Scientific American

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REPORTING THE PROGRESS OF SCIENCE AND INDUSTRY

Photograph by Robert Yarnall Richie

Welding, Knitter of Metals . . . See page 193

FM radio receivers are more static-free and less costly—thanks to research at RCA Laboratories.

NEW FM - noiseless as the inside of a vacuum tube!

Now, FM, or Frequency Modulation reception, provides still greater freedom from static and interference caused by storms, ignition systems, oil burners, and domestic appliances.

It's radio at its finest—making your living room a part of the concert hall itself. You've no idea of how marvelous music can sound over the radio until you hear the golden perfection of FM reception developed by RCA.

Moreover, through this new RCA development, FM receivers can be made at a cost comparable to that of standard-band broadcast receivers. FM is no longer expensive! "Better things at lower cost" is one of the purposes of RCA Laboratories – where similar research is constantly going into *all* RCA products.

And when you buy anything bearing the RCA Victor name – from a television receiver to a radio tube replacement—you know you are getting one of the finest instruments of its kind that science has yet achieved.

Radio Corporation of America, RCA Building, Radio City, New York 20. Listen to The RCA Victor Show, Sundays, 4:30 P.M., Eastern Standard Time, over the NBC Network.

Stuart William Seeley, Manager of the Industry Service Laboratory, RCA Laboratories Division, perfected this new FM circuit. It not only operates equally effectively with strong or weak stations, but lowers the cost of receivers by eliminating additional tubes and parts that were formerly considered necessary in Frequency Modulation receivers.

RADIO CORPORATION of AMERICA

Scientific American

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CONTENTS • MAY 1946

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Industrial Drama: Symbolizing the increasingly important part which welding is playing in the industrial scene is our striking cover photograph taken in the plant of Engineering Laboratories, Inc.

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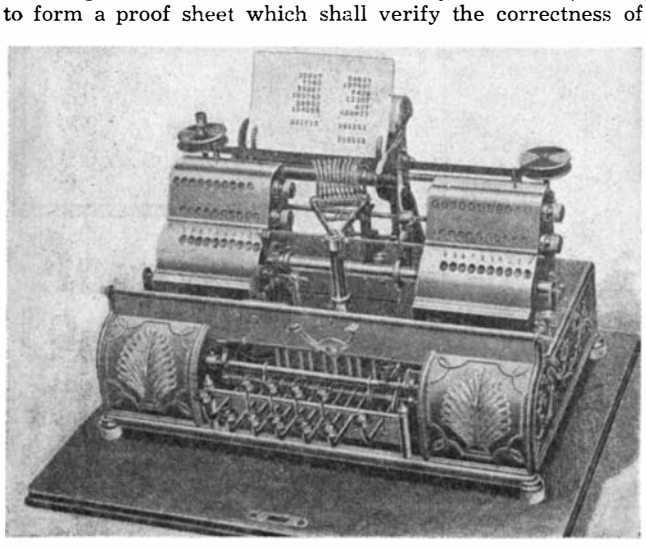
50 Years Ago in . . .

SCIENTIFIC AMERICAN

(Condensed from Issues of May, 1896)

MATCH-MAKING — "Five years ago the science of converting logs into matches was said to be a finished science, incapable of further improvement, but American ingenuity has shown that what was 'perfect work' in 1891 will not answer for 1896. Even now the machines used in making matches, wonderful though they are, are not to be left unchallenged, as inventors are working on new ones, whose capacity will, they claim, far excel that of the best machines now in operation."

ADDING MACHINE — "The accompanying illustration presents a machine intended to cover a substantially new field in typewriting and adding machines. . . The object of the invention is to quickly and accurately add a column or columns of figures and, at the same time and by the same manipulation of the keys, to print upon a sheet of paper or a blank book these figures in the order in which they are added, so as to form a proof sheet which shall verify the correctness of



the addition, and which machine, by special adjustments, may be made to print at the end of the column the sum total of the column, and to do the work in a vertically descending progression or vertically ascending progression or in a horizontal progression."

SLATE — "Slate is too much overlooked as a material for inside decoration. It exists in many different shades. It is easy and inexpensive to quarry, and by far the easiest stone to shape into pleasing forms. These qualities render it the cheapest of durable materials for interior purposes, and the wonder is that so little of it is in common use."

SPONTANEOUS COMBUSTION — "The reduction of fire risks is a most important point of economy and of vital interest to many manufacturers, or others that make use of any material or stock that is liable to be made combustible by the application of oil of any kind for facilitating its manufacture. The first care is to guard against the accumulation of such material or stock while in an oily condition, in heaps or in contact with heating pipes, or even in iron receptacles, without providing against its accumulation of heat by its absorption of oxygen from the air."

BRIDGE EQUIPMENT — "The trustees of the Brooklyn Bridge have made provisions for the expenditure of $100,000 for new electrical equipment. Two Babcock & Wilcox boilers, of 400 horse power each, two 600 horse power engines by the Southwark Foundry and Machine Company, and two Walker generators will constitute the power and light plant. Twenty cars, 48 feet long, equipped with electric motors, will be furnished by the Pullman Car Company. Improved terminal switching facilities, coupled with the new electric equipment, will enable the headway to be reduced to one minute."

PATENTS — "The Patent Commissioner's Annual Report is a document which has a special interest in a country like our own, which owes its wealth and power so largely to the genius and patience of the inventor and to the recognition and protection which are afforded him by our admirable system of patent laws."

RIGHT-OF-WAY — "The physicians of Chicago enjoy peculiar privileges as regards transportation. For fifty cents he can procure of the city clerk a badge with a red cross which gives him the right of way. The physician can then pin on the badge and mount his wheel or carriage and all vehicles are obliged to yield him precedence."

MOTOR-CAR SPEED — "Speed in a motor carriage is desirable, but it is not, however, the first requisite, for general utility and safety are of more real importance than great speed. . . It is stated that more than five hundred applications for improvements in motor carriages have been filed in a few months in the Patent Office."

RICE — "At present rice is a leading industry in only two States of the Union, though at one time it was grown in many States. Louisiana and South Carolina are now the rice-producing States, and in these States its production continues to be profitable."

100 Years Ago in . . .

SCIENTIFIC AMERICAN

(Condensed from Issues of May, 1846)

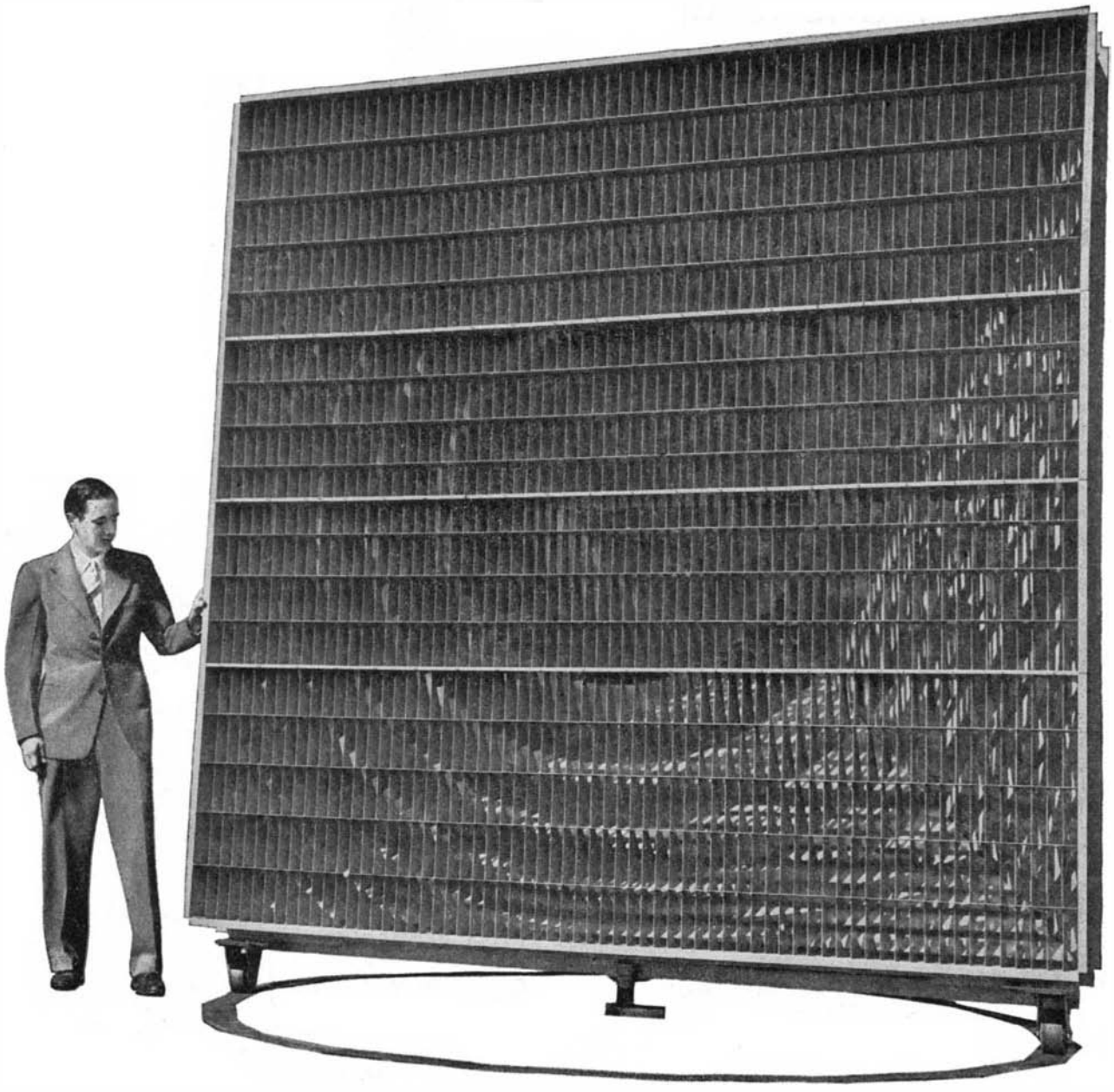
ELECTRIC MOTORS — "There are several kinds of curious machines now in use, in which a rapid rotary motion is produced by means of an arrangement by which the Galvanic circuit is broken and renewed in quick succession."

COMPRESSIBILITY — "All gasses, or aeriform substances, are elastic, being capable of being reduced into a smaller compass by pressure. . . Atmospheric air has been compressed into 1-128th part of the space that it usually occupies; but the pressure requisite to affect this is nearly 2,000 pounds per square inch."

MUSICAL TELEGRAPH — "A gentleman writing from St. Petersburg, Russia, speaks of the invention of an electromagnetic telegraph by which sounds instead of characters, are made the medium of communication. Ten wires are used, each of which produces a peculiar sound, and one or more of these sounds may be produced at the same time."

AMERICAN SILK — "We have on hand some samples of sewing silk, manufactured at Manchester, Ct., and which is at least equal to anything of the kind that we have ever examined."

TRACTION — "By the term friction, is understood the resistance which the surface of one body presents to the motion of that of another, when in close contact. Traction is a word of recent origin, and implies the same resistance, but in such a degree as to prevent any motion of the second surface on the first."



A "SEARCHLIGHT" TO FOCUS RADIO WAVES

In the new microwave radio relay system between New York and Boston, which Bell Laboratories are developing for the Bell System, giant lenses will shape and aim the wave energy as a searchlight aims a light beam.

This unique lens—an array of metal plates—receives divergent waves through a waveguide in the rear. As they pass between the metal plates their direction of motion is bent inward so that the energy travels out as a nearly parallel beam. At the next relay point a similar combination of lens and waveguide, working in reverse, funnels the energy back into a repeater for amplification and retransmission.

A product of fundamental research on waveguides, metallic lenses were first developed by the Laboratories during the war to produce precise radio beams.

This "searchlight" is a milestone in many months of inquiry through the realms of physics, mathematics and electronics. But how to focus waves is only one of many problems that Bell Telephone Laboratories are working on to speed microwave transmission. The goal of this and all Bell Laboratories research is the same—to keep on making American telephone service better and better.

BELL TELEPHONE LABORATORIES

Research and Development in Telephony • Telegraphy • Television • Wire Transmission • Radio • Aided by Physics • Chemistry • Acoustics • Mathematics Electronics • Metallurgy • Magnetics • Microchemistry • Electron Dynamics • Spectroscopy • Vibration Mechanics • Statistics • Crystallography Fundamental Studies in Speech and Hearing • Lubrication • Contact Alloys • Electrical Measurements • Corrosion and Decay • Quality Control Design of Antennas • Cable • Capacitors • Coils • Cords • Dials • Microphones • Networks • Outside Plant Apparatus • Resistors • Vacuum Tubes Circuit and System Design for Crossbar • Panel • Step-by-Step • Manual • Amplifiers • Modulators • Oscillators • Repeaters • Gain Control

Previews of the Industrial Horizon

By A. P. Peck

PAY AND PRODUCTION

SOMETHING of a tempest was stirred up among readers by the item "A Day's Pay For . . ." that appeared on this page, February issue. Some accused us of labor baiting; others interpreted the item as a slap at management; still others, pinkish in hue, placed all blame on the economic system of the United States. The latter are herewith quietly ignored, although their implications cannot be overlooked.

The subject of worker pay *versus* production and management profit is one that can never be settled on editorial pages; it must be thrashed out in shops and factories throughout the nation—sometimes collectively, more frequently individually. No matter how it is done, there is one premise from which all thinking must stem: Labor must be paid a fair wage for its work and management must be assured a fair profit on its investment. Labor puts its work into the pot; management puts work plus capital into the same pot. As the cooking proceeds, each must be able to take square meals out of the pot, else the whole thing becomes unpalatable for the whole country.

So now let's take a quick look at the science of labor management and see where it can fail. First, two questions: In any given plant, do the employees receive a fair wage? Do the employees give a fair day's production?

If the answer to either of these two questions is "no," it shows that something is radically wrong with the administration policies of the plant involved. Perhaps it is operating on antiquated stop-watch techniques in which standards are set by mediocre workers. Perhaps there is no merit system for upgrading and promotion from within the ranks. Perhaps there is no incentive offered for maintenance of standard performance. Perhaps there is not even an adequate method for evaluating worker worth. If any of these "perhaps" are the case, the way is wide open to worker dissatisfaction, union trouble, and all the other headaches that can beset industrial operations today.

All of this just skims the surface; the scientific solution of labor problems is a complex matter, but one that, if correctly followed through, will pay huge dividends in production, wages, profits, and general all-round industrial peace and contentment. For those interested in pursuing the subject in more detail than can be offered here, reference to further material will be given on request.

MORE ON ATOMIC ENERGY

PROBLEMS regarding nuclear energy are many-faceted, but can generally be reduced to two classifications—engineering and sociological. And for glimpses of the two horizons involved, quotes are in order:

"It seems unlikely," says Dr. John R. Dunning, of Columbia University, "that atomic power ever will really replace our common fuels in most applications. The new fuel is likely to be a supplement to existing methods. The immediate applications seem to be in the premium-fuel field, and where the special advantages of atomic power outweigh costs. There is much development to be done," Dr. Dunning continues, "before atomic power finds wide application. Many problems must be overcome, and it will be a number of years before definite practical utilization is made."

On the other side of the ledger is the matter of *how* nuclear energy will be applied—whether for the good of all or to appease the greed of the few. Says Dr. A. R. Stevenson, Jr., of General Electric Company: "Whether nuclear energy will be used for the benefit of mankind, or whether it will be reserved in dark secrecy for destructive purposes only, will depend more on our leadership as citizens than as scientists and engineers." To achieve the more desirable end, Dr. Stevenson points out, engineers will have to climb out of their specialties and look around in other fields, will have to develop a knowledge of the inexact art of human engineering, will have to expand their analytical faculties, and, in short, will have to prepare themselves to take an active part in the applications of atomic energy as well as in its development.

Today the world stands at a cross-road. Atomic power offers vast potentialities. Improperly channeled by the few, it can destroy every vestige of life on this planet—even that of its greedy directors—and can nullify man's laborious ascent from the caves of pre-history. Properly handled, it can open new ways of life for every man, woman, and child from pole to pole. The same engineers who have contributed so greatly to human comfort through industry are responsible for the creation of the possibility of atomic energy; they—the only ones who fully appreciate its possibilities—must make themselves equally responsible for its future use.

MORE TO COME

BERYLLIUM, obtained largely from the mineral beryl, and chemically belonging to the magnesium family, is second lightest of the stable metals. It is so brittle, however, that it is seldom used alone for structural purposes, and probably never will, extensively, because of its cost. But beryllium oxide can be used as a refractory at temperatures around 4000 degrees, Fahrenheit, and is undergoing investigation as a lining for furnaces, combustion tubes, and so on.

Most important application of beryllium today is as an alloying agent. Copper to which 2 percent of beryllium has been added shows high-strength and elasticity characteristics, even under extreme heat. More will be told about this phase of beryllium in our June issue, by Contributing Editor Fred P. Peters.

COST REDUCTION

EVER HIGHER machining speeds can do much to increase production, reduce costs, and improve products. Thus, one machine-tool maker has just announced a new group of tools in which high speeds are coupled with automatic operation, improved lubrication, and electronic controls. It is reported that these new machines will consistently increase production by at least 10 percent.

By such means as this is industry finding the answer to the problems of increasing labor and materials costs.

FOR FUTURE REFERENCE

SAYS a spokesman for the Civil Aeronautics Administration: The personal airplane must be so safe and simple that both grandmother and her sub-deb granddaughter can drive it with a degree of ease and safety comparable with that of an automobile. . . A new plant-hormone weed killer is reported to eliminate dandelions and other broad-leaved weeds in less than two weeks. . . Two-coat finishes for new wood, particularly for frame houses, use a non-penetrating primer followed by a coat of high-pigment paint. . . Color television looms large on the radio horizon: RCA has it but calls it impractical as yet—Columbia Broadcasting System is going all-out for color—Zenith Radio says that they will produce only color-television receivers—and the public (including this writer) waits with more or less patience for the final outcome. . . An alloy of germanium (by-product of the manufacture of cadmium) and gold expands slightly on solidification, melts at the low temperature of 673 degrees, Fahrenheit, is harder than ordinary gold alloys; it holds promise in dental inlays, jewelry, and electrical equipment.

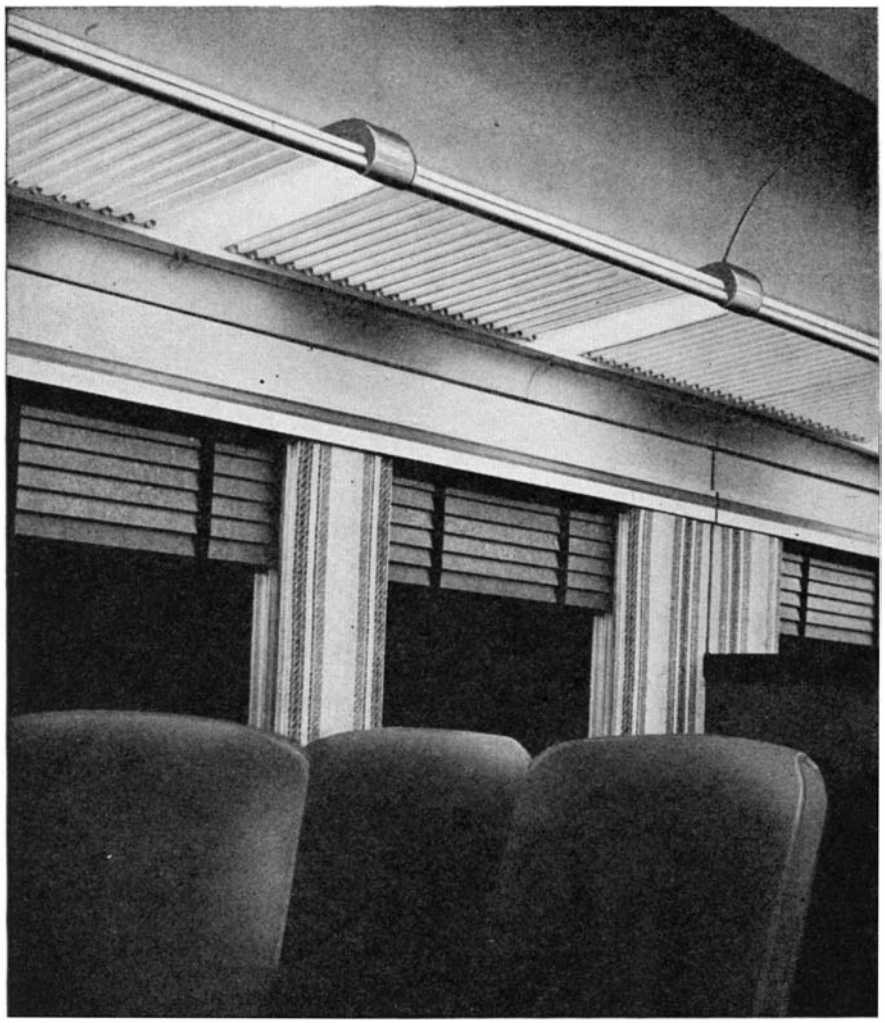
Scientific American

MAY · 1946

PLASTICS

• LOOKING AHEAD •

With the "Dark Ages" of lighting behind, something more than just illumination should be expected of both commercial and domestic equipment. . . . Lighting in "meet-the-public" areas should help to create the desired atmosphere; in industry it should be a stimulus to production, worker morale, and safety. . . Bare light alone falls short of these goals, but materials that can guide, blend, transport, and control light spell the difference. . . Plastics are one of the best light-handling mediums.



Baggage rack and lighting fixtures are combined in rugged acrylic plastics unit. Railroad service affords excellent test for durability of materials and design

Partners of Light

Ideally Suited for Diffusers, Shields, Fixtures, and Glowing Radiant Panels, Plastics can Join with the Light Source Itself to Provide a Harmonious Lighting System. Strength, Light Weight, and Low Thermal Expansion All Contribute to Plastics' Growing Importance in this Field

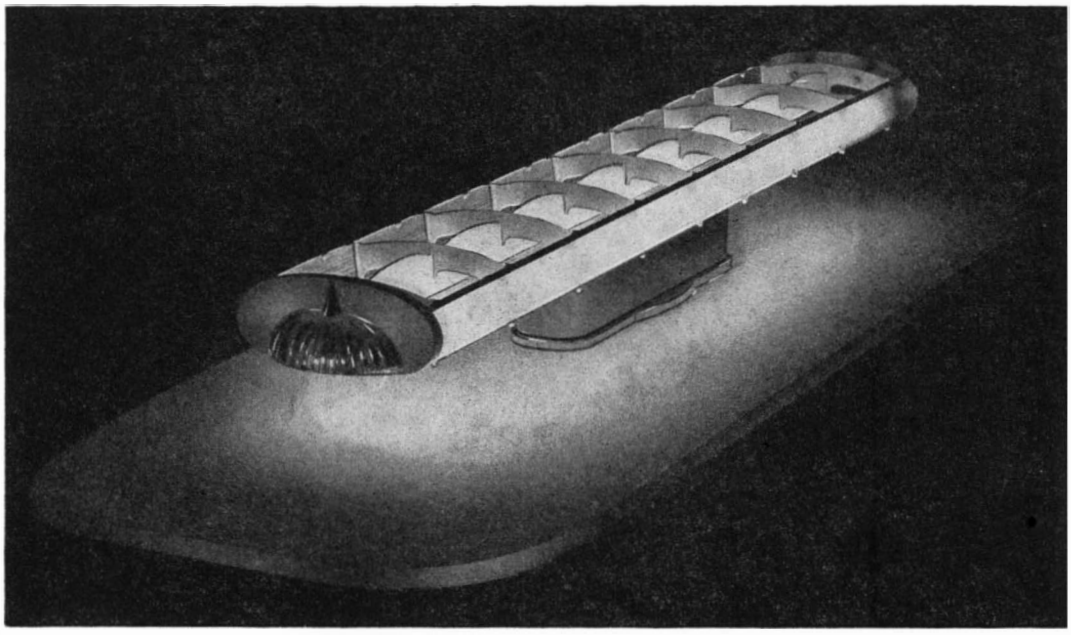
By CHARLES A. BRESKIN
Editor, *Modern Plastics*

One of the big difficulties in the minds of builders and designers, whether they are busy with plans for homes, offices, plants, or railroad cars, is: "What type of lighting are we going to use?" A few years ago there would have been no question in their minds. Lighting fixtures would have been incandescent—of course. But today the solution is not so easy. This last Christmas saw the introduction of round fluorescent bulbs, a development which should go far toward liberalizing the use that is made of this type of lighting. There is, too, the growing prominence of "piped" light in which the illumination from concealed fluorescent lamps is diffused over a wide area of wall or paneling.

According to a survey conducted by *McCall's* magazine several years ago, the preferences of housewives as regards lighting fixtures stood somewhat as follows: 25.2 percent out of every 100 average readers intended to install fluorescent lighting in their living rooms, 41.6 percent like it and were considering it, 2.5 percent had fluorescent light, and 30.7 percent did not like it. During the elapsed period—between 1938 and 1945—the sale of fluorescent lamps rose from 200,000 to 37,500,000—nearly 90 percent of the total going into commercial and industrial use.

With this type of lighting further stimulated by the growing popularity of radiant light walls and round fluorescent bulbs, builders and decorators are going to find increasing uses for plastics as shields for light fixtures, for while these synthetic materials were used to some extent with incandescent lamps they are ideally suited to fluorescent lighting.

Plastics find that the main advantage of fluorescent lighting is its coolness. This characteristic opened the field of lighting shields to the thermoplastic as well as the thermo-

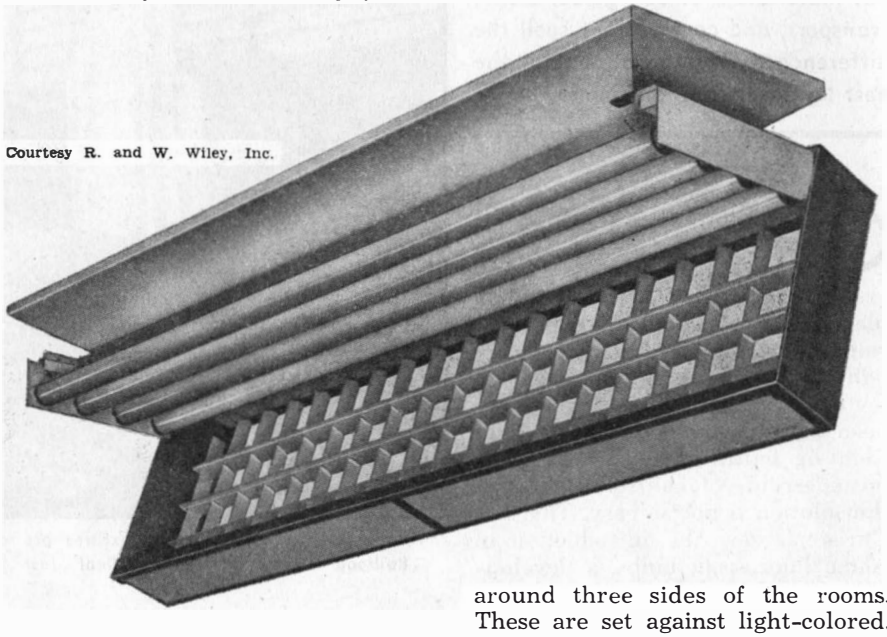


Light weight and soft illumination mark attractive fixture (left) with polystyrene side and end panels.

Shown in "opened for cleaning" position, fixture (below) with white translucent panels has excellent age and heat-resistance features

Courtesy John C. Virden Company

Courtesy R. and W. Wiley, Inc.



setting plastics materials. Of course, the thermosetting materials were used for this purpose before the introduction of fluorescent lighting. but it was either in the form of sheets or as woven monofilaments for lamp shades.

Because of the heat given off from incandescent lamps, care had to be taken even in designing thermosetting reflectors. An example is the semi-indirect urea lighting bowls, the first of which was made of Beetle for the Pullman Company by the Richardson Company. These were followed by a Plaskon automotive dome light produced by Chicago Molded Products Corporation and the American Insulator Corporation. In both cases. a considerable amount of designing was necessary to achieve a shape which would keep the plastics material away from the direct heat of the bulbs and ensure correct wall thickness. However, when melamines, with their higher critical temperature, came into use in this field a number of new plastics applications became possible.

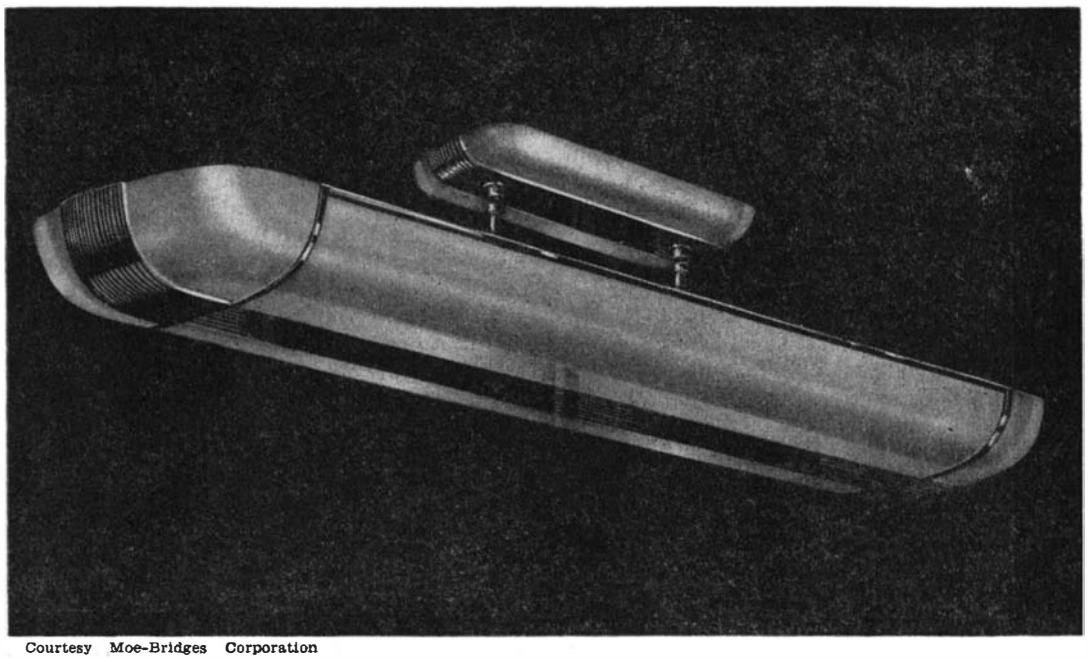
Furthermore, plastics lighting bowls offered several important advantages that more than offset the problems involved in their production. They were light in weight and therefore less dangerous than glass to use and less expensive to ship; they could be mass produced with precision; they were low in cost; and they had excellent lighting properties.

Whether or not fluorescent lamp sales for residential use alone reach the 10,000,000 figures predicted for them for 1950 by the lighting industry, the 333,0000,000 lamps with incandescent lights that are expected to be sold in the same year offer a wide range of uses for plastics, since all of these lamps must be shaded and the light from them must be diffused.

RAILCAR LIGHTING—Most indicative. perhaps, of the growing importance of fluorescent lighting is the development work now being carried on by the Safety Car Heating and Lighting Company. Although this company has used plastics lighting fixtures for a number of years, all its post-war railroad cars will be lighted through plastics shades exclusively. And the shields will not be the usual type that has become familiar to the average traveler. They are using plastics with a purpose. For example, in the mock ups of powder rooms, bedrooms, and all other places where mirrors are installed, this company is placing tubular fluorescent ceiling fixtures around three sides of the rooms. These are set against light-colored, but not glossy, wall finishes. The result, due in part to the good diffusing qualities of plastics shields. is plenty of light on the face but little in the eyes.

More unusual still, and almost outside of the true lamp diffuser field, is an experimental Plexiglas wash basin with a Circline lamp placed under it. Here, the plastics serves not only as a light shield but also as a wash bowl. Another example of the way in which this company puts plastics to double use is the combination baggage racks and light fixtures. Heavy-gage, translucent acrylic, deeply corrugated for extra strength, is set in metal frames positioned against the sides of coaches so as to run their full length. Over each pair of seats a fluorescent lamp is set above the corrugated plastics, shielded by the metal.

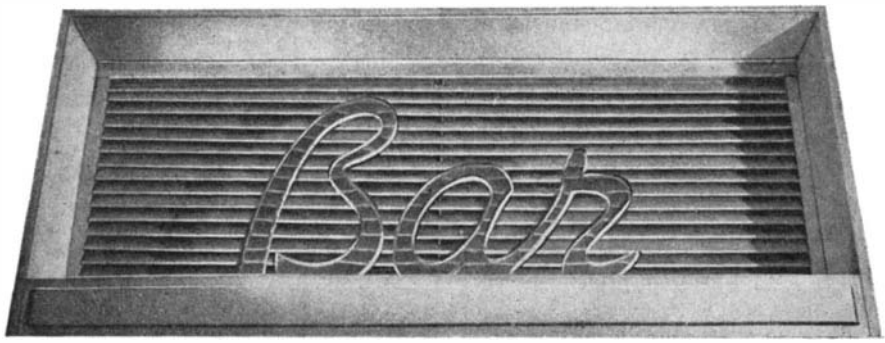
It seems probable that adaptations of some of these designs will



Advantage is taken of light-control abilities of urea plastics in semi-indirect fixture on right.

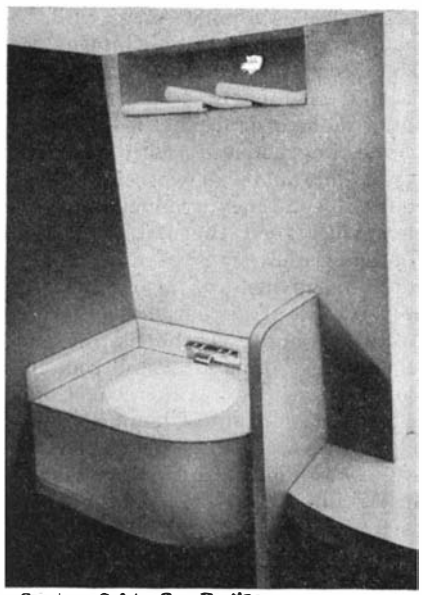
Another plastics characteristic, "piping" of light, makes acrylic letters of sign (below) glow with light from a concealed source

Courtesy Moe-Bridges Corporation



Courtesy Hotel Pennsylvania

make their appearance in hotels and restaurants, and even in private homes. For one thing, the railroad industry is a rugged testing ground of both ideas and materials. Plastics for railcar light fixtures must not only be light but they must satisfy at least these basic requirements: good dimensional stability, expansion or contraction of less than 1/32 inch per three-foot length for every 15 degrees, Fahrenheit, change in temperature; strength enough to bear such weight as that of baggage when used in overhead racks; life equal to that of the car; flexibility enough in thinner gages to be snapped into position in fixtures: excellent light transmission qualities (82 percent in 0.060 inch thickness); and the ability to withstand vibration.



Courtesy Safety Car Heating and Lighting Company

Lighted from below by circular fluorescent tube, plastics lavatory symbolizes range open to designers in this field

Even industrial plants do not present such severe operating conditions as do the railroads, and offices and homes even less. So lighting equipment which will stand up on the railroads should be highly satisfactory elsewhere.

DIFFUSERS—It has been stated that the ideal light is that encountered at high noon on a hazy day. Everything can be seen clearly because the illumination is high; yet there is no glare to hurt the eyes, and no over-intensity to throw color values out of scale or to create dense shadows. The fact that man is now able to rival this outdoor perfection in interior illumination by the combined use of fluorescent lamps and plastics diffusers may explain why these products intrigue designers.

Recently the Underwriters Laboratories, Inc., when questioned regarding the suitability of all thermoplastics for lighting fixtures, authorized the following statement:

"The Underwriters Laboratories, Inc., have gone on record that they will accept fluorescent lamp holders made of polystyrene and have no objection to the use of this and other slow-burning plastics in diffusion material for fluorescent lamps in locations where normal operating temperatures are not such as to adversely affect the plastics material, thereby causing it to burn, deform, or disintegrate."

With designers and engineers planning the fixtures to suit the materials, with material makers evolving special formulations, and with molders and fabricators keeping pace with both, this statement suggests that plastics will be taking over more and more of the lamp diffuser field.

FIXTURES—This indication is borne out by both old and new plastics fluorescent fixtures. In one example, the peculiar ability of acrylics to carry light is put to use. Letters on a sign are picked up and highlighted by the light given off by a fluorescent tube hidden in the base.

Polystyrene is also finding wide use in many of the new fixtures just coming on the market. A shield, sold by the John C. Virden Company, has the side panels extruded and the end cup molded of this material. Both parts are produced by the General Electric Company. The advantage of polystyrene in this application is that it has the appear-

ance of crystal-clear glass; yet is a fraction of the weight of glass. In addition, it is rigid and permanent, and in the form selected it provides prismatic diffusion. The company is also experimenting with tinted polystyrene and is working on matching finishes for the exposed metal parts of the lamp fixtures.

Another lighting company, R. and W. Wiley, Inc., is using white translucent Vinylite, choosing this material because of its dimensional stability, color quality, pliability in heat and cold, resistance to change due to moisture and age, and non-support of combustion. They have developed a rather unusual light shield so constructed that the plastic sides can be opened easily to allow for cleaning.

One of the earliest uses of plastics in fluorescent lighting was in Louverplas, made by the Doane Products Corporation from Plastacele. This acetate product is a lamination of sheets of clear and colored acetate, sliced to make a thin sheet with built-in louvers of white, black, or pink. It can be either polished or given a prismatic ribbed surface and is commonly used for the control of glare.

And then there are the combination Plaskon housings and Vinylite sheet canopies for semi-indirect commercial fixtures brought out by Moe-Bridges Corporation and molded by Plastics Engineering Company. Beetle also has been used by this company for reflecting shields and bracket housings, while the F. W. Wakefield Brass Company has produced a fixture in which extruded Tenite II is the diffusing material, the plastics being supplied in 48¼ inch lengths by Sandee Manufacturing Company.

Experimental work is under way on applications of translucent contact laminations, larger and longer plastic extrusions, architectural panels for whole ceiling diffusion, and black-light filters of cellulose acetate butyrate to reflect luminous pigments. Moreover, bigger fixtures for commercial use are planned. This will mean increasing necessity for decreasing weight—and will broaden the utility of plastics for designers and users of such lighting equipment.

MOLDED RIM

Holds Wire Mesh Firmly in Place

TEA STRAINER problems appear to be solved by a new unit molded by Plastic Metal Manufacturing Company, in which the metal mesh forming the strainer is molded right into the edge of the transparent

Molded strainer is heat-resistant

Styron sides. The only limitation is the suggestion by the producer that the strainer not be used where the liquid to be strained is hotter than the boiling point of water.

LEATHER-LIKE

Coated Fabric Resists Sun and Rain

BABY CARRIAGES are now being brought out with bag and hood covered with Terson, a resin-coated fabric. Athol Manufacturing Company developed the leather-like material which resists sun and rain and has a long life span. Because it is also resistant to cracking, abrasion, and puckering, and because it has good elastic properties, the fabric appears to be well suited to this and other out-door uses.

COCKTAILS IMPROVED

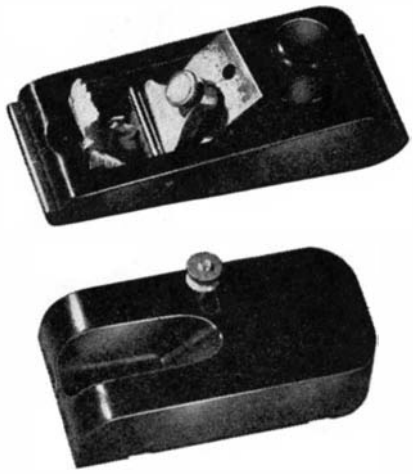
By Use of Vinyl-Lined Container

ALUMINUM cocktail containers, coated on the inside with Cordo-Clad, a vinyl-resin blend, offer an advantage over older containers in that the inner coating prevents any possible transfer of metallic taste since the liquid does not come in contact with the aluminum. The Eliott Manufacturing Company fires the vinyl, purchased from the Cordo Chemical Company, right into the metal to form an integral part of the container wall.

HOBBY TOOLS

Made of Plastics For Special Uses

INDICATIVE of the spread of many hobbies is the development of tools for the exclusive use of hobbyists, yet which match the best full-size woodworking equipment in quality and usefulness. For example, there are the plane and the balsa stripper molded of polystyrene that is being put out by X-Acto Crescent Products Company. Although small in size, there is nothing of the toy about either of these tools. The plane can be used for delicate work as well as heavy-duty planing and shaving, being strong, well-balanced, and



Precision tools, plane (above) and stripper (below) are sturdily made

equipped with a high carbon surgical steel blade. It is molded in one piece with no inserts. The polystyrene gives good dimensional stability; the bulk of the piece provides good impact strength.

The stripper is equipped with two knives for cutting strips of balsa 1/16 to 1/2 inch wide out of stock 1/32 to 3/16 inches thick.

REFRIGERATOR PLASTICS

Show Trend Toward Wider Use

NEW REFRIGERATORS will be equipped with a number of new operating and use features, and in many cases the new parts will be made of plastics. In one line of refrigerators, for example, a standard part on all models is an inner door panel molded of Capac, a laminated paper impregnated with phenolic resin. This material was chosen because it combines production economy with good thermal insulation characteristics.

Extensive use is also made of polystyrene. It appears as cold-control knobs and escutcheons, the material being supplied by the Bakelite Corporation, Dow Chemical Company, and Monsanto Chemical Company. Polystyrene is also used for evaporator doors, the fronts of hydrator units, and deep-freeze compartments.

And finally, there are Bakelite handles plated with metal, Lucite or Plexiglas nameplates and trim, and a storage tray composed of two pieces of compression molded laminated paper.

Wooden Wealth

Raw Materials and the Ingenuity to Use Them are the Fundamental Wealth of a People. Depletion, a Constant Threat to Some Materials, Emphasizes the Potentialities of Wood as a Chemical Storehouse. Chemurgy—the Ingenuity Factor—is Expanding Now, Holds Great Promise

By HOWARD C. E. JOHNSON, Ph.D.
Chemical Editor, *Chemical Industries*

A REVOLUTION is coming in the chemical industry. Not tomorrow, and perhaps not for 50 or 100 years, but it is coming. Petroleum and coal now stand supreme as veritable treasure chests for the organic chemist. But, although the experts disagree as to how long our reserves of these materials will last, it seems certain that the bottom of the barrel must eventually be reached.

Then it will become necessary to depend upon storehouses of energy that do not require geological ages to make, materials that can be grown on a short-term, crop basis. This means an ever-increasing utilization of such materials as wood, grains, grasses, and the like. It also means that chemurgy (chemistry based on agricultural products) will ultimately become a science of prime importance.

Wood, as a chemical raw material, is not new. Distillation of wood to produce acetic acid and wood alcohol is traditional, as is the production of turpentine and rosin from pine stumps and trees. Quinine, logwood, and quebracho are other wood products with long and useful histories. The newer technology, however, has greatly extended the range of materials obtained from wood, and one of its more salient features is the economical utilization of wood waste. Sawdust and small chips, which formerly were good for nothing except burning, are now being converted to many products. Some of these products are immediately useful; others cannot compete economically—now—with products from other sources but hold both promise and hope for the future when irreplaceable raw materials are gone.

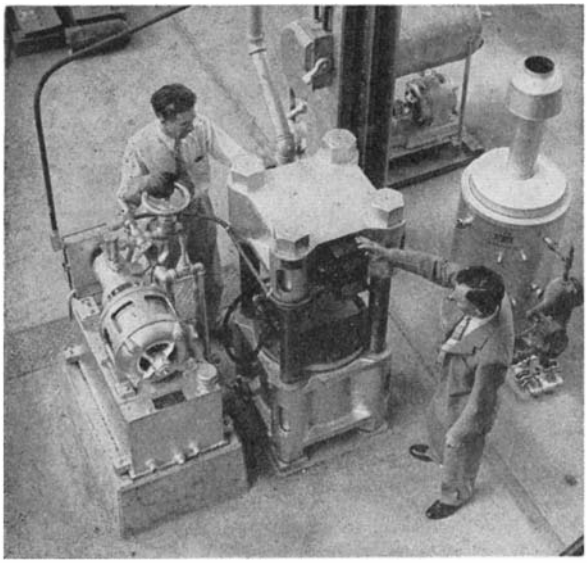
ALCOHOL — Although wood has been largely superseded by synthetic processes for the production of methanol and acetic acid, there has been increasing interest in the past few years in wood carbohydrates as a source of ethyl alcohol.

Very recently, the first successful plant for the manufacture of alcohol from the waste liquor of sulfite pulp has been put into operation by the Ontario Paper Company. Not only does this waste material provide a cheap raw material source for alcohol, but also the very annoying problem of stream pollution arising from its disposal has been solved by utilization of its constituents.

In the production of sulfite pulp for paper stock, wood chips are cooked with calcium bisulfite. During this cooking, about half of the wood material is dissolved or decomposed. Some of the dissolved material is sugar, normally present in the wood, and more sugar is formed by breakdown of the cellulose fibers. The total sugar content of the cooking liquor, then, is 2 to 4 percent, and 8 to 10 tons of liquor

• LOOKING AHEAD •

Scare headlines are legion, but the day when serious shortages of irreplaceable raw materials force chemurgy on the industrial world may yet be far off. . . Careful analysis, however, of non-timber uses for wood—a material about which too little is known even today—may bring dividends in useful applications for waste products. . . At present, the economic picture appears marginal for alcohol and some other products made from wood, but continued research may make them profitable.



A hydraulic press for making lignin plastics in pilot plant. Little is known about this material and many problems beset its use in plastics

is obtained for each ton of pulp.

The waste liquor is first cooled, aerated to blow out the sulfur dioxide, and then neutralized with lime to reduce the acidity to a degree suitable for fermentation. The lime sludge is separated and the clear liquid is then pumped to the fermenters where yeast and a trace of nutritive salts are added. Fermentation is allowed to take place, after which the yeast is separated for re-use by centrifugation in a manner similar to the separation of cream from milk. Finally, the clear "beer," containing about 1 percent of alcohol, is distilled to 192 proof. More than 18 gallons of alcohol are obtained for each ton of pulp produced, and it is expected that the yield may be raised to 25 gallons when additional equipment is available.

Essentially the same process has been used in Europe—particularly in the Scandinavian countries—for over a decade, but the Canadian installation is far more efficient. It is estimated that there are some 35 pulp mills in the United States whose daily pulp capacity is over 100 tons, the minimum for economical alcohol operations. If alcohol plants were installed at each of them, they could produce about 50 million gallons of ethyl alcohol a year at a cost, not including overhead and amortization, of 8 to 12 cents per gallon, depending on the size of the plant.

At this cost, alcohol production from sulfite pulp liquor might still be considered marginal. The process nevertheless points the way to economic utilization of one of this continent's greatest industrial wastes. Also, virtual elimination of the stream pollution nuisance can be one of the most important returns from such alcohol plants at pulp mills.

In the west, a new plant is producing alcohol directly from wood waste. Here, the unusable wood resulting from logging operations is chipped, digested with dilute sulfuric acid, and then neutralized, fermented, and distilled essentially as in the Ontario plant. About 230 tons of waste wood are processed per day to give 11,500 gallons of 190-proof alcohol—a yield of about 50 gallons per ton.

The project was conceived as an emergency measure to help fill the alcohol drums for war purposes. Whether it can continue to operate profitably in peace-time depends upon many factors. Representatives of the United States Forest Products Laboratory are of the opinion that wood waste should not have any difficulty competing with grain crops as a source of commercial alcohol "if the farmer gets a reasonable price for his crops." They do admit, however, that there is a question about its being able to compete with "give away" prices for molasses, or with alcohol from petroleum gases. To a large extent the economics of the process will depend on whether or not profitable outlets can be developed for the lignin, amounting to almost half the weight of the dry wood, which is obtained as a by-product. At present the cost has been estimated, exclusive of amortization, at about 13 cents per gallon.

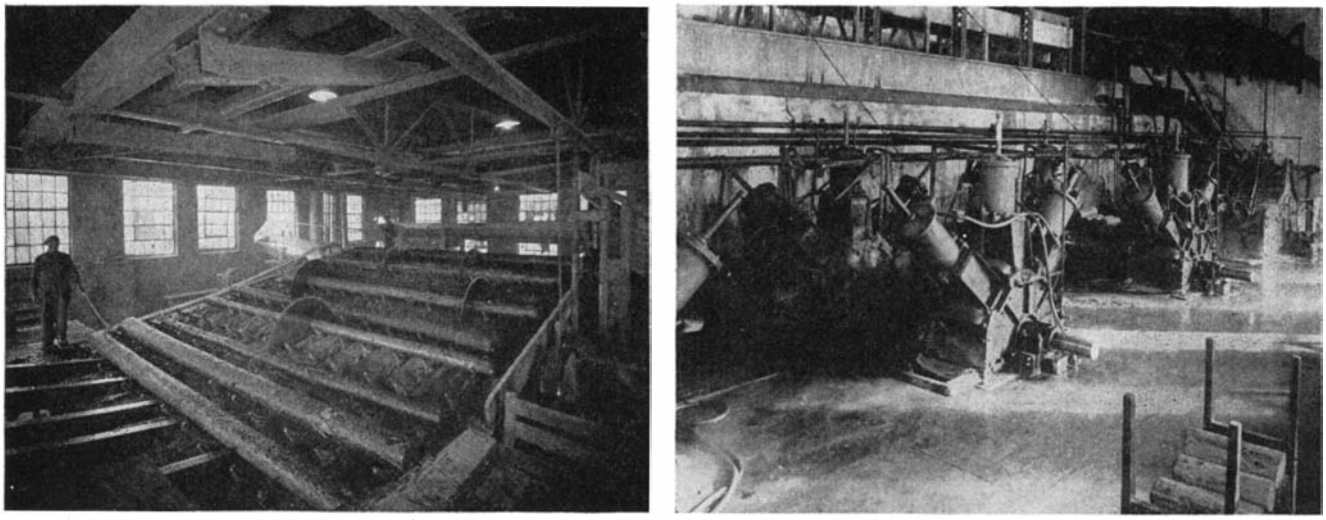
LIGNIN—Profitable use of the by-product lignin would make alcohol production from wood more economical. An interesting development of the last few years is the production from lignin of vanillin, the aromatic constituent naturally occurring in the vanilla bean. The structure of lignin is not entirely known, but it is expected that other compounds similar in structure to vanillin may soon be produced from it. Indeed, studies being carried out in several industrial and university laboratories on the structure of lignin may eventually make this material an important source of organic chemicals.

At present, however, the chief outlet for lignin appears to be in plastics. A simple treatment devised recently at the University of New Hampshire provides a water-resistant wallboard of the Masonite type.

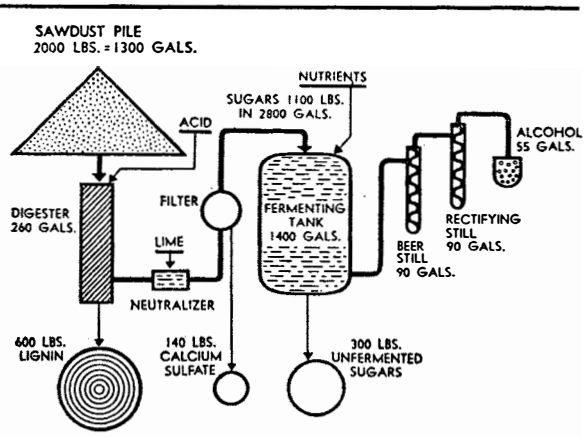
To produce this material the lignin is simply heated with a 10 percent solution of zinc sulfate for two hours. The lignin is then separated from the reddish-brown liquid and subjected to the action of hydrogen sulfide gas. After air-drying and molding at 300 degrees, Fahrenheit, under a pressure of 2000 pounds per square inch—ordinary commercial practice—the resulting material has properties which compare favorably with those of Masonite. If the material is further treated with formaldehyde after the hydrogen-sulfide treatment, the characteristics are markedly improved. Neither this product nor Masonite itself, which is produced from wood fibers disintegrated by steam "explosion" of wood chips and then subjected to high pressure, can be considered true plastics, however.

LIGNIN PLASTICS — The United States Forest Products Laboratory has experimented with the treatment of wood itself, in the form of sawdust, to produce so-called "hydroxylin" plastics. The sawdust is cooked either with dilute sulfuric acid or dilute aniline. Dried, ground, and molded with suitable plasticizers, or merely with water, dense black plastics are obtained which have excellent characteristics.

Partial hydrolysis of wood fiber gives lignocellulose, a material in which plastic properties are inherent. It cannot be used alone effec-



Five-saw slasher (left) and pulp wood grinders (right) are initial steps in wood processing



Processing stages in conversion of wood waste to alcohol. Lignin at lower left, a by-product, may be key to more profitable use of this process

tively, but the Northwood Chemical Company uses it with standard phenol-formaldehyde and phenol-furfural resins to produce useful materials at low cost. Other manufacturers are also investigating the process.

Another use of lignin plastics is in paper laminates. Marathon Chemical Company applies a lignin-enriched pulp to make a paper suitable for laminating with or without auxiliary resins. "Lignolite," the material so produced, can be readily drilled, sawed, turned, punched, and machined. Its excellent mechanical and electrical properties make it generally suitable for switchboards, switchbases, barriers, spoolheads, connection blocks, terminal strips, insulating spacers, mounting plates, washers, supports, cabinets for housing electrical equipment, and the like. It also has many uses other than electrical, including signs, nameplates, iceboxes, ice-cube trays, shower stalls, table tops, handles, and so on.

While Masonite is hardly a plastics, a modification of the process gives a material that may be powdered and molded into a dark, hard, water-resistant product. A similar product is made from redwood and marketed under the name "Shellerite" by the Sheller Manufacturing Company for such uses as steering wheels.

Robert S. Aries, of the Northeastern Wood Utilization Council, has recently written of lignin plastics, "Presently known lignin plastics do not, in general, have properties of their own which cannot be easily or economically duplicated by other plastics.

"It is difficult to base predictions of future possibilities on the basis of present performance, as research may alter the picture overnight. . . The future of lignin plastics clearly is in the hands of the chemist and engineer. The utilization of the available tonnages of waste lignin and the large additional amounts which could be produced will require the ingenuity of the research worker and the development engineer. Besides plastics and low-priced board-type products, other outlets should also be investigated, since plastics cannot be considered a panacea for all waste-disposal and by-product problems. Present work will yield new and improved substances of a resinous nature, and it may be expected that a number of new marketable products of lignin will soon make their appearance on the market. Research may transform lignin into a lucrative raw material of the future and place it in the permanent picture of the American chemical and plastics industries."

OTHER WOOD PRODUCTS—While cellulose—whose uses in paper and rayon are already established—and lignin—for which uses are being found—are the large-tonnage constituents of wood, other materials are also finding new uses. The Department of Agriculture, for example, is developing methods of obtaining myrcene and isoprene from turpentine. Isoprene is the building block of natural rubber, and myrcene is a highly unsaturated compound formed from two isoprene units. Myrcene has now been developed to a point where it may have application in the manufacture of certain types of synthetic rubbers.

In Germany during the war, 14 tons per day of dry yeast were produced from the waste liquor of a beechwood pulp plant which used 200 tons of dry wood daily. The yeast, containing 40 to 50 percent protein, was used to produce soup powder and other protein-containing foodstuffs, chiefly for the army. This wood food product sold for half the price of lean meat.

The research being done today by a wide variety of organizations portends that the traditional uses of wood and wood products will be augmented and complemented by a host of new uses, aimed chiefly at utilizing waste products. Eventually, perhaps, the tons and tons of wood waste which are daily poured into our sewers will provide the basis of a profitable chemical industry.

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PRESSURE DISTILLATION

Gives Major Savings in Water Purification

DISTILLING water by utilizing the heat produced by compressing steam is a method that has been successfully employed in purifying sea water for dr nking purposes. Instead of using fuel to boil the water, compression distillation burns the fuel in an engine to produce power to compress and thus heat steam in the system. When this heated steam is condensed, it gives up its heat to boil water and thus produces more steam to be compressed. Efficiencies as great as fifteen times those achieved in the ordinary method of distillation are possible. Not only is the new system successful on shipboard but it also promises important savings in industrial applications requiring distilled water.

FORTIFIED GLUES

Resist Tropical Conditions; Are Easy to Use

LONGER life for furniture, musical instruments, and other wooden products exported to the tropics is promised through the use of new fortified animal glues, developed by glue manufacturers in conjunction with independent laboratories.

Making use of formaldehyde solutions and organic fungicides-bactericides, these glues were originally formulated in response to war-time demands to protect glued assemblies destined for such areas of high humidity and temperature as the Burma theater.

Procedures used in preparing the glues are simple for the wood-working plant to adopt. No equipment changes or additions are necessary, and only two deviations from the customary procedure in the use of animal glue for joint work are involved.

First, the usual glue solution is made resistant to molds and extraneous bacteria by addition to the dry glue of 0.5 percent by weight of an organomercuric fungicide. Secondly, provision is made for pre-treating one side only of the assembly with a dilute formaldehyde solution, allowing the wood surface to absorb the free moisture before joining with the matching wood surface to which a film of glue has been applied in the usual manner.

Aircraft Radar

Often Hailed as a Cure-All for Commercial Aviation Difficulties, Radar Alone is Insufficient. It Must be Combined With Other Navigational Aids Before its Full Possibilities can be Realized. Several Systems, Surveyed Here, Offer Possibilities for Further Development

By VIN ZELUFF
Associate Editor, *Electronics*

• LOOKING AHEAD •

Television will play an important part in the future of aerial navigation. . . If predictions of half a million planes in the air within the next 10 years are realized, there will be a vast market for electronic navigation aids. . . Regardless of numbers of planes, aerial safety will be prompted by electronics. . . Demands offer possibilities for further development of existing and proposed systems.

SEVERAL different systems of navigation and traffic control for aircraft, utilizing television and radar techniques to present visual information directly to the pilot and to dispatchers on the ground, are now under development to cope with the expanding all-weather needs of commercial and military aviation. The ultimate choice of one system for the commercial airways will, of course, involve financial and political aspects, but the technical details will also have an important bearing on the decision as to which electronic system will be used to make timetables of airlines as reliable as those of railroads.

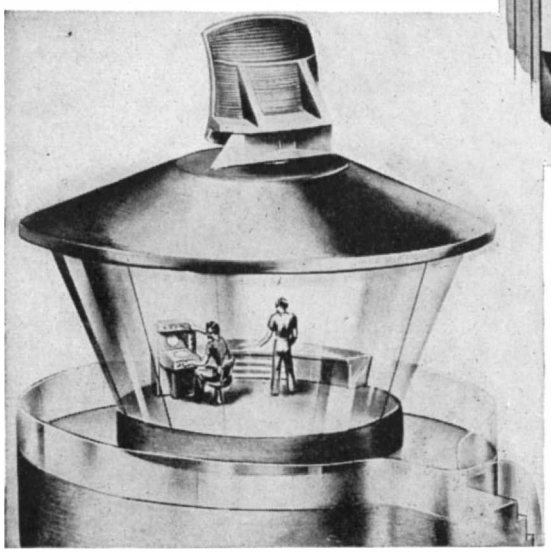
For control of traffic, accurate position data on all aircraft within the control area must be presented to the traffic control personnel, and resulting traffic instructions must be relayed to the pilot rapidly enough to be useful. Adequate warning must be given of impending collisions between aircraft, or between aircraft and the ground or fixed objects. The system must operate in conjunction with existing navigational and weather-data aids.

TELERAN—Use of radar alone for air navigation has several serious limitations. The equipment is relatively heavy and bulky for a plane, and requires skill for its operation. Furthermore, it provides no data on the ground for the use of the traffic controller. Ground radar, on the other hand, cannot by itself help the pilot. One answer may be the use of Teleran (a contraction of "television, radar, and air navigation"), proposed by RCA engineers, in which aircraft positions are determined by ground-based microwave radar equipment. The resulting pictorial information is combined with other graphic information, such as control instructions, maps, and so on, and transmitted aloft by television.

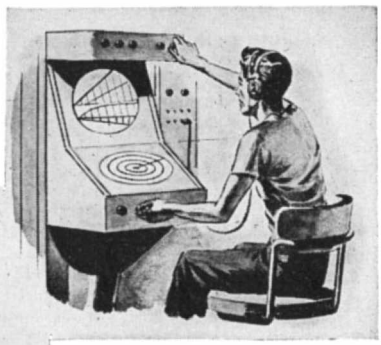
Since a composite picture of all aircraft at all altitudes would be confusing to the pilot, Teleran includes a system of separating signals received from aircraft at various altitudes, and transmitting a separate picture for each traffic level. Commercial aircraft move rapidly horizontally and slowly vertically, so the pilot needs information on objects many miles from him horizontally but not on objects more than about 1000 feet above or below him.

The basic Teleran system includes a long-range ground-search radar, a short-range ground radar, ground selection of codes to separate the signals received from various altitude levels, television cameras for picking up the radar presentations, a television transmitter for sending the pictures aloft, and a television receiver and transponder in each aircraft.

The transponder is a radio beacon which produces a clear image



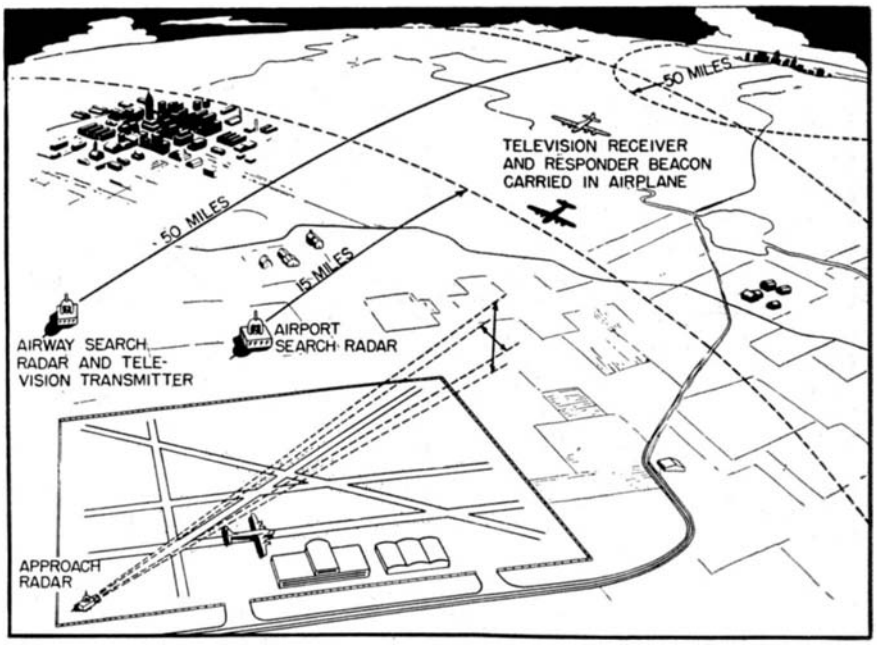
Control tower (below) of Gilfillan ground-controlled-approach landing system mounts a rotating antenna on top that searches 2800-square mile area of air space every two seconds



Cathode-ray screens (above) at ground-control operator's station; search indicator is on lower panel, azimuth and elevation indicators above

on the ground radar screens and permits altitude separation. The transponder is tied into the barometric altimeter so that its transmitted signal is coded in relation to altitude. Each pilot sees his plane as a spot moving on a map reproduced on his television receiver. He can identify his own plane by a radial line which appears in the picture and passes through his position on the map.

Should anything fail in either the ground or the airborne part of Teleran, the pilot will not receive false or misleading indications because he gets either a complete television picture or nothing at all.



Teleran installation showing station ranges. Information vital to individual planes is selected from composite traffic picture and relayed by television

GCA — Arrival and departure of commercial aircraft may soon be scheduled to and from airports without regard to the weather, by means of an Army-Navy radar equipment that has been used since early in 1945 to land aircraft during weather conditions of near-zero ceiling and visibility. This radar system, which makes closed-in airports a thing of the past, is known as "ground controlled approach" (GCA). The system can provide around-the-clock airport traffic control regardless of weather conditions.

In the GCA system, manufactured by Gilfillan Brothers, Inc., two microwave radar systems on the ground reveal the exact position of an incoming aircraft with respect to the landing glide path and permit the ground operator to radio precise flight instructions to a pilot coming in through zero-zero weather. One radar "search" system operates to aid in or control the homing, holding, stacking, and traffic pattern operations of aircraft. The second system controls the aircraft during its actual let-down along a predetermined glide path. No special equipment is required in the aircraft other than ordinary air-ground radio communications equipment.

The search radar system provides the GCA ground operators with information on the azimuth bearing and range of the plane from the airfield at distances up to 30 miles and at altitudes up to 4000 feet. The antenna is continuously rotated so that its transmitted and reflected pulses examine the space around the GCA location. The echo pulses received by the antenna are fed through electronic amplifiers that conduct them to a cathode-ray tube in the equipment. This is a high-persistence cathode-ray tube that displays the transmitted pulse at its center, and has an illuminated line from the center of the tube to its outer edge to display the azimuth of search.

With the search system, aircraft can be held at a given point and stacked in altitude prior to landing. It serves to line up the aircraft in azimuth with the second radar system. The latter is a precision system that provides operators with accurate information on azimuth headings, altitude, and range up to 10 miles. For more precise close-in work, a two-mile indication is also provided.

Instantaneous recordings are made on the screen of the cathode-ray tube, showing azimuth error in degrees and elevation deviation in feet with respect to the correct approach line and angle. This information is then relayed to the pilot who makes the proper corrections in heading and rate of descent.

The combination of the search and precision radar systems, the air-ground radio telephone, and the intercommunications system between operators, enables the GCA controller to give positive, accurate data on an aircraft's range and bearing from the airport. The pilot is given altitude, range, and bearing information in the last 10 miles of the approach which enables him to bring the plane to within a few feet of the ground.

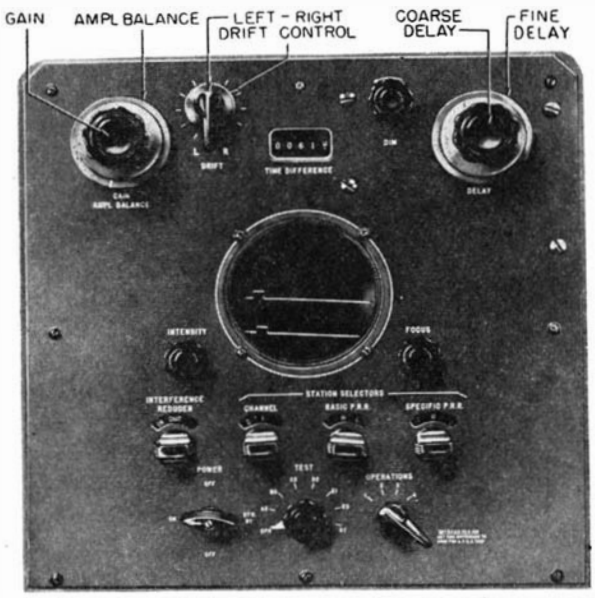
As used by the Army, GCA makes regular flight schedules possible around the clock when airfields are completely closed in by fog.

LANAC—A new war-born system for protection and navigation of aircraft while in flight, proposed by Hazeltine Electronics Corporation. is called Lanac, abbreviation for "laminar-air-navigation and anti-collision" system.

The system is based on the fact that aircraft in flight are restricted to certain laminae or air strata and that it is essential for these planes to know what obstacles are present in their respective strata of operation. Lanac makes it possible to prevent collisions between planes in the air or between planes and mountains, high buildings, or other fixed obstacles; identify individual planes while in flight as to airline and flight number; furnish direction and other data to the pilot without help from a ground crew; increase traffic-handling capacity of airways and airports; increase the safety of long distance flights; reduce the possibility of lost planes; and give airports and ground check stations continuous data on the location as well as the identity of all planes in the air.

Under the Lanac system, every airplane would be equipped with a challenger and a replier. These are radar sending and receiving sets controlled by barometric devices so as to be responsive only at the altitudes for which they are set. The challenger sends out a constant series of signals that are automatically picked up by the repliers of other planes in the same air stratum. Upon receipt of such signals, the replier automatically transmits a reply so that the presence of another plane in the same stratum is instantly known and collision can be avoided.

When ascending or descending, the pilot can temporarily change the barometric range of his challenger to investigate the air layers he is approaching. Through barometric selection, a plane in normal



Control panel of direct-reading type Loran indicator. Loran differs from radar and television applications; functions on an electronic stopwatch principle

Courtesy Sperry Gyroscope Company, Inc.

operation is advised only of obstacles in its own stratum of flight and is not confused by a multiplicity of signals from other strata.

Mountains, high buildings, and other fixed obstacles can be equipped with permanent repliers which will be responsive to challenges transmitted by any planes flying at a dangerous altitude.

Plane indentification is obtained by varying the reply signals in Morse code to give the letter designation of each individual plane. This information can be picked up by other planes and by ground stations.

For navigation, the pilot of a Lanac-equipped plane will be able to challenge beacons on the ground and receive their coded replies. With these navigational fixes the pilot can establish his exact position and determine his ground speed. These navigational beacons would be located at strategic points.

LORAN—A system of radio navigation which permits the navigator of an aircraft to determine his position at distances up to 1500 miles from shore-based stations at night, or 750 miles by day, by measuring the relative time of arrival of two or more radio signals sent synchronously from known points, is known as Loran ("long-range navigation").

Loran uses frequencies from 1700 to 2000 kilocycles (just above the broadcast band) and is substantially the same as the British "Gee" system that guided high-flying bomber aircraft over Germany. The Loran system involves a grid of radio signals across the earth's surface that are transmitted by numerous pairs of synchronized "master" and "slave" radio transmitters. Each master transmitter sends out radio pulses at fixed intervals; its slave transmitter (often hundreds of miles away) follows with a second series of pulses.

In the plane, the navigator uses his receiver-indicator to measure the number of microseconds of time-difference in the reception of the two sets of signals. He then consults a Hydrographic Office Loran chart which contains hyperbolic lines in color—a different color for each pair of stations in his area. To get his exact location, he switches his receiver-indicator to measure the time difference between another set of signals from a different pair of transmitters. By tracing the new line (of different color) he finds its point of intersection with the first line and thus determines his exact location on the chart. Under ideal conditions, Loran can locate ships or planes within a radius of 500 feet.

Besides its use over Germany during the war, Loran was the electronic guide for transport planes over the "Hump" between India and China and for B-29's after bombing Japan. Its maximum service area now covers more than half the area of the earth, and it can be used by both aircraft and ships.

TRAFFIC DEMANDS—At the present time, instrument-landing equipment is being installed by the Civil Aeronautics Administration at nearly 100 airports in this country. This is the three-element system developed by the CAA, consisting of a localizer, glide-path, and marker beacon. (See Scientific American, June 1945.)

Although the CAA favors gradual replacement of existing equipment after thorough tests of proposed systems, aviation experts agree that considerable development work will be necessary before radar techniques will be applied to commercial aviation. Acceleration of such development may take place, however, if the presently predicted 500,000 planes take to the air within the next 10 years.

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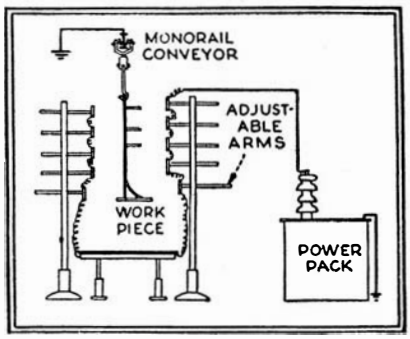
ELECTROSTATIC PAINTING

Assures Even Deposit Of Surface Coating

ELECTRONIC tubes provide high-voltage power for equipment being used in the electrodepositing of sprayed paint to achieve uniform coatings. The same equipment can be used to de-tear edges on pieces painted by the dip process.

An electric field is set up by fine wire electrodes positioned around the article to be coated, the article itself being at ground potential. These electrodes are fed pulsating D.C. power at voltages on the order of 100,000 volts.

Objects being coated do not necessarily have to be made of electrically conductive material. Wood and pottery parts have been satisfactorily handled. As an example of uniformity of coverage, it is possible to coat all sides of a part without turning it toward the source of the spray. The particles of paint which pass around the sides of the object turn in flight like homing pigeons and strike the rear.



Adjustable arms accommodate electrical field to various sized painting jobs. For de-tearing, polarity is reversed

For removing tears or drops of surplus paint, the electrode structure is replaced with a heavy grid and the dipped parts are stripped of surplus paint by reversal of polarity. This makes it possible for the paint chemist to formulate his finishes without regard to teared edges and thus use a wider selection of materials.

Speculum For Brightness

Electrodeposited Coatings of Speculum—an Alloy of Copper and Tin—Give Good Tarnish and Wear Resistance. Speculum is Less Expensive to Apply than Silver or Chromium Plating and Cuts Labor Requirements Considerably. Future Applications Will Cover a Broad Range

By FRED P. PETERS
Editor-in-Chief, *Materials & Methods*

• LOOKING AHEAD •

An ancient alloy, formerly used only in cast form, is bowing to the science of electroplating. . . When tin once more becomes plentiful, speculum plating will open new markets for it. . . Decorative possibilities of speculum plating run the whole gamut of metal uses, from the kitchen to jewelry. . . Not suitable yet for automobile trim and other outdoor uses, but research continues.

A NEW type of electroplated coating with a very old name has entered the highly competitive decorative finishes field and promises to find a permanent and increasingly important place among metal coatings. Known as speculum plating, and developed in England, the new coating looks like silver, has a hardness between that of nickel and chromium, possesses good resistance to tarnishing, and is relatively inexpensive.

Speculum is expected by its developers, the Tin Research Institute, of London (the American offices of the Institute are at Battelle Memorial Institute), to become in time a major rival of silver, nickel, and chromium as a decorative finish. First adopted commercially in Birmingham, England, in 1939, it was abandoned when bright metal finishes were eliminated in the interests of conservation, but was revived during the war for a few special purposes, such as non-magnetic metallic reflectors for certain aircraft instruments. Several commercial shops have been installed in Britain for these applications; full utilization has been held back, both in England and in the United States, by the tin shortage, but once tin becomes plentiful again and American designers and electroplaters are able to investigate the advantages and limitations of the new finish, it is expected to find wide uses. At present the sole American licensee is the City Auto Stamping Company in the mid-west.

AN ALLOY—Speculum is an alloy coating containing about 45 percent tin and 55 percent copper; actually it is a "white bronze." The alloy coating has been called speculum because its nominal composition and characteristics are similar to those of speculum mirrors first made by casting the alloy more than 2000 years ago. The only mirrors produced by the Romans were solid metal castings, the two most popular materials of that era being silver and speculum; the rapidity with which silver became tarnished and scratched retarded its general use and the speculum mirrors remained in wide use for 1000 years until the art of silvering glass was perfected.

The cast speculum mirror regained its prominence for a brief period in the 18th and 19th Centuries for making large diameter reflector telescopes. Thus, William Herschel made speculum reflectors up to 48 inches diameter with 40-foot focal lengths; he discovered Uranus and doubled the size of the then known solar system. Later, the Earl of Rosse cast speculum reflectors 6 feet in diameter with 60 foot focal length, which revealed many hitherto unknown star clusters.

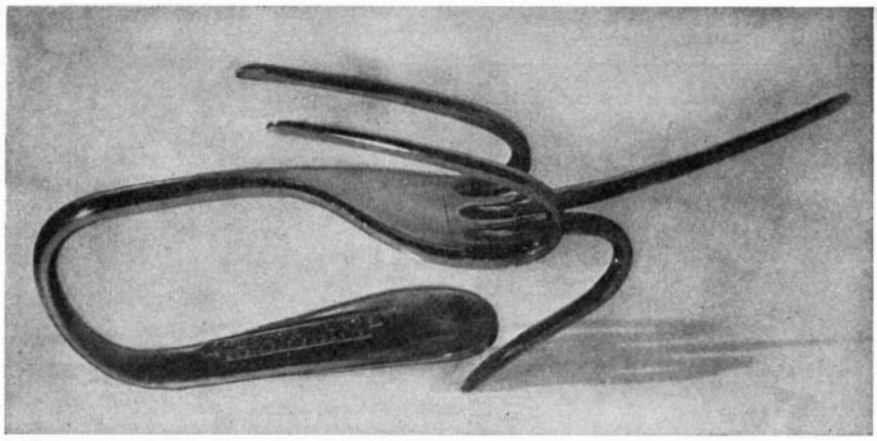
These speculum reflectors were massive castings and the difficulties that had to be overcome in their manufacture may be gaged by the fact that they took about three years to make. Also, they were lower in tin content than the electroplated speculum coatings of today, the composition of the cast alloy vary-

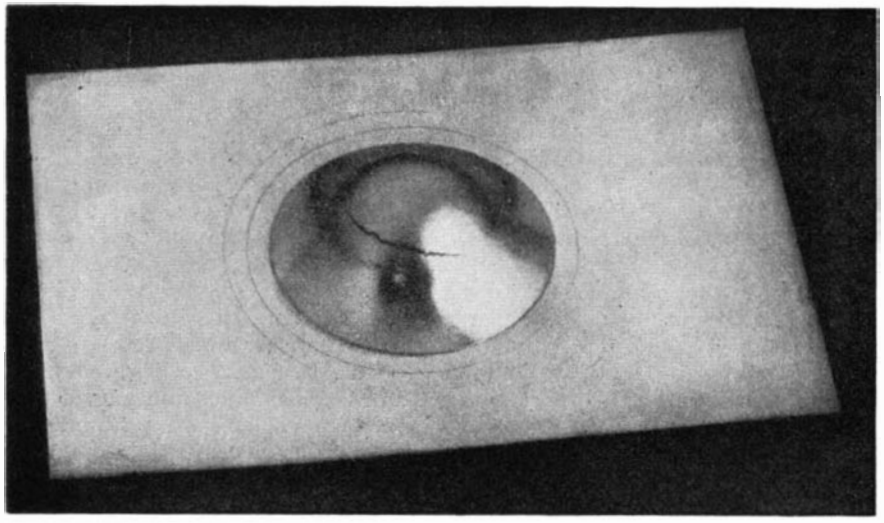
Photographs courtesy Tin Research Institute

Tea service of speculum-plated pewter. Not as blue as chromium, speculum has luster of silver but tarnishes less and resists food discolorations better

ing between 25 and 40 percent tin. Small cast speculum mirrors are still used for a variety of optical instruments because of their brilliant luster, but their relative brittleness in the cast form has restricted their general use. The modern electroplated speculum, which serves in the form of a brilliant coating on a ductile base material—for example, steel—overcomes this earlier limitation of brittleness.

The process of electrodepositing the alloy has roots both in the United States and in England. In 1931 a patent was obtained in the United States by H. M. Batten for a process that has since been used for the production of electrodeposited "red bronzes"—copper alloys with from 2 to 10 percent tin. The successful development of speculum plating baths, according to the Tin Research Institute, was more closely bound up with the art of plating pure tin from alkaline solutions, to which many workers have contributed.





Ductile, speculum adheres well to most base metals. Steel fork (above), bent after plating, shows no flaking of the speculum coating. In cupping test (left) base broke, speculum adhered

HOW DEPOSITED—The speculum plating bath now in use plates out tin and copper simultaneously to give a true alloy of controllable composition. The bath contains tin as sodium stannate and copper as cyanide, with free sodium cyanide and caustic soda also present. Because small variations in the composition of the coating are not critical and because of the nature of the bath, the process is relatively easy to operate. Sound chemical control is necessary to maintain the correct conditions of deposition—such control is required in all high-quality metal-plating—but the procedures are simple and well within the capacity of the normal plating shop laboratory. Cyanide and caustic soda contents have to be checked every two or three days, tin and copper every two or three weeks.

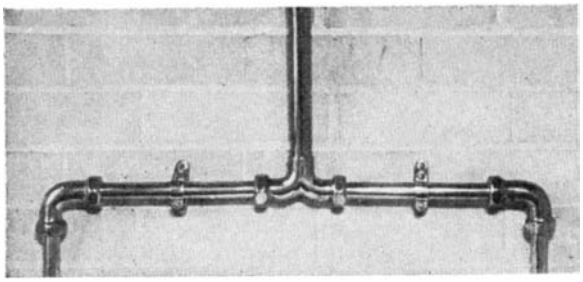
Because of the high corrosion resistance of speculum, it is not possible to use alloy anodes. Replenishment of the metal content of the electrolyte is obtained by using separate tin and copper anodes; the electrical circuit to the two anodes is split and each circuit is provided with separate means for individually adjusting the current. The copper anodes are operated under conditions similar to those in cyanide copper plating and the tin anodes are operated as in stannate plating of pure tin.

"ONE COAT" — Chief among the production advantages of speculum plating is that it is a "one-coat" finish, no undercoat being required. The bath has exceptionally good throwing power; depending on the base metal and the amount of protection or service life required, plating thicknesses usually applied lie between 0.0005 and 0.001 inch. The most important labor charges associated with the process are the time required for preparatory polishing and in final burnishing, and even here it is reported that less preparation is needed for speculum than for nickel-plus-chromium coatings. Indeed, the Tin Research Institute cites cases in which satisfactory finishes were obtained on stampings and spinnings right off the machines, and others—cast brass faucets, for example—in which the labor for polishing before plating was approximately halved over other coating requirements.

Speculum coatings may be applied directly to steel, iron, tinplate, nickel-silver, copper, brass, bronze, silver, nickel, pewter, and so on. The coating itself is ductile and will withstand a reasonable amount of deformation without flaking or spalling. In color it is very much like polished silver, being less blue than chromium and less yellow than nickel.

Tests made on speculum coatings to compare their tarnish resistance with that of other metals or coatings showed that after 30 days' exposure to ordinary kitchen and living room atmospheres speculum coatings had lost none of their brilliance or reflectivity, whereas silver fell off more than 50 percent in the living room and 80 percent in the kitchen. Even under the worst conditions of test, speculum needed no cleaning at the end of a month. Whenever it *is* necessary to clean speculum, no metal polish need be used; washing with water and wiping with a soft cloth when dry are usually sufficient. The metal is not affected by the sulfur from eggs nor by lemon or tomato juice.

WIDE USES—From the prospective user's point of view, the warm color of speculum is often more attractive than the slightly bluish tint of chromium; where used for interior metal trim, it should permit a wider choice of decorative color schemes. For jewelry or tableware it is as attractive as silver and has the merit of not requiring frequent polishing. Speculum plated spoons and forks have been in use for several years



Speculum-plated lavatory piping. Economy of its application makes this copper-tin alloy attractive for quantity use on plumbing fixtures

in some British homes and hotels and have remained perfectly bright with only the usual washing, while the coating, because of its hardness, has shown satisfactory resistance to mechanical damage.

Speculum coatings have also been highly successful for bathroom and plumbing fixtures. Wash basins fitted with speculum-plated faucets have been in constant use for six years and are still in perfect condition.

On the other hand, speculum cannot as yet be recommended for outdoor use or, for example, as ornamental trim on automobiles. The reason for the much better tarnish resistance of speculum in inside atmospheres as compared to its luster-retention outdoors is not yet clear, and may be a physical rather than a chemical phenomenon. At any rate the situation is currently the subject of technical research.

On the face of it, the cost aspects of speculum seem very attractive. The intrinsic cost of the metals used compares favorably with those of the other decorative metals or coatings in common use; it is, of course, much cheaper than some of them. Then, as only one plating operation is involved, equipment cost, space charges, and labor time are lower.

For these reasons, and especially because speculum provides a brilliant, long-lasting, easy-to-maintain finish at base-metal prices, increasing interest in its use is evident. With it, cheap tableware can be given as beautiful a finish as with

Service testing, on such articles as faucets, proved speculum's durability

silver. Speculum has already been used in plating electric lamps and fittings, cigarette cases and lighters, ash trays, brass ornaments, dressing table accessories, and—as already mentioned—bathroom fixtures. Service trials are now underway on speculum-plated cooking utensils, jewelry, golf clubs, bird cages, and even baby carriage parts.

Speculum pilot plants have been in operation for some years in England. When tin again becomes plentiful it looks as though the tin industry may have a new major market and manufacturers—here as well as abroad—will have a new type of decorative metal finish.

DUPLEX METAL

Produced by New Powder-Metallurgy Technique

AMOUNTING to a new type of metallic material, "Sinteel G" combines steel and copper in an unusual way.

Sinteel G is made by pressing iron or steel powder to form a porous briquette and then impregnating the pore structure with copper by immersing the briquette in a bath of molten copper alloy. The resulting product is dense—virtually pore-free—and, depending on the raw materials and subsequent heat treatments employed, may have tensile strengths ranging from 50,000 to 175,000 pounds per square inch. The latter figure is one of the highest ever reported for an essentially ferrous powder-metallurgy product. Because of its structure, the material is readily machinable and electro-platable.

From the standpoint of the powder-metallurgy fabricator, these "cemented steels" are especially interesting because their high strengths are obtained with low pressing pressures (20 to 45 tons per square inch) and without a coining operation, whereas heretofore such high strength in powder-metallurgy products has been obtainable only through the use of extremely high (and therefore expensive) pressures or with additional coining and repressing operations.

Another novel feature of these cemented steels is their self-brazing nature. Because of the copper they carry with them at all times, parts made of Sinteel G may be readily copper-brazed to each other or to other materials without the addition of external brazing alloy or flux. Very large or complicated parts, not normally producible by powder-metallurgy methods may thus be made by pressing simple or small components out of iron or steel powder, assembling them properly and then infiltrating the assembly with copper to give a uniform-impregnated and firmly brazed product.

Sinteel G, developed by American Electro Metal Company, is expected to find use for making large or complex parts or those requiring exceptionally high strengths that cannot be made economically by conventional methods.

AGE-HARDENING

Stainless Steel Combines Desirable Properties

THE COMPOSITION and physical properties of the United States Steel Corporation's precipitation-hardening stainless steel, which have been the subject of metallurgic conjecture for several months, were disclosed at the recent annual meeting of the American Institute of Mining and Metallurgical Engineers. The steel is of widespread interest because it provides a combination of high strength and excellent corrosion resistance without the necessity of cold-working the material for that purpose.

The composition of the new steel, called "Stainless W," is nominally 17 percent chromium, 7 nickel, 0.07 carbon, 0.70 titanium and 0.20 aluminum. By suitable age-hardening heat treatments—for example, heating to 1700 to 2000 degrees. Fahrenheit, quenching, and then aging at 950 degrees, Fahrenheit -- tensile strengths above 200,000 pounds per square inch and hardnesses up to 47 Rockwell C can be obtained. Titanium is the most important single element in the age-hardening mechanism.

Many applications are foreseen for the new age-hardening stainless steel, especially in bar form, for such products as cams and rollers in food handling and bottling equipment, and bearing and valve parts in the petroleum, chemical, and related industries.

Sell, Then Buy

Specialists, Familiar with All Phases of a Particular Process, and Fabricators, who Assemble and Sell, but are Not Manufacturers, are Supplementary Figures in Modern Industry. Interdependency, Mark of a Complex Civilization, Can Bring Better Products at Lower Cost

By EDWIN LAIRD CADY

BACK in the early 1930s, an old-time manufacturer of wood-working machinery was holding a management conference. The president, definitely of the old school, was pounding the table.

"Ya can always sell what ya ain't got," he said. Then, glaring at the sales manager and the purchasing agent who were opposing him, he added: "Never mind this stuff about buyin' cut gears on the outside. We've got a foundry and we're goin' to run it. What we want is a sales department that can sell the cast tooth gears, same as we always sold."

What this president was arguing was that manufacturing company profits must come from the operation of that company's own machinery.

What the sales manager and the purchasing agent were arguing was that business profits can come from the turn-over of operating capital no matter how this is achieved. They did not think in terms of any such economic philosophy, of course. All they had on their minds at the minute was to get some cut-tooth gears which would run more smoothly, and make less noise, and be more satisfactory to the customers than the old cast-tooth gears. But they were working toward the modern art of sub-contracting which could be defined as "the art of making money by selling what you haven't got."

Ball bearings are used in many products, but the art of their manufacture is concentrated in a few companies who supply, on order, either standard or special bearings

The lengths to which old-time manufacturers went in order to make everything themselves and "save the other fellow's profit" would amaze any modern management. They even went so far as to compound all their own cutting oils out of lard oil and similar raw ingredients, put in electro-plating departments which would function only one week out of every month, design and produce special electric motors for their machine tools.

NEW CONCEPTS — Modern management thinks the opposite way. It will not tool up to make anything until it has first made sure that it cannot buy that product from someone else to better advantage. There is too much competition for the services of every dollar available for investment. The same money which would go into an increase in the size of the gray-iron foundry might better be used to install an induction heat-treating set up, put on a more powerful advertising campaign, or open a Sacramento branch plant to manufacture goods for the west coast.

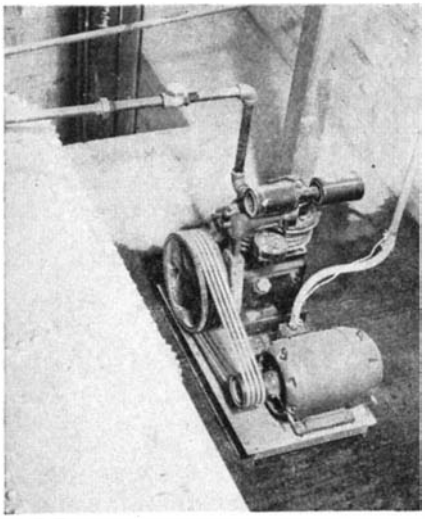
One result of this new philosophy is a host of brand new or greatly improved production methods. Specialists in various processes, learning that they could depend upon getting business from thousands of manufacturers, have been encouraged to develop their techniques and equipment to the point where they can produce at such low costs that it hardly pays a manufacturer who might buy from them to install his own production line.

The wood-working machinery company management which was arguing about whether to buy cut gears or continue to use its own cast-tooth products, could easily have installed equipment for cutting its own gears and obtained everything that a professional gear-cutting shop could offer. Tooth forms were simple and gear materials were few. Testing methods would have been confined to running pairs of the gears together to show up undue noises.

Today, that is no longer true; tooth forms can run all the way

● LOOKING AHEAD ●

Advances in the technology of most industries are so rapid in these times, that even those who manage to keep abreast of their own field must fall behind in others directly related. . . Add to this the cost of special machinery and trained personnel, and the worth of the specialized sub-contractor becomes apparent. . . This situation will continue with the almost geometrical growth of new techniques and their application to formerly slow-to-change products. . . Engineering, once confined to smoke-filled drafting rooms, will more completely take over the purchasing office.



Courtesy The Louis Allis Company

Simple air compressor is product of a complex economy. Motor, motor-control, belting, small fittings, and stampings represent specialized builders

from the simple involute spur gears to the various helicals, herringbones, hypoids, and others. Teeth can be ground for high dimensional accuracies, shaved for surface superfinishing to accuracies as close as one millionth of an inch, or burnished for long wearing qualities. Materials can include ordinary gray irons for low cost, steel forgings for toughness, heat-treated steels for high strength and hardness, fabric-reinforced plastics for silence, and many others. Inspections can be by micrometer-movement instruments, by shadographs, by electronic devices, and even by automatic X-ray equipment. Just to list the resources of a modern gear shop would take a thick catalog. To get what a well equipped maker of gears would offer, the wood-working machinery maker would have to invest hundreds of thousands of dollars in special equipment.

The gears might not even be made in a gear shop. They could be produced by a powder-metallurgy plant, in a precision investment-castings plant, on a press-forging production line, or by any of several other methods.

PURCHASE ENGINEERING — With all of these opportunities open, the modern management conference on how to produce a new design or new line has as much of purchasing as of manufacturing in its discussions.

The first step, of course, is working out the original design. And here is an abrupt break with old-line thinking. The old-timer would have told his engineers: "Don't design it unless you are sure we can make it." The modern manager is more likely to say: "Go ahead and work it out, we are almost certain to find someone who can make it."

After that comes a dividing of the parts or of the complete mechanisms which are to be bought outside from those to be made in the plant. A present-day engineer, for example, who planned on designing his own special electric motors and making them in his own plant, would have to have a highly unusual reason for doing so. But some of the gears might be made in the plant; others might be purchased outside; and still another group might be so specified that their holes were bored and their teeth cut in an outside contracting plant, but special facing or threading operations on them performed in the home plant.

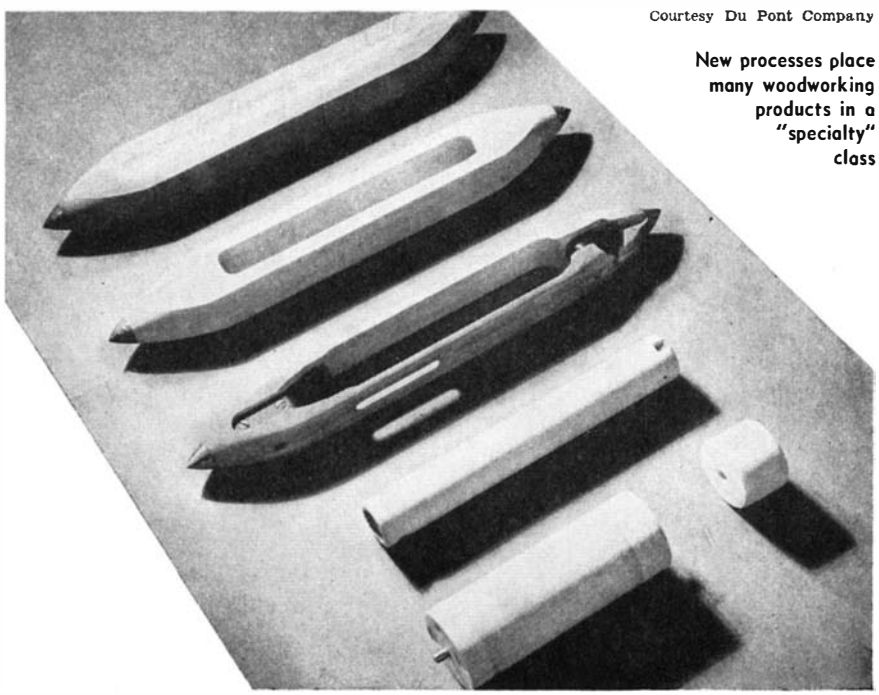
A new machine might need several types of stampings or forgings, some to be made to high accuracies and of stainless steels, and others to ordinary accuracies and of common steels. The high accuracy stainless-steel parts might be ordered from an outside contractor, the ordinary ones made in the plant.

All of this requires an engineering skill in purchasing which is a far cry from the days when the purchasing department was a mere checker of prices and placer of orders. But it pays dividends.

One purchasing agent had the engineering staff make a careful study of the possibilities of precision investment castings for their company's products. The first thing discovered was that the company would need at least $25,000 of capital outlay and a year of experimental time to get its own precision investment department into operation. This would not be worth while. But by dealing with outside contractors, three of the present parts could be cast integrally and made into one. The present methods call for two small stampings and one screw-machine product which are brazed together. The new method produces the whole assembly for less than the costs of its three members and eliminates two brazing operations as well.

NEW PROCESSES — Open to such purchasing agents are a large number of brand new processes and of old ones which are so vastly improved that they might well be classed as new. To mention a few which apply to small parts alone: Centrifugal casting, die casting, swaging, cold heading, plaster-mold casting, permanent-mold casting, press forging, upset forging, impact extruding, plastics molding. By merely adding to these and listing their variants, any good purchasing engineer could set down enough purchasing opportunities to fill an engineering directory.

An example is the purchasing agent who brought into his plant operations which previously had been bought on contract from outside companies. He was employed by an airplane company which was changing its models so constantly that parts had to be ordered in rather small lots. Here a problem arose on parts fabricated by stretch-pressing and other mild forming methods. The tool and die charges were high, the purchasing agent constantly had to send out new blue prints and wait for quotations, and when the first shipments of new parts arrived their designs often had to be modified to conform with



Courtesy Du Pont Company

New processes place many woodworking products in a "specialty" class

Westinghouse photograph

Extensive research equipment and skilled technicians make "outside" contractors "wise" in the ways of producing items needed by industry

further changes in the plane models.

Then, the agent had the purchase engineers study the cast thermosetting phenolic resin plastics which have sufficient structural strengths for some tool purposes. These can be cast to shape in wood, plaster, or metal molds which have been coated with a special lacquer to facilitate removal. By including an accelerator in the mixture of phenolic resins, dies good enough for short production runs could be made in only 12 hours of plastics setting time. By eliminating the accelerator and taking 96 hours of setting time, tools having the necessary structural strength and fatigue resistance for fairly long production runs could be produced. The making of the necessary molds was a simple process once the mock ups of the parts were completed.

The plant, then, could have the tools for turning out short production runs within 24 hours after completing the parts mock ups, and tools for longer runs could be ready in a week. Later on, decision could be made as to whether to continue making the parts with those same tools, or with more durable steel tools, or to have them made outside and free the production line for further short-run work.

SPECIALIZATION — While all this has been going on in plants which use metal parts and mechanisms, other industries have not stood still.

The textile industry has spent the past 40 years learning to specialize. There are some large and self-contained mills; plants that are sufficient to themselves still exist in nearly every industry. But more and more the weavers of textiles tend to obtain their fibers from one producer and send their materials to professional dye houses to be dyed in the skein or in the piece. Many mills do nothing but weave, getting their bobbins ready-wound and their warps ready-filled, choosing their fibers and colors in accordance with the materials and colors they can sell. And the higher the prices and qualities of finished fabrics the more likely they are to be the products of chains of specialists who run their individual plants but serve one another.

Woodworking is following a similar path. For a long time the only raw material of this trade was raw lumber, and every plant was a more or less direct competitor of every other. Now, with the new wood preparation processes—transmitted, stabilized, and hydrolized wood—there is plenty of room for specialization and its consequent sub-contracting.

One large fabricator of wooden products already has a crew of purchasing engineers in the field and is training more. The job of these men is to go to the smaller plants, teach them the new techniques, get them to make the specially processed raw materials and even the semi-finished and the finished products which the fabricator can sell. The use of new quick and sure-setting cements to make laminates of various woods and of woods and metals, glasses, plastics, and synthetic rubbers is one of the arts which these engineers will teach. They will be aided by sales engineers of the cement and the equipment making companies which want to sell to these processors. But the main objective of the fabricators is to add the flexibility of having widely diversified sources of supply from which to buy specially processed raw materials which he can fabricate and sell.

This trend toward buying products rather than insisting upon manufacturing them has one meaning that often is overlooked. A good description of "civilization" would be: "That state of society in which men can depend upon each other instead of having to depend upon themselves alone." And when manufacturers base their profits upon wide-spread purchasing of finished products in open markets rather than solely upon what they can make in their own plants, it means that industry is assuming a state of civilization.

MOBILE CARRIERS

Give New Flexibility To Industrial Operations

TAKING advantage of the extreme advances in the design of gasoline engines, Diesels, and electric motors which were made during the war, the development of mobile carriers for all sorts of repair and maintenance and even of production equipment promises to be one of the most interesting phases of engineering for the next few years.

One type of equipment embodies welding generators, hoists, and other positioning equipment for parts to be welded, and a small air compressor to supply pneumatic power for welding clamps and for chipping hammers.

Another type has a closing and stapling unit for boxes which can be run to any point on a packaging line and operated there. It is an adaptation of existing stationery equipment with a small Diesel to supply the power. Its use makes the shipping line far more flexible, permits freight cars to be spotted for loading with more of the platform spots available to take-offs or branches from the main gravity conveyor, and permits pallet loading to be carried on at enough stations along the production line so the line need never be stalled if the lift trucks do not arrive rapidly enough to keep the stapling machine free of filled boxes.

These two uses show extremes of adaptations for mobile carriers. And with the new engines and motors their development has just begun.

SUPER-HARD METALS

Now Find Wider Use in Familiar Articles

EXTREMELY hard metal surfaces that can be welded, brazed, or mechanically fastened to softer metal parts to prevent wear are finding new uses every day. One of the latest is as edges on snips used for cutting wire screening, aluminum sheets, and other metals which quickly dull the softer steel edges that are used for cutting tin plate. Another use is in nozzle tips to handle liquids in everything from fog-spray fire fighting apparatus to cotton and other farm sprayers. Only a few years ago these extra-hard metals were regarded as high-cost and temperamental products to be used only in high-capacity high-precision metals cutting equipment. Now they are to be found quite frequently in the "common" or "garden" varieties of equipment that everyone uses.

Petroleum Process Products

From about Two Percent of the Crude Oil Produced Comes a Myriad of Little-Known Materials that Aid—In Proportions Far Exceeding Their Quantity—In the Production of Nearly Everything We Use, Eat, or Wear, Emulsified Waxes and Textile Oils Have Major Importance, Wide Use

By JOHN C. DEAN
Technical Division, Process Products, Socony-Vacuum Oil Company, Inc.

THE SCOPE of petroleum's utility as a processing material is virtually unlimited. At present, over 30 basic industries employ petroleum in their manufacturing processes, and the individual applications are numbered in the thousands. Some conception of this use of petroleum, both as a processing material and as a source of organic chemical compounds, may be gained from statements that point out the possibility of more than a million such materials and compounds that have petroleum and natural gas as a starting point. This compares with about 500,000 derivatives from coal tar, long considered a chemist's treasure trove.

It is also interesting that a very small portion of the crude oil total is required for producing process materials. Fuels, lubricants, and greases—the petroleum industry's standbys—account for about 98 percent of the total output of the wells. Yet, the remaining 2 percent looms significantly large in terms of both financial and human values. For example, it is impossible to set a monetary price upon the accomplishments of the minute quantities of petroleum derivatives that are used in life-saving medicines. Neither can the values of the process products that contribute so much to ultimate consumer satisfaction be reckoned entirely in terms of financial return to the petroleum refiners.

WAX EMULSIONS — A typical petroleum process product is found in wax emulsions. Here a multitude of industries—textiles, paper, food, wood, and so on—profit from a tiny segment of the petroleum chemist's research.

Most of the familiar uses for petroleum waxes have been as "hot melt coatings"—that is, wax applied in a molten condition. There are, however, other methods of applying waxes, one of the most effective of which is in the form of an emulsion. These "wax emulsions" are suspensions of wax in water, stabilized with suitable emulsifiers and dispersing agents. Wax emulsions look like milk, and in fact are quite similar in general composition to milk, which is essentially a suspension of butter fat in water stabilized with casein. The wax particles of an emulsion are similar to the droplets of butter fat, and the emulsifiers are comparable in action to the casein.

One of the advantages of a wax emulsion is that it permits small quantities of wax to be applied in controlled amounts. This control is also possible with solutions of wax, but with emulsions, no costly solvent-recovery units are needed; the vehicle (water) is non-toxic and non-flammable; and the application can be effected at very low cost and with readily available equipment.

An easily visualized and important use of wax emulsions is the treatment of textiles to impart a water-repellent finish. This is accomplished by running the textile cloth through a wax emulsion bath in which it picks up some of the emulsion. Upon drying, small amounts of wax—generally between 1 and 4 percent—become deposited on the individual fibers and render them resistant to water. The cloth then has watershed properties. This treatment has practically no effect upon the appearance of the cloth or upon its feel or "hand." Furthermore, because of the openings which remain between the fibers, adequate ventilation is provided when the material is used for clothing. If the fabric were water-proofed by a hot-melt coating, however, it would be stiff and board-like. The armed forces purchased millions of yards of fabrics treated with wax emulsions for use as tent cloth, drills, cotton duck, and mosquito netting.

PAPER TREATMENT — A second extremely important use of wax emulsions is in the manufacture of paper, where once again small quantities of wax are capable of imparting water-resistance. Two methods are used for introducing the wax into the paper; one prior to the formation of the sheet, and the other as a treatment of finished paper. The former method is known as beater-sizing, and involves adding wax emulsion to the pulp while it is being beaten. By this method the microscopic wax particles of the emulsion are deposited uniformly on the paper fibers and give each

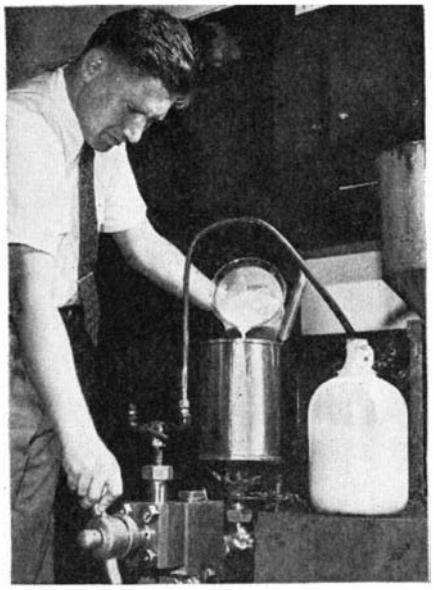
• LOOKING AHEAD •

More and more petroleum refiners are setting up laboratories to study industry's processing problems. . . And more and more specialized products are being produced to eliminate these problems. . . Industrial-refiner co-operation is often necessary to establish the facts. . . The final process product, as exemplified by textile oils, is compounded to do a precise job. . . The high costs of makeshifts vanish, and a competitive edge and better merchandise accrue to the manufacturer who searches scientifically for processing materials.

fiber a degree of water-repellency.

The other method of paper treatment is known as surface-sizing or top-sizing, and is accomplished by passing a finished sheet of paper through a bath of emulsion in substantially the same manner as in the treatment of textiles. With either method, wax emulsions improve the water-resistance of paper, enhance resistance to scuffing, provide better printability, and yield a smoother, more attractive sheet. The effectiveness of less than 1 percent of wax in these applications is truly remarkable.

USEFUL WAXES — Most petroleum-wax emulsions were originally developed for the treatment of textiles and paper, but they have proved to be so versatile that a number of other interesting uses for them have been found. For example, a wax emulsion is now being used for the treatment of white potatoes to improve storing properties. Clean potatoes are dipped in a diluted emul-



Small homogenizer for preparing wax emulsions uses 5000-pound pressures

sion and are then dried to deposit small amounts of wax on their surfaces. In actual practice, one gallon of emulsion will treat between 30 and 40 bushels of potatoes, which will then remain fresher, last longer, and show much less loss in weight during storage. In addition, wax emulsions have been found to be effective for the treatment of cut potato seed before it is planted. Here it prevents rotting of the seed during wet weather and ensures a healthier stand of potato plants after germination and sprouting, so that increases in yield up to 15 percent have been reported in many instances.

The manufacture of certain wooden articles, such as bowling pins and shoe lasts, can be facilitated by a wax emulsion treatment of rough-cut blocks which are kiln-dried before being turned down to finished articles. These blocks are generally cut from green lumber, which, if allowed to dry with no treatment, would develop cracks or checks that penetrate far into the wood. This splitting is caused by in-

Life of sole leather is upped about 25 percent by processing with special oil. Abraser in foreground tests soles

ternal stresses and strains that are set up in the blocks because of non-uniform loss of moisture. The thin film of wax which is deposited promotes uniform drying and practically eliminates the destructive internal stresses.

During recent years, many ceramic pieces, particularly steatite parts for radio and radar equipment, have been manufactured by automatic high-pressure extrusion. The body mixes are generally molded in a nearly bone-dry condition, and therefore require an agent to permit plastic flow, as well as a binder to maintain rigidity in the pressed pieces. An emulsion of a microcrystalline wax, especially selected because of its toughness and adhesiveness, has been found extremely well suited for this work. Many of these steatite parts and such other ceramics as porcelain and chinaware are finished with a glaze, in which another wax emulsion has been found to be effective as a binder. In these applications, replacement of starches and natural gums with waxes speeds production and produces more uniform glaze coatings.

The list of other uses of wax emulsions is long; a few are the

Photographs courtesy Socony-Vacuum

Testing a wax-emulsion-treated fabric for water repellency. Cloth remains porous, but water runs off its surface

polishing of clothes pins, treatment of nursery stock during transplanting, water-proofing of burial vaults, and as an additive for starch in laundries.

TEXTILE OILS—Wax emulsions illustrate the fact that certain basic petroleum products must be compounded to render them useful. A second field of activity where such compounded products are widely used is in the manufacture of textiles. The textile field is broad and includes woolen and worsted fabrics, cottons, rayons, and cordage fibers, all of which are treated with petroleum oils of one type or another.

In the processing of woolens and worsteds, it is necessary that the fibers be lubricated to prevent breakage during the combing, spinning, and weaving operations to which they are subjected. Wool, as it is sheared from the sheep, is covered with wool grease, but this fat is lost when the raw wool is scoured to clean it of dirt. Therefore, nature's lubricant must be replaced before the clean wool can be handled further. When fatty oils are used in processing, they are applied as crude emulsions made by adding them to warm solutions of caustic and alkali. A more modern method uses self-emulsifying petroleum oils, which produce highly stable emulsions when added to water.

Mineral oils have several advantages in this use. They do not become rancid with age, as do some fatty oils, and therefore cannot become spontaneously ignited as in extreme cases of autoxidation. In addition, petroleum products provide better lubrication of the fibers because fewer fibers are broken during processing. The result is the formation of a stronger yarn.

After the lubricated woolen fibers have been processed into woven

cloth, the lubricant has carried out its appointed task, and must be removed. This is accomplished in the "fulling and scouring" operations in which the cloth is wet with a concentrated solution of soap and alkali and subjected to a pounding which causes it to shrink. This shrinkage in length and width renders the cloth thicker, or fuller; hence the term "fulling." When fulled to the proper degree, the cloth is scoured or rinsed by passage through a succession of warm- and cold-water baths during which the dirt, alkali, soap, and oil are removed simultaneously. The finished wool, originally oiled with 3 to 10 percent of lubricant, emerges with its oil content reduced to 0.5 percent or less.

SIZING—In the case of cotton goods, petroleum is used largely in finishing or sizing operations where fillers and softening oils are applied to the cloth to improve appearance and hand, and to increase weight or body. Sizing materials, such as starches and gums, are generally quite brittle, and therefore require a softening agent. In many instances, petroleum oils of various types and certain petroleum waxes can successfully perform this plasticizing action. Numerous types of sizing operations are employed with cotton goods—for example, the sizing of warp threads, heavy back fillings of book-binding cloth, and plain sizing of cotton dress fabrics and similar materials. In addition there are certain emulsifiable petroleum products that are used in the Sanforized process as softeners and as agents to improve the re-wetting properties of the cloth.

The rayon industry is a particularly large user of petroleum oils which are employed as lubricants for the rayon fibers. While only very small percentages of oil are applied, tremendous quantities of rayon are produced and the consumption is so large that the oils are usually purchased in tank-car quantities. A less important application in rayon processing is their use in soaking oils which serve as softeners for the gums and starches used in the manufacture of rayon crepes and rayon stockings. These mixtures are applied to the yarn before knitting or weaving to set the twist, but are washed out after these operations, thus releasing the fibers and permitting them to develop the characteristic texture of the fabric.

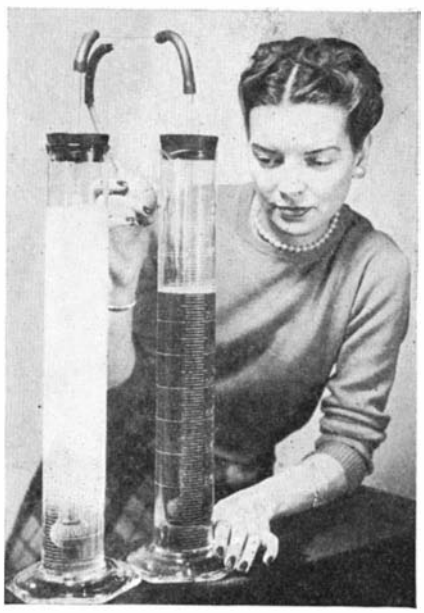
The processing of cordage fibers such as jute, sisal, and hemp also requires the use of large quantities of mineral oils, petrolatums, and waxes. They are employed as lubricants, softeners, or water-proofing agents for the finished products in order to prolong their service life or to render them more useful for specific applications. Addition is most generally accomplished by direct applications to the fibers either prior to or during stranding operations.

Probably the outstanding feature of an examination of the petroleum-process-products field, is the apparent endlessness of applications. Nearly every phase of industrial endeavor, from the manufacture of synthetic rubber to the formulation of chewing gum and candy, call upon petroleum for sometimes minute —but usually vital—quantities of processing products.

ANTI-FOAM ADDITIVE

Improves Engine Lubrication at High Power Outputs

OIL FOAMING, a condition stemming from the violent mixing of air and vapor with lubricating oil under high-speed and elevated temperature conditions, has at times promised to hamper the wide useage of the most modern engine designs. In its worst form, foaming may cause engine failure; milder cases frequently impair lubrication and give rise to oil loss through breather passages and other engine openings. Now, the development of an anti-foam additive that reduces the surface tension of the oil and permits each individual bubble to break up on reaching the surface is said to offer a material reduction of foaming troubles.



Additive-treated oil (right) does not foam when mixed with air. Same oil, if minus additive (left), foams vigorously

Previous attempts to limit foaming by means of mechanical traps and similar devices, while partially successful, complicated the lubrication system and did not correct the basic trouble source. Use of anti-foam additives, however, such as this one developed by Gulf Oil Corporation, may clear the way for more widespread use of the so-called "heavy duty" type engines.

THIOPHENE

Once Expensive, Will Alter Familiar Products

UNEXPLORED fields in chemistry—especially in the plastics, pharmaceutical, and dyestuffs industries—may be opened up as a result of a new and inexpensive method for producing thiophene from petroleum. Previously priced at $54 a pound, too expensive for extensive use, thiophene can now be produced, according to Socony-Vacuum Oil Company, developers of the method, at a cost that is commercially practical.

A colorless liquid, thiophene is heavier than water and boils at 183 degrees, Fahrenheit. Its odor somewhat resembles that of benzene. Also, thiophene resembles benzene in its reactions, although different reaction conditions may be necessary. A large portion of the chemical industry is built around the chemistry of benzene. Dyes, pharmaceuticals, plastics, and a host of other chemical commodities to a large extent are derived from benzene and its compounds. Thiophene, therefore, permits the chemist to prepare many of these products which differ in that they will contain the thiophene ring in place of the conventional six-carbon-atom benzene ring. This fact presents numerous opportunities for altering such characteristics as the color of dyestuffs, the physiological effects of medicinals, and the hardness, elasticity, brittleness, and many other properties of plastics.

Under suitable reaction conditions, thiophene also reacts with aldehydes, to form thermosetting resins. In this respect, the behavior of thiophene may be likened to that of phenol, although there are important differences. Nevertheless, in the condensation of phenol with aldehydes, under suitable reaction conditions, it is possible to replace phenol with thiophene in any proportion.

The raw materials from which thiophene is made are plentiful and it is expected that production of commercial quantities will soon be under way.

Aviation Engineering Emerges

Boosting Cooling-Air Flow with the Energy of Hot Exhaust Gases; Means of Making True Automatic Flight Commercially Possible; and Many Other New Ideas were Food for Discussion at a Recent Aeronautical Engineer's Meeting. Aviation Research went Far During War Years

By ALEXANDER KLEMIN

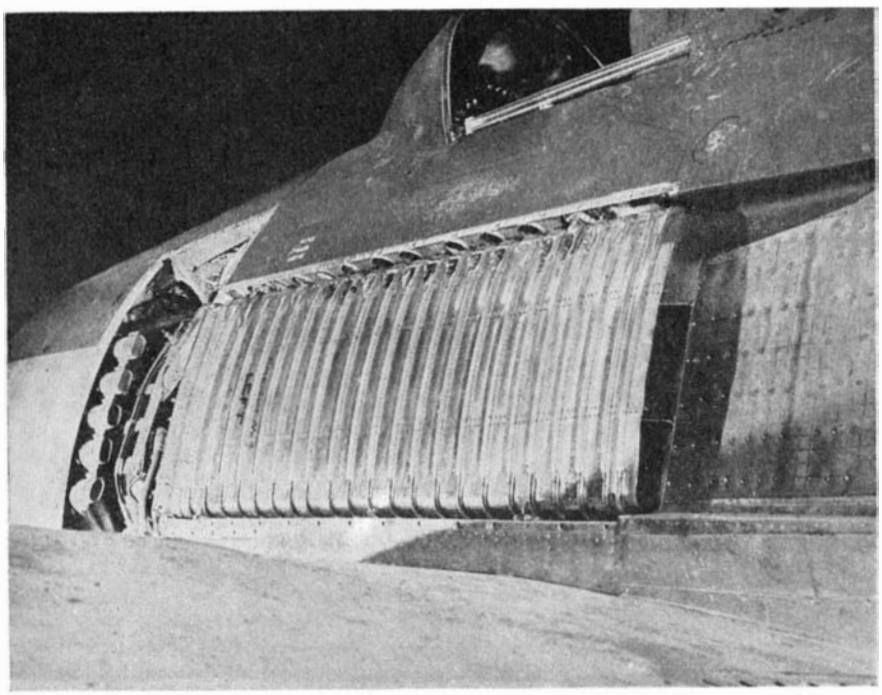
Aeronautical Consultant; Research Associate, Daniel Guggenheim School of Aeronautics, New York University

● LOOKING AHEAD ●

Aviation, involving nearly all the industrial sciences in one way or another, offers a fertile source of painstakingly obtained knowledge. As examples . . . the hydraulic motors that actuate so many aircraft controls must be unfailing, accurate, and rugged; qualities that make them potentially valuable to designers of machine tools and like equipment . . . dynamically similar models point the way to scientific but economical preprototype research for builders of a host of non-aeronautical devices concerned with critical dynamic forces . . . and instruments actuated by signals transmitted from a remote point of measurement may afford the laboratory worker and engineer an intimate picture of product performance in the field.

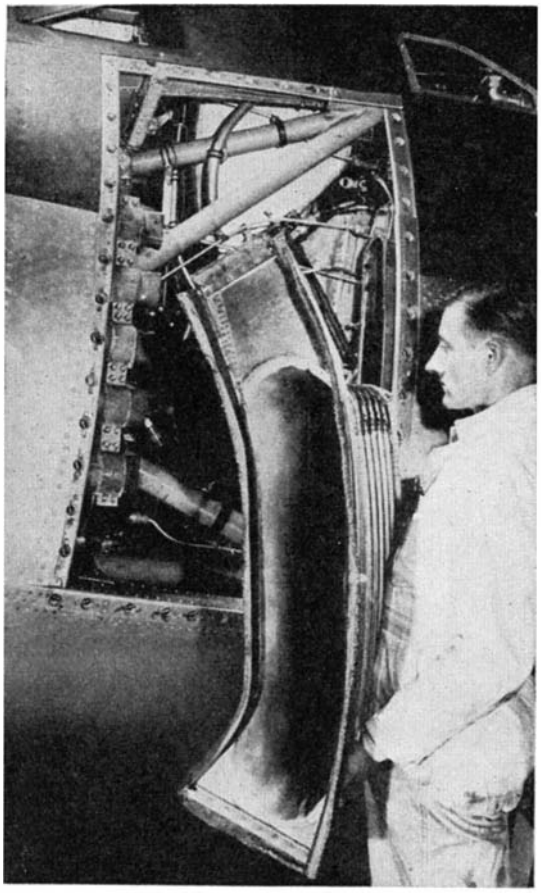
AVIATION'S war-time role was a large one, and while many accomplishments of both the industry and the planes and their crews have become legend, other activities have necessarily been carried on rather quietly because of their inherent nature. One of these comparatively unheralded activities was the work of the aeronautical design and research engineers. Now, with the tremendous pressure of war removed, many of the once-restricted research projects are being revealed and made public. Viewed in this light, the recent Annual Meeting of the Institute of Aeronautical Sciences opened a storehouse of data indicating the extent of aviation progress during the past several years and the manifold possibilities of future aviation. It is, moreover, well to note that many devices and methods originally slanted at the sometimes demanding requirements of aviation are often worthy of adaptation to other industrial fields.

TELEMETER INSTRUMENTS — Radio, quite apart from its well known navigational and communications uses, has aided aeronautics—scientific and practical—in numerous ways only recently revealed. For instance, in aircraft instrumentation systems, it is frequently necessary or desirable to have indications of measured values at some distance from the point of measurement. This is a common need in flight-test work and is particularly important in radio-control research where planes are sometimes flown unaccompanied by personnel.



Rear of exhaust-pump mixing ducts fit recess in fuselage; provide jet-thrust effect

For such conditions, means of reading flight instruments on the ground were described by David William Moore, Jr. of Fairchild Camera and Instrument Company. Called "telemetering," the system permits remote reading of a standard aircraft instrument which has been slightly modified by the addition of a pick-up device magnetically coupled to the pointer. The pick-up does not hinder the normal functioning of the instrument since no friction is involved, and the only actual change in the instrument is the mounting of a small permanent magnet on the pointer hub. The transmission of the pointer position is brought about by a magnetism-sensitive element, mounted on the instrument face, and a radio-electronic system of some complexity. The theory of operation is based on the phase-angle relationship of the pointer, the output signal, and the receiving instrument on the ground.



Easily removed for servicing engine, fore-part of exhaust-pump mixing ducts must be carefully designed and formed in order to merge cooling air and exhaust gases at proper velocities for effective cooling. Mixing ducts are only exit for cooling air. Quintet of short tubes at left is exhaust stack portion of cooling system

In operation, the pointer on the ground instrument moves in co-ördination with the pointer in the aircraft instrument.

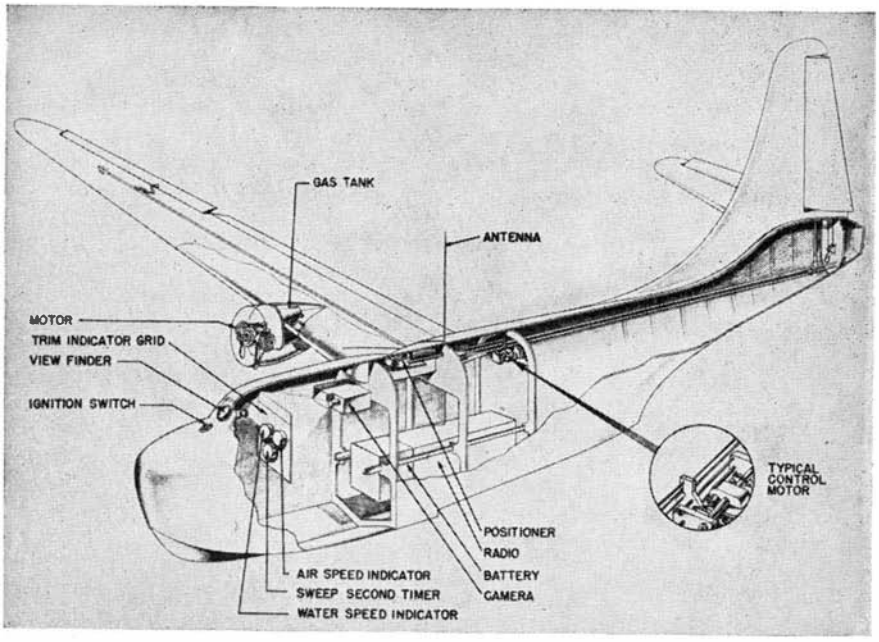
Although originally designed for aviation purposes, it is now indicated that the telemeter principle can well be adapted for many industrial uses where remote indications of instrument readings are needed.

DYNAMIC SIMILARITY — Radio-control has not been confined to full-scale aircraft testing. Under the title, Precision Radio-Control of Dynamically Similar Flying Models, Ernest G. Stout of Consolidated Vultee Aircraft, explained the flight testing of seaplane and flying-boat models which were controlled by radio and provided with a movie camera to record the desired data. These dynamically similar models, originally developed for tow-basin testing, must be built with great attention to similarity of elastic characteristics and the mass must be distributed in the model in precisely the same way as in the full-scale machine. The complexity and expense of such construction is much greater than for geometrically similar wind-tunnel models. However, the non-flying, although dynamically similar types first used, were limited as a completely reliable source of design data because of tow-basin testing methods that required restraining as well as driving forces to be applied while the model traveled the half-mile length of the water-filled test basin. Consequently, radio-controlled flying models which can take off, land, exhibit stability or non-stability characteristics, and generally perform like the full-scale aircraft without restraint from test equipment, represent a genuine step in research progress.

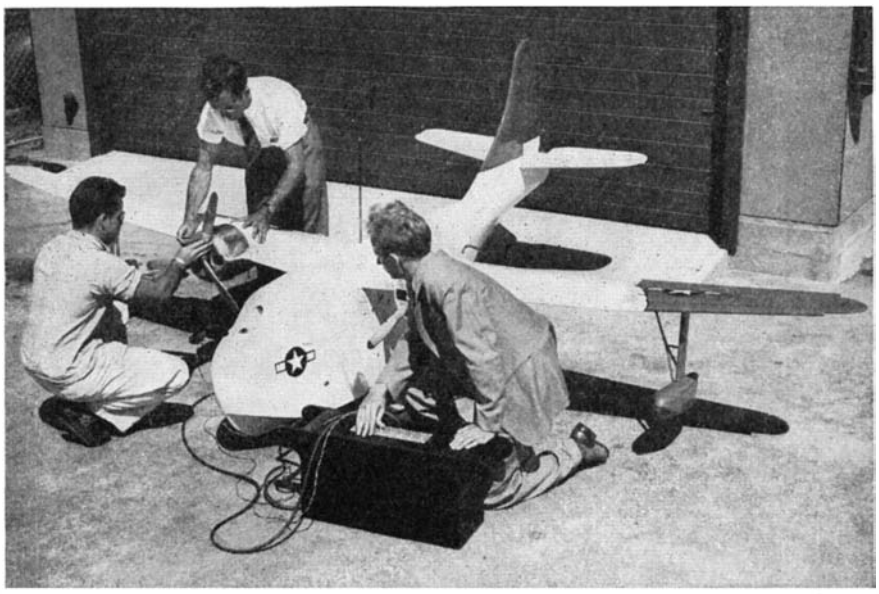
One model of this type, a ⅛ scale model of the Consolidated Vultee twin-engine flying boat, is powered by two one and one half horsepower, two-cylinder gasoline engines weighing about three pounds each. The entire model, complete with engines, propellers, fuel, radio receiver, servo motors, and batteries, weighs 78 pounds as compared with 40,000 pounds for the full-scale plane. The operator's ground control station is essentially similar to the plane's actual flight deck and carries full scale controls. A 63-watt output transmitter transmits a single radio-frequency carrier wave modulated by seven audio frequencies which control the flaps, ailerons, rudder, elevator, two throttles, and ignition. The pilot's control wheel is equipped with a micro thumb switch which engages the auto-pilot.

Thus, radio control, coupled with a movie camera and a special film analyzer as the recording portion of the team, now provides an accurate, relatively inexpensive, and thoroughly safe way to check preliminary aircraft designs.

HYDRAULIC MOTORS — Turning from general research to specific aircraft equipment, a paper by James Robinson of Vickers, Inc., discussed the hydraulic motors that found such extensive use in wartime aviation and now appear equally valuable for peace-time industrial applications. Basically simple and reliable, a hydraulic motor consists of little more than a cylinder, piston, and a pair of valves. Functionally these motors provide an efficient conversion of hydraulic power to rotary motion. As compared with electrical motors, hydraulic motors have greater acceleration and deceleration rates and improved reversibility; in fact, almost



Complex controls in dynamically-similar models allow realistic test maneuvers



Starting engines of 78-pound model; flight data will guide design of real plane

instantaneous reversal from full speed in one direction to full speed in the opposite direction is reported possible. The pressures used—in the 3000 pounds per square inch range—allow extremely compact and light designs. A hydraulic motor weighing only 6.5 pounds can deliver 15 horsepower. In addition, since hydraulic fluid is always present in the system, no special lubricant is necessary.

Aircraft uses for these powerful little units have been rather diversified. Hydraulic motors power gun turrets, wing flaps, landing gears, control surfaces, and even cable winches for air-sea rescue operations from helicopters. Adaptations in the non-aviation fields, however, promise to be equally extensive—particularly for actuation of such items as machine-tool controls and other automatic machinery.

ENGINE COOLING—As air-cooled engines increase in power and compactness, it becomes more and more difficult to cool them. Cooling air streams which are adequate for 400 or 500 horsepower engines, are inadequate for engines that develop 2000 or 3000 horsepower. This is, in part, due to the remarkable engineering progress that permits these latter powers to be obtained with very little increase in the frontal area exposed to the air stream. One remedy has been the installation of an engine-driven blower at the front of the engine so as to produce what might be termed a "forced draft." But, since the engine must devote a substantial amount of power to driving the blower, the improved cooling comes at the expense of a reduction in the over-all power available for thrust.

Now the exhaust pump, another approach to the cooling problem, appears as a possible solution, and the main features of this device were reported in a paper, The Exhaust Pump for Engine Cooling, by Carl de Ganahl of Kaiser Cargo. Paradoxically, the exhaust pump is reported to improve cooling and, at the same time, yield an actual increase in thrust power. The cooling improvement stems from the use of the high velocity exhaust gases as a means of increasing the rate of cooling air flow over the engine. The pressure differential necessary to accomplish this is achieved by sealing the cowl, with the exception, of course, of the usual frontal-inlet area. Thus, cooling air is forced through one or more small mixing ducts extending from the rear of the engine to the after edge of the wing. Here, in the ducts, the cooling air is mixed with fast-moving exhaust gases in such a manner as to produce the two-fold advantage of accelerating cooling air flow and imparting additional thrust to the plane at the point of ejection.

These two major advantages of exhaust-pump cooling are supplemented by further gains such as more effective cooling during ground operation, and dampening of exhaust noises and flame. It was emphasized that design and construction must be properly engineered for successful use of this system.

Among other discussions at the meeting was one directed toward potential expansion of the uses of the electronic-type automatic pilot. It was suggested, for example, that interconnection of the pilot with the radio altimeter, blind-landing equipment, and radio and radar-homing devices, might soon provide an almost completely automatic means of piloting and navigating either military or commercial aircraft. It was pointed out, however, that the inherent expense and weight of such a pilot would tend to rule it out as a private airplane unit.

Probably the most outstanding feature of the Institute of Aeronautical Sciences meeting was the great variety of active projects, ideas, and improvements represented. Certainly, it portends a healthy technical future for the aviation industry.

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AVIATION SURVEY

Is Issued by C. A. A.
In Pamphlet Form

THE AVIATION Information section of the Civil Aeronautics Administration has announced the issuance of a pamphlet entitled *Civil Aviation and the National Economy.* In it, exhaustive treatment of nearly every aspect of civil aviation is supplemented by many statistics; special emphasis is placed on the employment potentialities of the industry. Included in the booklet are many rather striking statements, among them: predictions of 400,000 civil airplanes for personal use by 1955; 2,600,000 families able to afford such planes, again by 1955; and estimates of about 1000 passenger and 200 cargo airplanes as representing the future equipment requirements for domestic and international air transport.

RUNWAY ILLUMINATION

Guides Planes in
With "Aisle of Light"

Two towering walls of light, on either side of a broad concrete runway, 8400 feet long are now being installed at New York City's new airport at Idlewild. This "aisle of light," together with radar and other blind landing equipment, promises to be a notable step towards making the airport an all-weather field, capable of handling an anticipated total of 900 flights per day.

The new landing guide will cause the pilot to see the runway as a dark area between twin "sheets" of controlled light that shoot upward without producing glare. Although the landing surface itself will be illuminated, surface brightness will be much lower than with present-day runway lighting. Each unit of the new system, installed by Westinghouse Electric Corporation, will include a 300-watt sealed-beam floodlight with a prismatic lens which will fan out light parallel to the runway.

Color To Order

Development of a Paint Mixing and Matching System Provides a Means of Producing, from a Minimum Number of Stock Colors and Vehicles or Extenders, Any Desired Color of Paint, for Exterior or Interior Use, and in Flat, Semi-Gloss, or High-Gloss Finish

A SIMPLE method of obtaining 1000 colors, tints, and shades is now offered by one segment of the paint industry as a means of alleviating a long-standing problem of the industrial or home interior decorator.

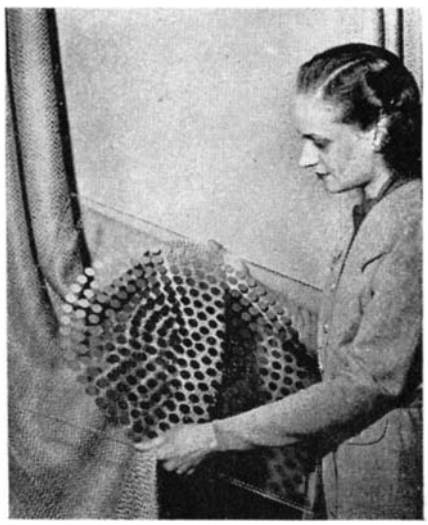
From time immemorial, these decorators have been plagued by the frequent necessity of accurately matching an existing color or providing a satisfactory complementary or contrasting color or tone in liquid paint. Results in the past have been obtained in one of two ways. The decorator or painter chose the nearest shade obtainable in standard ready-mixed paints, or he proceeded to approximate the desired results by combining available colors in a cut-and-try manner. Either the compromise was accepted—usually with undesirable mental reservations—or valuable man-hours were consumed in mixing pigments with little or no assurance that the final product would dry to the shade desired.

● LOOKING AHEAD ●

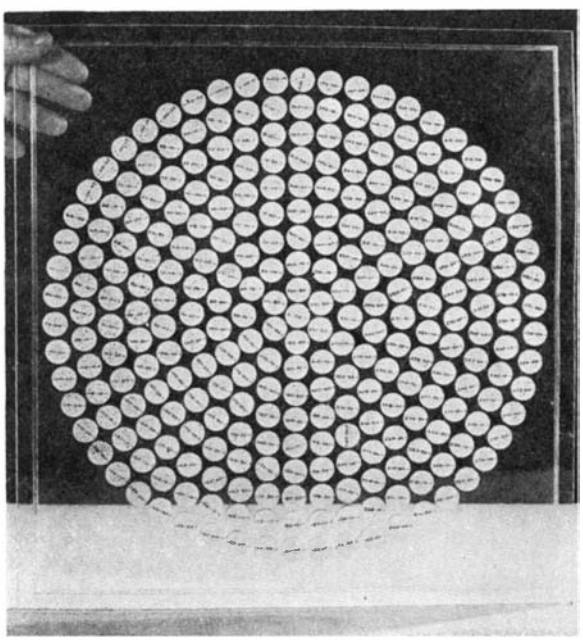
Paint stocks in dealer's stores can be greatly reduced yet customer's selection of desired colors can be expedited. . . Restrictions on available colors will no longer depend on ready-mixed paints that sell well. . . New system will be as helpful to small as to large dealers. . . Logical progression of available colors, tints, and shades should extend use of paint and give a greater appreciation of its possibilities.

Now, under a scientifically developed "custom-mixed" paint system, it becomes possible for the first time to select paint samples from a logically organized color directory and to have the exact paint shade mixed from a standardized formula. In this way, it becomes possible to produce a color or tint which will match exactly any fabric, carpet, furniture, or office equipment, or to obtain colors which harmonize according to personal tastes or preferences. The time involved in producing these "custom-mixed" paints is a matter of mere minutes.

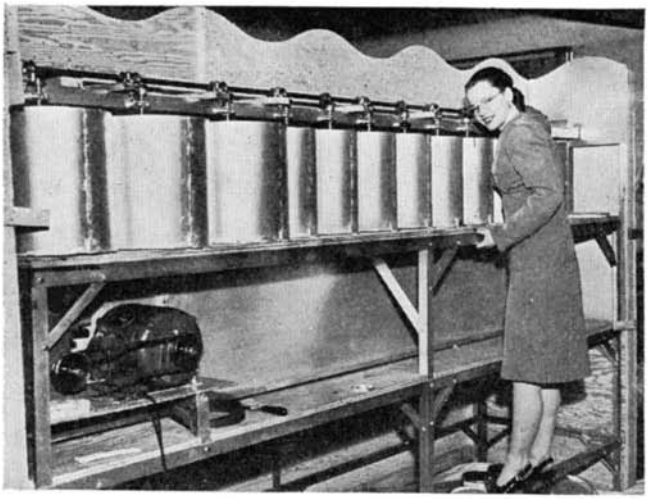
Basic to the new color system for paints, called Nu-Hue and developed by Carl Foss and Fred Rahr for the Martin Senour Company, is a group of six carefully chosen hues of yellow, red, orange, purple, blue, and green, plus neutral grey and white, plus a vehicle or extender, and a varnish if such an ingredient is required. The six colors have been developed for maximum purity of tone coupled with permanency. By combining one or more of these colors, according to a simple formula, with the grey and white, any one of the 1000 available paint tints, tones, and shades can be obtained with a high degree of accuracy. The formulas involved have been worked out to produce unvarying results after the paint is dry.



The six colors have been selected on the basis of what they will do when combined—not necessarily what they are when used alone. They are said to have a high degree of permanence for both interiors and



Code numbers on backs of color chips (left) identify paint formulas for selected hues and provide exact data for custom-mixing. Above, right: Matching or complementing colors for drapes and room furnishings are readily chosen from paint chips mounted in plastics visualizers



Front (right) and rear (left) of color dispenser to speed mixing of basic paints; motor driven agitators ensure pigment suspension

exteriors and can be used to produce a coating which will dry to any desired surface from flat through semi-gloss to high-gloss.

The surface characteristics of the paint when dry are determined by the type of white used when mixed. Available to this system are the varnish previously mentioned, as well as three types of white, flat, semi-gloss, and high-gloss.

Thus the advantages of this new system lie in the fact that, with only twelve containers of material, any type of paint for interior or exterior work, and in any one of the 1000 shades and hues of color, can be obtained by following a specific formula and can be repeatedly produced as often as desired. This means less stock for the paint dealer and complete flexibility of choice for the buyer of paint.

Departing from the time-honored Munsell and Ostwald systems, which for many years have served color users as standard guides, the Nu-Hue system presents a well balanced gamut of the paint spectrum, proceeding in simple, logical steps, each visually related to one another.

The color directories used with the system contain actual paint color swatches or chips of the 1000 different colors, arranged in spectral order for easy selection. On the back of each chip is the formula by which the color on the face of the chip is made. Then it is simply a matter of measuring—by weight or by volume—the required amount of color, extender, grey, and white. When these are mixed together there is complete assurance that the desired shade will be achieved.

For the painter, this means that there need be no wasted hours of experimentation in trying to match colors or tones. With a maximum of twelve cans of paint and with the formulas obtained from the color directory, the painter is equipped to produce any of a thousand colors

Basic paints in foreground offer the decorator the host of colors classified in the handy card-type deck directory

in the time that it takes to stir up any paint before using. For the paint dealer who handles a large volume of business, a simple dispenser for the colors and other materials has been designed. It is equipped with twelve containers, each feeding to a spigot. Motor driven paddles agitate the material in each of the containers to maintain perfect suspension of the solids. With such a dispenser any formula can be immediately compounded with a minimum of lost time.

So simple is the use of this new paint system that the most difficult formula requires the use of a maximum of two of the colors, plus extender, grey, and white. The formulas on the backs of the color chips are given in volumetric ratio, volumetric percentage, cubic centimeters per gallon, specific gravity, and grams per gallon. Thus the mixer can select any readily available method of measuring the required quantities.

In addition to the color directory there is also being made available a set of nine transparent plastics charts with actual color chips embedded in them. These nine charts cover the whole range of 1000 tints, tones, and shades. Because of the transparency of the charts, they expedite color selection by permitting the user to view the material to be matched or complemented right through the clear plastics, thus placing the color chips in close juxtaposition to the material. A code number on the back of each chip gives the key to finding the formula for the color selection.

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ENERGY FROM COAL

Defended Against Possibility of Industrial Atomic Energy

PREDICATING their conclusions on a price of $15 a ton for coal, as stated in a question asked by Dr. James B. Conant, President of Harvard University, atomic energy experts recently predicted that atomic energy might economically come into competition with coal for industrial power production in from three to twenty-five years.

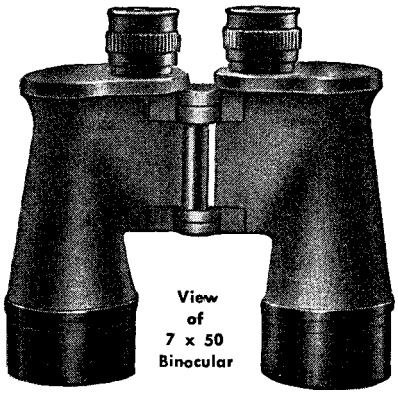
According to the Bituminous Coal Institute, this quoted price of $15 is greatly excessive at today's market prices or on the basis of any prices which the industry has experienced. In the last 40 years the average price of bituminous coal at the mines has ranged from $1.06 to $3.75 a ton and is today approximately $3 a ton.

Bituminous steam coal, which is the country's greatest source of power, is now being delivered to the power producers at a national average price of less than $6 a ton. In several instances electric power plants at the mines obtain coal at $3 a ton or less.

Great economies have continually been effected in coal use. In 1900 it took an average of about seven pounds of coal to produce one kilowatt-hour of electricity. The corresponding figure in 1944 was 1.30

SENSATIONAL WAR BARGAINS in LENSES and PRISMS

NOW! MAKE YOUR OWN BINOCULARS!



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Stock #5102-S
Near Perfect Binocular Set **$25.00 Postpaid**

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We have a large supply of other seconds in Condensing Lenses for Spotlights and Enlargers —diam. from 3½" to 6½"—priced very low. Write for list!

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Consisting of two Achromatic Lenses and two Convex Eye Piece Lenses which you can use to make a 40 Power Pocket Microscope, or 140 Power Regular Size Microscope. These color corrected Lenses will give you excellent definition.
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LENS CLEANING TISSUE—In spite of paper shortage, we offer an exceptional bargain in first quality Lens Cleaning Tissue. You get 3 to 4 times as much tissue as when you buy in the ordinary small booklets. One ream—480 sheets, size 7¾" x 10¾".
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2024-S	10 Pieces Circular A-1 Plate Glass (Diam. 31 mm.—for making Filter)	.25
523-S	Six Threaded Metal Reticle Cells	.25
624-S	Neutral Ray Filter, size 4¾" x 2½"	.25
3022-S	Round Wedge, 65 mm. Diam. Each	5.00
3021-S	Amici Roof Prism (3rd grade). Each	.25
16-S	Level Vial, 48 mm. long	.20
1030-S	2" Diam. Reducing Lens, Each	.25
535-S	Small First Surface Mirror	30¢ each
3003-S	Amici Roof Prism with Corrected Roof	$2.50 each
633-S	Combination Polarizing and Infra-Red Filters, diam. 20 mm. (Minimum order on above $1.00)	50¢

SPECIALS IN LENS SETS

Set #1-S—"Our Advertising Special"—15 Lenses for. $1.60 Postpaid, plus 10-page idea booklet. For copying, ULTRA CLOSE-UP SHOTS, macrophotography, experimental optics, magnifying and for making a two power f/16 Telephoto Lens, "Dummy Camera," Kodachrome viewer, DETACHABLE REFLEX VIEWFINDER for 35 mm. cameras, stereoscopic viewer, ground glass and enlarging focusing aids, TELESCOPES, low Power Microscopes and for many other uses.

NEW 50-PAGE IDEA BOOK "FUN WITH CHIPPED EDGE LENSES"
Contains wide variety of projects and fully covers the fascinating uses of all Lenses in sets listed above . . . only **$1.00 Postpaid.**

35 MM. KODACHROME PROJECTING LENS SET—Consists of Achromatic Lens for projecting, plus a Condensing Lens and piece of Heat Absorbing Glass with directions.
Stock No. 4025-S ..... **$1.95 Postpaid**

SPECTROSCOPE SETS . . . These sets contain all Lenses and Prisms you need to make a Spectroscope plus FREE 15-page Instruction Booklet.
Stock No. 1500-S—Hand Type Spectroscope. **$3.45 Postpaid**
Stock No. 1501-S—Laboratory Type Spectroscope ..... **$6.50 Postpaid**

ALL THE LENSES YOU NEED TO MAKE YOUR OWN TELESCOPE!

ALL ARE ACHROMATIC LENSES

GALILEAN TYPE—Simplest to make but has narrow Field of View.
Stock #5018-S—4 Power Telescope. . **$1.25 Postpaid**
Stock #5004-S—
Small 2 Power Pocket Scope ..... **$1.00 Postpaid**

PRISM TELESCOPES—Uses Prism instead of Lenses to Erect Image and are much shorter than Terrestrial Type. Have wide field of view.

Stock No.	in mms.	in mms.	Price
Stock #5010-S—	6 Power	Telescope. .	$3.00 Postpaid
Stock #5012-S—	20 Power	Telescope. .	7.25 Postpaid

RETICLE SET—5 assorted, engraved reticles from U. S. Gunsights.
Stock #2035-S..... **$1.00 Postpaid**

ACHROMATIC LENSES

Stock No.	Dia. in mms.	F.L. in mms.	Price
6158-S*	18	80	$1.00
6159-S	23	51	1.25
6161-S	24	48	1.25
6162-S	25	122	1.25
6164-S*	26	104	.80
6165-S	27	185	1.00
6166-S	29	54	1.25
6168-S	29	76	1.25
6169-S	31	122	1.50
6171-S	32	171	1.00
6173-S*	34	65	1.00
6176-S*	38	131	1.00
6177-S*	39	63	1.10
6178-S*	45	189	1.50
6179-S*	46	78	1.25

*ASTERISKED ITEMS are uncemented, but FREE cement and Directions included with uncemented sets. USES:—Use these Lenses for making Projecting Lenses, Low Power Microscope Objectives, corrected Magnifiers, substitute enlarging Lenses, Eye-Piece Lenses, Macro-photography, Gadgets, Optical Instruments, etc., etc.

BIG DOUBLE CONVEX LENS—74 mm. diam. 99 mm. F.L. Weighs 9 oz. Made of borosilicate Crown Optical Glass. Used as spotlight Lens, Condensing Lens, etc.
Stock No. 1048-S ..... **$1.50 Postpaid**

OPTICS FROM 4-POWER PANORAMIC TELESCOPE—Excellent condition. Consists of Objective Prism, Dove Prism, Achromatic Objective Lens, Amici Roof Prism, Eye Lens Set (. . . a $60.00 value).
Stock No. 5016-S ..... **$6.00 Postpaid**

RIGHT ANGLE PRISM—Flint Optical Glass, size 41 mm. by 91 mm. by 64 mm. Use in front of camera Lens to take pictures to right or left while pointing camera straight ahead. Also used in front of camera Lens to reverse image in direct positive work. Two of these Prisms will make an erecting system for a Telescope.
Stock No. 3076-S ..... **$3.00 Postpaid**

MAGNIFIER SET—5 magnifying Lenses—Powers from 1 to 10.
Stock No. 1026-S ..... **$2.00 Postpaid**

REMARKABLE VALUE!

$141.01 WORTH OF PERFECT LENSES FOR ONLY $10

Complete System from Artillery Scope (5X) . . . 9 Lenses low reflection coated, **absolutely Perfect.** Diameters range from 1 1/3 inches to 2 1/5 inches. Used for making Telescopes and hundreds of other uses.

Stock #5019-S ..... **$10.00 Postpaid**

PRISMS

Stock No.	Type	Base Width	Base Length	Price
3040-S	Right Angle	33 mms.	23 mms.	$1.00
3045-S	Right Angle	70 mms.	168 mms.	4.00
3001-S	Lens Surface	20 mms.	14 mms.	2.00
3006-S	Porro-Abbe	9 mms.	9 mms.	.25
3009-S	Porro	52 mms.	25 mms.	1.00
3010-S	Porro	43 mms.	21 mms.	.50
3016-S	Pentagon	45 mms.	22 mms.	.75
3029-S	Dove	16 mms.	65 mms.	1.25
3036-S	80 Degree Roof	60 mms.	36 mms.	4.00
3049-S	Right Angle	69 mms.	167 mms.	10.00
3047-S	Right Angle	53 mms.	103 mms.	4.00
3038-S	Roof Prism	18 mms.	34 mms.	2.50

TANK PRISMS PLAIN OR SILVERED

90-45-45 deg. 5¾" long, 2⅛" wide, finely ground and polished. Perfect condition. Would normally retail from $24 to $30 each.
Stock #3004-S—Silvered Prism **$2.00 Postpaid**
Stock #3005-S—Plain Prism **$2.00 Postpaid**
Illustrated Book on Prisms included FREE

TANK PERISCOPE

Complete Set Mounted Components
Rugged, strong, originally constructed for U. S. Tank Corps. Consists of 2 fine Periscope Mirrors mounted in metal and plastic. Perfect condition. Would normally retail at $40 to $50. **Stock No. 700-S $2.00. Complete Set Postpaid.**

Order by Set or Stock No. — Satisfaction Guaranteed — Immediate Delivery

EDMUND SALVAGE COMPANY • P.O. AUDUBON, NEW JERSEY

pounds and efficient plants are able to produce a kilowatt-hour today with the consumption of only approximately three-fourths of a pound of coal.

All of this explains why James D. Francis, a Director of Bituminous Coal Institute and president of Island Creek and other coal companies, states that "in view of the excessive coal cost quoted in the atomic discussion, it would appear to me that it will not be three years or twenty-five years, but something like two or three generations before bituminous coal has anything to fear from atomic energy."

TRACTOR JACK

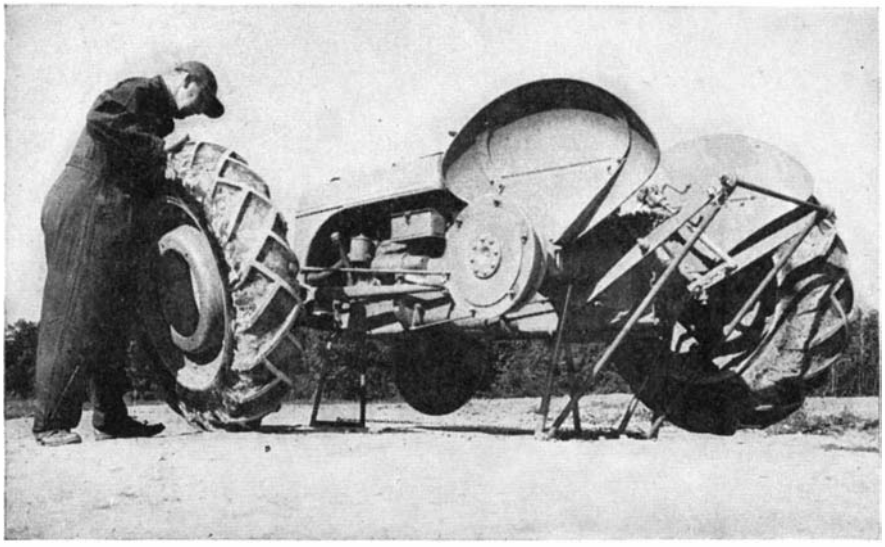
Combines Hydraulic Power and Ingenuity to Ease Job

VIRTUALLY able to lift a farm tractor "by its own bootstraps," a new hydraulic jack is now available that promises to ease materially the problems of changing tires and wheels. Consisting of a tubular framework which connects to the three-point hydraulically controlled linkage of the Ford-Ferguson tractor, it is claimed that the jack can be placed in operation in less than a minute.

When seen in position to lift, the device consists of two tubular arms sloping downward and forward with cradles at the top in which rests the tractor's rear axle. These act as pedestals, which are connected at their bottom with sleeves around an anchoring crossbar, which is the bottom of a four-sided tubular frame. This tubular frame extends beyond the rear of the axle and slants upward to connect with the two lower links of the three-link hitch on the rear of the tractor.

Hydraulic power, controlled from the driver's seat, is applied through the links to swing the frame, using the ground as a pivot, so that the axle rides upward and forward and meshes into the cradles. It is possible to lift the tractor to any height up to four inches.

The manufacturer, the K-P Company, collaborated with Ferguson engineers in designing the jack.



Hydraulic system on tractor actuates new jack for changing tires

REFLECTION CONTROL

Coatings Applied Easily to Glass and Other Materials

GLARELESS glass and transparent mirrors can now be produced as a result of new techniques for controlling light reflections developed originally to increase the efficiency of military optical instruments and radar equipment. The techniques control light reflected from large areas of glass, plastics, paper, oil paintings, and photographic prints without the use of acids or cumbersome equipment. In addition, it is said that the usefulness of reflection control is broadened by the new methods because previous anti-reflection techniques were generally limited to glass and were practical for small pieces only. An interesting feature of the reflection control techniques is their ability to increase reflections as well as to reduce them.

As explained by the developers, the American Optical Company, ordinary clear glass transmits about 92 percent of light, the remainder being lost through reflections. The 8 percent of reflectivity can be increased by the new technique to over 70 percent, and a piece of glass so treated resembles a mirror in that an observer can see his face reflected in it although the glass is transparent and can be seen through. Such a reflecting glass can also be made to acquire the characteristics of a filter, transmitting certain colors and reflecting others, a phenomenon that may be useful in taking color pictures. Other potential uses for

The disk of glass acts as a mirror, yet is transparent. The effect is obtained through the use of new glass coatings which can be applied to increase or decrease the amount of light reflected from the surface as desired

this glass include windows that would reflect the sun's heat rays from air-conditioned houses and vehicles; and one-way glass doors or windows for refrigerators and ovens, the glass in this instance being opaque until an interior light is switched on, after which it becomes transparent. The glass can also be utilized for structural and decorative colored mirrors.

When applied to the reduction of reflections, as in binocular lenses and prisms, the light control techniques permit a gain of over 60 percent in light transmission, thus enabling observers to see distant objects better in dim light. Used in an optical instrument containing a series of seven lenses, a light loss of nearly 43 percent is reduced to 10 percent. With respect to camera lenses, the lens speed is increased and false images or "ghosts" are minimized.

Three general types of reflection-reduction coatings have been developed for different uses, ranging from highly efficient compositions of moderate durability to efficient coatings of great durability. Depending on the size and shape of the substance undergoing treatment, the chemicals which produce coatings can be applied by either of four relatively simple methods; dipping, spinning, spraying, or swabbing.

RUBBER IN PRINTING

Will Probably be Replaced By Non-Swelling Synthetic

BECAUSE of their ability to resist chemicals and oils in ink, certain synthetic rubbers are superior to natural rubber for inking rollers, printing plates, press blankets, and

other rubber printing materials, according to United States Rubber Company. The principal difficulty with natural rubber is that it had a tendency to swell when exposed to ink, throwing the printing out of register and causing deterioration of the rubber. One of the outstanding virtues of buna N and Neoprene synthetic rubbers, according to the company, is that they resist this swelling.

It is probable that the printing industry will use rubber on a greatly increased scale in the post-war world. This expansion will extend mainly to inking rollers and printing plates, both molded and engraved. Rubber plates have been found far superior for printing on cellophane, wax paper, fine stationery paper, box board, bags, and other materials possessing a delicate surface easily cut or broken by metal plates.

FRESH CREAM

Processed To Keep Sweet and Tasty For Year or More

So-called "flash sterilization," followed by bottling and hermetically sealing, will soon enable consumers to keep fresh cream for over a year at normal room temperatures. The cream is not pasteurized, but is sterilized, and processing requires only four minutes. Scientifically conditioned air in the bottling and capping room is assured by use of the Precipitron, which electrically cleans the air of dust particles, and of Sterilamps, which will kill germs by ultra-violet rays. Both devices were perfected by the Westinghouse Electric Corporation. The California Milk Products Company are the originators of the new process.

HEAVY-DUTY MOTORS

May Combine Diesel Engine, Supercharger, and Turbine

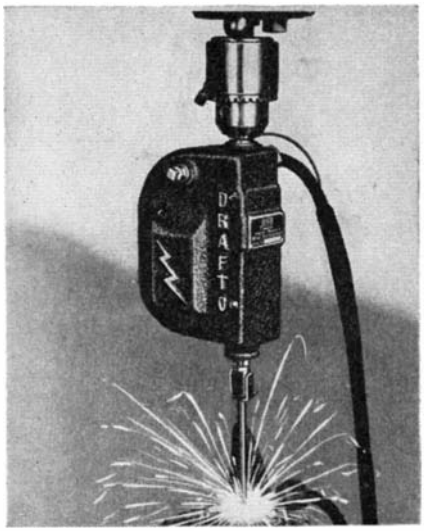
Powerplants of future heavy-duty motor vehicles may consist of a combination of Diesel engine, supercharger, and turbine, according to R. W. McLaughlin and C. F. Harms, of Elliott Company. As an effective method of putting exhaust gas to work, they explained, the application of the supercharger would increase the engine's power output approximately by 50 percent, and the turbine would perform useful work in driving the supercharger. They added that future possibilities include utilization of the Diesel engine merely to function as combustion chamber for the turbine and to drive the supercharger, with the turbine itself becoming the source of power.

New Products and Processes

BROKEN DRILLS AND TAPS

Removed Without Damage by Electrical "Sputterer"

A METAL disintegrator which rapidly and safely removes broken taps and drills from work in progress, thus saving the piece, was recently announced by the Drafto Corporation. Based on the electrical "sputtering" principle, the new Disintegrator, it is claimed, will remove broken drills or taps from work without injuring the metal of the workpiece, and regardless of the hardness of the metal, or will bore through hardened high-speed steel at the rate of about 1/16 inch per minute.



Cuts hard materials; useful as a drill

When used as a drill, the device will drill holes of practically any shape through tungsten carbide and Stellite, and will cut virtually all hard metallic materials.

Electrodes range in sizes from .065 to .310 inch in diameter, and square electrodes up to ½ inch. Two portable models and a table model are available.

SEALING MACHINE

Applies Tape to Container Lids Automatically

A TAPE-SEALING machine, for applying air-tight, moisture-proof tape to containers of coffee, baking powder, tobacco, and so on, is reported to increase the sealing rate to 25 containers per minute as compared to the former rate of six per minute for manual application. At the same time, the machine incorporates an easy-opening paper tab in the sealed tape.

The sticky tape, difficult to handle as it passes through the machine, is controlled by holding it against a guide bar by negative air pressure.

According to the manufacturer, the Package Machinery Company, the machine will accommodate round or square tin, glass, or other type containers ranging in diameter from two to four inches and in height from one half to six inches.

The cans or containers are fed into the machine on a conveyor belt. Each in turn is picked up by lugs and fed onto a turn-table device. This places the container in juxtaposition to the tape. The container then makes one complete revolution, pulling the tape from the spool. At the end of the revolution an automatic knife cuts off the tape, and the next container bumps the taped can onto a discharge belt.

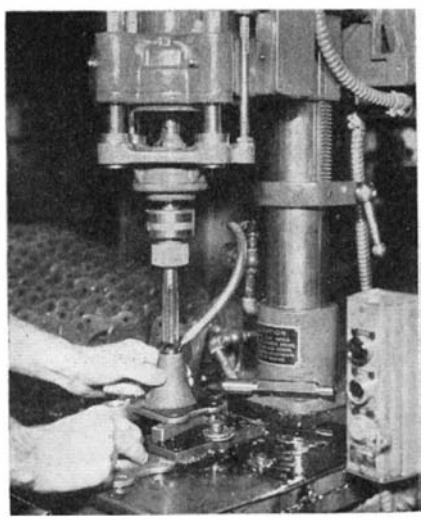
HIGH-SPEED TAP

Cuts Precision Threads in Eight Seconds

AUTOMOTIVE spring hangers of a new type, having thread designs which provide greater area to resist radial and thrush loads and should therefore result in decreased wear, are now being threaded in only eight seconds per hanger, floor to floor time.

The thread design, which is an .893 inch-11, straight side obtuse form with a 149 degree 43 foot included angle, is said to eliminate the necessity of a locking device, permit axial adjustment for alinement, provide full-length paths for the lubricant, allow limited oscillatory movement, and make possible the engagement of new contact surfaces to compensate for wear.

To thread the hangers, a Detroit Tap and Tool Company light-duty tapping machine is used for precision tapping to a depth of 1-45/64 inch with a standard six-flute tap ground with a four-thread chamfer. The tap is mounted in a floating tap-holder and the work is placed on a simple two-pin locating fixture without clamping. It is claimed that clamping is made unnecessary by use of the lead-screw type machine, which eliminates any tendency for the tap to bind on the return stroke. Tapping cycle is semi-automatic—tap, return, stop—to assure positive feeding at the high spindle speed of 400 revolutions per minute.


Lead-screw machine eliminates clamps

TINY PARTS WELDED

While Gripped in Tweezer-Type Electrodes

TWEEZER spot welding, with a portable unit weighing approximately 25 pounds, is now available for many metal fabricating uses. The welder uses 115 volt, 60 cycle power and may be used on metal parts measuring .0005 to ⅛-inch round or thick. To weld parts from .015- through ⅛-inch round, the machine is used with an auxiliary booster unit.


Welding current flows 1/1000 second

Heretofore, the welding of tiny parts has been limited because of the inherent difficulty in holding them in order to effect the weld. With the use of the tweezers, the electrodes may be applied directly to the elements to be joined. The tweezers probe for the parts, hold and bend them, and weld.

Because the voltage used is low, and the current flows through the welding tweezers for only about 1/1000 of a second, the tweezers may be held safely in the hands. A foot switch controls the welding current.

For heavy gage metal where more pressure is required, the tweezers may be removed and the welding machine connected to a drill press or hand arbor. With this method, as explained by the Tweezer-Weld Corporation, copper or copper-alloy rods may be inserted as electrodes with only the bottom electrode insulated.

PAPER WET STRENGTH

Increased by Resin Without Special Handling

WET-STRENGTH improvement of paper is reported to be obtained with a resin named Uformite 470, that represents

a new type of urea-formaldehyde resin modification, and requires no special handling, aging, or pre-treatment before use. After dilution with water, the resin is ready for immediate addition to the paper stock prior to sheet formation. According to its makers, The Resinous Products and Chemical Company, the resin represents an advance over previous types in that it offers superior retention and wet-strength development on sulfite, rag, and groundwood stocks; high wet strength with all stocks at low acidity; effectiveness with minimum alum or acid alone as catalyst; and excellent durability of wet and dry strength.

Development work to date with this resin has indicated particular effectiveness in producing high wet-strength glassine, towelling, light-weight absorbent tissues, sulfite wrapping papers, and blue-print, map, chart, and ledger papers.

LIGHTEST SOLID

Lithium Metal, Now Ready for Wider Industrial Use

NEW USES for compounds of lithium, lightest of all solid elements, were reported as available for industry, at a recent meeting of the American Society of Mechanical Engineers.

Although lithium is at one end of the periodic table of elements and uranium at the other, it was indicated that lithium may play a prominent part in nuclear physics investigations in the near future. Three lithium products new to industry, as described by Dr. Hans Osborg of the Lithaloys Corporation, included: lithium peroxide, a solid possessing high stability and providing approximately 35 percent free oxygen by weight; lithium borohydride, a solid stable in dry air, which generates 66 cubic feet of hydrogen per pound, in contact with water; and diborane, a gas at room temperature which liberates 78 cubic feet of hydrogen per pound when in contact with water.

The advances made in lithium technology have led to applications in the aircraft, chemical, electrical, air-conditioning, glass, ceramics, optical, and metallurgical industries. Lithium is used as a super-refining agent in metallurgy and as an alloying constituent in low-melting alloys. Lithium compounds are also used in aluminum welding, making of magnesium castings in the aircraft industry, air purification, and in air-sea rescue work.

ELECTRONIC BALANCER

Detects Amount and Location of Unbalance

A NEW electronic tool, so sensitive that it will detect the unbalance caused in a rotating body by the presence of a single wisp of lint, now is being made available to industry. Known as the Microbalancer and equally effective in balancing large or small rotors, the device is said to eliminate expensive imperfections in balance from rotating equipment.

A survey of the equipment benefiting from such delicate balancing operations on rotating parts includes: superchargers for the internal combustion engines, gas-turbines, and gyroscopic units for robot airplane pilots.

In operation, the microbalancer ferrets out the exact location of unbalance, measures its weight, and indicates the amount of correction to be applied. It can detect unbalance caused by a weight of one-millionth of a pound on a small area of a ten-pound rotor; or it can in effect determine vibration amplitudes as small as a quarter of a millionth of an inch—about the wavelength of X-rays.

Work to be balanced is suspended in a horizontal position between two floating bearings and rotated by an electric motor drive. Analysis is made in two separate but simultaneous and complementary operations. One determines the amount of any unbalance; the other locates the exact position on the circumference of the work at which weight must be added or removed to correct this condition. To aid the latter operation, identifying numbers are located around the circumference of the work. Vibrations caused by any unbalance are picked up mechanically from each bearing support and converted into electrical energy. These fluctuating voltages—read on a simple meter—indicate the amount of vibration or unbalance.

Position of any unbalance is determined by using a photo-electric cell and a stroboscope. Special electrical circuits cause this light to illuminate the work which appears to stand still

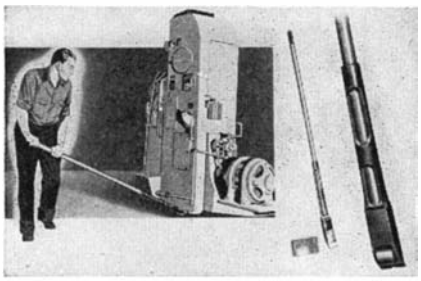
with the exact point of unbalance—readily identified by its number—holding steady under a pointer.

Addition or removal of the indicated weight at this point brings the work into perfect balance. Developed by Westinghouse Electric Corporation, the balancer will be incorporated in production machines by the Gisholt Machine Company.

LIFTING BAR

Has Roller Fulcrum, Changeable Toe Plates

A NEW lifting bar with which one man can easily lift as much as a five-ton load, is described as having a hardened steel roller for extra leverage, and ledges for safe gripping. Its manufacturer, the Arnolt Motor Company, offers the bar with three styles of interchangeable toe plates: notched for prying up spikes and lag bolts and



Straight, notched, and rubber-coated ends adapt prying edge to job needs

getting under heads and corners; straight-edged for general lifting and moving; and straight-edged with rubber-coating to prevent scratching enameled or finished surfaces. Both one-ton and five-ton sizes are available.

RECORDER TUBE

Gives Accurately Modulated Point-Of-Light Source

A MODULATOR glow tube of the crater type for facsimile and sound-on-film recording, oscillograph timing markers, stroboscopic devices, seismic recorders, and photo-electric counters, recently developed, is reported to be unusually rugged and dependable.

Usually operated by the single-ended output stage of a push-pull amplifier, the tube provides a modulated, high intensity point-of-light source by means of a hollow cathode producing high ionization density.

Current through the tube varies linearly with the signal voltage regardless of changes in tube impedance while light output-current characteristics produce good average light response and mica baffles reduce bulb blackening, according to the manufacturers, Sylvania Electric Products, Inc.

PRESSURE SWITCHES

Have Varied Adjustment and Re-set Features

DEVELOPMENT of three new eight-ounce switches, operable on either pressure or vacuum up to 200 pounds, for con-

Liquid or gas-actuated over 200-pound range, switches have 10 ampere rating

trolling liquids or gases that will not corrode brass, was recently announced by the Aerotec Company.

Typical applications are to compressors, pumps, and carbonated-beverage equipment, and the switches are rated at 10 amperes on 110-volt A.C. One switch has an externally adjustable range with a fixed differential; the second can be reset manually from the outside; and the third type has an adjustable differential. Contact arrangement in the first two can be specified as normally-closed, normally-open, or double throw. The third design is available only with normally-open contacts. Pressure connection is by means of a ⅛-inch pipe nipple.

AIR HOIST

Weighs 30 Pounds; Lifts 1000 Pounds

FILLING an industrial-plant need for portable ¼- and ½-ton hoists is a recently developed unit that, under accelerated break-down tests, has shown the capability of attaining the rated capacity of 17 feet per minute with a full load of 1000 pounds. Lesser loads were lifted at proportionately greater speeds. According to the makers, the Keller Tool Company, one man can carry the hoist comfortably and without fatigue; it weighs only 30 pounds.

The hoist housing, a one-piece alloy casting of high tensile strength, maintains all parts in alinement and also supports the air motor which is of

Lightened by aluminum housing design, portable half-ton hoist is easily carried or installed by one person

vertical piston design. The motor is said to start and stop instantly.

Variable speeds, from a "creep" needed to place a load carefully into position to a maximum speed of 17 feet per minute, are obtained by a control bar that opens a poppet-type throttle valve, slides a reversing valve into the desired position, releases the brake, and raises or lowers the load. The enclosed, centrifugally-governed brake is fully mechanical.

To prevent the hoist from operating beyond a safe working position, safety limit stops are provided at both ends of the lifting chain which is tested to carry over six times the maximum-rated load. A hardened-steel chain stripper prevents the chain from tangling.

The hoist is driven by planetary-type gears supported on ball bearings, as is the load shaft and other rotating parts. Dimensions of the hoist are: 13¼ inches hook-to-hook; 5 inches wall clearance; 14½ inches overall length.

Five hundred-pound and 1000-pound capacities are available.

THERMOPLASTICS AND CERAMIC

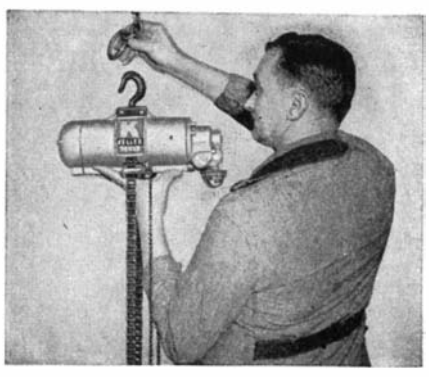
Joined to Make Re-Meltable Multi-Purpose Material

FINISHED castings in only five minutes, which can be reclaimed like metals by melting, are possible with a combined ceramic and thermoplastic called "Plastiform," developed by Duorite Plastic Industries. Used in making tools for aircraft work, art objects, protective coverings, insulators, scenic casts for stage and motion picture sets, toys, and office equipment, Plastiform is prepared for casting by melting in a double boiler. It can be melted or remelted innumerable times without additives. Above 240 degrees, Fahrenheit, the material becomes a fluid which can be poured, brushed, sprayed, dipped, or molded into almost any form. The fluid solidifies into a finished casting in five minutes or less. Plastiform dies for stretching metal parts are said to have withstood loads of as much as 1,250,000 pounds. Broken castings can be patched with an ordinary soldering iron.

MERCURY ARC LAMP

Equals 125 40-Watt Bulbs; Is Air-Cooled

A 1000-WATT tubular bulb, said to be the most brilliant lamp ever developed for general commercial use, was announced recently by the Westinghouse Lamp Division. The air-cooled lamp produces 60 lumens for each watt of electricity consumed, and the total light output of 60,000 lumens is equivalent to the light cast by a canopy of 125 incandescent bulbs of



40-watt size. Over-all, the lamp measures 14 inches long and is less than four inches in diameter.

Designed primarily for lighting high-ceiling factories, baseball diamonds, indoor sports arenas, and other expansive areas where a high level of lighting with a minimum of reflectors is desirable, the lamp is also well adapted

Inner quartz tube houses arc stream at four times previous vapor pressure. Lamp will burn in any position

for unusual applications such as the lighting of arc-welding booths.

The unusual light intensity was made possible by boosting the mercury vapor pressure inside the tube four times beyond pressure levels used previously. When electricity passes into the lamp, the mercury vaporizes and a flaming arc forms between the two electrodes, located on each end of the tube. The entire light source is the arc itself.

Equipped with a mogul-screw base—the same type as in high-wattage incandescent lamps—the new bulb can be burned in any position. A voltage step-up transformer and a simple current limiting device called a reactor, are used to supply current for the arc. Because the new bulb, operating at 1100 to 1300 degrees, Fahrenheit, generates much less heat than previous water-cooled lamps, it requires only a normal amount of natural surrounding air as a cooling medium.

FINER DDT POWDER

Permits Accurate Mixing, Dusts More Evenly

MADE-TO-ORDER solutions of DDT, designed to meet specific garden and household needs, are now being made available with the aid of new "micronized" grinding techniques. Developed by National Magnesium Corporation in the course of war-time experiments on magnesium powder, the grinding methods produce an extremely fine powder and are said to eliminate jamming, filling, and coarse agglomerates which previously made dusting and spraying with DDT difficult.

"Prescription method" mixing is aimed at stepping-up the insecticidal efficiency of DDT while materially diminishing the DDT content of the solutions. By using the proper solution, the toxic potentiality of the insecticide to animals, humans, and birds can be minimized while the usefulness of DDT against insect pests is increased. Also, the uniformly fine powder promises to improve airplane dusting, heretofore handicapped by variations in grain size, which caused dusting devices to clog or distribute the powder unevenly.

SCRAP RUBBER SORTING

Speeded by Color-Changing Sensitized Paper

BEFORE the advent of synthetic rubber, reclaiming plants had no difficulty in separating different types of basic natural rubbers; now the use of increasing quantities of GR-S and other synthetics, which must be reclaimed by varying methods, has created a sorting problem.

A test developed by Mr. Harry P. Burchfield of United States Rubber Company has the advantage of being simple and reliable. It is based on the discovery that paper, impregnated with special chemicals, will develop characteristic colors when exposed to smoke from different types of rubber branded with a hot iron. For example, the smoke from a synthetic GR-S tire will turn the paper green, but smoke from natural rubber will turn it blue. Similarly, oil-resisting synthetic GR-M or Neoprene will produce a character-

istic red color in the chemical test paper.

The procedure is sufficiently rapid to be practical in the testing of representative samples from car-load shipments, or for establishing the identity of materials on which indecisive results are obtained by less specific methods.

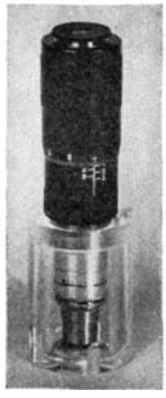
MICROSCOPE MICROMETER

Measures Thickness of Transparent Materials

CENTRAL portions of large sheets of glass or plastics are inaccessible to the ordinary micrometer. Also, the measurement of even small curved plastics sheet is exceedingly difficult by ordinary means, since the ball head of the mechanical micrometer tends to sink into the plastics. Similarly, optical surfaces may be damaged.

For these and similar cases, a new optical micrometer has been worked out on the principle of apparent depth.

Essentially, this instrument consists of a microscope, which is movable for focusing, and an outer tube with a plastics nose-piece that is held against the sheet to be measured. In use, the transparent sheet is marked with a crayon on the side away from the instrument and the measurement is taken by sharply focusing the mark in the microscope. Readings on the barrel and thimble, smiliar to those on an ordinary micrometer, give directly the thickness of the sheet. The time involved is about the same as with the purely mechanical instrument. The optical micrometer is made by the Aireon Manufacturing Corporation.

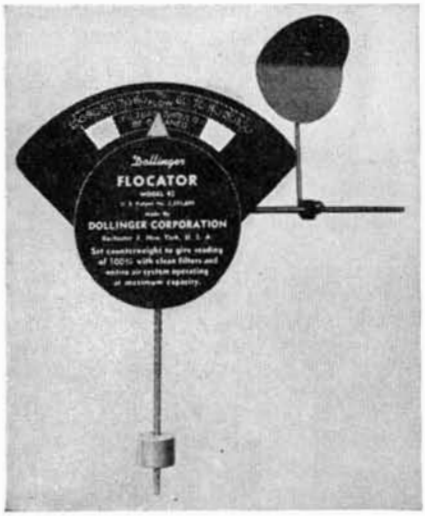


Crayon mark on back of material is brought into sharp focus by means of adjustable barrel and thimble marked like standard type micrometer

AIR FLOW

In Heating Systems is Indicated by Simple Unit

INDICATING the percentage of maximum air flow, a recently marketed low-cost device named Flocator mounts in the air duct of domestic forced-warm-air heating systems. Its most important function is to show when air filters need replacement or cleaning. Also, the indicator, made by the Dollinger Corporation, will warn against dry or damaged fan bearings, fan-belt slippage, dirt-coated fan blades, and constricted or damaged ducts or improperly adjusted dampers. An easily-read dial shows proper rate of air flow as well as percentage of re-



Shows when air filters need replacing

strictions as filters become increasingly loaded with dust. A sudden change in air flow indicates more serious trouble.

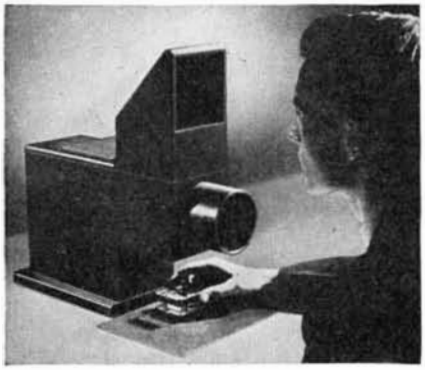
Installation in either vertical or horizontal ducts involves simply cutting a hole in the main duct approximately 2½ by ½ inch, mounting with self-tapping sheet metal screws, and adjusting the indicator to read 100 percent with clean air filters and with the system functioning properly.

INTERFERENCE VIEWER

Plus Rectangular Optical Flats Add Uniformity to Light-Wave Tests

ACCURATE measurements of gage blocks, anvils, sealing surfaces, and other precision articles are reported to be obtainable with a newly designed interference viewer in which the interference patterns are both illuminated and viewed on a line perpendicular to the plane of the pattern. Distortion of the pattern is said to be eliminated and each pattern appears the same to different observers. This latter feature allows the inspection of one pattern by several observers, thus making instruction easier.

The monochromatic light source in the Optron Viewer is completely concealed, and the light wavelength—20.8 millionths of an inch—was selected to give interference patterns of maximum brightness and sharpness. To permit convenient comparisons of straightness or direct measurements between in-



Measurement scale may be superimposed on interference image pattern

terference bands, without using a ruler or straightedge, the user may superimpose the image of any convenient scale on the interference pattern itself. It is also claimed that the viewer permits the use of Haidinger bands in tests for parallelism, without accessories of any kind. Deviation in parallelism from ½ to 15 seconds may be detected with this system.

For use with the viewer, square and rectangular Optron flats are available and are claimed to be more economical and easier to handle than those of the conventional round shape. For example, a 10 by 2⅜-inch flat can be used in place of a round flat 10 inch in diameter, but weighs only one fourth as much according to the makers, Optron Laboratory.

The straight edges of the flats provide reference lines for comparison of straightness of interference bands, and are said to reduce the need for rules or straightedges.

DIE-CASTING MACHINE

Can be Controlled Automatically or Manually

ELIMINATION of cold metal from the shot furnace, improved hydraulic performance, automatic timing, and adjustable bearings for the movable platen are features of a new die-casting machine announced by The Cleveland Automatic Machine Company.

A double-compartment furnace, with separate automatic burners for each compartment, is said to eliminate the presence of cold metal in the shot compartment. New metal is placed in the second compartment, automatically causing the overflow of readied molten metal into the shot section. Even temperature and uniform condition of the shot metal are maintained by this method.

Uniformity in hydraulic performance is achieved by addition of a new heat-exchanger oil cooler. The water-flow heat absorption is augmented by fin construction of the outer shell which affords a high rate of heat radiation, and provides a combination of air and water cooling.

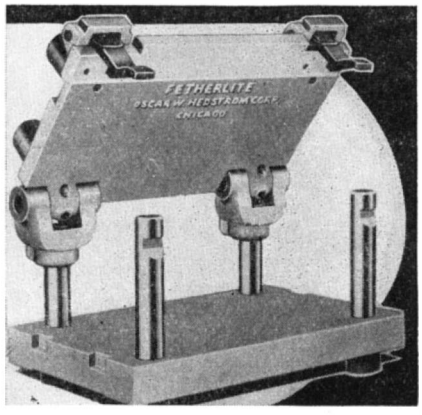
Automatic timing is combined with manual controls so that method of operation may be selected in accordance with the type of production involved. All controls are centered on a single panel close to the operating station. Bronze adjustable wedge-type slide bearings, under the movable platen carry the full weight of the platen. This construction is described as strengthening the platen assembly and helping to maintain accurate alinement.

LIGHT JIGS

Feature Instant Opening and Closing

IF THE WEIGHT of jigs is reduced, jig operations can be speeded up, since weight is a primary factor in operator fatigue.

This is the basis on which "Fetherlite" Snap-Lock jigs were designed. Construction is of an aluminum alloy that is tough, durable, and easy to bore



Aluminum jig bores easily for bushings

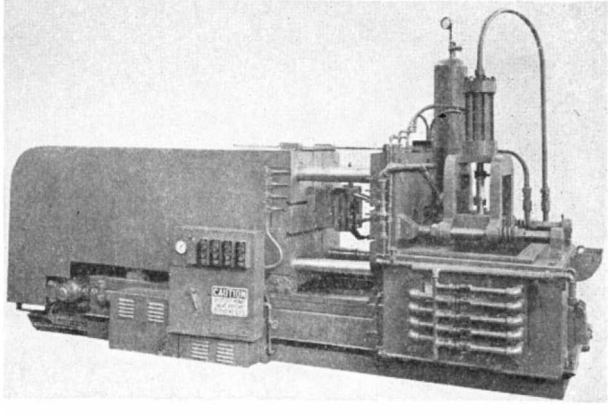
for bushings and pins. Its lightness—1/3 the weight of steel—makes possible easy shifting of the jigs to any position.

Lock construction permits instant opening and closing, so that loading and accurate placement of the work piece are speeded up. The unit is easily assembled into 1, 2, 3, or 4-way jig. Interchangeable posts accommodate work of practically any height. The new unit, made by Hedstrom Industries, Inc., is offered in many standard sizes.

HYDRAULIC PUMP

Delivers Large or Small Volumes at High Pressures

PROVIDING continuous-duty development of 5000 pounds per square inch at 40 horsepower, and delivering up to 17 gallons per minute at 1200 revolutions per minute, a new hydraulic pump is said to broaden substantially the po-



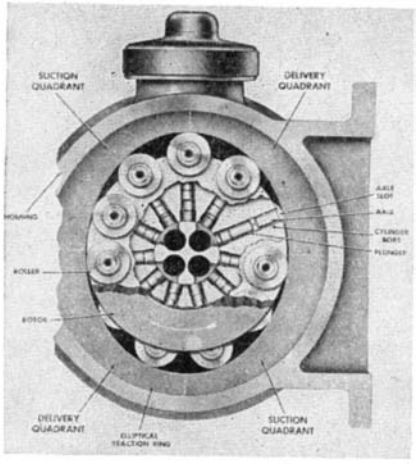
Double compartment furnace keeps hot and cold metal separated; shot metal maintains even temperature

tentialities of hydraulic design. The pump is light enough to be carried by one man.

Applications, in addition to the hydraulic-press and cylinder-actuated-machinery field, are expected to be found in test equipment; automotive, marine, and railroad hydraulic drives; and in the petroleum, Diesel, and plastics industries. Two models, either constant or variable delivery, are available.

Known as the Superdraulic Pump, and manufactured by Hydraulic Machinery, Inc. and Superdraulic Corporation, the pump operates on the radial-plunger principle. Centrifugal force maintains the plunger rollers in contact with an elliptical reaction ring which actuates the plungers to provide the desired pumping action.

Each plunger makes two inlet and two delivery strokes per revolution. Volume control is achieved by means of gears which turn the elliptical reaction rings—one ring for each bank of plungers—in opposite directions to vary the angular relationship of the major axes of the ellipses. At full



Section of new hydraulic pump showing shape of elliptical reaction ring

delivery, the major axis of these reaction rings are parallel, and at zero delivery the major axes are 90 degrees apart. Intermediate angles vary the pump delivery proportionately.

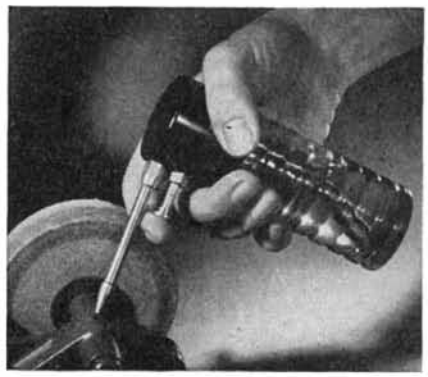
A small circulating pump provides circulating oil direct from the oil tank at near-zero pressure. This oil cools the pump housing under conditions of extreme pressure operation at zero or near-zero delivery.

OILER-SPRAYER

Has Visible Supply; Interchangeable Jets

TRANSPARENT Tenite plastics forms the half-pint barrel of a new oiler-and-sprayer. It can be used as an oiler for many garage, machine-shop, and household oiling jobs or as a sprayer for gardening, animal care, laundry, and general cleaning. The can is converted from oiler to sprayer, or vice versa, simply by changing nozzles and liquids.

Tenite provides not only visibility of the liquid level within the can, made by Midwest Production Machine Company, but also toughness and impact strength. The can may be dropped or



Plastics barrel is strong, transparent

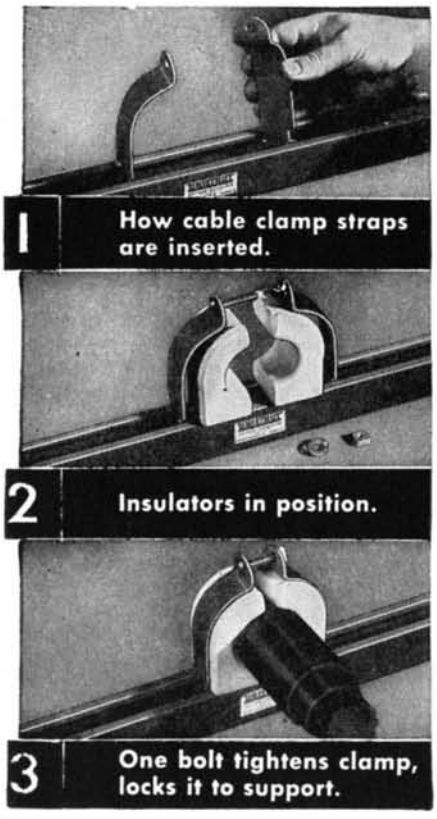
submitted to hard blows without shattering the tough material. A segmented design provides a good grip.

The plastics barrel screws onto a metal top, to which is attached a plunger-type mechanism. Properly primed, the pumping device delivers a charge of oil from one to one and one quarter cubic centimers per stroke to a distance of not less than 48 inches. For priming, the handle requires not more than six full strokes.

SIMPLE CLAMP

For Use With Slotted Structural Members

FOR USE on Unistrut hollow-square support members, a new clamp for cables, conduit, pipe, or wires, is installed by tightening a single bolt. There are no holes to locate or drill, the slot in the Unistrut member being the equivalent of a series of holes throughout its entire length. The pipe-strap clamps are hooked into the member as



Three steps in clamping insulator to slotted hollow-square support members

illustrated, the insulating clamps are placed against the cable (the porcelain insulator is omitted for conduit or pipe), the bolt inserted, and the nut turned up tight. This closes the insulators firmly around the conductor and also causes the pipe-clamp straps to lock tightly.

SPATS AND LEGGINGS

Protect Legs and Ankles of Foundry Workers

SPECIFICALLY designed spats and leggings to afford complete leg protection for foundry and other industrial workers, with plus features of easy adjustment and quick release, were recently announced by American Optical Company.

The new leggings protect front, back, and sides of leg, from instep to knee. Available in chrome leather, specially

Industrial workers and others who need protection for legs and ankles can use these chrome-leather leggings. They are also made in asbestos and canvas. For instep and ankle protection, spats are available

tanned to resist heat and hot metal splashes, they may also be obtained in asbestos or fire-resisting duck. All leggings have a chrome leather flare over the instep.

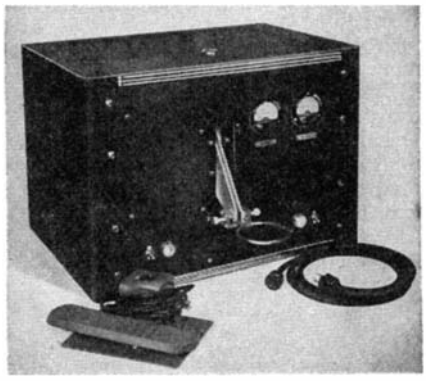
The spats are identical in construction with the legging, except for shorter length. Their design provides full protection for the instep and ankle of foundry and other workers.

INDUCTION-HEATER SOLDERING

Gives Clean Job at Lowered Cost

TO MEET the need for clean soldering of small parts, and for soldering of metal to metallized glass and ceramics, a new portable, bench-type induction heater is offered that is described as capable of materially reducing unit costs for soldering operations.

Made by the Marion Electrical Instrument Company, the low-powered induction heater was originally used by this firm for producing sealed instruments. Other uses included terminal assembly, magnet assembly, and bearing assembly, all of which are said to have been improved in quality and lowered in cost by the application of this unit. Advantages of induction-heat soldering are restriction of solder to the work area and the elimination of cleaning operations. Another advantage is that it is possible to jig-locate parts of the assembly accurately and avoid subsequent machine operations. Working efficiency of the induction heater is greatest when the work to be heated has a high resistivity, as in the case of ferro-magnetic materials, and somewhat less with low resistivity materials, such as copper and silver, because with these materials a smaller percentage of total power is converted to useful heat.



For soldering by induction

Applications seem indicated in the electronic industry, as well as in the production of jewelry, watches, toys, instruments, automobile parts, electrical-fixture components, household fixtures, and similar items involving small part assemblies.

DEFLECTION MEASUREMENTS

Taken Electrically; Read on Inexpensive Meters

IN THE form of a hermetically-sealed electrical unit which translates minute deflections or pressure variations, applied to its plunger, into linear changes in its D.C. output voltage, a new deflection pick-up is said to be accurate even under unfavorable conditions. Readings are obtained in the range of 0.0005- to 0.1-inch movement of the plunger and reliable response up to 100 cycles per second is reported.

This Stevens-Arnold pick-up, with an output of 75 millivolts and an internal resistance of less than one ohm, may be connected directly to standard indicating instruments of a type that are rugged, inexpensive, and portable. Pick-ups may be connected in parallel.

The combination of a pick-up and an indicating voltmeter may be used to obtain remote indications as an

Hermetically sealed measuring unit

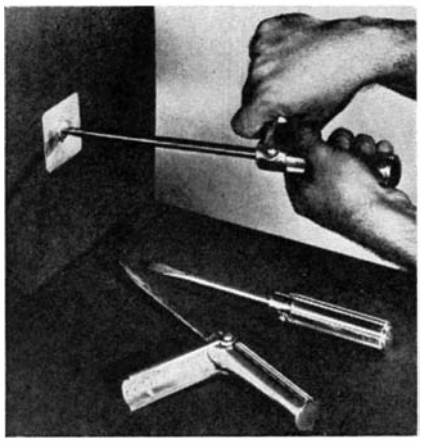
electrical micrometer, or for measurements of force, acceleration, pressure, or deflection.

Vibration, temperatures up to 300 degrees, Fahrenheit, or immersion in water, are said not to influence the instrument. Power supply may be 115 volts A.C. or an 8, 12, or 24 volt battery.

SCREW DRIVER

Gets Extra Twist from Power-Arm

A POWER-ARM on a new triple-purpose screw driver gives extra power to unlock rusted screws and makes possible the pressure needed to tighten screws



Attached arm gives added power

firmly. With the power-arm folded back into the handle, the tool, labeled Tuffy, becomes a standard type screw driver, with an aluminum handle and a plated drop-forged steel blade.

FLOOR MATS

Produced in Colorful Synthetic Rubber

SYNTHETIC rubber floor matting for theaters, hotel lobbies, office buildings, elevators, apartment houses, and other floors is now said to match the quality of pre-war mats made of natural rubber. Produced of GR-S rubber, by United States Rubber Company, the mats are colored black, maroon, red, white, green, blue, yellow, and salmon.

The mats are made with conventional corrugated or pyramid surface with or without perforations, and they also may be imprinted with special monograms or patterns to blend with various decorative schemes.

GLAZED COATING

Increases Life of Furnace Refractories

A REFRACTORY coating which is applied to refractory brickwork or plastics refractories by paint brush or spray gun, is composed of high-fusion clays and metal oxides combined in oils. Known as Brickseal, it fuses under heat to form a highly-glazed, monolithic protective coating over the entire refractory structure.

Available in four grades to suit various operating temperatures, Brickseal practically eliminates cracking and spalling of brickwork, stops infiltration of outside air, greatly simplifies the removal of slag and clinker and, by reflecting heat back into the furnace, definitely increases firing efficiency.

Suitable for protection of oil-, gas-, or coal-fired equipment, this coating, made by Brickseal Refractory Company, has been used in all types of boilers, incinerators, industrial heat-treating furnaces, and similar high-temperature equipment.

RUBBER-COATED WIRE

Used in Baskets Which Protect Contents

A BASKET designed to safeguard potatoes against bruising was announced recently as a post-war product for the farmer.

The basket, developed by United States Rubber Company, is made of steel wire coated with rubber and cushions the potatoes against bruising when they are thrown into it during field harvests. The rubber also protects the metal against corrosion. Open construction of the sides and bottom of the basket prevents collection of debris inside. It weighs three and three-quarter pounds and holds five-eighths of a bushel.

FIRE EXTINGUISHERS

Using Carbon Dioxide Are Available in Several Sizes

CARBON-DIOXIDE portable fire extinguishers, in a complete range of sizes from two to 100 pounds and called CD-Sno Fog, are now offered for fighting fires in electrical equipment, oil, grease, and flammable liquids. Since the carbon

A number of desirable advantages are claimed for these new CO_2 fire extinguishers now available in a number of sizes ranging from two to 100 pounds

dioxide is a non-conductor, it is safe to use on electrical fires even while the current is on. Moreover it leaves no stain on clothing, equipment, or premises, and is harmless even when used around food.

The cylinder of the extinguishers is made of steel, with brass fittings. The discharge horn is of shock-resistant plastics construction. CD-Sno Fog extinguishers are the products of The General Detroit Corporation and The General Pacific Corporation.

The Editors Recommend

Best Sellers In Science

PROCEDURES IN EXPERIMENTAL PHYSICS — ***By John Strong, Ph.D.*** A wealth of useful data of a practical kind for the constructor, experimenter, and skilled craftsman. **$6.80**

HIGH FREQUENCY INDUCTION HEATING — ***By Frank W. Curtis.*** Answers many questions concerning induction heating and its utility in industrial processes. Thoroughly practical in scope. **$2.85**

TOOL MAKING — ***By C. M. Cole.*** Instructions for making and using all kinds, from personal tools to arbor presses, lathes, planers, etc., in different metals. **$3.60**

TECHNIQUE OF PLYWOOD — ***By Charles B. Norris.*** Technical information on all phases of plywood manufacture and use, compiled for engineers, designers, and users of plywood. Important to many phases of peace-time housing and manufacturing problems. **$2.50**

YOUR HAIR AND ITS CARE — ***By Oscar L. Levin, M.D., and Howard T. Behrman, M.D.*** Scientific facts about hair—how to save and beautify it, treat infections, and so on. Real facts — not a "cure-for-baldness" screed. **$2.10**

HANDBOOK OF CHEMISTRY AND PHYSICS — A classic reference book recently revised and brought up-to-date to keep pace with recent research. Includes materials on all branches of chemistry, physics, and allied sciences. Used in laboratories and by engineers throughout the country. Flexible binding. 2640 pages. **$4.10 Foreign $4.50 postpaid**

ATOMIC ENERGY FOR MILITARY PURPOSES — A General Account of its Development Under the Auspices of the United States Government, 1940-1945. The famous Smythe report, telling in relatively non-technical language of the developments in nuclear physics that lead to the manufacture of the atomic bomb. **Paper cover, $1.35; cloth $2.10**

PLASTICS — ***By J. H. Dubois.*** Third edition, again revised and enlarged, with two four-color plates. This is an important book on the whole general subject of plastics, plus much brand new material on synthetic rubber, manufacturing processes, and plastics moldings. **$4.10**

PLANNING TO BUILD — ***By Thomas H. Creighton.*** Answers many of the questions asked by prospective home builders. Planning, design, and construction are fully covered. **$2.60**

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SLIDE RULE SIMPLIFIED — ***By C. O. Harris.*** How to use a slide rule, without any of the mystification that often surrounds this important tool of the engineer. Excellent illustrations make everything clear. **$3.60** including a slide rule; for book alone. **$2.60**

HOW TO SOLVE IT — ***By G. Polya.*** The text deals with the general method of solving problems. It will be of value to teachers but will also find wide use by those who have to solve problems requiring scientific reasoning. **$2.60**

MACHINERY'S HANDBOOK — ***12th Edition.*** "Bible of the mechanical industry." 1815 pages of latest standards, data and information required daily in shop and drafting room. **$6.10**

MACHINE TOOL GUIDE — ***By Tom C. Plumridge, Roy W. Boyd, Jr., and James McKinney, Jr.*** A convenient compilation of data on all types of machine tools, assembled in organized form for tool and mechanical engineers, millwrights, and tool equipment salesmen. **$7.70**

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ELECTRONIC PHYSICS — ***By Hector, Lein and Sconton.*** A simplified text for those who desire to acquire a sound basis for following the advance of applied electronics. **$3.85**

A LABORATORY MANUAL OF PLASTICS AND SYNTHETIC RESINS — ***By C. F. D'Alelio.*** How to prepare many of the well-known resins and plastics in the laboratory. Understanding of the text requires a knowledge of organic chemistry. **$2.10**

FUNDAMENTALS OF OPTICAL ENGINEERING — ***By Donald H. Jacobs.*** This new work starts out at the very beginning, is mainly non-mathematical, and is probably the best suited of all existing books as an introduction to optical design. Author is a physicist at Bureau of Standards. **$5.10**

WITH THE WATCHMAKER AT THE BENCH — ***By Donald DeCarle.*** Simple, practical, straightforward instructions on the repair of timepieces, with direct implications to the manufacture and repair of delicate instruments of all kinds. **$3.10**

TRIGONOMETRY FOR HOME STUDY — ***By William L. Schaaf, Ph.D.*** Extensive and detailed, giving explanations as the text progresses, together with numerous practical applications of trig, such as machine shop problems, surveying, navigation, and so on. **$1.10**

URANIUM AND ATOMIC POWER — ***By Jack Dement and H. C. Dake.*** Somewhat technical treatment of the underlying principles and theories of the work. Includes a valuable bibliography. **$4.10**

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CURRENT BULLETIN BRIEFS

Conducted by K. M. CANAVAN

(The Editor will appreciate it if you will mention Scientific American when writing for any of the publications listed below.)

ORGANIZATION OF TECHNICAL RESEARCH IN INDUSTRY is a 16-page monograph prepared as a result of extensive investigation into the requirements of research as it applies to industrial organizations. Some of the phases covered include the set-up of the research organization, costs, process development, library and patent work, and so on. *Industrial Research Institute, Inc., 60 East 42nd Street, New York 17, New York.—Gratis.*

DUREZ CASTING RESIN. This technical discussion, in 12 illustrated pages. gives complete details on the use of the resin. Actual applications are shown and described. Uses covered include masking, dies, plating shields, models, jigs, and so on. *Durez Plastics and Chemicals, Inc., North Tonawanda, New York.—Gratis.*

THE INVISIBLE RAY is a six-page catalog containing information and prices on various black light kits, as well as lamps, bulbs, and fluorescent and luminescent materials. A comparative data sheet presents details on eight types of lamps and their principal uses. *Black Light Products, 450 East Ohio Street, Chicago 11, Illinois.—Gratis.*

ENGINEERING SERVICES describes the facilities offered by an independent organization of consultants and outlines the advantages that can accrue to industrial clients who have no engineering departments of their own or who have need for specialized advice and services. *Foster D. Snell, Inc., 305 Washington Street, Brooklyn 1, New York.—Gratis.*

OPERATING A SMALL BUSINESS. This four-page bulletin is essentially a bibliography which will serve as a guide to literature on all phases of the subject. The articles and books to which reference is made are described briefly but clearly. *Business Information Bureau, Cleveland Public Library, Cleveland 14, Ohio.—Ten cents.*

FORMING ARTICLES FROM EXTRUDED TENITE SHEETING is a 12-page booklet describing and illustrating the nine principle operations in the fabrication of sheet plastics articles and the equipment which may be used for the work. Part of the discussion involves methods of laminating and heat sealing. *Tennessee Eastman Corporation, Kingsport, Tennessee.—Gratis.*

YOU AND THE RETURNING VETERAN. This 40-page illustrated booklet, printed as a guide for foremen, discusses the important phases of industrial readjustment from the standpoint of the vet-

eran. It considers the problems from both physiological and psychological aspects, and points out how foremen can help. *Allis-Chalmers Manufacturing Company, Milwaukee 1, Wisconsin.—Gratis. Request this booklet on your business letterhead.*

CASE HARDENING. This four-page bulletin covers the application of pack, liquid, and gas carburizing and the ideal types of furnaces for the various methods. Included is a table of pot recommendations, with pot materials, maximum bath temperatures, and type and composition of salt baths. Request Bulletin SC-127. *Surface Combustion Company, Toledo 1, Ohio.—Gratis.*

PLYLOCK BELT JOINT is a four-page catalog section describing and illustrating the step-by-step Plylock method of making rubber belts endless. *Public Relations Department, The B. F. Goodrich Company, Akron, Ohio.—Gratis.*

HASTELLOY FACING FOR CORROSION RESISTANCE is a four-page folder outlining a new process for protecting chemical-plant and oil-refinery equipment from corrosion. Data on the grades of Hastelloy and the procedures to be followed are given. *Haynes Stellite Company, Kokomo, Indiana.—Gratis.*

WIRE STRIPPERS, in a single sheet, illustrates and describes a number of wire stripping units ranging from hand-operated plier types to high-speed, motor-driven production units. *Ideal Commutator Dresser Company, 1291 Park Avenue, Sycamore, Illinois.—Gratis.*

REFRACTORIES FOR INDUSTRIAL FURNACES is a four-page bulletin which gives details of standard fire resisting tile and the methods by which they can be applied to different types of furnace construction. Request Bulletin 845. *Chicago Fire Brick Company, 1419 North Elston Avenue, Chicago 22, Illinois.—Gratis.*

LEDEX ROTARY SOLENOIDS is an eight-page illustrated pamphlet which describes a powerful and efficient electrical unit which was developed for military purposes and which has a number of possible applications in industrial control and power units. *George H. Leland, 155 Webster Street, Dayton 2, Ohio.—Gratis.*

TOGGLE CLAMPS is a four-page bulletin, in file-folder form, which illustrates and describes a series of self-adjusting clamps that are widely adaptable to holding all kinds of work in jigs and fixtures. *Products Engineering Company, 9045 Wilshire Boulevard, Beverly Hills, California.—Gratis.*

AIR MOTORS describes, in eight thoroughly illustrated pages, the range of operations involving pulling, pushing, or lifting which can be handled by efficient and flexible air-operated motors. *The Bellows Company, 861 East Tallmadge Avenue, Akron 10, Ohio.—Gratis.*

Our Book Corner

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By John R. Baker

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By Russell, Dugan and Stewart

AFTER 19 years, the first volume of this two-volume standard textbook—still the most complete astronomy in the English language—has been revised as extensively as tested and accepted advances in its portion of the science justify. Page-by-page comparison of the 1926 and 1945 editions—dealing with the solar system alone and not the stars—indicates changes of perhaps 5 percent; those likely to come in later revision of the volume on the stars will no doubt be much heavier. (470 text pages, appendix, 5¾ by 8¾ inches, 183 illustrations.)—$3.10 postpaid.—*A.G.I.*

ELEMENTARY STATISTICS

By Hyman Levy, M.A., D.Sc., F.R.S.E. and E. E. Preidel, M.Sc., A.R.C.S., D.I.C.

IN SPITE of the imposing lists of letters that follow their names, the authors have created a readable and understandable book—a book intended to be used rather than merely to be studied. Their chapter on "Elementary Ideas in Probability" alone can pay big dividends to many a business man who has been thinking glibly in terms of "averages." (184 pages, 8 by 5 inches, unillustrated.)—$2.35 postpaid.—*E.L.C.*

ROCKS AND RIVERS OF AMERICA

By Ellis W. Shuler

IT IS doubtful whether a tenth of the people, even among those of scientific inclination, realize how much an elementary knowledge of geology can add to one's yield of scientific sidelights when one is afield. Earth features, not all of them spectacular but as often commonplace and unnoticeable, then tell their own story, thus enlarging one's comprehension of the world he is in. In this book for the layman a professional geologist renounces the two-dollar words that make geology a bore to non-geologists and explains waterfalls and canyons, caves and mountains, and many other earth features in everyday plain talk. (300 pages, 6 by 9 inches, 105 illustrations.)—$4.10 postpaid.—*A.G.I.*

Telescoptics

A Monthly Department for the Amateur Telescope Maker

Conducted by ALBERT G. INGALLS

Editor of the Scientific American books "Amateur Telescope Making" and "Amateur Telescope Making—Advanced"

IN THE following article Patrick A. Driscoll, Lima, N. Y., who went from "A.T.M." to a job as experimental lens maker in the Eastman Hawk-Eye Works in Rochester, tells how to furnish your wife with grounds for divorce for cruelty by casting metal lens or mirror grinding tools in the home kitchen, using the lost wax process.

In this you model in wax what you want to mold in metal, then cast in plaster a negative of that model, finally melting out the wax and pouring the space full of molten metal.

As was told in Scientific American, December 1943 and December 1945, in two three-page articles (which do not, however throw practical light on making metal tools for amateur glass pushers, though they are of incidental or background information interest) this ancient method which was once employed chiefly for accurate manufacture of small metal jewelry and dental parts is also being used today on a large scale for making precision castings in industry, where it rates high. Driscoll writes:

Into the life of every amateur optician there looms, at some time or other, the specter of the iron grinding tool. Requiring a lathe and attachments to cut its convex or concave radii, the iron grinder becomes a thing of complex machining to the average basement glass addict.

As a fellow "TN," suffering from lack of machine shop facilities, I wish to present an alternative solution to the production of the iron grinder. This requires a job of casting. The method is not claimed as new by the writer, but its application toward solving the amateur telescope maker's difficulties is original. We shall cast our grinders in zinc, and the process used is termed the "Lost Wax Method."

The low melting point of zinc (715° F.) does not call for a high-temperature furnace. The gas stove of ye long-suffering wife will suit the purpose admirably. The following materials and tools will be necessary.

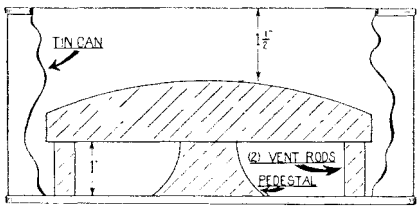
Plaster of Paris
Paraffin
Large tin can
Scrap zinc
Rotating spindle (temporary)
Glass gage of the desired radius.

We shall assume that a grinder is needed for a 6" (152 mm) mirror. The grinder should be 5/4 of the mirror diameter or 7½" (190 mm), but if the worker prefers the equal-diameter mirror and grinder, let him proceed on that basis. [The philosophy of the 5/4 grinder was explained by Driscoll in the October, 1945, number.—*Ed.*]

The glass gage should be made from thin glass and as close to radius as possible.

To begin, the paraffin should be melted in a container about ¼" larger than the grinder diameter desired. After it cools, apply heat around the outside of the can until the block drops out. The aim now is to shape this paraffin block into an exact model of the grinder we are to cast.

At this stage, we must have a rotating *vertical* spindle. This can be a temporary setup and does not have to be elaborate or complicated. The spindle speed should not be much over 100 r.p.m.—slower if possible. Here the amateur who possesses a polishing machine can leer with satisfaction. The spindle should have a flat, horizontal metal surface attached and on this we place our wax disk. We warm the spindle table, center the disk and allow



Drawing by E. F. Lindsley after the author

Molding a tool by the lost wax process

it to cool. Now with a sharp knife we *scrape,* not cut, the disk roughly to curve and check the radius with the gage. When the disk is close to the gage curvature, we abandon the knife scraper and to finish the disk to curve we use the gage itself as a scraper. With the spindle rotating, we hold the gage to the surface of the disk and shave off all irregularities.

We have now produced a grinder, modeled in wax to exact curvature—in other words, a pattern.

Now our large tin can comes into action. It must be at least 2" larger in diameter than our pattern. The pattern is mounted on a wax pedestal, two ⅜" wax rods are attached, and the whole is placed on the bottom of the can. See the illustration. The can bottom is then heated *locally* to adhere the wax to the metal and prevent shifting of the pattern. To forestall tipping, be sure that the pedestal and rods are of equal length. The next step will be making the plaster mold. Mix ordinary plaster of Paris thoroughly to a consistency that will just allow it to run slowly out of the mixing pan. It must not be putty-like. It must not be watery. Mixing and pouring must be completed in one minute. Time and plaster wait for no man.

Pour this mixture into and around the wax pattern until every nook and cranny is full and the pattern is covered with plaster to a depth of at least 1½". Allow the plaster to set for 48 hours in a warm room. Do not try to hurry setting by using excessive heat at this stage.

With the mold firmly set we can now invert it and remove the bottom of the can with one of the new-fangled smooth-cutting can openers. The mold is now placed, pedestal end down, in a large pan. The mold must be placed on three blocks to keep it at least 2" up from the bottom of the pan. Be sure that none of the blocks covers the pedestal or the ends of the wax rod. Place the whole setup in the kitchen oven and bake it at 350°F until all the wax has melted and run out. Continue to bake it until certain that all moisture has been driven out of the plaster. As a test, hold a cold metal surface to the hole in the plaster. If moisture collects on the metal, continue to bake until dry. Remove from the oven and allow to cool to room temperature.

We now have evolved a plaster of Paris mold having a pouring spout and two vent holes to relieve trapped air in casting.

Zinc is recommended as a casting metal because of its low melting point and its advantage over lead in point of hardness, but the home optician may substitute lead if he desires. The difference in price will be negligible. Lead will have the drawback of retaining particles of emery or Carbo in rough grinding that may cause trouble in the fine grinding. To the amateur who has access to large quantities of lead, we say use it, making a new mold and casting a grinder for each size of emery. Here again, as was stated here last October in an article on the hand-lever type of machine, may I mention that, by machine, 180, 500, and 1200 emery are all the sizes required to produce a perfect surface for polishing. Finer sizes will tend to scratch when used with a metal polisher.

Place the plaster mold in the oven and heat slowly until it is fairly warm (200°F).

To ascertain the amount of zinc needed, weigh the paraffin model and multiply by 12 or 13.

Melt the zinc on a gas flame and skim off impurities.

With the warm mold resting firmly, pour the molten zinc *deliberately,* but do not stop until the mold is full and zinc is expelled through the vent holes. Allow to cool naturally, until cold.

Cut the rest of the tin can away from the plaster and then attack carefully with a hammer. Out of the cocoon will emerge a perfect metal grinder having a pedestal and two rods attached. Saw these off and the flat back can then be drilled and tapped for any type of plate or driving stud the worker may decide on.

I have purposely outlined the production of a flat-backed grinder to simplify the job of casting. The amateur with a flair for complications can cast this grinder with its spindle-fitting at-

tachment in one piece, if so inclined.

Having turned my own kitchen into a foundry at one time or other, and knowing the reaction of the better half, may I wish you luck.

THE MANUSCRIPT of the above was sent to Dr. D. Everett Taylor, Willimantic, Conn., with an invitation to comment upon it. He replied: "This casting method—wax—is, as you probably know, the fundamental of the precise process in making dental inlays. Either Ransom and Ransome (Toledo, Ohio) or Kerr Dental Manufacturing Co. (6081 Twelfth St., Detroit, Mich.) dental inlay investing compound would be even more accurate than plaster of Paris, causing less distortion from expansion or contraction and remaining unchanged in high temperatures (2000° F), and the cost would not be prohibitive. If plaster of Paris is used, the addition of 30 to 50 percent sand would improve the mix."

He further offers as a substitute for zinc, lead 1: tin 1: bismuth 1, having: a melting point 250°F, where that of zinc is above 700°F; contractibility, 0.00066 where zinc's is 0.01366; hardness, 0.042 where that of zinc is 0.018; brittleness, 7, zinc, 5. "This combination," he adds, "is attractive; with it the melting point is greatly reduced, the contraction is reduced to about one twentieth, and the hardness is more than doubled. The brittleness is increased somewhat, but, as I see it, the added brittleness is desirable rather than the reverse."

ONE AMATEUR to whom Driscoll's article was shown asked, "Isn't this a lot of work to make a tool?" Looked at in the light of work alone, it is. Telescope makers, being philosophers, don't look at things in quite that light. You might say, "I've always wanted to play with that old lost wax process and making a tool provides a good excuse, with the tool itself thrown in free." As Haviland says in "A.T.M.A.", what is a hobby if not to murder time—every moment of which is enjoyable.

URGENTLY, readers of this magazine often prod its book sales department to obtain for them second-hand copies of two famous old books that are out of print—Webb's classic "Celestial Objects for Common Telescopes," which went through seven editions after the first in 1859 (the seventh dates 1898-99), also Barns' "1001 Celestial Wonders," published 1927 and 1929 and patterned on Webb. It is probable that these requests come from readers who have only heard of their fame, since they are listed in numerous other books, but who have had no opportunity to inspect them.

Today the nearest substitute for Webb or Barns is "Norton's Star Atlas." Told this, readers ask "How near?", and think, "Wish I could see all three side by side and decide for myself."

Your scribe, one of whose many vices is a habit of haunting New York's numerous second-hand bookstores, has come across Webb but once, Barns never. Recently a fifth edition of Webb, brought up to 1900, was picked up. With it, Barns, and Norton spread out side by side it is thus possible to give the reader a comparison of these three. This particular three are singled out from other books about the stars for one specific feature, their main feature —they contain extensive lists of show objects for users of 2" to 6" and larger telescopes *equipped with setting circles;* lists prepared to facilitate systematic survey of these sights such as double stars, variables, nebulae, and clusters.

It is true, the Ephemeris contains star lists with coordinates but not arranged as described and not nearly so useful to the amateur.

Webb's book "has done more to introduce the possessors of telescopes to the remarkable objects in the heavens and to create observers than any book ever written." This was said in the *Monthly Notices of the Royal Astronomical* Society in 1886 when Webb died. It is still true in 1946.

All three books being similar, what are the differences? Not much in presentation. Typical examples—same object, *sigma Cassiopeiae:*

Norton: R.A. 23, 56.4; 55.29; 5.4, 7.5; 327°; 3" .1. Grand low power field.

Barns: 235455; D.5.4.—7.5; sep. 3" Teeming with jewels.

Webb: XXII h 53.9 m; N.55° 12'; 5.4, 7.5; 323.5; grn.v.bl. wh., tawny. Glorious low-powered field.

Thus, Webb's descriptions are a little more detailed.

Lesser differences: Norton contains star charts, so does Barns, Webb contains none. Norton is large—9" by 11⅜"—Barns and Webb are pocket sized. Norton's data are for Epoch 1950, the others earlier.

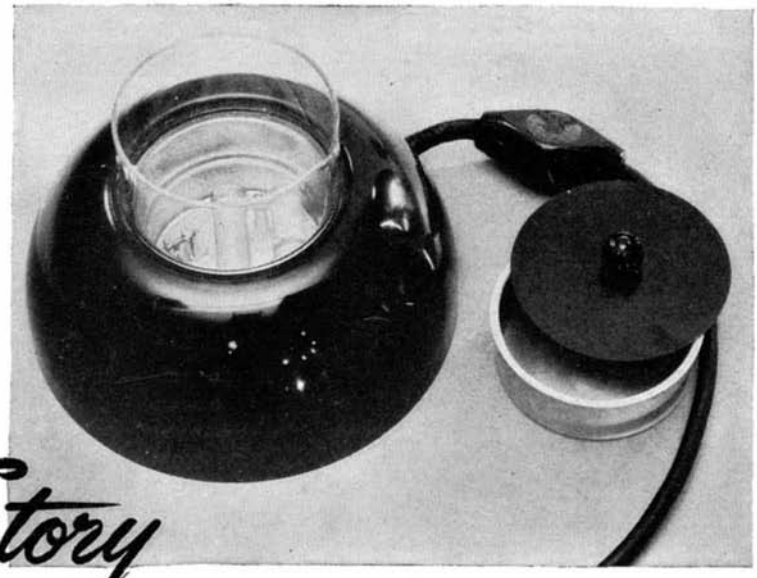
The chief difference is quantitative. Where Norton lists about 500 show objects and Barns about 800, Webb lists 3177.. Of this excess a large part consists, however, of doubles, an emphasis perhaps reflecting Webb's preoccupation with doubles due to his remarkable eyesight. Average observers are seldom equally preoccupied with doubles.

Webb therefore is a book to seek after the hunting in the available Norton has been exhausted, a book for the advanced amateur. For such, it is a treasure.

Lowell's three Mars books, "Mars" (1895), "Mars and its Canals" (1896), and "Mars as the Abode of Life" (1908), all out of print, are only medium rare —in the five-dollar class at second-hand.

"The Splendour of the Heavens" is rare—in the thirty-dollar class. Goodacre's "The Moon," not an old book (1931), is rare and in the same cost class, at second hand and, even then, virtually unobtainable. We know of an amateur who has searched far and wide for it for several years, advertised for it, been ready to give his fortune for it, yet without result. Recently, a small cache of brand new copies has been located where it was hidden away and forgotten during the war and they can be had without sacrifice of fortune —provided they are still there when we transmit your order.

Printed in the U. S. A. Press of the Wilson H. Lee Company, Orange, Connecticut.



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PLASTICS THAT FIT THE JOB