Scientific American

JULY
1946

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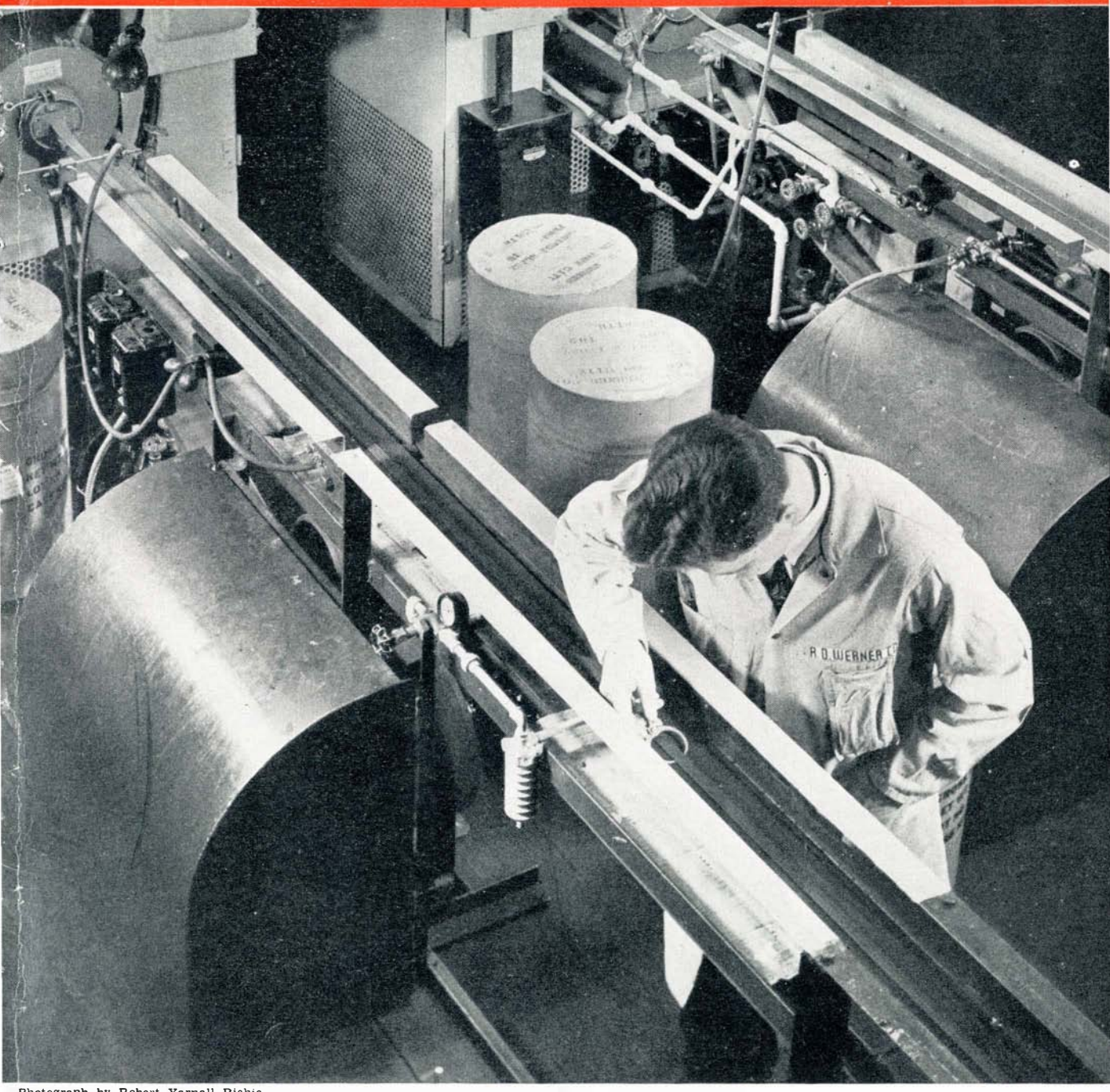
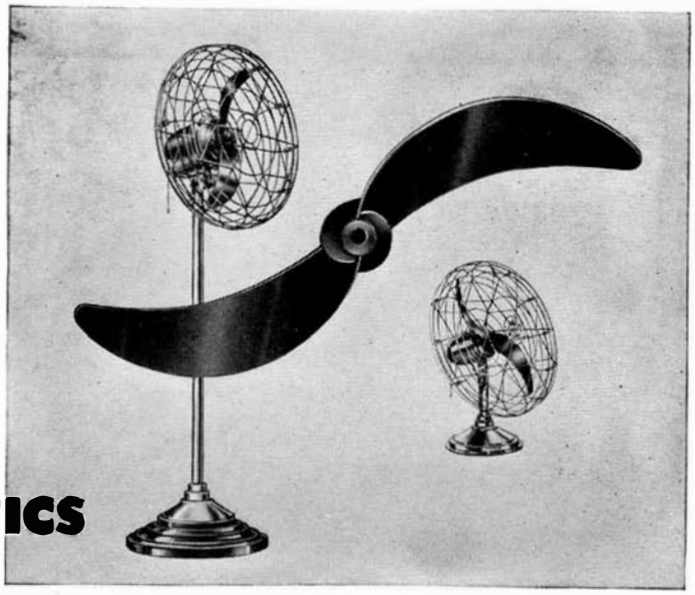
REPORTING THE PROGRESS OF SCIENCE AND INDUSTRY



Photograph by Robert Yarnall Richie

Checking Up On Plastics . . . See page 1

"CLEARING THE AIR" ABOUT PHENOLIC PLASTICS



The use of plastics by industry is increasing daily on a scope that is practically universal. Nevertheless, there still exists much confusion about the different types of plastics, their properties and their uses. The purpose of this message is to help "clear the air" about phenolics —the most versatile of all plastics... the type of plastics which Durez has specialized in producing for the past twenty-six years.

The custom molded Durez propeller illustrated is the first plastic propeller that has been developed for such use . . . marks a new step forward for the plastics industry. In varying sizes, it is used by the Fresh'nd-Aire Company in several of their most popular Fresh'nd-Aire Circulators.

Why Plastics?

Moldability — a common denominator of all plastics — naturally makes them highly desirable for producing an item of this sort — provided, of course, several other necessary properties exist.

Why Phenolic Plastics?

Because the Fresh'nd-Aire propeller must be statically and dynamically balanced to perfection and because it revolves at high speeds, good dimensional stability was of paramount importance.

The only plastic material which would provide this property and meet other requirements such as impact strength, heat resistance, tensile strength, and low-cost production, was a phenolic.

Why Durez Phenolic Plastics?

As specialists in the production of phenolic plastics, Durez offers more than 300 versatile phenolic molding compounds — each scientifically developed for a specific purpose — from which to select the plastic that precisely fits the job.

Furthermore, Durez laboratory technicians possess a rich background of successful product development experience which makes their services invaluable in solving any unusual plastic material problem.

Expert Assistance Available

The services of the Durez staff are available at all times to you and your custom molder. Durez Plastics & Chemicals, Inc., 17 Walck Road, North Tonawanda, New York. *Export Agents: Omni Products Corporation, 40 East 34th Street New York 16, New York.*

PLASTICS THAT FIT THE JOB

Scientific American

Founded 1845

INDUSTRIAL DRAMA: Plastics strip, widely used as edging and trim, is extruded from the machine shown in the upper left corner of our front cover. The continuous strip then passes under the watchful eye of an inspector who checks it to eliminate deviations in width. Photograph courtesy Hercules Powder Company

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In This Issue • July 1946

SCIENTIFIC AMERICAN, July, 1946. Vol. 175, No. 1. Owned and published by Munn & Co., Inc. Orson D. Munn, President; I. Sheldon Tilney, Vice-President; John P. Davis, Secretary-Treasurer; A. P. Peck, Assistant Secretary; all at 24 West 40th Street, New York 18, N. Y. Entered at the New York, New York, Post Office as second-class matter June 28, 1879, under act of March 3, 1879. Additional entry at Orange, Connecticut. Published monthly by Munn & Co., Inc., 24 West 40th Street, New York 18, N. Y.

Subscription $4.00 per year. Canada and foreign $5.00.

50 Years Ago in . . .

SCIENTIFIC AMERICAN

(Condensed from Issues of July, 1896)

FIFTY YEARS of publication of Scientific American were editorially observed in the July 25, 1896, issue. The following comment is abstracted from that issue: "The material world has advanced so rapidly during the last half century, and with a pace so accelerated, that mankind has almost lost one of its most important faculties, and one essential to happiness—that of surprise. The *nil admirari* faculty is attaining a wide spread. The most marvelous developments are taken as a matter of course—the condition of things fifty years ago is seldom pictured to the mind—and all the material blessings which we now enjoy are used as conveniences of daily life, and no more."

CYCLE TESTING — "The American bicyclist has become a most exacting judge of the qualities of a wheel. He insists on perfect finish, silent running, and lightness. . . To meet this condition of things, the Pope Manufacturing Company, the makers of the world-famous 'Columbia,' have established a system absolutely unique in the bicycle world; namely a testing department, where every article which enters into the construction of a bicycle can be tested with the highest degree of accuracy. Samples of the tubing are subjected to direct and vibratory strains to see if it possesses the desired mechanical qualities. . . Steel balls are broken to test what they will stand; cranks, sprockets and chains are experimented with to ascertain the best shape and material for each. Spoke wire is fractured and its data are fixed."

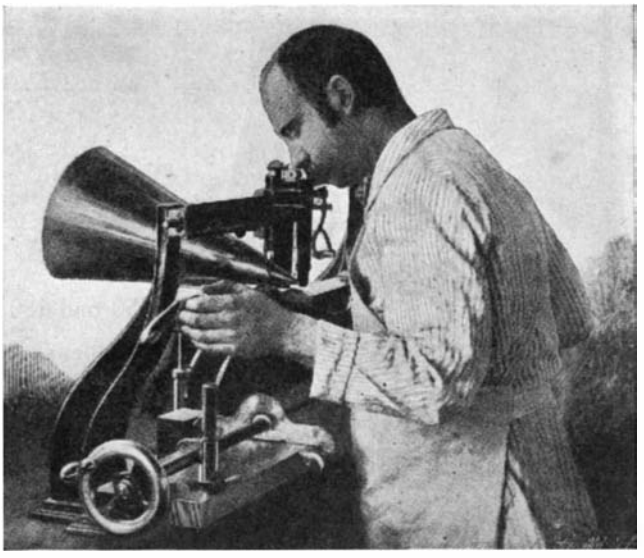
LUMINOUS PIGMENT — "M. Henry is a French savant of the school of higher studies, who has revealed the power of sulphate of zinc to absorb sunlight and give it back in the dark. . . The luminous pigment is not liable to be spoiled by damp, by carbolic acid or by any weak acid."

TEMPERATURE INCREASE — "The question of the rate of increase in temperature from the surface of the earth downward has long been one on which prominent authorities differ. . . Among the scientists who have recently given this subject considerable thought is M. Joseph Libert, who records observations made at Produits colliery, Flenu, Belgium. These observations have been carried to a depth of 3,772 feet. Taking 82 feet as the depth at which atmospheric variations of temperature cease to have any influence, it was calculated that the rate of increase of temperature given by the tests at Flenu was 1° Fah. for 53.97 feet of vertical depth."

BUILDING — "With the development of the art of steel construction, and the increase in the number and complexity of the problems which it involved, the line of demarkation between the engineer and architect began to grow more distinct, until today it is common practice for the architect to call in the aid of the engineer to design the structural steel work which gives stability to his buildings."

KNOT TYING — "Two of the most interesting automata now working within the limits of the United States are those used by the government for counting and tying postal cards into small bundles. These machines were made in Connecticut, and the two are capable of counting 500,000 cards in ten hours and wrapping and tying the same in packages of twenty-five each."

ACCURATE MEASUREMENTS — "Accurate readings from a micrometer caliper can be made to 1/10000 of an inch; from this one is able to judge with what care the parts of such an instrument must be made. . . The final testing of a



caliper of the kind mentioned must be made with the most delicate instruments, or with standards made to exact size. The accompanying cut shows the measuring machine, one of the numerous appliances for securing great accuracy peculiar to the shops of the Brown & Sharpe Manufacturing Company, of Providence, R. I., and used for the measuring of standard gages, and other tools that must be finished to exact size. . . Above the scale is a microscope, fitted with a micrometer eyepiece, for reading the graduations: the microscope is mounted upon a slide parallel with the scale. . . The micrometer graduations are read by means of a vernier scale, making the value of the graduations equal 0.00001 of an inch. The cone shown at the back of the machine is for the purpose of concentrating the light upon the graduations of the scale."

100 Years Ago in . . .

SCIENTIFIC AMERICAN

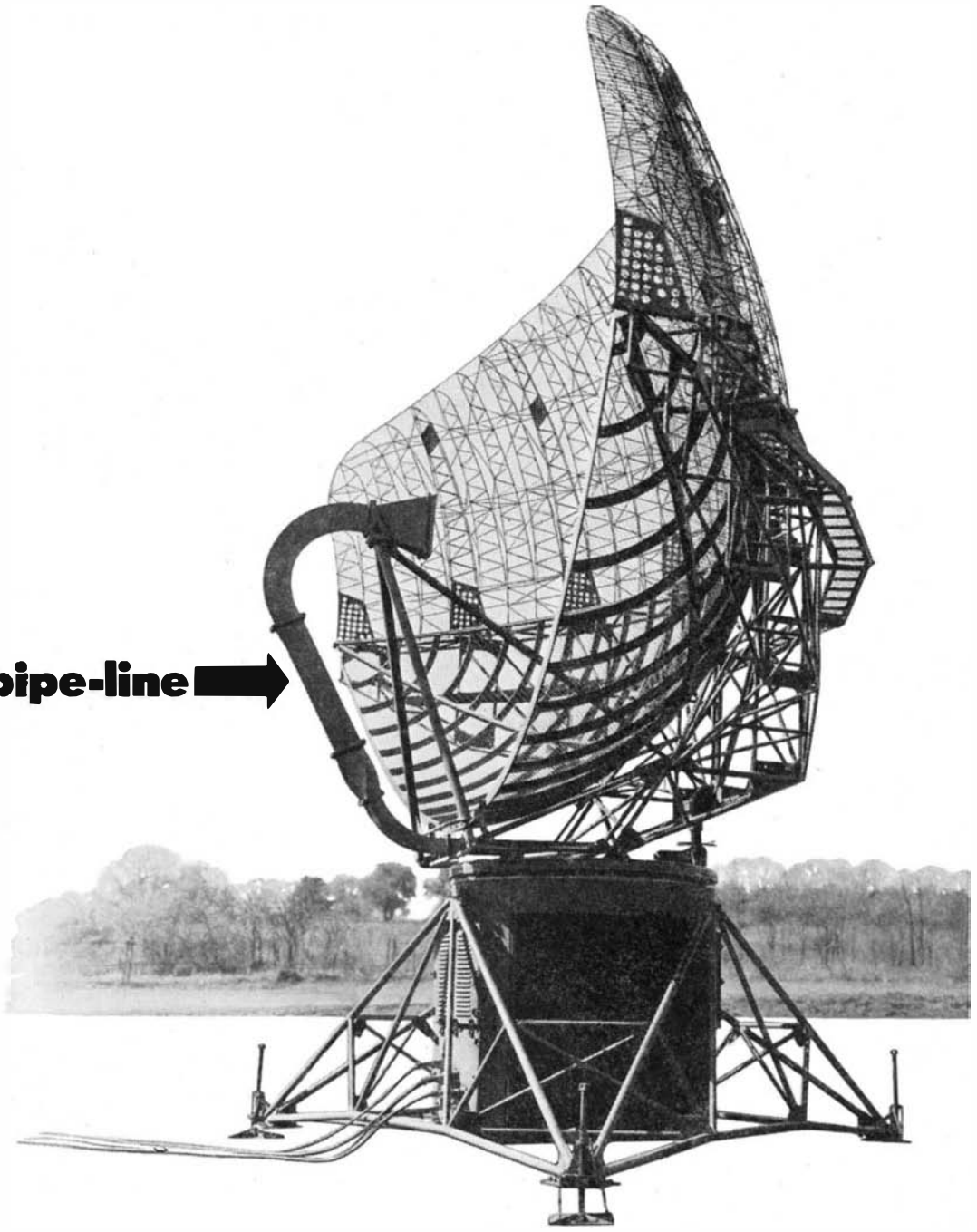
(Condensed from Issues of July, 1846)

PRESERVED MEAT — "An English paper says that a case of preserved meat, taken from the wreck of the Fury which was lost in the Frozen Ocean in Captain Parry's first voyage, about twenty years since, it was opened by a gentleman at Brentwood, when it was found to be as fresh as on the day it was packed, and when cooked it was excellent."

ELECTRIC CLOCKS — "One of the latest exhibitions of the power of the electric fluid directed by human skill, is now manifested in regulating, setting, and running of clocks at any great distance from each other. A clock has been so arranged, by its connection with the wires, that the oscillations of its pendulum mark the hours on dial plates in two widely separated cities, at one and the same moment."

TELEGRAPH PROGRESS — "There are now in operation in the United States, about 960 miles of telegraph lines; and there will be 500 miles more added, according to present prospects, by the 25th of August."

NAVY — "England seems bent on outdoing the world in the way of a navy. She has now building 100 ships of war, among which are no fewer than 35 steam frigates and other war steamers; four 36-gun frigates; ten 50-gun frigates; and ten ships of the line, averaging from 80 to 84 guns each."



electrical pipe-line

Microwaves make their journey from apparatus to antenna not by wire, cable, or coaxial — but by *waveguide*.

Long before the war, Bell Laboratories by theory and experiment had proved that a metal tube could serve as a pipe-line for the transmission of electric waves, even over great distances.

War came, and with it the sudden need for a conveyor of the powerful microwave pulses of radar. The metal waveguide was the answer. Simple, rugged, containing no insulation, it would operate unchanged in heat or cold. In the radar shown above, which kept track of enemy and friendly planes, a waveguide conveyed microwave pulses between reflector and the radar apparatus in the pedestal. Bell Laboratories' engineers freely shared their waveguide discoveries with war industry.

Now, by the use of special shapes and strategic angles, by putting rods across the inside and varying the diameter, waveguides can be made to separate waves of different lengths. They can slow up waves, hurry them along, reflect them, or send them into space and funnel them back. Bell Laboratories are now developing waveguides to conduct microwave energy in new radio relay systems, capable of carrying hundreds of telephone conversations simultaneously with television and music programs.

EXPLORING AND INVENTING, DEVISING AND PERFECTING FOR CONTINUED IMPROVEMENTS AND ECONOMIES IN TELEPHONE SERVICE

BELL TELEPHONE LABORATORIES

Previews of the Industrial Horizon

By A. P. Peck

SCIENTISTS *VERSUS* POLITICIANS

WHAT makes a politician? What makes a scientist? Answer to the first question tempts a parody on the childhood formula involving puppy-dog tails; answer to the second brings in the inquiring mind plus academic education plus a certain detachment of self from the problem in hand.

It is encouraging, then, to both science and industry, that scientists, *per se,* are rapidly gaining recognition in the field of politics. To that field they bring a fresh viewpoint, largely divorced from most of the mundane considerations of politics as it has grown to be accepted. Stemming from the six geographical unions of atomic scientists, the Federation of American Scientists is indeed a step in the right direction. Here is a new political (perhaps quotes should be used here) force to be reckoned with. The Federation, composed of social scientists with a genuine realization of their obligations to the world at large, should be an ideal body to attack such problems as unemployment, fair wages, housing, labor relations, and the like. To such studies they would apply a detached point of view completely refreshing in contrast to the usual political selfishness.

The public at large, and industry in particular, should give its whole-hearted support to the Federation. From such a group can come such benefits as have never before emerged from any political organization.

FIRE!

FOR MORE generations than seem possible, in light of the seriousness of the problem, the matter of fire-proof buildings has been kicked around by building codes that refuse to take a realistic view of the situation. For example, many cities will permit unprotected wood-joist interior construction in gasoline service stations, but will not sanction steel, concrete, and other non-combustible materials unless they are fire-protected! Such building codes stultify the progress of new and improved materials. The sooner industry puts on the pressure to have them modernized, the sooner will tremendous fire losses decrease.

BOUNCING SYNTHETIC

LATEST news from the synthetic-rubber industry concerns a material made from isoprene which exhibits more bounce and stretches farther than any other synthetic rubber now on the market. Reports have it that this latest elastomer is available in experimental amounts for those who would investigate its possibilities.

At the same time comes a statement from Goodrich that GR-S can now be produced at a "plant cost" of about 12 cents a pound or an all-in-all price—including overhead and return on invested capital—of 15 to 17 cents a pound. Here is the beginning of an answer to the synthetic-*versus*-natural rubber question. The price is down. The quality is up. The United States can produce economically the rubber that it needs. As a simple insurance policy—regardless of isolationist or non-isolationist tendencies—our synthetic rubber productive capacity must be maintained. To abandon it now, as a sop to international policies, would be the worst kind of technological suicide.

PREFABS

DEMAND for prefabricated houses is zooming, regardless of anything that the public may have to say concerning the undesirability of some types of homes built on mass-production principles. Yet, despite this demand, the prefab industry is impotent to fill the bill. Shortage of materials is the answer.

A recent survey showed that the prefabricated-house industry was geared to produce 150,000 home units a year. But reconversion has been slow. As of now, it appears that if 50,000 units are built during 1946, the industry will be doing very well under existing circumstances.

Designs for prefabs range all the way from conventional practice to weird hemispherical structures of aluminum alloy and steel with a central steel mast, the whole unit built on suspension-bridge principles. Some are so radical in appearance that there is a serious question as to whether or not the public will accept them. But, no matter what the design, the problem of materials still haunts. Until shortages are relieved, and home builders can perfect their plans in all aspects, prefabs as well as conventional hand-built homes will suffer delays.

Without being too optimistic, it is safe to say that the prefabricators with sound bases—such as Gunnison, Precision-Built, Hodgson, Shelter Industries, and so on—will come out on top. The principles of prefabrication are well established; the trend is away from the all-alike-in-a-row style of building; prefabs can fill a definite need in the nation's critical housing shortage; but they will not get their chance until materials are available to them as well as to conventional building proponents. Then the battle for markets will really start. Our money goes on those prefab builders who take into consideration the fact that most people want a home which not only gives them the fundamentals of shelter and comfort but also permits them to express their own tastes.

OIL FOR THE LAMPS OF INDUSTRY

COTTONSEED oil, basic to a number of industries ranging from food to chemical processing and surface coatings, is receiving intensive study in a number of laboratories. Improved methods of extracting the oil have been developed. Pressure extraction and solvent extraction both hold promise of increasing the amount of oil obtained from a given quantity of cottonseed. Results to date show higher yields per ton of seed, with decreases in cost of operation.

FOR FUTURE REFERENCE

STRUCTURAL panels made with a new reinforced Du Pont resin are being tested for such diverse applications as tooling jigs, automobile bodies, airplane fuselages, kitchen sinks, and refrigerators. . . Unwoven cloth, that eliminates the need for looms, is being made by a "felting" process using cotton fibers bound together with plastics; result is a fabric that, while exhibiting only unidirectional strength, has already found uses in shoe linings, draperies, handbags, and diapers; although the new cloth is porous, it has not yet reached a point where it can be used for shirts or dresses. . . If the radio industry—when it gets into full swing—hopes to recapture its markets, designers of radio receivers must take into consideration mechanical performance, appearance, and functional convenience; if the industry ignores these primary factors, established firms will lose business to new-comers who have business sense enough to heed public demands. . . Industrial accidents have taken a big jump since V-J day; accident prevention is sound business that should not be neglected under any circumstances. . . Small or isolated wheat-producing areas can benefit by a new portable flour-mill which can be operated right in the field, being towed to the operating site by a tractor or a Jeep.

ENGINEERING

Processes Must Mature

To Evaluate Properly All the New Processes that Appear, Industrial Management Would Need a Crystal Ball. Next Best are Standardized Tests—Often Unestablished—and Long Experience, which Demand Time. Hence, Most Developments Need a Long Maturing Period

By EDWIN LAIRD CADY

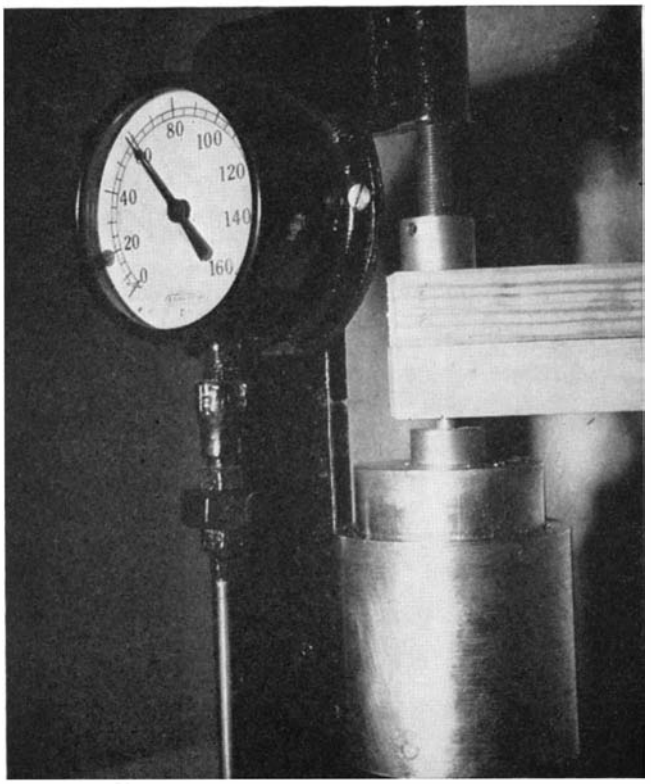
About four years ago, scientists in the Portland cement industry announced that if concrete-reinforcing steel shapes were put under heavy tension and held that way while the concrete was poured and allowed to set around them, then the final strength of the concrete could be increased in almost direct proportion to the tension on the reinforcement.

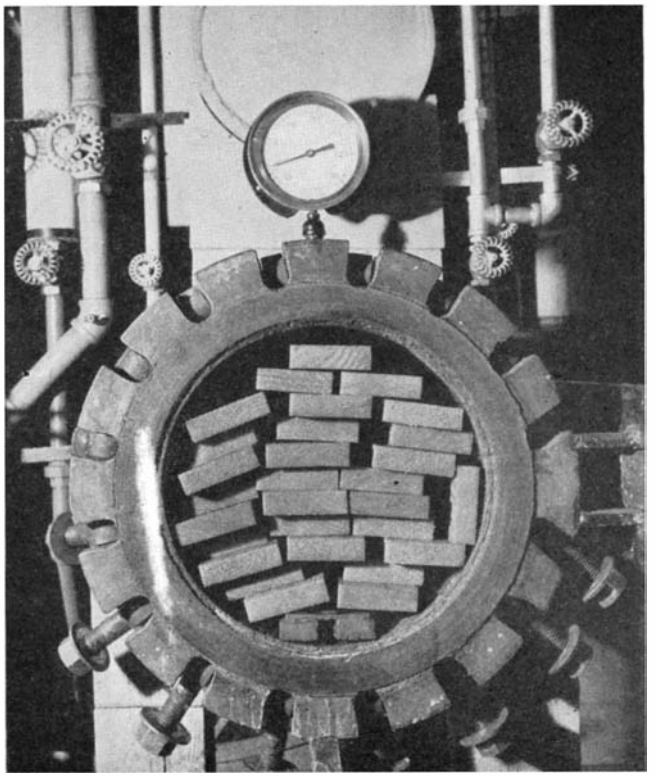
Working along similar lines, steel engineers were finding that if steel were pre-stressed either by shot peening its surfaces or by rolling to special indented patterns, then for the same service the weights of parts made from it could be reduced anywhere from 25 to 50 percent.

Each of these new techniques promised to give engineers something they long had wanted; greater strength with less weight and space. Yet, no more than a bakers' dozen of plants in the entire United States are equipped to do a real job of concrete reinforcement pre-stressing for more than a limited number of special products such as tanks. And, aside from the few large makers of automobiles and airplanes and agricultural machinery, there probably are not 50 factories operating shot-peening machines for the sole purpose of strengthening steel parts.

The slowness of this progress is not to be blamed upon any lack of knowledge or of appreciation of the merits of these processes by the engineers who might use them. The processes simply are too young to have gone very far.

Industrial processes and products grow much like human beings. They





DMU-treated wood is in process of "growing up." In test set-up (left), pin is buried in untreated upper slab, but only dents treated lower board. Kiln (right) typifies problems common to new industrial processes. Here, automatic controls must supplant manual systems

• LOOKING AHEAD •

Many spectacular war-born products and processes won't find immediate homes. . . Some, however, will emerge several years from now as standard industrial items. . . Others will come to rest on the scrap heap. . . . A few, certainly, will eventually be "discovered" as boons to supposedly remote businesses. . . Efforts to apply new ideas may meet less resistance than in the past. . . Cost-saving processes now particularly welcome.

emerge as infants, interesting but weak and in need of careful nurturing. They go into adolescence, into strong and aggressive youth, balanced and steady middle age, seasoned but fading senility. And one of the hardest problems of industrial management is to know just what "age" any one process should be allowed to reach before it is taken on.

Such decisions can be based upon both emotional and practical grounds. Individual executives or whole managements can be youthful-minded, and prefer the new developments; "middle of the road," and strong for the middle-aged processes; conservative, and sticklers for the traditional. But besides acting the way they like to act they will usually do whatever will become the most profitable.

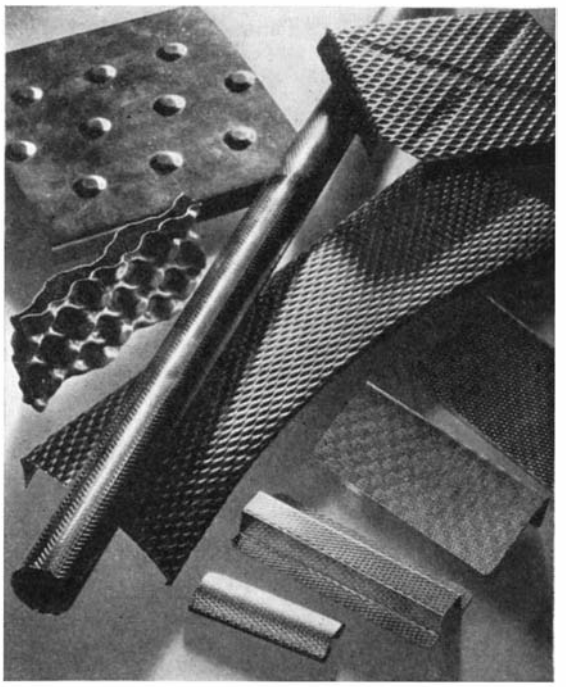
TREATED WOOD—Dimethylolurea—DMU, for short—treated wood is an example of what is likely to happen to any brand-new process. Its story is much like that of the prestressed concrete reinforcement, the shot-peened steel, and many others.

DMU was announced about four years ago by Du Pont, who make the chemicals for it. It got the wide publicity which usually is received by anything unusual. But aside from the news stories nothing much happened.

Then S. S. Keeley and Sons decided to pick the infant up and see what could be done with it. The Keeley company was old but its management was young, hard hitting, open to the possibilities of a fresh, new product.

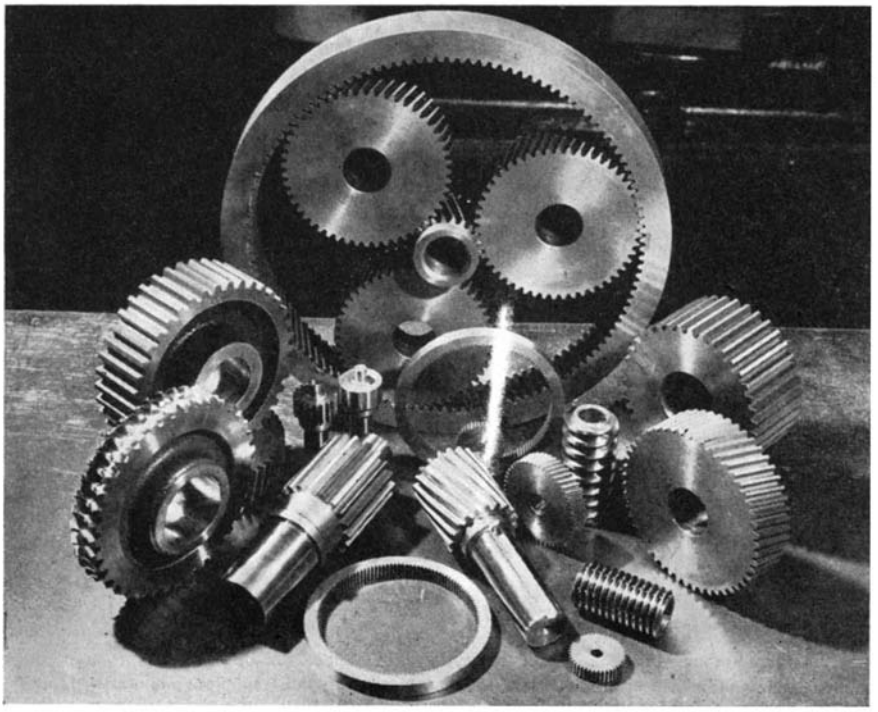
Known facts were that the process would make woods much harder—pine being made as hard as untreated maple, and maple much harder than in its untreated state; that the transverse strength of the wood would be increased to the point where splitting was as difficult as breaking by tensile pull; and that the dielectric characteristics and the resistance to chemicals would be greatly increased. There also would be process difficulties—two kiln dryings instead of one, and careful control of vacuum, heat, and pressure being mandatory.

The second kiln drying had to be done after the wood had been impregnated with the DMU, and it presented unusual problems. Ordinary operation permits men to enter the kiln, see just how the drying is progressing, and change the temperature and the humidity to get the quickest results while avoiding damage to the product. But the DMU-impregnated wood gives off dangerous gases and men cannot enter the kiln after the process is well under way. Experience, plus the records of instruments and the use of automatic controls far more accurate than those commonly used with kilns, had to be substituted for personal inspection of the work.



Courtesy Rigid-Tex Corporation

Rigidized metal (right) suggests a variety of useful applications. Wide-spread and universal acceptance, however, will probably require time. Gears (below) exemplify a time-proven and fully matured product



TEST PROBLEMS — Experiments with various species of woods had to be made, are still being made. Not more than one fourth of the kinds of wood in common commercial use proved themselves to be fully suited to this process. Some of the others proved to be partially acceptable, others wholly unsuited. The results with various species were not uniform. Pine became as

hard as maple but it did not become maple; it became a brand new industrial material with pine as its main ingredient.

As is all too common with new materials and processes, means for testing the finished product were lacking. The hardness of one wood could be compared to that of another but not very. directly with that of plastics or metals.

An old-line maker of textile machinery had problems severe enough and management youthful-minded enough to try the DMU-treated woods. It was found that these woods would not "hair-up" or raise the grain at the surface of the finished parts, and thus these parts could be kept in service much longer than those of untreated woods. The haired-up grain, formerly experienced, caught the yarns that passed over the parts and damaged them. But there were no mechanical or other practical tests for hairing-up of wood surfaces; the superiority of DMU in this respect had to be established by experience and the experience took time.

In the meantime, other users were experimenting with the resistance to splitting of the product, were finding that they could eliminate the metal reinforcements which they had applied to untreated woods. One had a product in which the wood had to hold metal parts which were driven in like nails. There was no other test of this holding ability than to drive the parts in and pull them out again and keep on doing it until the DMU superiority for this purpose was established.

TIME NECESSARY — The Keeley company also was finding out more about their product. For example, ordinary wood-working methods could give it such a fine finish that sanding often could be eliminated. A wood-working planer of the kind that uses high-speed knives and takes many cuts per inch actually can put a mirror finish on DMU-treated wood. Small holes can be drilled more accurately in it since the drill does not turn and follow the grain.

Every bit of this new knowledge made new markets possible for the product. But those markets had to be found among customers who had youthful-minded executives willing to try something new, or else had problems so severe that they would try anything once.

Now there are at least 20 companies doing DMU processing in the United States. Keeley is greatly increasing its facilities and with markets in plain sight for all its output.

Hand-scraped bearings still hold their own on many important jobs in industry since their characteristics have been proved through long and successful use

But, even so, this product does not enjoy one customer for every thousand it probably will have when it reaches middle age.

Between the inception of DMU or any other new product, and its fully matured markets is a long period of finding out what qualities to test for and how to test for them; of getting customers used to buying it and habituated to its fabrication methods; of finding out where it does not fit, as well as where it does.

INDUCTION HEATING—A fair example of a process which is just getting well into young manhood is induction heating.

In spite of the fact that induction heating dates from about 1922, has been used for the melting of metals since the early 1920s, and for hardening and soldering for well over ten years, there probably are not more than 3000 companies having induction heating equipment in the United States.

Probably 50,000 factories could use this process with profit. It can save as much as $5.00 per unit on the hardening costs of a single complex part; can permit the substitution of low-cost, easily-machineable carbon steels for high-cost and hard-to-machine alloy steels; can solve a multitude of brazing and soft-soldering problems. But induction heating has progressed very slowly from precision melting of small lots of alloys to the hardening of the bearings surfaces of crank shafts, to the heating of steel for forging, the hardening of gear teeth and other contoured parts, and finally to all sorts of hardening and soldering operations.

In the beginning, nearly every installation was tailor-made for a single operation or a known combination of operations. The user who wanted to convert his equipment from one operation to another commonly had to send for the service engineers of the equipment maker to plan the new job and even to change parts of the equipment itself. To a large extent this still is so. But as the varieties of parts handled by induction heating have grown from tens to thousands, and

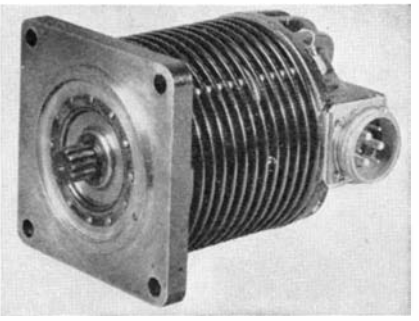
then to hundreds of thousands, more and more engineers have learned how to handle induction heating and what may be expected of it. Single installations costing more than $500,000 are being made. Flexibility and adaptability are on the increase. Induction heating has gotten past the risk and the experiment stages which attend a completely young industry, but it still is so young and lusty that it is making even faster progress now than during the war.

OLDER PRODUCTS—Gears are an excellent example of a middle-aged industry. They keep on improving, of course, but not too radically. A new hardening process like induction heating or like modern carefully controlled flame hardening; a new machine with electronic or other improved controls; a new production method like powder metallurgy or precision investment casting; a new alloy or new plastics material; any such improvement means that some part of the gear industry takes a long step forward. But gears are well established, well understood, universally accepted.

Very seldom is there any large profit margin in making them, or any risk in adopting them. They are a safe, sane, middle-of-the-road means for the transmission of power, in most cases as free from drama as from gambles when any engineer designs them into his products.

Hand-scraped bearings are a very old institution. At one time, there was no substitute for them when a shaft had to be held in strict alinement. Now, there are anti-friction bearings and many other kinds which have passed through their youthful stages and become well established. And yet, on many large motors and other important jobs the hand-scraped bearings are preferred. Every weakness as well as every good point about them is fully known and understood. In common with nearly all of the "old" products which persist in industry, this completeness of understanding of them, this perfect knowledge of what they will do and how they will do it, makes them highly profitable for some uses.

The progress of any product or process from extreme youth to old age is one of swapping high profitability, plus somewhat unknown and uncontrolled risks, for lower unit profitability but with risks more controlled or eliminated. But it is the use of well-established, risk-free products which enables a management to take the gambles and gain the profits with the younger and less developed ones.



Four-horsepower, one-minute motor

is largely determined by its temperature rise under load, and this in turn depends upon how long the load endures. If the motor is to run for less than one minute, and then is to rest, it can have very high capacity for its size and weight. For example, a four horsepower motor of this type may weigh only 7.2 pounds.

Industry has a large variety of such short-interval jobs for motors to do on pumps, instruments, regulators, and so on.

PLASTICS VALVE SEATS

Match Rough Surfaces; Extend Valve Life

SMOOTHNESS, toughness, and the conforming qualities that make some artificial fibers suitable for ladies hose, make the plastics forms of those fibers highly useful in pump, faucet, and other valve seats. The new plastics seats will hold air pressures of over 2500 pounds per square inch when mating with surfaces which have not been hand lapped. One result of this may be to greatly prolong the lives and reduce the maintenance costs of high-pressure and of some low-pressure valves. The abilities of the plastics to conform to slight surface irregularities will permit valves to be kept in service which by previous practices would have been too badly worn or eroded on their mating faces to hold the pressures.

ADHESIVES FOR METAL

Secure Multiple Pieces For Production as Unit

BY THE use of war-developed adhesives, aluminum parts can be fastened together with joints having shear strengths of over 5000 pounds per square inch. Engineers are just beginning to examine the possibilities of such simple and inexpensive fastening methods. One immediate use is to fasten or gang together several parts which are to be machined, riveted, or otherwise fabricated as single assemblies. The method eliminates many costly clamping and inspecting operations.

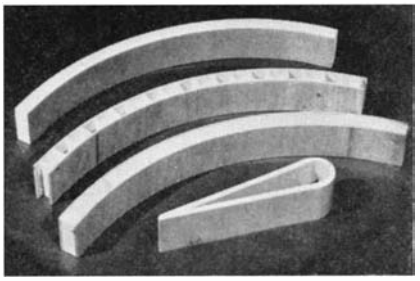
USEFUL WOOD

Finds Ever-Wider Range as New Processes Develop

IN SPITE of the rapid development of metals, plastics, and other materials, wood still is the handiest material to fabricate with simple tools and machines.

Working hard to make wood more useful are such processes as chemical fire-proofing, followed by compression. The compressed wood loses only its air cells, retains all of its strength and its workability, offers high strength with light weight and reduced volume.

Heat-stabilized wood, being taken from press, was originally same thickness as block in technician's hand



Formed wood parts hold their shapes

Light and soft woods can be laminated or faced with wear-resistant compressed woods or heavily compressed papers. Thus bulk with light weight, stiffness, and strength may be had. And these combinations can be formed to hold their shapes with high stability.

ONE-MINUTE MOTORS

Give High Power for Size in Short-Run Applications

AMONG the surplus war items finding readiest sale to industry are the one-minute motors especially developed for aircraft use.

The capacity of an electric motor

Industrial Hemstitcher

Closely Approaching a "Sewing" Machine for Metal, Resistance Welding has Multiple Advantages of Which High-Speed and Economy are Only Two. Spot Welds, Seam Welds, and Flash Welds are All Variants of the Resistance-Heat Theme. Keynotes are Versatility and Ease of Use

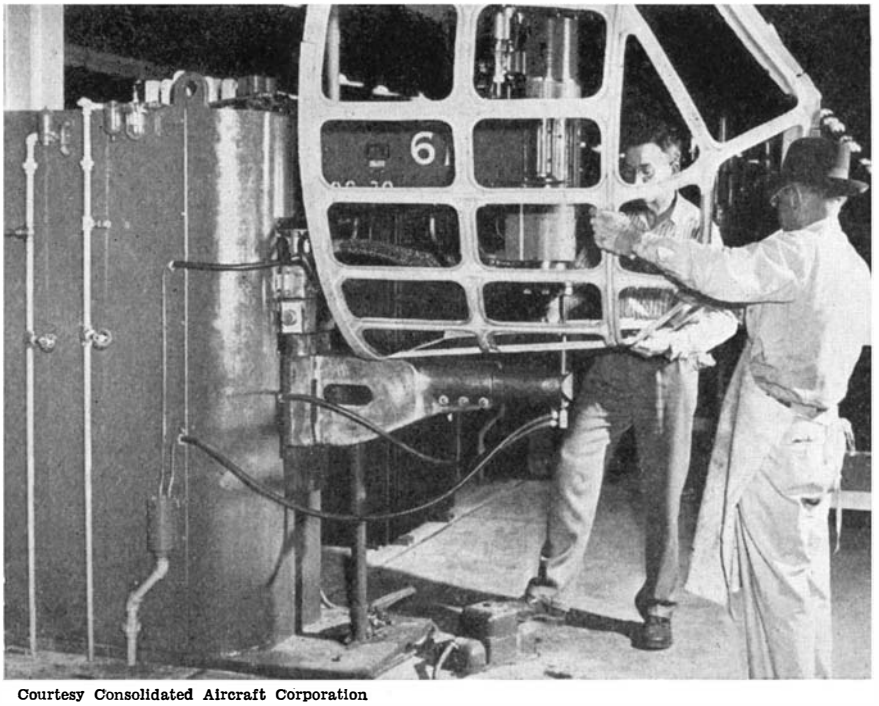
By FRED P. PETERS
Editor-in-Chief, *Materials & Methods*

INDUSTRY is hearing more and more about resistance welding today, and if developments now on the drawing boards mature, this form of fastening may eventually become as familiar as soldering and riveting. Resistance welding is basically the process of joining two pieces of metal by placing them in contact with each other, pressing them together, then heating locally to fusion by passing a heavy electrical current—A.C. or D.C.—directly through the joint. No extra metal or filler rod is added as in arc or gas welding, and the area of heating —and therefore of metallurgical changes—is sharply localized.

Resistance-welding machines are in the "machine tool" class with respect to both initial cost and suitability to production-line operations. Indeed, metal-joining resistance welders have been the subject of as much development and improvement in recent years as have their metal-cutting machine tool counterparts. Resistance-welding equipment, according to the Resistance Welder Manufacturers Association, sold to the extent of about $4,000,000 worth in 1939. By 1944, admittedly a peak-production war year, this figure had become $30,000,000. And resistance welders, now manufactured by some 30 companies, are key production equipment in thousands of plants for making a vast number of different products, ranging from aircraft fuselages and railway cars to tea-kettles and jewelry.

• LOOKING AHEAD •

More resistance welded products as designers come to predicate production on this process. . . Changeover from general-purpose welders to specific-use units. . . Higher production of articles stymied by solder shortages. . . Replacement of skilled welders and brazers by welding-machine "operators". . . Substitution of welded multiple-part assemblies for intricate castings.



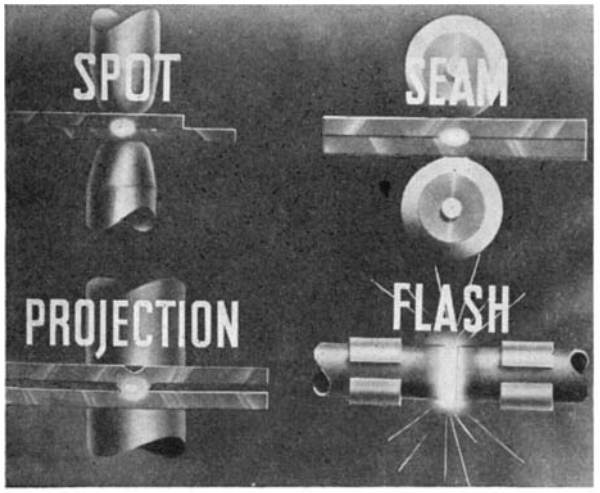
Courtesy Consolidated Aircraft Corporation

Light but awkward-to-fabricate structures are well suited for resistance welding

VARIED PROCESSES—The many possible adaptations of resistance welding have given rise to several distinct types of processes, including spot welding, seam welding, projection welding, upset-butt welding, and flash welding.

Spot welding, the most versatile of the resistance-welding processes, consists of clamping the mating pieces between the ends of two rod-like electrodes connected to a high-current, low-voltage transformer; electrode pressure and the heat generated by current passage produce a fused button or weld "nugget" joining the metals at the spot between the electrodes.

Seam welding employs rotating-wheel electrodes which roll along the joint, producing a continuous pressure-tight seam instead of a series of spot joints. Projection welding is a form of spot welding but has the added feature that tiny projections, previously stamped or



Resistance-welding technique has many facets from which stem wide adaptability. Here diagramed are four of the more common ways of accomplishing metal fusion by this process

Courtesy General Electric Company

machined on the work, serve to concentrate the current at the spot even though relatively large-diameter electrodes are used. In upset-butt welding, the ends of two pieces, each clamped in an electrode, are pressed together without overlap while current is passed through them. Flash butt welding—commonly called just "flash welding"—is similar to upset-butt welding except that the current is turned on as the pieces to be joined are moved toward each other; an intensely hot arc is formed, and when the metals reach the proper temperature they are forced together and the current is cut off.

Each process has a variety of subdivisions and equipment types. Thus, spot-welding machines include portable welding "guns" and pedestal types which may in turn be rocker-arm or press machines. Machines for projection welding closely resemble press-type spot welders—in fact, spot welders are often used as light-duty projection welders. Seam welders have their own operating features, including flexibility in the choice of current pulsation to produce either a tack-welded or a continuous weld (overlapping-spots) effect. Upset-butt and flash welders are still different in design.

Because the heat for resistance welding is generated by the resistance of the metals to the passage of current, very high currents are usually necessary; hence a high peak demand is made upon the power supply. To help reduce these peaks one of the most important of the recent improvements in resistance welding—the use of "stored energy" systems—was devised. Such systems, which employ transformers, capacitors, or storage batteries to store the supply-line current between welds, have been a boon to the welding of aluminum, which, because of its low resistance, requires unusually high current for successful welding.

Close control of heat, pressure, and time cycles is essential to successful welding. Modern electronic-control equipment has made resistance welding a simple, foolproof, precision operation that lends itself ideally to automatic mass-production requirements, and has probably contributed more than any other factor to the rapid expansion in use of the process.

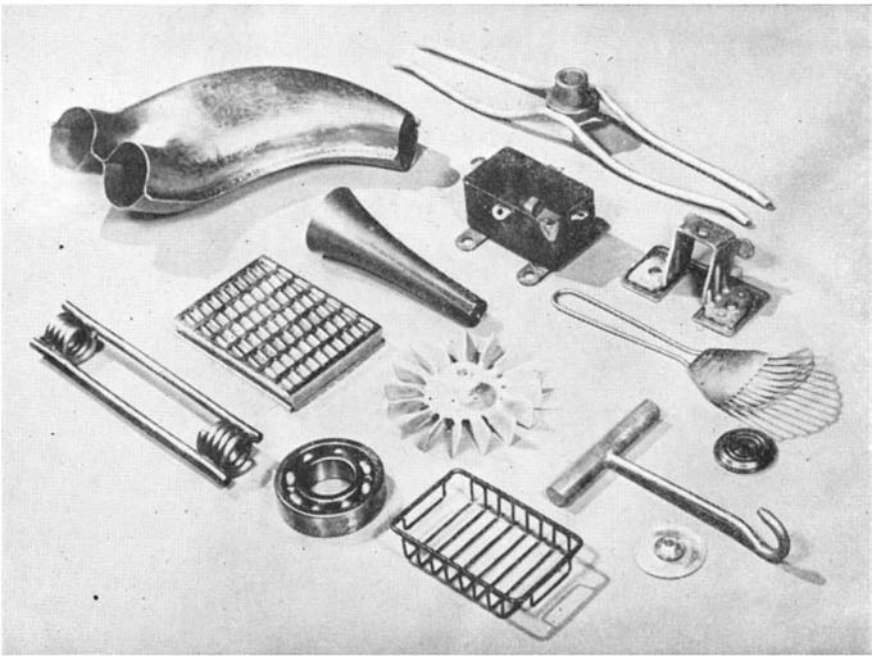
ADVANTAGES—All these factors and the resultant benefits to industry have recently been the subject of a searching survey by General Electric Company, from whose report many of the following examples have been taken.

For the various applications to which it is readily adaptable, resistance welding has demonstrated several production-simplifying or cost-reducing advantages, alone or in combination. These include: faster welding, easier assembly and handling, minimum distortion, virtual freedom from undesirable metallurgical effects, lower skilled-help requirements, savings in material, and so on. Most metals commonly welded in industry by any method, plus some that are extremely difficult to handle otherwise, can be resistance welded. Dissimilar metals, very thin sheets, thick-sections-to-thin-sections, tiny parts, and mammoth products are all easily handled.

On the tiny end of the scale, hard iridium nibs are resistance welded to gold-plated points for fountain pens, and wires half the thickness of a human hair are resistance welded for thermocouples, instruments, and electronic tube filaments and grids. At the other end of the scale lie such applications as resistance-welded railroad passenger cars, automobile X-frames, flash-welded steel auto-body sections, aircraft fuselages, and similar products.

An interesting use that has affected many fields is the resistance welding of sheet metal stampings to give intricately shaped parts which would normally have to be made as more expensive castings or forgings. Thinner sections of sheet metal can be used than are readily cast; also, the welded sheet metal is stronger than the very thin cast sections. Small sheet metal sections may be built up by multi-layer welding to make an exceptionally strong piece. The use of coined projections on stampings up to ½-inch thickness has made possible the replacement of many heavy castings with projection-welded parts.

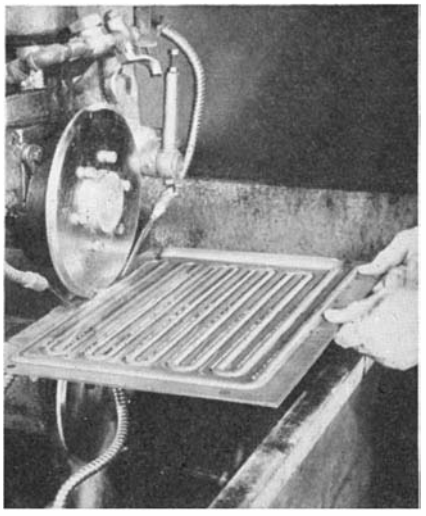
Resistance welders with slight modification can also be used for brazing and soldering. Thus, brazed contacts and windings give superior



Welded articles from several fields emphasize need for specialized welder units

electrical connections that will not open or melt during overloads. There are portable resistance-brazing machines that can braze the windings of electrical machines after the windings have been installed, and others are used to make connections in heavy bus-bar systems.

WIDE UTILITY—During the war the Army standardized on a five-gallon gasoline can, the body of which was drawn from sheet steel. The metal, drawn hard and thin by the forming



Refrigerator part was simplified and production speeded by seam welding

operations, made arc welding attachment of the handles difficult because of the ease with which the arc burned through. Spot welding was adopted and 80 percent of the time previously required was saved.

Again, spot welding of steel switchgear has been reported to be five times faster than arc welding, four times faster than bolting, more than six times faster than riveting. Resistance welding the studs on to the gear panels of switchgear eliminates seven operations formerly required—punching a hole in the panel, threading the hole, countersinking for the screw-head, inserting the screw, peen-locking the screw, grinding the peened surfaces smooth, and filling-in the rough surfaces.

Demonstrating the production-line utility of resistance welding is an installation in which a number of sheet-metal stampings were welded together to form an aircraft part. Eight portable spot welders were arranged inside a circular track about 20 feet in diameter, over which a conveyor moved in an endless circle. At the first station, the stampings are placed into fixtures, and the conveyor table moves on under each welding gun in turn, each with a specific operation to perform. At the final station, the finished piece is removed from the fixture and the conveyor moves on to the first station again. About 10 fixtures, permanently mounted on the conveyor table, keep the entire group of guns in continuous operation.

Resistance-welded steel auxiliary fuel tanks for airplanes represent an example of weight-saving possibilities. The elimination of rivets, even for the swash plates inside, gave a light, strong, fluid-tight product. Resistance welding also gave a smooth finish that cut down the air resistance. The resistance-welded tanks were produced faster, better, and at an 83 percent reduction in cost.

Both uniformity of product and amenability to continuous processing are exemplified by a resistance-welded refrigerator evaporator. Two pre-formed flat halves are held in a jig and tack welded with a spot welder, the final seams being seam welded before the evaporator is bent to its final form. More than a million of these evaporators were made with rejects of less than ½ of 1 percent.

ECONOMY—Savings, by resistance welding a complex assembly, were clearly shown in the manufacture of welded armored half-track sections during the war. These heavy pieces were formerly made by a combination of arc welding and riveting that was slow and required many skilled operations. After the job was redesigned for resistance welding, one company saved $240,000 just in the cost of training the necessary personnel, in addition to other operating economies.

In still another case, a flash welder paid for itself in four months of use through the savings that it effected in fabricating stampings for automobile rear-axle housings. And in a railroad shop, large amounts of expensive seamless-steel tubing for locomotive boilers are saved by cutting off worn tube ends and resistance welding new pieces in place. The main sections of the tubing are used dozens of times before they need total replacement.

In the future, one authority believes a large percentage of the resistance-welding machines will be specially designed for individual jobs, the implication being that much present-day equipment will be made obsolete or must be refixtured. For example, five years ago refrigerator liners were manufactured at the rate of 35 per hour; today, newly and specially designed resistance welders produce these same parts at the rate of 100 per hour. Again, low-capacity welders will be more widely used, especially in the costume-jewelry field where outmoded models are still fairly common.

Many steel companies are planning to aid the expansion of resistance welding by supplying a larger variety of cold-rolled strip designed for easy spot welding. In light metals, too, various extruded sections are available which can advance resistance welding further in the field of light, durable products.

Other important future uses for resistance welding are expected to be in the production of many building-components for mass fabrication of homes; in the large-scale production of metal boats less than 40 foot long; and in the manufacture and assembly of air-conditioning equipment—all this in addition to the substantial and still growing use of the process in the basic transportation-equipment industries: railway, automotive, and aircraft.

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COPPER-COATED

Aluminum Has Advantages For Electrical Uses

EXPERIMENTAL test runs are now being conducted on a new aluminum-base product designed to compete with brass for electric light sockets and other wiring devices. The new material is copper-coated aluminum and it has the special advantage of being easy to solder. Its conductivity, of course, is excellent and in addition it is said to have a price advantage over brass.

NON-AGING STEEL

Results from Use of Titanium in Alloy

TITANIUM alloy steels are coming along fast, especially the sheet steel recently developed for vitreous enameling. Non-aging and non-blistering when enameled without the customary ground-coat, titanium steel possesses excellent deep-drawing quality. All carbon in it is combined with titanium, the finished steel containing 4.5 times as much titanium as carbon. Its stress-strain curve is more like that of a non-ferrous alloy than low carbon steel. In an oil refinery, exposed to reducing gases at over 700 degrees, Fahrenheit, at high pressure, no appreciable change of properties was evidenced, while in the same application, plain carbon steel lost virtually all its ductility, and high chromium steel absorbed nitrogen excessively.

By-Product Bonuses

Petroleum By-Products, Like Ordinary People Working Without Great Fanfare, Receive Scant Attention Because There are so Many of Them. But They do Their Jobs Well, and the Background of Many By-Products Hold Bright Stories of Careers Salvaged from Oil-Refinery Wastes

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

• LOOKING AHEAD •

More by-products, rather then fewer, as petroleum chemistry expands and processes grow more complex. . . And for these materials, some with characteristics all their own, there will be jobs. . .Specialized jobs mostly, requiring research to match by-product and use. . .New textiles needing revised processing techniques. . . Stronger emphasis on preservation of organic materials. . .Better anti-rust and packing measures. . .All at least partially based on petroleum products with unusual abilities.

GIVEN a problem in which it appears that some form of petroleum might be useful, it is a better-than-average bet that the process products technicians will come up with a much better-than-average answer. And frequently this answer will be a process product made from one of the so-called refinery by-products.

When a substance as complex as petroleum is subjected to the extensive refining and compounding sequences, it is inevitable that a large variety of by-products will appear. Equally inevitable is the probability that many of these by-products should prove extremely useful. But the very fact that so many of these valuable substances do exist, in addition to there being so many uses for them, makes any attempt at discussing them a difficult task. Necessarily, they must be grouped into general classes and offered as examples of the inherent possibilities in refinery left-overs. A few of the more important examples come under the heading of naphthenic acids, petroleum resins, and petroleum sulfonates.

Synthetic rubber for printing rolls takes large proportions of plasticizer oils

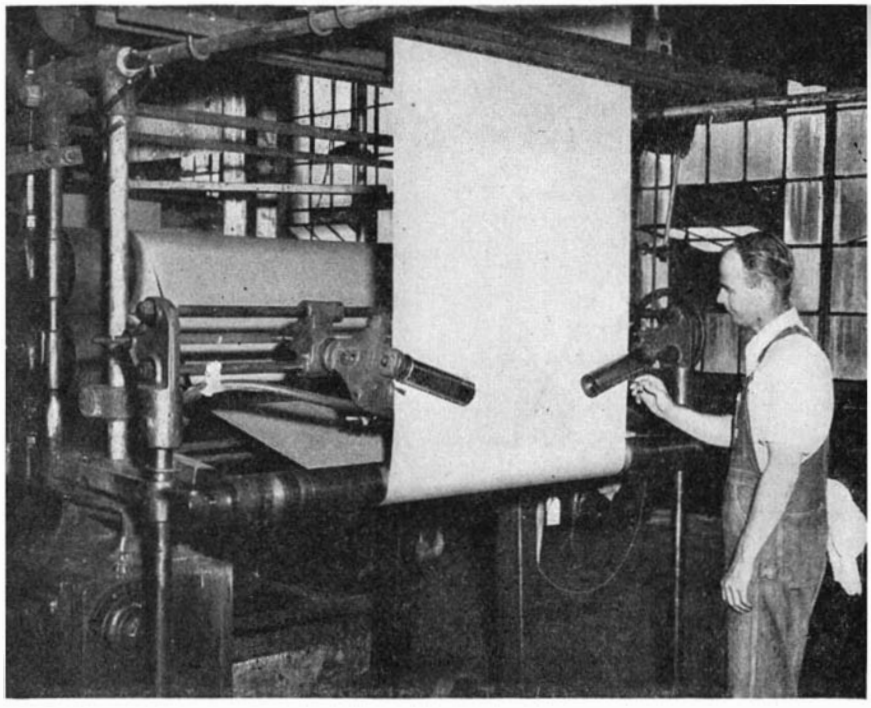
NAPHTHENIC ACIDS—In the refining of certain west-coast gasolines and kerosines, it is necessary to scrub from them certain odoriferous and corrosive organic compounds known as "naphthenic acids." These acids are formed by nature and are very similar in chemical composition to fatty acids. Like fatty acids, they can be converted to soaps, in which form they have their greatest use.

Lead, manganese, and cobalt soaps of naphthenic acids are excellent paint driers because they catalyze the setting of paint and varnish films. In addition, copper soaps of naphthenic acids are extremely useful as fungicides and insecticides. The petroleum industry markets sizable quantities of these copper naphthenates dissolved in either petroleum solvents or in ammonia for the treatment of wood and various cotton and cordage materials.

When impregnated with small amounts of copper naphthenate, cellulose products become resistant to attack by mildew and other fungi, teredoes, termites, and many related insects. In this preservative treat-

ment it is actually the copper which is the active ingredient, but its action is intensified by combination with naphthenic acids. A great variety of articles have been so treated, including sand bags, tent material, ropes, tent shrouds, camouflage netting, marine hawsers, bottoms of wooden ships, marine pilings, fish nets, and tobacco netting.

Other by-products from petroleum which have found wide use in industry are the so-called "petroleum resins" which are materials extracted from gasoline to reduce gum-forming tendencies. As a by-product, however, they are useful because of this characteristic, and upon exposure to air they dry to hard varnish-like films. Hence they are employed as extenders for difficult-to-obtain paint- and varnish-making oils, are applied to metals as protective coatings, and serve as binders for sand in preparing foundry cores for casting metals. In the latter use, petroleum resins burn out cleanly once they have been properly blended for the job in hand.



Wetting oils are essential to many textile dyeing and shrink-proofing processes

PETROLEUM SULFONATES — Mineral oil sulfonates are a third group of important by-products. Chemically, they are mixtures of sodium soaps of sulfonic acids, formed in the refining of petroleum oils with sulfuric acid. Depending upon their molecular weight, which in turn is related to viscosity, they are either water-soluble or oil-soluble in nature. The water-soluble sulfonates are powerful wetting agents and detergents, and have great utility in a myriad of applications. One of the main uses of a wetting agent is in the dyeing of textiles where it is essential that water will wet the cloth rapidly and uniformly and permit it to become evenly dyed to the proper shade. Other textile processes, such as shrink-proofing, also require these wetting agents.

Mineral oil sulfonates of the detergent type are used as important ingredients in special hard water- and salt water-resistant soaps, and in many of the familiar domestic cleaners. Mineral oil sulfonates of the emulsifying-agent type are useful for the manufacture of self-emulsifiable oils, such as cutting oils, and also many of the newer type rust preventives.

Rust preventives are of extreme importance in many phases of industry's activities. Practically all metal articles such as precision parts, instruments, tools, replacement parts for automotive and aircraft engines, and machine tools must be protected against rusting with products which can be removed before the articles are used or will not impair operations if allowed to remain. This is accomplished by coating them, or at least their most susceptible parts, with a rust-resisting film of one of a great number of special compounds designed for this service.

Practically all of the commonly-used rust preventives have a petroleum base of oil, petrolatum, or wax which is commonly compounded with other materials to enhance its properties. Products of this type are available to give protection against all degrees of rusting—indoors, outdoors, in the rain, in the sun, and on exposure to salt water. Rust preventives are highly specialized products because such a diversity of service conditions must be met and because such factors as the ease of application and removal, and the type of film required must be taken into consideration.

UNCOMPOUNDED OILS — Most of the products mentioned thus far are compounded materials that were developed for specific uses. In addition to these, the petroleum industry produces a wide variety of uncompounded oils which are extremely valuable in processing applications.

For years, the industry has produced a number of highly refined oils such as the so-called "white oils" which are used for medicinal purposes. Because these oils are so pure, and so bland in reaction, they find other applications in cosmetics, hair oils, ointments, and even in animal feeds. Other less highly purified oils made by various methods of refining are employed in packing houses for slushing chutes, tables, knives, and hooks during shutdown periods. Such products are also used as ovicides in tree sprays, as impregnants for wrapping papers and fruit wraps, and in the preservation of eggs.

The rubber industry is a large user of uncompounded petroleum products, since it consumes at least one part of petroleum for each six or seven parts of rubber. Were it not for petroleum products, it would be virtually impossible to convert many of the basic synthetic rubbers into useful articles of trade. For example, it was only when the rubber industry employed certain special asphalts that it was able to produce a GR-S tire which would approach a natural rubber tire in wearing and aging qualities. When petroleum products are compounded into rubber they assist processing and may impart such desirable properties as long life, flexibility at low temperatures, softness, and resistance to abrasion to the vulcanized articles. A number of synthetic oils have also been produced from petroleum which have found use in specialized rubber compounding operations.

Two other synthetic oils made from petroleum have unusual applications. The first of these is an oil employed for the inspection of raw quartz which is to be cut into quartz oscillators that control wavelength in electronic and radio equipment. The oscillator crystals can be made only from sections of raw quartz crystals which have no internal imperfections, and in addition must be cut at very definite angles with respect to both optical and electrical axes of the crystals. The crystals

must therefore be inspected, but since most raw quartz is scarred and has many opaque surfaces, careful study of the interior is often impossible. This, however, can usually be accomplished by immersing the quartz in a liquid having the same refractive index, upon which the crystal boundary becomes invisible. Since light is not bent in passing through the liquid-solid interface, surface flaws no longer obscure the internal defects. Such inspections cannot be accomplished with conventional petroleum oils because of their low refractive index, and consequently this operation was originally accomplished with chemicals which are highly odoriferous and somewhat irritating to human skin. Later, a petroleum product was developed in which these undesirable properties were reduced appreciably without loss in inspection efficiency.

The second synthetic oil is one that is being employed for the control of mosquitoes. Heretofore, the commonest methods of chemical control were to spray infested bodies of water with fuel oil, kerosine, or crankcase drainings. This treatment is effective because mosquito larvae breathe at the surface of the water, and are smothered when their respiratory organs become filled with the surface oil. The main drawbacks to the surface treatment are that on large areas, the oil blows away with heavy winds or evaporates in warm weather. As a result of these adverse conditions, oiling must be repeated every ten days or two weeks to ensure the continuity of the surface film.

Recent studies have been made of mosquito control with a synthetic oil which is heavier than water. This product, applied in emulsion form, has been used successfully for controlling pest mosquitoes of the culex and culicini families. The larvae of these tribes feed on the bottom, and for unexplained reasons are attracted by the oil, feed upon it, and soon become poisoned. The use of an emulsion of this high-specific-gravity oil overcomes the drawbacks of surface oils, because wind will not blow it from the surface nor will it evaporate. Treatment of infested areas with the synthetic product need be made only a few times a season instead of every ten days.

All in all, the applications of petroleum by-products and process products are almost unlimited in scope. They touch on nearly every phase of industrial activity and, indeed, are vital to many. It should be emphasized, however, that the use of these products is becoming far from a hit-or-miss proposition. In most cases, the sequence is one of establishing the problem and its contributing factors, analyzing the vulnerable points, and then compounding or adapting a specific petroleum product to its solution.

Photographs courtesy Socony-Vacuum Oil Company

Wax emulsion protected upper potato in storage. Lower potato untreated

EAST COAST OIL

Still Sought in Second Test Off Carolina Shores

PLANS to continue the search for oil in North Carolina were recently announced by the Standard Oil Company of New Jersey. The decision was based on information obtained from the first test well at Cape Hatteras.

It was explained that even though the first well failed to encounter signs of oil or gas, the geological findings justify additional exploration. Two sands which produce oil in the Gulf-Coast area were found to be present at Hatteras and to have favorable qualities. These sands were identified as the Lower Black Creek and the Massive Tuscaloosa, and were found at approximately 4000 and 6500 feet respectively. Further, these sands were found in association with marine-type shales—the type geologists consider to be possible source beds of oil. Additional seismograph work for the purpose of attempting to locate a definite structure capable of containing oil therefore seems justified, and work in Pamlico Sound will be started in the immediate future and will continue for a number of months.

According to the Standard Oil Company, a second exploratory well will be drilled in the area if the seismograph results are sufficiently encouraging. It is considered probable that such a well might be started within the next three or four months. The site will be determined by the technicians' interpretations of the new geological and geophysical work.

FORM SPREADERS

Easily Pulled if Greased Before Using

AUTOMOTIVE grease is now being used as a lubricant for the spreader ties which are used to stabilize concrete forms. Spread in a thin coat, 1/32 to 1/16 inch thick, over the entire surface of the tie, except (to prevent staining) that part of the tie which is closer than one inch to the face of the finished wall, the grease is said to permit easier removal of the ties. In the summer Marfak grease of hard consistency, known as the No. 5 Grade, is used, but in the winter a medium or No. 3 Grade must be used.

After the concrete sets in the form, the ties are pulled out from which ever side of the wall is to be left unfinished or unexposed. If the ties are properly withdrawn, the holes may be filled with grout from an air-pressure gun, the resulting wall then being solid and uniform throughout. Moreover, by the use of such a lubricant the ties are removed undamaged, and can be reused, thus adding to the economy of construction.

OIL BURNER FUEL

Heats More Efficiently with Better Air Mixing

COMBUSTION heads for domestic oil burners that are another step towards utilization of all the heat available in a gallon of oil are the outgrowth of recent research in oil-air mixtures. Increased burning efficiency is achieved by more thorough mixing with a consequent reduction in the amount of cold air intake required. As explained by Shell Oil Company, Inc., instrumental in the research program, excessive quantities of cold air intake tend to cool the combustion chamber and permit a large portion of the heat to escape by way of the flue. Because of the thoroughness with which oil and air are mixed, smoke and carbon deposits are virtually eliminated when the burner is properly adjusted.

Flying's Easier, Now

Private Aviation has Shed its Aura of Glamor, Now Aims at Sounder Business Based on Comfort, Safety, and Satisfied Customers. Better Training Methods Help; So do Easy-To-Fly Planes, and Lightening of Government Rules. Limited Airport Facilities Remain a Major Problem

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

• LOOKING AHEAD •

New comfort features in personal planes may "taste like more" to buying public. . . Accessories, instruments, attractive interiors will be competitive selling points. . . Instruction may be chalked up to "sales" cost. . . Safety planes will eventually triumph. . . Simplified controls are as inevitable as were four-wheel brakes on cars. . . Continued freedom from government restriction hinges on sane flying, fewer mishaps.

FLYING, once considered a hazardous sport calling for superhuman physical endowments, today requires no more balance and muscular coördination than riding a bicycle, no more judgement than driving an automobile well. Moderate physical capacities, coupled with reasonable alertness and the ability to make decisions, are all that is necessary for routine private piloting.

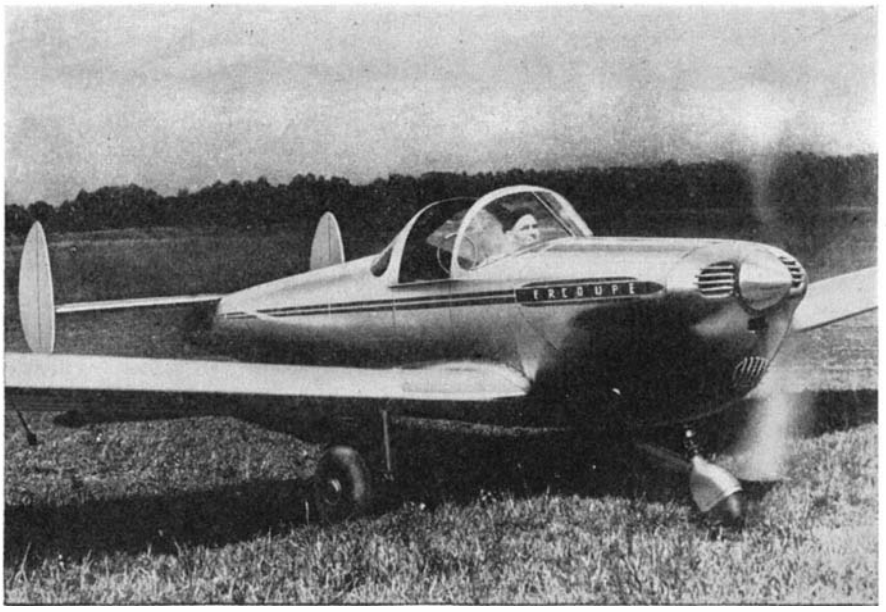
More important than unusual physical characteristics, is the training the prospective pilot receives. Fortunately, time has brought changes, and the poorly managed training operations of the "barnstorming" days have yielded to well-regulated systems of instruction. Instructors, who have been required to learn efficient teaching methods as well as flying, take pride in students who solo quickly. Airport operators have awakened to the "penny-wise" foolishness of prolonging flight instruction for the sake of the few dollars profit gained by additional hours of unneeded training. In this case, the better business is to teach the student quickly and well so that he will want to purchase a plane. A satisfactory business relationship means another customer for hangar space, service, and fuel at a later date; a disgusted student usually means another person with a cooled-off enthusiasm for private aviation.

Aircraft manufacturers are also showing an aroused spirit of cooperation with new pilots. Attractive, interesting, and thoroughly understandable instruction booklets provide the student pilot with something he can study at home, and aid him in overcoming the embarrassment of the novice who hates to admit a complete lack of knowledge. Some of these booklets illustrate complete step-by-step procedures for all the maneuvers of ordinary flight.

Warm, quiet, and roomy cabins (left), plus clear vision (above), make learning to fly modern planes a pleasant, if not heroic, task. Plane shown is new Cessna model

BETTER PLANES—With all of the additional training skills and aids, however, private flying would not have reached its present stage without genuine improvement in airplane design. The changes are sometimes small and occasionally very large, but all of them are significant because they are predicated on knowledge gained from experience. There is usually a well-established and substantial reason for the design features of any given airplane.

An example, still in the training field, is the shift from the noisy, uncomfortable, and thoroughly unhealthful open cockpits of several years ago. Under such conditions even the most elementary communication between instructor and student was difficult. Now, enclosed, heated cabins, sound-proofing, properly-arranged seating, and a full view of the instruments by both student and instructor make learn-



Spin-proof, tricycle-gear Ercoupe is easy to taxi, steers like an automobile

ing to fly much more comfortable. In addition, the student receives more for his money because he can ask questions and talk with the instructor while in the air.

The general flying qualities of the modern private airplane also help. Early private planes had little reserve power, and were easy to stall. Their flat climb made hangars or trees loom large as mental hazards for the pilot, and the lack of brakes created a feeling of helplessness during fast landings. In addition, controls were apt to be slow or "loggy." Thus, the plane would lag in entering a desired maneuver and the pilot would become impatient and push the control too hard. When the control did take hold, the ship would move too violently. "Over control" was one of the worst faults of the early fliers and also one of the most difficult to cure.

Capping this sluggishness of control was a lack of inherent stability. Planes refused to fly "hands off" and mental or physical relaxation was impossible. Trim tabs, now used to balance the craft for varied conditions of flight were also missing. Finally, among the major faults of yesterday's planes, were landing-gear shock absorbers which did not sufficiently absorb shock. The energy of landing was not dissipated and ships would bounce back into the air after landing. Modern planes have eliminated the foregoing troubles and many others.

EASIER TO FLY—Modern private airplanes are stable—longitudinally, laterally, and directionally. If the aircraft should nose down involuntarily, the large horizontal tail surfaces and other properly distributed forces will bring the ship back to its level position without action by the pilot. Lateral stability is provided by dihedral, the term applied to the slight raising of the tips of the wings. Directional stability is assured by large vertical tail surfaces. It is possible to fly a modern plane without touching the controls for long periods of time.

The controls of the old training planes were not only slow in response but they were hard to move. In today's airplanes, rudders, elevators, and ailerons are so beautifully balanced, with a part of their area ahead of the hinge, that little more than finger-tip control is needed. In addition to efficient, automobile-like wheel brakes, there are brakes on the wings in the form of flaps. With the latter, the flier can steepen the landing glide without nosing the ship down. This decreases the landing speed and permits the use of smaller fields. A variety of shock-absorber designs are used to dissipate landing energy and thus eliminate bouncing.

Outstanding, too, are the tricycle landing gear and swiveling nose wheel, which have made cross-wind landings considerably less difficult. With this design, when the nose wheel strikes the ground it swivels and brings the airplane correctly into its line of motion. Also the nose wheel minimizes any chance of the airplane nosing over; the plane can even come straight in out of the glide without flattening out except that the nose wheel will not withstand such rough treatment very long. Moreover, during take-off, the ship can run along the ground with all three wheels touching, and if the stick is held back just a trifle, the plane will take off without any further effort when it has reached a certain speed. There is a penalty to this automatic take-off. It is apt to be longer than in the classical take-off from the two-wheel attitude.

SPIN-PROOF—The one aerodynamic feature which overshadows all others is that a good many of the modern planes are highly resistant to the stall-spin—responsible for so many accidents in the past. The principles of the spin-proof plane have been understood for many years, but the application of these principles has been slow. To make a plane stall- and spin-proof, said the experienced flyers, robs the pilot of some of his unrestricted power. More progressive pilots, on the other hand, point significantly to the rather permanent restriction that often accrues to those who spin too close to the ground.

Prevention of the stall-spin is partly mechanical in that the upward travel of the elevator must be partially limited. It is the unlimited upward travel of the elevator which can bring the nose of the aircraft up to too great an angle of attack, causing the wing to stall and lose its lift. Likewise, the ailerons can be restricted since, when pulled down beyond a certain point, they do not improve the rolling moment but increase the turning tendency too much.

The aerodynamic trick in eliminating the stall-spin lies in washing out the tips of the wings; that is, introducing a slight twist and thus reducing their angle of incidence at the outboard portions. When this is done, the center of the wing not the tips stall first. As a result, the tips retain their lift and control any rolling tendencies that develop. These simple aerodynamic precautions have proved surprisingly effective; planes of this sort cannot be stalled and spun and a great cause of accidents is thereby removed.

OTHER FEATURES—Substantial improvements have been made in the direction of visibility. With inline engines, plus the liberal use of Plexiglas, forward vision is now remarkably good. As a bonus feature, well-fitted windows keep out cold air and allow the pilot to dispense with a flying suit. Since most private flying is done under better than "instrument weather" conditions, an unobstructed horizon reference line is vital. Thus, with the aid of visual reference alone the private flyer can tell whether he is flying level, climbing, or banking. Few private planes carry extensive navigation instruments, but all the necessary instruments are there, clearly in sight and grouped according to a

logical plan. A typical instrument panel incorporates an engine tachometer and an air-speed indicator placed naturally together at the left. The compass is in the center of the panel, and to its right is the altimeter. Compass and altimeter are the private pilot's simple navigational instruments and they logically go together. Oil temperature and oil pressure gages are further to the right near the engine primer and the cabin-heat control. Seats are adjustable to accommodate the short and the tall. Controls, single or dual, are well designed relative to the occupants, doors are near the ground and easy to get in and out of.

PILOT REGULATIONS — Much of the unpleasantness of examinations and difficulties of obtaining an Airman Certificate from the Civil Aeronautics Administration have been removed. In order to fly, a person is required to obtain an "Airman Certificate" comparable to the license issued to motorists. Solo flying may be done on a "Student Pilot Certificate" which has been endorsed by a rated instructor, but it is only with the Airman Certificate that a private pilot can give a ride to his friends, and then only without pay.

Physical examinations need not be made by a specially designated flight surgeon. A family physician, if preferred, may fill out a simple form. Common physical deficiencies will not bar a prospective flyer, nor will the wearing of spectacles. Any normal person over 16 can qualify as a student pilot, and when over 17 can seek an Airman Certificate. Solo flights may be made after eight hours of dual instruction at any time the instructor thinks the student qualified, but before appearing for a flight examination ten hours of dual instruction and 30 hours of solo flight are required. With the "spin-proof planes" however, seven hours dual and 20 hours of solo suffice. Examinations in meteorology and navigation have been discontinued; examinations are now limited to simple questions on Civil Air Regulations.

From the over-all viewpoint, many things have been done to make flying easier. Systematic instruction, good flying equipment, and lightened government regulations all help. There are, however, some remaining difficulties. Landing fields are not available in sufficient numbers and the all-around safety record of private flying has not yet become entirely satisfactory.

CHANGED AIRCRAFT RULES

Drop Stall-Speed Limits; Emphasize Other Factors

STALLING speed requirements for transport aircraft were recently removed by the Civil Aeronautics Board. This action, which on first thought may seem surprising, was intended to eliminate what might become a severe handicap to greater performance and economy in transport airplanes. Long considered a vital safety factor—high stalling speeds are reflected in higher landing speeds—stalling speeds have moved consistently upward with the evolution of aircraft design. Compared with 30 miles per hour for the Wright brothers' planes, the popular DC-3 stalls at a speed close to 70 miles per hour.

It is noteworthy, however, that safety has also continued to improve through the years. This is, in part, due to a greater recognition of the part played by other operating requirements such as the minimum rate of climb with all engines functioning, and the minimum rate of climb with one or more engines inoperative. These factors are closely tied with stalling speed but are more truly representative of desirable airplane performance from the standpoint of optimum safety.

ANTI-FRICTION

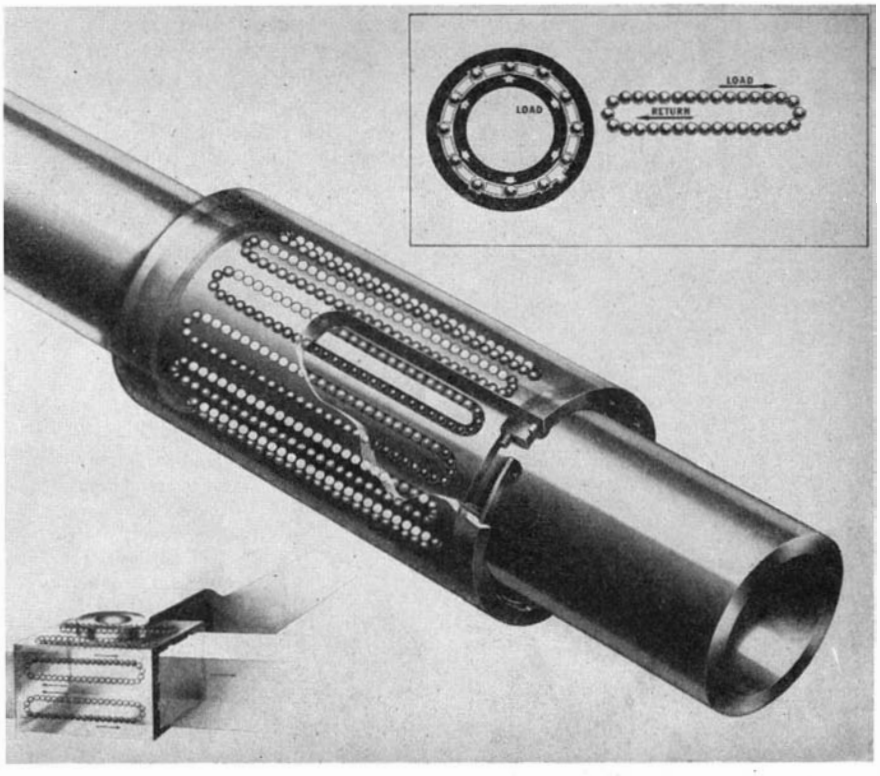
Bushings Give Free Reciprocating Action

BALL and roller bearings, traditional reducers of friction, can ordinarily be used only on rotating parts in journals, thrust bearings, and the like. In aircraft, however, it is sometimes important to reduce friction in reciprocating motions, as in engine controls, in the operation of flaps, or in the actuation of landing gear.

Now a new mechanism, termed a "ball bushing" has been introduced to reduce friction in the reciprocating travel of mechanical members in a bushing. Members whose contours are round or square, or a variation of these shapes may be accommodated by variations of the design.

The ball bushing contains a series of ball circuits. One side of the circuit carries the bearing load; the other side returns the balls in a clearance provided in the outer race member of the bushing. The continuous bearing is reported to prevent cocking or binding on the shaft because the balls always remain centered under load, while rolling contact and sealed-in lubrication ensure long life. Ball circuits can be infinitely varied for different load capacities and shapes of bearing members.

The principle appears well adapted for many applications besides aircraft. One such use is suggested in the instrument field where reciprocating motion is sometimes avoided by complex rotational hookups.



Balls move in closed circuit, one side carries load, other side returns balls

Chemicals Grow on Trees

In Searching for an Answer to Their Marginal Economic Status, Wood Distillers have Uncovered Some Highly Interesting Wood-Tar Products. What Can be Done With Them, How to Recover Them, and Various Other Problems Make "Question Marks" of These Complex Chemicals

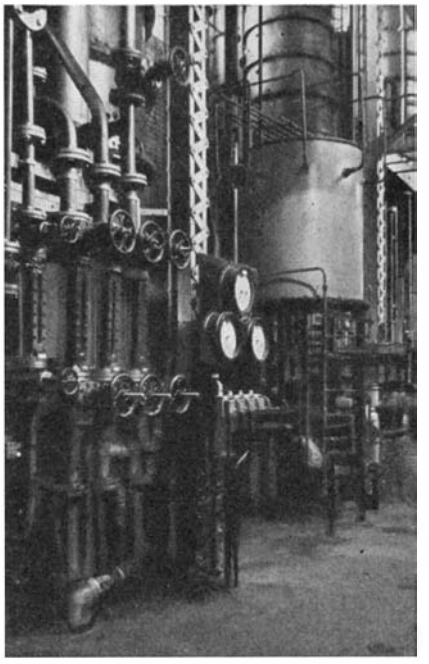
By D. H. KILLEFFER
Chemical Engineer

• LOOKING AHEAD •
Wood-distillation for chemicals is still young. . . Not yet even an industrial entity. . . But its future, on a long-range basis, appears good. . . Wood is one of few replaceable raw materials. . . Its tar products are not open to easy competition or duplication. While still too early to predict specific uses, it seems inevitable that continued research must find them. . . . Until then, far-seeing industrialists will "watch wood."

Wood distillation — modern version of the ancient art of the charcoal burner—enjoyed a brief respite during the war from the devastating economic attacks of synthetics on its slim profits. Indeed, the slender margin between costs and income has frequently put this industry in grave economic danger. Synthetic processes have successively attacked its principal products, and have left the wood distillers' position quite unenviable. But the peculiar upset situations growing out of war provided an opportunity for the wood-distilling industry to do something about this basic problem. Researches lately completed suggest that new products, hitherto left in low-value tars and tar oils, may add enough profit to convert red ink figures to black.

WOOD TARS—Actually, the entire matter of the chemical products of wood, as distinct from its structural applications, needs to be reappraised. In general, wood chemistry progress is not as well recognized as is the tremendous recent growth and importance of wooden structural members of a new kind developed through the remarkable cooperation between wood, the oldest structural material, and synthetic resins, the newest.

The most recent phase of wood chemistry digs deeply into the tar-products of distillation and comes up with some interesting and strange new stuffs that will be extremely difficult to synthesize. So far, little more is known of their potential values than that they can be obtained. Often, that is enough, for it is rare indeed to unearth a complex chemical compound that is not exactly the answer to someone's particular problem. If it should prove to be like that in this case, then the wood distillers may be able to add to their slim profits a tiny increment that will mean success. To understand what is going on, it is necessary to go back a few decades and recall the recent history of this industry.



Photographs courtesy Cliffs Dow Chemical Company

Control station of fractionating columns for wood-tar distillation (right) indicates the complexity of such processes. Large retorts (left) are further representative of extensive equipment required. Retort doors open to receive wood on cars

Basically, the wood distillation operation consists of heating wood in an oven or retort to drive off everything that is volatile, leaving charcoal. The volatile matter, amounting to about 64 percent of the weight of the wood, consists of acetic acid, wood alcohol (methanol), acetone, a considerable quan-

Products from Hardwood Carbonization

	Yield/Cord	Pounds	Wt. %
Charcoal (17.5% volatile)	54.0 bu.	1080	36.0
Acetic acid (including formic and propionic)	14.3 gal.	125.8	4.2
Denaturing grade methanol + methanol + methylacetone	9.3 gal.	61.4	2.0
Tars and oils	38.4 gal.	366	12.2
Noncondensable gas	7260 cu. ft.	650	21.7
Water of pyrolysis and loss	.....	.....	23.9

tity of non-condensable gas and wood tars, and oils. Synthetic processes, and others having high convenience values, have step by step destroyed the one-time monopoly that wood distilling enjoyed respecting these products. Acetic acid is now cheaply synthesized from acetylene, methanol from water gas, and acetone can be either synthesized from acetylene or produced by fermentation from grain.

Formerly it was customary to subject the wood-tar product to only the simplest and most casual kind of separation to yield constituents of low value. Now that is being changed. Wood distillers have come to realize that wood tars contain chemical compounds so curiously and intricately fashioned by Nature that man's ingenuity will be sorely taxed to duplicate them synthetically.

TECHNIQUES—The problem now is the economical separation of these valuable constituents of wood tar, which contains great numbers of closely similar compounds which are extremely difficult to separate in the type of equipment ordinarily available in the wood-distillation industry. As a matter of fact, the precision stills of the type required have been available for only a very few years; they were built to meet the extraordinary demands of the modern petroleum-chemical industry. The remarkable war-time achievements exemplified by synthetic rubber and aviation gasoline are based to a considerable degree on the perfection of distillation methods of a precision and nicety never before realized. These methods and tools are now available to other industries and promise results quite as revolutionary elsewhere as in their original applications.

Recalling the remarkable values dug out of coal tar and out of petroleum by the industries now devoted to their exploitation, it might be assumed that the case of wood tar will be similar. But the situation is scarcely a parallel. The known compounds in wood tar prove to be more intricate and elaborate in their molecular structures than the common ones of either coal tar or petroleum. Obviously the greater the intricacy, the more difficult will these compounds be to synthesize; and cheap, easy synthesis is the *bête noir,* the haunting ghost in the closet, of the wood distillers.

If the compounds recoverable from wood tar, which is produced to the extent of some 12 percent of the weight of the wood distilled, should prove as useful as is now hoped, the inducement for synthesists to destroy the profit in their recovery by making them will be rather less than it was for chemically simpler methanol, acetic acid, and acetone. Furthermore, and this may be highly significant, the basic recovery process will necessarily separate several groups of products which will be relatively far easier to purify by other means from this point on than they were from the original much more complex mixture. Thus there will be several products simultaneously contributing to the new income for the industry, and not just one or two.

New Compounds from Wood Tar

Guaiacol
Creosol
Butyrolactone
Acetol acetate
Butyric acid
Crotonic acid
Maltol [3-oxy-2-methyl-(4)-pyrone]
2-Hydroxy-3-methyl-Δ2-cyclopentenone
2,6-Dimethoxyphenol
Tiglaldehyde
Methyl isopropyl ketone
Methyl ethyl ketone
Methyl furyl ketone
4-Ethylguaiacol

COMPLEX PROBLEMS—The possibilities latent in the complex mixture that constitutes wood tar are many. Researchers Goos and Reiter of Cliffs Dow Chemical Company, recently reported 183 compounds found to exist in the products of distillation of hardwoods. These compounds are listed in the accompanying tabulation by chemical types, but it must be realized that the quantities of most of the member substances are present in only minute proportions.

Fractional distillation, employing highly efficient modern stills, is an important step in separating a complex mixture of this type, but without the help of other separating processes based on other differences of properties, distillation alone can effect only a partial resolution of the complex. Thus it is necessary to utilize chemical differences between the compounds involved to supplement precision distillation in effecting the most complete separations required. For example, forming compounds of alcohols with a fatty acid may yield a mixture of esters that are far more readily separated than the alcohols themselves. Once the separation of the esters from each other is effected (by distillation, for instance), recovery of the alcohols from them by treatment with alkali or steam is a simple process.

While this suggested process oversimplifies the separating problem, it indicates the direction of thinking and processing that seems now likely to provide the chemical industry with a new group of raw materials,

Chemical Types of Compounds from Wood Distillation

ACIDS, ALIPHATIC		ETHERS		KETONES	
Saturated	19	Aliphatic	1	Aliphatic mono	9
Unsaturated	9	Aryl monohydroxy	1	Aliphatic di	4
Other	6	Aryl dihydroxy	9	Unsaturated mono	3
ACETALS	3	Aryl trihydroxy	7	Aliphatic-furyl	1
AMINES		ESTERS		Cyclic saturated	9
Aliphatic	3	Aliphatic	8	Cyclic dione	1
Pyridines	3	Other	4	Cyclic unsaturated	6
ALCOHOLS		Lactones	2	MISCELLANEOUS	
Aliphatic	6	FURANES	9	Oxypyrone	1
Unsaturated	3	Hydrofuranes	2	Glucosan	1
Cyclo	6	HYDROCARBONS		Cyclic ketol	1
Furyl	1	Paraffins	8	Other ketol	1
ALDEHYDES		Unsaturated	2	PHENOLS	
Aliphatic	7	Aromatic	7	Mono	7
Cyclo	2	Condensed-ring	3	Di	1
Furyl	4	Terpenes	8	Tri	3
Unsaturated	3				

and the wood distillers with a possible new source of the added revenue they will need to survive the peace. Goos and Reiter, quoted above, report that the methods are now available to supply some 14 new compounds from wood tar as a starter. Their list is given in an accompanying table.

These compounds are in addition to the customary products of the wood distillers: acetic acid, charcoal and activated chars of several varieties, creosote and creosote oils, methyl acetone, pyroligneous acid, wood alcohol, and a few others. The new products would be recovered from the creosote oils and tars, and to a lesser extent from the further purification of pyroligneous acid. Whether they are recovered by wood distillers, who will have to rearrange their plants for the purpose, or by chemical manufacturers already equipped in part for this kind of operation, remains to be seen.

WOOD SUGARS—These possibilities in the greater chemical utilization of wood supplement other developments that have also grown somewhat in significance during the war years. Production of wood sugars by the acid treatment of wood wastes was undertaken during the past few years to supplement customary sources of alcohol, required particularly for synthetic rubber production. While this is related only through the parental raw material, wood, with the products mentioned above, a possible new industry may be built upon it. This is already having a curious and interesting corollary.

Production of sugar from cellulose by acid hydrolysis is not new, but was employed in this country during World War I as a source of ethyl alcohol. The process proved uneconomical under peace conditions and was abandoned here. In Europe, the need for alcohol and for a source of even low-grade sugar was greater, and consequently the process was advanced to a working basis there. Efforts to re-establish the much-modified process here were unsuccessful until World War II magnified the demand for alcohol to such an extent that some alarm was felt as to the ability of ordinary sources to meet the needs. Then the so-called Scholler process was put into operation here.

One essential difference between the wood sugars and those found in molasses is that the former contain a comparatively large proportion of compounds—the pentoses—that are not fermented to alcohol by the ordinary yeast, *Saccharomyces cerevisae.* Consequently, these sugars remain in the slop from the alcohol stills and pollute the streams into which it is emptied. Not only do these unfermented sugars escape from the process, but their quantity is great enough to be serious both as an economic loss and as substantially affecting the cost of waste disposal. An answer has been found in the growth on the still slop of a different strains of yeast which destroys the objectionable sugar content of the slop and at the same time grows mightily. Yeast of the *Torula* family thrives on the sugars left by the ordinary yeast and the *Torula* yeast constitutes a valuable high-protein feeding stuff. European stock raisers have found yeast a valuable supplement to animal feeds and so, too, may American agriculturalists. If that proves true, and the new feed is acceptable here as it is in Europe, it is possible that the added value thus given production of the wood sugar-alcohol industry may provide for it a permanent place in our industrial economy.

FUTURE UNKNOWN—These two industries based upon wood have heretofore been in the marginal class, economically. Wood distillation has been just possible, and wood sugar-alcohol, just unprofitable economically. Both have contributed important shares to wartime necessities, but both are faced with trouble now.

Operators of these industries, realizing that success depends on doing something better soon have turned to research for the answers. Whether the present answers are complete solutions to the fundamental economic problem or not, yet remains to be seen. Whatever the future may hold for these industries, certainly prospects are the brighter for research already done and may be still brighter as more research, yet in progress, is completed.

INSULATING BOARD

Resists Destructive Agents, Made at Low Cost

A QUARTER'S worth of glue is the principal raw material required to produce more than a cubic foot of a new type of insulating board. The product weighs one to three pounds per cubic foot and compares favorably with other commercial heat insulations. The process of manufacture is described as simple and yields a board resistant to most destructive agencies. Although the board has fair strength, it is not intended to be used unsupported in structures.

In thin layers, the new product somewhat resembles flannel, but as usually made it is more like dried natural sponge which has been cut into slabs about a foot square and an inch thick. By using different fillers, the characteristics of the product can be varied between wide limits, and the curing process imparts to the glue high resistance to water, fungi, and other destructive agents. The product is suggested for insulating railroad cars, trucks, and airplanes, or wherever extreme lightness is required together with efficient insulation against heat, cold, or noise.

NON-METALLIC MAGNETS

Of Powdered Oxides are Light in Weight

MAGNETS are now made for special purposes by sintering a mixture of the oxides of iron and cobalt. The special advantages claimed for these non-metallic magnets are very low electrical conductivity and light weight combined with valuable magnetic properties.

MINUTE PARTICLES

Are Accurately Measured by Colored Light Method

PARTICLES as small as 0.000002 inch in diameter—too small to be seen with an ordinary microscope—can be measured rapidly and with a high degree of accuracy by a new method evolved in the laboratories of the Du Pont Company.

The procedure consists of passing different colors of light through a suspension of the particles in a liquid, and then measuring the proportion of light of each color which emerges. Suspensions containing particles of different sizes vary with respect to their transmission of different colors. From the data obtained in this fashion, not only can the average size of the suspended particles be calculated, but a curve can also be obtained which shows the relative amounts of each particle size present.

The entire operation requires only two hours—a considerable advantage over previous techniques.

Measurement of particle size has wide application in industry. It is of primary interest, for example, in research on pigments for paints and enamels; in the study of synthetic rubber and plastics; in protein and other biochemical work; and in the manufacture of catalysts, as well as in a host of other industries.

Sight At Night

Presaging Fulfillment of the Age-Old Desire to "See Through" Fog, Smoke, and Dark, Come Reports of Infra-Red Beams that Penetrate 600 Feet of Blackness. Quite Simple and Inexpensive, Headlights Without Light, and Eyes that See Heat may Guide Trucks, Buses, and Airliners

By VIN ZELUFF
Associate Editor, *Electronics*

MEN who drive while others sleep—the truck drivers, railroad engineers, pilots, and others who know the dangers of darkness and fog—may soon gain "extra" vision with new infra-red night sight. Beset by time schedules paced out on clear nights, drivers fear fog as a deadly menace, and operators of common carriers find it boosting the costs of operation at unexpected times. Patches of fog in the low areas along highways on otherwise clear nights force intermittent slow downs and plague drivers trying to keep their schedules.

INVISIBLE RAYS—Fog-piercing infra-red beams were used during the war to detect enemy night infiltration of our lines. One such instrument, called a sniperscope, resembles a telescope unit mounted on a .30-caliber carbine. The infra-red light source is suspended under the carbine so that the invisible rays project wherever the gun points. Infra-red rays, reflected from the target, are focused by an objective lens in the telescope to form an image on a chemical coating on one end of a special electronic picture-converting tube. This coating is sensitive to infra-red, and as the rays strike it, electrons are released in direct proportion to the light rays distributed over its surface.

These electrons are attracted to a positively charged coating at the other end of the tube and their passage to this second coating is accelerated by an electron-multiplier arrangement in the center of the tube. The second coating is similar to the phosphor coating on the screen of the conventional cathode-ray tubes and, as the electrons strike this, they produce a visible, greenish image of the objects viewed through the objective lens.

To the military services, the important feature of the infra-red equipment is that the enemy does not see the tell-tale infra-red light that spots him. To peace-time industry, however, the prime advantage of the equipment is that infra-red rays pierce fog, mist, smoke, and other obstructions to human vision. In addition, any heated object in the field of view produces its own infra-red radiation and will appear with a still greater intensity on the viewing surface. Thus, a lighted cigarette shows up as a two-inch circle of light. Japanese soldiers who made tea at night on the ordinarily invisible flame of a Tokyo tea boiler unwittingly offered themselves as perfect targets in the center of a prominent circle of light.

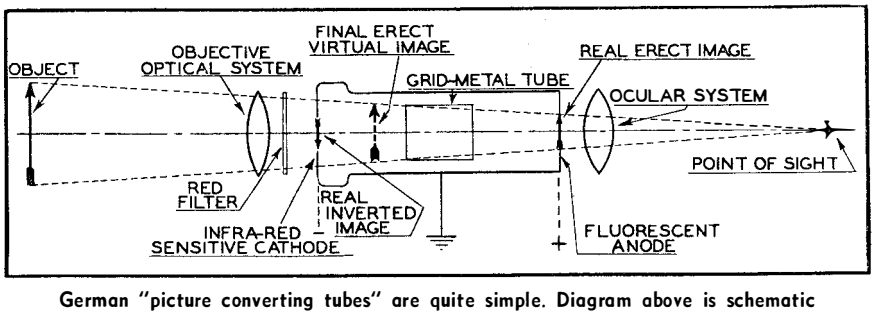
Although infra-red vision equipment was only recently released from military secrecy, much of the development work has been done and package units for consumer sales should not be long in coming on the market. In fact, the advantages of the infra-red sensitivity in television equipment have already been described—Television in the Dark Scientific American, January 1946.

SIMPLE EQUIPMENT—For infra-red sight, however, complex television equipment is not necessary; the sniperscope is a simple and inexpensive unit. A high-voltage power supply operating on the same principles as the B-supply unit in automobile radio receivers is used to maintain the high potential in the infra-red-sensitive electron tube. Even simpler systems were developed by German scientists during the war. Most of these devices used a picture-converting tube containing an infra-red-sensitive screen which emitted electrons, an electron-lens system that focused the electron stream, and a fluorescent coating on which the image was formed by the lens.

The picture-converting tube was used in three types of infra-red equipment: the *nachtfahrgerat*, night-driving equipment for trucks and tanks; *zielgerat*, rifle-sighting

• LOOKING AHEAD •

Faster schedules, lower rates, in all fields of transportation when allowances for fog delays can be cut. . . Insurance rates lowered because of greater safety. . . Vehicles and trains spaced closely without overtaking-collision danger. . . Perhaps infra-red vision will greatly simplify blind aircraft landings. . . Help solve traffic problems at fog-bound air fields.



German "picture converting tubes" are quite simple. Diagram above is schematic

mechanism for snipers; and an aircraft experimental model *muecka,* mosquito.

The *nachtfahrgerat* was used for driving in complete blackout at any rate of speed the vehicle could maintain, and for firing at objects without the use of flares. It clearly reveals the roadway ahead for 100 yards, and most objects are discernible at distances greater than 200 yards.

The device contains a picture-converting tube called a *bild-wandlerrohr.* One end of this tube consists of an infra-red-sensitive coating of a transparent cesium compound that emits electrons when infra-red light strikes it. At the other end of the tube, the end facing the observer, there is a fluorescent-coated screen on which the image to be viewed is formed by the electronic system. Light from the object being viewed passes through an optical lens system and a red filter to the infra-red-sensitive cesium coating. The latter then acts like the cathode of a conventional tube in that electrons are emitted from the opposite side according to the intensity of the infra-red radiation. These electrons are focused electrostatically by an electron lens that is equivalent to a grid at the center of the tube.

Electrons from the grid are next attracted to the positively charged fluorescent coating used as the anode. As they strike the anode, it fluoresces to form a visible image that corresponds to the distribution of infra-red radiation on the cathode coating. A similar action, of course, takes place in television-image tubes and fluorescent lamps.

The objective optical system forms a real image on the infra-red screen. This image, after passing through the remainder of the system, appears in its normal size for the selected distance, if the eye is held about 15 centimeters from the outside surface of the ocular. Moving the eye further or closer than 15 centimeters from the *nachtfahrgerat,* the object appears larger or smaller. This is due to the fact that the final vertical image is not at the same place, in distance, as the original object but closer, although with the eye at 15 centimeters from the instrument, it subtends the same angle at the eye as the original object.

Sniperscope, American night gun, mounts infra-red light and scope on a carbine

The source of the infra-red light is a 100- or 200-watt infra-red lamp. A Fresnel lens projects the rays in front of the vehicle. In addition, infra-red filters are used to cover the headlights of the car or tank.

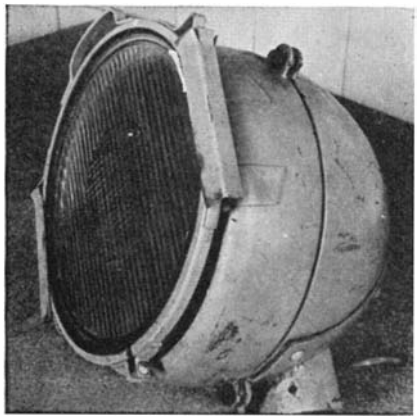
The red filter in front of the picture-converting tube is needed to prevent bright, normal illumination from striking and injuring the infra-red-sensitive coating. High potential must be applied to the electrodes of the electron tube to bring the electron beams to a focus within the tube, and also to accelerate the flow of electrons to give a brighter picture on the fluorescent screen. For this, the high voltage is obtained from a vibrator resembling those used in automobile radio receivers, and an automobile-type spark coil is used as a step-up transformer. Two D.C. outputs are provided, one of 6000 volts and the other 8000 volts.

OTHER MODELS — A second German infra-red receiver is a small unit like the American sniperscope, that mounts on a rifle in place of telescopic sights. Called the *zielgerat,* this unit enables a sniper to pick off individual men at night. The infra-red lamp is mounted in a small reflector on top of the unit and is said to be effective up to 100 yards. The power unit uses an Edison-type battery and is carried in a regular gas-mask holder.

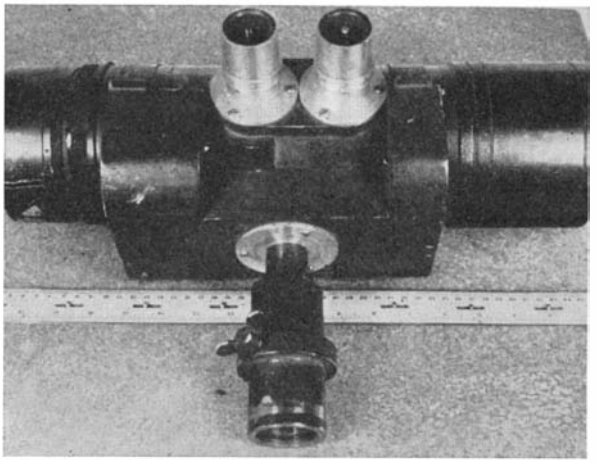
The receiver continues to operate for about 15 seconds after the power supply is turned off. This action is provided by a large value capacitor in the power supply so that the value of the applied voltage gradually decreases. Although the rifleman must stop periodically to apply high voltage, he has ample time to sight and aim.

An aircraft experimental model, the *muecka,* is a small receiver less than six inches long that was never put into production. Infra-red lights were to be installed on a plane's wing tips, so that the pilot could use the receiver to identify or locate planes near him at night.

A very simple device for observing the presence of infra-red searchlights is described by C. W. Hansell of RCA. He reports that about 10,000 such devices were produced for use by the Wehrmacht to detect anticipated uses of infra-red searchlights by the Allies. Consisting of a simple paper tube having an infra-red window and lens at one end and a sensitive screen at the other, they use no vacuum. In this case the sensitive screen has the remarkable property that, after exposure to strong sunlight, it becomes sensitive for a long time and will respond by emission



Infra-red lamp (left) and viewing scope (right) are main units of German "night driving equipment for trucks." Road definition was clear enough for normal speeds in spite of a complete blackout



of red visible light when illuminated by invisible infra-red light. Although these simple cells do not have the sensitivity of the electron-tube system, they may also find useful applications.

As peace-time production accelerates, and the long-promised new products appear, infra-red sight equipment holds definite promise for industry. Not only can the transportation field find ready use for such vision aids, but they also can be used in case of mine fires where ordinary light cannot penetrate the smoke, in chemical processing plants where gases block white light, and in burglar-detecting devices which spot, but do not warn, the intruder.

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VACUUM SYSTEMS

Checked for Leaks With Helium Gas

EXACT locations of leaks in a vacuum system can be accurately determined by spraying helium gas over the system while the vacuum pumps are running, and watching the indicator of a Westinghouse mass spectrometer that has been coupled into the vacuum system. So sensitive is this arrangement that it can instantly detect any helium entering through a leak. The helium nozzle is moved about until the leak detector shows a maximum reading, at which time the nozzle is pointing to the leak. Ordinarily, a mass spectrometer weighs and sorts individual molecules of different gases, but here it is adjusted to respond only to helium molecules. This electronic leak detector was used with many of the high-vacuum systems in the atomic-bomb project, and promises to have even greater importance in industry now that high-vacuum techniques are being applied to many different fields.

LIQUID LEVEL

Shown by Accurate Capacitance Gage

THE principle of operation of an electronic gas gage for bombing planes, recently announced by Minneapolis-Honeywell, may find applications in a large number of manufacturing operations, in refineries, large storage vats, and even to measure the moisture content of wheat and other materials.

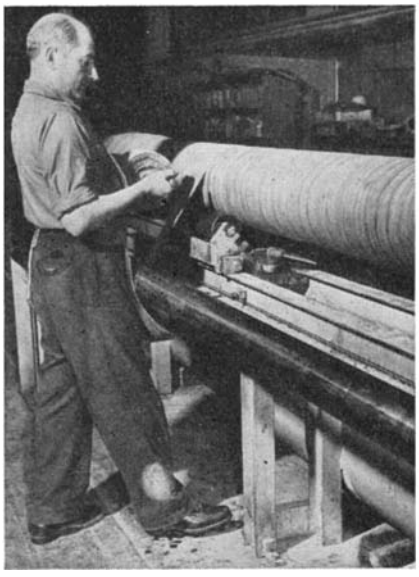
In the gas tanks of a four-engined airplane are mounted capacitance units which connect to an electronic amplifier and meter. Each capacitance unit consists of a piece of tubing which contains two smaller pipes inside to form the elements of an electrical capacitor. Gasoline can flow inside the tubing and between the two inside pipes. The electrical capacitance of the gasoline changes with the height of the liquid within the tank unit and is measured electronically by the amplifier. Actuated by the amplifier, an indicating dial on the plane's instrument panel shows the contents of the tank in gallons.

PHOTOELECTRIC SWITCH

Gives Remote Control for Huge Machine

A FIFTY-FOOT light beam controls a rotating mandrel in the making of heavy hose at the Hewitt Rubber Corporation. Part of the hose-making process involves wrapping material on a huge 50-foot rotating mandrel, this being the standard length of finished rubber hose.

To control the driven chuck which rotates the mandrel, the operator previously stepped on a wire cable



Operator interrupts light with foot

stretched the full 50-foot length, or he signaled an assistant at the chuck by a nod of his head whenever the machine was to be started or stopped. This signal was sometimes not seen or the response to it was slow, and the operator could then be caught in the machine.

Photoelectric equipment is now installed about 12 inches above the floor so that the light beam extends the entire 50-foot length. The machine is stopped instantly when the operator kicks either foot forward and interrupts the beam and the control is effective at any point along the machine. A telescopic lens of 32-inch focal length focuses the beam on the phototube.

The operator now controls the machine with a minimum of effort, greater safety is provided, and the floor is clear of gear that might impede the operator as he walks along the mandrel.

FOILESS CAPACITORS

Formed of Metalized Paper, Heal After Breakdown

A VERY thin coating of zinc, vaporized directly onto paper strips, is the basis of a new manufacturing process for making fixed capacitors used in radio and electronic equipment. The metallized paper units are about 40 percent smaller than equivalent types having alternate sheets of paper and metal foil rolled together, and production costs are estimated to be about 20 percent less.

It is claimed that the metallized units can fail many times before they need replacement, because the unique construction makes them self-healing after the insulating paper is punctured by an electrical breakdown. Developed in Germany by the Robert Bosch Company, the basic patent on the method is controlled by the Alien Property Custodian and licenses are available to American manufacturers.

RADAR ON BOAT

Will Aid "Close Quarters" Navigation at Night

THE passenger-carrying night boat, *City of Richmond,* will benefit from radar navigation equipment now being installed by Westinghouse. The Old Bay Line, owner of the ship, also plans to add radar units to other ships of its fleet.

Providing a continuous map-like picture of ship traffic and shoreline conditions from 100 yards to 32 miles distant in three ranges—of 2, 8, and 32 miles distant radius—the equipment uses a seven-inch cathode-ray tube mounted in a small cabinet convenient to the watch officer's station on the bridge.

The antenna is mounted under a large mushroom-shaped plastics dome atop a 5½-foot pedestal on the wheel-house roof. Other units are mounted in the weather-proof base of the pedestal, and the receiver-indicator is in a cabinet two feet square and 48 inches high. Power is provided by a below-decks rotary converter operating on the ship's power line.

Although the antenna is designed to provide full 360-degree horizontal rotation, the stack will obstruct its scan for about nine degrees dead astern. If complete coverage aft is needed, it will be necessary to elevate the antenna.

Pin-Ball Proving Ground

When Materials Stand Up Against the Ravages of "Jive" Fans, Irate Nickle "Recoverers," and Table-Tilt Artists They've Got to be Tough. Coin-Machine Applications have Proved that Plastics can Endure Rough Treatment and still Retain Their Clean and Colorful Sales Appeal

By CHARLES A. BRESKIN
Editor, *Modern Plastics*

• LOOKING AHEAD •

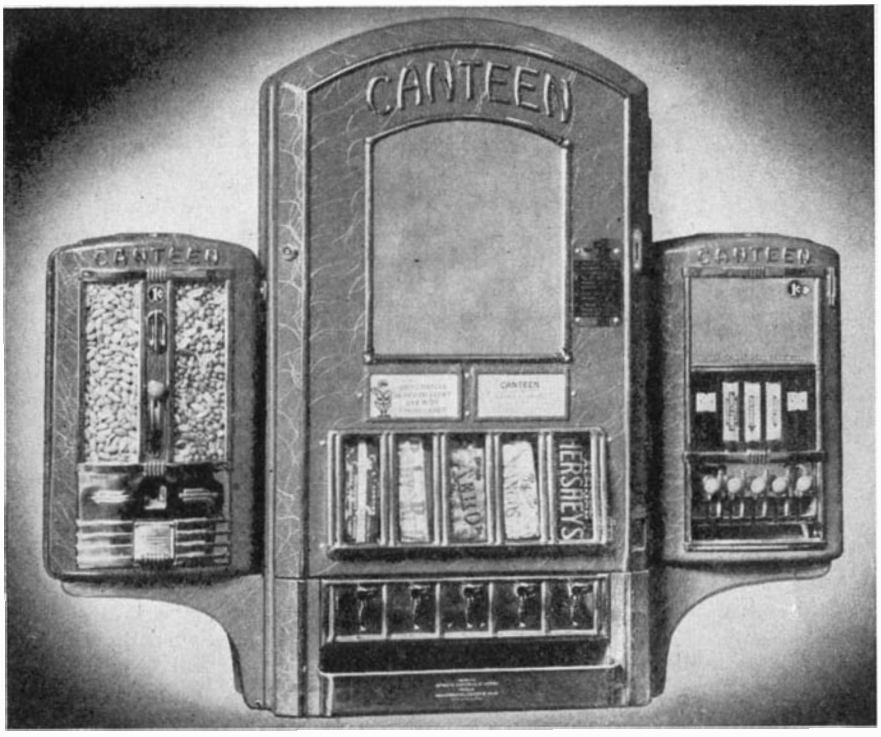
Plastics have an indisputable ability to meet-the-public. . . "Bugs" will be worked out of coin-machine uses. . . Later, more plastics parts for store fixtures, show cases, self-service units. . . Light-to-ship and eye-catching, plastics should find a place in retail-merchandising aids. . . Colors and contours, plastics features unmatched by other materials, would call buyer's attention to display.

COIN MACHINES—a tremendous potential field for expanding plastics applications—were given a big play by the public during the war, both for amusement and for purchasing food. And the coin-machine industry, converted almost entirely to war work, could do little more than patch the pre-war machines and hope that they would last the duration.

Now, having come out of the war with greatly improved equipment and increased plant capacity, the manufacturers of these machines are planning not only to replace the worn-out units but to increase the total number. Estimates for 1947, now set as the first post-war year of normal output, indicate a production of 1,500,000. This figure, of course, divides into three broad fields—vending machines, juke boxes, and pin-ball and similar units.

In all of these fields, plastics promise to play an increasingly important role. However, since the reasons for the popularity of this material vary with the different groups, it is best to consider the three types separately.

VENDING MACHINES—While producers of the other two groupings of coin machines have indicated that refinements are on the way, the vending-machine manufacturers have entirely new units to offer—machines that were proved by dispensing food to war-plant workers. To the familiar gum, cigarette, nut, and candy machines have been added sandwich and hot-dog purveyors.



Peanut dispensing unit uses cellulose-acetate portion wheel; candy displayed in center is protected by acrylic window. Machines must resist hard wear and tear

While no one questions the service which these units rendered in war plants, there has been some question as to their future. Many men in the industry, however, hold the optimistic view that the devices fill a distinct need in the nation's merchandising structure; they increase total sales of quick-turnover items and reduce overhead costs. On the other hand, they do not compete with personal selling, but supplement it, operating in locations where the use of a sales person would be expensive or impracticable.

This factor is evidenced by figures on the number of different machines in operation at the end of 1941, before the hot-dog and similar units had been developed. At that time there were in use approximately 126,500 cigarette-vending machines and 28,000 beverage-vending machines. Added to these were 250,000 candy-bar units, 3,000,000 penny vending devices, and some 25,000 miscellaneous machines.

For all of these units, durability is a prime requisite. The life of a vending machine is no bed of roses. If a machine is empty or when, on rare occasions, the mechanism jams, it may be subjected to some very rough treatment. Whether it gets off with just a few blows by an angry fist may depend on what other

Plastics parts are lighter, reduce shipping weight of automatic phonograph (above). Game machines (right) profit from color and lighting effects possible with plastics

weapons are handy. Hammers, screwdrivers, wires, saws, and other implements may be employed by the disgruntled patron, determined to "get his money's worth."

Investigation of the models now being readied shows a marked increase in the use of plastics, which speaks well for the ruggedness of these materials. Their decorative qualities are important, too, since the machines must catch the eye and do a selling job before the efficiency of their mechanism becomes of any value.

In the past, plastics have been incorporated in vending machines largely for this quality of decoration. The exceptions were in such conventional electrical applications as are to be found in motors, switches, and so on. While this conception of the use of plastics has by no means been abandoned, many of the men who design and build vending machines are discussing that, over and above the mere factor of appearance, plastics can accomplish certain results more satisfactorily than other materials.

This is exemplified by the hot-sandwich dispensing unit soon to be placed on the market by Automatic Canteen Company of America. This machine has an electronic cooking mechanism which will heat prewrapped sandwiches under the purchaser's watchful eyes, affording hot, nourishing food at the drop of a coin. The focal point of this unit is a chamber in which the sandwich is heated before delivery.

The problem in the construction of this heating chamber was to find material which would have display value and a low power-loss factor at one and the same time. Polystyrene was found to meet both these conditions and has been adopted for the panels in the interior of the display compartment which encloses the sandwich while it is heated. For the same reasons, polystyrene will be employed in the housing and trap-door assembly where the sandwich is dispensed.

Another functional use of plastics is to be found in the nut dispenser put out by the same company. Until the war, the portion wheel on this unit was made of aluminum, but when this metal became scarce, a molded cellulose acetate wheel was developed. This part, measuring approximately four inches in diameter and slightly over an inch in thickness, contains four pockets in the outside edge and rotates a quarter-turn each time the machine is operated, delivering the proper portion of nuts. The company reports that the plastics wheels gave satisfactory service, although occasional warpage was experienced and it was necessary to avoid excessively hot water in cleaning them. They met ordinary operating conditions well, but were sometimes subjected to more mechanical damage than the metal parts which they replaced.

To reduce breakage and pilferage from candy-dispensing units, this same company has recently adopted Plexiglas compartment windows. The only difficulty experienced with this particular application, and it was slight, was due to a certain amount of brittleness evidenced by the material when used in cold locations.

Low thermal conductivity is responsible for other plastics applications in this field—notably in the Coca-Cola vending machines of the Vendo Company. This quality caused the selection of laminated phenolics for door guides and of molded phenolic material for service door and sill.

Throughout all these units, of course, plastics are used as display and decorative materials—in show windows, name plates, and similar applications.

AUTOMATIC PHONOGRAPHS—It is in the so-called juke boxes that plastics really come into their own as decorative materials. Because of their light weight, they can be used in lavish quantities without increasing the weight of the boxes beyond the point where they can be shipped economically and easily placed on location. In fact, the matter of weight has accounted for quite a number of change-overs from other materials to plastics and from one plastics to another.

This is one of the reasons why the first post-war juke boxes being brought out by the J. P. Seeburg Corporation use cellulose acetate rather than the cast phenolic employed in the company's old machines. When work was started on the new machines the designers decided that by switching to a different type of plastics they could save some of the 20 or 25 pounds that went into the cast phenolic and still have as lavish a color effect.

But in utilizing plastics in automatic record-playing machines, many factors besides appearance must be closely watched. For example, if too much plastics and not enough wood is used in a cabinet, objectionable vibration and noise may result. The sound-deadening properties of wood are vital to the attainment of proper tone quality.

From the standpoint of design, particular care must be taken to ensure that the curves used in plastics panels will not produce serious internal strains in the material. Sharp bends which call for excessive stretching of the sheets in the forming operation result in thin spots and must be avoided.

Fastening the plastics sections in the cabinet requires a method which will assure a close, attractive fit, yet make due allowance for the fact that the machine may be carried on a truck through sub-zero temperatures and abruptly transferred to a

heated room. The plastics sections may be fastened to the wooden frame members by means of wood or metal strips, or by drilling the material and screwing it directly to the cabinet, using washers of rubber, fiber, or other resilient materials for vibration insulation and as expansion joints.

Because of their frequent location in taverns and other places where liquor is served, automatic phonographs must be able to withstand occasional accidental spilling of alcoholic drinks. In this respect, many plastics work out quite satisfactorily, not being harmed by the dilute alcoholic solutions encountered. Cigarette burns, another operational hazard, can be sanded out and a smooth finish restored, provided the burns are not too deep.

With due allowance for all these conditions, all the leading juke-box manufacturers are increasing their use of plastics in their new models. Seeburg, besides developing cellulose-acetate pilasters to take the place of cast phenolic parts, has worked out red cellulose-acetate sections for the dome ventilator unit on top the machines, and clear Plexiglas selector bars on which are engraved the numbers of the records.

The Rock-ola Manufacturing Company combines cast resins, cellulose acetate sheet, molded acetate, and extruded acetate in its new units. This company has found the cast phenolic particularly good for their needs because it gives rich illumination effects due to the absence of filler content.

Various plastics for both decorative and functional parts are used by the Rudolph Wurlitzer Company. This manufacturer has found that the dimensional and color stability of acetate under a wide range of conditions make the material particularly good for the pilasters and for internal light shields.

PIN-BALL MACHINES — Problem-child of the slot machine industry, so far as publicity is concerned, is the pin-ball machine. Even more than the vending machine and juke box these devices need bright colors and light for success. And to achieve these ends the makers use plastics.

Since new games must be offered constantly to supplant those in which interest is waning, it was found more practicable to standardize on cabinet sizes, electrical assemblies, and other components, and use the plastics bumpers, islands, and posts to achieve variety. With this arrangement, manufacturers can now change their lines

Polystyrene panels line the cooking compartment of hot-sandwich machine

of games almost overnight by working out new wiring hookups and modifying the mechanical arrangement. Cellulose acetate bumpers, which may consists of from one to several parts, are ideal for this application because they combine ease of molding, resilience, and bright color with translucence, giving the playboard the necessary merchandising punch.

So continues the march of plastics in the coin-in-the-slot field. As engineers and designers gain further knowledge of what plastics have to offer this enterprising industry, even more advanced applications may be expected. And to a large extent this public proving ground of plastics use will open other and even larger fields to these tough, decorative, versatile, and utilitarian materials.

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EXPANDED PLASTICS

Make Attractive Christmas Baubles

AN INTERESTING application of cellular plastics, ordinarily used as the core material in plastics-sandwich construction, is in decorative ornaments. One manufacturer, Schwab and Frank, Inc., has brought out expanded-cellular-plastics balls and bells for Christmas decorations. The line may eventually be extended to include a wide variety of decorative ornaments.

PLASTICS CANDIES

Used as Models for Shape and Color

TO CONTROL appearance, an important sales factor in candies, one company producing quantities of multi-colored coated chocolates, has set up a checking system based on a set of plastics replicas of its candies at every stage in the production cycle.

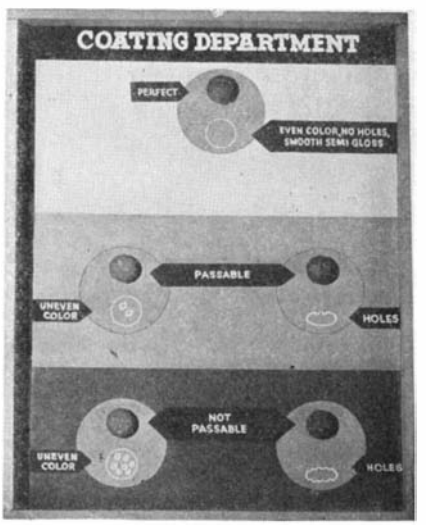
The replicas, cast from an experimental resorcin casting resin developed by Pennsylvania Coal Products Company, are made up exactly to simulate perfect, passable, and non-passable candies at every stage of manufacture. Mounted on colored cards they are used by the inspection staff.

As explained by the candy manufacturers, M and M, Limited, the chocolate centers are automatically squeezed out of multiple orifices in a dropping machine and fall on a moving belt. The chocolate must be of a definite viscosity. If too thin, it falls down; if too thick, the centers will be conical in shape. In either case the pieces will not be usable in the next process. The first two quality-check cards show perfect, passable, and rejected replicas at the center-making stage.

For coating the centers, the operation changes from a continuous one to a batch system in which six different colors are used. Here, the colors of the candy covering must match the standards, and the color must be evenly distributed. Six cards with cast resorcin replicas act as criterions for the six colors.

The plastics was used for these models for several reasons. First, if the candy itself were used on the inspection cards there would be the need of constantly refreshing the models. Trial and error showed that various other materials tried out for the replicas were too subject to temperature and humidity changes. Resorcin, the selected plastics, could be cast in simple plaster-of-Paris molds rather than in expensive, metal molds.

It is suggested that this use of resorcin opens a new field of replica reproduction specially suitable for those with small plastics production facilities and limited capital.



Inspectors match candies to replicas

Diffusion Defeats Drafts

Coolers, Heaters, and Air Ducts are Not the Alpha and Omega of Industrial Air Conditioning. Diffusion—Without Drafts—From the Points of Discharge is Equally Important. Losses through Worker Discomfort and Illness May be Incurred by Overlooking this Function

By LEONARD R. PHILLIPS
Consulting Engineer

• LOOKING AHEAD •

With the application of skilful air diffusion will come lower industrial heating and cooling costs. . . The end of "cave of the winds" theaters. . . Bus heaters that provide warmth minus blasts of stifling heat. . . Cleaner smelling air, banishment of unventilated pockets in public buildings. . . And cool air in transport planes without disturbing ventilator noises.

FACED with the need for low temperatures in the shipping room, the owners of a dairy plant installed air-conditioning equipment of a modern and highly efficient type. But when the equipment was placed in operation, some unforeseen difficulties arose. The blasts of conditioned air were so severe that employees could not endure room temperatures of 50 degrees, Fahrenheit, although even lower temperatures were required for proper operation.

A thorough investigation of the problem revealed the trouble source to be two ceiling-type unit coolers with horizontal grilles that failed to properly diffuse the rapidly moving discharge air. When changes were made in the air-duffusion system, the troubles were greatly reduced.

Another, and familiar example, of the same air-diffusion problem is the air-conditioned theater. Colds, stiff necks, and general discomfort are frequent by-products of a few hours of entertainment. Here again, otherwise excellent air-conditioning systems receive the blame that actually should be directed to the devices controlling the air at its point of discharge.

In addition to physical discomfort, inefficient air distribution can reflect on the industrial balance sheet as well as on theater box-office receipts. In the case of industry, common colds are responsible for more than one third of the number of work days lost in factories in the United States.

Uniform and draft-free distribution of conditioned air appear to be major factors bearing on worker's health and efficiency. Where industrial requirements necessitate forcing cold air directly into the work areas, uneven distribution of temperature and humidity are very likely to result in chilling drafts, cold feet, and similar discomforts.

DIFFUSION ESSENTIAL — The problem of achieving comfortable air distribution has been attacked in many ways. Basically, it is important that air-conditioning systems be equipped with air-diffusing units that deliver conditioned air gently so that drafts and stale air-pockets are minimized.

Air, when discharged from a restricted opening, tends to travel in a stream or mass until its velocity energy has been dissipated or overcome by some opposing force. Only after this motion has been expended does the mass of air mix slowly with the surrounding atmosphere. In order to mix the incoming air readily with room air, it is necessary to create a turbulence that will break up the incoming mass into a multiplicity of smaller masses or streams which can intermingle with other small masses of room air. Moreover, this must be accomplished at the point of discharge of the incoming air.

Ordinarily, grille, register, and louver air-outlet devices employ the pressure principle of discharge. With this system, air is forced through the outlets in unidirectional streams without mixing with smaller masses of room air. Here, little turbulence is created, and the energy of motion must either run itself out, or expend itself on occupants or other obstructions.

In operation, pressure discharge air-outlets do partially separate the incoming air into parallel streams,

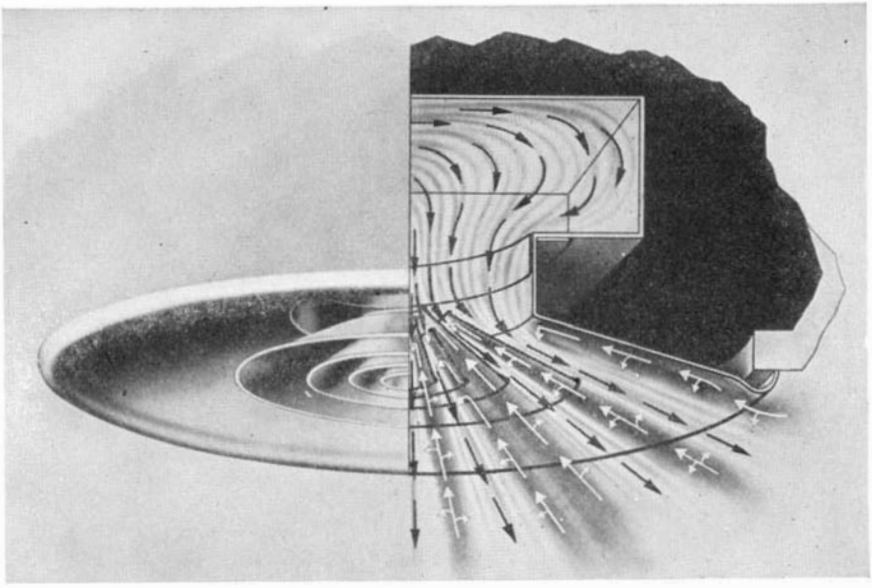


Diagram of Anemostat diffuser—arrows indicate pre-mixing action of counterflow

but each incoming stream draws along a parallel stream of air from that portion of the room air adjacent to it. Generally, these streams adhere to each other, traveling as a single stream, and the diffusion that results with such air supply methods is often inadequate.

Efforts to prevent the adherence of adjacent air streams and to effect adequate diffusion have shown favorable results from diffusing devices that provide a multiplicity of planes traveling in divergent directions and radiating hemispherically from the device. A diffuser constructed to accomplish this must also create counter-currents, essential to thorough diffusion.

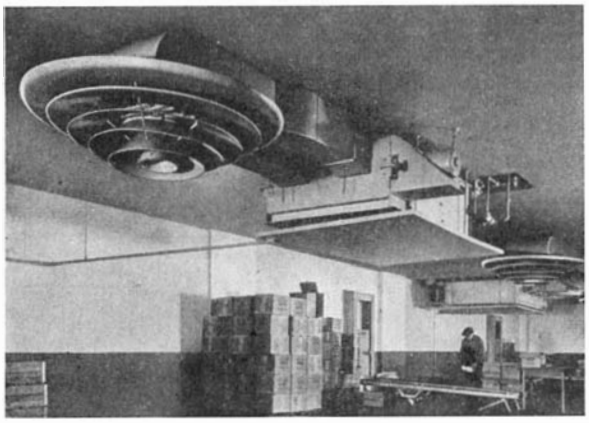
The number of planes into which the incoming air is divided to effect thorough diffusion is largely determined by the volume of air which the device is required to handle. The number of diffusers required in a room is determined by the area of diffusion allotted to each diffuser; and, in turn, this area is determined by the size, shape, and content of the air-conditioned space.

One diffuser based on this concept of air-diffusion is composed of flaring, concentric, metal cones which, although simple in appearance, required considerable research in hydrodynamics and air-flow actions to establish their contours.

REDUCED VELOCITY—When air at duct velocity reaches this device, called an Anemostat, its velocity is immediately reduced by expansion of the air within the flaring cones. This expansion distributes the kinetic energy of the air molecules over a wider area, thus converting the velocity energy of the air into a "pressure blanket" on the room air beneath the diffuser.

The concentric cones of this diffuser are so formed and fixed that the passage of incoming air through them gives rise to a series of counter-currents of room air back into the cones. These multiple counter-currents carry room air equal to about 35 percent of the incoming air into the diffuser, where it is mixed with the incoming air stream before recirculation.

By these two actions—air expansion and counter-current movement—incoming air is pre-mixed with room air and spread out in the form of multiple pressure blankets on the room air below. This pre-mixed air travels in definite proportions and in all directions away from the air-diffuser. Thus, a hemispherical pattern of slow-moving air blankets is discharged into the room, drafts are greatly reduced, and temperature and humidity approach equalization throughout the room.

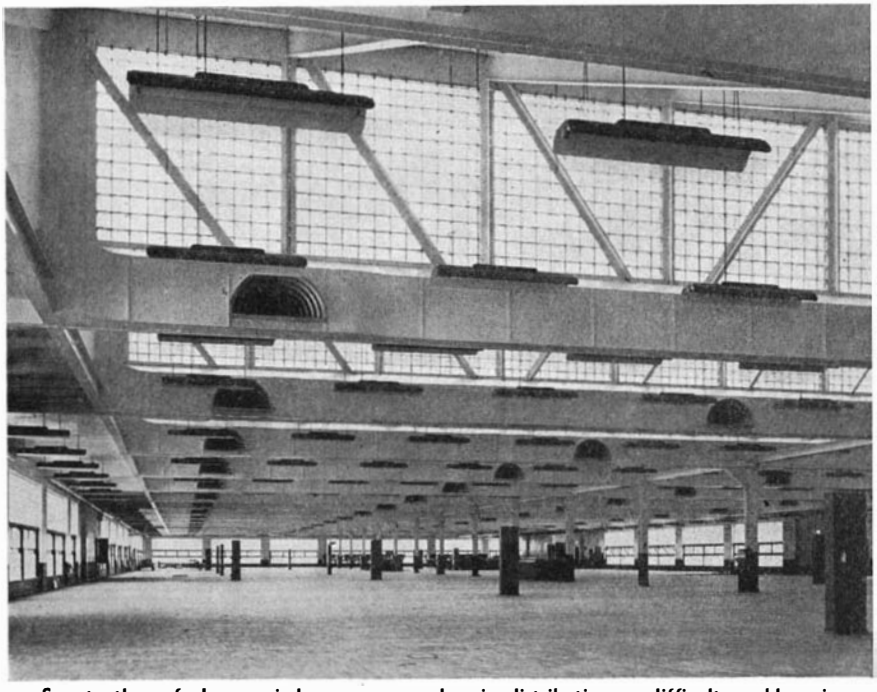


Dairy plant shipping room is example of situation where cold air must be fed directly into work area. Proper air diffusion reduced drafts and increased worker comfort materially

In addition, the air-mixing action causes the desired over-all room temperature to be established at a location level well above the breathing level of the occupants. This permits the comfortable use of colder—or warmer—incoming air than would otherwise be possible. And, as an economy factor, the greater temperature differential in turn results in smaller volumes of air requiring conditioning. Hence, plants equipped with efficient air-diffusers may use smaller air-heating and cooling equipment and smaller air-ducts. Moreover, higher duct velocities—which may be employed because of draftless diffusion—result in further reduction of duct sizes and simplification of duct layouts.

PUDDING PROOF — High velocity air-diffusers of the type just described have found wide use under a variety of conditions. The actual number of units involved is estimated to be over 1,000,000. First tried at Madison Square Garden in 1936, the units diffused 400,000 cubic feet per minute of air throughout the stadium in such a manner as to supply 22 cubic feet per minute without drafts to each of the 18,500 spectators. With regard to industrial use, a large number of plants have incorporated high-velocity diffusers in their air-conditioning systems and many have reported measurable increases in the productivity of workers.

Examination of the specific results obtained from these air-diffuser installations reveals something of the performance that may be expected under typical conditions. In one case a two-story reinforced concrete building offered a problem because of substantial heat transfer through glass-block windows and saw-tooth ceiling construction. For comfort, it was necessary to circulate 400,000 cubic feet per minute of air throughout the structure, and 180 air-diffusers were installed to distribute this volume uniformly and without drafts. The air velocities employed vary from 900 to 1500 feet per min-



Saw-tooth roof, large window areas, made air distribution a difficult problem in this building. High-velocity type diffusers equalized temperatures successfully

ute for the ceiling-type Anemostats, and from 1000 and 1200 feet per minute for the wall-type diffusers installed under the saw-tooth roof. In spite of the high duct velocities, however, velocity readings taken at the breathing level in occupied zones do not exceed 40 feet per minute.

Pneumatically-operated controls regulate temperature and humidity, while the diffusers keep the air uniformly distributed throughout the conditioned areas. In addition, the effects of any delayed action of the thermostatic controls are not so noticeable with well-diffused air, and the absence of drafts and over-cooled or under-cooled spots aids in stabilizing the controls.

TRANSPORTATION USE—Applications of the science of air-diffusion are not, of course, limited to air-conditioned industrial plants and other large buildings. Comfortable air-distribution is equally essential in air-conditioned ships, planes, buses, and railroad trains, and modifications of the basic high-velocity air-diffuser design have been developed for the transportation fields.

Variations in the construction, accessories, and installation of air-diffusers must be engineered to provide air-diffusion patterns matched to the particular type and design of the transportation equipment. To cool or ventilate the many different rooms in a ship, for example, it is necessary to distribute incoming air in a great variety of patterns. By re-adjusting the geometric relationships between the various cones in the air-diffusers, and in some cases by removing certain cones entirely, draft-free air may be distributed in a way that meets the individual requirements and limitations of berthing spaces, galleys, staterooms, and engine rooms.

In aircraft, likewise, a great variety of air-diffusion patterns are needed to meet the different requirements of passenger quarters, cargo spaces, and flight decks. During the war, many models of military and naval aircraft were equipped with high-velocity air-diffusers, and these units are now being incorporated in new planes of various airlines. Air-conditioned railroad trains and buses were also equipped with air-diffusing units prior to the war, and even more of those now being built will be so equipped.

Today, air-conditioning, backed by scientific air-diffusion, makes possible better working and living conditions, new and improved manufacturing processes, and more profitable operations in commercial and industrial enterprises. A better general understanding of the importance of scientific air-diffusion to successful air-conditioning will enable industry to get the most out of investments in such installations.

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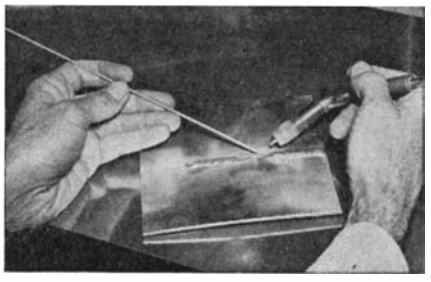
HELIUM-SHIELDED ARC

Originated for Aircraft Welding, Now Available for General Use

HELIARC welding has proved to be a successful medium for working magnesium, stainless steel, brass, inconel, monel, and some of the carbon steel alloys. Research work is now in progress to extend its use to aluminum and to other carbon steel alloys not heretofore Heliarc welded. In the Heliarc welding process, a shield of helium gas envelops the molten metal. Because helium is an inert gas, it prevents oxidation and eliminates the use of a flux and the danger of entrapped flux in the weld ingot that would promote corrosion. The arc in this process is produced directly between a tungsten electrode and the base metal rather than between two tungsten electrodes.

The Heliarc process was first used successfully in 1940. It made possible the use of magnesium, then a new material for aircraft construction. In addition to welding magnesium sheets, extrusions, and tubing into simple, light, and rigid structures, the Heliarc torch may be used to repair magnesium castings containing foundry defects with welds equal to or stronger than the surrounding metal. The weld metal is described as much denser than the surrounding cast metal and less susceptible to corrosion. It is said that almost any thickness of cast metal that can be poured may be readily welded with this process.



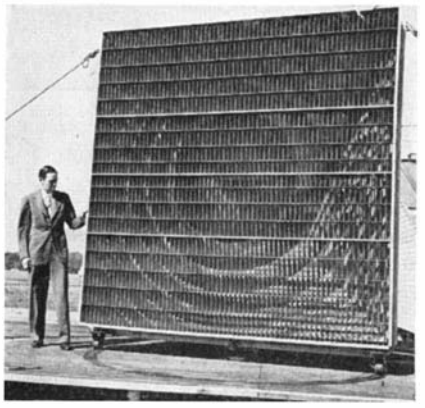
Ordinary arc burns ragged channel in magnesium (left). Helium-protected arc (right) forms smooth, even bead

Welding rod of the same alloy as the parent metal is usually used for castings and wrought alloys. The weld ingot appears to have better corrosion-resistance properties than the parent metal in salt-spray tests. Heliarc welding was developed by Northrop Aircraft, Inc. for use in aircraft production; however, the process now promises to find wide application in other metals-fabricating fields.

LENS ANTENNA

Beams Radio Microwaves Between Relay Stations

A METAL LENS, capable of focusing radio waves as an optical lens focuses light, is expected to find widespread application in micro-



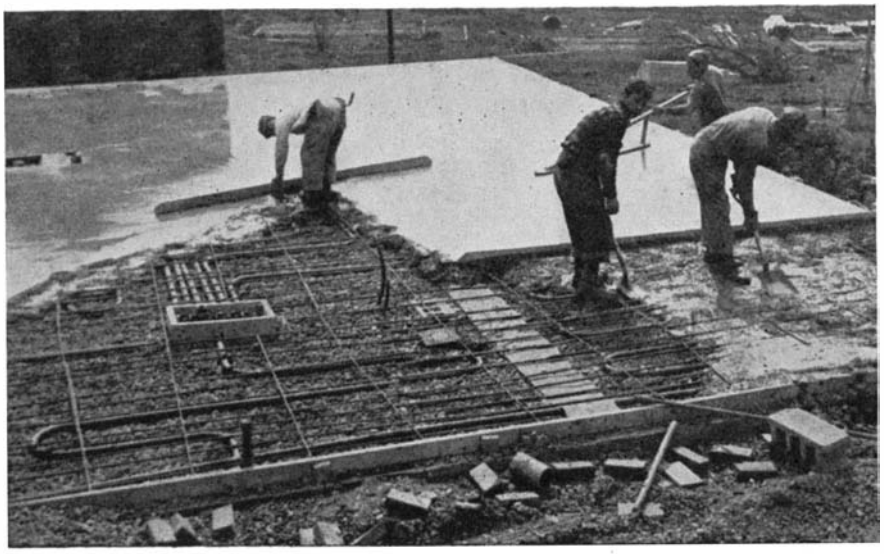
Radio waves change wavefront velocity on passing between metal lens plates

wave radio-relay systems. The relay systems, although designed primarily as adjuncts to telephone networks, will probably find additional use in transmitting pictures, radio broadcasts, and television programs. Aside from its use in such microwave communications systems, the lens also promises to be of value in the development of radar as an aid to sea and air navigation.

A major problem in developing static-free microwave communications has been that of transmitting the wave energy in the form of a narrow beam like that of a searchlight. This requirement stems from the fact that microwaves travel only as far as there is a clear, unobstructed, straight-line path.

Hence, communication over longer distances requires the use of beam-like signals between relay stations so that the total distance is traversed by a series of intermediate transmissions. The new metal lens, which can focus radio waves into the sharpest beam of its kind ever produced, is reported to have solved this problem.

The lens is based on the theory that radio waves undergo a speeding up, or increase in wavefront velocity, when they pass between metal plates, and that the total advance of the wavefront could be fixed by controlling the length and contour of the plates and the dis-



Heating pipes, layed before slab is poured (above), keep floor warm, dry, and save space. Portable bending unit (right) speeds fabrication on the job

tance between them. The necessary design theory was worked out in mathematical detail at the Bell Telephone Laboratories and systems of metal plates were subsequently built to duplicate the action not only of convex and concave lens but also of other optical devices, such as half- and quarter-wave plates and prisms. In addition, the new lens is more rugged than the delicate parabolic reflectors formerly used.

RADIANT HEATING

Proves Well-Adapted to Single Story Residences

A HOUSING DEVELOPMENT, now nearing completion, features radiant-heating systems supplied with hot water from gas-fired boilers in each house. It is claimed that this type of heating will eliminate any danger of damp, cold floors that might be encountered in basementless houses.

Radiant heating, unlike other heating systems, is based upon the principle of controlling normal body heat losses by warming surrounding cooler surfaces. Thus, comfortable conditions are obtained with lower air temperatures than those found in conventionally heated structures.

Since the homes are of the "utility type," space utilization is an important consideration. With the wrought-iron radiant heating pipes concealed in the floor, virtually every inch of floor space is available for use and the floor is kept uniformly warm. Sinuous coils of the 1¼ inches radiant heating pipes were fabricated at the site of each house by the contractor, Frank Corace. Cold bending was accomplished by means of an electrical-hydraulic portable bending device shown at the right above.

When the coils had been positioned on the gravel fill, welded together, and tested under 250 pounds pressure, the 5 inch reinforced concrete floor slab was poured. For finish flooring, mastic asphalt tile was used.

Hot water for the radiant heating system is circulated through the coils by a small pump, and each house system contains about 55 gallons of water. The pump action is controlled by an ordinary wall thermostat. An aquastat regulates water temperature. Balance cocks for supply mains to individual rooms are centrally located in a pit with a removable plate in the utility room. Once the cocks have been adjusted according to the desired conditions of comfort in each room, they need not be touched during the entire heating season.

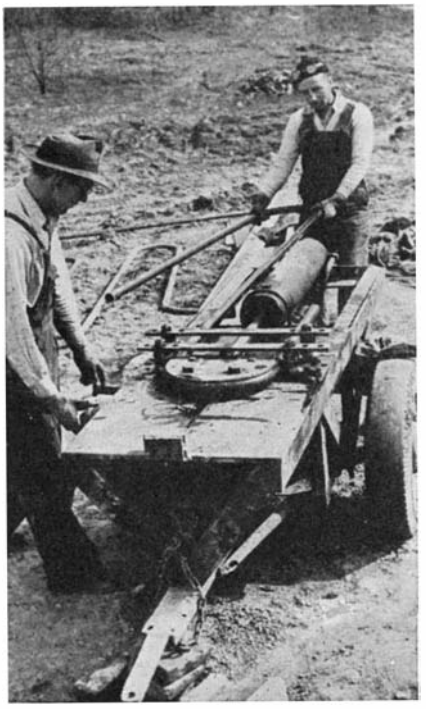
STATIC ELIMINATOR

Provides Conducting Path of Alpha Rays

STATIC electricity is removed from industrial machines and processes, where it constitutes a fire hazard and complicates production, by a new method developed by United States Radium Corporation. The method utilizes a radioactive source of alpha rays, located near the points where the static charge tends to build up. This ionizes the air, so that it carries off the static electricity, eliminating the possibility of sparks or cohesion. The unit, known as the Ionotron static eliminator, is self contained and has no electrical connections or moving parts.

Moving, non-conductive materials, like paper, cellophane, rayon, and nylon yarns create and store static electricity at points where there is friction, such as where paper leaves a roll, or a belt leaves a pulley. This is the same static which causes a comb to give off sparks on cold, dry days. In many industrial processes, static constitutes a serious problem, for the sparks it generates can ignite inflammable gases and liquids. In addition, static-charged sheets of paper and cellophane tend to stick together and curl. This slows up production.

Alpha rays emitted by a radioactive unit surface in the Ionotron ionize the surrounding air. Ionized



air is a conductor of static electricity, and serves as an invisible "wire" over which trouble-making static flows and is carried harmlessly away to ground.

The Ionotron static eliminator consists of a specially designed housing strip containing radioactive foil, which emits alpha rays, in a controlled direction. No changes in machine design are needed, nor are special precautions required to safeguard operating personnel. Service is no problem, as there are no moving parts, and half of the potency in the foil will remain after 1600 years of service.

HOPPER CAR

Holds More, Weighs Less; Built of Welded Steel

REDUCTION of dead weight and increase of capacity, without sacrifice of durability, are basic ideas behind the construction of a new all-welded steel hopper car. The car weighs 6540 pounds less, and will hold that much more coal, than the standard hopper car.

In general, the new car does not differ radically from the dimensions

of the conventional hopper. A smooth interior surface, resulting from the elimination of protruding structural members and seam ledges, permits a free flow of material during unloading, and prevents accumulations of moisture and dirt where corrosion may start. The car is built of Cor-Ten, a high-strength, low-alloy steel, described by the United States Steel Corporation as corrosion resistant.

MOON RADIO

May Answer Television and H-F Communication Problems

RADIO TRANSMISSION between two points on the earth after reflection from the moon may enter the realm of practicality, according to engineers of the Federal Telecommunication Laboratories who have been engaged in an analysis of this project for some years. Now that it has been publicly demonstrated by radar that the space surrounding the earth is not impassable to radio waves, a consideration of this subject appears pertinent in view of developments that may not be far in the future.

The ionosphere, the currently utilized reflecting medium for long-range, high-frequency radio transmission, is held to consist of various layers of ionized upper air, 60 to 250 miles from the earth's surface, which reflect the radio waves. This reflection enables the signals to be received at points located far beyond the horizon and over the curvature of the earth—often halfway around the globe. Certain disadvantages, however, are presented by the behavior of radio waves on contact with this reflecting medium, notably that waves of the higher frequencies are not reflected but penetrate the ionosphere. This prohibits long range transmission in the upper ranges of the frequency spectrum.

For long-distance radio, transmitted in the higher frequencies, it now seems possible to use the moon as a reflecting medium. The fundamental principle of this transmission would be the same as that of the Signal Corps moon-radar experiments. In these, an ultra-high-frequency pulse was beamed at the moon from an antenna somewhat similar to that used for radar airplane detection, and the answering echo was received at the same point. Since the reflected waves radiate from the moon's surface in a wide angle, it is apparent that the receiver could be located at a distance from the transmitter—in fact, any place on the earth where the moon could be "seen" at the same time as at the transmitter. By setting up a transmitter and receiver at New York and Paris, for example, two-way communication could be established between the two stations.

It is said to be possible to send radio telegraph or facsimile communication over such a set-up. Both the transmitting and receiving antennas would have to be directionally oriented toward the moon, and would have to maintain their orientation as the earth revolves. This, however, is a mechanical problem which can readily be solved by a clockwork mechanism similar to, but simpler than, that used by astronomers to keep telescopes trained on a celestial body.

The advantages of moon-reflected transmission would include the known, desirable characteristics of very-high-frequency transmission, plus allowing for a considerable number of channels. At present the useful band width is narrow, thereby limiting the transmission to code messages, but it is probable that future developments will overcome this disadvantage, when higher power transmitters become physically and economically feasible.

A further advantage of the system, since the radio waves strike the receiver from above, would be freedom from interference by natural obstacles between the transmitter and receiver. Hence the blocking action of the earth's curvature, mountains, cities, and other obstacles to high-frequency line-of-sight transmission would be eliminated, and nation-wide television broadcasts from a central station might become practical. Elaborate receiving stations, if necessary, could pick up the program as reflected from the moon and re-broadcast it to the home receivers within their effective radius. This arrangement would eliminate the necessity of an expensive and elaborate network of line-of-sight repeater stations to reach out-of-the-way locations.

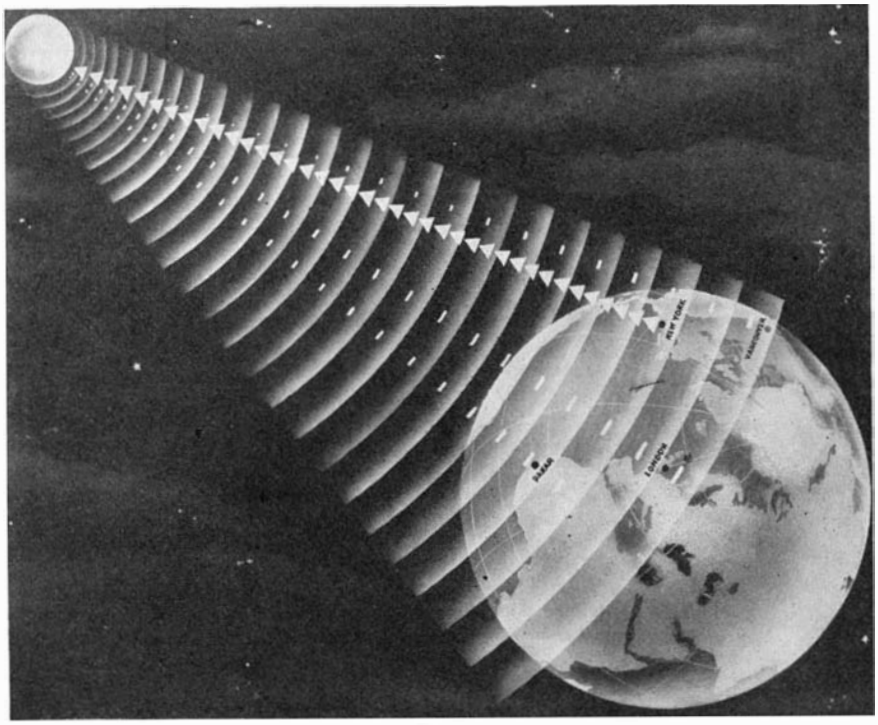
BARNACLES BAFFLED

By Plastics Paint on Ships' Hulls

HOT PLASTICS paint, at temperatures of 300 degrees, Fahrenheit, is being used by the Navy in a spraying operation on ships' hulls. The plastics paint forms a "skin" which minimizes barnacle growth and is a war-time development that increased the effective range of vessels in tropical waters.

The hot plastics paint is delivered by a synthetic-rubber hose with Fiberglas reinforcing. This combination, selected because of its high tensile strength and heat-resisting qualities needed to withstand the operating pressures and temperatures encountered, was developed by the DeVilbiss Company.

Hot plastics paint on hulls is reported to double the time a ship can stay out of dry dock between barnacle-removal jobs and still operate efficiently. With spray painting equipment using the new hose, a crew of 140 men can apply the hot paint to an entire battleship hull in 16 hours.



Radio-echo principle could eliminate interference from mountains and buildings, would allow widely spaced global stations to receive broadcasts from New York

New Products and Processes

TOOL TIPS

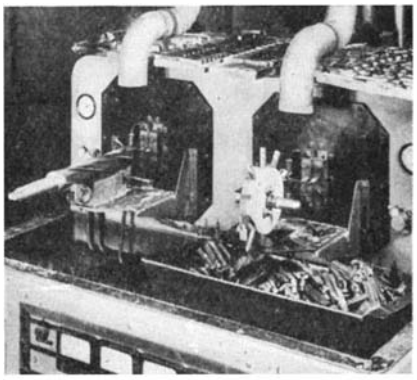
Brazed Rapidly and at Low Cost by Induction Heat

IN THE practice of brazing tungsten-carbide tips to cutting tools, a recently devised application of induction heating is reported to have brought about greatly increased output with no increase in manpower. One factor in the new method is a rotary fixture which enables one operator to do in an hour what formerly was achieved in approximately eight. These operations are being performed on two 15 kilowatt, two-station, 9600-cycle units of standard Ohio Crankshaft-Tocco Process make, equipped with water-cooled inductor coils. With two stations each, the self-contained induction-heating units, 48 by 32 inches in base dimensions, are located in the production area of the shop.

Compared to other methods used to braze tips, The Willey's Carbide Tool Company reports that the cost-cutting advantages of induction treatment include: no need for removal of excess metal from the shank of the tool; elimination of wiring tip to shank; reduced wear on the finish grinding wheels by elimination of the wiring on tip; cooler and cleaner operation; more positive, uniform type of braze; and limiting of rejects to a fraction of one percent.

When using this system, the tip and brazing material are positioned in the recess, then the tool is placed beneath the inductor. The heating cycle may run from three seconds upwards to a minute depending upon the type of tool being brazed. As the heating progresses, a small rod is used to "wipe" the tip into place as the material softens. Cycles can be controlled automatically or manually.

The rotary fixture which helped increase production is a transite block six inches in diameter, mounted on a revolving spindle. The block has a capacity upwards of 20 tools ranging in size from ¼ to ¾ inch square and of moderate length. The tools are held in the fixture by spring tension and as the operator manually rotates the block the tool enters the field of the inductor coil where it becomes heated. When the short cycle concludes, the tool is moved to the vertical. Here, it releases automatically from the fixture and drops into a box or onto a conveyor below.



Methods of holding tools while being tungsten-carbide tipped in an induction furnace include a rotary fixture (right) and a magnetic check (left)

MODIFIED THERMOPLASTIC

Shows Improved Properties, For Higher-Temperature Use

A THERMOPLASTIC injection-molding powder, a modified polystyrene, is intended for use at temperatures above the heat-distortion point of unmodified styrene compounds or of Plexiglas, the acrylic plastics made by Rohm and Haas Company. Claimed superior in weathering properties and in resistance to chemicals, the material, known as Plexene M, also has improved machining qualities. Moldings made with the new material are reported not to show any tendency to the crazing characteristic of many unmodified styrene compounds.

In molding, Plexene M requires slightly higher cylinder temperatures than styrene formulations and best results are obtained in the 430 to 480 degrees, Fahrenheit, range using medium to high molding pressures. Residual strains are lessened by its flow characteristics. Although shrinkage is affected by molding conditions, size and shape of part, and other factors, Plexene M moldings are said to show very low shrinkage even for "heat resistant" thermoplastics.

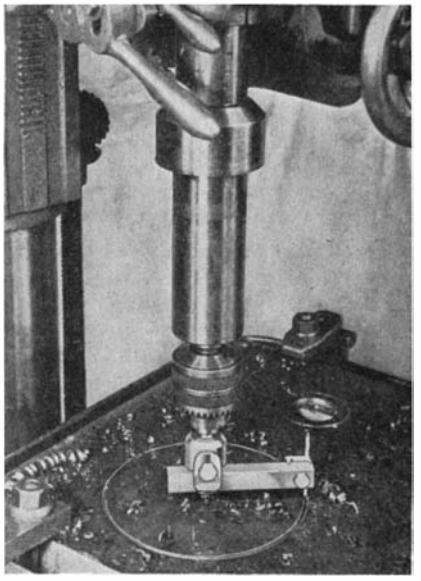
Described by the makers as odorless and tasteless, the company is practically unaffected by acids, alkali, and dilute alcohol, and is resistant to gasoline and commercial inks. It is attacked, however, by organic solvents such as acetone and ethylene dichloride. The natural color of Plexene M is a light amber, and translucent and opaque colors ranging from ivory to black are available.

CIRCLE CUTTER

Adjusts Easily to Accurate Diameters

SMOOTH, large-size holes in wood, steel, brass, hard rubber, aluminum, fiber, plastics, and other materials may be quickly cut with a new tool. Called the Bruno Adjustable Circle Cutter the device cuts holes to any diameter from 1⅞ to 8 inches through ¼ inch thickness in steel or other tough metals, and any thickness up to 1½ inches in plastics, fiber, or wood. Thickness capacities may be doubled if cut is taken from both sides of material. The tools are designed to operate in any standard drill press, wood-working machine, or suitably mounted spindle machine.

The circle cutter is said to be designed on a new principle which permits easy, yet accurate adjustment. It consists of a combination drill and pilot with a high-speed cutting blade, adjustable to depth and diameter. A "Wedge-lok" cutting-blade holder permits the cutting edge to recede or yield from work while still maintaining steady pressure and feed. The cutting blade is re-sharpened without special tools by grinding on one edge only. The twin-blade holder—fixed ½ inch center—cuts washers, wheels, disks, and gaskets in one operation.



Cuts clean holes in many materials

SALTS IN OIL

Removed by Washing and Glass Fiber Treatment

PROGRESS in the development of a new process for removing from crude oils the inorganic salts that have a corrosive effect upon refining equipment was recently described at a meeting of the American Institute of Chemical Engineers.

Essentially, the process consists of washing the crude oil with water at a temperature in excess of 250 degrees, Fahrenheit; passing the oil and water through beds of fine glass fibers to coalesce the emulsified water; and separating the de-salted oil from the aqueous phase.

The glass fibers employed have an average diameter of 28 one-hundred-thousandths of an inch, and provide 1079 square feet of surface area per pound of glass. The water phase is recycled to conserve heat. Only sufficient fresh water is used to maintain the salt content of the recycled water at a maximum of 3 percent by weight.

It has been found, according to the paper on the subject, that salt con-

tent can be reduced to less than five pounds per 1000 barrels of oil by proper control of temperature, superficial velocity, density of the Fiberglas beds, and total depth of the beds. Temperature of at least 275 degrees, Fahrenheit, gave the best results.

ANTI-FOAM AGENT

Reduces Foaming During Industrial Processing

CHEMICAL processes and industrial operations, particularly when aqueous alkaline solutions are used, are often handicapped by severe foaming. Now a new silicone compound, DC Antifoam A, has been developed especially for use against foam in such solutions and emulsions.

Tests indicate that the anti-foam agent eliminates or reduces the foaming of various aqueous solutions even when they are subjected to steam distillation or vacuum concentration. It also appears that the material is effective in very low concentrations, ranging from a maximum of one part per 10,000 against strong foamers to one part in a million against weak foamers. The manufacturer, Dow Corning Corporation, states that the ability of DC Antifoam A to reduce foaming in any specific material can be established only by testing it in various concentrations in the solutions that are to be defoamed.

MINIATURE WELDER

Brings Precision Control to Small-Weld Operations

ELECTRONICALLY - controlled welding equipment that does away with the human element of control of the quality of the weld is now available in the low-price filed. A miniature welder,

Capable of 120 welds per minute, unit operates on standard 60-cycle current

capable of high-performance welding on diversified types of metals—those required in radio tube construction, for example—is said to offer precise values of welding pressure and energy.

The unit is small, measuring 9¾ inches high, 13 inches wide, and 13½ inches long, and can produce 60 to 120 welds per minute on a total thickness of .035 inch for practically all metals and principal alloys, or on combined pieces being welded of .060 to .070 inch in cross-wire welding. The instrument plugs into a standard 110-125 volt, 60-cycle power line. Current drain averages three amperes at maximum setting.

Called the Raytheon Miniature Weld Power Unit, the device allows the power output into the weld to be varied. A voltage-adjustment control varying the capacitor-charging voltage from 750 to 1500 volts and a three-position capacitor switch by which values of 14, 28, or 56 microfarads can be attained, are mounted on the front panel of the control unit. Having once been adjusted for a given power and time cycle for a certain material and thickness, the miniature unit requires no further adjustment to produce constant uniform welds. The materials to be welded are placed between the electrodes and the energy stored in the electric storage system is applied to the pieces to produce a weld.

The welding head of the unit is designed to give a pre-set pressure to the material being welded, and when the pressure is applied the power is triggered by a micro-switch mechanism located in the head, thereby controlling the applied pressure and cycling of the weld power. Metals that may be welded by the device include iron, aluminum, copper and copper alloys, nickel flat and wire, nickel alloys, tantalum, platinum sheet or wire, tungsten sheet or wire, gold sheet or

wire, constantan sheet or wire, stainless steel, and alloys of the above materials.

The electronically-controlled unit is expected to find many applications in the manufacture of small jewelry, electrical equipment, electro-chemical apparatus, and radio parts.

NO-STARCH TEXTILES

Produced by Treatment With Resins

CRISPNESS in cotton fabrics, without the use of starch, is now possible with a resin textile finish for application at the time of manufacture. Garments will be bought with the resin already applied. It is said that despite repeated launderings and dry cleanings, the finish will not wash out of the fabric but will remain to restore its newness and crispness after each washing and ironing.

Called Kandar, the United States Rubber Company's treatment can also be used on rayon fabrics to give them better drape and fullness. A rayon blouse or dress will drape, shirr, or gather better because of the new treatment.

HOT TANK

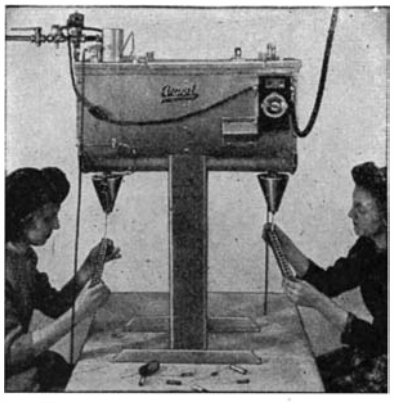
Melts Insulating Compound; Supplies Two Operators

FOR HEATING, melting, and pouring battery, transformer, capacitor, and resistor compounds, a new gas fired, electrically controlled, and fully insulated, production tank is available. The unit, known as Model 22TGT and made by Aeroil Products Company, is heated from the inside through a removable immersion-tube system. This method of heating, plus full insulation, is claimed to bring the user a substantial saving in time, labor, and fuel.

A novel feature of the tank is that it is equipped with two outlet valves that are separately heated. Since the outlet valves are at opposite ends of the tank, two operators can work independently with both hands of both workers free. The distance across the table between the valves is 21 inches, leaving room to set up cooling racks or other production aids. The ends of the valve are 15 inches above the table level, thus giving ample clear working space.

While the tank itself is gas fired, it is equipped with electrically-operated thermostatic controls for temperature regulation from 100 to 550 degrees, Fahrenheit. A dial thermometer is installed in each unit for visible temperature check. In addition, each heating tank incorporates a safety pilot control to shut off the gas line should the pilot light be extinguished.

Instantaneous flow control is claimed by the manufacturer because of the gravity-type, poppet-acting valves together with strainer and heat-baffle plates to give added assurance against freezing or clogging. The full liquid capacity of the new tank is 10 gallons but other sizes are planned.

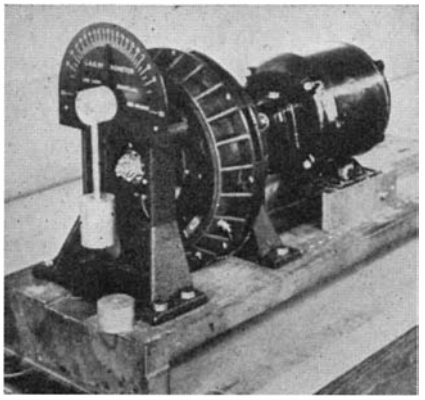


Outlet valves are separately heated

MOTOR POWER

Measured Conveniently with Small Dynamometers

FOR QUICKLY measuring torque and horsepower of fractional-horsepower motors, including flea-power, dynamometers of the eddy-current type with D.C. excitation are now offered as more accurate and convenient than prony brakes. Torque loads are varied by rheostat adjustment.



Suitable for continuous-duty testing

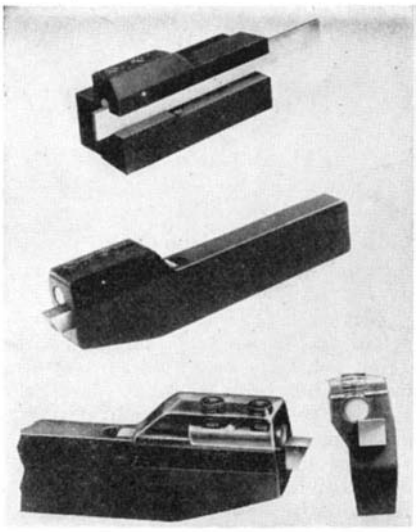
Said to save time in both laboratory and production use because they are self-damping and self-cooling, the Absorption Dynamometers are described by the L. A. B. Corporation as permiting one-man operation. Reported as meeting the need for continuous service units, they are intended for speedy production set ups for testing electric, hydraulic, pneumatic or internal-combustion motors, and flexible shaft transmissions.

Either running or stalled torques may be measured; no springs or frictional devices are used. The smallest sizes measure torques at speeds up to 15,000 revolutions per minute and up to 10 ounce inches. Other sizes measure up to 25 inch pounds.

LATHE TOOLS

Gripped Firmly with Solid Support

DROP-FORGED lathe turning and cut-off tool holders, embodying a feature for holding the cutting bit rigidly in place, were recently announced by The Cooper-Bessemer Corporation. The new turning-tool holders are forged from a special analysis steel and incorporate a clamping pin which engages the bit for nearly its entire length.



Cut-off tool and turning tool (above) are secured in holder by clamping pin visible in lower phantom view. Long gripping area gives better dissipation of heat, helps resist side pressures

Two flush-type set screws are said to lock the tool bit into position with a vise-like grip and prevent any possible slippage. According to the manufacturer, the turning-tool holders have a number of advantages including: better dissipation of heat, use of short bits, reduced chattering and less bit breakage, and convenient tool adjustment features.

Similar advantages are reported for the new cut-off tool holders. These securely grip the cut-off blade vertically by a clamping pin at the top which is accurately machined to a V-groove at the bottom. The clamping pin engages a considerable portion of the blade, holding it to a true cutting position, it is claimed, regardless of side pressure imposed on the blade.

DRAWER-TYPE OVEN

Utilizes Space Efficiently, Regulates Temperature Accurately

INCREASING oven capacity without increasing floor space is a possibility featured by the manufacturer of a drawer-type oven. Offered as proof is the experience of a paint brush manufacturer who is reported to have gained 2½ times more oven capacity—for vulcanizing brushes—with this type oven. The reason for this, according to the Despatch Oven Company, was that there was less waste space inside of the oven and with a new type of heat-distributing and air-circulating system the interior work space could be utilized to the maximum for production.

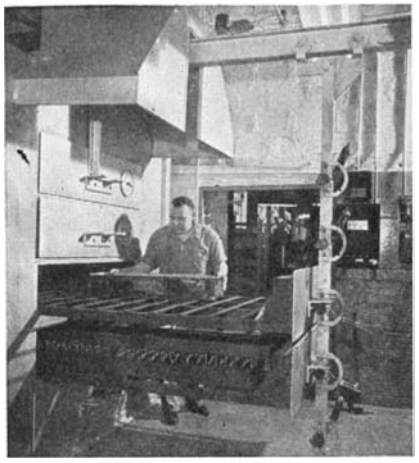
In addition, the drawer-type oven eased loading the paint brushes because they could be handled in pans. The oven has five drawers, each one 4 feet wide by 6 feet long by 8 inches high, which provides sufficient loading capacity for approximately 1800 pounds of paint brushes per charge. An overhead loading mechanism makes it possible to withdraw one or more drawers at one time, thereby meeting the load-

ing and unloading conditions as necessary.

It was said that the new oven showed a heat uniformity within the working area of plus or minus 2½ degrees, Fahrenheit. The temperature range is from 125 to 350 degrees. An automatic temperature-control instrument provides automatic regulation of the oven at the temperature desired and a Partlow recording instrument provides a constant record of the operation.

The ovens have an approved safety system manufactured by the Brown Instrument Company that automatically shuts down the oven in event of gas, or power, or fan failure. There is also a special high limit cut-out thermostat so that if the temperature exceeds the desired setting by more than 10 degrees the system is automatically shut off.

The Despatch direct gas-fired heater



Oven drawers are conveniently loaded

is mounted on top of the oven to conserve floor space. It has a rating of 150,000 British thermal units per hour and is of the atmospheric type with a "Controlled Combustion" feature which is claimed to assure high operating efficiency under all conditions.

LEAK-PROOF BOTTLES

Retain Corrosives Even When Shattered

TOUGH, nitrocellulose-plastics coated bottles in which corrosive liquids can be shipped or stored without danger of the liquid leaking out if the bottle is broken, are now available. The coating provides a protective armor around the bottle and holds its shape even though the glass underneath is shattered.

In tests, when bottles containing acid were thrown against a metal wall with sufficient force to break all the glass, the coating retained its shape and prevented the acid from seeping through. Other advantages of the coating are transparency and colorability with dyes for identification purposes, plus protection of the label on the bottle. Also, the bottles can be washed without affecting the qualities of the coating.

Developed by the Detroit Macoid Corporation, the coated bottles are expected to find wide acceptance for use in laboratories and plants where corrosive liquids are used and stored as well as for shipping these liquids. In manufacture, the bottles are dipped into a solution based on a Hercules Powder Company nitrocellulose. When the excess plastics has dripped off, an even film of from 20 to 25 thousandths of an inch remains on the bottle.

ANTI-RUST FILM

Adheres to Metal During Forming Operations

PROTECTION of metal during manufacturing stages, a tighter bond with paints, and longer life through enhanced corrosion resistance, are advantages claimed for a new rust-proofing technique for steel and galvanized steel. Basis of the method, called the Banox process, is a flexible, glassy, metal-phosphate coating, that will bend with the steel or even permit die-stamping without harm to the coating. The coating, which has a thickness of from 5 to 15 millionths of an inch, may be put on by the spray, immersion, or brush methods and requires no heat.

According to the developer, Calgon, Inc., the treatment prevents rusting between cleaning and painting; insures a grease-free and alkali-free surface for maximum adherence and flexibility of organic finishes; increases the durability of the finish as measured by outdoor exposure, salt-spray, "sweat-box" humidity, and water immersion tests; and prevents spread of

rust from unprotected edges, scratches and other areas where the basis metal is exposed. Applications of the process are expected in automotive, domestic appliance, and other lines where high quality finishes are important.

FIRST-AID HEAT

Immediately Available from Self-Contained Device

RAPID and safe, an emergency source of heat for medical use employs no liquids of any kind. Called the Redi-Heat Block, the unit is entirely self-contained and always ready for use, requiring about one minute to reach top heat. Wrapped in a towel or blanket, the block maintains its temperature for approximately one hour, and furnishes safe heat for emergency treatment of victims of shock or other injury.

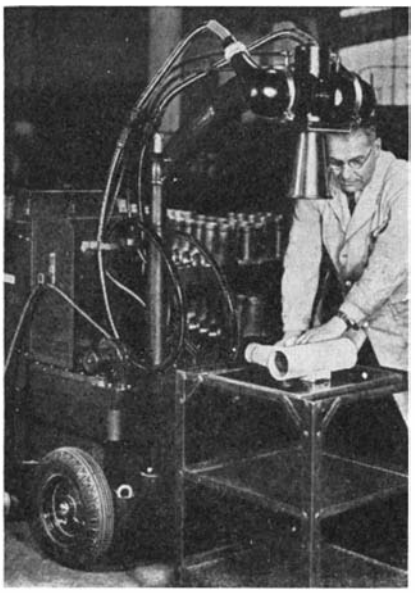
Made by Mine Safety Appliances Company, the heater consists essentially of a block of light-weight metal with high heat-transfer value, encased in a cover and containing a replaceable charge. The Redi-Heat Charge is a small, sealed metal cylinder containing a chemical compound. The charge is inserted in the block, where it is activated by raising and releasing a spring-loaded lever—thus starting a chemical reaction which evolves safe, dry heat.

Weighing 22 ounces and measuring 3½ by 4 by 1½ inches, the device fits conveniently into industrial first-aid kits, cabinets, dispensaries, and field station units. It is impervious to heat, cold, and moisture and is said to store indefinitely without deterioration.

RESIN OIL LINE

Resists Deterioration, Carries Coolant to X-ray Anodes

IN COOLING the anodes of modern X-ray machines, hose assemblies must resist oil, heat, and pressure. A new polyvinyl resin product is reported to provide a resilient oil-imprevious conduit that solves the problem satisfactorily for all types of oil-cooled machines. Called "compar" tubing and developed by Resistoflex Corporation, the tubes carry the oil which flows over the anodes of the machine to carry away the heat.



Long life and no internal sloughing are advantages of resin coolant hose

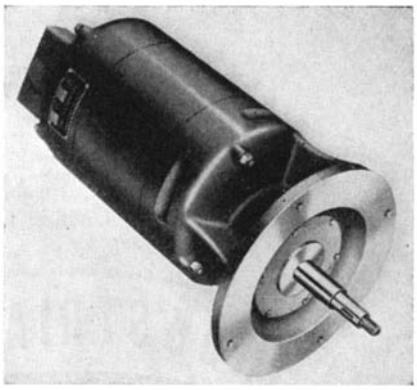
The imperviousness of the compar core of the tubing to the effects of the hot oil circulated at varying pressures is said to permit almost unlimited service life. Flexibility and resiliency remain constant throughout the lifetime of the tubing and in addition the compar is described as offering complete freedom from sloughing or rotting. Thus there are no particles dislodged from the tubing to contaminate the system or to clog intricate parts.

COMPACT MOTOR

Gives High Speeds on Standard Power

A GEAR-MOTOR for industrial electrical equipment delivers five horsepower at 8000 revolutions per minute, using commercial 3-phase, 60-cycle, 220-volt power.

Designed for limited-space applications, the motor is a fan-cooled, open-type, two-pole 3600-revolutions per minute unit, with output speed stepped up to 8000 revolutions per minute by single-reduction helical gears in a sealed gear box. Smaller, lighter, and more compact than the conventional ungeared motor, the same Electrical Engineering and Manufacturing Corporation design, with changed gear specifications, will fit a variety of applications requiring output speeds not ordinarily obtainable with commercial current.



Gears provide unusual output speeds

PLASTICS PRESS

Speeds Pre-Forming of High-Bulk Products

PRODUCTION time for heavy-duty plastics products is promised to be markedly reduced as a result of a new semi-automatic pre-forming press that will permit high-bulk phenolic materials, previously pre-formed by hand, to be pre-formed into units weighing as much as one pound.

Also, the new press allows material to be dielectrically pre-heated, a treatment that cannot satisfactorily be applied to non-formed compound and is reported to reduce the molding cycle considerably on most applications. Another feature of the General Electric press is the safety factor effected by external loading of the machine.

TELEVISION LENS

Combines with Mirror To Enlarge and Sharpen Images

LARGER, clearer television pictures from home television receiving sets are said to be possible with a new image-correcting glass lens. Described as the heart of a television receiver's optical system, the new lens, with wave-like curves, corrects aberrations caused by projecting television tube images on a reflecting mirror used in the optical system to enlarge the images. A reflecting glass mirror, as a companion piece to the correcting lens, provides a combination that permits screen images five times larger than the pre-war variety.

Lens-mirror combination for television receivers. The mirror (center) distorts the image; the Schmidt lens (left) corrects the mirror aberrations

Made by the American Optical Company of a durable, stable glass, the image-correcting lens will retain its optical properties during the entire lifetime of a television receiver. The lenses are claimed to be more than 10 times as fast as an *f*/2 camera lens.

Prior to the war, according to American Optical, there were fewer than 50 lenses of this Schmidt correcting type in the world, and these were used in high-speed astronomical photography. Days, weeks, and sometimes months were required by a skilled lens grinder to make one by hand, whereas the new correcting lens can now be produced in quantity in a few hours by a new production method.

In manufacture, the wave-like curves of the correcting lens are produced by heating a flat piece of glass until it flows into the specially curved surface of a refractory on which the glass is placed. The refractory serves as a mold in some respects and is made of a special composition that does not adhere to the glass. The lens is then ground and polished to a sparkling finish.

A television optical system, using the correcting lens-mirror, receives television images from the receiver's cathode-ray tube, projects them on the special mirror, then reflects the image through the correcting lens onto a flat mirror which in turn reflects the focused picture on the viewing screen. Larger, clearer television pictures re-

sult. For example, a cathode-ray tube only five inches in diameter produces an image which fills a screen 18 by 24 inches.

HALF-CAR LOADS

Handled Conveniently by Aluminum Freight Holder

MADE from strong aluminum, a new light-weight freight container has a capacity equal to half of a box car. Weighing less than a ton, the container, 20 feet long, eight feet wide, and eight feet high, is especially designed for truck-trailer transportation of general merchandise between loading docks and railroad flat cars. Easy shifting from truck to train is aided by built-in hydraulic jacks and ball-bearing rollers.

High corrosion-resistance, according to Reynolds Metals Company, helps cut maintenance costs, insures longer and trouble-free life. As a compact container, the unit also lends itself readily to water and air transit. Used with a delivery service similar to those now in existence, the unit would make possible door-to-door delivery on one-half box car shipments with no intermediate handling of the contents required.

Besides use for shipment of general merchandise, the Reynolds unit has been designed also as a refrigerator container and can. Through controlled refrigeration, it maintains zero temperature for 36 hours without re-icing.

SPHERICAL BEARING

Solves Load-Speed-Temperature Problems

CAPABLE of carrying heavier loads at higher speeds and lower temperatures, a new-type spherical roller thrust bearing is expected to facilitate wind-tunnel operation for research into such aeronautical projects as gas turbine and jet propulsion speeds and designs. It also promises to ease maintenance and operating problems on large vertical water pumps, electric generators, and other high-speed machines. It is explained by SKF Industries, Inc., that the design solves long-standing problems in the bearing field.

Other applications have been suggested as thrust blocks on marine propeller shafts, on roll necks in steel and aluminum rolling mils, and as thrust mountings for rairoad turntables, water turbines, water wheels, oil well swivels, dredge pumps, extrusion machinery for plastics and rubber, and various types of gear drives. Ability of the new bearing to carry heavy loads at high speeds is possible because of an unusual design which permits more effective lubrication.

PHONO PICK-UP

Couples Amplifier More Closely to Record

AN "ARMORED VACUUM" tube in the tip of a phonograph tone arm gives direct-action translation of mechanical sound from the record into electronic modulations. Featuring simplicity, and capable of reproducing the full beauty of recorded music including delicate tones, the new pick-up resists abuse and is claimed incapable of damaging records.

Operation of the device, as described by the manufacturer, Bendix Aviation Corporation, depends on transmission of the mechanical undulations from the record groove by a filament which introduces them directly into the electron stream within the new vacuum tube. The entire pick-up occurs within a small fraction of an inch. By this means many intervening steps are eliminated together with the danger of loss of fidelity, trouble possibilities, and increased cost of manufacture.

Temperature and humidity proof, climatic conditions do not limit use of the pick-up, nor does it deteriorate from disuse or require any special protective measures to insure its operation.

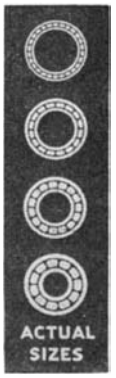
Record wear is said to be eliminated by the fact that less than two-thirds of an ounce of pressure is exerted on the record. The tone arm is designed to the "minimum tracking error," permitting the contact point to follow faithfully each record groove, even through the heaviest bass passages. When necessary, the entire reproducing element may be replaced by simply

plugging in a new tube, and since the pick-up contains all of the elements necessary to translate mechanical vibrations into electrical energy, replacement restores the unit's full capacities.

ANTI-FRICTION BEARINGS

Meet Precision Needs in Small Sizes

MINIATURE ball bearings, designed for use in small motors, computers, electronic equipment, drive movements of recording devices, testing and laboratory equipment, and other precision mechanisms, are now available to meet the needs for anti-friction bearings in restricted locations. Supplied with an outside diameter of 5/16 inch and bores of 7/32, 3/16, 5/32, and 1/8, the bearings are manufactured of chrome bearing steel and finished to precision tolerances. As described by their maker, Miniature Precision Bearings, the bearings will accept unusually heavy loads and high speeds for their size and weight.

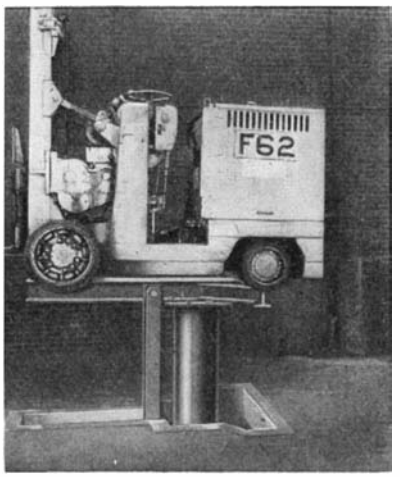


Advantages of anti-friction bearings in locations where space is restricted can be realized with small, light precision units

OIL LIFT

Raises Industrial Trucks for In-Plant Service

FOR SERVICING power trucks within a factory one manufacturer uses a hydraulic lift equipped with a platform consisting of one longitudinal and a transverse beam. Tops of these beams are flush with the floor when elevator is not in use, a sump pit being provided for this purpose. A power truck to be serviced is driven over the



Power truck lifted for servicing

hoist so that the rear axle comes to rest directly over the transverse H-beam. By means of adjustable axle blocks, two under the front axle and one under the rear axle, the power truck is held in position on the elevator with its wheels turning free when the elevator is raised to servicing position.

A steel safety guard drops to vertical position when the elevator is raised, the bottom of the guard resting on the bottom of the sump pit. This guard must be folded along side of the H-beam when the elevator is lowered.

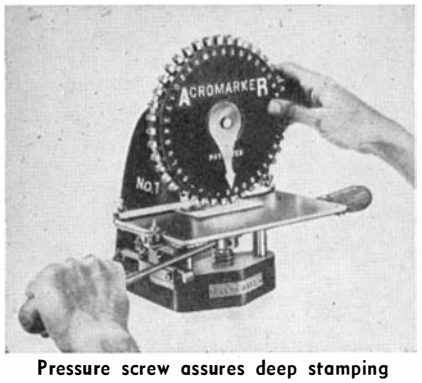
Said to be safer than other arrangements, the Revolvator elevator is raised by forcing oil under pressure into the ram, the same oil cushioning the load when lowered. A lever operated against spring pressure controls the operation both up and down.

STAMPED LETTERS

Easily Impressed in Stainless Steel with Five-Ton Squeeze

AN IMPROVED thread in the heavy "pressure applying screw" of a nameplate and parts stamping machine is claimed to give sufficient power to stamp letters, figures, and other characters into stainless steel to required depth in sizes from 1/16 to 3/16 inch.

When stamping polished stainless steel surfaces, the impressed characters



Pressure screw assures deep stamping

require enamel or other filling for maximum legibility and the deeper stamping permits easy filling of all characters.

Efficiency of operation is claimed to have been engineered in this improved machine, called Model No. 1 Acromarker, in that the right hand may be used to turn the index wheel, while an easy left-to-right swing of the operating lever applies pressure estimated at over five tons. This powerful screw pressure is sufficient to sink the individual characters into low-hardness, heat-treated alloy tool steels, iron and beryllium castings, as well as the stainless and chrome-plated steels used for name plates and machine parts.

WINDOW FAN

Quickly Installed; Gives Large Volume Circulation

RAPID air circulation in small homes, apartments, tourist courts, small stores, shops, offices, and so on is provided by a new 20-inch cooler fan, for window


3500 cubic feet of air per minute

installation, that will exhaust 3500 cubic feet of air per minute, in free air.

Modern in design and finished in ivory enamel to harmonize with modern home furnishings, the fan, according to the Emerson Electric Manufacturing Company, is easily and quickly installed. The latter operation requires only putting two screw eyes in the window jamb, setting the fan on the window sill and raising the window. Plugged into a convenience outlet, the fan is ready for use.

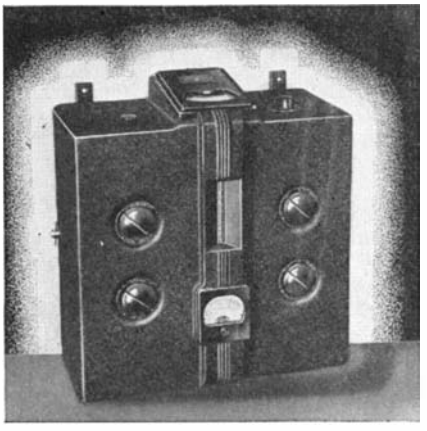
Features include a capacitor motor for quiet, economical operation; blades formed from sheet aluminum for large volume air delivery and quiet performance; and minimum maintenance. Cabinet dimensions are 24 inches square by 9 inches deep, suitable for mounting in any window with a minimum opening of 20 inches square.

GAS IMPURITIES

Detected by Precious-Metal Catalyst

BOTH OXYGEN and hydrogen impurities in gases may be detected and measured with a new dual-sensitive instrument known as the Deoxo Indicator. This device uses a precious-metal catalyst for measuring the presence of oxygen or hydrogen in inert gases—nitrogen, carbon dioxide, and saturated hydrocarbon gases. When required, the indicator can be furnished with a circular-chart type potentiometer-recorder and air-operated controller.

Ruggedly constructed and capable of operation for long periods with little or no attention, the instrument is stated by Baker and Company, Inc., manufac-


Contaminated-gas indicator

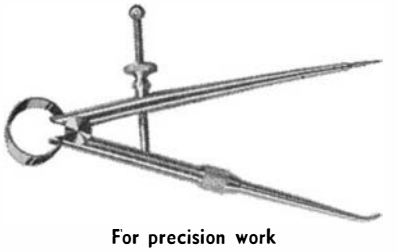
turers, to be suited for both industrial and laboratory use. It indicates the presence of from .001 percent to 1.0 percent oxygen impurities, and tests have shown that the accuracy of indication may be estimated at plus or minus 2 percent of the range in use at any time.

In industry the indicator promises to be useful in many ways. It will check losses resulting from large batches of a product spoiled by traces of oxygen in sintering atmospheres; and it will also help to avoid costly spoilage by detecting and measuring any oxygen impurity in the gases used for filling tubes and lamps. The company's literature states: "Minute quantities of oxygen in the atmosphere of heat-treating and brazing furnaces may result in impaired quality, especially when working with stainless and other alloy steels."

CALIPER

Features Rigidity and Precise Adjustment

A TOOLMAKER's hermaphrodite caliper with round legs, a stiff spring, and a tapered fit between the spool and the legs, is reported to have improved rigidity and other advantages over conventional flat-leg calipers. Precise adjustment is made with the adjusting



For precision work

nut and screw. As described by Nork Products Company, its manufacturer, one leg is reversible by loosening the firm-grip chuck, and the scribing point is easily replaced. Both four and six inch models are available.

CASTING RESIN

Solves Air-Bubble Problem in Complex Moulds

A WATER-LIKE synthetic resin has been developed to eliminate the air bubbles that have often made the production of complex plastics casts extremely difficult. The new version of Plastitool resin, according to Duorite Plastic Industries, cannot retain air bubbles because its low viscosity enables the force of gravity to draw the liquid resin down into a homogeneous mass within a mold.

When completed, the casts are described as having essentially the same strength properties as those made with more viscous resins.

TOOL BITS

Shear Metal; Use Same Grind for Various Materials

SAID TO utilize the principle of molecular cleavage, a pre-sharpened tool bit cuts metal with a knife-like action. Standard in size, the new tool embodies

Pre-sharpened bit takes deep cut

a chip pressure channel which is described as ensuring true shearcutting.

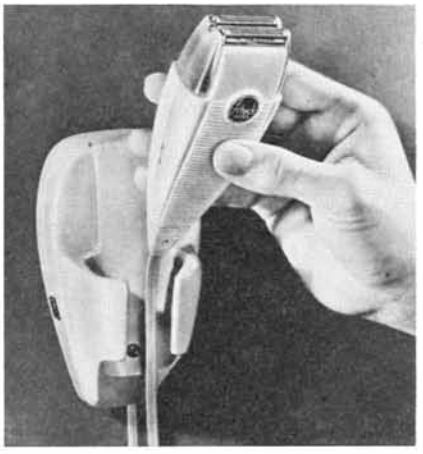
Advantages are claimed to be an elimination of digging in and chattering, a designed-in chip action which tends to keep the cutting edge sharp, and unusual depths of cuts up to three times the nominal size of the tool bit used. Further features are said to include holding precision tolerances with finishing cuts frequently unnecessary, plus adaptability to cutting ferrous and non-ferrous alloys and plastics without changing the original grind.

It is emphasized by the manufacturer, Fearless Tool Company, that with the knife-like action of these tool bits, called Shearcutters, heavier cuts may be taken at higher speeds with reduced heat and machine wear.

SHAVER HOLDER

Supplies Cord from Reel, Attaches to Wall

AN ADDED convenience in electric shaving is a neat, electrically operated, plastics wall holder in which Schick electric shavers fit snugly. A length of electric cord is reeled up inside the Shaverest, extending to convenient length for shaving. After shaving, a touch of the button on the side of the unit automatically reels up the cord. Thus is eliminated dangling loose cords or the need to wind up the cord and place it in the box. With the shaver



Added convenience for shavers

in the wall rest, there is no danger of its being damaged or misplaced.

When the shaver is lifted from the rest, the current is automatically turned on. When the shaver is replaced, the current is shut off. Attachment of the Shaverest to the wall is solid, but it can be taken off easily.

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. **$7.10**

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**

EXPERIMENTAL SPECTROSCOPY — *By Ralph A. Sawyer.* Covers theory and types of spectroscopes and spectrographs, mounting and use of gratings, determination of wavelengths, infra-red spectroscopy, spectrochemical analysis, and so on. Somewhat elementary but requires knowledge of physics and some physical optics. **$5.10**

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**

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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**

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TRIGONOMETRY FOR HOME STUDY — *By William L. Shaaf, 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**

THE FUNDAMENTALS OF RADIO AND HOW THEY ARE APPLIED — *By Henry Lionel Williams.* Good basis for understanding radio equipment. Suggested for general readers and beginning students. **$1.10**

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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.)

SILASTIC FACTS No. 1. Punched for ring binders, this four-page pamphlet describes this silicone rubber which is useful over a temperature range of from minus 70 degrees to plus 500 degrees, Fahrenheit. Its characteristics are described in detail and reference is made to other Facts sheets containing more specific information. *Dow Corning Corporation, Midland, Michigan.—Gratis.*

INSPECTION HANDBOOK FOR MANUAL METAL-ARC WELDING. This 156-page book is based on the requirements and duties of a welding inspector and the methods used for testing welds. The book also discusses weld defects and how they can be detected and corrected. *American Welding Society, 33 West 39th Street, New York 18, New York.—$1.50.*

AIR-DRAULIC CYLINDERS. In 16 pages this booklet outlines a principle which combines the advantages of air and hydraulic cylinders. These cylinders, offered in five standard mounting types (each available in three types of feed control and with three types of piston rod end), are powered by compressed air and provide smooth, uniform, hydraulic-type feed control in a self-contained oil circuit which does not require the use of a hydraulic power unit. *Logansport Machine Company, Inc., Logansport, Indiana. Request catalog 471 on your business letterhead.*

PLYOPHEN PHENOLIC RESINS FOR BONDING AND LAMINATING. This 16-page illustrated booklet contains formulas and descriptions for all RCI Plyophens, technical data and manufacturing information, and photographs of the newest impregnating and laminating processes. *Reichhold Chemicals, Inc., 601 Woodward Heights Boulevard, Chicago 20, Michigan.—Gratis.*

SCIENTIFIC THOUGHT IN THE AMERICAN COLLEGES 1638—1800, by Theodore Hornberger, describes in 108 pages of detail the sketchy scientific courses taught, with their content, in our primitive times, and shows that the average college freshman before 1800 knew less mathematics than the average high-school freshman today. *University of Texas Press, Austin 12, Texas.—Paper covers, $1.00.*

INDUSTRIAL SAFETY CHARTS are folded charts depicting work hazards and dangerous work practices. They cover the following: Safe Practices Around Engine Lathes (Series D); Safety Around Grinding Wheels (Series F); Safe Operation of Metal Shapers (Series G); Use Ladders Safely (Series H); Use Wrenches Safely (Series I);

Use Arc Welding Equipment Safely (Series J); Safe Practices in The Use and Maintenance of Low Voltage Electrical Equipment (Series K); Use Screwdrivers Correctly (Series L); Safe Operation of Punch Presses (Series N). *Superintendent of Documents, Government Printing Office, Washington 25, D. C.—Five cents per chart.*

ELECTRONICS FOR EDUCATION. This eight-page booklet discusses the ways in which electronics can be used in education. Also included is a complete bibliography of publications available to educators. Request booklet EBR-28. *General Electric Company, Electronics Department, Publicity Section, Thompson Road Plant, Syracuse, New York.—Gratis.*

PRACTICAL PROSPECTING, by Barry Storm, is a 32-page pocket manual of electronic prospecting for the modern counterpart of the old "sour-dough," using the Fisher Metallscope. *Southwest Publishing Company, Tortilla Flat, Arizona.—$1.00.*

INSTRUMENTS FOR MEASURING LOW RESISTANCE is a four-page folder which outlines the following Megger instruments for measuring low resistance: Bridge-Meg resistance tester, a combination Wheatstone bridge and Megger insulation tester; Ducter low resistance ohmmeter, which operates by pointer deflection down to .000001 ohm; and the midget Megger circuit-testing ohmmeter, which reads from a fraction of an ohm up to 20,000 ohms. Request bulletin 1805. *James G. Biddle Company, 1211-13 Arch Street, Philadelphia 7, Pennsylvania.—Gratis.*

WHY A RIVET WENT NUTS. This entertaining 10-page booklet is based on the development of the Rivnut. Given this name because it can serve both as a rivet and nut plate, it was originally made only in aluminum for the aeronautical industry. Now it is furnished in brass, steel, and stainless steel, and in various styles. *The B. F. Goodrich Company, Public Relations Department, Akron, Ohio.—Gratis.*

THE G-R TWIN G-FIN SECTION, a 16-page bulletin, is based on the characteristics of the Twin G-Fin section as a universal heat exchanger and its many applications in cooling, heating, condensing, and heat-exchange service. Installation views are shown and field reports of service are given. Request bulletin 1614. *The Griscom-Russell Company, 285 Madison Avenue, New York 17, New York.—Gratis.*

TELEVISION TALK is a 64-page, cartoon-illustrated booklet designed as a ready reference for television broadcasters. Compiled from the workaday language of television engineers and production units, it contains about 250 commonly-used television terms and their definitions. New terms and their definitions will be included in succeeding editions. *NBC Television, 30 Rockefeller Plaza, New York 20, New York.—Request this booklet on your business letterhead.*

Our Book Corner

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THE ENGINEER IN SOCIETY

By John Mills

WRITTEN out of 45 years of observation of engineers and scientists in action, and mellowed to a corresponding extent, this is a compact and intellectually stimulating book. Valiantly it attempts to place careers in science and engineernig in a proper perspective so that the reader can evaluate arguments, pro and con, on the subject of the participation of these groups in our political and economic society. In essence, the text is a many-pronged plea: It argues for the betterment of the financial lot of scientists and engineers; for these groups to organize for their own advancement; for broader recognition of technology as the basis of all human endeavor; and for a clearer understanding of the scientific method in thought and action. This book is decidedly recommended reading for those striving to select a career; those already engaged in technological pursuits; and particularly for those who do not fully comprehend the present and potential place of scientists and engineers in society. It expands fully on the item "Science *Versus* Politics" appearing on page 4 of this issue of Scientific American. (196 pages, 6 by 8½ inches, unillustrated.)—$2.60 postpaid.—*A.P.P.*

AUTOMATIC WEAPONS OF THE WORLD

By M. M. Johnson, Jr. and Charles T. Haven

COMPLETELY revised and up-to-date to encompass the multitude of automatic weapons used by all nations in World War II, as well as automatic weapons used since the original crude inventions that presaged this type of armament, this book might be termed an encyclopedia. History, development, working mechanisms, and theories of operation are comprehensively covered. Strategic problems involving automatic arms and the reasons underlying the development of the many types are carefully analyzed and presented in an interesting and readable manner. Probably the most outstanding feature of this book is its thoroughness; both sides of the many arguments surrounding these arms are presented in a dispassionate fashion. Recommended for general readers, collectors, hobbyists, ordnance personnel, police, or others whose interests or vocations indicate a need for a complete knowledge of automatic firearms. A great deal of ballastic data and recommendations for trouble-shooting malfunctioning weapons are also included in this omnibus of armament. (644 pages, 6½ by 9½ inches, elaborately illustrated with half-tones, diagrams, tuck-in drawings, and line-cuts.)—$7.75 postpaid.—*E.F.L.*

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By Edward Podolsky

WAR HAS emphasized the swift advances of medical and surgical techniques and, with compelling force, has brought many developments to fruition that might have remained years longer in the laboratory and clinic under less urgent necessity. All of these now assume vital roles in the peace-time battle to conquer disease and to prolong life. Dr. Podolsky writes entertainingly yet with authority about these signal victories of the healing art. The whole is a series of fascinating essays on that most fascinating of all subjects—our own health. One's curiosity is whetted by the word "steel" in the title; it refers to steel instruments used by today's surgeons. (384 pages, 6 by 9½ inches, illustrated.)—$3.85 postpaid.—*D.H.K.*

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By G. Edward Pendray

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By E. C. Crocker

AN EXCELLENT reference book on the various aspects of flavor. Well organized, the book starts with an explanation of the elements of the perceptions involved in sensing flavor. The chemistry of flavoring agents and condiments and the physical means for stimulating or repressing the respective sensory factors to attain a desired flavor objective follows and leads into the subsequent discussion of prevention of undesirable or off-flavors. Intended

for food technologists, the book is both practical and theoretical. The general reader will find it interesting, and while not directed towards the recipe field, those to whom cooking is a science as well as an art will find it worthy of study. (172 pages, 5½ by 8½ inches, 33 half-tones, numerous charts, reference tables.)—$2.60 postpaid.—*E.F.L.*

NEW CAREERS IN INDUSTRY

By John M. Amiss and Esther Sherman

INDUSTRY, because of its growing complexity, creates new jobs of kinds which were entirely unknown only a couple of decades ago. The tendency toward greater and greater subdivision of labor, and its consequent continually increasing specialization, became especially pronounced within the past decade. Now, the new opportunities are being eagerly sought. The authors assay mechanical industry for its possibilities of careers for youth today and come up with a tidy list of potentialities, all worth investigating. One might characterize the book as a guide to new vocations, just now much needed. (227 pages, 5½ by 8 inches, illustrated.) —$2.60 postpaid.—*D.H.K.*

LUMINOUS TUBE LIGHTING

By H. A. Miller

UNDERLYING principles of luminous tubes for lighting purposes—as distinguished from incandescent bulbs—are briefly but clearly outlined here for electrical engineers, contractors, physicists and research workers, and students who wish to acquire an up-to-date knowledge of the subject. Materials for the construction of lamps are thoroughly discussed, as is also manufacturing equipment. (143 pages, 6 by 9 inches, 78 illustrations, well indexed.)—$3.60 postpaid.—*A.P.P.*

PLANNING YOUR HOME FOR BETTER LIVING

By Clarence W. Dunham and Milton D. Thalberg

COMBINING a considerable portion of the best of the ideas, innovations, developments, and general home building lore that has lain fallow over the past few years, this book is interesting and instructive reading for all with a personal or business interest in residential construction. Fundamental to the book is the "planning with a reason" theme. Starting with a commonsense presentation of the pleasures—and problems and responsibilities—of home ownership, the book follows along the steps of land choice, purchase, formulating a general home plan, and so on. The balance of the text treats the specialized considerations of each room, heating, electrical, and decorating schemes, and exterior landscaping. Legal matters and financing are given attention, as is the matter of supervising the actual construction of the building. (278 pages, 7½ by 10 inches, thoroughly illustrated with many diagrams, floor plans, and photographs.)—$4.10 postpaid.—*E.F.L.*

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"

CYRIL G. WATES, Edmonton, Alberta, Canada, before his recent lamented death, wrote the description which follows:

"In 'A.T.M.,' page 275, F. J. Sellers describes a simple drive for small telescopes, which is based upon the principle of a weight to perform the work, and a clock to control the speed. Several years ago H. Boyd Brydon, of Victoria, B.C., a member of the Royal Astronomical Society of Canada, greatly developed Sellers' drive, improved it to the point where it has become an ideal drive for the amateur of limited means and average mechanical talents, and described it in Volume 37 of the Society's *Journal*.

"The Brydon drive (Figure 1) involves the use of two worms engaging with a single worm gear, a principle which is believed to be completely new, despite Solomon's dictum to the contrary. In the drawing the drive has been cut down to the barest essentials, omitting such features as idlers, hand control and so on, which may be devised by the builder to suit his own tastes. The drawing shows the view straight down the polar axis, to which is secured the large wheel *W*. A length of braided brass (or steel) picture wire is secured at *P* to the roller *R*, around which it is wrapped five times, thence passing twice around *W*, again five times around *R*, but in the reverse direction, finally passing under the pulley to which is suspended the weight.

"*R* is free to turn on its shaft, except for the friction of the spring-operated clutch. With the clutch out of engagement, the weight would turn the telescope from east to west. On the roller shaft is the worm *A1*, engaging with the worm gear *G*, which may be of any convenient size. Disregarding for the moment the second worm, *A2*, it will be seen that the weight will turn the roller *R*, which in turn will drive the worm *A1* and the gear *G*. However, the second worm *A2* locks the Gear *G* and prevents any of the parts from moving under the influence of the weight. Nevertheless, the telescope may be moved freely in right ascension by hand, since the clutch will slip and the roller turn without affecting the worms or the worm gear.

"The shaft to which *A2* is secured is attached in turn to the winding key of an ordinary alarm clock. In most such clocks the key makes one turn in six hours. Therefore, if the roller *R* is made exactly one fourth the diameter of the wheel *W*, the telescope will move at the rate of one revolution in 24 hours. The clock is, of course, adjusted to keep speeded sidereal time.

"Important features of the Brydon drive are the fact that the clock does no work whatever and that the smoothness of motion is independent of the accuracy or fit of the gears, since the weight automatically takes up all lost motion. In the original design, connection between the worm *A2* and the clock is by means of a simple jaw clutch fitting over the key, but we venture to suggest that *A2* be secured to its shaft by a lock nut. The right-hand end of the shaft may then be permanently attached to the clock by threading or, better still, by means of a simple universal joint. The clock may be wound at any time by loosening the lock nut and turning the shaft by a suitable key.

"As stated, the drawing is diagramatic. In the complete drive the cords cross below *W*, pass over idlers and thence to the roller, which is only a few inches wide instead of extending right across the diameter of *W*."

When replying to a question put to him by this department, Brydon commented as follows on his drive: "You might suggest the desirability of fitting a pawl to prevent the wheel between the two worms from turning backward, or trying to, and thereby putting an enormous end thrust on the worm attached to the clock. This happened in one instance. I think the trouble was too great friction in the friction plates. It can happen when the telescope is turned back toward the east, and a pawl is a safety factor."

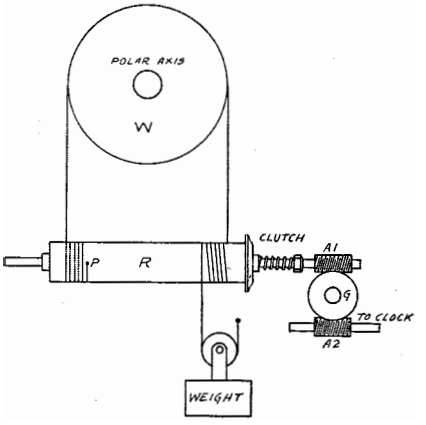

Figure 1: The Brydon drive

LEO J. SCANLON of Valley View Observatory, 106 Van Buren Ave., Pittsburgh 14, Pa., writes: "I've recently had occasion to make some four-bar spiders and have devised an adjustment feature for secondary mirror supports which I've never seen before. It works fine and has provision for centering the diagonal in the tube and a tilting arrangement that's simplicity itself. For the parts I went to the bathroom."

The sketch, Figure 2, is almost self-explanatory. The four fins of the diagonal support are attached to a piece of ¾" brass pipe 2" long. Within this is a length of ¼" thread rod (from closet tank float ball). It is held by two brass dome nuts (used to hold closet bowl down to floor) tightened against two 1" iron washers. These are not attached to the brass pipe but held there by tension and friction alone.

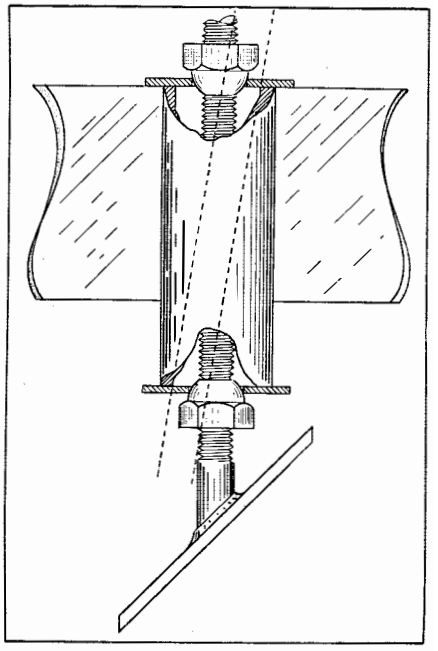

Figure 2: The bathroom secondary

The dotted line indicates extreme adjustment possible. Shifting the washers laterally permits tilting the diagonal (if the shifts are opposite) or centering it in the tube. The nuts afford a longitudinal adjustment in the tube, and the diagonal may be rotated.

SILVERED MIRRORS are believed to be largely extinct—but how largely? There is an Old Guard who stick to straight razors, stiff collars, shirt tails worn inside, and silver coatings, and continue to swear by them all. In "A.T.M.," page 102, Ellison tells how silvered mirrors may be protected from tarnishing, by means of a loose pad of blotting paper. F. J. Hargreaves of England has an even better method. He cuts out a disk of ¾" corkboard, dishes it to the mirror's curvature, shellacs it and allows the shellac to dry. Then he cuts out an equal circle of wash leather (chamois skin), lays it on this disk, temporarily lays a piece of clean paper over it, and through this he presses it on the shellac with a hot iron.

He finds that, unless the chamois is everywhere in firm contact with the silver, the latter will tarnish, also that this contact does no harm to the silver.

As a check test, he removed a central circle from the chamois, choosing the

area that lay behind the diagonal of the telescope, and watched the gradual effect. That patch later showed up as a round "tonsure." Tarnish.

Chamois skin is hygroscopic—thirsty—not alone when on the mirror but when off during observation, and therefore must not be given a drink by being left in the open during those intervals.

EVERY YEAR Westinghouse systematically searches out native talent in science among high school seniors the nation over and awards 40 scholarships, two for $2400, eight for $400, and 30 for $100, at colleges of winners' choice. This year by written competition Westinghouse boiled down some 16,000 applicants to 40 finalists and brought the 40 to Washington, D. C. for further boiling and entertainment.

This department was agreeably surprised, yet not surprised, to find among the 40 a keen youth with whom it had exchanged letters on things telescoptical—Kenneth Widing, 611 N. Fifth St., Brainerd, Minn. When Widing reached Washington he too was agreeably surprised to find that, of the 40 telescope making finalists present, six were amateur telescope makers and a seventh, a young lady, had started telescope making when given a refractor. Of the seven TNs, three won $400 scholarships and four won $100 scholarships; but after Westinghouse puts a finger on this promising material, various colleges usually volunteer additional offers.

Some time ago with the (easy) catalytic help of this department, three wartime Roof Prism Gang "alumni," learning that polio had left Widing one-armed, laid an RFT on his doorstep. English of St. Paul dug up a spherical mirror, Broadhead of Wellsville, N. Y., parabolized it, and Johns of Larchmont, N. Y., using long probes in his shop for the search, located an RFT mounting under nine strata of post-Paleolithic telescoptical accumulations such as you, too, probably have.

Telford of Florida has helped Widing with advice on a fairly good mirror of *f*/8 type which he has made one-handed, but the mounting proves to be more of a problem, a sketched-up affair. Who will send this lad a good mounting for that general-purpose type of telescope? For insight, try putting it in shape with one hand behind you. There must be scads of them lying unused, supplanted by newer jobs.

Asked what originally aroused his scientific bent, as revealed by Westinghouse, Widing replied: "Telescope making was my source-inspiration and I'm a TN for keeps."

TOUCHING a point hinted at above is an appeal from Professor Charles H. Smiley of the Department of Astronomy at Brown University, Providence, R. I., president of the American Association of Variable Star Observers, who seeks recruits for this application of telescopes made by amateurs. He writes:

"What becomes of all the telescopes made by amateurs? Ingalls has said this question is as difficult to answer as that better-known question, 'What becomes of all the pins?' In an effort to determine whether possibly some of the telescope makers eventually use their telescopes for regular observations, I wrote ten letters to members of the American Association of Variable Star Observers reputed to have made telescopes. The replies told me of ten members who, together, have made 33 telescopes. In addition, these persons have suggested 14 more telescope makers in the organization.

"In the following list of the ten mentioned I include only the largest telescope made by each, with apertures and focal lengths rounded off to the nearest inch.

Prof. Walter Moore, University of Louisville, Ky.	12"	*f*/3.5
F. E. Ellis, Cambridge, Mass.	11"	*f*/7.6
W. S. Houston, Moundsville Ala.	10"	*f*/8.6
R. W. Hamilton, Norwalk, Conn.	10"	*f*/6.7
S. F. Thorpe, Louisville, Ky.	10"	*f*/5.4
Miss Martha E. Stahr, Wellesley College, Wellesley, Mass.	8"	*f*/6.4
E. A. Sill, Mamaroneck, N. Y.	7"	*f*/14
R. A. Seely, New York, N. Y.	6"	*f*/10
S. Park, Fall River, Mass.	6"	*f*/7
F. J. Kelly, Fall River, Mass.	6"	

"The A.A.V.S.O.," Prof. Smiley continues, "is an organization having 290 members in the United States and 16 in foreign countries. They observe regularly the magnitudes of stars known to be variable in brightness, and periodically report to the Recorder, Mr. Leon Campbell, at Harvard College Observatory. In the near future, the combined members will have completed their millionth observation. Performing well a task which would otherwise fall upon professional astronomers, these amateurs are providing the basic material on which important researches on variable stars will be made in the coming decades. Persons who think they may have some talent for the observation of variable stars may obtain information concerning the A.A.V.S.O. from Mr. Campbell at Harvard College Observatory."

STELLAFANE CONVENTION of amateur astronomers, telescope makers, and of telescopes, will be held this year on Saturday and Sunday, August 3-4. The evidence is that this time more of all three categories will hit the Stellafane trail a resounding whack than ever before, and if you are not bringing a tent or otherwise sure of accommodations, reserve them before July 1. Try Hartness House or Adnabrown Hotel, both Springfield, or Windham Hotel, Bellows Falls or Fullerton Inn, Chester—all Vt.

Porter expects to come east for the meeting—has done nothing but write about it for months. (He has also been told that a D.Sc. degree is to be conferred on him but not at Stellafane, so when you see him there he'll be Doctor Porter but still the same Porter.) Bring your telescopes; everybody else does.

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