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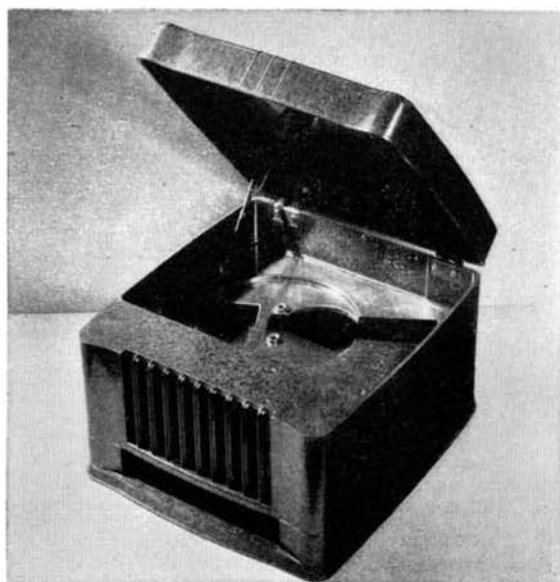
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Blower Blast Tests Engine Cooling . . . See page 145



INTERESTED IN LARGE PLASTIC PIECES ?

Dispelling the time-worn theory that large molded plastic pieces are impractical and uneconomical, these Admiral phonograph and radio-phonograph cabinets effectively demonstrate that large products as well as small can be molded of Durez phenolic plastics.

The bigger cabinet (right) when assembled contains a five tube radio and automatic record player. The molded Durez body weighs 9½ pounds and the cover 3½ pounds. This makes a total cabinet weight of only 13 pounds.

Radio Frequency Preheat

Compression molded in a 400 ton press, the special Durez compound used in this larger unit is preheated by radio frequency. This modern method of production facilitates the

molding operation considerably and results in the strong, attractive cabinet shown.

The smaller unit, Admiral's automatic record player, is also molded of Durez but in a 300-ton press.

Why Plastics?

The progressive Admiral Corporation experimented and found that for top quality cabinets of this type—having light weight and an integral, lustrous finish, plastics were better suited than any other material.

Why Phenolic Plastics?

The excellent moldability, impact strength, eye-appealing finish, and the non-resonance of phenolic plastics proved the decisive factors in the choice of these most-versatile-of-all-plastics.

Why Durez Phenolic Plastics?

As specialists in the production of phenolic plastics for the past quarter century, the Durez staff have developed more than 300 multi-proprietary Durez phenolic molding compounds from which to select the plastic that precisely fits the job.

Write for Free Booklet

"Machining Data on Phenolic Plastics" is an informative manual which covers all the standard machining operations encountered in the average plant. Write for your free copy. No obligation, of course. Durez Plastics & Chemicals, Inc., 14 Walck Road, North Tonawanda, New York. *Export Agents: Omni Products Corporation 40 East 34th Street, New York 16, N. Y.*



PHENOLIC
RESINS

MOLDING COMPOUNDS

INDUSTRIAL RESINS

OIL SOLUBLE RESINS

PLASTICS THAT FIT THE JOB

Scientific American

Founded 1845

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Our Cover: A huge blower at the NACA Aircraft Engine Research Laboratory (see page 164) produces an air blast of 250 miles per hour, permits ground testing engines at maximum take-off power, and eliminates the dangers of take-offs with untried engines. It is also valuable in research on such problems as cooling of newly developed power plants.

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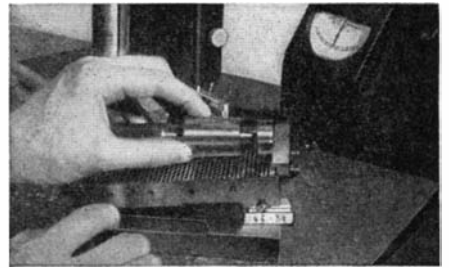
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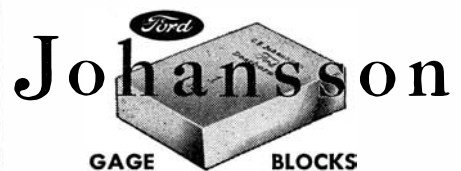


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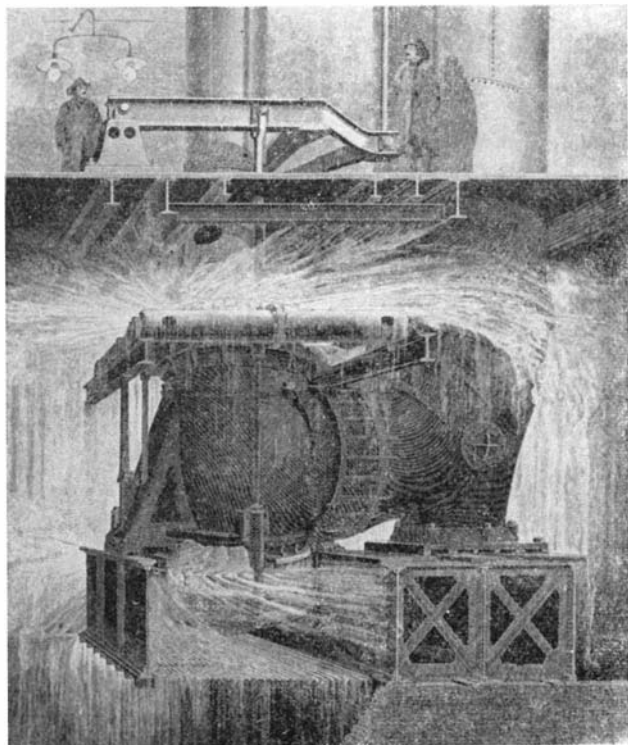


SCIENTIFIC AMERICAN

(Condensed from Issues of April, 1896)

FOCUSED X-RAYS — “The sharpness of the image obtained in photographs with a new tube for producing X-rays is due to the fact that the cathode rays are focused to a point where they impinge on a plate of platinum fixed on the anode.”

NIAGARA — “From many points of view the development of the power plant at Niagara Falls is of special interest. The undertaking from its outset was conceived on original lines, and even in the purposes to which it is applied, such as the production of aluminum, of calcium carbide, and of carborundum, there are elements of novelty and interest. . . Below the solid floor, and directly beneath the dynamos, a great rectangular pit descends nearly two hundred feet through the solid rock. Near the bottom of this pit the 5,000



horse power turbines are established. . . The wheels are double Fourneyron horizontal turbines, one placed vertically over the other, the upper one being inverted. . . The water delivered by the penstock enters the space between the wheels, which is inclosed by a casting, constituting a sort of drum. About half of the water rises and, rushing out through the upper wheel, actuates it, while the rest of the water drives the lower wheel. . . The vertical shaft which transmits the revolutions of the wheel to the dynamo is of sheet steel riveted-up to form a tube 38 inches in diameter.”

ACETYLENE — “M. H. Moissan finds that cerium carbide produced in the electric furnace yields when treated with water seventy-five per cent of acetylene, with much methane and some ethylene.”

MINES — “At the greatest depth ever attained by miners in the history of the world, the mines in the vertical Red Jacket shaft of the Calumet & Hecla copper mine have recently stopped sinking at a depth of 4,900 feet, as this is

the required depth necessary for this company to reach the limit of its underground territory. Bored wells have been carried down to a greater depth, but the Red Jacket shaft is the largest and best constructed mining shaft in the world.”

ANIMALS — “According to statistics published by the Department of Agriculture at Washington, the aggregate value of farm animals in the United States has declined very materially in recent years. At the present time the value of these animals is \$755,580,597 less than it was in 1893.”

INVENTION — “The true standard of invention should rest upon the broad basis of public service or utility and not upon a mere nebulous idea which the inventor has failed to develop.”

GAS — “The possibility of supplying cheap gas to the people is one of the live questions of the day; and it has largely sprung out of the competition between the great gas and electrical industries. Additional prominence has been given it of late by the rapidly increasing use of the gas engine, and by improvements in its design.”

ALUMINUM — “According to researches of Lord Kelvin, the conductivity of pure aluminum is 68.5 per cent of that of pure copper. The usual conductivity, as given in the books, hitherto has been 56 per cent that of copper. . . As a conductor, aluminum is now about twice as costly as copper; but by the electrolytic process the price has already been reduced in eight years from 90 cents per ounce to 35 cents per pound.”

AERONAUTICS — “The Boston Aeronautical Society was organized May 2, 1895. . . The objects of the society are to encourage experiment with aerial machines and to disseminate knowledge concerning the great problem of aerial navigation.”

SCIENTIFIC AMERICAN

(Condensed from Issues of April, 1846)

STEAM ENGINES — “The extensive engine manufactory of Mr. Wm. Burdon, of Brooklyn, is probably not excelled by any establishment in the United States. . . Mr. Burdon has now 60 engines constructing and nearly finished, of from eight to sixty horse power.”

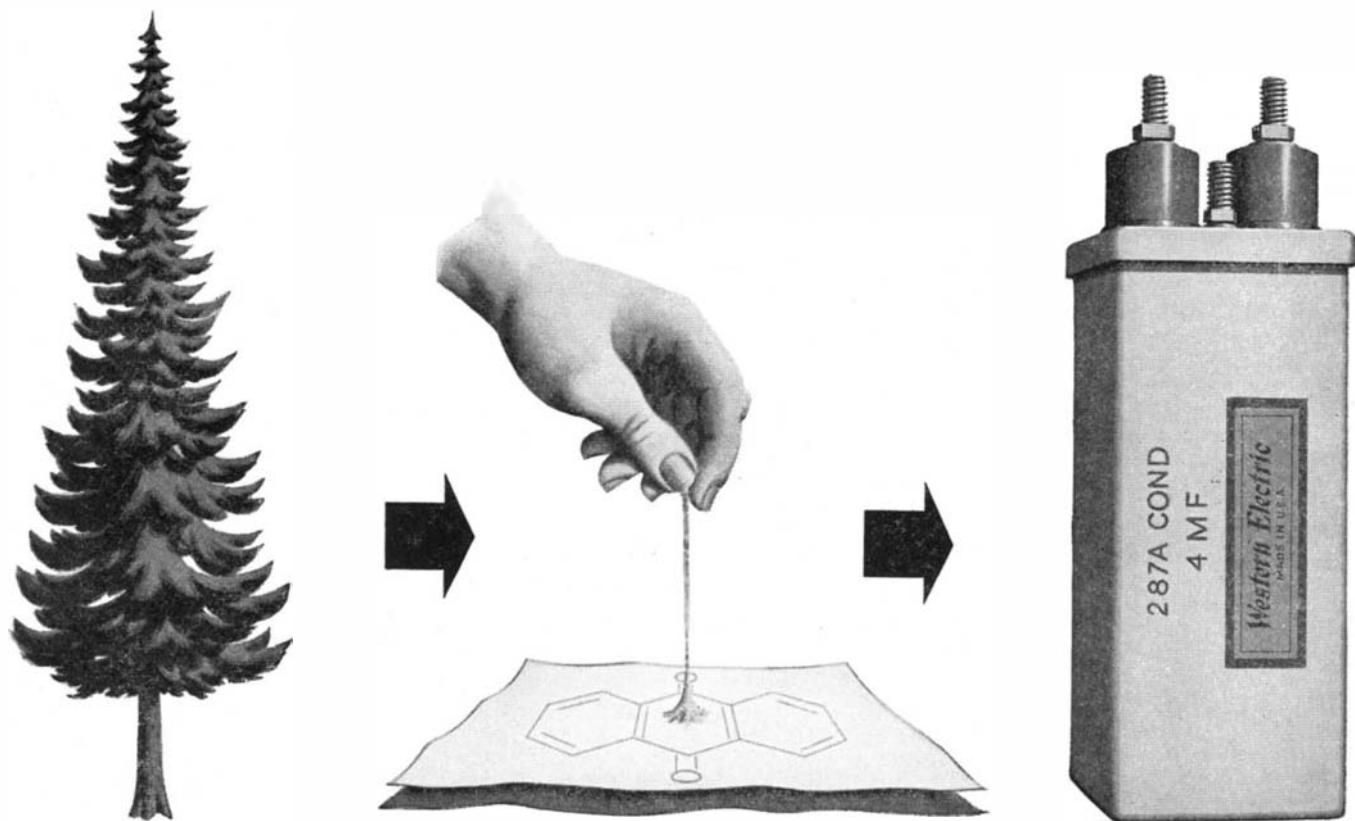
RAILROADS — “Three of the principal railroads running from Boston are now made to connect in such a manner that the cars of one road may run on to the track of another. It would afford a great accommodation to travellers if all seven of the railroads could be connected.”

STEAMBOAT — “The steamboat Oregon is in length 330 feet by 35 feet width of beam, and of 1,000 tons measurement, having berth accommodations for about 600 passengers. . . The propelling power consists of an engine of 1,100 horse power, with a 72 inch cylinder and 11 feet stroke.”

SALVAGE — “A party of working men are engaged with a diving bell, at New Orleans, in recovering the cargo and machinery of the steamboat Dr. Franklin.”

VACUUM — “Timber of any kind, fruit or other articles may be much more rapidly and effectually dried and seasoned in vacuum, than in air.”

LIFE-EXTENSION BY THE GRAM



CRUCIAL links in every wire and radio system are paper capacitors — rolls of impregnated paper and metal foil. At least one is in every telephone — and more than 100 million are in the Bell System. A single failure can sever a telephone call, put a costly line out of service. So finding out how to make capacitors stand up longer is one of the big jobs of Bell Telephone Laboratories.

All-linen paper was once the pre-eminent material. Then wood pulp was tried — and found to last longer

under heat and direct voltage. But why? Something in the wood was helping to preserve life. What was it?

Ultra-violet light, delicate micro-chemical analysis and hundreds of electrical tests gave a clue. Researchers followed it up—found the answer by treating the impregnated paper with anthraquinone—a dye intermediate. A mere pinch of the stuff prolongs capacitor life by many precious years.

When war came, great quantities of capacitors were needed for military

equipment, where failures could cost lives, lose battles. The Western Electric Company, manufacturing for the Bell System, willingly disclosed the life-preserving treatment to other manufacturers. Today in communication capacitors, the new “life-extension” is helping to give more dependable telephone service.

Day by day, resources of this great industrial laboratory are being applied to perfect the thousands of components which make up the Bell System.



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

Previews of the Industrial Horizon

WRAP IT UP

MORE goods will be packaged in new, more attractive, or more practical wrappings in the near future than ever before. A number of industries have learned a lot about the mechanics of packaging in the past few years; they are finding out now that a properly packaged product will attract a greater number of purchasers than one that is offered "raw" or poorly packaged. And this applies equally well whether the wrapping serves an obvious purpose or not.

There is hardly a product of industry—from nails to hydraulic presses, from socks to shirts, from frankfurters to fresh lettuce—that is not today receiving attention from manufacturers of packaging machinery. The surface is just being scratched. Elementary to the all-inclusive problem is the axiom that packaging must not increase the final cost appreciably—or, if it does, that it must offer instantly appreciated advantages that offset any increase.

One of the fields that is now being explored is the high-speed packaging of textiles. Machines are being developed that will wrap in cellophane or similar material such things as women's and children's underwear, men's shirts, pillow-cases, and linens. Displayed in their transparent wrappings, these goods reach the consumer dust-free and unsoiled.

In pre-packaging fresh vegetables—cleaned, trimmed, and wrapped in open-face trays or simply in transparent bags—machines are reaching new highs in efficiency and ingenuity of design. So, likewise, are retail sales of the vegetables.

Operation of many of the new packaging machines is more than human. They work faster and more accurately than human hands, do not tire, and frequently do multiple jobs that could manually be done only at great expense. For example, there is a machine that will open a collapsed carton, fill it, close the lid, and pass it along for final wrapping. Another device will glue and close the tops of shipping cartons.

Competition of packaged goods is growing keener every day. And keeping at least a step ahead is the perfection of packaging machinery that operates at increasingly higher speeds and is easier to supervise and maintain.

FUN AT WORK

NO COMPANY is too large or too small to indulge with profit in that form of labor relations which provides recreation in one form or another for its workers. The program need not be as comprehensive as Eastman Kodak's, where three and a half million dollars are being spent on a recreation building for employees. It may be merely a horse-shoe pitching ground; or a game room for cards, checkers, darts, and the like; or an athletic field; or even a small theater for employee-produced plays. No matter what form it may take, it will—if properly managed—**increase the interest of employees in their work, foster loyalty to the company, and frequently reveal unsuspected qualities of leadership.**

ENGINES TO THE REAR

ALWAYS an advocate of breaking with tradition, when tradition stands in the way of technological progress, automotive-and-airplane-engineer William B. Stout still plumps strongly for rear-engine motor cars. Urban buses have proved the mechanical feasibility of rear-engine vehicles. Now, according to Mr. Stout, rear-engine motor cars can be produced just as soon as the public demands. Advantages of designs already made include the roominess of large vehicles, the economy of small cars, and the feasibility of using removable engines which will contribute materially to low maintenance costs.

Over a period of eight years a Stout rear-engine car has been driven some 200,000 miles. Tests have shown the

By A. P. Peck

superiority of the design in such matters as traction and steering, and the advantages of a low center of gravity that go along with the rear location of the engine. These factors, coupled with the obvious possibilities of better utilization of space in the interior of the car, should make a strong bid for the public demand which Mr. Stout seems to see on the horizon.

COAL IN GAS TURBINES

PRESENT research is aiming at the use of pulverized coal—of the fineness of talcum powder—as a fuel to operate gas-turbine locomotives. If the problems involved are successfully solved, it appears possible to reduce fuel requirements to about 25 percent of the consumption of today's standard locomotives. Big drawback to the use of solid fuel in gas turbines has been the ash. Now, with finely powdered coal, burned under pressure, the resulting ash is removed by **mechanical separators of the cyclone type.**

If coal-burning gas turbines are perfected, as seems likely, they will have great advantages in economy and where adequate water supplies do not exist.

SOAPLESS SOAPS

SOME four billion pounds of soap are sold in the United States every year. Here is big business. But a bite is being taken out of it by "soapless soaps"—detergents that do a better job than soap and without some of soap's shortcomings. The bite is small thus far. Capacity for making the new chemical detergents is only about 100,000 pounds a year, but expansion now underway points to a possibility of producing close to 400,000 pounds annually in the not far distant future.

Big disadvantage of soap is that, while it emulsifies dirt and grease and holds them in a water suspension, it at the same time forms insoluble salts with the minerals in hard water. These salts are evidenced by the ring in the bathtub, and the difficulties of thoroughly rinsing many soap-washed materials.

The soapless-soaps, on the other hand, form soluble salts. No ring around the tub; easy rinsing of washed materials. Then, too, they are more powerful in their detergent action than ordinary soap, yet are harmless to the skin or to the materials on which used.

Although there is no foreseeable prospect that these newer detergents will ever completely replace soap, their possibilities are tremendous. Even a 10-percent bite of present soap sales will put soapless soaps in the big-business class.

FOR FUTURE REFERENCE

LOOK for more intelligent applications of existing plastics as the result of a long-range research program now underway at Massachusetts Institute of Technology; objective is a better understanding of the fundamental engineering properties of plastics. . . New midget batteries offer compact power source for low-current demands; they promise a mild revolution in hearing-aid and small radio field, particularly in portable transmitter-receiver units. . . Synthetic rubber production will remain an essential peace-time industry. . . Captain Eddie Rickenbacker offers the ingenious suggestion that atomic bombs be used to blast through the ice covering Antarctica and thus permit exploration of already proved mineral possibilities.

ENGINEERING

Quality Control Creates Jobs

By EDWIN LAIRD CADY

With an Increase in Facilities for Quality Control, Engineers Have at their Command a Powerful Tool for the Creation of More Jobs and New Industries. Materials, Methods, and Machines All Contribute



Controlled metal qualities permit contour engineering for best strength-weight ratio in aircraft engine parts

A FEW SHORT years ago the windows of certain loft buildings in New York were occupied by men who put large bolts of cloth on overhead mandrels and slowly pulled the fabric down, looking through it at the light and searching for flaws. Their job was to look for faulty quality control on the part of the weavers, although they would have told an interviewer that they were keeping flaws out of finished garments.

Garment makers made claims against the textile mills on the basis of the number of flaws found, and often shipped bolts of cloth back for credit. This led to a chain of events.

The textile mills put in thousands of loom stop motions, electrical devices which would shut off a loom instantly if a thread broke. The thread could be tied and no "run" or flaw would appear in the finished cloth. Speed controls and other flaw preventers were installed also.

Now the fabric inspectors disappeared from the windows. They were needed for other jobs, such as cutting up many layers of fabric at one time.

This multiple layer cutting came on as fast as the development of flaw elimination would let it. Given flawless cloth, a cutter could cut 20, 60, or even 100 layers at a single pass of his machine, thus produc-

ing perfect pieces for sewing. But so long as it was possible that a flaw would be found in one of the middle layers, the number of layers had to be kept down so the cost of finding and eliminating the faulty one would not be too high.

As the economies of flaw-free fabrics made themselves felt, the prices of finished garments went down until the housewife no longer could make garments as cheaply as she could buy them. But in the meantime things were going on in the textile labor situation and consequently in the national economy.

MORE JOBS—The installation of the flaw-preventing automatic devices meant that men did not have to watch the looms so carefully and one man could run more looms. Soon, 75,000 men could run the same number of looms that formerly had needed 125,000, and 50,000 men were looking for new jobs.

Now, something else was happening among the garment workers. With flaw-free cloth they could make so many garments and sell them so cheaply that their employment went up. Where in the old cloth inspection days they had employed a maximum of 60,000 workers, they now needed a minimum of 400,000. In the whole chain of production which started with the spinning and ended with the

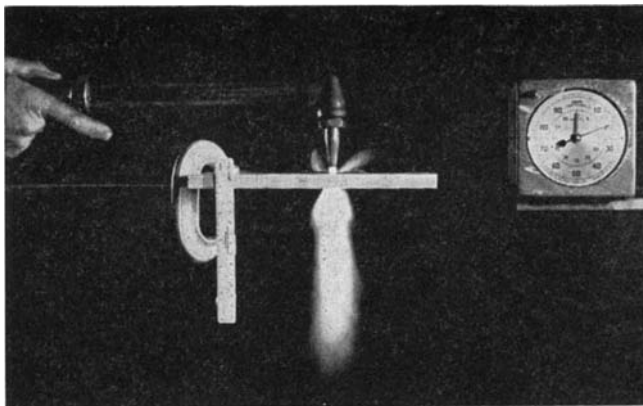
● LOOKING AHEAD ●

Strongest single force in industry is quality control . . . Better end products, at lower cost, can be obtained . . . And employment can be increased at the same time . . . Full control requires scientist-engineer co-operation . . . Product quality can be influenced by extension of new processes now available.

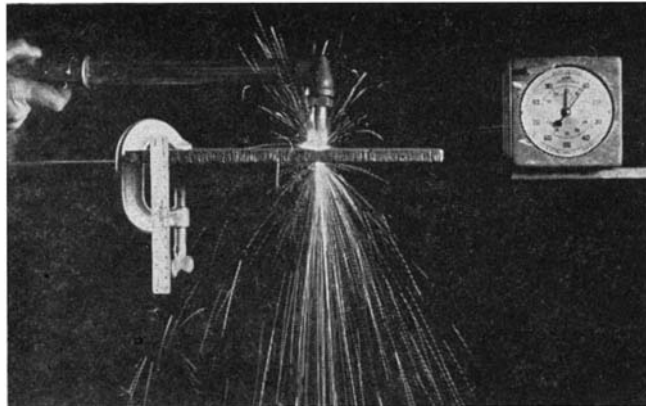
finished garments the gain in jobs was 340,000, the loss 50,000, the net gain 290,000.

Add to this the fact that the jobs in garment industry were much more highly paid than those of the loom workers, and that the distribution of those garments created tens of thousands of jobs in transportation and in retail stores alone, and the complete picture takes form of what quality control has done in one industry. There are, of course, back-ground items like the sale of thousands of electric motors and the building of huge industrial plants to make new equipment for the quality controlled industry.

One of the troubles with quality control is that it may take a long time to make its real effects apparent. Anyone discussing it is almost forced to talk about its 20-year effects in the textile industry or its 10-year effects upon the strip steel and the stamping industries. Its



An oxyacetylene torch takes twice as long to cut through a half-inch panel of wood treated with methylolurea (because of the



low heat conductivity of the material) as through a half-inch steel plate. Such known factors are important in all design

short-term effects often are confusing. And industrial managements are mostly interested in short-term, "right-now" effects.

WHAT IS "QUALITY"? — Another trouble is that although everybody knows what "quality" means, the wisest men of the centuries have been unable to define it. Aristotle toyed with it and wound up by including it as one of his categories; Cicero fumbled it like a wet football; a standard dictionary can do no better than "definitely and characteristically superior for a specific purpose;" one engineer said "a quality product has everything needed for its purpose, and in addition, is free of flaws and variants so you can trust it;" another engineer said "quality control is the business of adding to the costs of your first operations in order to reduce the costs of your last ones."

Whatever the ultimate definition

of "quality" may be, quality control is the strongest single force in industry. It is the most common meeting ground of the engineer and the scientist. Far more research is devoted to problems of quality control than to finding brand new products. Atomic fission was scientifically known for years before a two billion dollar experiment in quality control made it practical.

A maker of thin gray iron castings which were to hold pneumatic pressure was faced with a quality control problem. Some of the castings had porous walls and would leak. This fault often could not be detected until several expensive machining operations had been performed on the castings, and often it did not appear until the parts were in service in the field.

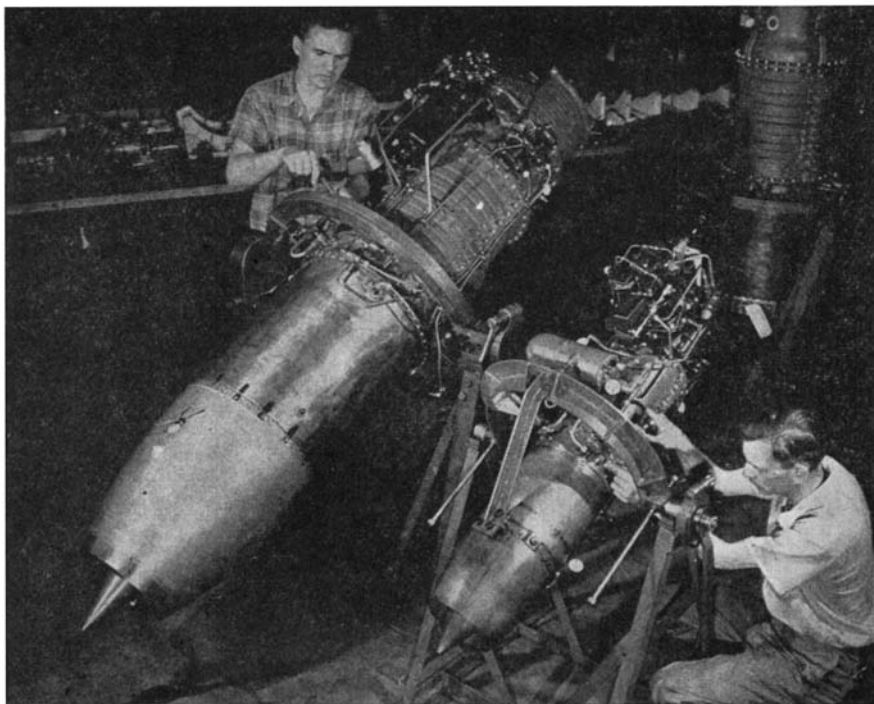
The trouble had to be stopped where it originated—at the pouring of the castings. But this was no simple matter. Before the job was

done the scientists of a great engineering school had been called in and had worked for months with the engineers of the company, and more than \$300,000 worth of new equipment had been installed. Continuous pouring cupulos had to be installed, every pound of sand had to be conditioned with complete laboratory control over the conditioning equipment, the molding had to be reduced to a production-line basis that took full advantage of the skill of the molders and minimized the human equation. The net result, as usual, was far better castings at much lower costs, but obtained only after months of development work.

INCREASED INVESTMENT—Greatly increased investments per productive man are one of the most common factors in quality control. It is not very long since \$1000 of invested capital per production-line worker was a high figure. Now \$5000 is such a common figure that only rarely can an industry having less compete on a large scale basis, and in many a plant the investment is much higher. Costs like these mean a great deal of employment for equipment designers and for the machine tools upon which equipment parts are fabricated. They also mean a great deal of elbow to elbow co-operation between the scientist and the engineer—the scientist to evolve new principles and the engineer to put them to work.

Stainless steel is another example of what happens when the scientist and the engineer work together for quality control.

When stainless steel first came out some 25 years ago, it was stainless all right but different heats of it varied so widely in their machineabilities, forgeabilities, and other workabilities that the engineer had to be in desperate need of its combined strength and corrosion resistance before he would try to



Courtesy Westinghouse Electric Corporation

Turbo-jet engines demand unusual and very specific qualities in metals used

fabricate it into his finished product.

Metallurgical scientists began working out specific alloys or "grades" for specific purposes; this process is still going on. One grade is highly suitable for machining and can be made into pump shafts, another can be cold formed into automobile trim, and so on through some 50 known grades.

The mill engineers worked right with the scientists. The properties and qualities of stainless steel depend largely upon how it is rolled, drawn, and processed; the labor costs per dollar's worth of stainless are comparable to those of such high precision operations as the manufacturing of ball bearings.

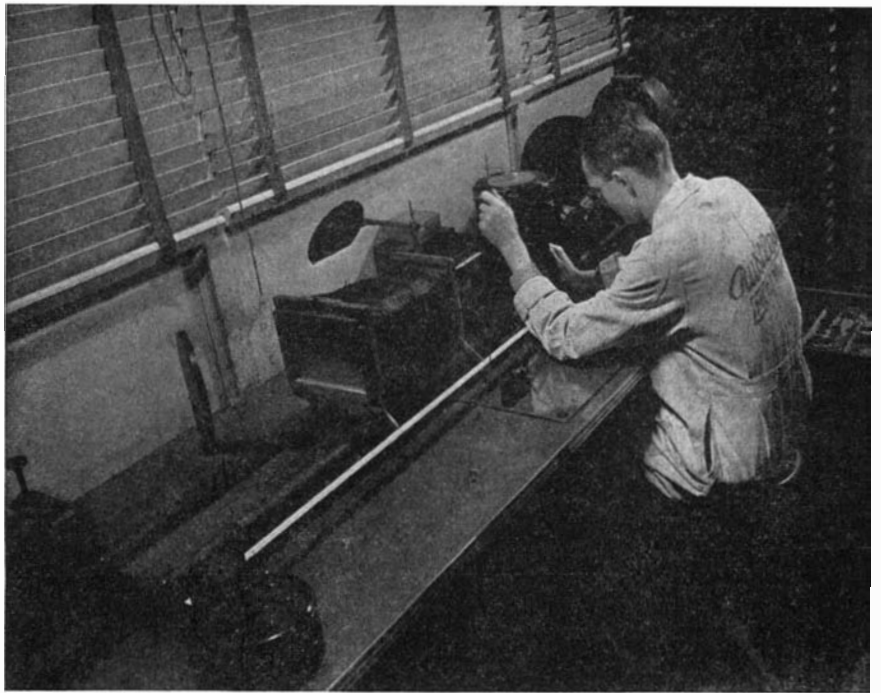
In the meantime the makers and users of machines and tools were approaching from the other end of the line. They worked with stainless steel sales engineers to develop tools, working speeds, and cutting oil formulas for fabricating stainless steels.

The large-scale use of stainless steels for quality control began to build up. With the high strength of stainless steels, sizes and weights of parts and products could be reduced while obtaining equal or greater qualities. Parts made of stainless steel would not be weakened by corrosion while in service and they were subject to little erosive wear; therefore they could be made lighter or smaller than ever before and still have superior durabilities. Quality control in the stainless steel mills is permitting fabricators to obtain improved qualities in thousands of different kinds of parts.

CONTOUR ENGINEERING — Similar quality control is being applied to dozens of different materials in an engineering science which is coming to be known as "contour engineering."

The strength and durability of a part is governed by its materials, its sizes, its accuracies, and its contours. Increase any one of those factors and the other three can go down; increase any two and the other two can go down considerably—all conditions of service being equal.

Contours other than simple ones have been the hardest of the factors to control and therefore have been able to contribute the least to the quality of the finished part. A curved or ribbed contour is stiffer than a flat one in a thin or light section; a carefully developed contour on a gear tooth will transmit more power at higher speed with less back lash and vibration—every engineer faces dozens of contour problems in the course of his work.



Courtesy Holmes I. Mettee

Laboratory control of stainless steel quality ended wide variations between heats; allowed engineers to make wide use of a previously troublesome metal

Science and engineering have developed new processes such as powder metallurgy, extrusion, permanent mold casting, and precision investment casting to produce contours that never were economically practical before, and to produce them of metals and to accuracies which have the very best effects upon the qualities of the resultant products.

Older or better known processes such as machining, die casting, sand casting, stamping, and forging are making rapid advances of their own.

The net result is that the engineer has more facilities for quality control than ever before. And in field after field the benefits of quality control will be as great as they were in the textile industry. Quality control bids fair to do more to create jobs and build industries than any other influence.



CARBIDE DIES

Show Great Superiority Over Tool Steel Dies

CEMENTED tungsten and tantalum carbides, long used in metal cutting tools and in wear resistant parts, are finding new employment in metal stamping dies.

An example reported by the New England Carbide Tool Company is a die having all cutting surfaces and all pilot pins made of solid carbide. This die cost four to five times as much as a similar tool steel one. The saving is in the reduction of lost

time of the press while dies are being sharpened, and minimizing of the need for duplicate stand-by dies so one can be used while another is being repaired.

This die punches lamination parts from silicon steel. A tool steel die would have to be resharpened after every 35,000 parts. The carbide die already has punched more than 500,000 parts—a 14 to 1 superiority in life between resharpenings—and since the carbide die is still turning out parts which are sharp, flat, accurate, and free from burrs, its final superiority before regrinding is not yet known.

GRINDING WHEELS

Molded to Shape to Reduce Production Costs

GRINDING wheels having rim or side shapes formed to fit the contours of work to be ground are an old story. A new angle is that wheel makers are arranging to press the special shapes right into the rims or sides of the wheels, thus eliminating the dressing-to-shape costs to users—although the users will have to redress the wheels to restore lost contours.

Wheels having one hard and one soft side, or hard middles with soft sides, and so on, also are well known. The harder area prevents the wheel from wearing unevenly when one area of the wheel face has to do more work or to meet more severe conditions than another. Incorporation of this principle in special molded-to-shape wheels is expected to increase greatly their service between dressings.

Alloys Beat the Heat

Brand-New Alloys, and Some Old Standbys from Other Fields, are the Key Materials of Turbosuperchargers, Gas Turbines, and Jet Engines. Long Held as Top War Secrets, Their Compositions and the Methods by Which They were Formed, are Now Revealed to the Industrial World

By FRED P. PETERS

Editor-in-Chief, *Materials & Methods*

SUPER HIGH-TEMPERATURE alloys and their war-time applications to turbosupercharger, gas turbine, and jet engine construction represent a story of outstanding metallurgical achievement that is now unfolding in piece-meal fashion. It may be several months before the picture will be completed through gradual relaxation of government restrictions, and it is even likely that publicity will never overtake actual developments, for research and investigation on high-temperature problems and metals to solve them are still continuing.

INDUSTRIAL CO-OPERATION — The super-alloy project was one of the many war-time developments that were almost entirely co-opera-

tive in nature and whose final success depended on the collaboration of dozens of manufacturers, metallurgists, and engineers. The need was for materials—either metallic or non-metallic—that would withstand the continuous 1200 to 1500 degrees, Fahrenheit, temperatures required for even minimum-efficiency operation of turbo equipment. The real problem was to find alloys that could be made into precision parts that would not oxidize, rupture, nor change their shape or precise dimensions in service at the high temperatures encountered.

Both the War Metallurgy Committee, headed by Clyde Williams of Battelle Memorial Institute, and the Super-Alloys Project of the War Production Board, headed by Rus-

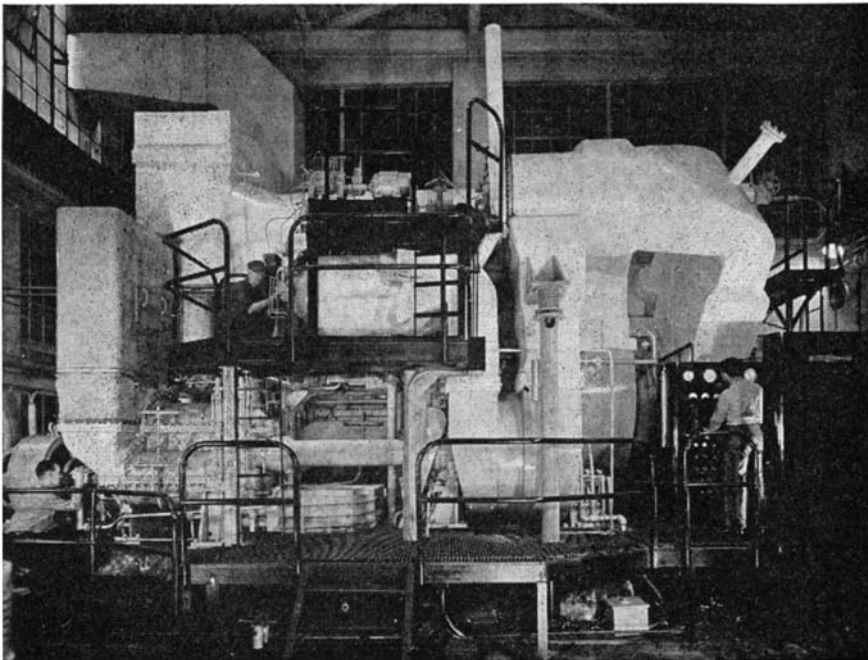
● LOOKING AHEAD ●

High-temperature alloys will find dozens of applications in the power field. Long-standing industrial problems—such as heat-treat furnace parts, oil-refinery and process industry equipment, exhaust valves, high-temperature bolting, and steam equipment in general—may be solved by use of greater quantities of the various metals than the specific applications that prompted their initial development.

sell Franks of Union Carbide and Carbon Corporation's Research Laboratories, were active nerve centers in the development. Engines were made by Westinghouse, General Electric, Allis-Chalmers, Elliott Company, and others. The special high-temperature alloys were developed or made by several manufacturers: Westinghouse, General Electric, and Allis-Chalmers precision-cast or otherwise fabricated materials and parts; Timken Roller Bearing Company, Haynes Stellite, International Nickel Company, Climax Molybdenum Company, Molybdenum Corporation of America, Allegheny-Ludlum, Rustless Iron and Steel, Austenal Laboratories, other stainless steel companies, and other precision casters all participated in the development of alloys, and many others in the manufacture of parts.

MODIFIED STAINLESS—Two types of materials emerged from this scientific attack as fundamentally best suited for ultra-high-temperature service: austenitic or ferritic stainless steels—iron-base alloys containing nickel and chromium in amounts up to 45 percent—to which molybdenum, titanium, and tungsten are added separately or in combinations; and cobalt- or nickel-base alloys containing as major alloying elements chromium and tungsten, molybdenum, nickel, or cobalt.

The two major problems of load-bearing strength and dimensional stability at high temperatures are not simultaneously solved with any



Strength and distortion resistance at 1200 to 1500 degrees, Fahrenheit, are vital requirements for hundreds of metal parts in the Elliott gas ship turbine

one alloy as yet removed from the restricted list. The modified stainless steels prove to have excellent strength at high temperatures but are not ideally stable dimensionally, whereas the cobalt-base alloys are the precise but not necessarily the strongest members of the team. In jet engine and gas turbine applications the materials are individually

combination of characteristics for this service. Details, however, have not yet been released.

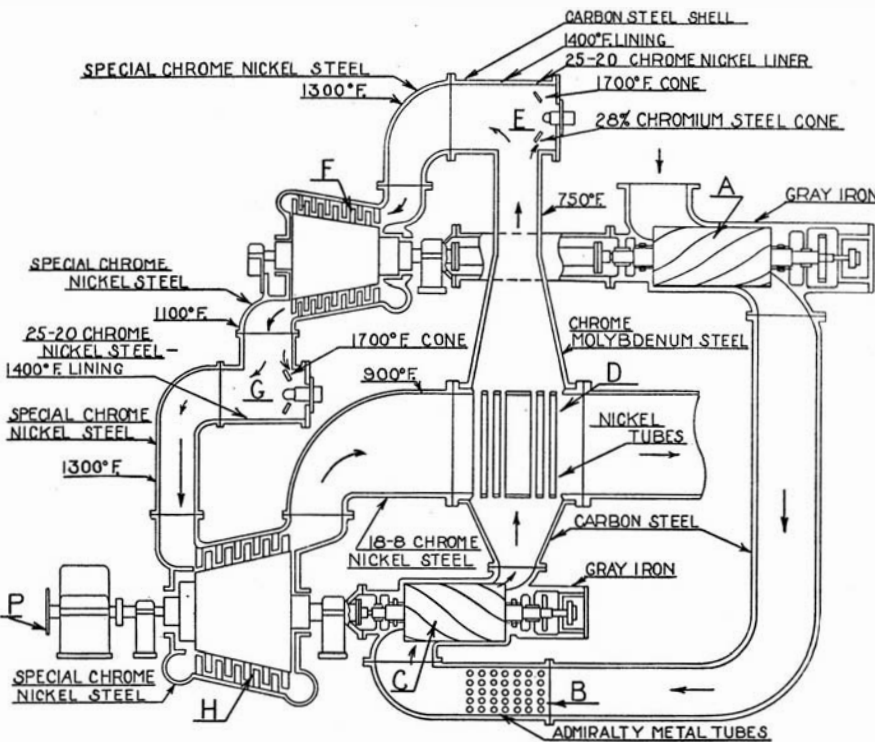
Modifications of well-established nickel-base alloys are also finding specialized uses in critical areas of jet and gas turbine units. A new variety of Inconel—Inconel "X," 75 percent nickel, 14 percent chromium, 6 percent iron, 3 percent

percent chromium, 8 percent nickel steel, and ultimately to a special 19 percent chromium, 9 percent nickel stainless steel containing tungsten and molybdenum.

The Elliott-Lysholm gas turbine nicely exemplifies the two-way problem of meeting service requirements, while still providing a design that can be manufactured, which the materials engineer on such projects must somehow solve. Because all metallic materials "creep"—that is, they grow or deform slowly under stress at high temperatures—turbine rotors will grow, flat-sided ducts will bulge, and round ducts will grow too large and thin. These changes are inevitable, but the engineer must handle materials and loads so as to hold the changes to an absolute minimum and thus extend the life of the engine.

The best materials-and-processing set-up for the Elliott engine, as determined by its engineers, has been the use of rolled plate and arc welding wherever possible, thus fabricating many pieces into one permanent assembly. This method of construction was used on all the duct work and the combustion chambers in the Elliott engine, while the turbine rotors were machined from rolled plate and forgings, and welded into an assembly.

The extensive use of welding in assembling these high-temperature materials introduced some knotty problems. For example, S.A.E. 4130 steel is an air-hardening steel, so that joints had to be individually studied and checked in advance to determine whether their nature and mass were such as to require pre-heating. Again, welding of the 19 percent chromium, 9 percent nickel steel



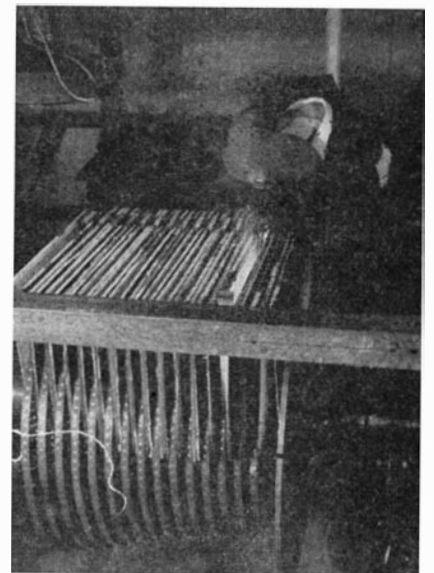
The Elliott Lysholm gas turbine cycle—temperatures vary throughout and metals must be selected for specific uses. Large capital letters locate major parts of turbine: A, low pressure compressor; B, intercooler; C, high pressure compressor; D, regenerator; E, high pressure combustion chamber; F, high pressure turbine; G, low pressure combustion chamber; H, low pressure turbine; P, propeller

employed to use their best properties to the maximum advantage and to minimize their weaknesses.

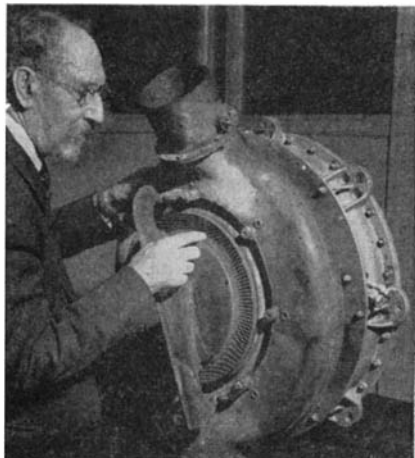
PRODUCTION PROBLEMS — In recent years many users have become familiar with Vitallium—65 percent cobalt, 30 percent chromium, 5 percent molybdenum—and the related tungsten-bearing Stellite alloys for turbosupercharger blades and similar parts of gas turbines and jet engines. Such alloys are strong, highly scale resistant, and corrosion resistant, but they are also virtually impossible to machine and forge. They were made into parts by the millions, however, by precision casting methods—"lost wax" or "investment" casting as described in *Scientific American*, December, 1945—which permitted these intricate parts to be produced directly to close tolerances without any machining. A Haynes Stellite alloy called Multimet—N-155—was developed especially for high-temperature uses in turbo equipment, and is said to offer an unusual com-

titanium, and 0.6 percent aluminum—is now used for combustion chambers. Westinghouse's K-42-B alloy,—40 to 50 percent nickel, 20 to 30 percent cobalt, 15 to 30 percent chromium, 5 to 15 percent iron, and 1 to 4 percent titanium—originally developed for electronic tube applications, was found to be highly suitable for certain jet engine parts as well. In at least one engine—the Elliott—a special grade of pure nickel was fabricated by spinning and used for torroidal joints in the high-pressure combustion chamber inlet because of its combination of relatively low expansion coefficient and good heat resistance.

Indeed, to date, the most information about the materials used in any gas turbine has been released by the Elliott Company, builders of the Elliott-Lysholm 2500-horsepower gas turbine for the United States Navy. Their power plant runs the gamut of materials from the nickel spinings just mentioned, through S.A.E. 4130 chromium-molybdenum steel and high-grade gray iron, up to 18



Fabricating Elliott gas turbine rotor by welding together rolled plate and forgings. The special metals involved required unusual welding techniques



Dr. S. F. Moss, turbosupercharger and gas turbine expert, examines metal in heat-resistant turbine wheel of B-17 Flying Fortress turbosupercharger unit

containing tungsten and molybdenum required the development of a new welding electrode that would have the necessary high-temperature strength together with satisfactory working characteristics.

NEW METALS—The newest high-temperature material of those made public to date is the 16 percent chromium, 25 percent nickel, 6 percent molybdenum steel developed by Timken Roller Bearing Company. Originally applied in the rotor wheels of airplane turbosuperchargers, this interesting alloy was later used for jet-engine impellers. In most cases the material was supplied in billet form and then forged to give the final product, although some was made available as small rounds and flats for turbine blades.

During the past four years over 12 million pounds of the 16-25-6 al-

loy have been used. The largest use was in the production of General Electric turbosupercharger wheels, hundreds of thousands of which were made from four-inch square billets of this alloy.

One of the special features of this new material is its susceptibility to precipitation hardening, which not only improves its room-temperature properties but its creep resistance as well. Actually, however, even this enhancement of properties seems small in comparison to the great high-temperature-strength advantage the ordinary annealed 16-25-6 alloy seems to have over earlier heat-resistant alloys.

Thus the stress required to produce a given rate of creep in the new material at 1500 degrees, Fahrenheit, is approximately twice that required to produce the same rate of creep in 18-8 stainless steel at 1400 degrees, Fahrenheit. In the sometimes more reliable stress-to-rupture test, 16-25-6 alloy is shown to be two and one half to three times as strong as 18-8 stainless at 1500 degrees, Fahrenheit.

The future of this material and of all the new high-temperature alloy seems bright indeed. The equipment for which they were specifically developed—gas turbines and related products—is expected to increase markedly in use, especially *if the present alloys are bettered or if they are joined by even more refractory materials.* Today these “super-super” alloys are being sought and studied, and the 1500-degree, Fahrenheit, temperatures now considered maximum for gas turbines may eventually be regarded as old-fashioned and inefficient.

STAINLESS STEEL

Age Hardens; May be Worked “Soft”

A NEW age-hardening stainless steel was recently announced as Stainless “W” by the United States Steel Corporation. So formulated as to be a “ferritic” rather than an “austenitic” material the new steel contains 17 percent chromium, 7 percent nickel, 0.7 percent titanium, 0.2 percent aluminum, and 0.07 percent carbon. In the annealed form it has a tensile strength of 120,000 to 150,000 pounds per square inch, and hardness of 22 to 28 Rockwell C; after precipitation hardening the tensile strength becomes 195,000 to 225,000 pounds per square inch, and the hardness 39 to 47 Rockwell C. The element chiefly responsible for the steel’s precipitation-hardening behavior is titanium—although co-

lumbium may be successfully substituted for it.

Strongly magnetic, the steel combines the strength and corrosion-resistance of conventional cold-rolled “18 and 8,” but does so without the need for prior cold-working treatment. The new stainless steel is thus similar to the strong aluminum alloys in that it can be worked in the soft state and then heat treated to achieve full strength and hardness. The new material can be produced in any cast or wrought form.

NITROGEN FLUX

Gives Advantages in Aluminum Casting

NITROGEN gas is now being successfully used as a fluxing agent for molten aluminum in several foundries making high-grade aluminum castings and also as a flux in re-

verberatory furnaces producing casting ingots. Results obtained by the method are equal to or better than those achieved with chlorine gas, with the added advantages for nitrogen of low cost and non-toxicity.

Bubbling the gas through molten aluminum picks up finely dispersed slag and dross and brings them to the surface where they can be skimmed off. Also, it traps the minute bubbles of air entrained in the melt and brings them to the surface, and transfers dissolved or absorbed hydrogen from the melt to the rising gas bubbles so that the hydrogen concentration is reduced to a point where it will not impair the soundness of the aluminum casting.

A slow rate of gas flow is essential to best results, according to Air Reduction Company, who have developed the technique. Tests show that the total volume of nitrogen needed is one cubic foot per 100 pounds of aluminum. For example, in fluxing an 800-pound melt 24 inches deep, a nitrogen flow rate of 24 cubic feet per hour at a pressure of two pounds per square inch is successful, the operation requiring 20 minutes. The nitrogen gas used must be dry (or “oil pumped”) for satisfactory results.

METAL POWDERS

Now Applied as Hard Coating; Extruded for Small Tubes

TWO RECENT developments in powder metallurgy processing show promise of important future applications. One is the extruding of tungsten powder into very small tubing for electronic parts. The other involves a process for hard facing of powder parts. Instead of steel powders, which are often difficult to handle, iron powder is used as a base over which is applied a coating of hard material—Rockwell 72 C—by powder metallurgy methods. Thicknesses of the hard surface can be made to vary from 1/16 inch down to one ten-thousandth of an inch.

LOW-EXPANSION ALLOY

Is Available for Instrument Parts

A LOW-EXPANSION alloy with a promising field for instrument parts will soon be available for general use. It is a “cobalt invar” (cobalt-chromium-iron) alloy with a coefficient of thermal expansion lower than that of quartz. Parts, cast from melted metal powders, are expected to find application in precision optical instruments, for both aircraft and industrial uses.

'Huff Duff'

Instantaneous Direction-Finding Equipment, Perfected for Anti-Submarine Operations, Will Simplify Sea and Air Navigational Problems

By JOHN MARKUS

Associate Editor, *Electronics*

A SINGLE DOT or dash of the SOS call signifying tragedy at sea is sufficient to actuate a new high-frequency radio direction finder developed during the war by Federal Telephone and Radio Corporation. Though designed primarily to help the Navy in its battle against German submarines, the device quickly proved itself worthy of many other important applications, peaceful as well as military.

In peace, this h-f d-f (high-frequency direction-finding) system is being used to determine the positions of ships or aircraft and notify them of their location by radio; in war, it was used to locate the enemy and notify our naval forces of his location. In both cases, it gives an accurate bearing on high-frequency radio transmissions—something no

previous direction-finding system could do satisfactorily.

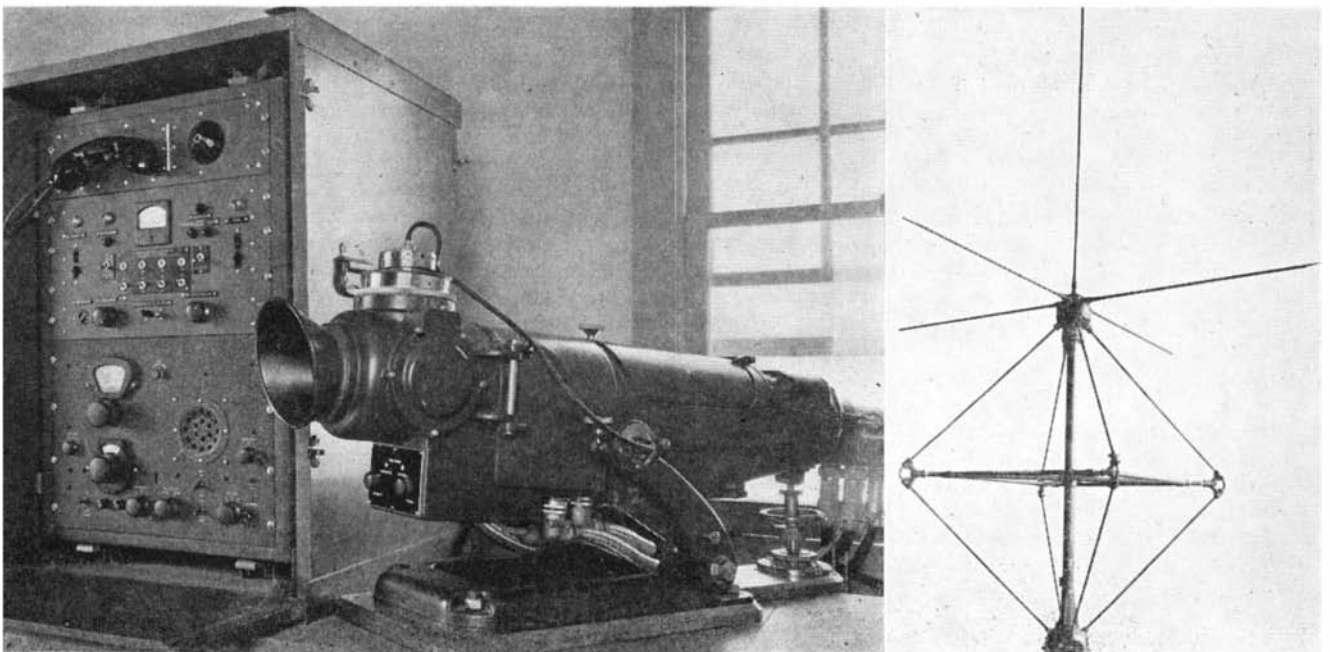
The new h-f d-f instrument, popularly known as "huff-duff," picks up any voice or code radio signal transmitted on international short-wave communications channels, and within a split second shows visually on the screen of a cathode-ray tube the

direction from which the signals are arriving. When such a bearing is obtained from two or more stations at different points ashore or afloat, a navigator can draw the lines of direction on a chart and read the position of the sending station at the intersection of the lines.

SUB SIGHTED—One spectacular use of "huff-duff" in getting a U-boat was made by Task Group 22.8, which on Christmas Day, 1944, was ordered to hunt down and destroy a weather-reporting German submarine operating about 500 miles north of the Azores. On January 1, 1945, the U-boat was picked up by radio direction finder bearing, at an estimated distance of 40 miles. No successful contact was made. The following day two ships got a fix (crossed bear-

• LOOKING AHEAD •

Transoceanic pilots will be able, by means of "huff-duff," to obtain exact positions at any time. . . Pin-point locations of planes or ships in distress can be obtained, and rescue parties dispatched. . . New radar beacons will make distance- and direction-finding simple and speed-up airport operations.



Courtesy Federal Telecommunications Laboratories, Inc.

"Huff-Duff" station equipment—telescope-like unit houses cathode-ray screen; antenna is shown at right

ings) placing the submarine within 20 miles. Unfortunately, on January 9th the group was forced to depart for the Azores to refuel. On January 13th the hunt was resumed. Relying on d-f bearings, the U-boat was pursued south, north, and west as the bearings on his transmissions indicated changes of course. Persistence was rewarded on the morning of January 16th when the U-boat's radio transmission was intercepted by ships which fixed the enemy at six miles distant. The Task Group closed in for the kill. Two hours after the intercept, the sonar man picked up the U-boat. Exactly five hours after the intercept a violent underwater explosion indicated the end of another U-boat. Apparently this U-boat transmitted from a submerged position, because at six miles distance, radar had failed to locate it. The German use of the *Schnorchel*, the breathing device which permitted U-boats to run submerged and still charge their batteries and transmit radio signals, put a higher value than ever on radio direction finders, as bearings could be taken on transmissions made by submerged U-boats.

Another outstanding accomplishment of the equipment, Navy officers recently disclosed, was the locating of the German submarines which landed spies and saboteurs on the Long Island and Florida coasts in the spring of 1942.

SQUIRT TRANSMISSION — Enemy submarines used *Kurier* or squirt transmission—a system of radio communication in split-second bursts—to their bases in occupied territory, to one another in organizing their wolf-pack attacks, and in conveying weather information from this side of the Atlantic to the German high command. These compressed messages were picked up at the enemy receiving station on high-speed recording devices which later stretched the recorded message by playing it back at reduced speed.

It was believed by the enemy that the brevity of these radio contacts forestalled detection by any devices known to them. They were, of course, unaware of the new American direction finders on escort ships which revealed the location of the underseas craft the instant they started to transmit, no matter how briefly or, relatively, how far away. The new direction finder responds with precise accuracy to radio waves from across the Atlantic, or farther.

The location of an airplane crossing the ocean can now be determined immediately by "huff duff." Installations being provided on both sides

of the Atlantic will make available to a transoceanic pilot, who might be having navigational difficulty, a service which will give him his exact position at any time he requests it. Furthermore, these stations can immediately obtain a pin-point location of any plane in trouble and relay it to the nearest ships and shore rescue stations.

The high-frequency direction finder is now a vital instrument in the air-sea rescue system of the United States Coast Guard, which is organized through its bases along United States coast to dispatch immediately an airplane-rescue boat team to any scene of trouble at sea.

RADAR BEACON — Another wartime electronic development having commercial applications in the aviation industry is a radar beacon system that provides the pilot with a constant indication, on a cathode-ray tube screen, of his distance from, and his rate of approach to, the beacon. When a fix is desired, the plane sends out radar pulses toward

the nearest land radar beacon. The beacon responds automatically with an answering pulse carry an identifying code. The time it takes the pulses to make the round trip gives the plane's exact distance from the beacon.

Combining this data with a single direction bearing obtained with "huff-duff" or a similar high-frequency direction finder carried on the plane then gives to the pilot his exact position with relation to the beacon. Since beacon locations are known and are plotted on navigational charts, this information is entirely sufficient for a position fix.

Utilization of radar beacons on a nation-wide scale for all commercial planes and all airports would eliminate much of the bad-weather approach delays now encountered and would speed up landings, since the pilot would know his exact position with respect to the landing-strip radar beacon at all times. The Civil Aeronautics Authority is now investigating commercial utilization of this system.

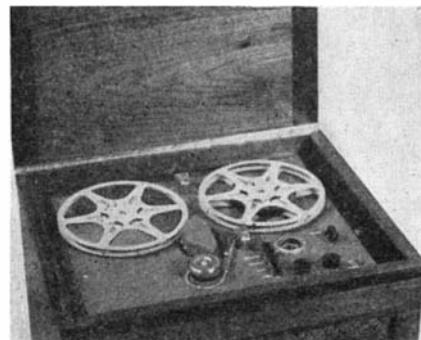
SOUND ON PAPER

Made Possible by New
Magnetic Coating

AFTER many false starts, magnetic recordings of voices, favorite radio programs, and messages for mailing to distant points are being made available on a new medium—a paper tape coated by a printing process with a thin film of magnetic material.

The development of the paper tape technique for home and office use is an outgrowth of forward strides made during the war in magnetic recording on a thin steel wire. The paper tape is about 0.003 inch thick and comes on a reel like that used on eight-millimeter home movie equipment. It passes from a supply reel to a take-up reel through a magnetic recording head. The latter is supplied with electrical energy by an electronic amplifier similar to those used on present-day home recording instruments. Variations of the sound-modulated electrical energy are transformed by the head into magnetic variations in the paper coating. The sounds to be recorded can be taken from a radio program or picked up by a microphone supplied with the instrument.

One of the advantages of the paper tape is that it can be cut at any point and a portion of the tape deleted. This permits the user to edit out unwanted portions of a radio program; for example, com-



Paper tape recorder and reproducer, with cabinet lid raised. The magnetic head is in center foreground

mercial announcements. Splicing of the cut ends of tape is easily accomplished with an adhesive. Recordings can also be magnetically erased, in full or in part; this permits re-recording of new programs or sound, or adding material between wanted portions. The tape is expected to have a useful life in excess of that of the usual disk recordings. The first model of the paper-tape magnetic recording instrument, a product of The Brush Development Company, will be about the size of a table-top radio and is planned to be an accessory to the present home radio receiver. Each full reel of paper tape will accommodate a half hour of recorded material and can be rewound in less than a minute. Operation is quite simple and requires no more technical skill than that needed for

loading a movie camera. Business dictation machines are also contemplated.

Although magnetic recording offers many novel features, it cannot be expected that the conventional disk-type records will be replaced by reels of paper or wire. Disk records are pressed from a master in a matter of seconds in mass production. So far, no similar method of reproducing magnetically recorded reels is even on the horizon. Each reel of wire or coated paper tape would have to run through the recording head to receive the proper magnetizing effect; time alone is a considerable factor in this operation. For special programs, business records and dictation, and similar purposes, however, magnetic recording offers many advantages.

DULL-TOOL ALARM

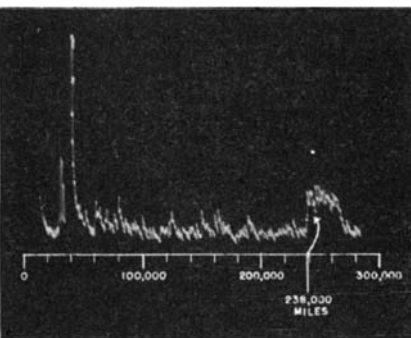
Prevents Overload and Breakage of Drills

AN ELECTRONIC control device, responding to increased torque load on the spindle of a drill, causes the drill to be withdrawn automatically when the cutting edges become dull. Torque loads exceeding a predetermined amount—usually between 1 and 10 percent above normal—start the automatic retractors, thus reducing drill breakage and speeding the drilling of deep holes. Where danger of breakage is negligible and automatic retraction unnecessary, the electronic control can simply be connected to operate a signal light. Ford Motor Company and H. E. Farmer Engineering Company are two of the firms that have already used this unique dull-tool alarm.

LUNAR RADAR

Presages Moon's Use as Radio Sounding Board

ON JANUARY 10, 1946, man made contact with the moon for the first time in the history of the world. Many authorities believe that this may point to radar controlled jet- or rocket-propelled missiles and space ships, circling the earth above the



Moon's reflection of radar signal is marked by jog in trace at 238,000 miles

stratosphere. But of more immediate significance is the possibility of improving radio reception over greater areas by reflecting radio signals off the moon rather than off the relatively low ionized layers in the upper atmosphere. Moon signals could be heard over the entire hemisphere of the earth that faces the moon, with essentially equal strength at all points. Success here depends on building a sufficiently high-power station and transmitting a sufficiently narrow beam so that the signal will be strong enough for radio reception after travelling its 480,000-mile round trip path. A number of laboratories throughout the world are now working on this commercial utilization of the moon.

COLLAPSIBLE TUBES

Can Now be Sealed Electronically

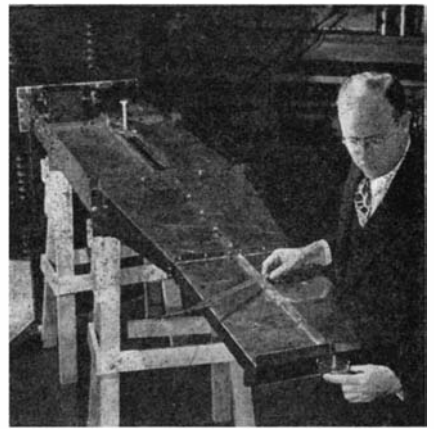
THE PROBLEM of having the ointment, tooth paste, or other contents of a collapsible metal tube squirt out at the wrong end due to opening of a folded and crimped seal, has been solved with the aid of electronic heating. The inner metal surfaces at the end of the tube are coated with a plastics bonding film, the end is folded as usual, and the fold is inserted in a single-turn coil connected to an electronic heating generator. The radio-frequency energy induced in the metal foil raises the temperature instantaneously to 250 degrees, Fahrenheit—enough to seal the tube securely. Heated crimping dies have hitherto proved unsatisfactory for the purpose because the soft lead would stick and the seal would pull open as the dies were retracted. With induction heating this is avoided because there is no physical contact between the metal and the source of heat. Up to 17,000 tubes per day are being sealed by this method, developed by Commonwealth Edison Company.

ELECTRONIC HEAT

Applied by High-Frequency "Blow-Torch" Technique

NEWEST in electronic heating is a unit that sprays radio-frequency energy onto the object to be heated, doing away with the older method of placing the object between two energized metal plates. The object, material, or liquid to be heated is simply placed in the opening of a rectangular metal pipe—technically known as a wave guide—that is energized by a high-power electronic generator. This blow-torch technique can be used effectively on irregular-shaped objects.

There is no danger of burning or



Electronic blow-torch in test stage. Later models will have smaller nozzles

scorching the material at points nearest the energy source. The higher the frequency, the smaller can be the opening in the pipe or nozzle, so that with sufficient power at a high frequency the beam of invisible heating energy can be squirted from a nozzle no larger in diameter than a flashlight.

SAND DRYING

Expedited by Phototube Cell Control

TWO JOBS at the new Diesel locomotive maintenance shop of the Erie Railroad are done by phototubes.

The door of the shop is opened by the beam from the headlight of an approaching locomotive while it is still some distance away. This permits the locomotive to enter the shop without a preliminary stop. A sun visor over each phototube prevents the rays of the sun from activating it.

The sand for the sand boxes of the 5400-horsepower four-unit Diesel freight locomotives is dried by steam coils over a drum. A pipe in the side of this drum is so shaped that it permits sand to spill over when the drum is full. Through windows in the pipe a beam of light passes to a phototube.

When the drum fills with sand, the surplus flows into the pipe and interrupts the beam of light. Compressed air then closes the inlet to the drum and blows sand into elevated bins, where it is ready for use when required for servicing the locomotives.

When the drum is empty the windows are again clear and the light beam reaches the phototube. This turns off the compressed air, reopens the inlet to the drum, and allows it to fill again, ready for the next operation. This mechanism has proved more dependable than any previously used springs, switches, or other devices.

Premiums in Plastics

Advertising Specialties and Premiums are Big Business. Successful Use of these Mediums Means Meeting Unusual Requirements; Plastics are Often Naturals for the Job. Adaptable to Clever Designs, Permanent in Color, and Mass-Produicable, Plastics have a Real Edge in this Field

By CHARLES A. BRESKIN

Editor, Modern Plastics

BEFORE the war, premiums, prizes, and advertising specialties—in which category fell many plastics items—were big business. It is estimated that at manufacturers' prices their volume in 1941 exceeded 500 million dollars. And they are expected to pass the 600 million dollar mark as soon as goods are flowing freely again and competition once more sets in.

In the past, plastics products accounted for about 25 million dollars of this business, or 5 percent. Exactly what portion plastics will take of future business is still subject to question. However, authorities believe that plastics can reasonably hope to represent 10 to 15 percent of the total premium-prize-advertising specialties volume—a percentage that would be equivalent to 60 to 90 million dollars worth of business.

Before the suitability of plastics for this diversified field can be fully appreciated, a word of explanation on the premium and advertising specialty business seems necessary. Premiums are products offered in return for coupons, box tops, letters to advertisers, a trip to a store, services rendered, special purchases, or any of these plus a small amount of cash. A premium is an inducement to buy. It involves an effort as well as an outlay on the part of the customer.

Advertising specialties, on the other hand, are straight goodwill-promoting gifts, requiring no effort or outlay from the customer.

Some of the best known and largest volume plastics items have been premiums; for example, the Bab-O container of which over three million were turned out in urea-formaldehyde in a variety of colors. Started

● LOOKING AHEAD ●

Business competition is coming back . . . So are the clever little advertising "give-aways" and inexpensive premiums. When designing them, production problems should be considered . . . Right now, sales-minded business men should be looking for premium ideas—and designers . . . Plastics offer possibilities as an outstanding material.

as a three-month promotion to expand sales, the holder proved so popular that the molding presses ran steadily for two years. Equally successful was the molded-urea Wheaties cereal bowl, and the Little Orphan Annie molded-urea mugs and shakers used to promote Ovaltine. Lone Ranger whistles, which were molded in three pieces of cellulose acetate, also reached a painfully popular level.

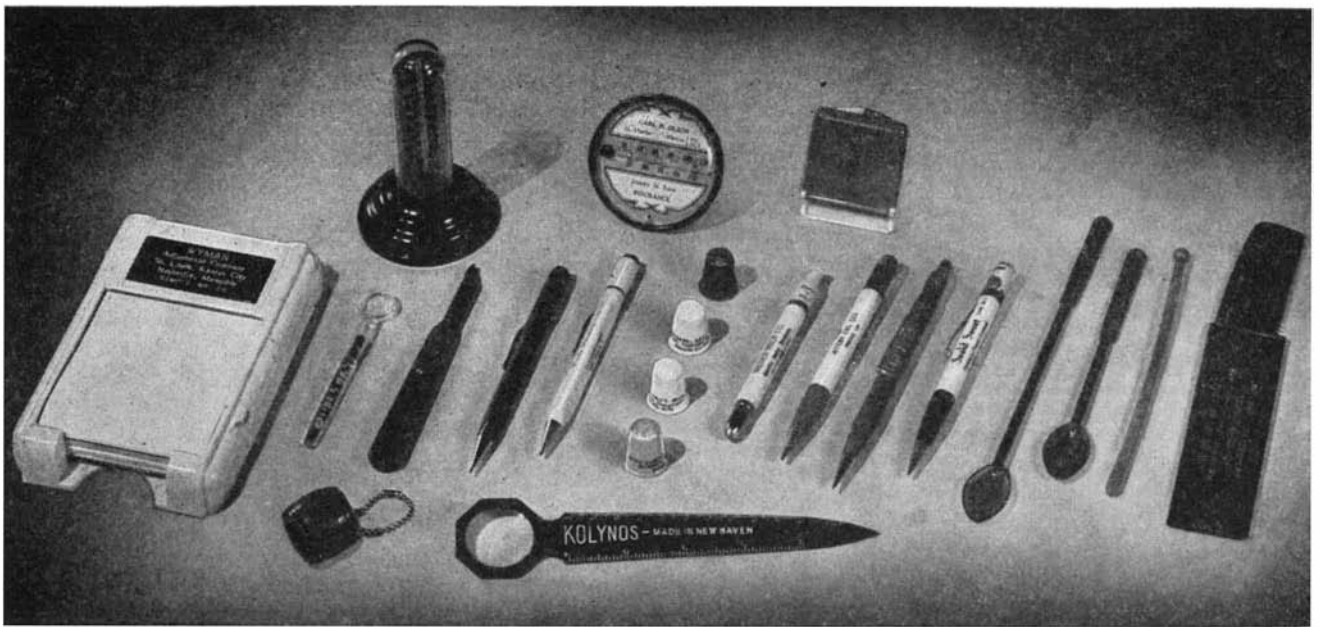
Why were these premiums so successful; and why were they made of plastics? Duane Jones advertising agency directs the distribution of over three million premiums a year. On the basis of their experience in the field they have set up a list of six desirable qualities for premiums, with comments on how plastics fit the picture.

REQUIREMENTS — 1. A clever idea is the basic element in all successful premiums. Standardized gadgets, no matter what the material, will never receive an enthusiastic response. If the idea is not new, it must possess other compensating advantages. Since these items are frequently "sold" to the public sight unseen, there must be a good talking point for advertising.

At first, the newness of plastics themselves gave them intrinsic



Popular cellulose acetate refrigerator bank was a durable, long-lived premium



Business names print well on plastics surface. Color, an important attraction factor, does not wear off with use

cleverness. But, when the novelty wore off, plastics materials had other qualities which made them important to the achievement of something original. Because of their formability, plastics lend themselves exceedingly well to new design. Plus features are color and texture. Both the Lone Ranger whistle and the Bab-O container benefitted from these qualities of plastics. At the time these items went on the market, only plastics could give them inherent color—color that would not wear off—and do it at a low price and in mass production.

2. It is customary practice to try out an offer in a sales-resistant territory for a few weeks before making a national offer. Possibly 25,000 pieces are needed for the trial. If the results are good, orders varying between 400,000 and 1,000,000 may be placed. If the premium is that good—and many plastics premiums have been—additional orders for more millions may be placed.

Plastics are at a distinct advantage in meeting this premium testing sequence. Single-cavity molds can be made up for the test run; or a limited number of jigs may be used. This can be done without bringing the price up to a point where the part would be prohibitively expensive. In short, plastics are able to offer mass-production techniques on relatively small runs.

3. Premiums must have a universal appeal for housewives. Women are the big market for soaps, foods, dentifrices, and other things sold with premiums. An exception to this rule is the children's premium market. But even here it is preferable to offer something that will appeal to both boys and girls in a wide range of ages. And, again,

the color and formability of plastics are important. Moreover, formulations can be used that do not tarnish or stain, qualities of importance to women in their kitchen equipment. The variety of forms in which these materials are available is another element in helping them to meet these premium requirements.

4. A premium must be worthwhile and useful; the product leans on the premium, not the premium on the product. The numbers of plastics items that began their careers as premiums and are now standard retail merchandise prove the worth of these materials.

It would be hard to find a more useful, yet attractive piece than the Wheaties bowls. Being made of urea, they are less subject to breakage than china dishes; yet at the same time they are just as functional and colorful as bowls of any other material. Thus the use of plastics has added extra qualities while retaining all the traditional "musts" of tableware.

5. Exclusiveness is important. For real stimulus in a premium offer, the product should not be available anywhere else and, for at least six months after the offer is cancelled, should not be offered at retail at less than twice the "price" that people paid for it when it was a premium.

Proper management and an original designer are prerequisites to the fulfillment of this fifth premium qualification—points that can be worked out as well for plastics as for other materials. It is even possible that the formability of plastics gives them a slight edge here, since designers are less restricted than they are with many other materials.

6. A premium should, if possible, tie in with a fad or outstanding news event. The recent "Freedom-Sword Pin" premium, issued by Duane Jones, is an example. It was a miniature replica of the sword presented to General Eisenhower by the Lord Mayor of London, and it immediately caught women's fancies.

In meeting this sixth condition, fabricated plastics items have a distinct edge in that they can be put into production with a minimum of delay. To date most plastics premiums—and advertising specialties too—have been molded pieces. Fabricated parts should, however, play an increasingly important role due to the development of automatic machinery, improved techniques of fabricating, and the availability of new materials.

IDEAL MATERIALS—From the foregoing six premium qualifications, it would seem that plastics are ideal materials for this field, particularly in view of these materials' adaptability to mass production. Furthermore, they can be processed at a price which will not throw the advertising budget out of balance.

This low cost also has its dangers for plastics, and it is essential that premium buyers realize that. "Can we make it cheaper of plastics?" is no sound criterion on which to base a decision. The slogan should be: "Can we make it better of plastics?" If a premium is to be worthy of the product linked with it, it will cost more in any material than a mere expendable gimcrack. A premium properly made of the right material need not be out of the question as far as cost goes. Post-war premiums have proved that, as did also a survey of premiums and



A plastics container for a household cleaner. Production topped 3,000,000

used. Prices to the jobbers range from two cents to two dollars a piece. Here is a list of advertising novelties found acceptable at all times:

Letter openers, thermometers, six-inch rulers, drink swizzlers, memo-pad holders, strong thimbles, desk calendars, pocket combs, desk magnifiers, key-chain gadgets, match-book cases, mechanical pencils, blotter covers, ash trays, long-drink spoons, and drink coasters.

Lack of materials and mold making facilities are presently delaying the development of new plastics premiums and advertising specialties. But this is a temporary matter which should be ironed out by the time goods are in free enough supply to warrant once more the use of these sales aids. In the meantime, plans are being perfected so that, once the way is opened, plastics will be ready to help in the big push.

premium plans for 1940 conducted by *Printers' Ink Monthly*. In this last big year before the outbreak of war, the highest price to a customer for a premium was found to be 65 cents, plus a Rinso wrapper, for a three-quart saucepan. There were a few offers involving the sending of 50 cents in cash, many at 25 cents, a few at 15 cents. But most of the premiums went for 10 cents in cash.

While many of the qualities that are desirable in premiums are to be found in advertising specialties or "give aways," the emphasis is different. The cardinal features of a successful item in this category are light weight and a surface which takes a good imprint. The first is essential if costs of shipping and handling are to be kept down; the second in order that the name and address of the donor, and sometimes a sales message, can be permanently affixed to the item.

The big market is for office supplies, for premiums that can be used by business men, preferably at their desks, where purchasing decisions are made. But there is now a growing market for items with appeal to housewives, as well as an expanding children's market.

Advertising specialties must be clever enough in design to make an impression on the prospect. In most cases, this means that they must be designed especially for this field—not as an afterthought to the re-sale market. Ninety-five percent of the millions of dollars' worth of merchandise used in the advertising specialty field is manufactured solely for this purpose.

This field is wide open for new merchandise. Plastics molders are currently far behind orders on pre-war-designed items. The business is starving for goods and for clever ideas.

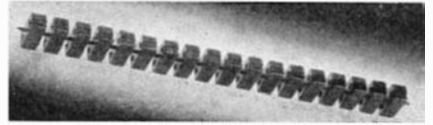
Thermoplastics hold the big interest in this field but many items made of urea and phenolic compounds and vinyl sheet are also

the materials' resistance to alcohols, oils, water, and acids.

CABLE STRAP

Holds Firmly, Allows Air Circulation

THE JOB of binding together multiple cable lines very often is a difficult one. If the holding strap is not tight, the cables can slip back and forth, quickly cutting the outer protective coverings. And the result is much the same if the binding is too tight. Now The Railroad Accessories Corporation offers a



Plastics-block cable strap

"beaded" strap as an answer to these troubles. This binding is an assembly of small compression-molded plastics blocks which are strung together on pliable wire. A special metal hook simplifies the union of the two ends. Using this strap, the cables can be pulled tightly together without danger of abrasion.

PLASTICS PUMP

Safely Handles Many Types of Solvents

THE ABILITY of certain plastics materials to withstand the effects of acids has been put to good account in a new suction pump produced by the Alden Speare's Sons Company. Except for two metal parts, the unit is entirely fabricated of Saran. The pump attaches to acid carboys and thus eliminates the juggling of carboys and the splashing of liquids. Bulk perfumes, flavoring extracts, syrups, and so on, can also be transferred with this pump, because of



Acids won't affect this pump

LETTERS AND MASKS

Made of Plastics To Aid Artists

ARTISTS and layout men will be aided by two new shortcuts based upon the success enjoyed by the cellulose acetate films used for military maps and documents during the war. Both developments, as announced by Arthur Brown and Brothers consist of thin flexible Lumarith sheets coated on one side with a special pressure-sensitive adhesive and laminated, for protection, to thin opaque paper.

One product, the E-Z Frisket, is used to mask off the sections of a photograph that an artist does not want touched by the airbrush spray. The cellulose film is easily cut to the desired shape and is then peeled from the paper backing and placed over the art work. When the job is finished the film can readily be pulled from the copy, leaving no residue of adhesive.

Presto-Type, the second new use of Lumarith film, is printed with a quantity of black or white characters in any of 18 popular type styles. With this material a layout man can set his own type for headings in advertising and editorial layouts. The user cuts out the desired letters from the transparent film and places them in the final position on the copy where it remains because of the special adhesive on the back.

Rust Not — Want Not

• LOOKING AHEAD •

Costs of metals will increase as rich resources approach exhaustion. . . Rust prevention can conserve huge quantities of needed materials. . . Corrosion cause can be eliminated by use of inhibitors. . . Process is particularly adaptable to closed circulation systems. . . Metal life can be prolonged and operating efficiency improved. . . Other methods.

OUR BILL for rust and corrosion is almost equal to the value of our total metal production. The difference between the two represents new construction as compared with replacement. This huge bill for corrosion losses may not disturb you, because your part of it is so small; but if it doesn't yet, it will.

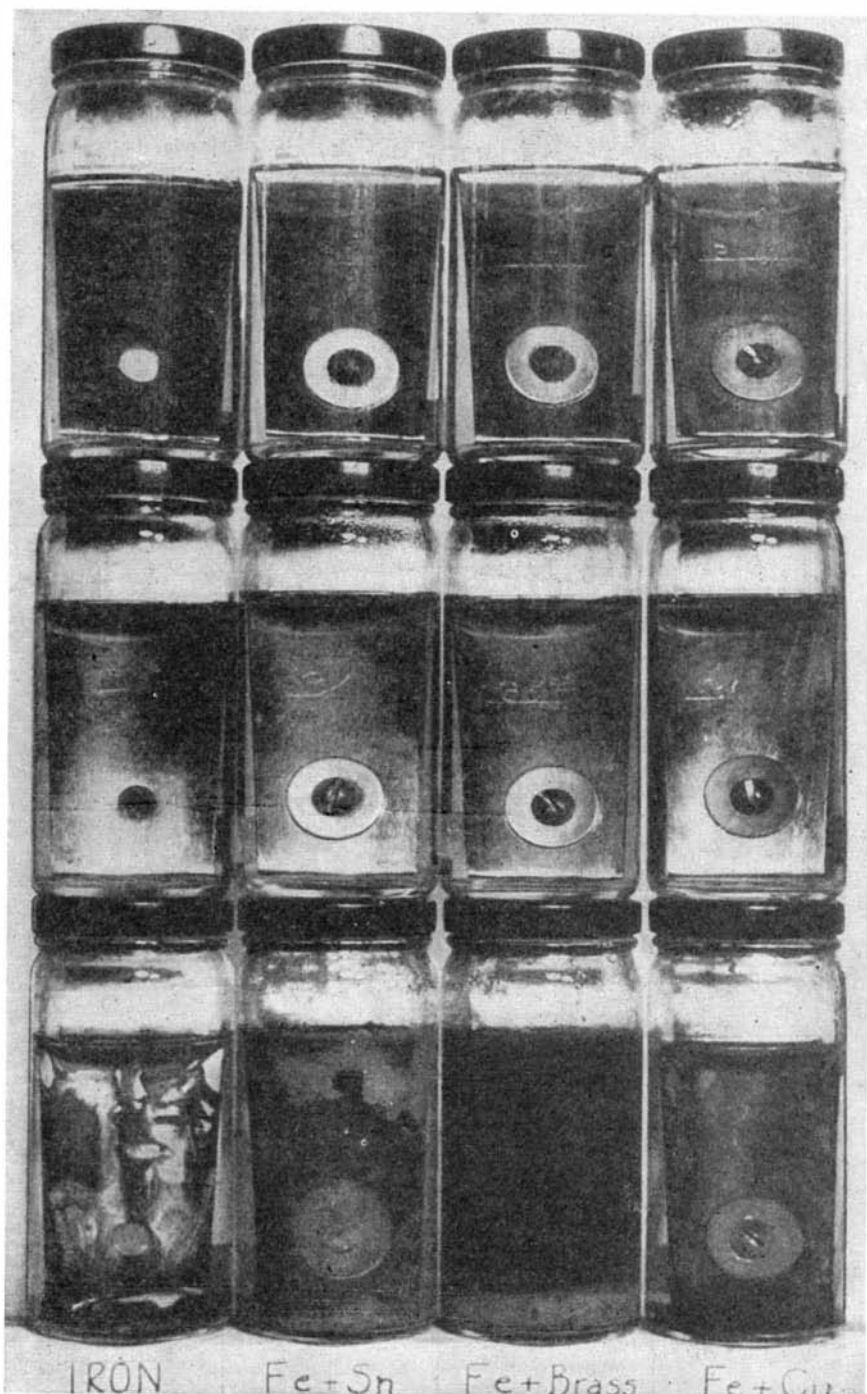
If the demands of war have proved anything, they have shown that our mineral resources are decidedly finite in extent and that already we are approaching limits. We still have plenty of most of the minerals that are important to us, but every indication points to eventual exhaustion of many and severe depletion of others. We shall be soon forced to perfect methods of using lower grade ores; they will yield higher priced metals. Thus, whether we realize it or not, the problems of suppressing rust and corrosion press for solution now and must be solved to relieve the mounting strain on our mineral deposits.

Several important advances in corrosion prevention have been forced by war. Not the least important of these is the wider recognition and use of inhibitors—substances which, added to water in extremely small concentrations, profoundly affect its corrosion char-

Right: Corrosion tests using tap water, and tap water plus inhibitors, to determine effects on iron and combinations of iron and other metals as labeled. Photograph was taken after six months at room temperature. Bottom row of containers hold plain tap water. To containers in second row had been added sodium chromate; to ones in top row, sodium bichromate

Of the Various Methods of Protection Against the Ravages of Corrosion, Inhibitive Treatment Offers Simplicity and Wide Applicability. Corrosion Control Now More Necessary Than Ever as Metals Supplies Dwindle

By D. H. KILLEFFER
Chemical Engineer



acteristics. While agents of this type have long been known, and used, the present situation and the immediate prospect lend particular importance to them.

Most important in the class of inhibitors are silicates, chromates, and phosphates. When any of these is added to water in tiny concentration, it exerts a powerful influence on what happens to metals immersed in the water. Corrosion is prevented, stopped, or materially reduced. Fortunately enough, these agents protect, to useful but variable degrees, all of the common metals ordinarily subject to more or less severe corrosion. That fact became especially important during the war years when other protective means—alloying, plating, and painting—were restricted by lack of required materials. Furthermore, the simplicity and wide applicability of inhibitive treatment make it particularly interesting and valuable.

ELECTROLYTIC ACTION — Basic among causes of corrosion are electrolytic differences between parts of a system made up of metal and water. The metal itself may have areas exposed to the water which differ from each other in composition or in previous treatment. Tiny and otherwise negligible variations may be great enough to set up minute differences of electrolytic potential between them when immersed in water. This may easily happen even on a single piece of sheet metal. If no variation occurs in its composition, so slight a cause as a blow by a hammer or a bend or other deformation may be sufficient to set up a corrosion-promoting potential difference. Because the tiny forces involved continue to act over long periods of time—years and not just minutes—the forces themselves and the effects produced per unit of time need not be great to work grave havoc ultimately. If two quite dissimilar metals such as iron and copper are in contact, the effect may be greatly magnified.

A second and only slightly less important cause of corrosion lies in the creation of electrolytic potential by differences of concentration of substances dissolved in the water. Oxygen, for instance, is only sparingly soluble in water, but becomes so concentrated at the surface of water as to set up severe corrosion at this point on a piece of steel partly immersed. This pronounced effect occurs in milder form wherever an opportunity exists for variations in concentration of dissolved substances to come in contact with submerged metal.

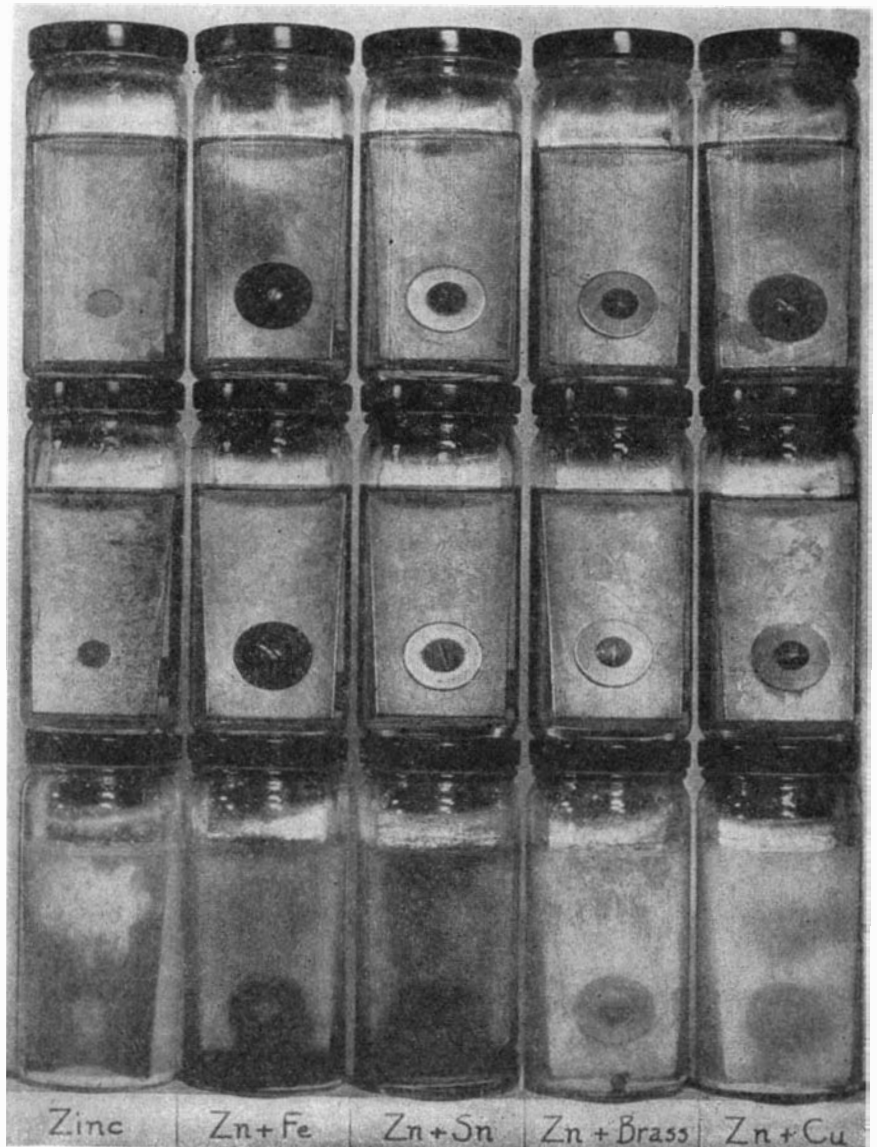
The effect in either of these cases

is to create what amounts to an electric battery. This results in dissolving metal anodic areas and thereby causing corrosion and ultimate failure of the metal part. Experts in corrosion carry this explanation considerably farther, but it suffices to look upon corrosion of submerged or wetted metal as occurring in a miniature of an electric battery where the two plates may actually be different parts of the same metal surface.

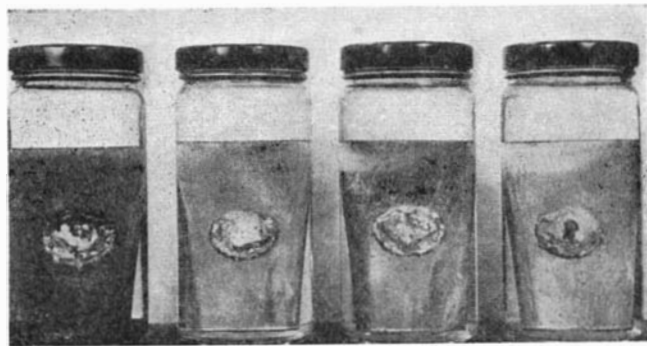
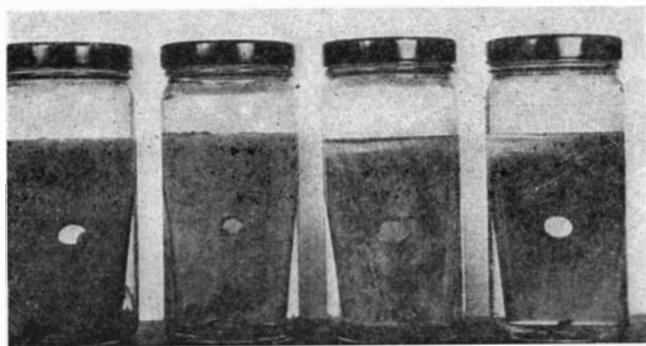
KEEP WATER AWAY — Obviously the most satisfactory way to protect metal under such circumstances is to prevent its contact with the water—the electrolyte. Plating and painting are the obvious methods of applying such protection but neither can be universally employed. It is impractical, for instance, to plate or paint the surfaces of the water channels in the castings of internal combustion engines or in the restricted water passages in radiators of auto-

mobiles. Alloying, too, for the purpose of minimizing potential differences is ordinarily impractical in these items. However, the cooling water of such systems is used over and over by recirculation. That is ideal for inhibitive protection and the addition of tiny amounts of inhibiting substances practically prevents corrosion in the system in spite of the fact that several metals—iron, brass, solder, and so on—are usually present.

Numerous substances have been successfully employed as inhibitors—so many, in fact, that mere naming of them would unduly lengthen and complicate this discussion. Many organic substances—tannin, numerous amino compounds, and certain of the phenols among them—possess inhibitive properties. Several classes of inorganic compounds, notably chromates, silicates, and certain of the phosphates, are similarly effective and are generally applicable in concentrations so small



Corrosion tests on zinc and combinations of zinc with other metals. Conditions and inhibitors used are the same as in the tests on iron, shown on page 161



All illustrations with this article courtesy Mutual Chemical Company of America

Above: Corrosion tests on iron panels submerged in (from left to right) tap water and, respectively, 62.5, 125, and 250 parts per million of sodium chromate. The test jars in the illustration at the right show cathodic protection of iron panels in contact with zinc anodes. Inhibitor used was the same, and in the same

respective concentrations, as in the illustration at the left. Note that cathodic protection due to the zinc was insufficient to prevent corrosion of the first panel but that 62.5 parts per million of chromate produced almost perfect inhibition. Tests were conducted at room temperature over a period of two years.

that any other effect they might have is quite negligible.

These corrosion-inhibiting substances apparently act by forming protective coatings which consist of compounds produced from initially dissolved traces of the metal. For example, a piece of clean iron or steel immersed in a dilute, neutral solution of sodium chromate (25 to 250 parts per million) is quickly covered by an extremely thin film of what may be considered an iron chromate. This film seems to be continuous and self healing in solutions of chromate. It is also insulative even in extremely thin layers and effectively prevents the flow of electric current, essential to corrosion, to and through the solution.

The mechanism of the protective action seems reasonably clear: formation of an insulating and protecting layer over the endangered area by precipitation on it of an insoluble compound of the metal itself. Such an explanation serves admirably for ferrous metals protected by chromates, silicates, and glassy meta-phosphates. The needed concentrations of any of these are so small as to be negligible for most industrial purposes, being conveniently expressed in parts per million rather than as percentages.

CLOSED SYSTEMS—The type of corrosion which lends itself best to inhibitive protection is that encountered in stationary or recirculated water systems. Examples are: cooling systems for internal combustion engines; refrigerating brine systems; hot-water heating systems; air washers of air conditioning systems; boilers of heating systems; and similar installations. In any of these the life of the metal involved can be prolonged many fold and the operating efficiency of the system greatly improved by avoiding the formation of rust and other corrosion products on heat transfer surfaces.

The protection imparted by inhibitors has also been provided by so handling the composition of the water as to create a thin, controlled film of calcium carbonate scale over the ferrous metal surface. Under careful control a crystalline, insulating film of this scale-forming compound can be maintained in piping systems, for instance, to suppress corrosion effectively.

The increasing use of the light metals, aluminum and magnesium, emphasizes greater need than ever before for such protective measures wherever these metals are immersed in water or aqueous solutions. Aluminum readily forms protective anodic coatings of aluminum oxide, as do some of the alloys of magnesium and the pure metal itself when properly treated. Both possess, however, properties quite different from those of iron and the more familiar structural metals and require suitable modification of methods of treatment.

Magnesium is so easily corroded in the pure state that it has found important use in the "sacrificial" protection of pipelines buried in moist corrosive soil. For this purpose, pigs of pure magnesium are buried close to oil pipelines and connected to them by heavy electric conductors. Under these circumstances, the magnesium becomes the anode of an electrolytic system in which the iron of the pipeline is protected as the cathode. Varying the composition of the magnesium ingots permits selection of the most efficient alloy to give adequate protection with minimum consumption of metal.

ONE OF MANY—This by no means exhausts the subject of corrosion prevention. It simply points out the importance of one phase of the attack on a universal problem. The return of alloying and plating elements, now demobilized; improvements in protective coatings, both

temporary and permanent; and new techniques involving dehydrating the air around metal objects in storage are all contributing importantly to reducing corrosion and its drain on our metal resources. But all effective efforts in this direction are useful. Before it is too late, all industry must adopt the slogan: "Rust not—want not."



ARSENIC HAZARDS

Reduced by War-Gas Antidote

BBRITISH scientists are reported to have developed a compound effective against Lewisite, most dreaded of all the war gases. Fortunately unneeded during the war, this compound, 2,3-dimercaptopropanol, called BAL,—British Anti-Lewisite—is expected to be valuable in the treatment of civilian arsenical poisoning occasionally encountered among trades employing arsenic compounds.

NEW ELEMENTS

Possess Atomic Numbers 95 and 96

AATOMIC fission and atomic bombs have resulted, among other things, in the discovery of four new elements having atomic weights and atomic numbers greater than those of uranium, long considered the probable end of the chemists' periodic system of elements. Neptunium and plutonium played important parts in the atomic energy operation. Two other elements have now been discovered which follow neptunium and plutonium in the expected sequence. They have not yet been named. The latest discoveries possess atomic numbers 95 and 96, following uranium as 92, neptunium, 93, and plutonium, 94.

Research For Power

Aircraft Engines, Turbines, and Jets do not "Just Grow." Painstaking Research must Precede even Minor Advances, and Tomorrow's Supersonic Speeds Require Experimental Laboratories Undreamed of Yesterday. The NACA Engine Laboratory at Cleveland Meets these Needs

By ALEXANDER KLEMIN

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

FLIGHT at sonic or supersonic speeds points with new emphasis to the need for laboratories for fundamental aeronautical research. Paper and pencil and slide-rules, coupled with actual flight test can, respectively, pave the way for, and prove, technical advances. But fundamental research calls for high-speed wind tunnels; for wind tunnels that can simulate the conditions present at extreme altitudes; and for extensive precision equipment.

Outstanding among the aircraft engine research facilities of this type is the new Cleveland Aircraft Engine Laboratory operated by the National Advisory Committee for Aeronautics, of which Dr. G. W. Lewis is the able director. Whereas other NACA laboratories are largely specialized in aerodynamic research, the \$24,000,000 Cleveland Laboratory devotes 15 large buildings—the Engine Research Building alone comprises five and one half acres of floor space—to all the elements of the power plant; the engine itself and its many accessories.

The Altitude Wind Tunnel, of particular interest even in this wealth of equipment, is probably the only one of its kind in the world. Here, expensive, difficult, and sometimes inaccurate flight testing is supplanted by operation of complete aircraft propulsion installations under precise temperature, humidity, and pressure conditions such as would be found at 30,000 feet. Moreover, pressure conditions up to 50,000 feet can be simulated, and when the full 50,000 horsepower available to the tunnel is employed, air speeds as high as 500 miles per hour may be obtained. Temperature controls for the tunnel require the world's largest refrigeration plant with a capacity equivalent to 20,000,000 pounds of ice daily.

TURBINE RESEARCH—But interesting as the tunnel is in itself, the projects tested in it are of even greater interest. Considerable work is being done on gas turbines and "compound engines" of various types. Gas turbine driven propellers

• LOOKING AHEAD •

Economical 500-mile-per-hour transports a possibility within the next five years. . . Gas turbine plus conventional engine combination points way toward increased payload. . . Athodyd engines offer possibilities of supersonic plane speeds. . . Icing of plane parts still being studied.

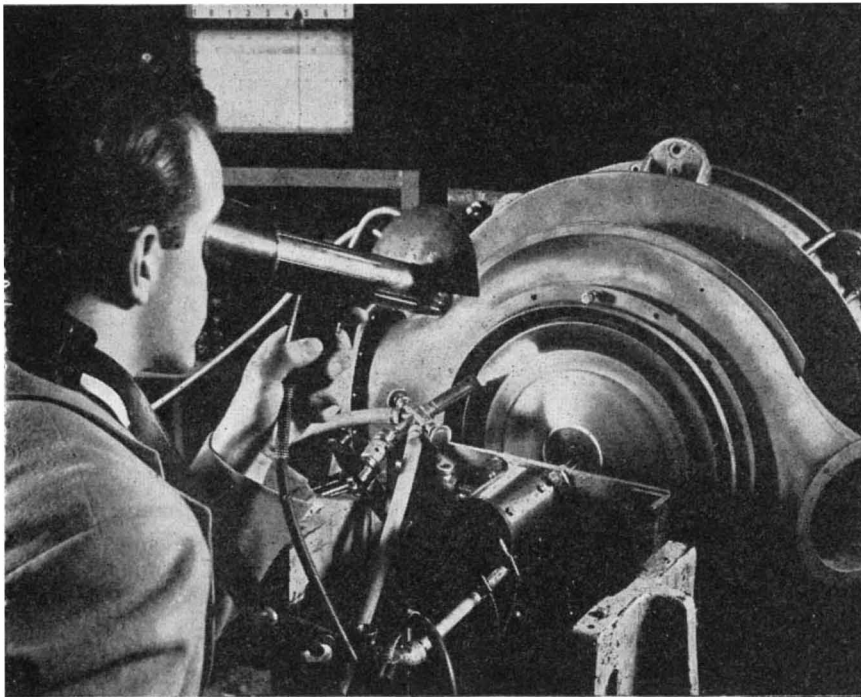
—described by some authorities as making economical 500-mile-per-hour transports a possibility within the next five years—are being tested and compared with "compound engines." The latter term is applied to a reciprocating engine combined with an exhaust-driven gas turbine which is geared to the engine crankshaft. Further reports describe "blow-down" turbines that incorporate siamese exhaust stack arrangements through which gases are fed to separate turbine nozzles from each engine cylinder.

The following results are an excellent illustration of the valuable data obtainable through experiments in the altitude wind-tunnel. The engine used in each of the three combinations was a conventional Pratt and Whitney reciprocating design of the radial type and with 2800 cubic inches piston displacement. The three combinations tested were: the engine with a standard turbo-supercharger; the engine with a steady-flow exhaust-gas turbine geared to the crankshaft; and the engine with a "blow-down" turbine and steady-flow turbine in series. Fuel consumptions for the three combinations were: .41, .34, and .30 pounds per brake horsepower hour respectively. While the importance of these fuel consumption differentials may not be apparent when

viewed alone, they loom surprisingly large when viewed in terms of payload. If, for example, the .11 pounds per brake horsepower hour differential between the turbo-supercharger and the "blow-down" plus steady flow turbine combination could be maintained under flight conditions, the slight margin of fuel saved would amount to approximately 25 more passengers or 5000 pounds of cargo on a 10 hour flight. This is based on a four-engine plane and an estimated passenger-plus-baggage weight of 200 pounds.

Another important altitude tunnel project is concerned with increasing the thrust of turbo-jet engines during take-off and climb. The low thrust, characteristic of jets under slow-speed conditions, has been augmented in wind-tunnel tests in three ways: water-alcohol injection in combination with an adjustable tail-pipe nozzle; combustion in the tail pipe; and an auxiliary combustion chamber and nozzle plus water-alcohol injection. Flight tests have confirmed wind-tunnel findings of increased thrust and shortened take-off runs.

Gas-turbine and turbo-jet investigations at the Cleveland laboratory are not, however, confined to overall measurements of thrust and propulsive efficiency. The most minute operating parts in turbine engines must function unflinchingly, usually under conditions of extreme heat, pressure, and speed. Typical of the research efforts concerned with elements rather than entire units, are the programs aimed at improving the design of turbine blades and compressor impellers. Maximum turbine efficiency, from the thermodynamic standpoint, requires high initial temperatures for



the incoming gases. But this desirable factor must be weighed against the ability of the metal turbine wheels to withstand the high gas velocities, temperatures, and rotational speeds involved. Ordinary metals would be short-lived in such an application. Present metals stand up amazingly well when the severity of the service is considered. But the road to the ultimate in turbine efficiency and blade life is now being scouted at Cleveland with laboratory equipment designed to simulate actual operating conditions. By rotating the wheels under intense heat and pressure, while engineers make close observation of the temperatures and other variables, design features effecting power output and blade life may be accurately evaluated and analyzed.

Similar testing is carried out on the impeller unit of the compressor—needed to compress the fuel-air mixture before burning—to insure that the impellers have the required strength at high rotational speeds. Frequently the impellers are tested to the point of destruction by rotating them so fast that they burst apart.

ATHODYDS—Turning from problems involving reciprocating engines and turbines to the pure ram-jet or athodyd engine, entirely new methods of research become necessary. Although it appears that this type of engine alone can bring planes into the supersonic speed range, singular research difficulties are encountered. These difficulties hinge on the vast amounts of outside air required for athodyd combustion and the extreme speeds at which

If test results are to be accurate, aviation research must simulate actual flight conditions.

Above: Testing gas turbine blades with heat;

Right: Measuring ice build-up on test antenna in icing tunnel



this air must be handled. Under such circumstances, the air-flow patterns differ considerably from those obtained at normal speeds. Consequently, it was necessary to construct a "supersonic-propulsion-research" wind tunnel. An integral part of the altitude tunnel, the supersonic tunnel uses the former's air conditioning equipment and exhaust system but provides wind velocities equivalent to 2000 miles per hour, or well into the supersonic range. The supersonic tunnel has a cross section of only two and one quarter square feet—explaining in part the high velocities obtained—and provides a means of mounting the model so that all aerodynamic forces as well as thrust may be measured.

The athodyd tested at Cleveland consists of a long tube with interior passages carefully shaped to take maximum advantage of the ram action of the fuel-air inlets, and an electrical source of heat to ignite the fuel. At low Mach numbers—the ratio of the air speed to the speed of sound—the athodyd's fuel consumption is prohibitively high. But when the Mach number is two—the speed of the air twice the speed of

sound—the fuel consumption is only .8 pounds per thrust horsepower hour. This alone makes the athodyd highly promising for the so-called "super-aviation" of the future.

Visualization of the air flow as well as measurement of the forces involved, is extremely helpful in studying these high-speed power plants. For this purpose, a "Schlieren" camera—old in principle but new in application—is used. The Schlieren camera depends on the change in the air's index of optical refraction that accompanies a change in air density. This principle, aided by strong electrical sparks, provides photographs which show regions of varying air density and enable the skilled interpreter to determine

regions of compressibility shock. Further investigations are then carried out to find means of avoiding these shocks by appropriate aerodynamic changes.

FLIGHT TEST—Ultimately, power plant installations must be tested in flight, and the first flight always involves certain critical factors. In particular, it is most important that the engine be adequately cooled. Accordingly, the Cleveland Laboratory has devised a portable blower capable of producing a 250 mile-per-hour blast for test cooling prior to take-off. This portable blower helps reduce any element of doubt that might exist as to engine cooling.

Modern aircraft research equipment is too complex for flight observation by one or two men, no matter how skilled and efficient. Personal observers are replaced as much as possible by automatic recording devices and on a single flight of a B-24 bomber with experimental equipment, 10,000 readings can be obtained and recorded. Nevertheless, well protected research workers, complete with heated suit and oxygen mask, are still needed to observe and operate

the many instruments and recording devices connected to various parts of the airplane or power plant.

The trend of modern airplane operation indicates future all-weather operation, immune to wind, fog, and ice. Wind no longer stops an airplane, and its effects will be less and less as cruising speeds go up. Fog will be met, it is now hoped, by radar and other blind flying devices. But ice formation, in spite of de-icer boots and exhaust-gas heating of the leading edge of the airfoils, still constitutes a problem. The NACA is therefore continuing and expanding its investigations of icing with such equipment as the Ice Research Tunnel. This tunnel consists of three sections: the first six feet by nine feet for studying engines, cowls, and wings; a larger 12 by 15 foot section for work on propellers; and the largest, 26 by 29½ feet for tests on helicopter rotors. So far there has been no reported instance of helicopter rotors icing up, but the possibility must exist. Temperatures in the icing tunnel can be reduced to minus 60 degrees, Fahrenheit, and the air speed can be raised to 400 miles per hour. Accurate controls of temperatures, spray drop sizes, and air speeds to simulate any flight conditions are obtainable. Measurement of the thickness of ice deposited in a given period of time is an important element of research and one that varies greatly with meteorological and operational factors.

Another project of considerable practical importance is directed towards a reduction of fuel vapor loss. When gasoline in airplane tanks or drums is subjected to the heat of the sun at ground level, and is then carried up to altitudes of 15,000 feet or more, the fuel literally boils away, and the range of aircraft may be greatly reduced. It is reported that on one experimental flight of a B-29, vaporization loss started at 15,000 feet, amounted to 450 gallons out of 8000 gallons at 25,000 feet, and 900 gallons at 35,000 feet—equivalent to a payload loss of 2¼ tons. There is a further loss due to foaming, which increases with rate of climb. In the NACA investigation of boiling and foaming problems, three remedies are under consideration. One is the use of intercoolers similar to those used in superchargers; another is pre-cooling of the fuel on the ground; and the other is pressurization of the fuel so that the boiling away process is checked.

Although the NACA Engine Laboratory does not actually design and build engines, it is charged with providing designers and con-

structors with fundamental information of the highest value. During the war, Langley Field, Moffett Field, and Cleveland necessarily concentrated their efforts on aiding the Army and Navy, or helping the airplane and engine contractors working for the Army and Navy. Now, part of the research of the NACA will undoubtedly be focused on peace-time aviation.



BELL JAR

Provides Made-to-Order "Altitude" for Aircraft Ignition Research

FOR TESTING aircraft engine ignition under altitude conditions, a new bell jar has been developed by Wright Aeronautical Corporation. Two troubles are common to aircraft ignition systems: corona, a faint violet light indicating electrical leakage around ignition system parts which are under high electrical stress; and flashover, due to moisture, which permits energy to go to "ground" instead of to the spark plug. Both troubles are more likely to occur in the thin air and low temperatures of high altitude. The bell jar, providing varying atmospheric conditions and sealed by its own weight on a rubber gasket at its base, consists of a 350-pound Plexiglas dome, built by Rohm and Haas from basic Wright designs.

The ignition harness is mounted within the dome in the same position as in actual operation. Spark plugs are set into spark plug bombs, with the bombs set up on a spoke-like arrangement of nine arms

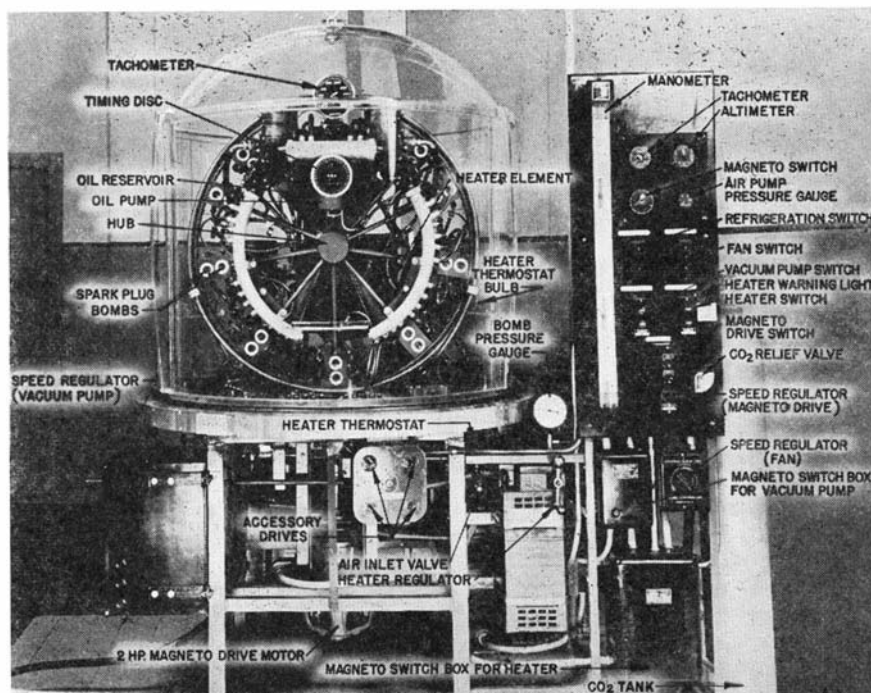
stemming from a central hub. Each bomb carries four plugs and has a window for observation purposes.

To simulate the hot gases and fuel mixture of an actual engine, carbon dioxide under pressure, is supplied to each of the bombs. An electrical motor drives the magneto and distributors and progress of the ignition cycle can be checked by a timing disk. Pressure inside the bell jar is reduced very quickly by an aircraft vacuum pump to the equivalent of a 65,000-foot altitude, while a special refrigerating system and an electric heater give rapid and powerful temperature control. The bell jar has proved invaluable in ignition research, and enables data to be obtained in a few hours in the laboratory which could otherwise be obtained only by hours of expensive test flights.

HELICOPTER RECORDS

Prove Design Progress as Well as Aircraft's Abilities

NEW HELICOPTER records were recently established when a Sikorsky R-5, flown light, reached an altitude of 21,000 feet. With 16 people seated on benches secured to the landing gear, and one extra passenger inside the cabin—a total load of about 27000 pounds—the rotary-winged craft hovered 10 or 15 feet off the ground. Top speed—light—with a 450-horsepower Wasp engine and an estimated gross weight of over 4000 pounds, was recorded as 114.6 miles per hour. This compares with a 76 miles per hour record speed set by a Focke helicopter only seven years ago.



Simulation of many high-altitude ignition variables requires complex controls

'Alloyed' Oils

No Longer Dependent on any Particular Crudes for Top Quality Engine Oils, Lubricant Manufacturers Can Now Refine Severely, then Build Oils to Specific Jobs. Chemical Additives are the Answer

By A. BRUCE BOEHM

Assistant Manager, Paraffin Sales Division, Stanco Distributors, Incorporated (Subsidiary, Standard Oil Company, New Jersey)

HIGHER speeds, higher loads, higher pressures, higher temperatures, leaner fuel-air ratios, and thermally-cracked fuels all tend to cause oil deterioration in modern engines. These increasingly severe conditions occur in both Diesel and gasoline engines. And they call for new oils—oils that are resistant to deterioration in the crankcase—and

● **LOOKING AHEAD** ●
 Lubricating oils for gasoline and Diesel engines can now be "tailor-made" for specific purposes. . . New lubricants can keep engines clean, prevent formation of gum and varnish, and be made with controlled viscosity. . . All of which points toward greater economy for commercial fleet operators—and even for the individual motorist. . . Less wear on engine parts and reduced corrosion will mean reduced maintenance costs.

and other parts of the engine. Alloy bearings have suffered from corrosion brought about by severely oxidized oil. Sludge deposits have formed in the valve chambers, crankcase, and elsewhere to give harmful, dirty, engine conditions. All this meant expense to the engine operator—expense for maintenance, repair, and for idle equipment.

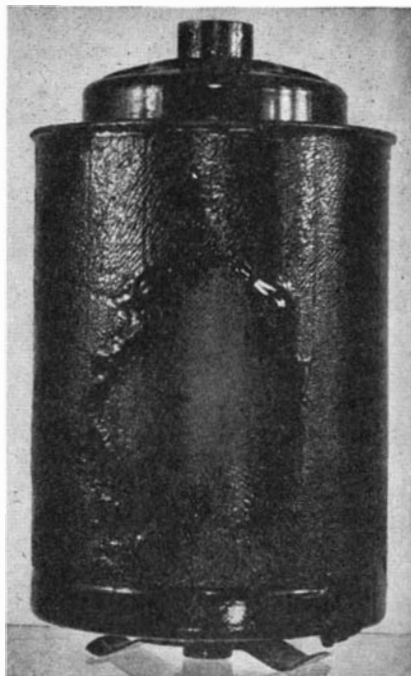
Not all users of motor oil, of course, had these worries. Fortunately, such troubles have generally been confined to engines in heavy duty service. But as engine development continues, more and more equipment is coming within this rather broad "heavy duty" classification.

Petroleum refiners, aware of the new demands thus brought about, have directed a tremendous amount of research towards the development of oils that will solve the most severe lubrication problems. Such oils, to meet the service requirements, must be able to improve engine cleanliness substantially, provide really trouble-free lubrication of pistons and rings, and minimize any excessive wear that may be experienced under heavy-duty conditions. Moreover, these oils must

be non-corrosive with respect to bearing alloys, and must remain so under the most severe use.

Just as the steel industry turns to alloy steels for tough jobs, so has the petroleum industry turned to what might be thought of as "alloyed" oils.

ADDITIVES—To make heavy-duty oils, special substances are added to well-refined petroleum oils. These substances, often complex chemical compounds, and generally used in relatively small proportions, are known as "additives." Additives have been defined as chemical compounds not normally present in a refined oil, which give certain properties not possessed by the oil, or



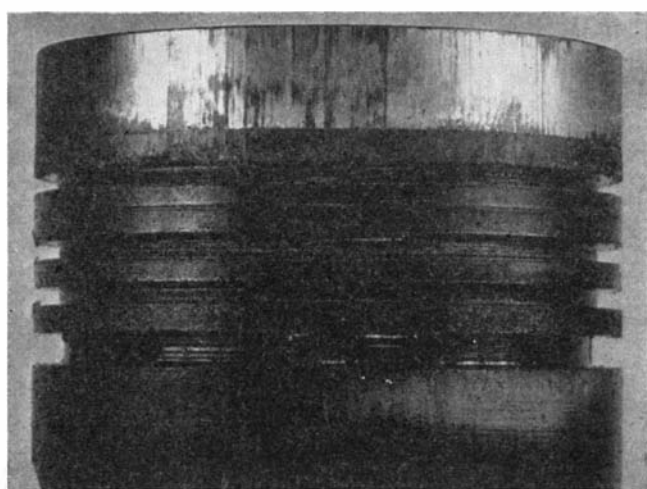
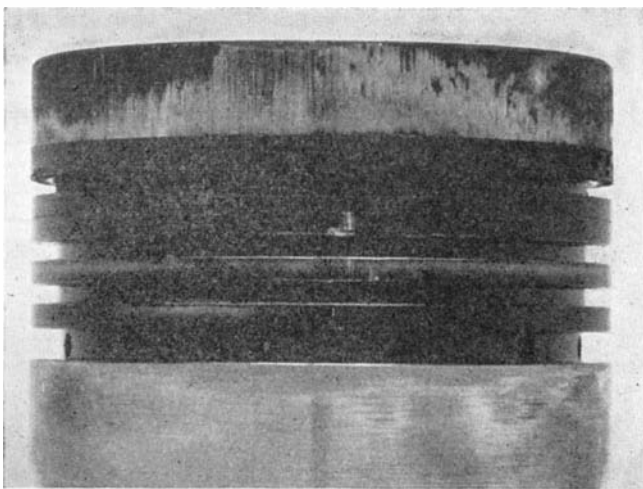
Oil filter after 300 hours operation on good motor oil without detergent

that lubricate without breaking down on the flame-bathed pistons, cylinders, and valves.

Stuck piston rings have been the nightmare of operators of high-speed Diesel and heavy-duty gasoline engines. Even the best oils have, at times, been unable to prevent deposits in the ring zone and formation of "varnish" on the piston skirts



Remarkably clean, this oil filter was operated 300 hours on detergent oil



Photographs courtesy Standard Oil Company (New Jersey)

Piston ring grooves respond well to detergents—300 hour runs on (left) detergent, and (right) non-detergent oils

improve on properties already possessed by the oil. Various classifications of additives have been made. From the standpoint of engine cleanliness, the most important classes are detergents or dispersing agents, anti-oxidants, and anti-foaming agents. Besides these, there are oiliness or extreme pressure agents, pour depressants, and viscosity controllers.

Adding modifying agents to petroleum oils is not in itself new. "Compounded" oils, dating from the early days of petroleum, are related to oils containing additives. Perhaps one of the first motor oil additives, in the modern sense, was Paraflow, a synthetic-wax-naphthalene compound which altered the way in which wax crystallized in lubricating oil on chilling. With it, oil remained fluid far below its normal solidification temperature or "pour point." Detergency and other features of modern heavy-duty oils were not, however, considered at that time.

DETERGENTS—The function of detergents is to maintain an engine in a clean condition in spite of such contaminants as soot collected in the crankcase oil from combustion chamber blow-by, oil partially burned to carbonaceous material, and other oxidation products. These contaminants, in the absence of a detergent, would gradually accumulate as troublesome carbon, sludge, or varnish deposits on engine parts. With a detergent, they remain dispersed in the oil, or else deposit as a harmless, fluffy sediment. In the case of an engine already fouled by operation with a non-detergent oil, a detergent should help to clean the engine.

Some oils possess natural detergent properties to a greater extent than others. Early in the development of additives, only the

naphthenic type of oils—those possessing relatively high detergency—could be improved by added detergents. Newer detergents, however, are effective in all types of lubricating oils, making it possible to take advantage of any desired characteristics inherent in lubricating oils from different crudes.

One of the most important properties of a detergent or dispersing agent is the ability to hold finely divided solid particles dispersed throughout the oil. Mechanically, the result is similar to the action of soapy water. Soap in water lowers the inter-facial tension between water and dirt particles. This allows wetting of the insoluble particles so they may be held dispersed in the water. In a like manner, detergents enable oil to wet and hold in dispersion the particles of impurities that find their way into the crankcase. In an engine, dispersing agents hinder the settling of sooty material or carbon particles; they hold them in the oil where they can be drained out, and thus prevent their retention in the engine.

To be satisfactory as an oil detergent, a substance must not impair lubrication. Equally important, it must have a high boiling point, otherwise it will evaporate so fast as to become ineffective at engine operating temperatures. For example, a detergent that evaporated readily at 300 degrees, Fahrenheit, would not adequately wash hot engine parts and inhibit formation of varnish. High boiling points together with high solvency characteristics are prime requirements for detergents. On the other hand, the solvency characteristics of an effective detergent for lubricating oil must not be such that it will remove the lubricant from metal surfaces.

The chemical constitution of additives gives little indication of their action. Detergents or dispersants in-

clude chemical compounds of almost every type, although some of the more effective appear to be metallic derivatives of organic compounds, often with sulfur somewhere in the molecule. Among substances patented for use as detergents have been organo-metallic and other metal compounds, metal phenolates, acids, esters, various condensation products, and others.

To satisfy the dual requirement of solubility in oil plus high boiling points, detergents are generally high molecular weight compounds. Metal components of the molecules that have been suggested include aluminum, barium, calcium, cobalt, and magnesium. Barium compounds of alkylated phenols, sometimes further converted to sulfides, are among patented detergent additives

ANTI-OXIDANTS — Oxidation of lubricating oils causes the formation of varnish on pistons, sludge, deposits of various sorts, and organic acids corrosive to bearing metals. High resistance to oxidation is, therefore, one of the most important characteristics of an oil. Indeed, much of the need for detergents and dispersing agents comes from the undesirable products of oil oxidation. And where an oil is highly refined to reduce the formation of these products, corrosive acids may develop in the oil in service. The purpose of anti-oxidants is to inhibit oxidation of the oil under crankcase conditions.

Anti-oxidants have long been studied for turbine oils and transformer oils where a very long useful life is expected of the oil. Consequently, anti-oxidants represent the largest single field of patented additives. Anti-oxidants, or inhibitors, are really negative catalysts that prevent oxygen in the air from attacking the oil. Chemicals suggested for this purpose include sul-

fur and sulfur compounds of various types such as sulfides, hydroxy sulfides, and many others; amines and other nitrogen compounds; phenols; phosphorous compounds; organo-metallic and other metallic compounds; plus many miscellaneous agents.

By combining detergency, dispersing ability, and oxidation inhibition, "inhibitor-dispersant" type motor oils were made that gave outstanding service during the war. Inhibitor-dispersants can be used effectively in any type of motor oil whether it is more or less highly refined and whether it is of paraffinic or naphthenic base crude. They can increase the service and dependability of any motor oil, especially under severe conditions. In short, these additives can give results that are otherwise unobtainable even with the best oil the refiner can produce.

Additives sometimes have a tendency to make oils foam when agitated with air. Factors of surface tension, which make the additives effective, also favor foaming. Foaming may be injurious through loss of oil or, where less severe, by reducing the crankcase oil surface cooling capacity, resulting in increased crankcase oil temperature. Although many substances have been tested as anti-foaming agents, by far the most effective are certain silicones of which a small fraction of 1 percent is sufficient to prevent foam formation.

OTHER ADDITIVES—Cold weather starting may depend wholly upon the viscosity of the crankcase oil at the existing temperature. Viscosity increases markedly between normal summer temperatures and zero degrees, Fahrenheit. The extent of these changes in viscosity with temperature is termed Viscosity Index or "V. I." The best natural lubricating oils from paraffin base crudes have about 100 V. I. as compared with much lower V. I.'s for other types of lubricating oils, whose characteristics vary more seriously with temperature changes. Although original detergent type oils were of low V. I., newer type additives are able to make good detergent oils from high V. I. lubricating oils. However, highly treated paraffin type natural lubricating oils cannot be made to have much over 100 V. I. For higher V. I.'s, special additives are required. Among the first of these were polybutenes—thick, sticky substances made by polymerization of refinery gases. These substances, when dissolved in oils, raise the viscosity of the oils somewhat, but raise the V. I. to a much greater

extent. Certain esters and other non-hydrocarbon materials are also effective V. I. improvers.

For oiliness agents, extreme pressure agents, and pour point depressants, a large number of additives have been suggested. Additives for the first two include sulfur compounds, halogen compounds, phosphorous compounds, oxygen compounds, metal compounds, and miscellaneous substances. For pour point depressants they include hydrocarbons, halogen compounds, oxygen compounds, nitrogen compounds, metal compounds, and other materials. Crankcase oils, whether for high-speed automotive Diesels or heavy-duty gasoline engines, do not require extreme pressure additives. However, some investigators claim added lubrication value and lower wear from the use of oiliness additives. Pour point depressants, on the other hand, particularly the wax-paraffin hydrocarbon additives, have been quite generally used in motor oils. For the most part, individual additives have specific properties, but efforts are being made to prepare single complicated compounds that might have several different characteristics.

COMMERCIAL "H-D" OILS — For peace-time use, motor oils containing additives have been grouped, by the American Petroleum Institute, into two classes: "Heavy-Duty Oils" which meet the military specifications, as established during the war for all-purpose heavy-duty oils; and "Premium Oils" which must show good oxidation and bearing corrosion resistance, but permit less dispersant effect than called for in Heavy-Duty Oils.

Use of these motor oil additives is another illustration of the trend toward making special products for special uses. Petroleum refiners no longer depend completely upon the gasoline existing in crude oil for the quantity and quality of the aviation gasoline they require, but through cracking and synthesizing they make additional quantities of gasoline of superior quality. Similarly, refiners no longer need depend upon the specific type of crude oil for the final quality of the lubricating oils they manufacture. By severe refining of lubricating oil stocks, the refined oil is completely free of any impurities harmful to its use as a lubricant. Through additives, the quality of the oil is then made to excel the best oil that could be obtained directly from any crude source. The demand for improved performance of motor oils has arisen from the new standards of performance developed during the war and the con-

tinuous gradual shift to engine design and operating conditions that are harder on the oil. Improved oil is coming from the petroleum industry's new source of quality and performance—chemical additives.



CORN EARWORM

*Stopped by Mechanical
Injection of Oil Mixture*

INJECTING a very small amount of a heavy, highly refined mineral oil combined with an insecticide into the silk channels of sweet corn is the most effective and practical means available for combating corn earworm, according to reports from the New York State Agricultural Experiment Station.

"While further experimental work toward better control methods is in progress," says Dr. L. A. Carruth, Station entomologist, "this form of control of the corn earworm deserves wider usage by growers in sections where the pest is a problem."

Ordinarily, the insect is most troublesome on Long Island and other areas near New York City, although it may appear in serious numbers in other sweet-corn growing sections of the state as well. The pest is generally most serious from mid-August to the end of the growing season. The mineral oil treatment involves the individual treatment of each ear with a carefully measured quantity of the oil-insecticide preparation about four days after the emergence of the silks. Best results have been obtained with mixtures containing pyrethrum, dichlorethyl ether, or styrene dibromide as the active ingredient. Commercial oil-insecticide mixtures for this purpose are now available.

The maximum dosage permissible without danger of injury to the ear is one-fiftieth fluid ounce, and some sort of mechanical applicator is required to insure the correct dosage. On this basis, a gallon of the oil-insecticide combination should treat 6400 ears, or more than half the average production of an acre of sweet corn. The time required depends on the operator, but it should be possible to treat from 1000 to 1200 ears an hour, says Dr. Carruth. Unfortunately, this treatment will have no effect on the European corn borer nor will control measures aimed at the corn borer have any effect on the corn earworm, it is explained.

Plastics Precede Production

Familiar to All in Their Manifold Applications as Finished Products, Plastics Aren't so Well Known as Highly Usable Experimental Materials. Here, an Inventor Plans with Plastics and Develops a Meat-Saving Germicidal Lamp Unit. Casting Plastics Paved Way for Molded Product

By CLARK SIMMONS

WHEN A MAN engaged in the meat-cutting equipment business—producing saws, cube-steak machines, and like items—combines his energies and perseverance with some of the latest scientific developments, it is natural, perhaps, that the appliance he perfects will have direct implications to the meat industry. At least that's what happened when J. L. Suter started working on a new unit for standard germicidal lamps that would stand up under meat-cooler conditions of low temperature and high humidity. When he finished, the lamp spelled lower cold-storage losses to meat-market operators, and promises wide uses in other places.

The need for such an appliance is not, of course, new. Meat deterioration from mold, shrinkage,

and odors is an old problem. Neither are germicidal lamps entirely new; it has been recognized for some time that ultra-violet rays will reduce losses during meat storage. But two things were new, or at least clever, about Mr. Suter's development. One was the way he used casting plastics for experimenting on the limited means available to him. The other was the successful solving of the moisture and corrosion problems that occur when an electrical device is placed in the atmosphere of a meat cooler.

Fundamentally, the success of the lamp unit depended upon finding a suitable design and material for fixtures to house the miniature transformer, starter mechanism, and wiring located at each end of the standard tube-shaped lamp. The housing fixture caps had to provide a maxi-

● LOOKING AHEAD ●

Small manufacturers and experimenters, and large ones too, will find wider usage for casting resins. . . Low-cost plaster molds combine with complete formability of the resins to allow complex shapes in otherwise expensive experimental parts. . . Not to be overlooked are the possibilities for quickly-made production jigs of the same casting resins.

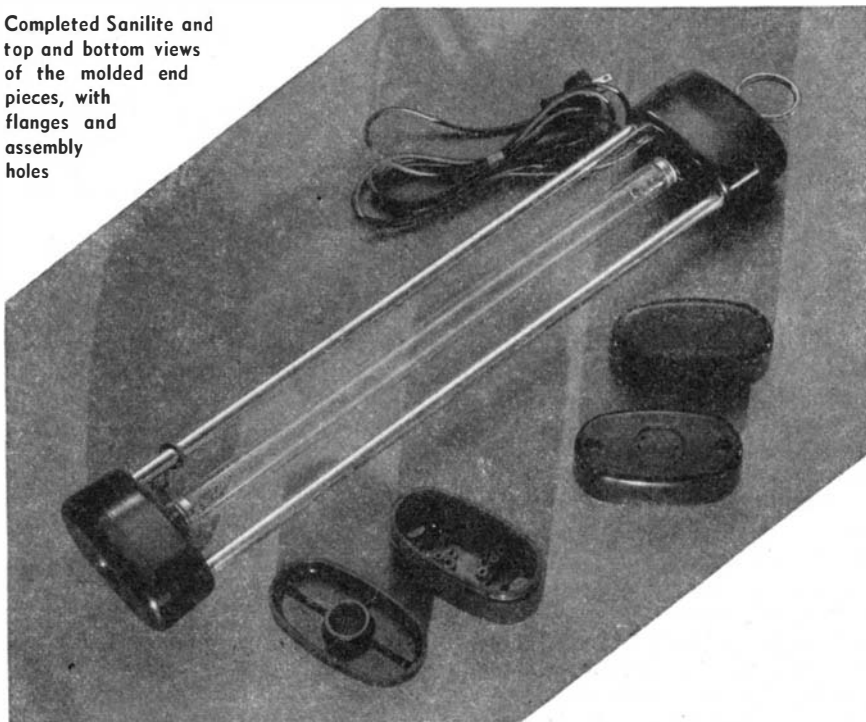
imum of protection against the low temperatures and relatively high humidities which Mr. Suter knew existed in refrigerators and meat show-cases. Furthermore, the fixture cap material had to lend itself to quick and economical production. Clearly, research was necessary.

When the basic design problems of the fixture caps had been worked out on paper, several sets of experimental caps were made up from a casting resin, using inexpensive plaster-of-Paris molds. Use of this Durez phenolic casting resin gave a flexible and easily handled material. Moreover, according to Mr. Suter, the economy and suitability of the material for small scale experiments were largely responsible for his ultimate success in developing the Sanilite lamp unit into a mass-producible article.

Changes had to be made in the experimental fixtures. Sometimes, the changes were small, and the excellent machinability of the casting resin permitted them to be worked in without recasting. Sometimes, problems showed up that required starting over with new castings for further tests. But Mr. Suter went on; many sets of caps were cast and finally the last design-bugs were eliminated. Now, since casting resin was not an economical production material, the problem changed to the selection of a substance suitable for quantity production runs of the fixture caps.

Plainly, conditions indicated a non-hygroscopic material with first grade dielectric qualities. Stainless steel rods carrying electrical wires ran end to end on the lamp unit,

Completed Sanilite and top and bottom views of the molded end pieces, with flanges and assembly holes



and these had to be embedded in the end fixtures with a moisture-proof joint. Non-corrosiveness, low thermal expansion characteristics, and self insulation were "musts." Therefore, it was decided to mold the cap fixtures of Durez phenolic molding compound which also possessed the desired properties.

Each cap was designed in two halves. Molding allowed the required flanges to be integral and the assembly-hole openings did not have to be drilled later. Orders for steel molds were placed. The details, worked out in casting resin, were known to be correct. Production got under way, and the four molded pieces for the lamp unit, the results of so much effort and experiment, are now being made for the Sanilite Company by the Grigoleit Company.

On the assembly line, Mr. Suter once more loosed his ingenuity with the casting resin—this time to make up quick and inexpensive jigs. The characteristics of this material made it possible to cast a jig and have it in operation in less time than would be required to make up the drawings for a part fabricated from more conventional materials.

From the standpoint of the butcher who uses Suter's Sanilite unit in his show-cases and refrigerator, the hard work and experiment were something more than worthwhile. The ultra-violet rays emitted by the lamp prevent slime and mold from forming on the meats. Odors are thus eliminated and coolers may be operated at substantially higher temperatures, reducing both meat shrinkage and cooler operating expense. The unit is trouble-free due to its moisture-proof construction and resistance to the corrosion found in meat coolers.

The lamp unit should find other applications in such places as food processing plants, hospitals, and schools; nearly anywhere, in fact, where a sterile atmosphere is desirable. Sanilite is one of these "small business" developments that has succeeded—in the words of the developer and producer—"thanks to the co-operation of the plastics manufacturer and molder."

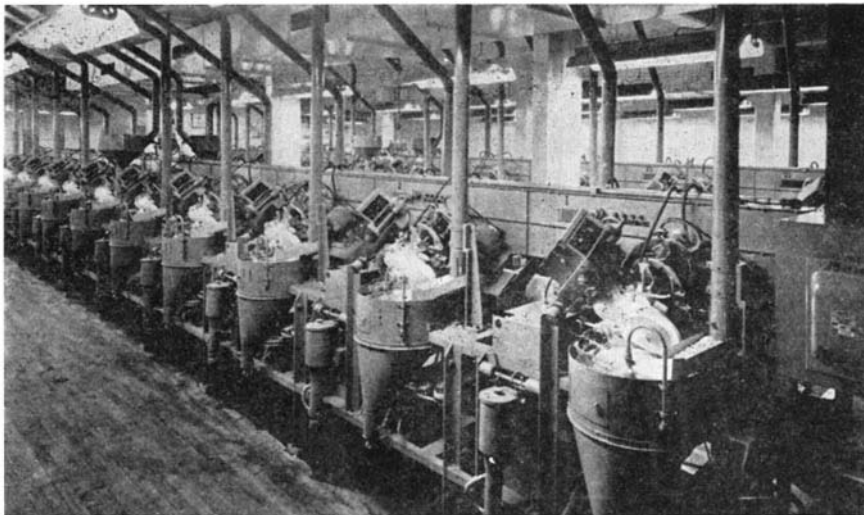


BEAN SORTING

*Only One of Many Jobs
Now Done Automatically*

AIDED BY one of the growing industrial uses of electron tubes, the formerly tedious task of sorting beans—and other things—now becomes a speedy, automatic operation.

Equipped with a couple of photo-



A bank of electronic bean sorters—separation is based on beans' color range

tubes for eyes and a cathode-ray tube for a brain, the electronic sorting machine, according to the Tube Division of the Radio Corporation of America, "looks" at each bean individually and separates the good ones from the bad ones much faster and more accurately than could human sorters.

Approximately 1000 of these "super sorters," all manufactured by the Electric Sorting Machine Company, are now sorting about one and one-half million pounds of food each day in plants from California to Virginia and in Canada. Each installation consists of at least 16 machines. The foods include beans of various kinds, seed corn, peanuts, coffee, and even potatoes.

In the sorting of beans, for example, acceptance or rejection of each one depends on the respective percentages of red and green light reflected by it. The mechanical design of the machine provides for feeding the beans, one at a time, through an optical system consisting of an incandescent lamp, a focusing lens, two mirrors, and two phototubes.

Light from the lamp is reflected by the bean through the lens to the first of the two mirrors. This mirror is what is known as a "partial" mirror or "50 percent" mirror. It reflects part of the light through a red color filter to the first phototube, but transmits another part of the light to the second mirror, which reflects it through a green color filter to the second phototube. The first phototube is especially sensitive to red light, the second to green light.

The output of each phototube is amplified and fed to one of the two pairs of deflection plates of a cathode-ray tube. This permits one phototube to control the horizontal sweep of the electron beam in the cathode-ray tube, while the other phototube controls the vertical

sweep of the beam. The degree to which the beam is deflected in either direction is governed by the respective amounts of red and green light reaching the phototubes.

A partial mask covers that part of the face of the cathode-ray tube on which the electron beam will appear when controlled by the color range of an acceptable bean. When a bad bean passes through the optical system, the color of the reflected light affects the output of the phototubes, and this in turn alters the sweep of the electron beam so that it appears outside the mask. Any position of the electron beam outside of the masked area actuates a third phototube whose output is amplified to operate an ejector mechanism which rejects the faulty bean.

Although the steps involved seem numerous in a description, the action is virtually instantaneous. The sorting of foodstuffs is one of the long and growing list of industrial applications in which electron tubes are doing a better, surer, more accurate job, in addition to effecting dramatic savings of time, labor, and operating space.

STABILIZED RAYON

*Produced by New
Chemical Treatment*

RAYON FABRICS that are fully washable are promised by a new stabilizing finish called "Definized."

Thus far the "Definized" procedure is reported to reduce dimensional change in rayon fabrics to 1 percent or less; indications are that this is the percentage of residual shrinkage which will apply to fabrics processed with this new chemical finish.

Because rayon fabrics may be "Definized" simply by applying special chemicals in the finishing process, there are no complicated manufacturing problems. According

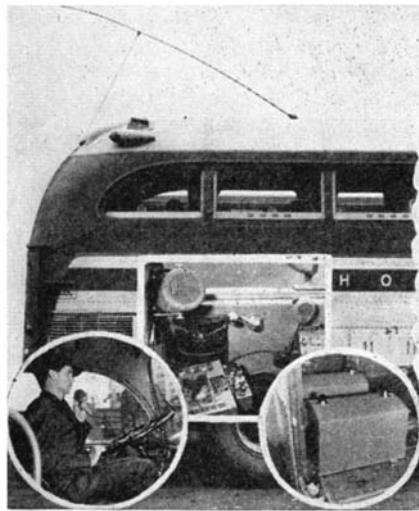
to the Aqua-Sec Corporation, finished "Definized" articles put on the market will be appropriately labeled for consumer identification. The corporation further states that the "Definized" process means that the apparel industry using rayons can now cut and manufacture garments to size. No longer need so-called washable rayon garments come in "large," "medium," and "small" sizes only, nor need manufacturers allow for shrinkage or stretching in cutting garments. At the same time, "Definized" does not alter the feel, appearance, or the character of the rayon fabric.

BUS DISPATCHING

*Expedited by Radio-
Phone Installation*

TWO-WAY radiotelephone equipment is currently being used by the Greyhound Bus Lines of Chicago, Illinois, on an experimental basis for dispatching and maintaining contact with buses while en route.

The bus lines have long faced the problem of a lack of communication with buses in service, because a bus, like an airplane, is usually not reported from departure until arrival at its destination. The function of the radiotelephone would be mainly



Radio unit parts are: (left) "Mike," (center) controls, and (right) transmitter. Antenna mounts above the bus

to give location of the buses on the highways, advise of delays, and, in emergencies, to provide rapid assistance to any bus in trouble and handle other details incident to highway bus control.

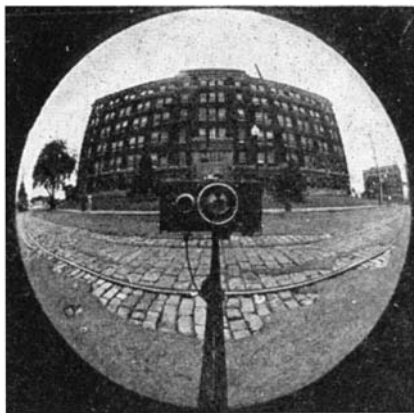
The equipment being used is the standard 50-watt Motorola mobile, police-type, two-way radiotelephone and operated in the 30-44 megacycle frequency band. At the terminal station is a Motorola FM transmitter-receiver of 250-watts output power. Two-way contacts

have been made up to 50 miles, and transmission from the buses to the fixed station have been received up to 80 miles.

ILLUMINAGRAPHIC

*Camera Measures Light
In Given Area*

A CRYSTAL-GAZING camera which, minus swami garb, peers into a convex mirror and photographs measurable light reflected therein,



Distortion is normal to new camera with mathematical, not artistic, uses

has been devised by Frank Benford, physicist in the General Electric research laboratory, and is technically called an "illuminagraphic" camera. The new instrument eliminates complicated computations in spherical trigonometry heretofore necessary for measuring light in a given area. This simplified system of measure, according to Mr. Benford, will enable illuminating engineers and architects to easily obtain data from which structures can be designed wherein maximum light is provided.

The instrument consists of an ordinary, small camera mounted directly above a convex mirror, which at casual glance could pass for the top of a swami's crystal ball. Perimeter of the mirror, instead of being perfectly spherical, is deliberately curved in such a manner that the distorted reflection of any light source in it is directly proportional in size to the illuminating value of that light source. This process of so reflecting light is called "double projection," according to Mr. Benford.

The peculiar curvature permits the mirror to reflect everything in a given area above the level of the mirror. Thus, at any point where the instrument is placed, the crystal-gazing camera can photograph a complete picture of light being received at that point.

From the photograph, the area of light surfaces is measured against the total area of the picture. The

percentage of light in the picture thus computed also is the percentage of light being received at that point from the various light sources since the photographed reflections are directly proportional in size to the effectiveness in size of the light sources.

With sources of artificial illumination a known quantity, and with standard averages for sky brightness available, the exact amount of foot lamberts of light at that particular place can be computed.

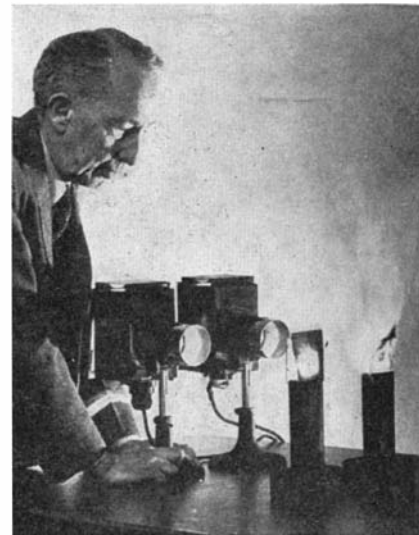
Because of the convex mirror, photographs taken resemble images seen in mirrors at an amusement park fun-house. Railroad tracks appear undulating, telephone poles curtsy gracefully, and solid, block long buildings become narrow skyscrapers.

Using an illuminagraphic process, illuminating engineers will be able to evaluate scientifically the actual lighting worth of present types of illumination, according to Mr. Benford. They will be able to estimate accurately the effect on lighting of various types of walls and ceilings, windows and window frames, alcoves, and other physical building properties. The illuminagraphic camera should aid in the design of new types of lighting and new planning for buildings, rooms, and offices, Mr. Benford claims.

HEAT ABSORBING

*Glass Transmits Light
With High Efficiency*

IMPROVED projection of color pictures and cooler working conditions for motion picture and television actors are possibilities promised by a new heat-absorbing, color-transmitting



Proof of heat-absorbing power of new glass for color projector shielding. Film in pedestal on left, shielded by it, does not burn. Film on right has an ordinary shield; is ignited by heat

glass announced recently by American Optical Company. Dr. E. D. Tillyer, research director, says that the new glass, when used as a heat screen in a projector, absorbs heat emitted by the light source so that films and slides are protected against damage or burning. This insulating property, he adds, enables film editors and educators to study a specific projected scene by stopping the projector and relying on the heat-absorbing glass screen to protect the film.

The glass can also be used in spotlights and floodlights as a heat screen to protect movie and television actors against scorching heat generated by the powerful lights. Approximately 90 percent of the heat is absorbed by the glass.

Development of the glass, according to Dr. Tillyer, makes possible improved, safe color projection on an extended scale in homes, schools, theatres, and stores. In the post-war world, he predicts, projection of films, slides, printed works, and color reproductions of works of art will be as common in schools and homes as the reception of radio broadcasts is today.

"The new glass," he states, "absorbs approximately 90 percent of infra-red (heat) radiations and transmits approximately 85 percent of light out of a possible 92 percent (8 percent is always lost by reflections). If reflections are reduced by glare-removing methods, light transmission can be increased from 85 to 90 percent."

The glass is reported to transmit colors accurately, to be chemically stable, and to resist weathering without requiring a surfacing treatment. It can be molded, ground, and polished, and fabricated like ordinary glass. It is formed from carefully balanced proportions of phosphorus, aluminum, and silicon oxides, supplemented by various conditioning ingredients together with ferrous iron as the heat-absorbing agent.

SMALL SHOPS

*Point the Way to
One-Man Industries*

A MODEL machine shop suitable for one-man operation which requires but little space, has been designed by Leighton Wilkie, chairman of The DoALL Company. The model is one of eight types of service and repair shops prepared by industrial planning engineers of the company to assist veterans with mechanical skills who desire to go into business for themselves.

"With big industry unable to maintain employment levels at war-



One of eight model service and repair shops planned by industrial engineers to assist returned service men who want to go into business for themselves. This well-designed machine shop can be housed back of a store, in a two-car garage, in a basement, or wherever space is available. The equipment includes: (1) a contour sawing machine; (2) supply cabinet; (3) drill press; (4) tool cabinet; (5) lathe; (6) arbor press; (7) bench drill press; (8) toolmaker's bench; (9) vise; (10) bench plate; (11) tool grinder; (12) anvil; (13) electric arc welder; (14) oxyacetylene welder; (15) rough bench; (16) vise; and (17) stock storage rack. Equipment is arranged for maximum utility

time peak," Wilkie stated, "the organization of new small enterprises of this kind appears to be the logical answer to employment of the nation's manpower."

Although the various types of shops are designed primarily for repair and service work in any of the thousands of communities scattered from coast to coast, ambitious operators, Wilkie points out, may readily expand into small specialty parts manufacturing, and from this point, they may follow logical expansion into large modern industries producing industrial and consumer goods.

HAM RADIO

*Offers Possible Profit
As Well as Public Service*

RETURNING servicemen with wartime communications training are being advised by the American Radio Relay League to enter the field of amateur radio. One reason is because this hobby of self-training often is the stepping stone to professional radio engineering or manufacturing. For example:

Ivan Farman began his radio ca-

reer in 1914 with a spark coil transmitter and his amateur station 6MG; today Brigadier General Farman runs the worldwide network of Army Airways Communications System. Edwin H. Armstrong, inventor of frequency-modulation broadcasting, spent many of his younger days operating amateur station 1BCG. Bill Eitel and Jack McCullough were radio "hams" in southern California when they hit on new ideas for vacuum tube construction; today the Eimac plants employ hundreds of people and have turned out many thousands of high-power tubes for military radio. Jack DeWitt is well-known in amateur circles as operator of W4ERI; as Lieutenant Colonel J. H. DeWitt, he recently won fame as supervisor of the Signal Corps' successful attempt to obtain radar echoes from the moon. The million-dollar Collins Radio Company was formed in 1931, but its real history goes back to the middle twenties when young "Art" Collins was experimenting in transmitter design at his personal station, W9CXX.

The institution of amateur radio, like most hobbies, provides its fol-

lowers with that priceless intangible which the League, national association of "ham" operators, chooses to call "the amateur spirit in research." The professional man who is also an amateur does his work for the love of it, they point out. Not confined to a formal knowledge of radio phenomena, such a man has the inquiring mind, the unfettered viewpoint which often gets otherwise unobtainable results.

The League also invites the interest of returning communications servicemen because amateur radio has long been traditionally charged with the responsibility of furnishing a vast reservoir of equipment and trained personnel to set up communications systems for use in case of disaster. Further, in time of national emergency, volunteering amateurs can be made crack military operators and technicians with but a slight amount of additional training, a fact proved again during the early period of the recent war.

GARAGE DOOR

Has Self-Contained Operating Mechanism

WHEN more room is needed in a garage, a newly developed aluminum overhead door will often solve the problem. This new door does away



Light-weight door operates easily

with all tracks, weights, and exposed springs inside the garage. The entire operating mechanism of the Berry door is enclosed in a small box installed on the back of the door. It is reported that it can be installed, ready to use, in less than 30 minutes.

TOOL CONTROL

Accomplished by Sensitive Electronic Set-Up

AN "electronic finger" which automatically controls the operation of a machine tool can be used on work ranging from shaping graceful can-

dlesticks to forming supercharger housings for aircraft engines. In fact, almost anything that can be cut with a motor-driven tool from a pattern or template can be produced accurately and completely automatically with a machine equipped with this versatile device which literally has a "sense of touch."

The vital part of this control device is an "electronic finger" which feels its way around the angles and curves of a pattern to control the operation of the cutting tool.

This feeler or tracing stylus comprises, in electrical terms, two magnetic bridges, each consisting of two identical magnetic circuits, one pair mounted on an axis at right angles to the other pair. The four magnetic poles are assembled on a diaphragm which is fastened to the stylus, a finger-like projection which touches the pattern or template.

In operation, the stylus of the tracing head is moved against the side of the contour on the pattern to be reproduced. The very slight pressure of the feeler against the template causes a deflection of the diaphragm which in turn creates a change in voltage in the coils of the tracing head. This voltage is then carried to the "brain" of the entire device, where the signals from the bridge circuits are amplified many times and "mixed" into what is called a vector signal—a signal which is related to the direction of the pressure on the stylus. This signal causes the stylus to be driven against the template. As the deflection of the stylus increases, the vector signal is shifted by a "bender" circuit to cause the stylus to move along the surface of the template with a uniform deflection.

The signal from the "bender" circuit is sent into a translator circuit which produces two separate D.C. voltages. Each voltage determines the speed of one of the two feed motors. These voltages are so coordinated that the resultant speed of the stylus around the template is constant, regardless of the direction. When a change in contour is encountered, one motor will automatically slow down or speed up just the proper amount to reproduce on the piece of work in the machine the same contour encountered by the stylus on the pattern.

Rapid changes in the direction of machine motion are dependent on fast motor control. The thyatron tube, also a General Electric development, provides the means for controlling motor speed and direction from the translator circuit signals—and almost instantaneously. So sensitive is the control over the



Precision contours for supercharger housing or delicately shaped candlesticks are accurately duplicated from master pattern by "electronic finger"

motors, that each can be stopped or started in less than an eighth of a second.

Extremely simple to operate, General Electric's new control can be applied to many different types of metal cutting tools and is capable of a variety of intricate cutting operations.

CONDUCTING RUBBER

Seen as an Efficient Means of Electrical Heating

RUBBER is an excellent material for electrically heating many parts on airplanes with which difficulty is encountered in the extreme cold of high altitudes, according to The B. F. Goodrich Company.

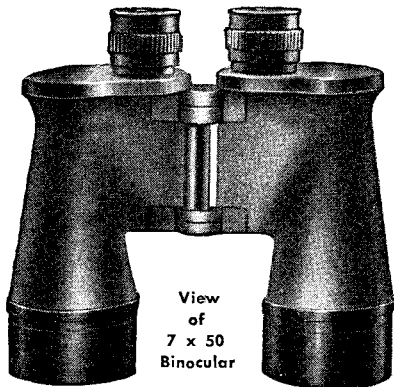
Most engineers, including those in aviation, are accustomed to thinking of rubber as a non-conductor of electricity, but such is not always the case. Special compounding changes the characteristics of the rubber so that it can be used in some applications as a conductor and in other cases as an insulating covering for conducting compounds or for other electrical heating elements.

Among applications where rubber has been effectively used to provide heat are some hydraulically operated plane parts where the fluid has to be kept warm for efficient operation. A conducting rubber shoe is placed over the spot to be warmed and electrical current does the job.

Because rubber can be molded to almost any shape, the company points out that literally anything on the plane can be heated by such methods, and complete, as well as spot heating, can be accomplished. Hydraulic, water, or steam lines, can be fully covered and uniform temperatures throughout obtained by the application of rubber and electricity.

SENSATIONAL WAR BARGAINS in LENSES and PRISMS

NOW! MAKE YOUR OWN BINOCULARS!



FLASH! JUST RECEIVED!
Metal Parts and Bodies for Navy's
7x50 Binoculars

You get a Right and Left Body, 2 Objective Mounts, Left and Right Prism Shelves, Right and Left Cover Plate for Eye Piece mounting, miscellaneous Screws and Parts. This assortment represents nearly all the main parts you'll need for your Binocular construction. It's truly an exceptional War Surplus opportunity.

Stock #804-S—Binocular Parts Set. \$10.00 Postpaid
Stock #805-S—Monocular Parts Set. 5.50 Postpaid

Complete Sets of LENSES and PRISMS
from Navy's 7x50 Model

Save Up to \$150.00!

Here's an unusual opportunity to secure a fine set of Binoculars . . . at a tremendous saving of money. Build them yourself with all of the very same optics contained in the Navy's 7 Power Glasses . . . the Binoculars which received such wide acclaim during the war. Depending on your choice, you may buy a perfect set of Lenses and Prisms for the Binocular construction job, or a set of seconds (exactly the same units, but Lenses are uncented and have slight imperfections). If, however, you wish to construct a Monocular (1/2 a Binocular) you may do so, choosing either perfect components or seconds. The Monocular sets comprise 1/2 quantities of the same optics required for the Binocular. The full perfect Binocular set comprises the following: 2 Cemented Achromatic Eye Piece Lenses, 17.5 mms. diam.; 2 Eye Field Lenses; 4 Porro Prisms; 2 Cemented Achromatic Objective Lenses, diam. 52 mms. Complete assembly directions included.

Stock #5102-S—
Perfect Binocular Set. \$25.00 Postpaid
Stock #5103-S—
Perfect Monocular Set. 12.50 Postpaid
Stock #5105-S—
Seconds for Binoculars 11.00 Postpaid
Stock #5104-S—
Seconds for Monocular. 5.50 Postpaid

NOTICE! If you buy both the Binocular Optics and the Binocular Metal Parts, your purchase becomes subject to 20% Federal Excise Tax. Be sure to add amount covering tax to your remittance or your order cannot be filled.

All Items Finely Ground and Polished but Edges Slightly Chipped or Other Slight Imperfections Which We Guarantee Will Not Interfere with Their Use. Come Neatly Packed and Marked.

TO KEEP POSTED on all our new Optical Items, send 10c and your name and address to get on our regular "Flash" mailing list.

MICROSCOPE SETS

Consisting of two Achromatic Lenses and two Convex Eye Piece Lenses which you can use to make a 40 Power Pocket Microscope, or 140 Power Regular Size Microscope. These color corrected Lenses will give you excellent definition.

Stock No. 1052-S \$3.00 Postpaid
Consisting of Prism, Mirror and Condensing Lens. These used together with Stock No. 1052-S will make an excellent Micro projector enabling you to get screen magnification of 400 to 1000 Power according to screen distance.
Stock No. 1038-S \$2.00 Postpaid

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

BIG DOUBLE CONCAVE LENS—74 mm. diam. 110 mm. F.L. Made of extra dense Flint. Used as reducing Lens, for trick photography, etc.
Stock No. 1049-S \$1.00 Postpaid

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

LENS CLEANING TISSUE—In spite of paper shortage, we offer an exceptional bargain in first quality Lens Cleaning Tissue. You get 3 to 4 times as much tissue as when you buy in the ordinary small booklets. One ream—480 sheets, size 7 3/4" x 10 3/4".
Stock No. 704-S \$1.50 Postpaid

RAW OPTICAL GLASS

An exceptional opportunity to secure a large variety of Optical Pieces both Crown and Flint glass (seconds) in varying stages of processing. Many prism blanks.
Stock No. 703-S—8 lbs. (min. wt.)—\$5.00 Postpaid
Stock No. 702-S—1 1/2 lbs. \$1.00 Postpaid

MISCELLANEOUS ITEMS

Stock No.	Item	Price
1031-S	6 Power Magnifier—Diam. 29 mm. Each	\$.25
2043-S	Standard Crossline Reticle—Diam. 29 mm. Each	.50
1034-S	Burning Glass Lens. Each	.25
2024-S	10 Pieces Circular A-1 Plate Glass (Diam. 31 mm.—for making Filter)	.25
523-S	Six Threaded Metal Reticle Cells	.25
624-S	Neutral Ray Filter, size 4 3/4" x 2 1/2"	.25
3022-S	Round Wedge, 65 mm. Diam. Each	5.00
3021-S	Amici Roof Prism (3rd grade). Each	.25
16-S	Level Vial, 48 mm. long	.20
1030-S	2" Diam. Reducing Lens. Each	.25

(Minimum Order on Above—\$1.00)

TANK PRISMS PLAIN OR SILVERED

90-45-45 deg. 5 3/4" long, 2 1/2" wide, finely ground and polished. Would normally retail from \$24 to \$30 each.

Stock #3100-S—Silvered Prism \$1.00 Postpaid
Stock #3101-S—Plain Prism \$1.00 Postpaid
Illustrated Book on Prisms included FREE.

TANK PERISCOPE

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

SPECIALS IN LENS SETS

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

NEW 50-PAGE IDEA BOOK "FIN WITH CHIPPED EDGE LENSES"

Contains wide variety of projects and fully covers the fascinating uses of all Lenses in sets listed above . . . only \$1.00 Postpaid.

35 MM. KODACHROME PROJECTING LENS SET—Consists of Achromatic Lens for projecting, plus a Condensing Lens and piece of Heat Absorbing Glass with directions.

Stock No. 4025-S \$1.95 Postpaid
SPECTROSCOPE SETS These sets contain all Lenses and Prisms you need to make a Spectroscope plus FREE 15-page Instruction Booklet.
Stock No. 1500-S—Hand Type Spectroscope. \$3.45 Postpaid

Stock No. 1501-S—Laboratory Type Spectroscope \$6.50 Postpaid

ALL THE LENSES YOU NEED TO MAKE YOUR OWN TELESCOPE!

ALL ARE ACHROMATIC LENSES

GALILEAN TYPE—Simplest to make but has narrow Field of View.

Stock #5018-S—4 Power Telescope. \$1.25 Postpaid
Stock #5004-S—

Small 2 Power Pocket Scope \$1.00 Postpaid

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

Stock #5010-S—6 Power Telescope. \$3.00 Postpaid
Stock #5012-S—20 Power Telescope. 7.25 Postpaid

REMARKABLE VALUE!

**\$141.01 WORTH OF
PERFECT LENSES
FOR ONLY \$10**

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

Stock #5019-S \$10.00 Postpaid

ACHROMATIC LENSES

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

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

RETICLE SET—5 assorted, engraved reticles from U. S. Gun sights.
Stock #2035-S \$1.00 Postpaid

RIGHT ANGLE PRISM—Flint Optical Glass, size 41 mm. by 91 mm. by 64 mm. Use in front of camera Lens to take pictures to right or left while pointing camera straight ahead. Also used in front of camera Lens to reverse image in direct positive work. Two of these Prisms will make an erecting system for a Telescope.

Stock No. 3076-S \$3.00 Postpaid

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

PRISMS

Stock No.	Type	Base Width	Base Length	Price
3040-S	Right Angle	33 mms.	23 mms.	\$1.00
3045-S	Right Angle	70 mms.	168 mms.	8.00
3001-S	Lens Surface	20 mms.	14 mms.	2.00
3006-S	Porro-Abbe	9 mms.	9 mms.	.25
3009-S	Porro	52 mms.	25 mms.	1.00
3010-S	Porro	43 mms.	21 mms.	.50
3016-S	Pentagon	45 mms.	22 mms.	.75
3029-S	Dove	16 mms.	65 mms.	1.25
3038-S	80 Degree Roof	60 mms.	36 mms.	4.00
3049-S	Right Angle	69 mms.	167 mms.	10.00
3047-S	Right Angle	53 mms.	103 mms.	4.00
3038-S	Roof Prism	18 mms.	34 mms.	2.50

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

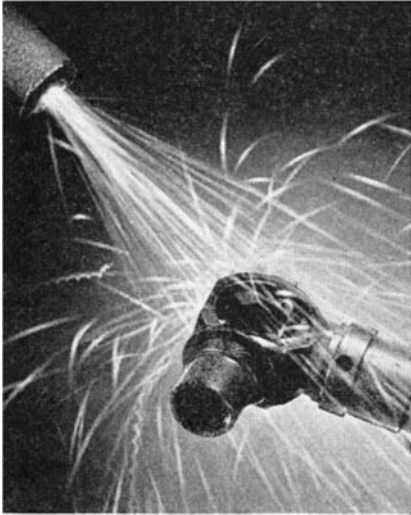
EDMUND SALVAGE COMPANY ♦ P. O. AUDUBON, NEW JERSEY

New Products and Processes

PELLET BLASTING

*Cleans Soft Metal
Without Abrading*

TENITE plastics pellets, blown from an ordinary blasting machine, are reported to remove completely the minute particles of dust which are given up through the pores of sand-cast aluminum-alloy castings. This method of



Plastics pellets leave satiny finish

cleaning, according to the pellet manufacturer, Tennessee Eastman Corporation, seems to draw out the dust, rather than pound it in. In addition, it imparts a satiny finish to the metal without abrasion, and is quicker and more economical than methods previously used.

The Tenite pellets employed for this purpose are similar to those supplied regularly to the plastics molding industry, although slightly smaller. As blasting agents, they have also been extensively used in blasting carbon from airplane pistons.

VISCOUS PLASTICS

*Moulded to Shape
With Little Heat*

HIGH optical and electrical properties, good resistance to abrasion and high resistance to oils, greases, and most chemicals—including acids and alkalis—are some of the characteristics of a non-flammable thermoset plastics recently introduced under the name Kriston. One of a series of new thermo-setting resins, forming of this material is accomplished by polymerizing the liquid monomer in the presence of a suitable catalyst. Low temperatures and no pressure are required.

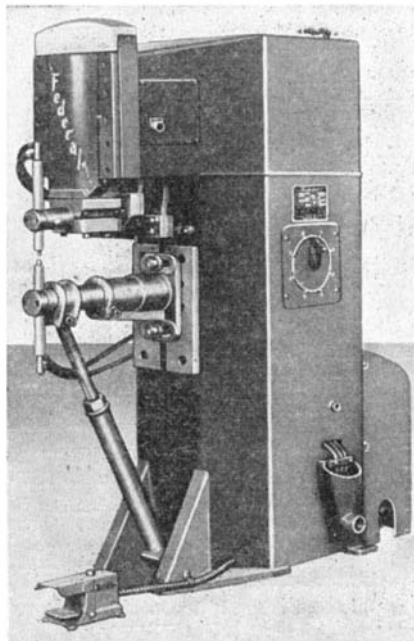
Before forming, this B. F. Goodrich Chemical Company product is a some-

what viscous, water-clear, anhydrous liquid, having a specific gravity of 1.25, that can be cast in simple molds and which sets with very low shrinkage to a hard, heat resistant plastics. No water or other volatile products are released during the process, thus aiding the preparation of dense, non-porous, odorless, tasteless, and dimensionally stable articles. The final products may be water-clear or in a wide range of colors which can be transparent, translucent, or opaque. Possible applications are: optical lenses, prisms, or transparent sheets—Kriston's refractive index is somewhat higher than that of glass—electrical insulating parts, and in the chemical and processing industries where imperviousness to corrosive materials and solvents is important.

PRESS WELDER

*Uses Hydraulic Pressure;
Has Automatic Controls*

AN AUTOMATIC, hydraulically operated, press-type welder in 30, 50, and 75 KVA capacities is described as suitable for either spot or projection welding by the Federal Machine and Welder Company. Welding pressure is applied through an inverted-type hydraulic cylinder. The cylinder is a part of the so-called fixed member, its upper end being secured to the top of the welder by a heavy-duty transverse, adjustable spring. This spring serves a dual purpose by actuating a switch that initiates the timing controls and providing a



For either spot or projection welding

quick "reaction" for a fast follow-up on the welding stroke. Welding pressure is adjusted by the hydraulic pressure regulator and gage.

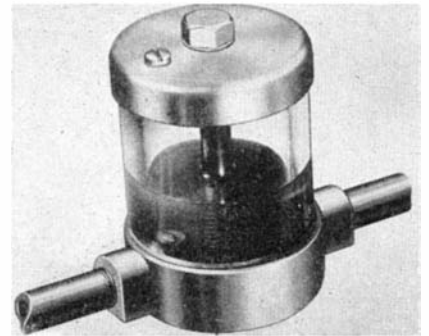
A foot switch is the only operating control, and is attached to a flexible cable which permits easy positioning for each job. A single light pressure and release puts the welder through one complete welding cycle. Welding speed is governed by timing controls. Automatic recycling continues as long as the switch is held in contact. Water cooled transformers and water cooled electrodes are standard equipment.

The welders are available in three sizes, with a working range from 26 gage to 6 gage steel sheets or comparable material.

AIR TOOL LUBRICATOR

*Has Visible Oil Supply;
Adjusts to Meet Demand*

AN AUTOMATIC lubricator for pneumatic equipment was recently announced as having several new features. These include a full-view, non-breakable transparent plastics window with "O" rings for top and bottom seals; needle valve lubricant regulation, easily adjustable to meet varying equipment requirements; and fully automatic operation. The adjustability



Transparent window is non-breakable

of the "CCA Lube" prevents oil flooding as well as oil starvation, helps eliminate freezing of pneumatic equipment, and thus tends to cut down maintenance operations. The needle valve can be turned off altogether in cases where no lubrication is required.

Small but rugged, the unit is manufactured by CCA Products Engineering.

PANEL LIGHT

*Uses "Black-Light" from
Miniature Fluorescent Tube*

UNSEEN ultra-violet rays from a fluorescent tube now promise to transform the dial markings of home radio or television receivers into uniformly-glowing colors. Primarily intended to improve dial lighting and to beautify radio sets, "black-light" is now expected to find very practical application in television where fluorescent control knobs and dials would aid visibility and reduce interference with the television image.

The tubular panel lamp itself is a simplified, miniature version of the ordinary fluorescent tube but instead

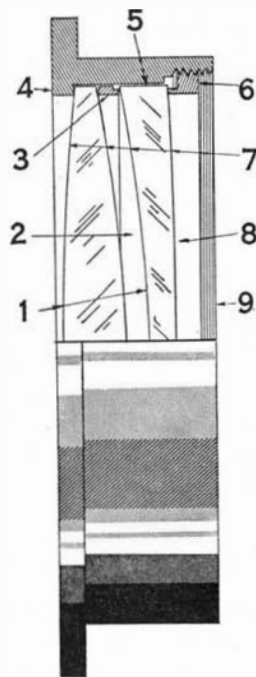
COATED 2" and 3" ASTRONOMICAL OBJECTIVES

WE ARE STARTING a production run for 2" and 3" astronomical objectives completely mounted in a flanged lens cell ready for use. We feel that there is no better objective available for the price and to support our claims we guarantee complete satisfaction or we will return your money. The following features of these objectives are noted.

1. B&L optical glass, fully annealed, ground and polished to test plates.
2. Fraunhofer-type design, giving superior correction for zonal and comatic aberrations when achromatized for C and F lines for visual work.
3. Spacer hand corrected to remove residual zonal errors.
4. Flanged cell permitting simple, accurate mounting without laborious thread chasing.
5. Cell of brass, precision machined to assure perfect and permanent centering.
6. Retainer ring sealed in place after all adjusting and correcting is done.
7. All surfaces coated with magnesium fluoride in accordance with Navy specifications.
8. Air Space Design eliminates flexures and stresses that occur in cemented objectives due to temperature changes.
9. Cell chemically oxidized to give a dull black non-reflecting surface that is non-scaling.

THE 3" objective is 77 mm in diameter and 1125 mm E.F.L. The 2" objective is 51 mm in diameter and 800 mm E.F.L. Each cell has a serial number engraved on it, corresponding to the objective. Every purchaser will obtain a certification for his objective giving: (1) Glass melt, indices, and dispersions; (2) Test plate mate; (3) Coating inspection; (4) Artificial Star Diffraction pattern test; (5) Measured exact B.F.L. We will have on file a duplicate and, therefore, will have a complete record for every objective we sell.

BECAUSE of tooling costs, we are going to produce the 2" and 3" objectives only. The price for the 2" objective and cell is \$26.50, and the 3" objective and cell, \$53.50 postpaid, in the U.S.A.



BRANDON SCIENTIFIC DEVELOPMENT

A New York Corporation

P. O. Box 85

Malverne, New York

of the visible fluorescent-light phosphors, special black-light phosphors coat its inner surface. A special glass mask blocks out stray visible light that is present even with black-light phosphors. Featuring a five-year life, non-blinking instant starting, and unaffected by frequent turning on and off of the radio, the new Westinghouse lamp has a luminous length of seven inches, an overall length of eight and one-half inches, and a five-eighths inch diameter. Initial starting voltage for the miniature fluorescent lamp is provided by the radio's power transformer.

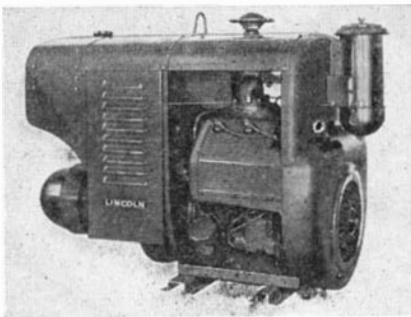
PORTABLE WELDER

Uses Air-Cooled Engine;
Is Light and Compact

FOR WELDING applications in non-electrified areas such as farms, oil and gas fields, construction work, and so on, a new 200-ampere welder known as the "Shield-Arc Jr.," is of exceptionally compact design. Measuring 24 by 48 by 30 inches, and weighing 660 pounds, the welder has a current range of from 40 to 250 amperes. Uses for the machine, as explained by its makers, The Lincoln Electric Company, include welding of light or heavy gage metal, repairs to cast-iron structures such as engine blocks, repair or fabrication of tools and machinery parts, and hard facing of worn parts.

The welder is powered by a Wisconsin air-cooled, four-cylinder engine.

Welding current is controlled by adjusting the engine speed between a maximum of 2100 revolutions per minute—22 horsepower—and 1500 revolutions per minute—16 horsepower. This type of drive not only reduces weight but the air cooling eliminates the necessity of winter radiator care.



Engine speed controls welding current

Equipped with a six gallon capacity gasoline tank, the unit will operate under normal welding conditions for approximately six hours between refuelings.

STEEL WHEELS

Lubricated by
"Floating Ball"

Two pressed steel disks, permanently joined by a special copper brazing method, form the basic structure of newly available industrial wheels

rugged enough to support loads up to 500 pounds. Tires are vulcanized directly on the wheel which has a "V" groove center line in the rim to assure permanent alinement.

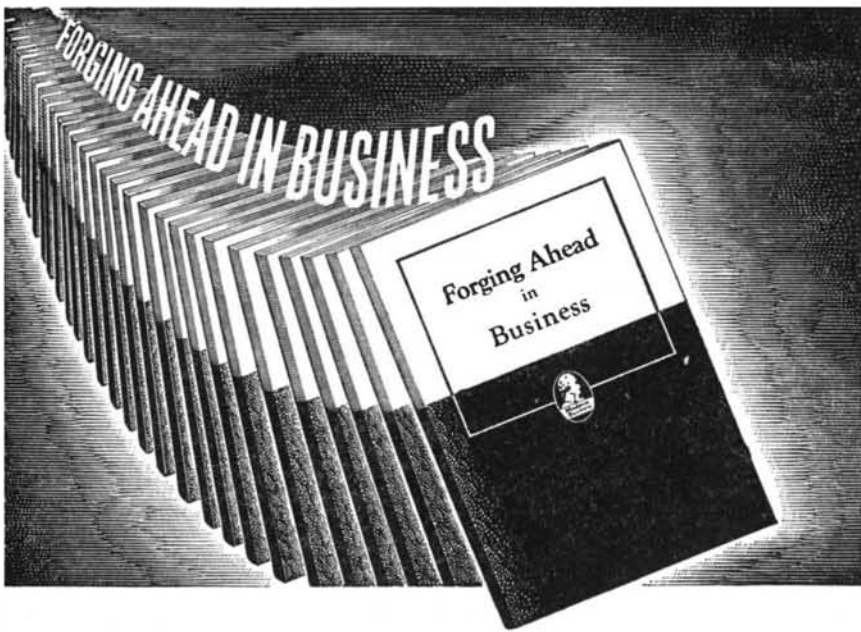
The 1/4 inch wall hub is lubricated by the "floating ball" method which consists of placing a steel ball in the oil reservoir before brazing so that the ball action in the lubricant provides automatic lubrication and in addition rattles when the reservoir is dry. The wheels, as described by the American Brazing Company, may be obtained in either six- or eight-inch sizes and with roller or needle bearings.

SYNTHETIC ENAMELS

Produced for Household
Equipment Applications

ALL-SYNTHETIC, high-bake enamels that give an exceptionally hard, stain-proof finish designed to endure heavy household usage have been developed by The Arco Company. These finishes, called Synox, are already being produced in several whites which have been thoroughly tested and adopted by some of the country's largest household appliance manufacturers. One type is designed for refrigerators, deep-freeze units, stoves, ironers, and electric mixers, and another for dish-washers and washing machines.

Tests in the Arco evaluation laboratories and by initial users show that these enamels have an unusual degree



All Serious-Minded Production Men SHOULD HAVE THIS FREE BOOKLET!

FORGING AHEAD IN BUSINESS contains a message of particular importance to production men. This is your opportunity to obtain a copy of this famous book, which has been described as a "turning point in the lives of literally thousands of men!"

Although "Forging Ahead in Business" has been distributed to more than 3,000,000 men, today's timely edition was written in the light of recent worldwide developments. Its 64 pages represent more than three decades of successful experience in training men for leadership in business and industry.

It demonstrates the method which the Alexander Hamilton Institute uses to give you immediate help in your present position, while preparing you for post-war opportunities. Subjects directly related to the work you are doing now, PLUS other subjects of fundamental value to the business executive, are discussed in the book and placed in significant relation to one another. Thus, a helpful, over-all picture is provided.

Said one man who had sent for "Forging Ahead in Business":

"In thirty minutes this little book gave me a clearer picture of my business future than I've ever had before."

... and that represents the opinion of

the Institute's 400,000 subscribers, including 134,000 production men!

The booklet further explains how it is possible to offer this essential training in a minimum of time; how the Institute program fits in with the most crowded of post-war schedules.

Among the prominent industrialists who assisted in the preparation of the Course, which is described in "FORGING AHEAD IN BUSINESS" are: Alfred P. Sloan, Jr., Chairman of the Board, General Motors Corp.; Thomas J. Watson, President, International Business Machines Corp., and Frederick W. Pickard, Vice President and Director, E. I. du Pont de Nemours & Co.

Send for

"FORGING AHEAD IN BUSINESS" TODAY!

Frankly, this booklet has no appeal for the immature mind. It does not interest the man who, for one reason or another, is wholly satisfied to plug along in a mediocre job. But, for the alert, future-minded individual—the man with ambition and "drive"—"Forging Ahead in Business" has a message of distinct importance. If you feel that it is intended for you, don't hesitate to send for a copy today. Simply fill in and mail the coupon below.

of water and alkali resistance, stain resistance, and exceptional color retention. They resist normal fruit acids, vinegar, and so on, and are not affected by dilute or concentrated alkaline solutions which frequently attack and discolor enamel coatings in common use.

The coating resists the action of hot soapy solutions without dulling or excessive softening or embrittlement and is said to have greater abrasion resistance and lower water retention than other enamels.

SOLID TIRES

*Of Neoprene, Aid
Industrial Trucks*

INDUSTRIAL solid tires of neoprene type synthetic rubber, which promise to reduce power consumption up to 60 percent as compared with ordinary solid tires of present construction, are now available for use on electric and gasoline powered trucks and manually operated materials-handling equipment. Where minimum rolling resistance is a prime necessity, neoprene industrial tires closely approach the performance of natural rubber, according to United States Rubber Company. This is important in the operation of electric trucks and tractors, and is also an economy factor for gasoline powered vehicles because lower power and fuel consumption, gained through easier starting and rolling, result in reduced per-ton-mile costs. In addition, greater maneuverability, with neoprene tires, makes possible more trips per shift.

GRIPPER-END CHAIN

*Grasps Steel Sheet and
Barrels for Carrying*

A CAM-LEVER mechanism and chain that grabs up heavily laden steel barrels and steel plate, and holds with a vice-like grip that grows tighter the heavier the load, is announced by The Boyer-Campbell Company. Known as "Granny Grip"—no teeth, but what a



Chain and grips will lift four-ton load

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bite!—the standard unit consists of two stamped-alloy steel bodies—cam lever mechanism—and an alloy chain that is capable of lifting up to a four-ton load. The jaws can be opened to $\frac{3}{4}$ inch. Intended to facilitate handling of material with industrial trucks and cranes, the sling-like device may be installed quickly and releases immediately when the load is put down.

HAND POWER TOOL

*With Accessory Kit
is Portable Workshop*

DESIGNED for vibrationless high-speed operation, a new hand power tool has a special finger grip which makes it easy to control for close delicate work. An on-off switch allows one-hand operation.

Equipped with 35 interchangeable parts, this new electric hand power tool is intended as a versatile utility instrument. Included in the tool-kit are a grinder, emery wheel, polishing buffer, and sharpener. Other tools may be attached for jobs requiring roughing,



Versatile, complete kit has 35 parts

sawing, drilling, routing, and etching. Suggested uses are for making tool parts, repairing electric motors, cutting wood patterns from stock, and similar work. Various brushes are also handy for cleaning motor parts and getting into small crevices and hard-to-reach spots. The all-purpose tool has equipment designed especially for working on metal, plastics, glass, and wood.

Operating at over 20,000 revolutions per minute, on either a.c. or d.c., overheating and like problems are said to be offset by an air-cooling fan, oil-less bearings, and positive insulation. A ball thrust end bearing helps to absorb shocks; the case is also shockproof.

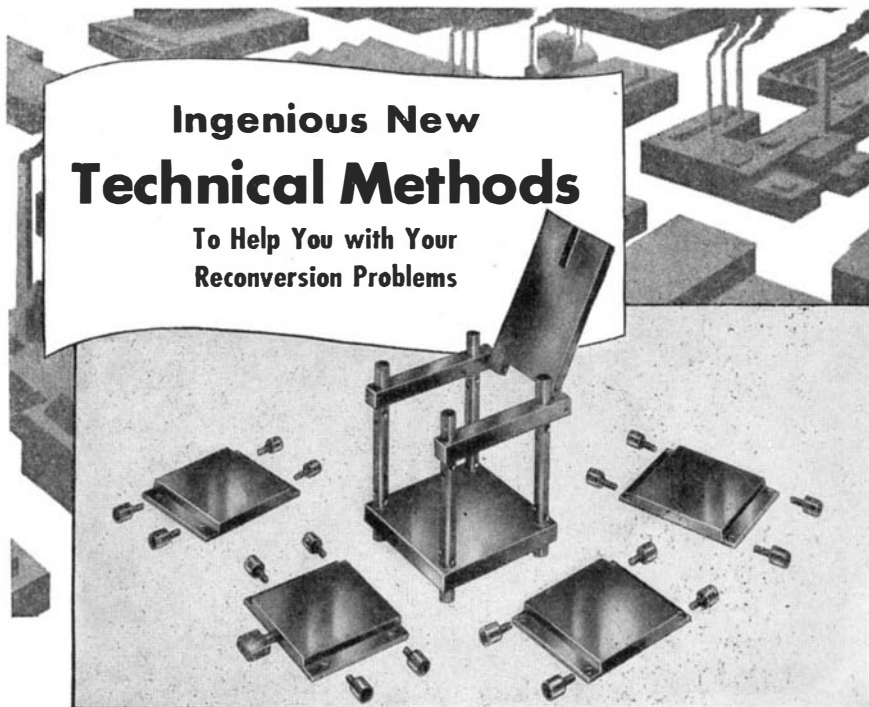
As a safety factor, the makers, Casco Products Corporation, have incorporated a safety clutch for locking the chuck to prevent slipping when tool parts are changed by the worker.

The tool and accessories are stored in a steel chest, 13½ inches long, 6 inches wide, and 4½ inches high.

EMERGENCY RESPIRATOR

*Provides Oxygen When User
Breathes through Canister*

EMPLYING a replaceable chemical canister, a recently developed breathing apparatus generates its own oxygen and gives the wearer one hour's pro-



Ingenious New Technical Methods

**To Help You with Your
Reconversion Problems**

Drillet Box Jig Saves Up to 75% of Jig Body Expense and Labor!

The six-sided Drillet Box Jig above and at right has a range of 125 different sizes, making it possible to accommodate all sizes up to 6" capacity—for drilling, reaming, counter boring, counter sinking, spot facing, tapping, etc.

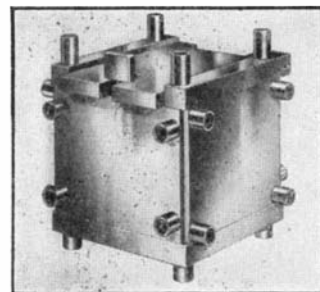
The Drillet Box Jig makes special tool design for drill jig unnecessary. Saves up to 75% of the time and cost of building a jig body. By merely turning thumb-screws and raising leaf, parts may be quickly loaded or unloaded. The jig may be used on all six sides, taking advantage of its full capacity.

Another useful product is chewing gum. You can enjoy chewing Wrigley's Spearmint Gum even while your hands are busy. The pleasant chewing helps to steady you—helps keep you alert and on your toes when you're doing a monotonous job.

Besides the satisfaction chewing gives you, it helps keep your mouth moist and fresh so you naturally feel better—and feeling better you work better.

Scores of industrial plants report that they have stepped up their workers' morale and efficiency by making chewing gum available to them.

You can get complete information from The Chicago Drillet Corporation, 920 S. Michigan Ave., Chicago 5, Ill.



Drillet Box Jig in Locked Position



AA-59

tection in unbreathable air. Weighing 13½ pounds, and with no cylinders, high-pressure valves, or fittings, the Chemox Oxygen Breathing Apparatus appears well suited to the requirements of industry and fire departments in meeting emergencies where high concentrations of poisonous gas or oxygen deficiencies are encountered. The mask was proved in Navy battle service during the war, according to its developer, the Mine Safety Appliances Company. In operation, exhaled breath passes from the facepiece, through the exhalation tube, and into the canister where carbon dioxide is removed. Evolved oxygen flows into the breathing bag reservoir, then to the facepiece through the inhalation tube.

Quickly put on and simple to use,

the apparatus has a pre-set alarm bell which rings a warning before the canister is exhausted.

PRODUCTION GRINDER

*Features Versatility and
Adaptability to Difficult Grinds*

A NEW design of multi-purpose grinder has the wheel-head mounted on two different compounds, each graduated to 180 degrees. This is reported by the manufacturer, Lempeco Products, Inc., to permit even the most difficult of internal or external taper grinds or turns to be easily and accurately done. The grinder has a workhead that can be moved 6 inches toward or away from work by removing and replacing four screws. This ad-

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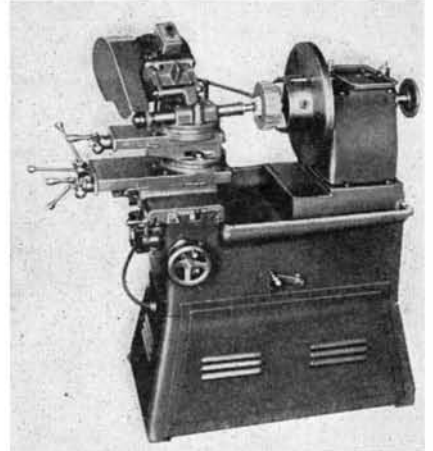
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justment increases the swing from 18 to 30 inches. Other features include both hand and power cross-feeds, a work length capacity up to eight inches, and two reversible spindle speeds of 80 and 130 revolutions per minute. Chucks are draw-bar mounted.

Wheel-head power is supplied by a two horsepower motor with ball-bearing spindle, and speeds range from 6000 to 12,000 revolutions per minute. A retractable tool holder bar enables finished grinding to follow turning operations without removing the cutter. Power cross-feed length can be set by



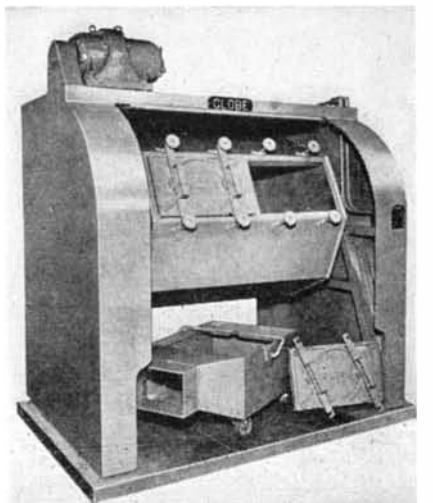
Cutter retractable for finish grinding

dogs on the side of the carriage, while longitudinal feed is controlled by an interchangeable screw or rack and pinion. An automatic sizing device is said to insure exact duplication of successive pieces on production runs.

DE-BURRING UNIT

Polishes and De-burrs Simultaneously

PROVIDING mass-production de-burring, and claimed to increase output by as much as 21 times over hand labor, a new "Burr-Rite" machine features double and triple compartments which can perform two operations—polishing and de-burring—simultaneously. Manufactured by The Globe Stamping Division, Hupp Motor Car Corporation, the



Two compartment unit; hoist pan below

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new device finishes aluminum, brass, and die castings. Parts handling has been simplified by the installation of a new hoist pan.

Three models are offered: a single compartment model with a cubical content of 18.4 feet; a double compartment model, with a capacity of 9 cubic feet in each compartment; and a triple compartment model, in which each compartment has a 5.1 cubic feet capacity.

PRECISION KIT

Allows "Large Shop" Gaging at "Small Shop" Cost

A NEW GAGE kit, called "Producto-Chek," and designed for production checking, is now being manufactured by the Gage Division of The DoALL Company. It consists of a number of instruments to be used in conjunction with gage blocks for quickly setting up practically any type of inspection gage. Examples of these combinations are a dial-indicating snap gage, plain bench comparator, dual bench comparator, angle comparator, square comparator, precision height gage, depth gages, and a series of go-no-go snap gages of any size up to 18 inches.

Plug gages and internal gages of any size, in steps of .0001 inches, can be



Kit has over a million combinations

quickly made up from the set. In addition, gages such as hole-to-hole, hole-to-base, parallel-bore, pitch diameter, and many others can be made up for special applications. A set of holders from two to 18 inches in length are designed to carry the gage blocks. Besides the hand-held gages, a series of bench and surface plate gages can be assembled by using the base block, master flat, or other attachments. In addition to the usual types of gages, there are several unusual ones such as an indicating snap gage incorporating a dial indicator, and an internal gage incorporating a dial indicator.

Also included in the kit is a set of "wires" of various diameters. These are lapped to the accuracy of gage blocks and are used direct as plug gages or in caliper jaws where square jaws could not function or where combination square and round caliper jaws are needed. Although it is used in conjunction with gage blocks and in some cases a surface plate, the kit itself does not include these items. Any one of the many gages can be assembled in five minutes or less. It is reported that the

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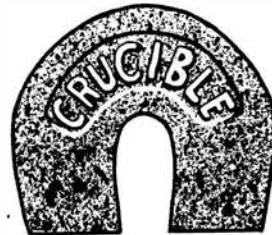
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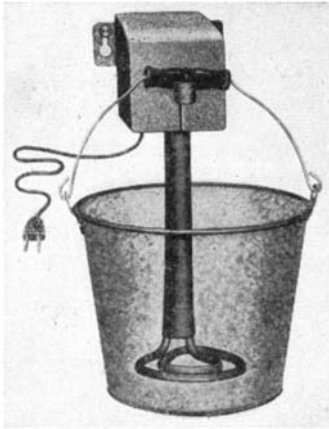
Producto-Chek Gage Kit will actually do the work of more than a million separate gages, but it weighs only 40 pounds and is housed in a hardwood box 10 by 20 by 4 inches.

Particularly adapted to the small shop, the kit has the advantage of limitless precision measuring equipment at the cost of barely a dozen separate gages. Thus it enables engaging in all kinds of precision production work not previously advisable because of the high investment in many separate instruments for proper inspection.

WATER HEATER

Conveniently Heats a Bucketful at a Time

A SHOCK-PROOF electric water heater weighing about ten pounds and designed for use in an ordinary bucket consists of a switch in a compact sealed metal box with the heater coil suspended beneath it. On the side of the box is a switch lever which also acts as a support for the pail handle, automatically turning on the current when a pail is hung on it. Should the water



Hot water when and where needed

boil away below a certain level, the switch automatically cuts off. The device can be suspended from a wall by slotted holes placed near any convenient electric outlet. The heater has many uses around a shop, factory, or farm.

CARPETS CLEANED

Conveniently "On the Spot" With Soapless Detergent

LOCATION cleaning of wall-to-wall carpeting in hotels, clubs, theaters, restaurants, and other places where removal of floor coverings is inconvenient, is an advantage offered by a new detergent, with high lathering properties, that is said to contain no soap. Used in solution and applied by means of a rotary brush, released dirt and soiled detergent are removed with a wet vacuum. The cleanser, called Neutrotone, removes ordinary types of soil, disinfects, deodorizes, and demoths, without leaving a residue or harming texture, color, or tensile strength, according to its manufacturer, The Mathieson Alkali Works.

Although designed for on-location

cleaning, carpet cleaning plants may also find it useful where shrinkage of the floor covering or untwisting of twisted pile carpeting might be caused by the regular plant shampooing process.

PAD DYEING

Done with Water-Resins, Requires no Solvents

OIL-IN-WATER pigment resin finishes, for the pad-dyeing of fabrics, are now available to the textile industry. The water-thinned emulsions require no expensive and inflammable solvent thinners. Extenders and high-speed mixers are also unnecessary, and it is claimed that the problems of color exhaustion and migration are eliminated. The new Sherdye "Water-Thinned Pigment-Resin" colors, manufactured by Sherwin-Williams Company, promise possibilities of substantial cost saving, and it is said that there is less time lost in preparing for a run or in changing colors between runs. Equipment is cleaned simply by washing down with water between operations.

DISTRESS SIGNAL

With Day or Night Colors Is Highly Visible

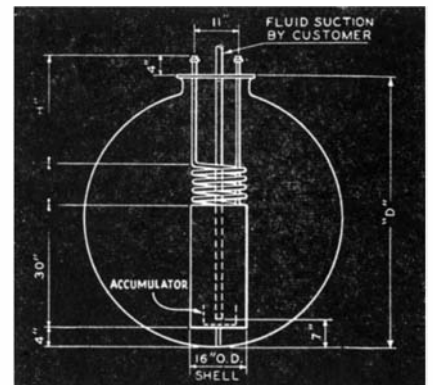
GIVING off a brilliant orange smoke for day-time use and a blindingly intense red flare at night, a double-ended, compact hand-held pyrotechnic signal is now offered for civilian users.

In use, the desired fuse is ignited by breaking the seal and pulling an igniter ring. Special construction prevents burns and allows the signal to be doused in water, after one signal color has been discharged, without damaging the signal color in the opposite end. Burning time is 18 to 20 seconds, according to Aerial Products, Inc., and both the day and night color charges are contained in one unit 5½ inches long and 1½ inches in diameter. The signal is expected to receive wide reception with commercial and private marine operators, sportsmen, and flyers.

TANK PRE-HEATER

Warms Heavy Liquids Stored in Bulk Tanks

LOWER grade oils, tar, asphalt, and other heavy bodied liquids requiring pre-heating for proper combustion or



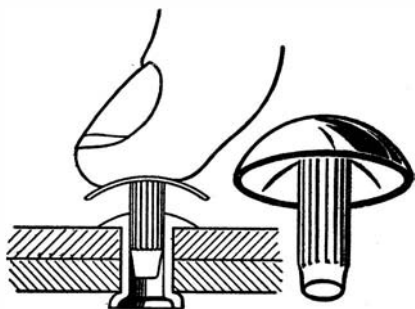
Pre-heater for heavy liquids

handling can be warmed before leaving the bulk tank, with a new pre-heater incorporating 38 square feet of direct radiation surface. Built for use with either steam or hot water, the pre-heater, developed by the Rempe Company, is provided with a flow accumulator which assures that the liquid will flow over the coils before entering the suction line. The unit fits any size tank having a man-hole of 16½ inches, or larger, diameter.

RIVET PLUG

To Be Used With
Hollow Rivets

USERS of hollow Cherry Rivets who find it desirable to have the head of the rivet match or harmonize with the surface color or texture of the material being fastened, will now be able to use newly developed Umbrella Plugs which fit into the center of the rivets. The head of the plug furnishes a smooth cap completely covering the head of the rivet. These plugs, available in aluminum, copper, or plastics, can be colored to match or harmonize with the



Plug presses into place

surrounding surface. Typical application examples are enameled signs, furniture, smooth surface household appliances, and industrial equipment.

Easy to insert, the plugs have a knurled and tapered shank which fits tightly into the hollow center of the rivet. The pointed end of the shank is inserted into the installed rivet, and the plug is pushed in by hand.

DEEP DRAWING

Facilitated by Stable
Chemical Compound

A DRAWING compound that maintains its inherent physical properties during repeated deep drawing of ferrous and non-ferrous alloys has a high film strength and does not separate even under intense stresses. The properties of the molecules at the interface, between the lubricant and the metal surfaces, remain constant during the drawing operation because of the chemical stability of the compound.

Superdraw, as the compound is called, is unaffected by atmosphere and heat, its complex organic molecules resisting chemical and physical deterioration. Chemically inert, it leaves no heavy scale nor does it leave stains on the surface of any alloy. Superdraw is easy to apply—by hand, brush, spray, roller, dipping, or pouring—and it may

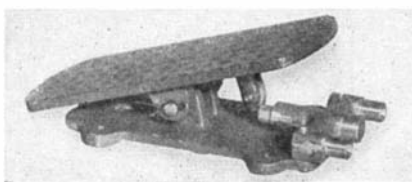
be extended to suit the draw by diluting with warm water. It is easily removed with any alkaline cleaner or any routine cleaning procedure.

AIR CONTROL

Valve Operated by
Simple Foot Pedal

DEVELOPED to meet a demand for an air control low in cost but constructed along the same lines as the higher priced controls, the new Redmer foot control has a brass valve which will withstand plenty of abuse.

The foot pedal is designed so as to make its operation as tireless as pos-



A roller makes action easy

sible. The opening and closing of the plunger of the valve on the foot pedal is operated by a roller on the pedal casting which relieves wear on the plunger and facilitates its operation.

SOFT SLEDGES

Have Replaceable
Striking Surfaces

SOFT hammers, in the light-sledge weight range, are now available in two new models. One has a replaceable copper or brass head; the other replaceable brass or copper tips. Each type comes in four head diameter sizes: 1¾, 2, 2¼, and 2½ inches, and weigh from 4½ to 10½ pounds. Equipped with safety leather washer handles, these Perfect Balance soft hammers have been designed for use in locomotive shops, for the assembly of heavy machinery in tool and die shops, and so on. The steel head on the removable-tips model is case hardened.

Made by the Gregory Tool and Manufacturing Company, the complete line of these hammers now consists of 12 different models and 56 different numbers, ranging in diameter of head from ¾ to 2½ inches, and in weight from 3½ ounces to 10½ pounds.

INTERNAL PLATING

Makes Steel Piping
Corrosion Resistant

A SMOOTH, ductile, pore-free nickel deposit, fully adherent to the base metal, can now be applied by electroplating to pipe or tubing up to 18 inches overall diameter, in random lengths of approximately 20 feet. The process endows steel pipe with the corrosion-resistance of nickel, while retaining the low cost, strength, and fabricating characteristics of the steel. Internally plated pipe can be welded, reduced, and bent—hot or cold—without destroying any portion of the internal lining, according to the proc-

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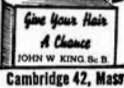
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Included with the book are 10 folded drawings 12" wide x 18" long. These drawings by Mr. Pearce show all the details of construction for this house — the wiring, the plumbing, the automatic oil heating system and the fluorescent lighting. The book is devoted to showing how similar savings can be made on any house of any style, size or floor plan.

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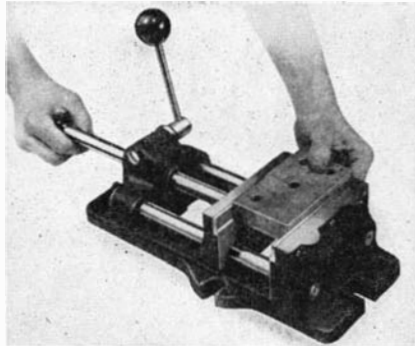
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cision ground. The wide clearance between jaw guides permits drilling right through the work and prevents interference from accumulating chips. Jaws have built-in, recessed parallels. A removable V-jaw accessory accommodates round pieces.

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Besides uses for roofing and siding, the material is suitable for gutters, ventilators, flashings, ducts, and so on. The sheets can be easily fabricated without special equipment and can be bent without impairing the coating because of its toughness and elasticity. They do not require further painting.

CONTAINER COATING

Covers in One Application;
Resists Heat and Food Acids

INCREASED production and better decorating results appear to be in the making for the metal package industry

with the introduction of Rolox vinyl white coating enamel.

Said to fill the need for a one-coat material with good resistance to food acids and fats, and to provide stability under high and repeated baking temperatures, Rolox vinyl white offers an improved sanitary lining coating for use on foodstuff containers requiring pasteurization, sterilization, and processing.

An unusually high solids content, heretofore difficult to obtain in vinyl coatings, contributes to the superior properties of this new flexible coating. This increased pigment is reported to give hiding power equal to that of two coats of conventional vinyl materials, while the greater vehicle content is responsible for the high gloss and tough, mar-resistant film surface, as well as better flowing qualities that help eliminate ridging.

The material may be applied directly to unsized black plate, electrolytic or hot dip tin, and is odorless and tasteless, the latter features being of importance in food and cosmetic packaging.

MICROFILM RECORDER

Photographs, Endorses, and
Face-Stamps Checks and Papers

FOR USE in banks and offices, a new microfilming machine simultaneously photographs the front and back of a business document. The document's area is reduced by 1000 times and the images appear side by side on a narrow 16 millimeter film.

Known as the Duplex Recordak, produced by Eastman Kodak Company, the new machine employs mirrors so that the front and back of a piece of paper are reflected simultaneously to the camera.

One hundred bank checks or reference cards, both sides, can be reproduced on one foot of 16 millimeter microfilm, or more than eight images per inch. On a 100-foot roll, more than 10,000 checks—front and back—can be photographed. A duplicate film can be exposed at the same time, since the



All the mechanism of the Recordak is contained in a desk-size cabinet

film unit has two lenses and holds two rolls of film.

The new machine will also endorse bank checks. Placing an endorser mechanism inside the microfilming machine is expected to save considerable time and work in banking procedures, by eliminating a separate operation.

A third job performed by the machine is face-stamping each document. "Photo by Recordak" is printed on each document before it is recorded. Thus bank checks or business papers which might become involved in legal proceedings are known to be "filed" on microfilm.

CONCRETE FORMS

Protected by New Surface Film

CONTRACTORS can now coat the surface of plywood concrete forms with the same thickness of protective film in one coat as was previously obtained in two coats. The additional protection and the saving in application and handling will be particularly welcome on large concrete jobs.

The new A. C. Horn Company Formfilm is used for preparing forms, such as plywood or other fibrous wood, in which concrete will be held in proper position until setting has taken place. The proper coating of plywood with Formfilm produces smooth concrete, free from grain markings and ready for painting if desired.

The film is said to condition the plywood so that it is highly resistant to warping or swelling because the Formfilm is highly water repellent. No concrete will adhere at any stage of setting. Tests have indicated that re-use of coated plywood forms as often as four or five times without recoating is possible, and that the life of the plywood is materially increased.

TELL-TALE LABEL

Warns of Dampness by Turning Pink

SENSITIZED labels—smaller than a postage stamp—which change color with humidity are now available to serve as humidity indicators in a multitude of applications. Color changes are distinct, definite, and reversible; the label being a brilliant blue-green when dry, and pink when humidity approaches the point where mold, mildew, corrosion, rust, soggy, and so on occur.

"Hygrolabels" are self-adhering and are supplied in roll and strip form upon a protective backing. Individual labels may be placed on, in, or between the material to be checked. By removing the label from the protective backing it may be affixed to any surface. Leaving the protective backing in place allows the label to be placed in any powdered, granulated, or flaked material without contaminating the product.

Some of the suitable applications appear to be: checking the degree of moisture in rooms, containers, tanks, and like places; determining the moisture content of powder, cereal, cotton,

cloth, paper, tobacco, and so on; and testing the leak-proofness of glass, cellophane, waxed, or other sealed packages. Labels may be used repeatedly.

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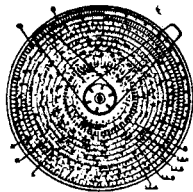
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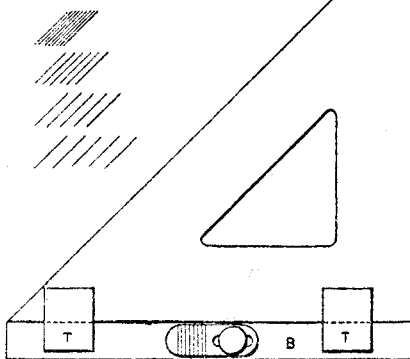
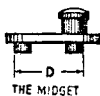
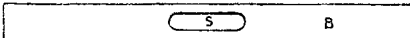
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CELLULOSE TEXTILE FINISH

Made of Wastes by Oxidizing Method

SUBSTITUTION of an oxidizing agent for heat is now reported to provide an improved method of making cellulose suitable for textile finishing. In the past, heat has been difficult to control in the exact amounts required, and local over-heating sometimes created non-uniformities in the finished product.

In the new process, cellulose is treated with an oxidizing agent for sufficient time to increase its solubility in aqueous-alkaline solutions. Waste-regenerated cellulose is the preferred material to use in making this finishing agent, according to Sylvania Industrial Corporation, developers of the method.

Inexpensive raw materials, and ease of controlling the manufacturing process, appear to indicate a large potential use for the product in the textile finishing field. It may also be used as a pigment binder in the printing and pad dyeing of textiles.

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

BRAZING CARBIDE TOOL TIPS WITH EASY-FLO NUMBER 3. This four-page bulletin discusses the advantages of the use of this silver brazing alloy and covers its application in torch, furnace, gas-air burner, and induction brazing. Request Bulletin 11-A. *Handy and Harman, 82 Fulton Street, New York 7, New York.—Gratis.*

NORELCO INDUSTRIAL X-RAY EQUIPMENT, a 12-page booklet, contains descriptions, specifications, and applications of the following equipment: Searchray Models 80 and 150, Searchray Model 150 CF (conveyor type), Searchray Model 90 (mobile type), X-Ray Spectrometer, and the camera-type X-Ray diffraction unit. *North American Philips Company, Inc., Publicity Department, 100 East 42nd Street, New York 17, New York.—Gratis.*

CATALOG NUMBER 45 compiles pertinent information on safety and relief valves. Line drawings depict basic types, with charts showing what each type can be used for. A condensed bulletin and price sheet are contained in a supplement (Number 45A) to this catalog. *Farris Engineering Company, 400 Commercial Avenue, Palisades Park, New Jersey.—Gratis.*

HOW TO SAVE MONEY ON INDUSTRIAL HAULING JOBS AND EQUIPMENT. Containing 38 pages and fully illustrated, this booklet on industrial tires outlines the following savings to users: less hauling time, floor wear, noise, and depreciation; reduced breakage; and fewer accidents. A section on care and maintenance is featured and descriptions of each model in the industrial tire line are given. *The B. F. Goodrich Company, Public Relations Department, Akron, Ohio.—Gratis.*

ELLPRO CUTTING ELECTRODES is a four-page bulletin describing cutting electrodes for underwater and surface cutting. Their use in harbor clearance, salvage, and certain construction operations has been revealed since the war's end. It is stated that these electrodes can be used with any portable welding set by just adding a tank of oxygen. *Ellwood Products Corporation, Ellwood City, Pennsylvania.—Gratis.*

EVALUATION OF EFFECTS OF TORSIONAL VIBRATION is a 578-page treatise covering experimental and analytical methods used by Diesel engine manufacturers to investigate and apply means of controlling torsional vibrations. Prepared in response to a request from the Navy, it has been authorized for general distribution to industry because of its broad applica-

tion and interest. Characteristics of torsional vibration measurement equipment are discussed and compared, short-cut methods are given, and fatigue testing of full scale parts is presented. This illustrated book has clothboard covers. *Society of Automotive Engineers, 29 West 39th Street, New York 18, New York.—\$5.00 to SAE members, \$10.00 to non-members.*

LOCKE THREAD GAGES is an eight-page catalog covering specifications and prices of gages designed with a new feature—a clearance below the roots of the threads—to increase gage life. All features of this clearance are outlined. *Locke Gage Company, 10232 Woodward Avenue, Detroit 2, Michigan.—Gratis.*

INDUSTRIAL LOGISTICS—A SURVEY FOR MANAGEMENT. In this 12-page booklet one of the simplest, most effective means for handling materials and manufactured products is presented with an explanation as to how it reduces costs in procurement, production, and distribution of goods by load transportation. *The Elwell-Parker Electric Company, Cleveland, Ohio.—Gratis.*

THE PRACTICAL DESIGN OF WELDED STEEL STRUCTURES. Of value to designers, engineers, and fabricators, this 150-page book covers various welding processes, simple welded joints and connections, beam connections, and temperature effects. A special section is based on the American Welding Society codes. *American Welding Society, 33 West 39th Street, New York 18, New York.—\$1.00.*

FRICTION SAWING. In this 24-page booklet is described a new technique for cutting materials with high-speed sawing machines. Containing information for those seeking a faster way to cut and shape ferrous materials, this booklet explains how friction sawing is made possible. *DoALL Company, Machine Tool Division, 1301 Washington Avenue South, Minneapolis 4, Minnesota.—Gratis.*

RELAY ENGINEERING HANDBOOK, containing 640 pages, is a comprehensive guide to the selection and application of relays and timers. In addition to fundamental principles, this handbook explains equipment and circuits encountered in applying relays. Many short-cuts are listed. This leatherette bound volume is cross-indexed, profusely illustrated, and comes with the user's name gold-stamped on the cover. *Struthers-Dunn, Inc., 1321 Arch Street, Philadelphia 7, Pennsylvania.—\$3.00.*

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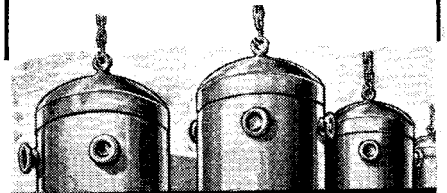
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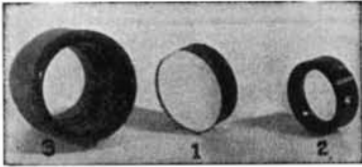
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FOR OBSERVING faint objects, such as nebulae and the Milky Way stars, telescopes of short focal ratio are the best suited; they concentrate the light gathered by the objective lens on a small area, well illuminated. On the other hand, for observing planets, where there is plenty of illumination, high magnification is possible and this may be had by use of telescopes of long focal ratio which have a large image, sufficiently well illuminated. Most ordinary telescopes are a compromise, and serve fairly well for both purposes.

The telescope described below has very long focal ratio (1:30) and is specialized on planetary purposes. Its tube is nearly nine feet long, though its aperture is only $3\frac{1}{2}$ inches. It was designed and built and the specifications for its objective lens are given below by Lieut.-Colonel Troy W. Lewis, an amateur telescope maker who both designs and constructs, and who lives at 1812 Schiller Ave., Little Rock, Arkansas.

Of course, in optics, whenever you gain some advantage you must pay for it with some kind of compromise (lucky if only one) and thus this refractor frankly abandons the advantage of compactness. It is true that the

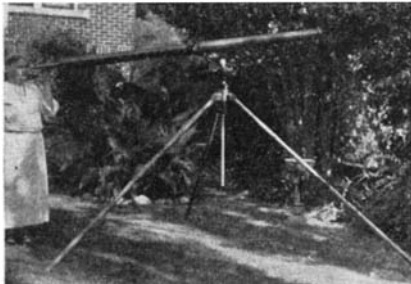


Figure 1: Lewis long-focus refractor

Cassegrainian type of telescope enjoys both long focus and compactness but it does not enjoy the same simplicity of construction as the Lewis refractor. Perhaps the following article, with the one on long-focus reflectors in the February number, will help start a new trend in the long-focus direction. Colonel Lewis writes:

THIS COMMUNICATION deals with several advantages found in designing, constructing, and using an achromatic refractor with focal ratio double that of the usual $f/15$.

Splendid pioneer work was done by astronomers some generations ago who used, through necessity, long-focus plano-convex single lenses made from inferior window or bottle glass. Perhaps some of the best work done by

those pioneers was with telescopes from 12' to 33' long, with apertures between 2" and 3". Inherent spherical and chromatic aberrations were rendered less obtrusive through the application of the well-known laws of diminishing curvature and the concealing of color errors into the image by diffraction. A maximum correction of aberrations under these laws occurred when the focal length approached 100 times the square of the aperture of the objective.

There were some monstrosities in telescopes in those days. Thus, the Huygens brothers made objectives up to 210' in length, with a 6" aperture, but their best work was done with a 23' telescope of $2\frac{1}{3}$ " aperture. It was with this glass, power 100, that Christian Huygens solved the great Saturnian mystery in 1659.

The achromat, invented by Chester More Hall in 1733, for many quite obvious reasons displaced the older long-focus single lenses in frail tubes or more unstable girders, but it could not wholly destroy the merits of properly designed long-focal-ratio lenses. Professor David P. Todd, as late as 1911, strongly recommended the construction of a long-focus open-air telescope in a steel box-girder, reinforced so as to be unyielding and rigid, thus to secure the many advantages of long-focus lenses under modern conditions.

Most astronomers agree that the visual refractor is ideal in the study of fine detail in planetary images, but for critical work in selenography, saturnigraphy, or in areography, it must be admitted that the focal ratio of the objective should be very much higher than the standard type $f/15$ established by Fraunhofer many years ago.

The amateur astronomer who wants a modern long-focus telescope for planetographic work will usually have to make one to his own specifications, for such telescopes are rated by professional opticians as exceptional and expensive. A special lens design is called for and that, in itself, is no small item of expense.

Such special lens designing is, however, possible. An achromat for any desirable focal length may be achromatized for any two bands of the visual spectrum at the designer's option, such as B and F, C and F, D and E, D and F, or, for photography, D and G'; and where the amateur makes his own objective an effort should be made to achromatize for his particular vision if he is allergic to either red or blue. Vision differs widely with individuals.

It had long been the desire of the writer to design and construct a mod-

ern 23' achromatic objective of 4" aperture, and a glass of that size was under actual construction when the war called him to active duty with the armed forces, thus suspending further activities in the optical field for the duration and six months. Fortunately, two smaller long-focus telescopes had been made, in 1939, as stepping stones to the ultimate $f/69$. One of those, Figures 1 and 2, is here described.

This $3\frac{1}{2}$ " achromatic plano-convex objective, $f/30$, was made from optical glass readily obtainable on the American market. It is shown (Figure 1) in its first temporary altazimuth mount. Should the amateur wish to make this telescope for his own use let him do so with complete confidence. He will find, provided his vision is entirely normal, that the objective has many of the characteristics of an apochromat. Such trying objects as Venus will be seen

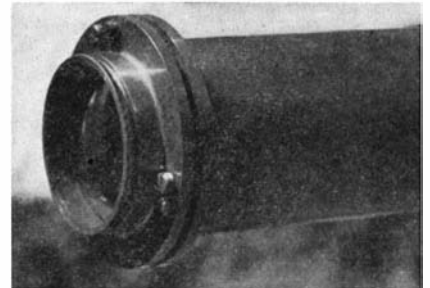


Figure 2: The brass push-pull cell

without noticeable secondary spectrum—bright and colorless. Fine details on the Moon are remarkably clear and distinct. It will resolve to the full theoretical Dawes' limit and, as an enthusiastic friend has commented, "a leetle more!" Its performance really has to be experienced to be fully appreciated.

This lens is a thin plano-convex achromat, cemented, of $3\frac{1}{2}$ " aperture and 105" equivalent focal length. It was designed from Bausch & Lomb glass, Crown, BSC-2; Flint, DBF-1. It was achromatized for the C and F lines. The following is a first approximation design:

Let f = focal length of the crown glass

f' = focal length of the flint glass

$$\text{Then } 1/f + 1/f' = -1/105$$

(1) For the crown glass:

Mean refractive index,

$$\mu = (1.51461 + 1.52262)/2 = 1.51861$$

Dispersive power,

$$= (1.52262 - 1.51461)/0.51861 = 0.01544.$$

(2) For the flint glass:

Mean refractive index,

$$\mu = (1.61242 + 1.62843)/2 = 1.62042$$

Dispersive power,

$$= (1.62842 - 1.61242)/0.62042 = 0.02585.$$

Then, from the algebraic formula for achromatization, it is seen that $0.01544/f + 0.02585/f' = 0$. The linear spectrum formed along the axis will be folded on itself, bringing the red and blue rays into coincidence.

The design was achromatized to bring the minimum focal point to the brightest portion of the spectrum as viewed by the designer's eye, leaving any outstanding blue and red rays equally pushed away from the axis

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where they can do no harm, since in an objective of this focal ratio both spherical and chromatic aberrations, chromatic residuals, if any, would focus both absolutely and relatively beyond the image plane, as was first observed in ancient long-focus single lenses.

To determine what must be the focal length of each of the two lenses: Let $1/f = -2585/1544 \times 1/f'$, Then, $(-2585/1544 + 1) \times 1/f' = -1/105$ Therefore, $f' = 70.79310$ ". Also $f = -1544/2585 \times 70.79310 = -42.28841$ ".

Since one of the surfaces of the flint lens composing this achromat is to be plane, the radius of curvature of the other surface will be identified as R, then, $1/f' = (\mu' - 1)/R$, therefore, $R = (\mu' - 1) \times f' = 43.92145$ ".

The intention being to cement this objective with Canada balsam it follows that the crown lens also must have one radius of curvature coincident with the divergent lens, $R = 43.92145$ ". Let the free surface of the convergent lens, therefore, have a radius of curvature denoted by r.

Then $1/f = (\mu - 1) (1/r - 1/R)$
and $1/r = 1/(\mu - 1) f + 1/R$
 $= -1/(.51861 \times 42.28841) + 1/43.92145$
 $= -232396$. Therefore, $r = -43.03$ ".

This completes the first approximation design. Specifications follow:

Crown lens	1st surface	-43.03"
	2nd surface	+43.92"
Flint lens	3rd surface	+43.92"
	4th surface	∞ flat
Crown focus	42.28"	
Flint focus	70.78"	
	Combined focus	= 105"

To afford full benefit of light traps or stops this objective should be mounted in 4" or 4 1/2" I.D. steel or brass tube and to obtain necessary stiffness this tubing should have at least 1/4" wall thickness. The objective should be housed in a heavy brass push-pull cell (Figure 2) for squaring on. Haviland's remarks on tube structure, page 215, "A.T.M.A.", should be read and his advice followed when calculating the size of the holes in the diaphragms and eye tube. At least six stops should be used; eight would be better. The Moon's image in this telescope is approximately 1" in diameter and very bright.

A battery of at least five Huygenian eyepieces is recommended. These should be a 3", 1.5" and 1" for low power and a .5" and .25" for high power. The 3" and 1.5" eyepieces should be especially made to avoid stopping off part of the light. The 1/4" eyepiece will give 420 diameters for resolving fine detail during moments of fine seeing.

There are several ways of designing a long-focus objective from this or other selected glass.

Thus, the Littrow type (cemented) may make a fair to middling objective with Chance Brothers 1.5115/60.8 Crown and 1.620/36 Flint, all radii of curves to be 42.00" except 4, which will be nearly plane. The Haviland first approximation formula (and it is a good one) indicates $R_1, R_2, R_3, 44.40$ " and $R_4, 671.72$ " convex (cemented) when using 1.516/63.5 Crown and 1.604/37.5 Flint to be had from Leo D. Keller, 2438 N. 19th St., Philadelphia, in 60 mm pressed lens blanks (see "A.T.M.A.", p. 226).

Incidentally, a Fraunhofer type long-focus objective, with small air space between lenses, may be made from B & L BSC-2 and DF-2 with this set of curves: $R_1, +63.87$; $R_2, -37.21$; $R_3, -37.59$; $R_4, -155.82$. The writer much prefers the cemented crossed crown lens for his long-focus objective because of its beautiful flatness and wide field. The crossed crown is not, however, the 2:3 structure mentioned in "A.T.M.", p. 110, by Reverend Ellison.

With the explicit information on first approximation design given in the above notes the amateur should be able to design his own objective for any part of the spectrum as he may choose if C and F be deemed undesirable.

Since Hastings has shown ("A.T.M.", p. 179), that it is no more difficult to make a flat for rays normal to the surface than to make a true curve, and since Driscoll has shown (Scientific American, March—April, 1945) how easy it is to grind, polish, test and figure a set of curves, it is believed that the amateur will no longer hesitate to indulge in making for himself a highly desirable long-focus plano-convex refractor for planetary work. Here is how, and luck to all who try.

ANY READER who undertakes the type of telescope described above is urged to keep in touch with Colonel Lewis or with this department or both, though reports to either one are likely to be seen by the other since this department keeps in direct-mail touch with numerous readers everywhere.

It has happened numerous times that the maker of some unusual piece of optics has omitted to write in and crow about it, either from modesty or from the supposition that editors are fed up and probably wouldn't care. It is true that the lower orders of animals lay their eggs and thereafter forget their progeny but the higher mammals, including editors (provided you do), maintain post-partum and post-parental interest. Of course, this department isn't the actual papa of the things it publicizes but it enjoys playing uncle, so crow.

STELLAFANE convention of 1946, Saturday August third, Sunday August fourth! This promises to be a mammoth meeting. Begin planning now. Porter is coming East—"going to Stellafane in August, shake hands on it," he writes. John W. Lovely, 27 Pearl St., Springfield, Vermont, secretary of the Springfield Telescope Makers, is the man to write to if you have any problems connected with the meeting.

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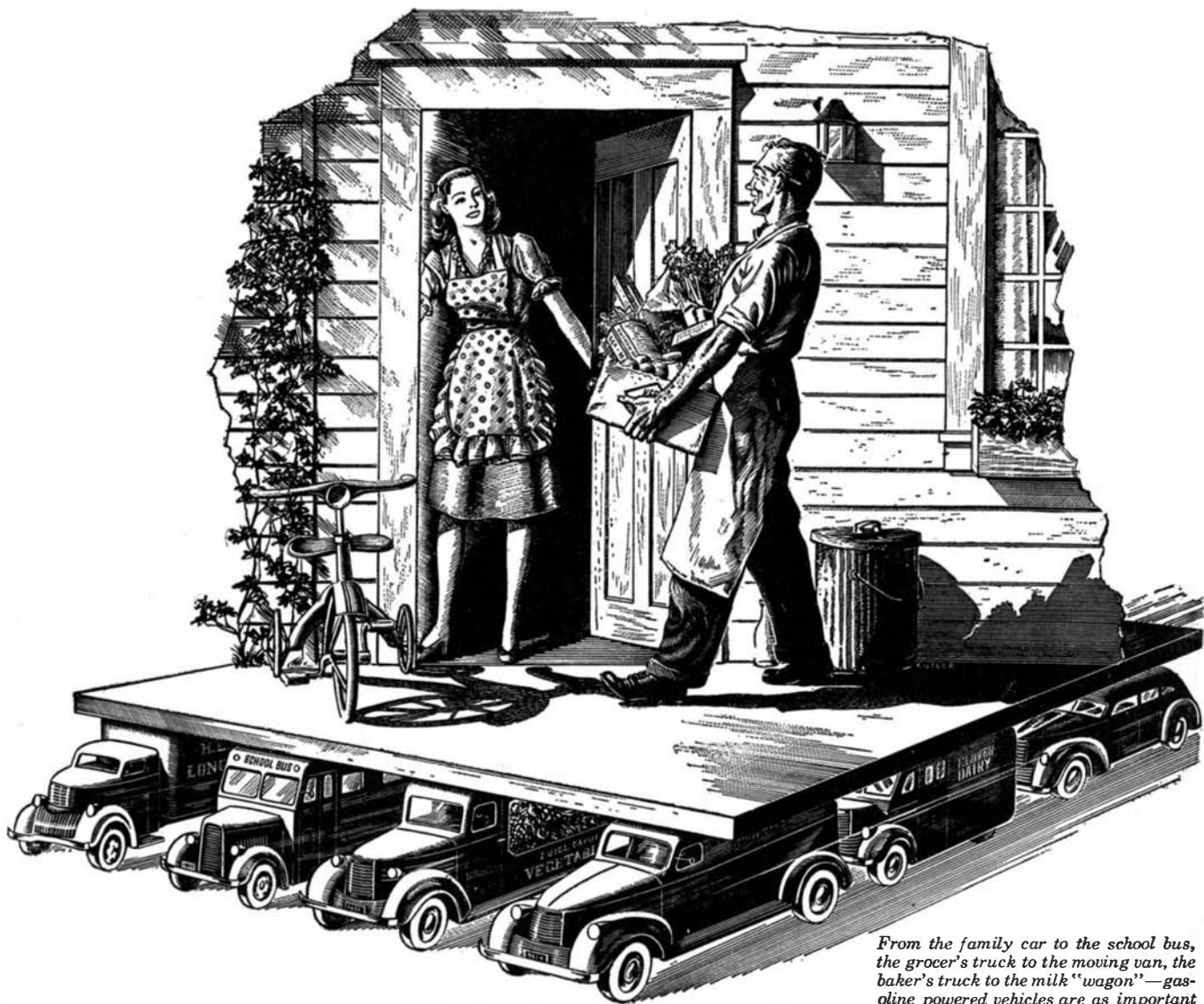
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