element as the sensing medium. The mechanism, by throttling the pressure in a 15-pound air line, positions an air-operated steam valve or other air-operated device. The control has a wide, high-visibility scale for both the setting and

indicating pointer. Setting adjustment is made by turning a knob on the outside of the case.

Accessories for both control instruments are available.

New Murex Powder Fluxes for Submerged Arc Welding

UNDER the generic name of "Muraflux", Murex Welding Processes Ltd., Waltham Cross, Herts., are producing a group of new powder fluxes for submerged arc welding. "Muraflux A" is the first of these new fluxes, and it has been specially developed to meet the need for a high-quality general-purpose flux for the submerged-arc welding of mild steel. It can be used on either A. C. or D. C. supplies with welding currents up to 900 amp. and on all machines suitable for submerged-arc welding.

The flux may be employed with a mild-steel filler wire containing approximately 2% manganese or with a normal mild-steel wire. Both types of wire, known as "Murawire W1" and "Murawire W2" respectively, can be supplied by Murex Welding Processes Ltd. When used with "Murawire", "Muraflux A"

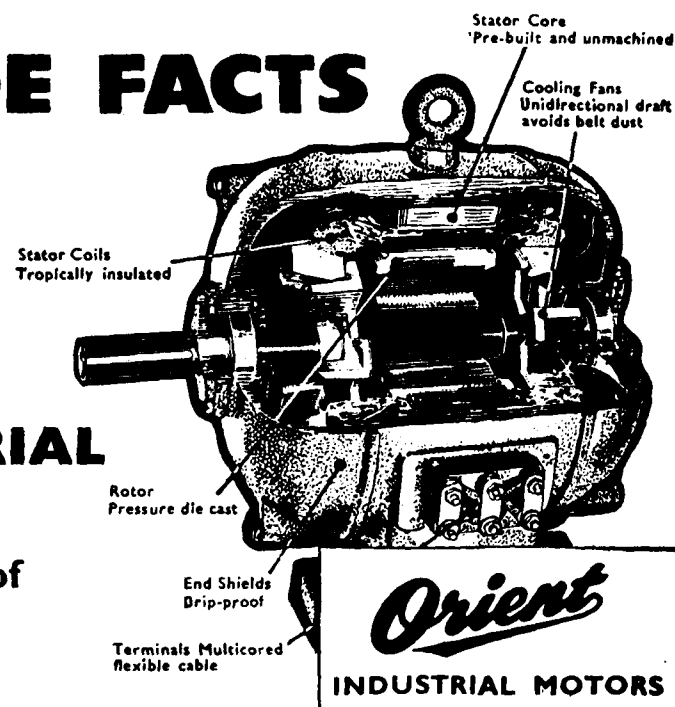
produces good-quality welds of a high radiographic standard, and it can be employed for Class I work. In conjunction with "Murawire" the flux has been granted approval by Lloyd's Register of Shipping and is accepted by the Ministry of Transport.

"Muraflux A" is suitable for either the single-pass or multi-pass welding of various joints in mild steel, as well as plug welds and the building up of worn mild steel parts. Good penetration can be obtained, and unfused flux can be recovered and used again.

These wires and fluxes are part of a complete service on automatic arc welding available from Murex Welding Processes Ltd. Equipment includes the "Muramatio" welding head, deckwelders, booms, manipulators, power packs, etc.

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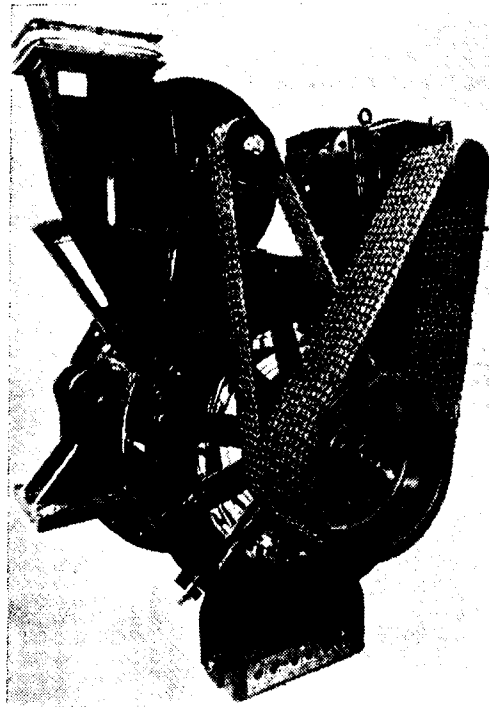
A New Firm for the Manufacture of V-Link Belts

IN collaboration with Messrs. H. Brammer & Co. Ltd., of Leeds, England, well-known makers of belts, a new factory BRAMMER V-LINK BELTING INDIA PRIVATE LTD., will go into production in Bombay early next year.

The Bombay Works will be equipped with British machineries and the Brammer personnel will instal these machineries and train the Indian workers to operate the factory.

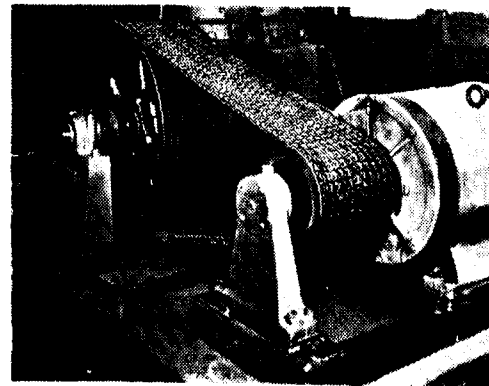
Belts manufactured in India with the English technical know-how and in conformity with all the standard specifications, will maintain the quality and the standard of the British manufacture.

Some technical details about Brammer Detachable Vee Link Belt will be quite interesting to many of our readers.



BRAMMER V-LINK BELTING was the first detachable link vee belting to be made in the World under British and foreign patents. This unique form of drive has many points in its favour as against the endless type of belts. One of the most important of these is its detachability, which allows the installation of the belt without the dismantling of bearings,

(Continued on page M.S.27)



withdrawing shafts and other similar time wasting operations.

It often happens that it is difficult or very costly to provide adjustment such as slide rails in certain drives. The detachable link belt overcomes this as it also makes unnecessary the use of jockey pulleys or other tensioning devices on fixed centre drives. Adjustment is a simple matter. The necessary number of links are added or removed as required without tools and in a very short time.

As the detachable link belt is not confined to standard lengths, it is not necessary to stock long lengths of belting. A stock coil of this belting will cover all needs, as any length can be quickly detached. Left-over short lengths can be added to another coil of the same section, with no waste either of material or time. Thus, five coils of Brammer will replace 300 sizes of endless belts—a big saving.

The unique construction, giving an unusual flexibility, permits the use of small pulleys without excessive bending stresses. The belt does not become distorted when flexed, as the links slide upon each other, maintaining the correct wedging action without the alteration of the groove angle on minimum pulleys.

In order to remove dormant elasticity arising from the extra shock-absorbing capacity of the belt, it is necessary that a new belt should be installed under considerably more initial tension than is employed for ordinary solid endless vee belts. They should be 7% short of the exact length measurement on average belt speeds and 8% short on extremely high speed drives. This percentage allowance is, of course, easily affected

German Industries Fair HANNOVER 1959"

(26th April, 59 to 5th May, 1959)

HANNOVER is a buyers' Fair open to all the world. Here can be found a complete range of not only producer's and investment goods but also of exportable consumer's goods complete in respect of all branches of industry, as shown by the 4300 exhibitors, of which more than 600 come from outside Germany. This year by year increasing participation of foreign firms has raised Hannover to a European market centre for trade with overseas countries.

Because of the strict division into trade groups within the industries exhibiting, Hannover has become virtually a concentration of Trade Fairs, each a complement to the others, within a limited area and period. This concentration makes it easy for every buyer in the shortest possible time to gain an impression of the technical progress and new developments within each of the exhibiting groups.

With its 270 000 sq. metres of enclosed hall space and 140 000 sq. metres of open exhibition ground Hannover now occupies a leading position—for size—among European Trade Fairs. For the industrial groups Mechanical Engineering, Electrical Engineering, Precision Mechanics and Optics, Iron and Steel, Tools, the entire Office Equipment industry and for the groups of consumer's goods China, Ceramics, Glassware, Jewellery and Silverware, Clocks and Watches, Electric Lamps, Radio, Television and Sound Recording Devices, as well as Electrical Household Appliances, Hannover has already for some years been the chief trading centre.

The world-wide importance of the exhibiting firms and their products matches the standing and the numbers of the visiting buyers who in their thousands

come from all parts of the world to Hannover, here to meet directly with the manufacturers and plan their business for years ahead.



A view of German Industries Fair.



Another View of The German Industries Fair.

In 1959 also the special exhibition "Aeronautic Instruments, Equipment and Accessories" will be held at the Hannover airport within the framework of the German Industries Fair.

There is probably no Trade Fair on the Continent

(Continued from page M.S.26)

by removing the requisite number of links. The belt will assume normal driving tension after a few minutes running under load.

The detachable vee link belt may be operated in either direction of rotation. On multiple drives it is essential, however, to ensure that all the link heads are arranged to point in the same direction.

The link belt is in considerable use on a great variety of drives. It is fitted as standard on a number of machine tools and used on heavy machinery and power plant drives. The textile industries have been quick to see its advantages and use it in large quantities on all types of textile machinery. The smaller sizes are in use in the clothing industry, on power operated sewing machines.

which has so pronounced an international bias. Owing to its location and function Hannover year by year continues to gain in importance particularly as a point of trading contact between West and East.

Visit the Hannover Fair—the true trading and business centre for definite commercial transactions.

GROUPS OF EXHIBITORS AT THE GERMAN INDUSTRIES FAIR HANNOVER 1959

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ELECTRICAL ENGINEERING—

All fields of Electricity production and Conversion, Distribution and Application of Electric Power including Electronics.

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Crystals and Semiconductors . Special Valves . Light Current Engineering Fittings . Aerials . Signals Engineering . Transmitter-, Receiver-, Navigational-, Locating-, Radio-, Beacon and Voice Radio Equipments . Radio and Television Instruments . Electro Acoustics . Sound Recording and Reproduction Instruments . Gramophone Records . Electro-Medical Equipment . Electric Carbons . Electric Insulating Materials . Galvano-Technique . Electro-Physical Instruments . Electric Vehicles and Equipment . Electric Aeronautical Equipment . Marine Electrical Engineering . Overhead and Conductor Lines . Cinema and Stage Electric Devices . Winding Machines for Cables . Spool Winding Machines . Various Electrotechnical Specialities.

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Special Exhibition of Industrial Designing

The special show of “**Aeronautic Instruments, Equipment and Accessories**” of German origin will be held at the HANNOVER AIRPORT within the framework of the German Industries Fair 1959.

Hadfields Contribution to Mining Industry

By A Special Correspondent

TRADITIONAL Sheffield skill, coupled with modern production methods has established a permanent reputation in all fields of Industry for the manufacture of best quality materials and equipment produced from the finest Steels.

In the Hadfields organisation continuous highly skilled supervision is exercised on the production lines which, coupled to the vast experience collated over a period of 75 years, ensures a reliable and continuous service to Industry. Hadfields are one of the pioneer organisations who have long enjoyed an established international reputation as leading manufacturers in the supply of High quality Special Steels, and as Engineers.

The Hadfields Foundry where Castings of all shapes, sizes and qualities are continuously being produced,

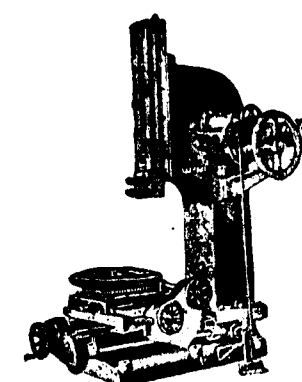
is classed as one of the largest in the World where unparalleled attention is focussed on quality in accordance to customers requirements. Over 130 different qualities of Steel are produced annually, and whatever the designer's aim may be, his request can be accommodated.

Among the many prominent Industries with which Hadfields have been long associated is the Mining Industry to which Hadfields supply Crushers of all sizes, and the World famous ESCO tapered side all welded dragline Buckets ranging from $\frac{1}{4}$ cubic yard to 22 cubic yard capacity. Dipper Buckets and Dredger Buckets are also supplied in quantities to Countries the World over for Mining and earth moving work. Colliery safety appliances and Castings in special Steels are supplied for under-ground work, and in all cases each product is tested and re-tested on

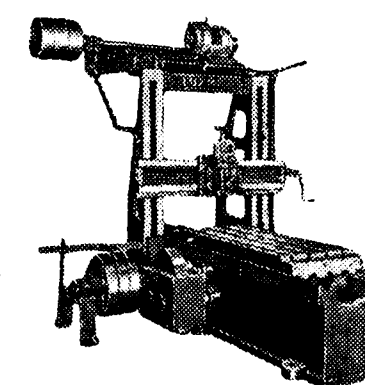
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the production lines and before despatch to ensure complete reliability and service under the most arduous working conditions.

In addition to the above, Hadfields are also very well known Forgemasters and supply Forgings in all weights and dimensions to several Industries.

Shipowners Asked To Build Up Sizable Tonnage

Pandit Pant, Union Home Minister, said in Bombay that the country's future prosperity was linked with the development of India's merchant navy and that every effort should be made to build up sizable tonnage to meet overseas and coastal trade.

The Union Minister, who was presiding over a function to mark the inauguration of the Malabar Steamship Company's overseas service, at Ballard Pier, stated that India's was spending between Rs. 150 to Rs. 175 crores every year by way of freight involved in the carriage of goods moved to and from this country through the employment of foreign ships.

Apart from being a great drain on India's foreign exchange, this constituted a sort of barrier to economic progress, the Minister said. The importance of building up tonnage could not be overstressed and in this activity shipowners had a special role to play.

"INFERIOR RANK"

Continuing, Pandit Pant referred to the statement of the chairman of the Malabar Steamship Company that Indian shipping had been relegated to a lower and inferior rank under the Second Five-Year Plan. He said that while it was important to raise the country's tonnage, it should not be forgotten that there were other equally important facts of development which could not be overlooked.

The Minister, however, visualised the day when India would be self-sufficient in the matter of merchant shipping whose role as a second line of defence of the country's 2,500 miles of coastline was also as important as its place in the development of foreign and coastal trade.

Pandit Pant congratulated the Malabar Steamship Company for having entered foreign trade and wished it all success in its ventures.

CO-OPERATION ASSURED

Mr. Pratapsinh Shoorji Lalabhdass, Chairman of the company, welcoming Pandit Pant, Mr. S. K. Patil, Union Minister for Transport and Communications, and others, said the present was an opportune time to secure modern steamers for overseas trade on favourable terms and the Malabar group of shipping

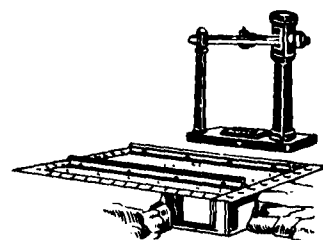
lines had decided to avail of it with the support of the Union Ministries concerned.

He said Indian shipping companies would always co-operate with the Government in achieving the tonnage target and hoped that the public sector in shipping would not overlap or hamper the private sector in carrying Government cargoes and due encouragement would be forthcoming from the State Trading Corporation.

The 10,000-ton "Janmada", with which the Malabar Steamship Company recently inaugurated its overseas service, berthed at Ballard Pier, was tastefully decorated. The function was held on the quayside. A large and distinguished gathering was present.

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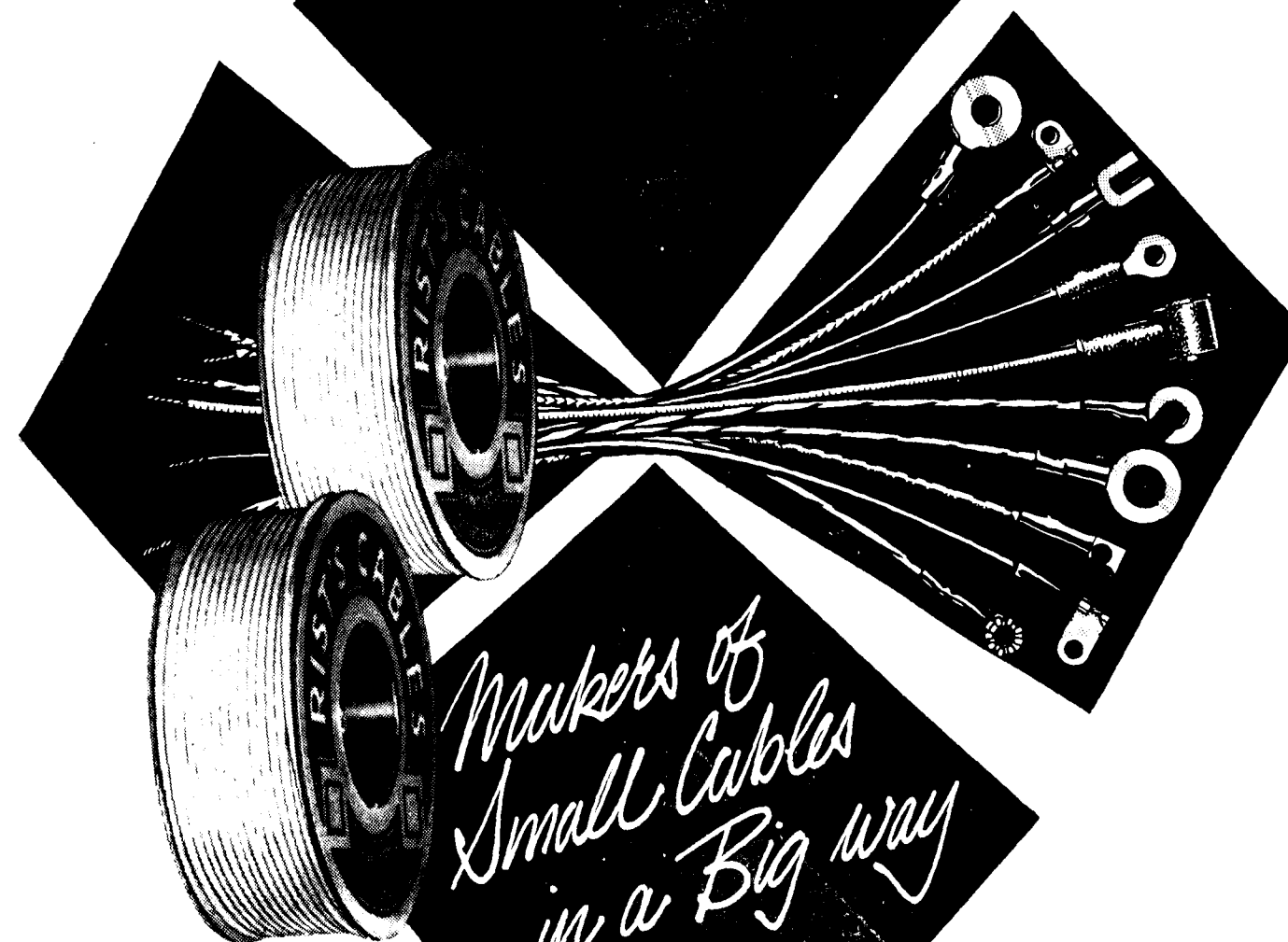
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We are glad to inform our readers and advertisers that the above special issue will be released along with the March 59 quarter's edition.

This will carry interesting articles, writeups, reviews, statistical reports etc., relating to the progress of the Indian Electrical Industries and the contribution made by Overseas Manufacturers in this respect.

The special issue will be quite useful as a reference publication for all those interested in the progress of our Electrical Industries.

Advertisement Space facing special articles, cover pages, etc., can be reserved by interested Manufacturers in advance either on application direct to us or through our Representatives mentioned in the attached tariff, both in India and abroad.

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