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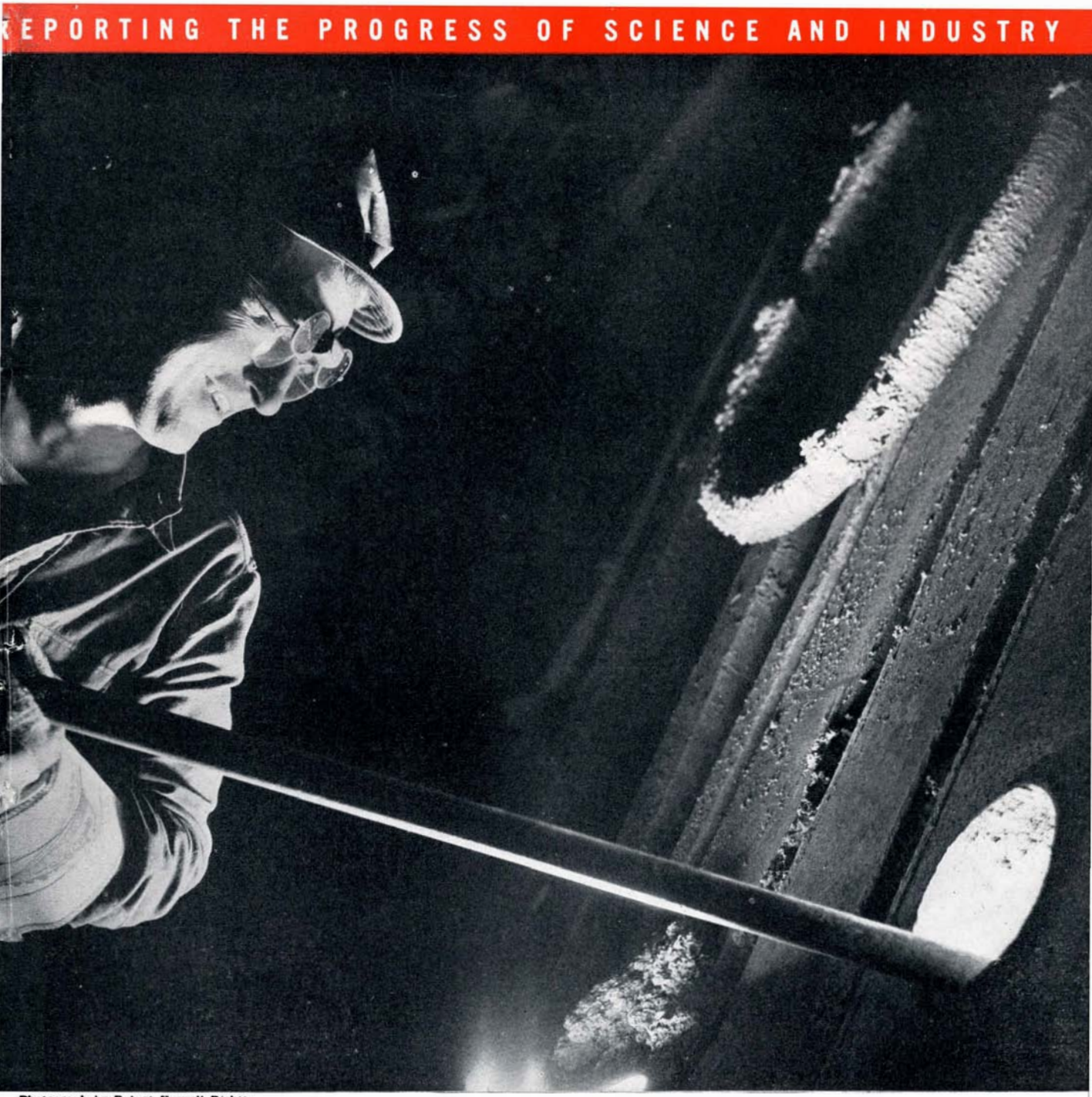
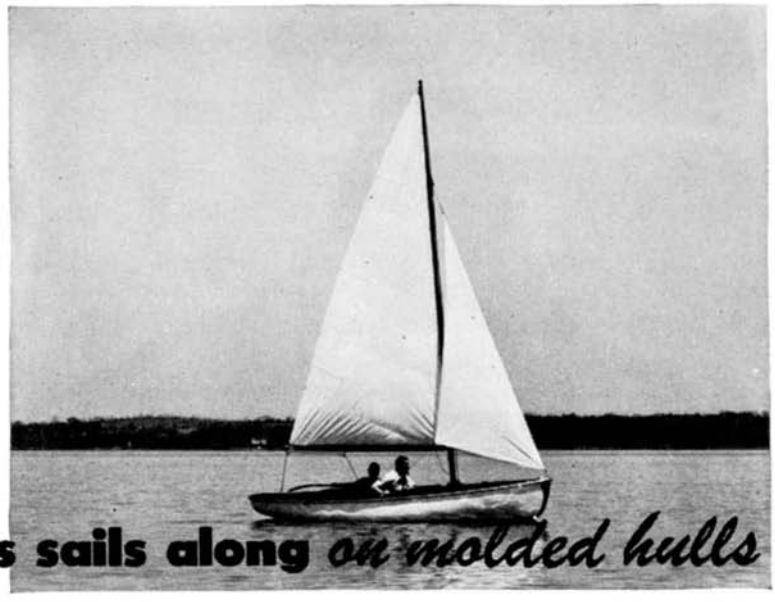


Photograph by Robert Yarnell Richie

Steel Meets the Test . . . See pages 97 and 101



Plastics progress sails along on molded hulls

Co-Ro-Lite, a Durez-resin-impregnated sisal fiber, has been noted as a plastic material of tremendous strength with unusual adaptability to large moldings. That the Columbian Rope Company, producers of Co-Ro-Lite should successfully develop a sailing boat with a hull molded of this material seems a logical step forward in plastics progress . . . typifies the forsight and progressiveness of the industry as a whole.

The development of this Co-Ro-Lite sailboat is an outgrowth of the Columbian Rope Company's wartime experience in making large moldings such as jettison tanks, glider noses, and engine nacelles. The experience gained in molding these items seemed to be applicable to fashioning a strong lightweight sailboat hull.

Molding The Hull

To mold the hull, a thick blanket of rope fibers was first cut into a rough shape resembling the finished boat. This blanket was then mechanically dusted in a vibrator machine with a powdered Durez phenolic resin to the extent of 50 to 55% content. This combination was then bag-molded into the finished hull. The deck was molded separately but in a similar manner.

The inherent properties such as durability, moisture resistance, and impact strength which the Durez resin used for this purpose possesses, combined with the tremendous strength of sisal fibers, make a lightweight hull of unusual durability...a hull with no ribs or internal bracing.

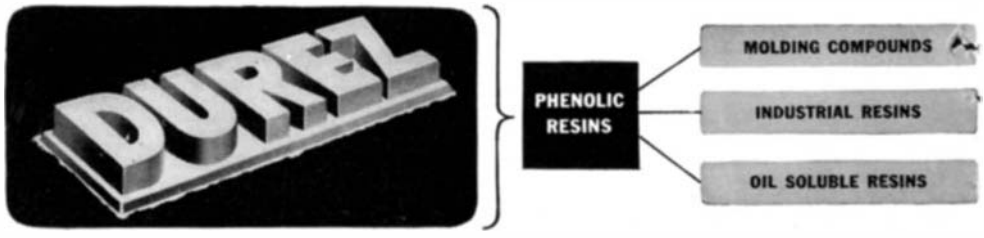
Many Advantages

In addition to the production economies which Co-Ro-Lite effects, this Durez-resin-impregnated sisal fiber sailboat has no seams to be caulked. Furthermore, the monocoque construction provides a boat which does not have to be worked over each season, aside from painting, and offers a clean interior with no ribs to catch dirt. Besides this, submersion tests conducted in Florida waters prove this plastic boat resists penetration by barnacles and other growth.

Competent Assistance Available

The Co-Ro-Lite sailboat is but one of many highly successful developments in which Durez phenolic plastics were used.

As specialists in the production of the versatile phenolics for the past quarter century, Durez technicians have acquired a rich background of successful product development work. The benefits which this background and a wealth of proved data can provide are available to you and your custom molder at all times. Durez Plastics & Chemicals, Inc., 13 Walck Road, North Tonawanda, N. Y.



PLASTICS THAT FIT THE JOB

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Our Cover: Taking a sample of molten metal from a melt, for laboratory test, at the Geneva Steel Works operated by United States Steel Corporation. Steel's present status and possible future progress are detailed in the article starting on page 101.

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50 Years Ago in . . .

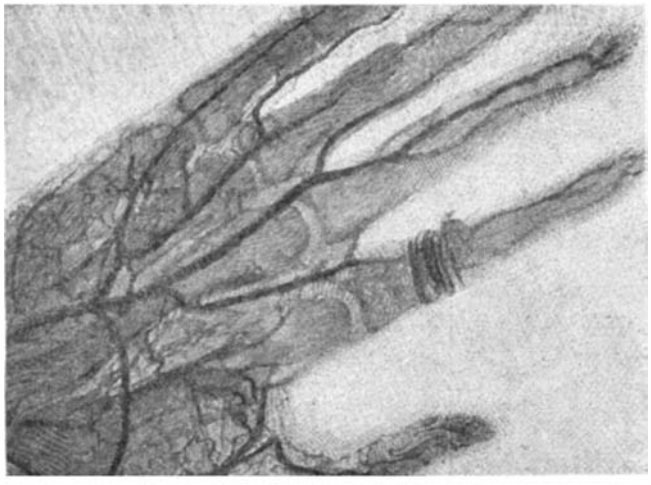
SCIENTIFIC AMERICAN

(Condensed from Issues of March, 1896)

INVENTION — "In the line of new invention and discoveries, notwithstanding all that has been already achieved, there are, without doubt, as many brilliant successes lying before the inventors of the future as have been credited to the inventors of the past. The way is open to all."

FUEL — "A process has lately been brought out by Carl Wegener for utilizing powdered coal. The coal is fed into a hopper which is located in front of the furnace. At the bottom of the hopper is a grating, which can be agitated from 150 to 250 times to the minute, according to the rapidity of feed desired. The coal dust falls through into the bend of an air supply pipe, which enters the furnace at the top of the furnace door. As it falls into this pipe it is met by the induced draught and carried into the furnace."

X-RAYS — "The accompanying X-ray photograph of a hand is of especial interest as being the first photograph that we have seen that shows clearly the position of the veins in the



hand. The effect was produced by injecting a fluid in the hand of a corpse, thus making the veins opaque to X rays and enabling them to be photographed. . . Another interesting development is the production of direct optical shadow effects on a disk charged with barium platino-cyanide. This is the fluorescent salt used by Roentgen in his first experiments."

SAWDUST GAS — "There are several large lumber mills in Deseronto, Canada, and the town is partially lighted by gas obtained from sawdust from them. The sawdust is charged in retorts which are heated by a wood fire. The gas from these retorts passes into a series of coils and thence into the purifiers, which are similar to those used for coal gas."

MOTOR-CAR TROUBLES — "A recent conviction for the illegal use of a horseless carriage has been obtained in England. The owners of the carriage were summoned for not carrying a flag in front of it."

FLYING — "Whoever has followed with attention the technical treatises on flying will have become convinced that human flight cannot be brought about by one single invention, but is proceeding toward its perfection by a gradual development; for only those trials have met with success which correspond with such a development. Formerly men sought to construct flying machines in a complete form, at once capable of solving the problem, but gradually the conviction came that our physical and technical knowledge and our practical experiences were by far insufficient to overcome a mechanical task of such magnitude without more preliminaries." By Otto Lilienthal.

GLASS — "A glass plate of different colors is formed by two or more layers of transparent or opaque glass cast upon each other so as to constitute a single plate upon which, by moulding or pressing, letters or designs of any shape or dimensions can be represented."

IRON AND STEEL — "There are seventy-four iron and steel bridge building works in the United States, twenty-two locomotive works, thirty-six iron and steel shipbuilding yards, sixty-four completed car axle works and two building, 112 completed car wheel works and one partly erected. and 112 car building works."

LATHES — "Nothing delights the heart of the true mechanic more than the examination of a perfect lathe, unless, indeed, it may be the actual possession of one. There are other machines more wonderful, and capable of performing intricate work, and imitating manual operations with remarkable fidelity and great rapidity. But for the lathe, such machines could not exist. The lathe may, therefore, be regarded as the progenitor of all machines. Having a perfect lathe, the machinist can produce anything required in the line of machinery or tools."

ABRASIVE — "Emery is one of the few valuable rocks not yet produced in important quantities in America. Large amounts are yearly brought from Turkey and the Greek Islands. . . Many new uses will doubtless be found for emery; but probably it can take no more important place in industry than that of the emery wheel and the emery millstone."

100 Years Ago in . . .

SCIENTIFIC AMERICAN

(Condensed from Issues of March, 1846)

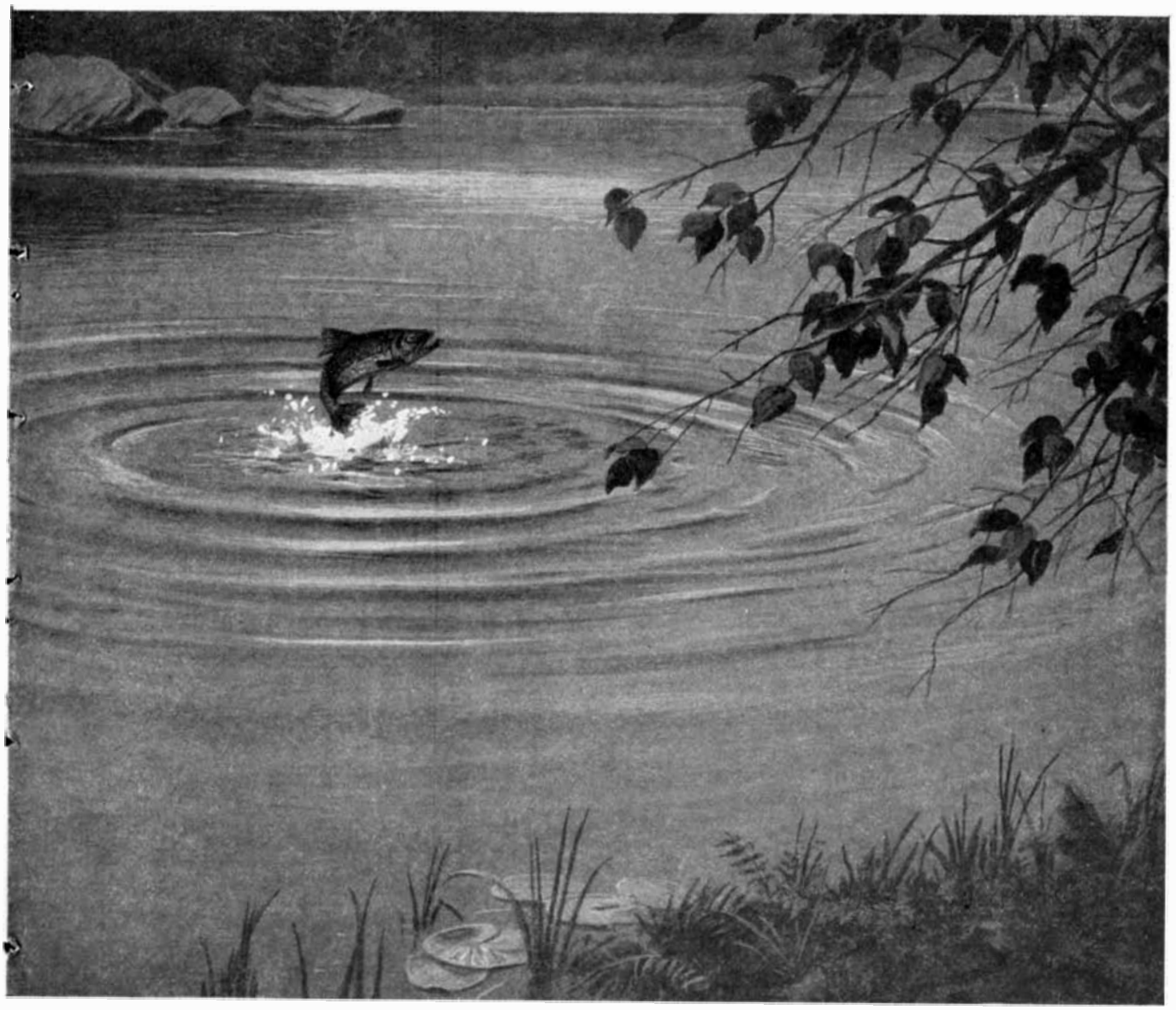
LUMBER — "One would think that such an everlasting and universal slashing as is going on in the woods would very soon exhaust all the pine timber. . . Meanwhile large fortunes will be amassed to be squandered by posterity after the sources as well as the results of their fathers' wealth are dissipated."

TELEGRAPH — "Morse's magnetic telegraph has been adopted in Austria in preference to all others. It is evidently the most simple and easy of management."

CARPETS — "M. Bigelow, an ingenious American artisan, has invented a power loom for weaving grain carpets, which is already in use by the Lowell Company, who have set 50 looms in motion, and expended nearly $100,000 in this branch of manufacture."

PRAIRIE CAR — "There are few plans of enterprise, now in progress, to which more importance attaches, or which excite more interest, than that of navigating the extensive prairies by steam-power, and with carriages capable of accommodating 100 passengers, besides twelve to twenty tons of merchandise."

IRON — "There are twenty-three furnaces now in full blast in Pennsylvania, and six more are in progress and nearly completed. When these are put in operation, the quantity of iron produced per week, is expected to amount, in the aggregate, to 1,750 tons per week."



Wave Makers

"A leaping trout awakens the still pool to life in waves that move in silent rhythm."

In the same way, when you speak over the telephone, vibrating electric currents speed silently away with the imprint of your voice over the wire and radio highways of the Bell System.

Tomorrow, the vibrations will be the living pictures of television. All are examples of wave motion.

How to produce, transmit and receive electrical wave motion is the basic problem of the communication art.

Bell Telephone Laboratories, which exist primarily to invent and develop better communications for the Bell System, devote the teamed efforts of physicists and mathematicians to the production and control of electric waves in all forms.

Out of these fundamental studies have come the discoveries which keep the Bell System at the forefront of the communication art.

BELL TELEPHONE LABORATORIES

EXPLORING AND INVENTING, DEVISING AND PERFECTING, FOR THE CONTINUED IMPROVEMENT OF TELEPHONE SERVICE

Previews of the Industrial Horizon

By A. P. Peck

TO OFFSET PRODUCTION COSTS

If ever the industrial engineering fraternity as a whole faced a challenge, it does today. Wages are up, labor's interest in its job seems to be decreasing, raw materials are increasing in price—all along the line costs soar while strikes and other impediments bring production down.

Here, then, is the challenge to engineers. In the vaunted efficiency of American industry, still more efficient techniques must be evolved. Production methods must be devised that will offset overall increases in cost. There are many approaches, and wise management is investigating them all as rapidly as ingenuity will permit. Two units must be produced where only one was produced before. Time and motion study, redesign of equipment for faster production, use of machinery that is more efficient, and—not the least of the engineer's problems—employee relations, are all a part of the present picture.

Worn threadbare by now is the statement that American industry has learned many production lessons from war-necessitated speed-ups. But such work was done under forced draft, with little or no thought given to cost. Now the scene is changing. Competition is back. Labor is striking for what it considers to be its "rights," regardless of consequences to the country as a whole. Wages will go still higher for awhile. Inflation will continue—to an extent that only time will determine. Through it all, industrial management remains saddled with the multi-sided job of carrying on the American way of doing things. And management must rely on engineering brains for the ways and means.

Here are a few examples—presented for purposes of thought stimulation rather than for operating detail—of some of the things that can be done. Air-operated fixtures in one machine shop have increased production in some operations more than 100 percent; new honing techniques speed removal of metal from stock by six to eight times while resulting in precision of high magnitude; incentive systems, whereby the worker's pay is increased in proportion to his productivity, are coming into wider use; formerly gloomy shops and foundries are being cleaned up, made brighter, with good psychological effect on labor; decentralization of industry is helping to get factories nearer to sources of raw materials and assembly lines closer to markets.

By means such as these, and many others, American industry can overcome the handicaps of mounting costs. And, showing the way, will be the industrial engineer who has the vision to view the picture as a whole without losing sight of its component parts.

HIGH PRESSURE STEAM

As an example of what can be done when necessity presses is the buzz-bomb launching system perfected by Babcock and Wilcox. The equipment uses steam at 1200 pounds per square inch pressure and can handle steam at the rate of 3,000,000 pounds per hour. This potential power is controlled by a valve having an opening and closing time of three one-hundredths of a second and remaining open for eight tenths of a second. In this short space of time, the equipment develops a peak of 25,000 horsepower.

Here is something for steam engineers to conjure with. The system may never be used to launch buzz bombs against an enemy, but it has many implications for peace-time applications.

DOWN ON THE FARM

Farms in the United States are growing fewer in number but larger in size, and it's all because of mechanization. Tractors, bulldozers, and combines have changed the entire agricultural horizon in recent years and will probably continue to do so for some time to come.

Down in the wheat and rice farms of the Texas Panhandle, in the cotton plantations of the south, up in the farms of Michigan and Wisconsin, even in the smaller units of the east, the trend is definite and encouraging. With mechanization, much of the arduous and distasteful labor of the farm is eliminated. Operating costs per acre go down. Farm operation becomes more attractive. And the entire nation will benefit by decreasing costs of production.

While looking at the farm picture, let's glance at the farmer's wife. According to a study made by the Kansas State College, there is a tremendous pent-up demand for electrical equipment in the farm kitchen, running water in the bathroom, fresh paint on the house and farm buildings, and linoleum on the floor. The survey further shows that two thirds of those planning purchases want to pay cash. Of the remainder, only 8 percent are planning on installment purchases. The average farmer surveyed expects to spend about $1000 in the next two years on household and farm equipment.

IN THE MOVIES

In recent years, industry has learned much about the value of moving pictures for training purposes, public relations, and employee education. A few specialized producers have attempted to fill the demand. Now Hollywood has cast an appraising eye on the industrial field and is starting to do something about it. Without plumping too strongly for Hollywood's blood, thunder, and sex technique, it is obvious that the moguls of moviedom could contribute greatly to the technical improvement of industrial films of all types.

ON THE RAILS

An order has just been placed with Pullman Standard by the Baltimore and Ohio Railroad Company for two eight-car streamlined all-coach trains. The Illinois Central, the Missouri Pacific, and the St. Louis-San Francisco have been conducting surveys to determine what their passengers want in the way of service, speed, and equipment.

These are all steps in the right direction. The railroads still have an odorous past history to live down. A few crack trains and sporadic surveys will not do it. Service must be improved all along the line. Schedules must be speeded up and maintained. Railroad personnel must be snapped out of its war-time attitude of "the public be damned" and re-educated to the fact that the public maintains the railroads. Only then will the railroads start once more toward the goal of reclaiming business from other forms of transportation. The technological means are available. Let the railroads make the most of them.

FOR FUTURE REFERENCE

The electrical utility industry, according to the Federal Power Commission, has "advanced significantly toward a degree of financial soundness". . . Reynolds Metals Company, with new acquisitions, will have sufficient capacity to produce as much aluminum as was necessary to fill pre-war demands; after filling their own requirements, they will sell alumina at cost plus 6 percent. . . Glass-reinforced plastics can compete with metals in many uses. . . Surface coatings for wood are being perfected that will prevent the growth of infectious fungi and bacteria; uses are indicated in hospitals, schools, theaters, and other public buildings.

Courtesy Timken Roller Bearing Company

Seamless steel tubing—seen here emerging from a reheating furnace during manufacture—offers economies in many uses by eliminating machining and promises to give strong competition to tubing of other metals

METALS IN INDUSTRY

Steel Fights Back

A Basic Industrial Material, Steel is Assured a Continuance of Its Top Position by New Production Methods, by Specifications Tailored to Definite Industrial Needs, and by Its Inherently Adaptable Qualities. War-Time "N.E." Steels have Proved Themselves and Are Here to Stay

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

Amid the forecasts of steel's decline as the champion among modern engineering materials, and of the dawn of a "light-metal era" or a "plastics age," certain fundamental factors stand out: (1) even on a volume basis the production of steel dwarfs the combined production capacity of light metals and plastics; (2) steel will be required in large amounts to equip and supply the industries producing and fabricating light metals and plastics; (3) on a price basis, which inevitably determines the disposition of the tonnage business, steel is the overwhelming favorite; and (4) the steel industry is developing its own special answers to the light weight, corrosion resistance, or beauty of the more glamorous materials.

In short, steel is and will long continue to be our basic industrial metal. During the war the steel industry developed stronger alloy steels; stainless steels that are cheaper to fabricate; steels with excellent resistance to the high temperatures encountered in gas turbines, jet engines, and turbosuperchargers; and coated and clad steels that combine the basic qualities of steel with the special surface properties of other materials. The industry's metallurgists and engineers worked out new fields and types of applications; taught users how to employ steel more economically; and formulated specifications that enable consumers to specify and order steel to the best advantage of the user.

Continued study of the physical chemistry of steel making, contributing to better regulation of metallurgical reactions, slag composition, temperature, and deoxidation, have led to greater refinement of produc-

tion practice and control of the end product. Many alloy steels formerly made in limited quantities in an electric furnace can now be made in huge open hearth heats. This means a lower price to the buyer. Consumers also find available "intensified" steels, whose hardenability has been greatly enhanced by addition of boron. Bessemer steel has seemed to be passing out of the picture, but better practices, improved standards, and elimination of rule-of-thumb methods of manufacture have made it a formidable rival of open hearth steel for many applications.

Speedy deposition of a thin phosphate film on sheet and strip steel found many applications in wartime and other new coatings are now helping to make steel more useful. Pickling processes have been developed, including continuous pickling which is faster and more efficient, while deep drawing of steel for cartridge cases, to supplant scarce brass, has taught many lessons. Improved automotive springs, used in military vehicles, will result in better peace-time equipment and another special steel, developed for landing mats, may now be adapted to preventing soil erosion. Other recent improvements include abrasion-resisting grips for conveyor belts, special galvanized sheet steel for air-conditioning ducts, and an enameling stock for signs and household goods that requires no ground coat.

ALLOY STEELS—The outstanding broad trend in ferrous materials engineering is the war-impelled and still increasing emphasis on alloy steels. These seem to be the steel industry's major strategical answer to any implied threat from light metals, carbide tool materials, plastics, plywoods, and so on. New alloy stainless and tool steels have met the need for improved strength to weight relationships; better resistance to heat, corrosion, and wear; and various specialized properties.

The development and specification of alloy steels have been carried forward with special attention to working properties and costs. The N.E.—National Emergency—steels have demonstrated their usefulness, and some are here to stay. Steel specifications based on hardenability —the "H" series—have been formulated and steels of various types have been produced specifically for easier welding and adaptability to welded structures. Machinability factors—with particular emphasis on behavior with carbide tooling, with new lubricants, and after heat-treatment—have also been the subject of much attention.

The N.E. steels of the war are unique in that they are not a trademarked brand of any one company but rather the products of the steel industry as a whole. Developed in 1942, by engineers associated with the American Iron and Steel Institute in co-operation with the Society of Automotive Engineers and other groups, they were devised to save critical alloying elements such as nickel, chromium, and molybdenum. In the N.E. steels the amounts of alloying elements are much reduced in percentages and they often depend on three or more alloying elements where two were used before. Again, they take advantage of the "residual" alloys present in ordinary scrap; residuals which increase in alloying percentages as the years go by.

The importance of these steels may be gaged by the fact that, during 1944, 36 percent of all alloy steel production was of the N.E type. This, of course, does not necessarily reflect the popularity of the N.E.'s, since war-time conditions compelled their use in many applications. The real test will come when steel is plentiful and consumers can choose freely the specifications they want.

Advances in the application of individual steels, and in methods and bases for specifying, have also been made. One of the foremost of these has been the promulgation by the American Iron and Steel Institute of the "H" steels specifications. It is now possible to specify engineering alloy steels of all standard types as to hardenability limits rather than on the former chemical-composition basis only.

By using "H" steel specifications, the steel user does not encounter the occasional off-hardenability heats that are common when steel is ordered to chemical-composition specifications only. On the new basis the chemistry may vary slightly but the hardenability—of greater practical importance—will be within the specified ranges. This will not only enormously simplify the user's heat-treating problem but will also aid the producer in fulfilling the specification requirements.

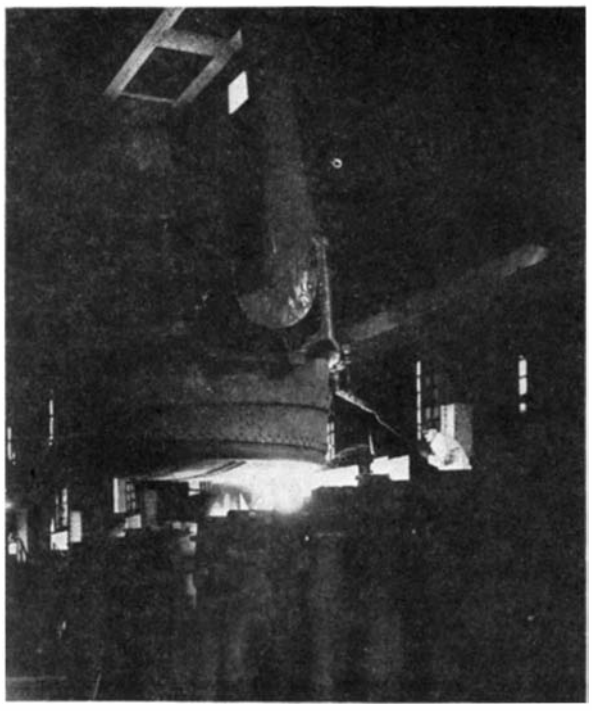
The "H" steels, identified by the letter "H" following the usual numerical designation—8730H, NE 9440H, and so on—are produced to conform to specific end-quench hardenability limits, which are based on hardenability bands for each steel as tentatively established by A.I.S.I. and S.A.E. committees. For users to whom hardenability problems are critical, the "H" steels are a definite solution.

Photo by Bethlehem Steel Company

High-tensile, low-alloy steel plus welded construction save 8300 pounds on each of these 50-ton boxcars. Use of the "right" steel for the job is important

EXTREME TEMPERATURE STEELS—Successful production of turbo-superchargers, gas turbines, and jet-propulsion units depended on finding materials that would withstand the 1200 to 1500 degrees, Fahrenheit, at which many parts of such equipment must run continuously. Usual heat-resistant materials either scale badly or lack strength or stability under load at these temperatures.

The materials developed and used overcame these limitations individually, and by careful application of



Large open hearths are now being used to meet tonnage demands for special alloy steels once limited in quantity by electric furnace production

Courtesy American Rolling Mill Company

the previously available materials where they could be used and of the newer "super" materials—often expensive or difficult to fabricate—for only the most severe-service areas or parts, the problem was satisfactorily solved. Research, however, goes on for even better materials to permit important improvements in the thermal efficiency of gas turbines and like devices.

Many of the new materials are nickel-base or cobalt-base alloys containing chromium and tungsten, titanium, and/or molybdenum. But some of the most useful are classed as steels. Thus, for impellers in aircraft jet-engines, a new steel containing 16 percent chromium, 25 percent nickel, 6 percent molybdenum, and 0.08 percent carbon was employed. Another modified stainless steel—19 percent chromium, 9 percent nickel, plus tungsten and molybdenum—was fabricated from plate and forgings into parts to operate at 1100 to 1300 degrees, Fahrenheit, in marine gas turbines.

A new steel, introduced during the past year and specially developed to have superlative mechanical properties at sub-zero temperatures, contains 8 to 10 percent nickel and less than 0.12 percent carbon. Capable of giving Charpy impact values of 25 foot pounds at minus 320 degrees, Fahrenheit, its minimum tensile properties in the form of normalized tubing—at room temperature—are given as 80,000 pounds per square inch ultimate strength, 50,000 pounds per square inch yield strength, and 20 percent elongation in two inches.

This cold-resistant steel is reported as being applicable to low-temperature work in place of the conventional 18/8 stainless steel tubing, and it appears to have especially interesting possibilities for oil refineries and the chemical industry. Corrosion resistance, one of its chief features, suggests logical fields of use where a combination of resistance to chemical attack and to low-temperature embrittlement is necessary.

LOW-ALLOY STEELS—Builders of all types of transportation equipment, striving for the lightest possible weight consistent with safety and cost considerations, are showing interest in two new low-alloy high-strength steels that have recently entered the specifications.

One of these—Aldecor—is of the traditional class of high-yield-strength, low-alloy steels, with corrosion-resistance superior to copper-bearing steel, and good formability and weldability as-rolled. Its distinguishing feature is an imposing array of alloying elements, the composition ranges being 0.25-1.5 percent chromium, 0.25-1.5 percent nickel, 0.07-0.6 percent molybdenum, 0.08-0.75 percent copper, 0.07-0.18 percent phosphorus, 0.50 percent maximum manganese, and 0.14 percent maximum carbon. Not only does the amount of each constituent serve a special purpose with respect to strength, corrosion resistance, or processing behavior but the whole composition will provide a suitable use for the quantities of tri-alloy scrap which will continue to come back to the steel mills for the next few years.

Another new low-alloy steel is "J-alloy," which is produced in three carbon-content grades; low-carbon for high ductility, formability, and weldability in the as-rolled condition; high-carbon for abrasion-resistant applications; and medium carbon for low-alloy shafting and other uses. The medium and high-carbon grades benefit from heat treatment and in this respect J-alloy differs from most of the other low-alloy steels, which are conventionally produced for use in the as-rolled state. J-alloy is described as also retaining good toughness down to sub-zero temperatures.

OTHER STEELS—In the tool steel field, the tungsten type high-speed steels have recovered much of the ground lost to the high-molybdenum high-speed steels—such as 6 percent tungsten, 6 percent molybdenum compositions—but the latter are "here to stay" in considerable amounts, like many other worthy war-time "substitutes."

A new free-machining tool steel, now on the market, is described as having 25 to 200 percent faster machinability than the usual tool steels and to surpass the ordinary tool steel specifications in many ways. It is an oil-hardening—to 65 Rockwell—very slightly distorting steel, with good impact and transverse rupture strength, and exceptional wear resistance. Suggested uses are in cold-work dies, hard machined parts, bushings, and so on.

An important trend is evidenced toward the use of tool steel tubing in place of bored-out hard steel rods for many parts. Tool steel tubing often saves much time and expense in producing a hard steel ring, bushing, arbor, annular die, liner, sleeve, or similar part, and may also simplify the problem of achieving full hardness where desired without excessive distortion.

Development of a new fine-grained titanium-bearing steel—christened Ti-Namel—gives manufacturers of vitreous-enameled products a base stock on which they can apply white or light-colored single cover-coat enamels without prior applications of a ground coat. The titanium, present in the steel in proportion to the carbon content, reduces or eliminates pitting, black specks, and blisters when the steel is enameled.

In general, steels may lose some end-use applications to other materials, but it is plain that the industry is highly active. Steel is developing its own answers to the challenge from without, but in any case is certain to find wide markets in machinery and equipment to manufacture the new competitive materials.

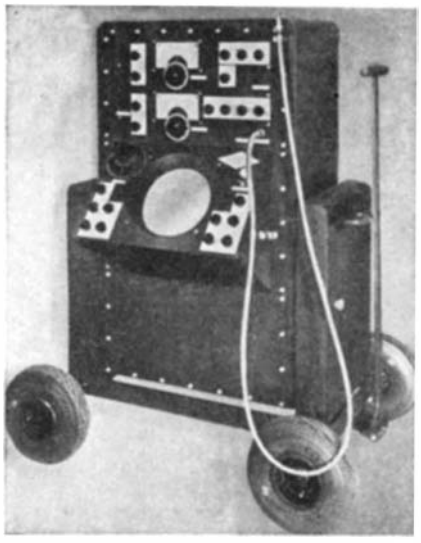
Detecting the Invisible

Sub-Surface Flaws are Revealed and Their Location and Size Determined by Non-Destructive Inspection with Supersonic Frequencies Formerly Used to Trace Submarines. Electronic Mine-Detectors, Also War Products, May be Ideal for Scouting Pipe and Cable Laying Projects

By JOHN MARKUS
Associate Editor, *Electronics*

ELECTRONIC detecting devices, relieved of their war-time concern with land-mine hazards and anti-submarine patrol, are now being adopted by the industrial world. These "electronic eyes," capable of probing for flaws in the depths of solid objects or of sounding the surface of the earth for unseen pipelines, cables, and other obstacles to excavation, hold promise of wide utility; they detect hidden flaws without destroying the part under test, and they can be mounted on a vehicle to scout underground installations with surprising speed and accuracy.

FLAW DETECTION — Electronic flaw detectors, for non-destructive inspection of castings, forgings, and similar items, employ supersonic frequencies—the sonar principle—used during the war for detecting and following submarines. Ranging between one million and twelve million cycles per second, these frequencies are too high for detection by the human ear. Moreover, supersonic waves travel best in solid or liquid materials and weaken rapidly in air; in this respect they differ from radio waves, in the same range of frequencies, which travel best in air and on the surfaces of metals.



Sperry type supersonic Reflectoscope; quartz-crystal search unit is seen on end of cable; cathode-ray tube screen is large circular area at center left

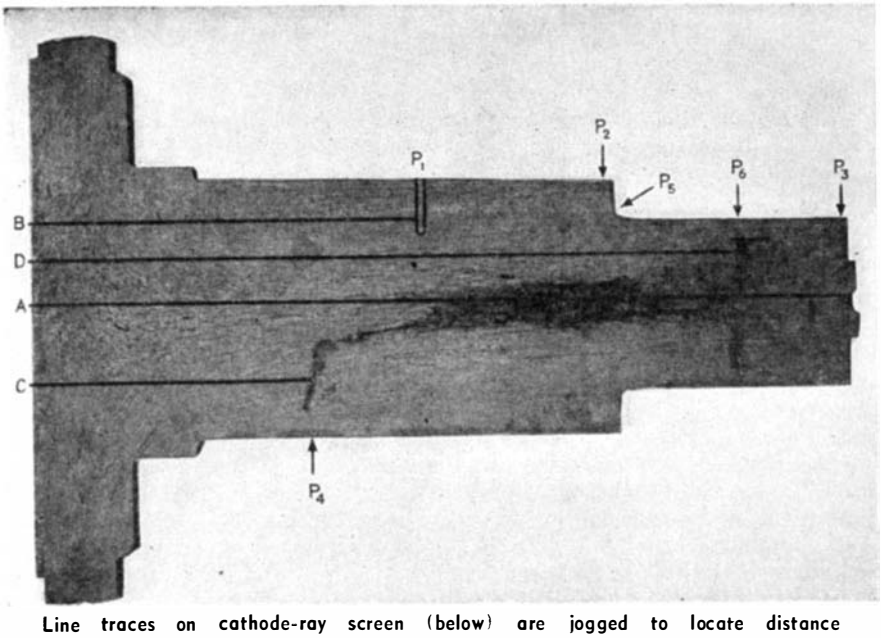
In use, the instruments send supersonic pulses into the material under test and measure the time it takes the pulses to travel through the material, reflect from the opposite side or from a defect, and return to the point of origin. Flaws and defects can be detected up to ten feet away from the point of application of the small search unit. This unit, consisting of a piezoelectric quartz crystal, not only transmits the supersonic pulse into the material but also receives it after reflection. A film of oil or other liquid, to aid the transfer of the pulses, is applied between the crystal and the material.

Electrical energy, supplied to the crystal for conversion into mechanical energy, is produced by an electronic generator and synchronizer that provides three different output pulses 60 times a second. These pulses actuate other electronic circuits that cause an intermittent horizontal deflection of an electron beam on the screen of a cathode-ray tube. The resultant broken line appearing on the face of the tube thus provides electronically controlled distance markers that can be adjusted to represent any desired length, in inches, within the material under test. Distortions of the line appear when a pulse reflects from a defect in the material, and the markers indicate the defect's distance from the point of application of the crystal.

Invented by Dr. Floyd A. Firestone, the flaw detector is manufactured by Sperry Products, Inc., and has been applied so far mainly to testing of metals. Both plastics and liquids, however, conduct supersonic waves at the frequencies utilized in the instrument and are therefore adaptable to this method of testing or measuring. Variations in materials, in wavelengths of sound, and in the size of the defects to be located, made a wide range of testing frequencies mandatory for general industrial use. Adjustment of only six knobs changes the testing frequency and for ordinary testing an operator may be trained in two weeks.

The maximum penetration distance of the supersonic pulse depends upon the material. Steel and aluminum permit relatively deep penetration while such metals as lead and copper are fairly resistant to penetration. Large grain sizes and small discontinuities make it difficult to test long distances in any material when these discontinuities are of the same magnitude or larger than the supersonic wavelength being used.

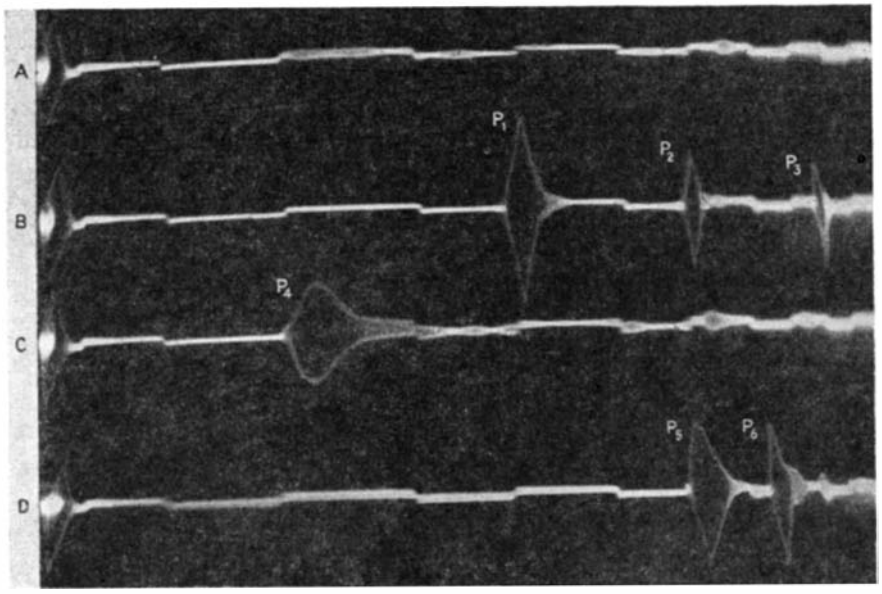
Portable mine detector spots metallic or non-metallic sub-surface objects; headphones and meter signal a pickup



Line traces on cathode-ray screen (below) are jogged to locate distance of flow indications—P_1, P_2, P_3, P_4, P_5, and P_6—from points A, B, C, and D where search unit was applied. Corresponding lettering and lines on sectioned axle (above) show sources of indications and sound paths

Although the size of the distortion on the cathode-ray tube screen and the size of the defect are only roughly proportional, the area of a large flaw may be plotted by moving the search crystal over the testing surface and noting the indications on the cathode-ray tube. Approximate sizes of small flaws may be determined by decreasing the testing frequency in steps until the supersonic wavelength approaches the major dimension of the defect and the indication disappears. Often, considerable information about defects may be deduced from the shape of the distortions appearing on the screen. Hydrogen ruptures, coring, inclusions, fatigue cracks, shrinkage cracks, stringers, piping, segregations, and laminations are some of the defects in metal that may be found with the supersonic detector. The thickness of a material can also be measured when one side is inaccessible. Defective bonds between similar as well as dissimilar metals can be found, and the soundness of many welds can be determined.

Pictures of the cathode-ray tube screen show the supersonic pulse reflections obtained by different positions of the searching unit. The cause of the reflections and the corresponding positions of the crystal search unit on the part being tested, in this case an axle, are readily identified in the cross-section. The reflection P_1 was due to a 1/16 inch diameter, two-inch deep hole drilled for comparison purposes. The reflected pulses P_4 and P_6 were obtained from the transverse defects, and the diminution of the end of the axle produced reflection P_3.



The search unit crystal used was one inch square.

The minimum area of the discontinuity required to give an indication depends on its distance from the surface being tested and the homogeneity of the material. In aluminum, for example, a void with surface dimensions of 0.125 by 0.002 inch will cause a reflection when this discontinuity is two inches from the searching unit, and a 5/32-inch diameter defect will give a reflection when the flaw is 10 feet from the crystal.

Supersonic testing should find wide application in industry, since axles, shafts, and other objects having one end accessible may be inspected for fatigue cracks while still assembled. The flaw need not extend to the surface, nor is it necessary to remove wheels or other parts from the axle or shaft. In the past, fatigue cracks, even though they extended to the surface, could be found only by disassembling the part and examining it closely. The advantages offered by supersonic testing, including high accuracy and ease of operation, will make the process an important addition to the non-destructive testing field for many materials.

UNDERGROUND—Crews surveying routes for proposed underground pipelines or cables have long needed a metal detector whose sensing elements could be supported ahead of a vehicle running at a reasonable speed. Such a device would prevent subsequent interference with existing installations or other objects in the path of the digger. Military demands for a vehicular-mounted mine-detector spurred the development of an electronic unit of this type that not only gives a visual and aural indication of buried metal but also stops the vehicle automatically and almost instantly by means of electrical controls.

The mine-detector consists of an oscillator-energized transmitting coil and a receiving coil connected to an amplifier. In the absence of mines or other metal objects, interaction between the two coils is nullified. Approaching a metal object, either buried or above ground, upsets the delicate electrical balance and energizes electronic circuits controling brake and clutch electromagnets.

The sensitive coils are carried ahead of the vehicle on a boom. Since the coil's elevation above ground would vary too much in rough terrain if a rigid attachment were used, most of the boom weight is balanced by an adjustable torsion-

spring system, and wheels support the boom a fixed distance above the ground. The use of plywood tubing and wooden blocks for the boom, and non-metallic wheels, prevents electromagnetic interference with the coils. The automatic stop system employs a combination of springs and trigger mechanisms working almost instantaneously on both the foot brake and the clutch, and is actuated by the mine signal itself.

Fail-safe features, necessary to prevent missing an object because of failure of the equipment are so designed that any breakdowns of the circuit automatically change the output signal and trip the brake and clutch mechanism to stop the vehicle. Meters on the dash of the vehicle would further indicate circuit trouble.

Before starting operation, the electronic detector circuit is balanced by means of manual controls and a water-proof cover is placed over the control panel of the oscillator-amplifier box. Thereafter, the operator uses a simple control box mounted on the steering column. This control box incorporates a meter which at all times enables the operator to know if the circuit is still in good balance, and also indicates the presence of mines. A switch is available to disengage the automatic equipment when automatic stopping is not desired and various tell-tale and warning lights show when the equipment is turned on and whether all the switches and circuits are in operating condition.

The vehicular mine detector was developed by Electro-Mechanical Research, Inc., for the Engineer Board, the development agency for the Corps of Engineers, United States Army.

PORTABLE DETECTOR — A new portable one-man mine detector that responds to buried mines or other metallic or non-metallic objects was developed during the war as a counter-measure for non-metallic anti-tank mines, and also has promising peace-time industrial applications.

This small detector consists primarily of a 300-megacycle vacuum-tube oscillator and antenna system mounted in an exploring head that is carried over the ground being searched. Indications are both aural —through headphones—and by deviations of a meter mounted on the carrying handle. Capable of indicating the presence of a standard American anti-tank mine at depths up to five inches, depending upon soil conditions, the detector is limited by water-soaked soils to a range of one inch or less. Extremely dry soils mask the presence of non-metallic mines while allowing normal detection of metal objects.

The detector responds to changes in the average dielectric characteristics of the soil over which it is carried. Non-uniformities in the ground must generally be at least five inches long, two inches wide, and one inch deep to be detectable. This means, of course, that indications will be obtained from stones, tree roots, and air pockets in the soil, but a trained operator can learn to distinguish the characteristic signals resulting from each type of object. Roots, for instance, could be followed for some distance along the ground, whereas the response for a mine would be localized.

The total weight of the detector, including batteries, is 23 pounds. In use, the operator moves the detector head from side to side, advancing approximately one foot per sweep while holding the unit somewhere between two and five inches above ground. Over normal soils, metallic mines make the audible signal weaker while non-metallic mines make it louder. In quiet locations a resonator on the unit eliminates the need for headphones.

Industrially, this detector set or its modifications may be used to detect the presence of metallic masses of finite dimensions in non-metallic objects, while discriminating against objects of smaller size. Voids or discontinuities in plastics objects can be detected with other modifications of the detector.

When adjusted off resonance, detection of personnel or vehicles in motion at ranges up to 100 feet is possible. In such an application the detector might be valuable for intrusion detection systems, particularly where ambient light or noise prevent the use of audio or photoelectric systems. Further suggestions propose its application as a safety control for machines where space limitations or other conditions prevent use of conventional safety equipment.

Initial research and development work was carried out by the RCA Victor Division and RCA Laboratories. The work was directed by the War Department Engineer Board and the National Defense Research Committee.

It is interesting to note that the electronic developments described here supplement rather than replace such other detecting methods as X-rays, radar, vibration-testing for flaws, and magnetic testing with such cathode-ray instruments as the DuMont Cyclograph. Each method has its own advantages and its own group of applications to which it is best suited for economic, engineering, efficiency, speed, or other reasons.

CRYSTALS

May Be Used in Push-Button Receivers

QUARTZ crystals for radio equipment are usually individually processed to increase the activity of vibration. As a result, each plate exhibits certain individual characteristics that are different from similar plates of equal dimensions.

In a new technique developed by Philco engineers, as many as 100 plates can be processed as a group to final square-edge dimensions within 0.0002 inch tolerance. All the blanks for a particular frequency are then exactly the same at the finishing stage. This minimizes the tendency to lap or etch beyond the desired thickness for that frequency and avoids most of the failures encountered in temperature cycling.

Such a mass-production technique may lead to the use of the quartz wafers in home push-button radio receivers to eliminate drifting away from the station frequency. Each desired frequency would have one crystal, so that a ten-station push-button set would use ten crystals. In the past, the amount of hand work by skilled operators brought the cost of ten crystals too high to be incorporated in any but a high-priced receiver.

ARC CONTROL

Made Automatic By Use of Thyratrons

WHILE THE charge in an arc furnace is melting down, the electrode must be lowered to maintain the arc. When melting scrap falls against the electrode and causes a short-circuit, withdrawal becomes necessary. Normal consumption of the graphite in the electrode also requires that corresponding adjustment be made.

An electronic unit which gives a wide range of speed and quick response in control of the motor drive which accomplishes all these regulations has been announced by Westinghouse Electric Corporation. The system works by varying the armature voltage of a constant-field motor with thyratron tubes to produce the required speed of electrode motion.

Plastics In 1946

Finding its Best Market in a Diversified Group of Other Industries, the Plastics Industry Looks Forward to a Busy Year. Production, Still Somewhat Limited by Materials and Equipment Shortages, is Expected to Smooth Out Soon. Will All-Plastics Cars be Forthcoming Eventually?

By CHARLES A. BRESKIN
Editor, *Modern Plastics*

WHAT PART will plastics play in the civilian products due to appear on the market during 1946? This question is in the minds of the public; the product manufacturer; the plastics processor—molder, fabricator, and extruder; and the plastics materials manufacturer.

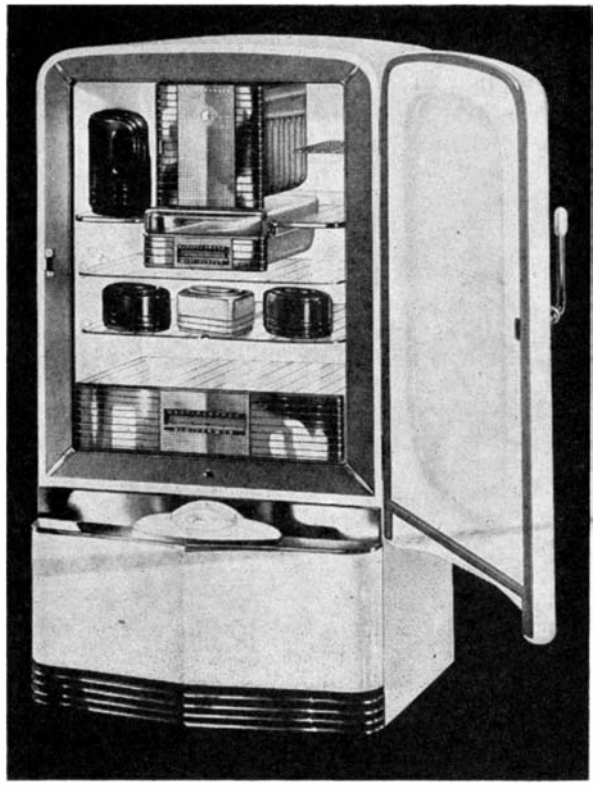
The answer would seem to be that within six months' time present troubles due to material shortages and scarcity of processing equipment will be at least partly in the past. Normal full capacity operations should have become well organized and production should be steaming along at a furious pace with customers fairly well assured of a date upon which their orders for various plastics parts will be delivered.

All this, of course, is predicated on the ability of American business to reconvert its plant facilities and to settle its many labor and management difficulties, upon a quick return to normal political relations between nations, and upon a fairly rapid adjustment to economic stability in the devastated nations. If these disturbing elements are alleviated, it is reasonable to expect that the plastics industry will be on its way to surpassing the 161-percent increase predicted for it by the Committee for Economic Development.

	Ounces
Butyrate	
8 rack supports	0.78
1 door knob	0.95
1 evaporator door knob	0.11
1 nameplate	0.25
	2.09
Polystrene	
1 escutcheon and button for lower front	0.67
1 door front and liner for evaporator	9.35
1 Crisper front	6.63
	16.65
Laminated phenolic	
1 control wheel and gear	6.88
4 breaker strips	14.85
1 inner door panel	57.67
4 food compartment supports	1.62
	81.02
Cellulose acetate	
Strike and ctr. rail gaskets	0.14
Total plastic used, 6 lb., 3.9 oz.	

OTHER INDUSTRIES—Judging by every known survey released thus far, this 161-percent increase is not as astounding as it would seem at first reading. Consumers in the United States are going to be in the market for more materials in 1946 than in any time in the nation's history. Because the plastics industry is so largely concerned with supplying parts and finished items to other industries—consumer durable goods, automobile, construction, transportation, textile, paint and varnish industries, and the electronics fields—expansion of these industries means, of necessity, an even greater increase in the volume of plastics products.

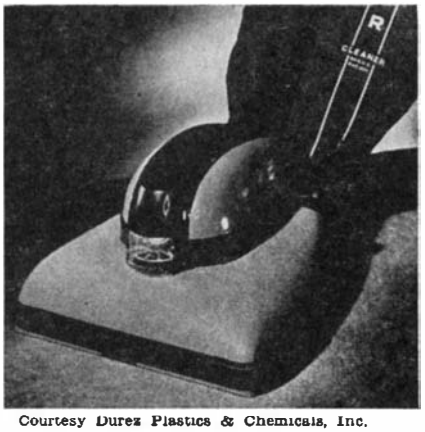
Take the metal-working industries as illustrative of the increased demands that may be expected by the plastics industry during 1946. According to a survey of the 55 metal-working industries which was released by the Civilian Production Administration in late 1945, the shipments of these industries by the middle of 1946 will be three times



Courtesy Westinghouse Electric Corp.

Innovations in modern refrigerators (right), such as Crispers and transparent doors, require various types of plastics in substantial quantities. Table (left) indicates amount of plastics used in a representative domestic unit

the average 1939 rate. Of course, it would not be surprising if the metals trade runs ahead of many other manufacturing enterprises in increased production in the first postwar years. Its production lines were almost completely changed over to special war items and the demand for its products, such as refrigerators, automobiles, machinery, and so on,



Courtesy Durez Plastics & Chemicals, Inc.

Many new vacuum cleaners employ some plastics parts, but amounts vary

has grown so tremendously that it may take a long time to satisfy all the potential customers.

However, this unusually high business potential is of great importance to the plastics industry because metals trades are among its best customers. Furthermore, plastics were just beginning to get a foothold in this field before the war. If the metals trades increase their production two and a half or three times in the next six months, it is to be assumed that their demand will be for even more than two and a half or three times the plastics they used in 1939.

Since it is impossible to detail every particular field where plastics are used, a few of the most representative industries have been selected to indicate the potential demand and supply possibilities for plastics.

AUTOMOTIVE PLASTICS—In automobiles there is little evidence to indicate that more plastics will be used per car by any of the old companies for the 1946 passenger car than were used in the 1942 model; the 1946 model being, for the most part, a reproduction of the last prewar model. But what of the 1947 models? Motor company officials are extremely reticent in discussing their plans, but it is certain that plastics will not fade out of the picture as some quarters have predicted.

As far as thermosetting applications are concerned, these have been well established for years. While certain poor applications may be corrected through redesign or the use of another type of raw material, there should be little change in this picture. Instead there may be an advance in the use of thermosetting materials if certain types of laminations fulfill the role anticipated for them.

The thermoplastic materials may find increased use in a number of parts of the 1947 automobile. Take, for example, its application in doughnut-shaped white sidewall disks which fit over tires and give the appearance of white sidewalls while protecting the tire from scuffing. And there is the huge field of car upholstery.

It has been estimated that at least 50 percent of all war-time truck-

Courtesy Emerson Radio & Phonograph Corp.

Sturdy and attractive, hand radio case is made of cellulose acetate butyrate

type vehicles requiring coated fabric seat covering used vinyl or coated cloth. Although synthetic rubber is now becoming available, plastics materials manufacturers expect to capture at least half of this market. And at five square yards for the average truck, this is a substantial market. If upholstery for station wagons and convertibles is counted in, the market for vinyls mounts tremendously.

Perhaps some of the greatest curiosity regarding new cars centers around the projected automobiles with plastics bodies. Two come from California—one, called the Bobbi-Kar, is to weigh less than 600 pounds —the other, the Californian, is to have but three wheels. A third model is the one being designed for Graham-Paige by William Stout, famous airplane designer.

DOMESTIC GOODS—Washing machine agitators of plastics, just beginning to come into use when the war broke out, still appear to be the most important item in washers, with respect to the plastics industry. Housewives were said to like them because of their color and because they did not corrode as metal units sometimes do as a result of the action of the soap.

However, because the cost of the plastic agitator is about 25 percent higher than that of a similar unit made of aluminum, the plastics industry expects to get only a part of the business in the older type machines. But even on the laundry units that lack this three to seven pound plastics part, there will be a few molded accessories such as the knobs.

A breakdown of the plastics parts on a typical refrigerator, which was supplied by a representative company, shows that a surprising amount of this material is used. The totals are somewhat of an increase over pre-war units where there were few Crisper fronts and where a transparent door and liner for the evaporator was the exception. Then, too, increasing use is being made of

Courtesy Bakelite Corporation

A plastics washing machine agitator, largest pre-war item in this field

laminates, particularly for the inner door panel. These last three plastics applications are appearing in more and more of the well-known models.

OTHER USES—Juke boxes, coin machines, and vending machines all represent a most interesting field for plastics. Surveys have shown an estimated increase in this industry of 110 percent for 1947 which is greater than the increase for any other industry save only plastics, rayon, and transportation.

There are two branches to this field; amusement machines and vending machines. Chief users of plastics up to now are the nickel

Courtesy General Electric Company

Plastics cases will probably be used on about half of the new alarm clocks

phonographs or juke boxes; the principal plastics used is cast phenolic. Its high color and forming qualities are desirable characteristics for this application.

Other plastics used in minor accessory parts today, perhaps in major elements later on, are polystyrene, cellulose acetate tubing, vinyl resin, and laminated parts. Whatever the material, it should be a type that will not scratch nor shrink. And it must lend itself to the music box's requirement of bright colors and resistance to rough-house treatment.

Today the demand for all types of coin machines is so great that the manufacturers are using any material available which means that, save for juke boxes, only the old type metal box is in production. Plans now on the drawing board, however, call for the use of quantities of plastics.

Probably none of its customers put so much pressure on the plastics industry as did radio manufacturers immediately following V-J Day. The reason, of course, was the great rush to be first on the market. The many uses of plastics in the radio field were fully discussed in the February Scientific American.

Different radio manufacturers use different amounts of plastics, and it is only possible to take a mean average. RCA reports that their pre-war plastics cabinet required two pounds, four ounces; a new model will need twice that amount. Stewart-Warner states that the average weight of plastics in one of their models be from 2½ to 3¼ pounds or about ¼ pound more than the pre-war model.

In general, all indications are that for the plastics industry the ending of the war opened the way to an even greater expansion in material manufacturing and processing facilities than it experienced during the war years.

FIRE CONTROL

System Uses Plastics Parts

RECENTLY developed rate-of-rise fire alarm, fire control, and fire extinguishing systems depend for much of their success on the diaphragm cases molded of Avtex by the Hood Rubber Company.

Front and rear views of plastics-molded diaphragm case used in new heat-actuated fire alarm system

Essentially, each system consists of one or more heat-actuated devices, or heat detectors, fastened at intervals to the ceiling and connected to the diaphragm case in a release mechanism by means of air-tight tubing. Heat from a fire causes the small amount of air that is trapped in the heat-actuated device nearest the flame to expand. In turn, this pressure is conveyed through the air tubing to the release mechanism where it moves a sensitive metallic diaphragm which starts the fire protection apparatus working.

The diaphragm case and the metallic diaphragm are the heart of the mechanism upon which the operation of these systems depends. Consequently, it is of utmost importance that the two molded parts which comprise the case be precise in their measurements. Otherwise, the sensitive diaphragm, which is held in place between the halves of the housing, may be thrown out of line so that the actuating air impulse will not blow against it with the necessary force.

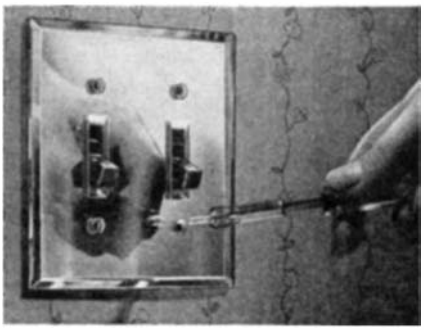
The sheets of material selected for the molding of the two parts of the laminated diaphragm case are cut into pieces three feet long. Each ply is laid at a 90-degree angle to the one below. These laid-up panels are preformed under pressure, the preforming plates being heated to a temperature that will just soften the resin. This treatment reduces the bulk factor and produces a laminated sheet that can be easily handled.

Blanks about the size and shape of the mold cavity are cut from the sheets and the load carefully weighed. These blanks are then loaded in the mold cavity. Both parts are molded under relatively high molding pressures in a flash-type compression mold.

PLASTICS SCREWS

Hold Mirrored Switch Plates in Place

EVER notice how incongruous are the dark metal screws which hold mirrored switch plates in position? Now, screws as light as the switch plate itself have been put on the market by the Haring Switch Plate Company. These transparent screws,



Transparent screws for switch plates

injection molded of Tenite by Plastics Division, S. S. White Dental Manufacturing Company, are lighter in weight than their metal counterparts and are said to exert less pressure during installation, thereby reducing the chances of the mirror being chipped or marred.

SCOURING CLOTH

Uses Plastics Beads as Abrasive; Stays Clean

LATEST plastics household help is a Plaskon coated scouring cloth in which the plastics is sprayed onto a terry cloth base to form little beads on the surface. These beads provide the abrasive necessary for cleaning. Advantages of this new Downy Products Company scouring pad are: no metal splinters to hurt the hands, absence of all film after the pot is cleaned, no breaking off of parts of the cloth, no absorption by the pad of dirt or food particles.

A New Eye for Industry

Millionth of a Second X-Ray Equipment Has Been Built Which Can be Directly Applied to Great Numbers of Practical Industrial Uses. Its Ability to Watch High-Speed Machinery in Motion May Practically Influence Present-Day Machine Design, Use, and Maintenance Techniques

By EDWIN LAIRD CADY

JUST ARRIVING on the industrial market is an X-ray device which can look through an inch of steel, stop motion—in a photographic sense—of the fastest moving mechanisms ever built, and produce pictures which will tell just what each hidden machine part is doing.

Designed originally for basic research, this millionth of a second X-ray machine is moving straight into the practical end of factory operation. It can give the right answers to many problems about which management men have been guessing. It can save a tremendous amount of time along the production line. Laboratory men may use it also, but there is too long a line-up of tasks on the shop floor for such a device to remain simply a research tool.

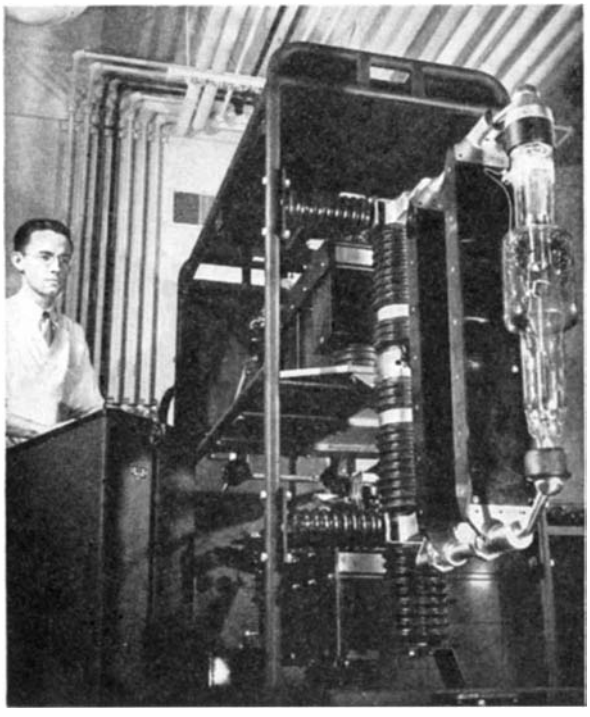
PEERING THROUGH MACHINES—Typical of what this machine can do is the experience of a large manufacturer in New England. In this shop is an automatic machine which, once it gets going, will turn out millions of brass parts without stopping. The trouble always was that when setting up the machine the ejection mechanism would jam. Nearly all of the working parts of this mechanism are hidden, shielded by steel housings. The set-up men had to make their adjustments by guess and by "sense" and by "feel." With good luck the machine might be set up in an hour. With bad luck it could take days. There seemed to be no dependable "average set-up time" which could be predicted when planning production runs.

One of the millionth of a second X-ray machines was available to the plant laboratory. Someone thought of bringing it to the automatic machine. This did not present any difficulties; the X-ray machine is mounted on wheels and can be transported as easily as any floor type, long framed shop crane.

The X-ray machine could look right through the steel on the ejector mechanism and give instantaneous pictures of what was happening to the brass. All the guess work was taken out of the setting up. Set-up time was reduced to minutes.

Problems like this exist by the hundreds. One of them is the stamping and forging of tough alloy steels and even of metals which are not so tough. Quite often a punch press will be working smoothly and then without warning the stock will begin to seize and gall in the dies. A deep drawing press may take minutes to set up and it may take days. Forging dies may seem to be perfectly designed and made, and yet the hot metal may refuse to flow in them. A thread rolling machine may not produce anything but spoiled threads until an operator who has "genius" in his finger tips makes adjustments which he cannot explain. Quite a few such situations are solved by sheer mechanical intuition, a process which is as costly as it is unpredictable. But now the high-speed X-ray will look through the steel dies almost as readily as if they were clear glass, and will show just what the troubles are.

Use of this machine is not going to be confined to the few big shops. Almost any medium-sized factory can afford one. The exact sales prices have not been announced at this writing, but a 150 KV machine should cost about $5000 and a 220 KV machine about $8000. These estimates are based upon $2400 for the purely mechanical parts, to which will be added a cost for the X-ray unit, varying with the power of the unit. No matter what power a shop may find that it needs, the cost of the machine will be no higher than that of a good turret lathe.



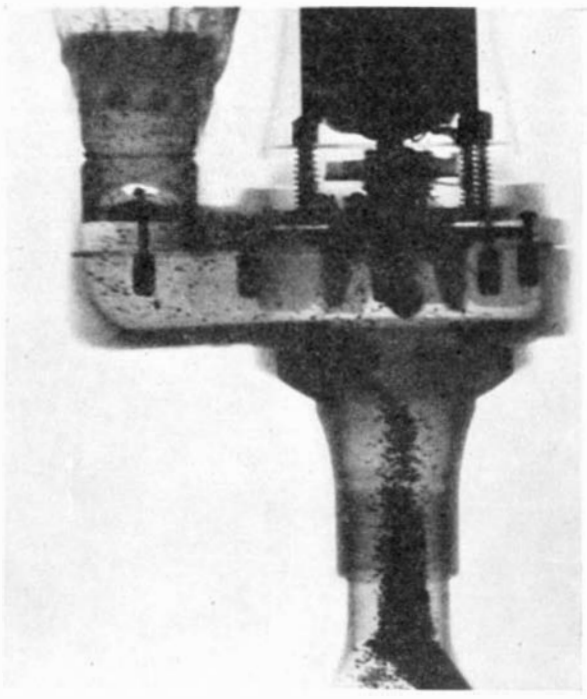
X-ray equipment built by Westinghouse for making exposures at a speed of one millionth of a second. The tube is mounted on the front end of the power source, called a surge generator. Industrial applications of this type of X-ray apparatus are beginning to be explored

TOOLS AT WORK — This leaves wide open the question of who will be the first to turn high-speed X-ray photography to profit in many

a situation. Some smart shop is going to X-ray the operation of metal-cutting tools on a high-speed lathe working on one of the hard-to-machine high alloy steels, and obtain a worth-while cost advantage over its competitors.

Strange to say, nobody really knows how metal-cutting tools operate. All present knowledge is based upon experience, logic, and assumptions. The high-speed spark or flash camera has yielded some interesting evidence, but it can only photograph dry tools and metals; it cannot look through floods of cutting oil and see how metal is cut under actual operating conditions. But the high-speed X-ray can see just how the chip is bearing on the tool, how the work is depositing packed material or "built up nose" on the cutting tool, and how this nose is being sloughed off by the abrasive action of the chip. After a little experiment to develop methods for using the X-ray, the exact machineability of any lot of steel may be determined by actual observation of chip performance on the first few turns of a lathe spindle. Then the tools can be ground to suit the steel, the speeds and feeds can be adjusted, and the cutting oil mixture and temperature varied. The result will be an ideal set-up made within minutes and with no wastage of expensive raw material, as contrasted to the hours of set-up time and large wastage of present cut-and-try methods. Moreover, every lot of steel will be fabricated at the highest possible speed instead of the present compromise speeds.

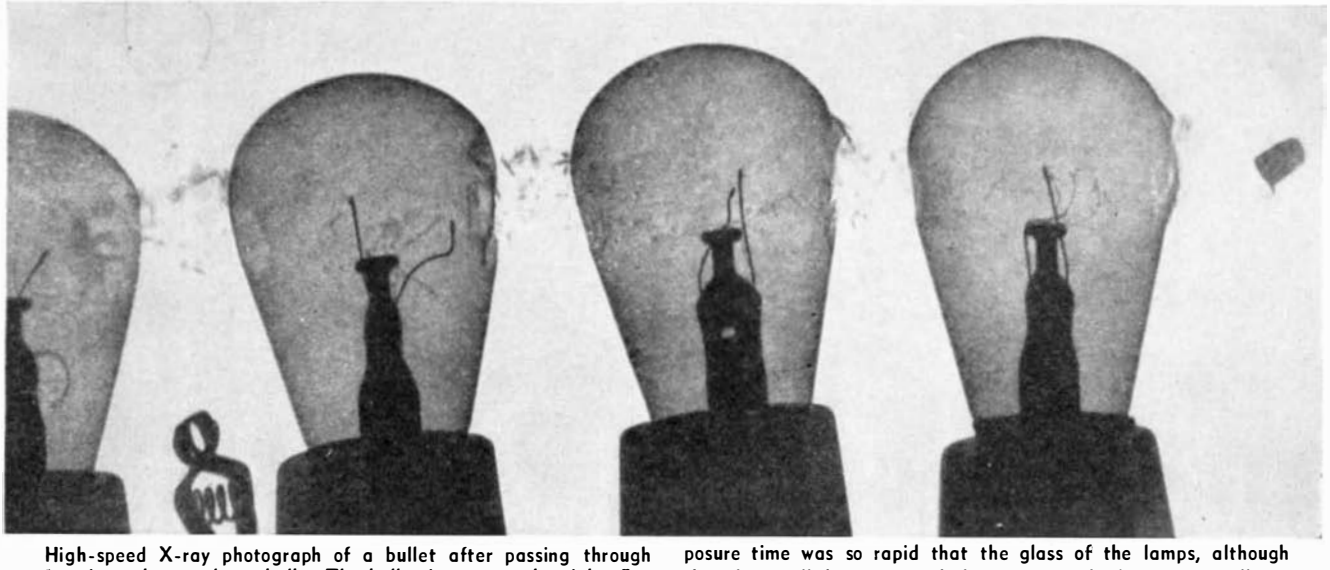
Arc welding of metals low in weldability can be improved. Photography has been nearly helpless to study the performance of welding operations; the extremely bright light from the welding arc overexposes the film. But the X-ray equipment will not be affected in any way by this light. It can follow the processes of experimental welds, show what happens not only at the surface but also beneath the surface of the steel, and so guide the development of better techniques.



Study of what happens when dirt passes through the mechanism of a vacuum cleaner is made possible by the Westinghouse ultra-high speed X-ray. The flow of air and relative air velocities can be judged by the distribution of the dirt particles "stopped" in their motion by the penetrating rays

Dust-collection systems and all sorts of pneumatic and hydraulic operations can be improved. When handling dusts and other air-borne materials through pipes and ducts, there are vexatious problems in keeping the air speeds down to practical limits while at the same time providing sufficient impelling force to carry heavy particles. There are other problems of eddy currents at bends and at joints. Mathematical calculations aided by cut-and-try methods and by experimental observation in glass ducts and pipes have reduced these problems. The X-ray can take high-speed pictures all along the pipe or duct and register actual behavior of particles in transit. It can show the way to greatest effectiveness and economy.

MAINTENANCE AID—Not all the industrial uses of this X-ray equipment will be in the machine shop. The power plant and the maintenance department will also find applications for it. For example, the high-speed X-ray can help to determine just when finely adjusted equipment such as turbines and gear reducers should be taken apart for servicing. A slower-speed X-ray is able to look through the casing of a machine that is standing still; by carefully positioning the machine parts and then holding them still to be photographed, the presence of



High-speed X-ray photograph of a bullet after passing through four incandescent lamp bulbs. The bullet is seen at the right. Exposure time was so rapid that the glass of the lamps, although they have all been pierced, has not yet had time to collapse

serious damage can be determined. But with the high-speed X-ray the tell-tale twisting of a slightly damaged turbine blade tip, the slight jumping of a gear when a tooth has worn away from its true curvature, the slight weaving action that worn thrust bearings can impart to a shaft, all can be seen plainly while the observed machine is operating at full speed.

Factory floor space arrangements will be affected. Right now many a complex high-speed high-capacity speed changer or other mechanism is being kept in a position convenient for servicing rather than in the out-of-the-way place where it could do its best work. It has to be watched carefully and to have its lubricants and adjustments checked at such frequent intervals that convenience is necessary. But when the check-ups are made by high-speed X-rays and servicing operations are performed only as and when the X-ray shows them to be necessary, the mechanism can be put where it ought to be.

Instruments will also benefit. Many of them are in full automatic control of extremely complex chemical processes. They have to be taken down at regular intervals just to be sure that nothing is clogging them and that their parts are not worn or out of line. This means stopping the process equipment, but it has to be done; failure of a single instrument could spoil tons of valuable materials. Now the high-speed X-ray can look through the working parts of an instrument while the instrument is functioning. It can give a far more informative picture of how that instrument is working and how long it is likely to keep functioning safely than can any disassembly for inspection.

DESIGN SPEEDED—Machine design is another use for the high-speed X-ray. At present the development of a new mechanism is a long and tedious process of trial and error, with everything run at break-down loads and speeds so as to find out what part will wear or break first. The trouble is, break-down tests are not true tests; they are simply the best methods available for trying to find out in a short time what is likely to happen to a mechanism over a period of years. With the high-speed X-ray taking pictures of hidden parts in motion, the mechanism can be run at normal peak overloads; then true interpretations made of how the parts are behaving. The result will be to find out in hours of research what now takes months of break-down testing of new models.

The exact behaviors of valves in internal combustion engines, of injection mechanisms in Diesels, of shafts making 100,000 revolutions per minute or more, of motion-sensitive and temperature-sensitive governors, are just a few of the things about which guesses are now made but about which the high-speed X-ray will tell the exact truth. With facts like these made available, many of the developments which would normally have taken until 1950 to complete will be ready before 1946 is over.

Observing the bursting of armor piercing shells was a war use of the high-speed X-ray. This was possible because the X-ray could be located safely behind a steel shield yet look through at what the shell was doing. When testing machines and materials, industrial researchers load plenty of them to the explosion point. Formerly the researchers had to look at the shattered pieces and guess about the sequences in which they broke and about the reasons why one fractured and another did not. Now they can get action pictures and eliminate much of the guess work.

This high-speed X-ray technique is new. Nobody yet knows how all of the techniques for using it will be worked out, what final forms they will take, what profits they will bring. But one thing is sure: The high-speed X-ray will make drastic changes in industry and make them soon.

PUMP CONTEST

Being Waged Between Precision and Rugged Units

A RAPIDLY developing contest is now going on between high accuracy pumps which need careful protection by strainers and rough and rugged pumps which depend very little upon strainers. In fact, the contest is between better and better strainers so the high accuracy pumps can work almost anywhere, and pumps which will handle nearly anything which will pass through a pipe.

Late entries in the strainer field are strainers made of perforated sheet metal so they will not be damaged in cleaning, equipped with quick opening slotted lugs for ease of cleaning and maintenance, and made magnetic if desired to hold even the tinest of ferrous metal particles.

Countering from the rough and rugged pump side is a pump which can be mounted at any angle, works with equal efficiency when its impeller is running in either direction, has bearings which are self lubricating with either oil or water, and has an impeller made of tough laminations, with a quickly removable face plate if any obstructions do succeed in blocking the impeller.

WORKABLE STAINLESS

Reduces Production Costs In Some Processes

LOST-WAX process casters find many of the stainless steels easier to handle than the plain carbon ones. This means that stainless, usually regarded as a "difficult" steel to work in the shop, will find its way into many a complex part on production-cost savings alone.

Fabricators of stainless are having similar results in some cases. One thin part which is fabricated by metals shaving, stamping, and punching processes, is more than 20 percent less costly in production processes when made of stainless as compared to plain carbon steels. The reasons are that the stainless does not suffer from oxidation problems in the shop and does not have to be heat treated to obtain the desired qualities.

MACHINE CONTROL

Manual or Automatic Question Has Many Answers

THE AGES-OLD problem of automatic controls for machines is the question of what to do when a correction of the operation being performed by the machine requires temporary manual control.

There have been three answers to this question: 1; Spend so much money on setting up the machine that manual control never is necessary. 2; Let the machine spoil a limited amount of work rather than resort to manual control. 3; Work out an automatic control that can be made manual if necessary.

The first solution has been used more in process industries than in metals and other fabrication industries. The second has found limited use in the process and the fabrication industries alike. The third is the ideal for metal working, wood working, and other fabrication industries plants.

Latest to join this third group is a control which will automatically control a machine-tool head through as many as 40 different and unrelated functions but can be changed from automatic to manual control and back without disturbing any sequence.

Fuels Rated By Performance

Aimed at New Motoring Pleasure and Economy, Borderline Knock Tests in Petroleum Research Use Road-Performance as the True Criterion of Fuel Quality. Present Cars also Benefit, But Gasolines of Aviation Quality, Tailored to Automotive Needs, Call for Better Engine Design

By E. F. LINDSLEY

WHETHER past improvements in automobile engines were responsible for corresponding improvements in gasolines, or whether improved fuels brought better automobile engines, is a question in common with the old saw about the relative seniority of the chicken and the egg. Examination of the progressive stages in the development of the automobile engine indicates that there have been times when gasolines contained more potential road-performance than the engines were able to take out of them; and there were other times, particularly during the recent war, when automobile engines could have utilized better gasoline had it been available.

Today, motorists know that improved gasolines have come from war-time refining and blending experience. In each gasoline, quality is as good as, or better than, its pre-war best. Premium grade gasolines are anywhere from one to five octane numbers higher than their 1941 ratings. The volatility lacking from war-time grades has been fully restored.

But pre-war cars and current production designs, with their moderate compression ratios, ranging from about 5.3 to 1 for early models to approximately 6.7 to 1 for later cars, are not capable of maximum utilization of these new fuels. By the same token, a great deal still remains to be done in tailoring the improved fuels to motor-car requirements; most of the war-time fuel development was directed towards the highly specialized demands of the modern aviation engine.

The engines in a B-29 and the engine in a sport-roadster, for example, differ widely in fuel requirements. Aviation engines fall in the highly stressed engine class. Designed for prolonged cruising operation at about 75 percent of normal rated power, aircraft engines must function with optimum efficiency over an altitude range of about 30,000 feet. Idling is secondary; so is starting; but the ability to provide extreme powers for limited take-off periods is mandatory. In consequence, tailor-made aviation fuels with very special characteristics are vital to safe operation.

Illustrations courtesy Ethyl Gasoline Corporation

Gasoline must satisfy all road conditions. Research crew, shown here testing high-speed performance, will also check fuel's ability on hills in background

Automobiles, too, require tailor-made fuels, but here fuels must be tailored to very different characteristics. This stems from the automobile engine's remarkable flexibility that allows high-gear speeds from 5 to 100 miles per hour, plus smooth idling, easy acceleration in traffic, quick starting and warm-up, and amazing durability with little care or maintenance.

In spite of these technical considerations and compromises, there are few cars on the road today that cannot benefit, to a limited extent at least, from the new fuels. Some benefits will be immediately apparent in quicker starting, greater mileage, faster warm-up and much better acceleration and hill performance without the familiar detonation "ping" that spells lost power and engine overloads. Other benefits, less immediate but equally important, are: longer between-overhaul life, reduced gum and carbon accumulations, economies in engine maintenance costs, and generally improved mechanical conditions within the engine. From here on, however, major improvements in performance await new engine designs and further fuels research before truly matched performance between engines and gasolines can be obtained.

DRIVING CONDITIONS — Certain controllable factors, the beloved "variables" of the engineer, cannot be overlooked in the petroleum industry's efforts to blend "super-fuels." The correct fuel for one

engine may fall short of its potential performance in another make of car. Such major engine design differences as valve-in-head or L-head cylinder porting are readily apparent when fuels are tested in automobiles of various manufacture. In fact, extensive tests have shown that engine characteristics, with respect to performance on a given fuel, will vary from model to model and even between cars of the same model. Coupled with these problems in engine design are problems in driver's requirements.

The commuter, who's wife must drive him to the station each morning, insists on snap starting and rapid warm-up. A traveling man, however, is more concerned with high-speed economy and long engine life. People who live in a mountainous region cannot help but judge a gasoline on its ability to provide power on steep grades and at high altitudes. And who can challenge the rancher, who must store bulk gasoline, if he attaches considerable importance to a fuel's ability to resist deterioration in storage. Clearly, a gasoline must be many things to many motorists.

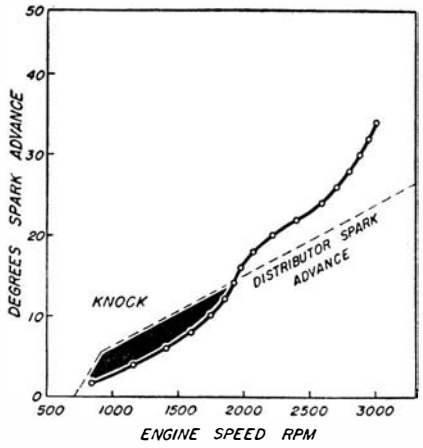
But demands for gasolines with a wide range of special characteristics are not new to the petroleum industry. Civilian motorists are not likely to operate under any more varied conditions than did the armed forces. War experience with all vehicle types from Jeeps to Sherman tanks, in arctic cold and blasting desert heat, showed the refiners how to compromise unusual demands and blend fuels generally satisfactory for the most critical conditions.

Matching fuels to driving conditions consists largely of blending various refinery stocks to vary the chemical composition of a base gasoline until the desired operating factors are obtained.

Before the war, such blending stocks were generally limited to straight run, thermally cracked, and polymer gasolines. Now, the industry has available the additional components of heavy alkylate, catalytically cracked, hydroformed, superfractionated, and isomerized gasolines. This means that automotive gasolines, more than ever before, can be purposely blended to bring out the best in a car under all driving conditions and in all speed ranges.

FUEL RATINGS — Once the more general requirements of a quality fuel are established, the question arises of comparative rating methods, for testing as well as sales purposes. "Octane rating"—once a term seldom heard in non-technical circles —has come to be widely used, and badly mis-used, as a yardstick of gasoline quality. Octane rating is usually considered as a numerical representation of a fuel's ability to resist detonation; commonly called "knock" or "pinging." The original octane scale was developed by Dr. Graham Edgar, Vice President of Ethyl Corporation, in 1930, and ran from 0 to 100. The higher a given fuel's octane number, the better was its anti-knock quality, or, more correctly, its resistance to detonation under certain standardized conditions of engine speed and load, spark advance, compression ratio, air-inlet temperatures, fuel/air ratio, and engine cooling.

When aircraft fuels of over 100 octane, unsuited to rating on a scale that ends at 100, were developed, and when, in the automotive field, it became apparent that laboratory octane ratings were often deceptive with respect to actual road-performance, more practical methods for testing gasolines became necessary. Road-testing seemed to be the answer, and several road-testing methods evolved, among them the CFR Uniontown method and the more advanced borderline knock method. The Uniontown method, satisfactory for certain types of

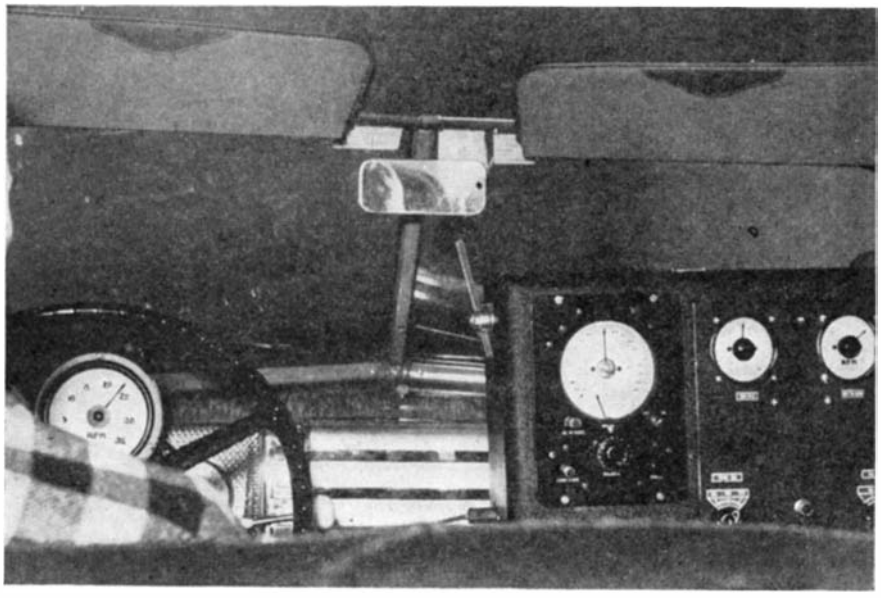


A borderline knock curve; black area shows that fuel knocks at low speeds

testing, was similar to the laboratory method of bracketing a test fuel on the basis of maximum knock intensity as compared with fuels of known octane number. Since knock intensity, without regard to the engine speed at which the knock occurred, formed the basis for octane ratings with the Uniontown method, it did not offer a practical tool for studying the effects of chemical composition on road-performance in different operating ranges. Consequently, two fuels with the same octane rating might knock at entirely different driving speeds.

BORDERLINE TESTS—The borderline knock method enjoys an advantage in that the test results provide a curve covering the entire driving speed range in contrast to the single numerical rating from the laboratory and Uniontown methods. With the borderline method, a series of test runs, at successively greater speeds and spark advances, spot points on a graph. These points shape into a curve with contours truly indicative of road performance when the graph is examined by a person acquainted with the testing method. In the terms of the petroleum engineers, the borderline knock test curve is the dividing line between knocking and non-knocking operation and it shows graphically a fuel's ability to tolerate spark advance throughout the entire speed range. For testing by this

Engine speed, spark advance, temperatures, and many other critical items are constantly checked by the petroleum engineers who ride in fuel research cars



method, a test car is equipped with a non-automatic distributor that can be varied manually by the driver, a suitable spark advance indicator, and an engine tachometer.

Briefly, the procedure for determining the borderline curve for a fuel is this: The spark is set manually to a relatively low advance, usually 2 to 6 degrees before top dead center. The car is slowed down to as low a speed as possible in high gear, generally about six to eight miles per hour, and then accelerated with wide open throttle. As the engine picks up speed after beginning to knock, the knock intensity lessens, and the speed at which the knock dies out is noted. This gives one point on the borderline curve, representing the two dimensions on the chart: spark advance (vertical axis) and knock-die-out speed (horizontal axis). The spark is then advanced two degrees and the entire procedure repeated to obtain the second point on the curve. This procedure is continued until the complete curve has been established for the entire spark advance and speed range under consideration. It should be remembered that the borderline curve obtained by this procedure is indicative of the anti-knock qualities of the test fuel only in the particular engine in which the tests were conducted. Because of differences in engine characteristics, it is necessary to test a given fuel in representative engines of various types.

BLENDING—Borderline tests are of more than academic interest to both the petroleum engineer and the user of the fuel. They furnish practical working data that enable selection and blending of a fuel that will fill the driver's needs, be they general or specialized. For example, the laboratory octane rating for a saturated type fuel, chemically similar to prewar straight-run gasolines, may show that fuel to have good susceptibility to lead—that is, the addition of quantities of tetraethyl lead up to three cubic centimeters per gallon materially improves the anti-knock qualities and raises the laboratory octane rating. A borderline road test, however, might show that the improvement due to the addition of lead was confined almost entirely to the high engine speed range. Since saturated straight-run fuels are characteristically good at high speeds and weak in anti-knock qualities at low speeds, a certain amount of blending would be necessary to bring up the low speed end of the curve. This might be accomplished by adding an unsaturated fuel with good low speed anti-knock characteristics and poor high speed anti-knock performance. Thus a gasoline could be blended that would perform better in all speed ranges than would either the saturated or unsaturated gasolines alone.

It is because of the advantages gained by such blending that future gasolines hold so much promise; for, as mentioned previously, there are a great many more fuel types, or blending stocks, available as the result of the war. It is worth noting that a satisfactory blend cannot remain static over a period of years or be considered the one best all-around fuel. Changes in automobile design require parallel changes in fuels. An example of this is the development of new transmissions that automatically prevent engine loading below certain crankshaft speeds. With such a transmission, a fuel blended for high anti-knock qualities at low engine speeds would, in a sense, be wasting its low speed anti-knock qualities. Similar problems will appear if supercharging becomes a common feature of automotive engine design.

Many commercial truck and fleet operators are advancing the spark mechanism on present-day equipment to take advantage of the new fuels. Past practice has been to advance the spark until a light knock was evidenced during high-gear acceleration. This was the point of marginal detonation for the fuels available at that time. Now, however, it is possible to advance the spark so far that efficiency is actually lost, without encountering the point of marginal detonation, or, for that matter, any detonation at all. In essence, the fuel has such anti-knock qualities that the engine's compression ratio is too low to force detonation. Operators planning a spark advance program should now advise shop personnel to adjust the spark to the point of maximum power instead of the point of marginal detonation.

Looking into the future, automobile engines are certainly going to be more efficient, although the exact mechanical means through which this efficiency will be gained is not yet revealed. Whatever the improvements in engine design, however, modern fuels are available to match them and give both motorists and commercial users a new high in motoring pleasure and economy.

CLOTH TREATMENT

Makes Many Materials Water- and Mildew-Proof

A WAX EMULSION that can be added to the rinse water of the family wash provides easy and economical means by which housewives or laundries will be able to make clothing, drapes, and other textiles water resistant, according to scientists of the Socony-Vacuum Oil Company, Inc., who developed the fluid.

During the war the quantity of the fluid available for civilians was limited because the armed forces used large amounts for tent duck, uniforms, blankets, and other fabrics, making such articles both water and mildew repellent.

The emulsion will have a wide range of use: such articles as sports jackets, slacks, shirts, play suits, fabric shoes, cloth hats, dresses, and shorts are cited as examples of articles especially suited for the treatment. Its application is obvious in protecting window shades and drapes that are subject to outside moisture or to dampness existing in bathrooms and kitchens, as well as for giving a water resistant finish to furniture covers.

Tests have shown that the wax-treated fabrics become not only water resistant but also do not spot easily. Because water does not adhere to the cloth, a suit, dress, or other garment retains its press longer and is less likely to wrinkle.

Since the emulsion does not fill the spaces between the fibres, clothing that has been treated retains its porous qualities and summer clothing, therefore, remains ventilated and cool. The emulsion does not make a fabric stiff but, if anything, is likely to give it a softer feeling to the touch. The wax itself is indiscernible and does not alter the color or appearance of the fabric to which it is applied.

The new emulsion, milky in appearance, is non-toxic and non-flammable. It is made up of minute paraffin wax particles, suspended in an aluminum salt and water solution. A simple form of a wax emulsion, it is explained, could be made by using soap to emulsify the wax in water. Such an emulsion, however, would deposit both soap film and wax on the cloth, the soap's affinity for water tending to offset the water-shedding characteristics of the wax.

In laundering, the wax emulsion can be used in conjunction with starch, and it can be used also with moth-proofing and mildew-proofing processes if desired.

Air Transport Progress

Passenger Comfort, Cargo Handling, Navigation and Traffic Control, All Involve Problems Basic to Full Realization of Air Transport's Potential Value. Specialists from Other Fields—Biomechanics, Lighting, and Even Air-Conditioning—are Enlisted to Add Comfort and Safety

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

AVIATION today ranks equally with rail, highway, and water carriers, and is assuming its long-predicted place in the transportation scheme of this country both at home and abroad. Currently, the airlines of the United States have approximately twice the pre-war number of seats in operation, in final stages of construction, or in conversion. Programs planned for the next two years will better than double this carrying capacity. Opening up of world trade routes will further add to the importance of air transportation, and the air-freight field, being explored by several airlines, has been found capable of providing tremendous expansion possibilities.

Truck-level cargo doors save handling; are partial answer to loading problem

This, in essence, was the keynote of a recent meeting of the Air Transport group of the Society of Automotive Engineers, as expressed by William Littlewood, S.A.E. officer and Vice President of American Airlines. The papers presented at the meeting stressed the realization that the fullest development of the opportunities open to commercial aviation depends to a large extent on practical and economical solutions to a variety of technical problems.

CONTROL-DECKS—The problem of crew comfort on the control-decks of long-range aircraft was once considered to be satisfactorily solved when the pilot had a comfortable cockpit in which to sit. On the larger over-land and over-water airliners, this now appears as a serious misconception in the light of present requirements for a multiple or relief crew. Possibly, as operation schedules increase in speed and flights shorten in duration, multiple crews will disappear, in which case only a pilot, co-pilot, radio operator, and flight engineer will be carried. But for present-day flight personnel, the design of crew quarters must be something more than an afterthought.

Some of the more important design considerations in this respect are: the relative distance between the pilot and co-pilot; the relation of the pilot and co-pilot to the instrument panels and controls; and the location of the flight engineer's station, which should be close to the co-pilot and visible from the captain's station. Suitable locations must also be found for the radio operator and the navigator. Among the suggestions offered by Captain H. J. Chase, of Pan American Airways, Inc., in a discussion of control-decks, was a thoroughgoing analysis of pilot fatigue as related to vibration. Since vibration is known to be fatiguing to personnel and to reduce their operating efficiency, it appears that special shock-mounting of all crew personnel stations, including their chairs, instruments, accessories, and tables would be worthwhile.

Visibility, another vital factor, is generally good on modern airplanes. However, some designs have relatively small windows with moldings in direct line with the pilot's vision. Such an arrangement, of course, adds to eye strain and fatigue, and limits the visibility with a resultant lowering of safety. A number of recommendations were made along this line. Visibility should be available in all directions, with curtains to eliminate intense glare. All instruments should be easily readable and variable instrument illumination should be provided; again, glare reduction is important. Most aircraft instruments have rim lighting, spot lighting, or other means of

Concealed fluorescent lighting contributes to passenger's sense of comfort and well-being

Photographs courtesy Boeing Aircraft Company

Crew comfort and convenient control set-ups keynote modern flight-decks

illumination, but it was noted that none of the methods is comparable with lighting from behind the dial face such as is used in home radios. Also, some dials might be improved by a change from a circular to a vertical scale.

Control-deck noise, always conducive to fatigue, must be held to a level that permits crew members to converse without effort. Not only does noise render the co-operation of the crew members difficult, but it may also give rise to dangerous errors and misunderstandings on long flights.

Many of these studies of crew comfort hinge on biomechanics—the combined study of biology and mechanics—and recent work in this field has materially improved the lot of all who fly. Some of the developments, such as the pressurized cabin, high-altitude flying suits, and improved food for both pilots and passengers, represent a tremendous amount of research work on the part of highly specialized medical men as well as aeronautical engineers and technicians.

CARGO HANDLING—Passing from considerations of crew comfort to air-cargo problems, M. B. Crawford, Chief Equipment Engineer for United Airlines, discussed some of the loading and unloading appliances now coming into the air-cargo picture. The front cargo-door height on the familiar Douglas DC-3 transport is nearly ten feet above the ground while the rear cargo-door requires a lift of about four feet from the ground level. Doors on other planes range between these two heights and, consequently, the problem of loading is not an easy one. Body lift trucks are one answer. The normal lift truck body has a height of four feet and can be extended up to 14 feet so that any airplane door height can be accommodated. Fork lifts are also extremely useful for any cargo that is too heavy to lift by hand.

Cargo discharge chutes, with gravity as the unloading force, are generally accepted as the most logical and practical means of handling the out-bound cargo. There have been many adaptations of the cargo chute, but the possibilities are not yet exhausted. Straight chutes have not been entirely satisfactory because some of the heavier packages come down too fast, while the lighter packages have a tendency to stick half way down. Moreover, some of the chutes are too heavy and require too much maintenance. Belt loaders have been of limited service because they can move only small packages from the lower to the upper end of the belt, and they require an additional cargo handler.

The entire answer to loading problems cannot be found in ground handling machinery alone, however ingenious. Airplanes themselves must be designed to suit cargo operations. Such features as high-wing design; at least two loading doors not less than six by eight feet in opening, one at each end of the compartment; a substantial floor with skid strips, tie-down fittings, and stressed to one thousand pounds vertical pull; and a clear cargo compartment equally distributed around the center of gravity to simplify weight and balance problems, were offered by Major David W. Long, of the Air Transport Command, as recommendations based on past military experience. It was also pointed out that the true aerial freighter, carrying nothing but cargo, might well be relieved of some of the more stringent weight restrictions imposed on passenger aircraft for safety reasons.

CABIN LIGHTING—Redoubled efforts in the direction of passenger comfort were also reported by engineers now free once more to concentrate on the more luxurious aspects of air travel. Attention was focused on fluorescent indirect lighting by Raymond A. Rugge, of Curtiss-Wright Corporation. Fluorescent lighting promises to aid passenger vision, induce relaxation, and produce a mild sense of well-being through the use of concealed light sources that give low values of contrast. Passenger cabin lighting objectives are summed up as: adequate illumination of all objects in the field of view, with a recommended minimum of five foot candles; soft white light that accentuates the color and freshness of objects and fabrics; light sources concealed or in a fixture of low surface brightness; adjacent reflecting surfaces of low surface brightness compared to the reflection of other objects in the general field of view; aisle lights for night use; and special passenger reading lights in combination with the general illumination.

AIR CONDITIONING—That there has been considerable engineering attention given to aircraft cooling was indicated in a report on "Refrigeration for Air-Conditioning Pressurized Transport Aircraft," by Bernard Messinger of Lockheed Aircraft. Popular misconceptions notwithstanding, aircraft air-conditioning does require refrigeration. Although it would at first appear that airplanes can be flown at a sufficiently high altitude to avoid excessive ambient temperatures, this is only approximately true for unpressurized aircraft and not at all the case for pressurized transports.

There are several reasons for this rather surprising fact.

If it is assumed, for example, that an outside or ambient temperature of only 75 degrees, Fahrenheit, prevails on a hot, summer day, at an altitude of 7000 feet, the cabin temperature, without the removal of heat, will run substantially higher. First, there are numerous internal

sources of heat in the cabin: the occupants; solar radiation through transparent surfaces; various electrical devices, such as radio equipment, inverters, motors, and lights; and a slight effect due to thermal lag. But there is another and somewhat more involved reason. This concerns the great difference between the static temperature and total temperature due to stopping of air relative to the airplane. For older type transports which have a climb speed of 110 to 120 miles per hour, this factor amounts to only 2 degrees, Fahrenheit, but for present-day aircraft, it may amount to 5 or 6 degrees, Fahrenheit, during climb. In level flight it can become 15 or 20 degrees, Fahrenheit; while in some high-speed military fighters this temperature rise reaches 50 degrees, Fahrenheit.

It may be noted that this effect is present not only in the air that is stopped while being brought into the airplane, but also in the boundary layer which envelopes the entire external surface. The practical result is equivalent to placing the airplane in an atmosphere at a temperature very nearly equal to the total temperature. All of these temperature elevating factors make it difficult to maintain the cabin temperature within less than 10 to 20 degrees, Fahrenheit, of the ambient static temperature, even though adequate ventilation flow rates are provided. Thus, at 7000 feet altitude on a summer day, the cabin temperature might range between 85 and 95 degrees, Fahrenheit.

While the plane is taxying, further cabin temperature difficulties arise, and passengers may be acutely uncomfortable if the day is at all warm. Under such circumstances, the only alternative to refrigeration is the use of prohibitively huge cabin fans. Reduced taxying time may help to solve this trouble, since refrigeration trucks or their equivalent, offer an acceptable degree of air conditioning when the plane is not moving. The refrigeration equipment, however, must be quickly removable.

TRAFFIC—"The air transport industry is today faced with a serious situation. Air navigation and traffic control development has not kept pace with the expanding volume of traffic." These words prefaced a talk on operational problems by Captain S. P. Saint, of American Airlines. Further comments indicated that fully-equipped modern airliners are still held to the same instrument approach weather minimums that were established for single-engine, poorly instrumented "mail-planes." In this situation, traffic control is the dominant factor and little has been done to eliminate the fundamental limitations that have prevailed since the late 1930's.

Recommendations for remedial measures include: a central traffic control agency with means to coördinate traffic control, plus self-checking control devices, and a clarification of the relationship of the pilot to the automatic systems. Many worthwhile advances could stem from material recognition of these recommendations. To summarize a few of them: radar and other devices could be incorporated to reduce the minimum practical separation between flights; standardized judgement on minimum separation could be built into and administered by the automatic system; coördination of movement would be automatically and instantaneously accomplished; provision would be made for regular over-control of the system by human dispatchers. The possibilities inherent in radar techniques would be brought into proper focus by application of these principles, which would incorporate every known principle of safety engineering.

WASP MAJOR

Is World's Largest Aircraft Engine

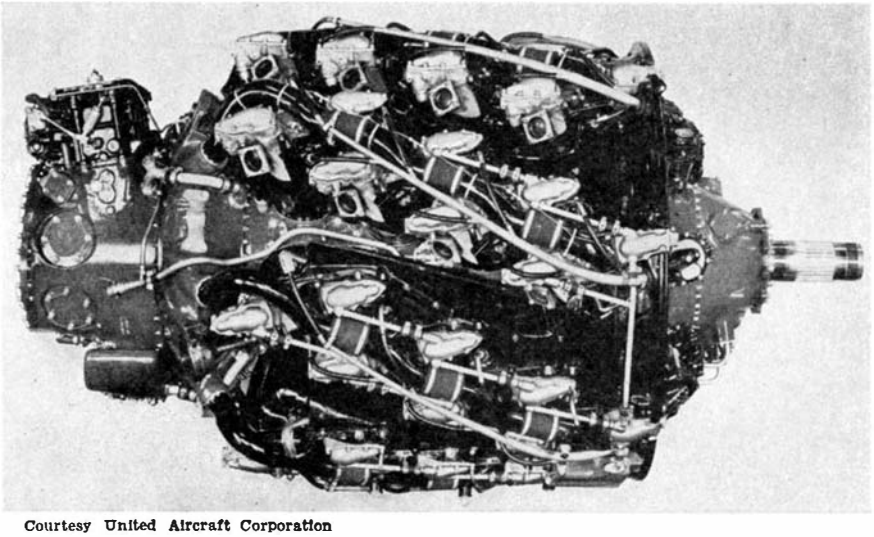
SAID to be the most powerful aircraft engine yet in production, the new Pratt and Whitney Wasp "Major" delivers 3650 horsepower with a dry weight of 3405 pounds. Pointing the way to further progress in air transport through the use of larger, more powerful, and more efficient engines, the 28-cylinder "Major" powers such outstanding planes as the 108-passenger, Douglas C-74 Globemaster; the 114-passenger, Boeing Model 377 Stratocruiser, the commercial version of the B-29; and the 105-passenger Martin Mars flying boat.

In addition to the Wasp "Major's" remarkable power/weight ratio—less than one pound per horsepower—the specific power ratio is .84 horsepower for each of its 4360 cubic inches of piston displacement, and fuel consumption is unusually low, an important factor in long-range operation.

A number of design features contribute compactness, accessibility, and efficient cooling to the engine. The cylinder arrangement, emphasizing low frontal area, consists of four banks of seven cylinders each, distributed in a helical pattern that allows each individual cylinder to receive cooling air directly from the air stream rather than from heated cylinders ahead. Supplementing this carefully directed flow of cooling air are deep-finned, forged aluminum cylinder heads and scientifically contoured baffles.

Conventional ignition harness installations have been discarded in favor of interchangeable magnetos, one for each cylinder bank. High altitude performance is boosted by the use of a hydraulically driven, variable-speed supercharger that is automatically controled. Improved vibration dampers reduce crankshaft vibration and the radial mounting of the accessories about the periphery of the accessory drive case is an innovation that should make for a substantial increase in service maintenance accessibility.

The design and development of the Wasp "Major," authorized late in 1940, was accomplished in approximately five years; a relatively short time for the introduction of an engine incorporating so many advanced features.



Courtesy United Aircraft Corporation

Side view of the Wasp "Major," showing the four banks of cylinders

Ion Exchange

Purification of Liquids and Gases, Selective Recovery of Valuable Materials, and the Removal of Undesirable Substances from Chemical Compounds, are Problems that Often may be Solved with Ion Exchange Resins. Both Industry and the Laboratory Find These Resins Valuable

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

INDUSTRY is constantly finding new ways to save time and money by the use of synthetic ion exchange resins. These resins have proved their worth not only in the chemical industry--as in the purification of formaldehyde—but also in such diverse operations as purifying pectin from grapefruit rind, removing harmful fluorides from drinking water, and recovering quinine from cinchona bark.

Ion exchange makes use of synthetic resins obtained from compounds containing free acidic groups, such as carboxylic acids; or basic groups, such as amines. When a solution of electrolytes is passed through the acidic resins, the metallic ions combine with the resins to form what might be considered an insoluble, resinous salt. In the same way, the acidic portion of an electrolyte—sulfate, fluoride, or the like—is absorbed by basic resins.

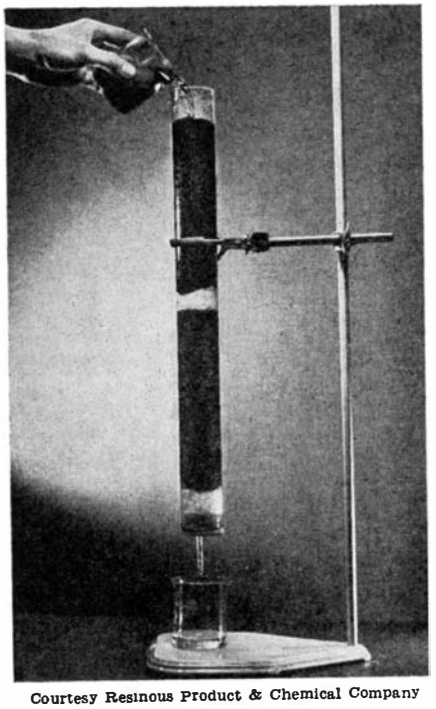
Actual "exchange" is involved because absorption of one ion requires liberation of another; otherwise the reaction would not be balanced. In simple water softening, for example, sodium ions might be liberated while the calcium and magnesium ions, which cause hardness, are removed. In another type of reaction—anion exchange—chloride might be substituted for sulfate or fluoride. Also, resins have been developed which liberate hydrogen and hydroxyl ions. These combine to form water and the solution is completely demineralized.

The principle of ion exchange, known for exactly one hundred years, has been applied industrially during the last 40 years—primarily for water softening—and only within the past 10 years have synthetic organic resins been developed which extend its usefulness.

These materials are serviceable not only for removal of impurities but also for recovery of valuable substances; for separation; for addition of certain electrolytes to solutions; and for a variety of miscellaneous operations.

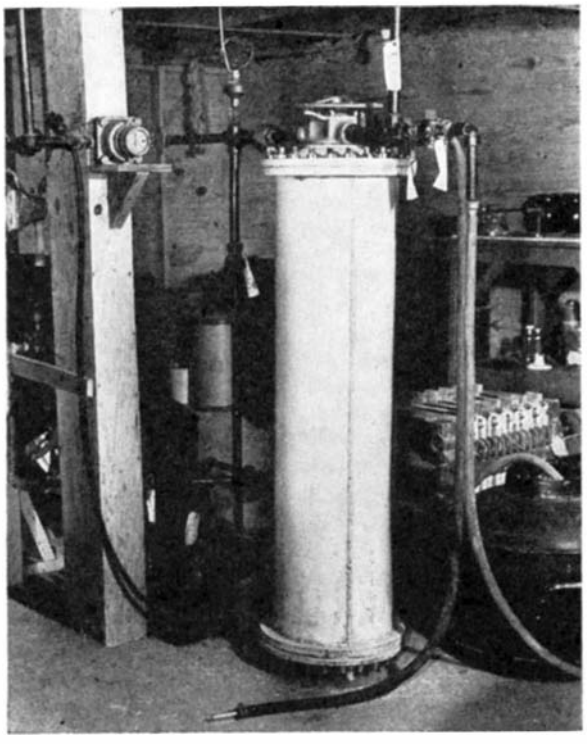
CHEMICAL INDUSTRY USES—An important industrial application of anion exchange is the removal of formic acid from formaldehyde. This is a specific example of the general process for the removal of acidic impurities from liquids or gases. Particularly in the laboratory have ion exchange materials been used to remove undesirable impurities from exhaust gases.

Sometimes the acid itself is a



Courtesy Resinous Product & Chemical Company

Ion exchange in laboratory quantities. Top resin layer absorbs metallic ions, bottom layer absorbs acidic radicals; liquid in bottom beaker is pure water



Scopolamine—a medicinal alkaloid used as a sedative and sometimes called "truth serum"—is recovered by a single-resin ion exchange in single tanks such as this one at Debruille Chemical Corp.

valuable product, and ion absorption provides a means of reclaiming it, as in the recovery of tartaric acid from wine lees. Similar recoveries of precious metals, such as gold and platinum, are accomplished by converting them to complex acids which can be absorbed by the proper resin. Cation exchange has also been used in a comparable fashion to recover copper from the waste liquors in the cuprammonium rayon process.

Compounds manifesting different degrees of acidity or basicity can be separated by selective absorption on ion exchange resins, and this principle has been applied to the separation of the amino acid mixtures as described in Scientific American, February 1946.

QUININE RECOVERY—The recent war in the Pacific increased our need for anti-malarial drugs, and at the same time it cut off our supplies from the Netherlands East Indies. Consequently, a great deal of work was directed to the possible use of ion exchange to recover quinine and related alkaloids from the lower quality South American cinchona barks.

The absorption of alkaloids by cation exchange materials had been known for many years, but commercial utilization of the knowledge was retarded by lack of suitable means for recovering the absorbed material. This latter problem was solved in 1941, and the process has since been adapted by the Cinchona Research Unit of the United States Army to provide a portable unit for quinine recovery at the site of harvest. The portable plant, which weighs only 1500 pounds, can process 13,000 pounds of bark a month, yielding 170 pounds of totaquine.

Of simple construction, the plant produces the quinine concentrate in the field from wet bark. Heretofore, dry bark had to be gathered from the jungle—generally an almost impossible task insofar as the South American areas were concerned—and shipped to a permanently located extraction plant.

WATER TREATMENT—Demineralization of sea-water and the production of a substitute for industrial distilled water by ion exchange are processes that have been described in detail in Scientific American, June 1944 and September 1944. A closely related problem is the removal from water supplies of excess fluorine, which is now recognized as the cause of mottled teeth prevalent in some localities.

Fluorides, it has recently been determined, can be rapidly and efficiently extracted by passing the water over a bed of an ion exchange resin which has been specially treated with a solution of an aluminum salt, generally aluminum sulfate. The exchanger is not depleted in the process and can be used repeatedly by intermittently regenerating the resin with an alkaline solution which removes the accumulated fluoride ions.

Although it has been known for some time that fluorine may be removed by bone, chemical removal methods are relatively recent developments. The problem involved finding a substance which would not leave any element in the water that was not already present, and which would not impair the potability by increasing undesirably the concentration of any ordinary constituent.

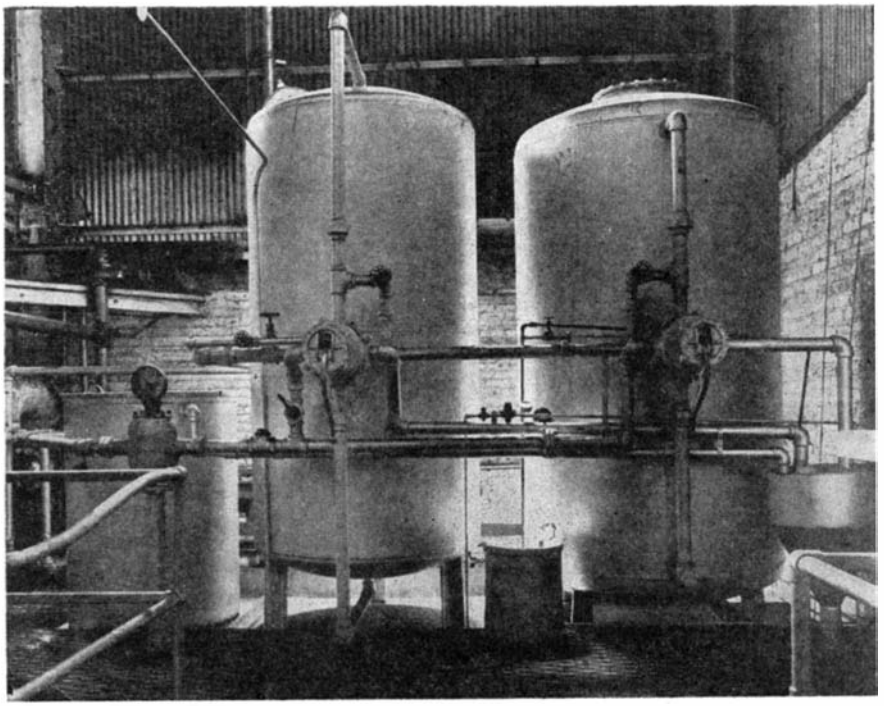
There were three possible approaches: precipitation of the fluorides, unsatisfactory because of their high solubility; desalting, which has proved uneconomical so far; and selective absorption by a solid. The latter has proved most promising.

Although a number of materials —titanium oxide, zinc oxide, copper hydroxide, copper sulfide, and others —answered most of the necessary qualifications, their principal disadvantages proved to be ready disintegration, low capacity, and inability to be regenerated. The use of resinous exchange materials has become a satisfactory answer for commercial use.

FOOD INDUSTRY—A number of ion exchange applications have been found in the manufacture of foodstuffs. Among these is the preparation of a high quality pectin from grapefruit hulls by the use of an acid-regenerated cation exchanger. Here, the resin is added to a slurry of the rind in water and is later removed by centrifuging. This treatment removes metallic impurities from the material.

In another commercial process, part of the calcium is removed from milk to make it more digestible for infants. This is one of several milk products modified by ion exchange.

As mentioned above, acidic impurities are often removed from products with ion absorbents. This has been applied in the food industry, again, to remove the chloride ion from glutamic acid hydrochloride, and to remove undesirable acids from dextrose, pectin, and vitamin B extracts.



Courtesy Rohm and Haas Company

Typical ion-exchange installation for purifying boiler feed water

Higher yield and improved operation have also been obtained in beet sugar production by the removal of organic and inorganic non-sugars by ion exchange absorption.

ION EXCHANGE COSTS—While the initial cost of some exchangers is relatively high, they are long-lived in most applications so that investment can be amortized in the same manner as other equipment. There are in use a number of plant installations where the exchangers have been operated for thousands of cycles.

Operating costs depend upon the type of exchanger required, the quantity and nature of electrolytes to be removed, the proportion of re-

moval required, and the nature of the regenerant. In a typical example of water treatment, assuming that soda ash and sulfuric acid cost two cents per pound, demineralization would cost 29 cents per 1000 gallons.

OTHER FACTORS—The chief limitation of ion exchange is the capacity of the resins. The process is limited to solutions of relatively low concentration; as the concentration of electrolytes increases, the volume of solution which can be treated before exhaustion of the resin decreases to a point where it is less than the volume of the exchanger.

Also, valuable materials are obtained only as relatively concentrated solutions which require evaporation or other means of concentration in order to obtain the desired material.

The ramifications of this principle are such that it reaches into almost every industry. Demineralized water is desirable for boiler feed and cooling water in all industries. Electroplating processes benefit from solids-free water; especially freedom from calcium, magnesium, sulfates, and chlorides. For producing high purity chemicals in general, pure water is an indispensable raw material. It is likewise important in distilleries and breweries, in pharmaceutical manufacture, in dyeing, and in other textile processing techniques.

Ion exchange is expanding steadily in scope and utility; and it will undoubtedly become of increasing value in a multitude of industrial operations.

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STREPTOMYCIN

Will be Increasingly Available As New Plants are Finished

INCREASING evidence of the growing importance of biochemical processes in the chemical industry is presented by plans now underway to construct streptomycin production facilities.

Streptomycin was not discovered by accident as was penicillin. Dr. Selman A. Waksman, of Rutgers University, experimented for years with soil microbiology before finding that *Streptomyces griseus* was effective when used against the microörganisms causing such diseases as typhoid, cholera, tuberculosis, influenzal meningitis, and others.

When Dr. Waksman brought his discovery to commercial producers of biologicals a team of 50 scientists were immediately assigned to work toward the goal of transforming streptomycin from an experimental substance to a therapeutic agent ready for application.

Now, with many questions answered due to experiments conducted on both animals and humans, streptomycin has moved from the laboratory and the pilot plant into large scale production. Merck and Company, Inc., is constructing new units to supplement its present plant facilities and Eli Lilly and Company is also building a plant for the production of the new drug.

SYNTHETIC LUBRICANTS

Are Made from Gases; Contain No Petroleum

Now being synthesized on a commercial scale from natural or other hydrocarbon gases, two series of synthetic lubricants were recently announced by units of Union Carbide and Carbon Corporation. One series, which is essentially insoluble in water, is designated by the symbol "LB" followed by a number representing the viscosity at 100 degrees, Fahrenheit, in Saybolt Universal Seconds, while the other series, the members of which are soluble in water at room temperature, is known as "50-HB."

These new lubricants, called "Ucon," are made from gases, contain no petroleum oils, and are inherently more expensive to produce than the best petroleum lubricants now sold.

Because of its special properties, the LB series is best adapted for the lubrication of machinery, including internal combustion engines. LB-300 has already been marketed in certain areas as Prestone Motor Oil for use in automobiles, buses, trucks, and tractors. This lubricant has been found successful for Diesel engine use and the Army Air Forces and the Air Transport Command have used lubricant LB-550 in aircraft engines. (See first report, page 84, February 1946 Scientific American.)

In addition to use in internal combustion engines, there are many places where the special properties of the LB series of lubricants—such as low pour point, high viscosity index, and non-sludging characteristics have been utilized to advantage. Such uses include their applications as hydraulic fluids and plasticizers. Further utilization as lubricants is being studied in such fields as powdered metal bearings; transmission and differential lubricants; electrical motors; textile machinery; wire drawing; metal rolling and stamping; and many others. Greases exhibiting unusual high and low temperature properties have been prepared from oils of the LB series, but, so far, on an experimental basis only.

The 50-HB series of synthetic lubricants is characterized by high viscosity index, low pour point, and in other properties is similar to the LB series. Compounds of the 50-HB series, however, are completely soluble in water at room temperature, with the water solubility decreasing as the temperature is raised. The series will depress the freezing point of water to a limited extent. Members of the 50-HB series having viscosities of more than about 100 Saybolt Seconds at 100 degrees, Fahrenheit, have very little swelling action on natural rubber and are excellent lubricants for both rubber and metal. Certain of these products are being used in hydraulic fluids including brake fluids, as high-temperature heat transfer media and textile lubricants, in cutting oils, for wire and metal drawing operations, and other uses.

While these materials are not in general competitive with natural petroleum lubricants, they presage a tendency—apparent in both the chemical and petroleum industries—to rely less and less on natural products and more on synthetic "tailor-made" materials designed for a specific purpose.

HYDROGEN PEROXIDE

Now Industrially Available In Concentrated Form

A CONVENIENT source of oxygen for industrial purposes is now available in the form of 90 percent peroxide. Heretofore, hydrogen peroxide of high concentration has been only a laboratory curiosity. Industrial material of 30 percent strength and the ordinary antiseptic, containing only 3 percent, have long been used, but the highly concentrated substance was thought to be too hazardous for practical use. Now, intensive research has shown that hydrogen peroxide of high purity is actually a stable material.

The possible industrial applications of this chemical are innumerable. Hydrogen peroxide is an ideal oxidant in that it leaves no residue. In its concentrated form it promises to be of great utility in many new chemical reactions since, being relatively free from water, it will react faster and more completely with organic compounds. Moreover, each volume of the 90-percent peroxide yields over 400 volumes of oxygen—three to four times as much as the 30 percent material.

Keeping the Heat In

Chemically Inert, Light, Strong, and a Highly Efficient Insulator, Magnesia, Mixed with Asbestos Fibers, Provides an Easily Installed Insulating Material for Boilers, Pipes, and Similar Surfaces. Above 600 Degrees, a Lining of Diatomaceous Earth Protects the Magnesia

INCREASED utilization of heat energy, and its wide-spread applications, make thermal insulation a problem of prime importance in modern industry. The vast majority of processing and fabricating operations require heat transfer, under controlled conditions, at one or many points in the productive process. Although steam power is, perhaps, the most quickly called to mind, numerous industries, including chemicals, plastics, petroleum refining, paper manufacture, and a host of others, are vitally dependent upon insulation as their various heated materials pass through transfer pipes, distilling units, heated rollers, or other equipment requiring heat and pressure to function.

Early in the development of steam engineering, it was recognized that radiation, convection, and conduction from boilers and hot lines were robbing steam engines of much of their efficiency. Insulating materials of various types were experimented with, most of them of an organic base—vegetable or animal matter—and most of them were subject to decomposition at around 300 degrees, Fahrenheit. Later, plaster of Paris mixed with sponge was tried—the small entrapped dead air cells of the porous sponge being a fairly good insulating substance—but the plaster rusted the pipes and boilers. Other insulating materials were also used and found unsatisfactory in that they shrank, charred, would not resist vibration, or otherwise deteriorated in use.

CARBONATE OF MAGNESIA — Sixty years ago, Hiram N. Hanmore of Philadelphia, discovered the heat insulating qualities of magnesia, an inorganic, inert, chemical compound known commercially as block magnesia and pharmaceutically as magnesia alba. It is produced from dolomite rock and its composition is somewhat indefinite, but is usually expressed by the formula: $4MgCO_3.MgOH_2.5H_2O$.

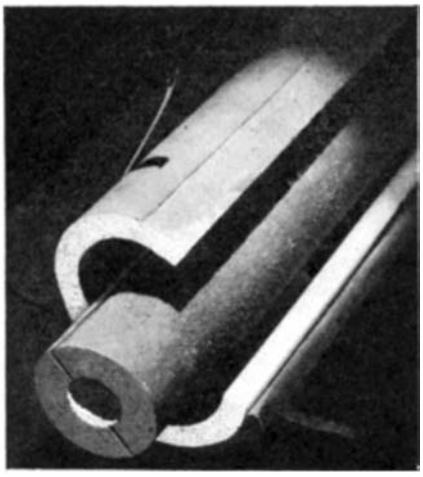
Courtesy Keasbey and Mattison Company

Inner lining protects magnesia outer sleeve from excessive temperatures

At first, silk fibers were used as a binder, but silk was soon discarded in favor of asbestos fibers. Experimentation and use quickly evolved a satisfactory working ratio of 15 percent asbestos fiber binding and 85 percent magnesia, although magnesia can be and is used with a lower percentage of asbestos fibers.

In 1887, the U. S. Navy realized the value of carbonate of magnesia as an insulating material and in ordering it specified "85 percent magnesia"; since that time the same phrase has become standard. Light in weight—approximately 15 pounds per cubic foot—magnesia is easily sawed or cut, withstands vibration, does not char or burn, or shrink or loosen in service. Moreover, it has no corrosive action on the metal to which it is applied, and it can be removed for inspection of pipes and replaced with ease. When properly applied, it will outlast the installation which it covers. Magnesia's durability is such that it will withstand years of immersion in water and when removed can be pulverized, mixed with water, and re-used as a plastic insulating cement. Being chemically inert, exposure to most chemicals and chemical fumes has no harmful effect, while its compressive strength allows it to be molded into many conveniently shaped forms which do not sag, buckle, or shrink.

For general industrial applications, magnesia is manufactured in standard three foot long half-sec-



Seams are sealed by 90-degree overlap

Telescopic installation of dual-layers

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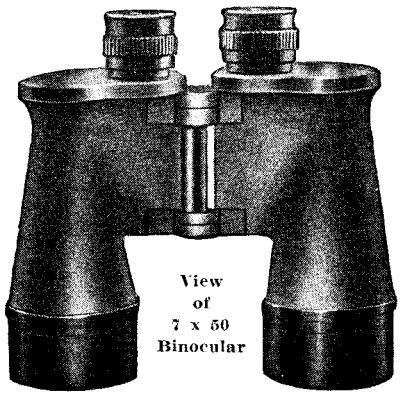

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3029-S	Dove	16 mms.	65 mms.	1.25
3036-S	80 Degree Roof	60 mms.	36 mms.	4.00
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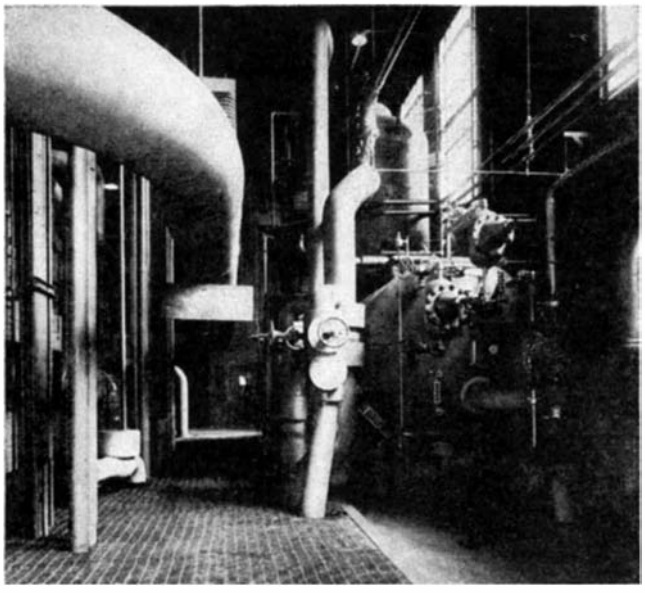
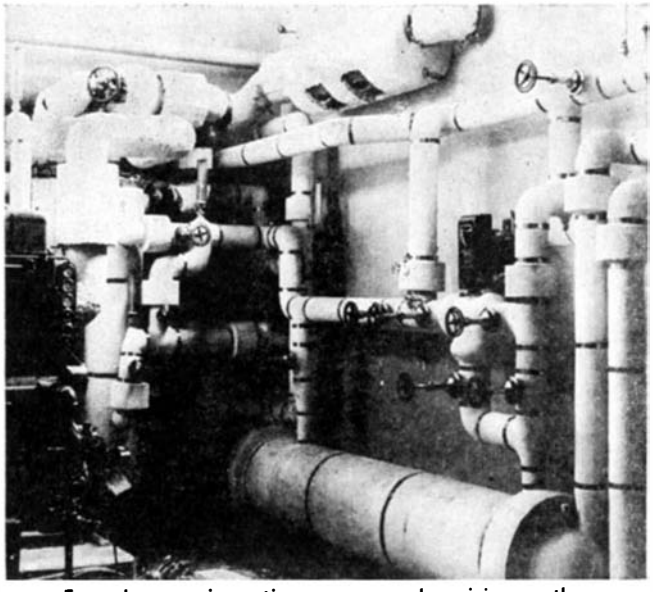


Magnesia blocks insulate these large pipes and boilers

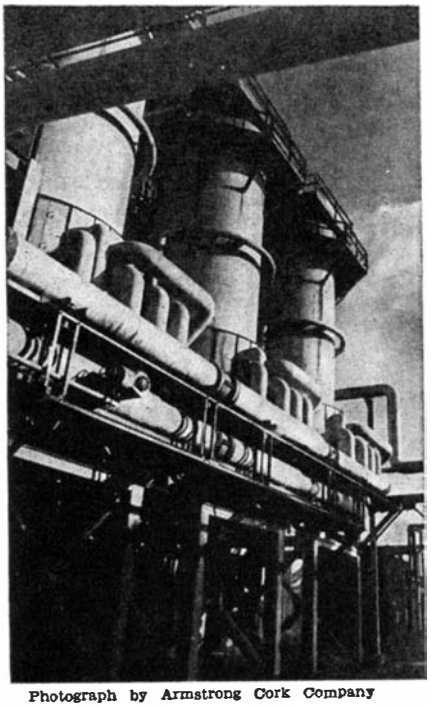


Formed magnesia sections cover complex piping neatly

tions for pipes, and in flat or curved blocks of various sizes, ranging in thickness from one to four inches. In applying multiple layers, the joining surfaces of sections are staggered to eliminate open joints and a plastic cement, made from pulverized magnesia, is used to fill in the joining areas. A canvas "jacket" is sewn tightly around the outside which is usually painted. Metal bands secure the insulation firmly in position.

ABOVE 600°—Magnesia solved the problem of efficient insulation for steam and other heat installations and was universally adopted throughout the industrial world where temperatures up to 600 degrees, Fahrenheit, were maintained. It was soon found, however, that when 85 percent magnesia was used on surfaces having temperatures above 600 degrees, Fahrenheit, there was a tendency for the insulating material to calcine on the surface next to the source of heat. This calcination produced a thin film of magnesium oxide which was found to be an even lighter and more efficient insulating substance than the magnesium carbonate. Magnesium oxide, however, is not as strong mechanically as 85 percent magnesia, and as higher temperatures became increasingly common in industry, the demand for an insulating material which could withstand temperatures above 600 degrees, Fahrenheit, became imperative.

This problem was solved by manufacturers of heat insulation who used pre-calcined diatomaceous earth in combination with asbestos fibers. This type of insulation is referred to as "high temperature" insulation, and is capable of withstanding temperatures up to almost



Photograph by Armstrong Cork Company

Refineries require heavy insulation

2000 degrees, Fahrenheit. Like 85 percent magnesia, although somewhat heavier and more expensive, it also is manufactured in standard lengths, shapes, and sizes. In practice, this high temperature resisting diatomaceous earth material is placed in direct contact with the heated surface in thicknesses sufficient to reduce the temperature on the outside of the insulating material to a little below 600 degrees, Fahrenheit. Another layer of 85 percent magnesia is then applied to protect the high temperature material. The combination produces a near-perfect type of insulation.

To reduce the number of various sized sections of insulating material now made and carried in stock, some manufacturers are planning to make all inside diameters of insulation sections the same size as the outside diameters of standard sizes of pipe.

Insulation manufacturers, continually carrying on research for better and more efficient insulation materials, have used glass wool, rock wool, slag wool, corrugated asbestos, and other materials with satisfactory results under certain conditions. Even highly polished metal reflectors have been successfully employed in some cases. But in the moderate heat range, 85 percent magnesia is the basic, all around, most satisfactory insulation available to industry today.

* * *

NEW FLUORESCENT

Lamp Gives Brighter Light, Has Longer Life

FLUORESCENT lighting giving brighter yet more mellow light, instant illumination, and double lamp life is reported to be possible with Safreen, a new fluorescent lamp developed by the Duro Test Corporation.

When not illuminated, the new light appears little different than any other fluorescent lamp, but, turned on, it is perceptibly brighter. Its glow—a blending of saffron with a touch of green—is restful to the eyes. Laboratory tests have demonstrated that a 40-watt Safreen produces 20 percent more light than the standard 40-watt white fluorescent and is approximately 40 percent brighter than the standard 40-watt daylight lamp.

Longer lamp life is achieved by the introduction of heavy-duty cathode which holds five times the emission coating of the standard cathode. Tests show that this cathode

increases lamp life to approximately 5000 hours—just double the 2500-hour rated life of standard fluorescent lamps.

Even more important to the large user of fluorescent lighting is the fact that the new Duro Test lamp will provide instant illumination with the flick of the switch. There is no delay and no flickering. No starters are required.

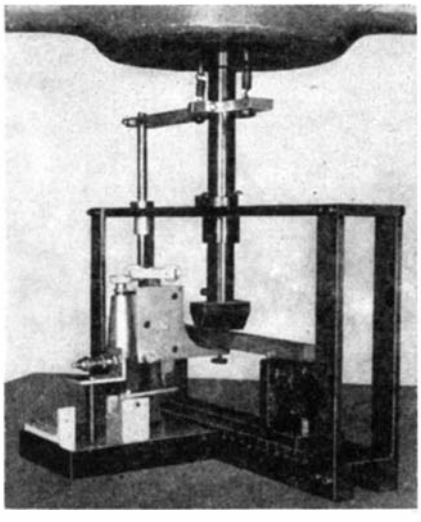
TESTING UNIT

Obtains Data on Stiff or Flexible Materials

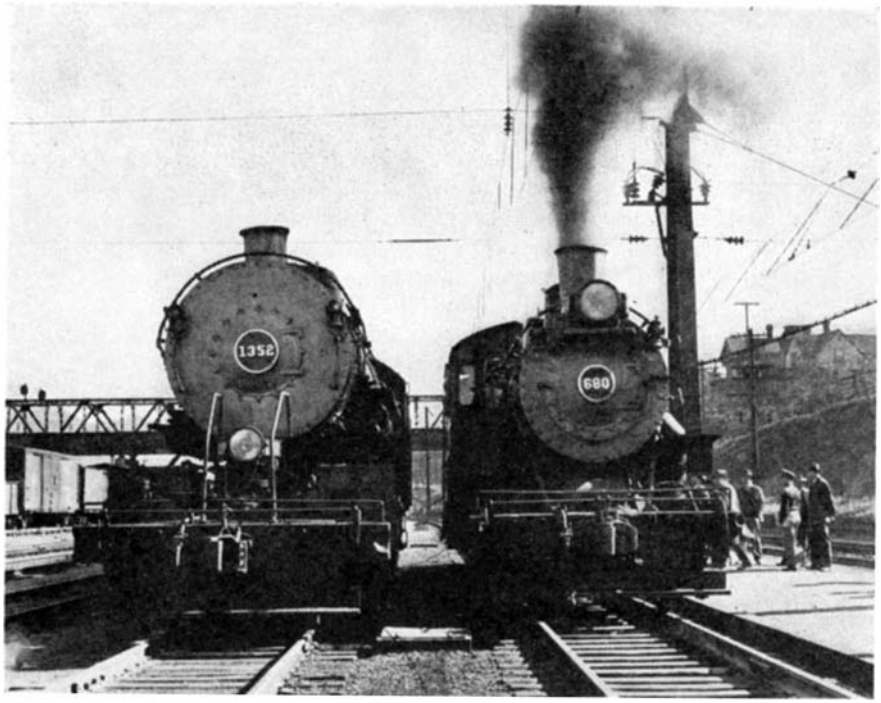
SUPPLEMENTING equipment for testing many different molded plastics, plastics laminates, and woods, the Southwark Division of the Baldwin Locomotive Works has developed a combination flexure tool and deflectometer. The new instrument will make tests in bending in accordance with the latest federal specifications and those of the A.S.T.M., and will fit any testing machine.

The deflectometer measures the deflection from the center of the specimen and conveys this to an autographic stress-strain recorder which gives the load deflection curve. One of the important features of this instrument permits the operator to adjust the magnification of the deflection in multiples of 5, 10, 20, 50, 100, and 200 times. The high magnification ratio is used for very stiff and brittle materials that deform only slightly before breaking. The deflection, therefore, is measured in terms of thousandths of an inch. The low magnification permits recording large deflections which may be as much as two inches with very flexible materials.

In order to obtain tension, compression, and flexure characteristics of the various plastics materials under extreme temperature conditions,



Specimen under test in new combination flexure tool and deflectometer



Locomotive at left is using new over-fire air jet; one at right is not

the instrument has been designed to fit inside a cabinet in which the temperature can be controlled. The deflectometer will operate from —70 to +170 degrees, Fahrenheit. Since a certain ratio must be maintained between the length and thickness of the specimen under test, the span is adjustable.

CELLOPHANE

Made Moisture Proof by New Coating

AN INVISIBLE application of a coating so thin that 60 of the coatings, piled on top of one another, would be only as thick as a human hair, has been perfected by the Sylvania Industrial Corporation. The new application keeps moisture from passing through sheets of cellophane to which it is applied, and it is tough enough to resist breaking when the cellophane is twisted around packages. It is as clear as a pane of glass and has no odor or taste. Because of these qualities, this moisture-proof cellophane makes a good wrapping material for foods, since it keeps them from drying out for long periods of time.

LOCOMOTIVE SMOKE

Greatly Reduced by Over-Fire Air Jet

ELIMINATION of all smoke from burning coal in locomotives, industrial boilers, and home heating equipment is forecast for the future by the Bituminous Coal Institute. This result is expected to come about with the universal adoption of a new principle of combustion, recently perfected.

One of the most striking demonstrations of the new development involved three locomotives, one from each of three railroads, equipped with over-fire steam-air jets at a cost of about $110 apiece. More recently the Norfolk and Western Railroad, which has installed the over-fire jet in 182 of its locomotives, has given similar demonstrations.

In five seconds an engine stack is completely cleared of black smoke by application of the jet. But, it is pointed out, the over-fire jet is not a cure-all for smoke caused by bad firing practice and equipment.

The new over-fire jet is extremely simple. Jets of steam are employed to force streams of air over the fire bed. The injected air is turbulently mixed with the gases given off by the burning coal, thereby promoting combustion of those elements which normally pass up the stack as smoke. There are two essential requirements in smoke elimination—a sufficient qualtity of air *above* the fire, and thorough mixing of that air with the volatile matter from the coal.

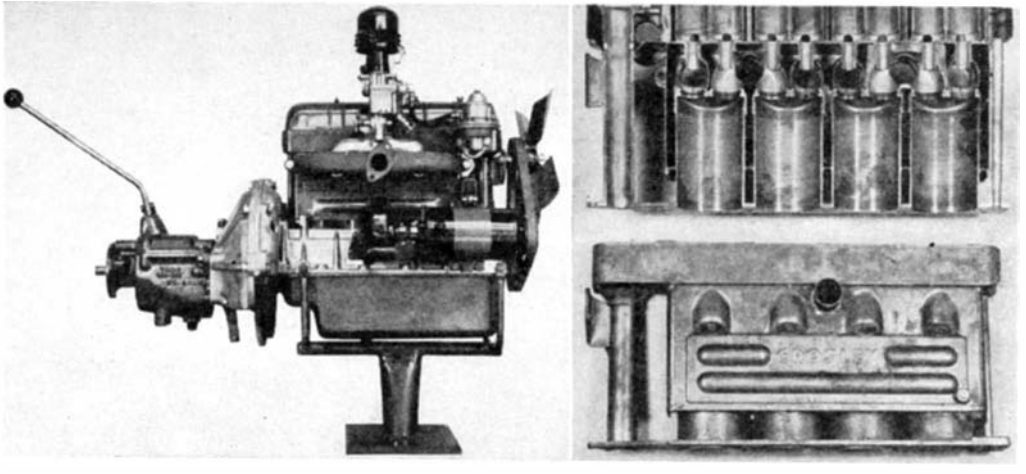
Earlier attempts to adapt over-fire jets to railroad locomotives were unsatisfactory, principally because there was frequent waste of steam and because the noise of their operation was objectionable to the engine crews. Both of those difficulties now have been overcome by engineers of Bituminous Coal Research, Inc., at Battelle Memorial Institute, through the perfection of an entirely new principle of design which not only increases the efficiency of the jets but also, by means of a simple and practical silencer, muffles the noise.

BRAZED ENGINE

Will Power Light-Weight Post-War Motor Car

STEMMING from an all steel stamped copper hydrogen brazed engine invented by Lloyd M. Taylor of Taylor Engines, Inc., the power plant of the post-war Crosley car will be a light-weight, high-compression engine of a type that has been proved in Navy service.

During the war, Crosley built engines of this type having a bore of 2½ inches and a stroke of 2¼



The complete Crosley car engine, with all accessories, including generator and starter, weighs 138 pounds. Photograph at extreme right shows (lower) the sheet-metal cylinder block and a sectional view

inches, designed to meet Navy specifications. The displacement for the four cylinders was 44 cubic inches. The engine had to develop 28 horsepower continuously at 5000 revolutions per minute to comply with the specifications. The short stroke was selected to keep the piston speed reasonably low for this high-speed operation, and also because it was the intention to use this engine in the post-war Crosley car.

A bevel gear drive was preferred to a chain drive for the overhead camshaft, because the vertical shaft could be used to carry the lubricating oil under pressure to the five camshaft bearings. The oil pump and distributor are driven by helical spur gears from the crankshaft. The oil pump, as well as the fan, generator, and water pump, is driven at ¾ engine speed for the car engine.

A cylinder spacing of three inches was selected, with a crankshaft bearing between each cylinder.

The outstanding feature of this engine is the construction of the cylinder block, which is made up of thin-walled alloy steel tubing for the cylinders and cam follower guides, and of sheet steel stampings for the cylinder heads, intake and exhaust ports, valve cases, and water jackets. These stampings number about 120 pieces for one four-cylinder block. The parts are held in place by shrink fit, spot weld, or crimping operations and form a firm structure even before brazing. The entire assembly is then copper brazed in a specially constructed furnace at 2060 degrees, Fahrenheit, in a neutral atmosphere, after copper in sheet, wire, or paste form has been applied to the joints.

The inside of the water jacket is covered with a clear, hard coat of plastics which, after baking, becomes so durable that it cannot be removed in a stripping tank of a strong caustic or acid solution. The material of the jacket is 20 gage sheet steel and the sides are ribbed in such a manner that nothing detrimental occurs to the block if the water in it is frozen solid.

The crankcase is only three inches high, weighs 7¾ pounds, and is a permanent-mold aluminum alloy casting. The hold-down bolts for the cylinder block extend through the case to the main bearing caps. The crankshaft thrust is taken at the rear main bearings, which is the only flanged bearing. All connecting rod and shaft bearings are of the precision replaceable type and no machining is required in assembly.

In addition to the stamped cylinder block, the crankshaft pulley, fan assembly and fan pulley, and the water pump impeller and pulley are made from copper hydrogen brazed stampings.

The cooling system holds five quarts of water and the lubricating system holds four quarts of oil, including the oil filter.

For the 1946 car engine, the mileage per gallon of gasoline, in a 1200-pound test car, with a 250-pound payload, is 50 miles at a speed of 30 miles per hour, decreasing to 35 miles at a speed of 55 miles per hour. At maximum torque, the specific fuel consumption is .48 pounds per horsepower hour. The reason for the high economy is, of course, the high compression pressure. The lack of detonation is due to the cool combustion chamber where preignition is prevented during the compression. The maximum wall thickness at any point separating the combustion chamber from the cooling water is .125 inch. Because of the uniform substantially thin walls of the fabricated steel construction, including the portion between the valve seat inserts, and because of the generous contact between these walls and the cooling medium, a much more even heat distribution is obtained.

New Products and Processes

MICROMETER

Increased in Versatility by Use of Dial Indicator

JUST introduced by Federal Products Corporation is a new micrometer which combines the accuracy, over its full one-inch range, of the micrometer screw and the precision of the dial indicator. It can also be used as a dial indicator comparator without the necessity of setting to a master; the micrometer feature furnishes its own precision setting.

As a micrometer, the spindle can be brought in contact with the work until the indicator hand indicates "0" and the measurement is then read on the barrel and thimble.

As an indicating comparator, it can be set to the nearest thousandth of an inch, and the variation from that set-

Combines micrometer and comparator

ting can then be read on the dial. The indicating dial is integral with the frame and is provided with tolerance hands, which can be easily set with the wrench furnished with the gage. When used as a comparator, the measuring spindle is locked positively in the desired position by a thumb clamp which grips evenly, and does not throw the spindle to one side or out of line. The opposite anvil is retracted by pressure on the finger or thumb button. This enables the workpiece to be inserted with less chance of the anvils scratching the work. It also prevents excessive wear on the anvils. Both contact faces are tungsten carbide tipped, and are lapped parallel.

LIGHT PLASTICS

Can be Compounded With Simple Equipment

TOUGH enough for use in making hammer heads, yet attractive enough to serve as a substitute for tile, a new plastics is called "Plastitool," and in its natural form it looks like well-polished ivory. However, it can be dyed any color.

Developed by Duorite Plastic Industries, it can be used in making tools, art objects, household accessories, toys, bathroom fixtures, scenic casts for stage and motion picture sets, electrical insulators, water- and acid-proof vats for chemical laboratories, and so on.

Most modern plastics necessitate the use of expensive molding equipment for satisfactory results, but Plastitool could be readily handled by an average housewife with ordinary equipment.

It can be mixed like batter in a cake mixer, and it can be poured by hand into any solid mold which will produce smooth surfaces. Then it can be hardened or "cured" in a thermostatically-controlled kitchen oven.

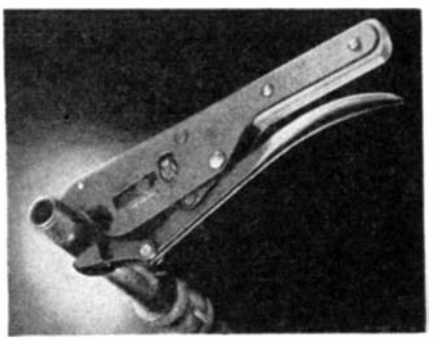
Although it has a surface hardness which makes it comparable to the aluminum used in building airplanes, Plastitool weighs less than any of the metals now in common use and can be cut or otherwise machined like hard wood.

Secret of the new plastic is a special "catalyst," which makes it possible to harden the basic phenolic material in any given form without the use of "fillers" such as are used in manufacturing most plastics.

HAND-WRENCH

With Vise Grip Adjustable Jaws

PROVIDED with a molded section of red Tenite plastics in its handle, a new wrench, which has more than a ton of gripping power in its steel jaws, has the portability of a pair of ordinary pliers, combined with the powerful locking grip of a vise, and is extremely useful as a clamp or wrench for handling awkward materials. Made by the Botnik Motor Corporation, it is designed for one-hand operation. The wrench is provided with a nut which may be adjusted by thumb and finger



Gripping power more than a ton

to regulate the jaws, which are parallel at any opening to provide maximum gripping surface. To grip, the jaws are placed over the work, and the rounded lever snapped shut. The jaws remain locked until the lever is released. A hard-drawn steel wire spring controls the locking device.

SOLDERING IRON

Has Automatic Feed of Solder to Tip

TRIGGER operated, a new automatic soldering iron ejects a measured amount of solder from a reel concealed in the handle; a special retracting feature prevents melting of excess solder on

Iron may be used on or off stand

the heating tip. The actual amount of solder deposited each time the trigger is pulled is regulated by an adjusting wheel easily accessible to the operator's thumb. If, during the course of a job, more or less solder is required, a touch of the wheel changes the amount ejected.

The Eject-O-Matic iron weighs one and a quarter pounds loaded, and is balanced so that it can be used for hours without fatigue. The non-corrosive tip is grooved to guide the molten solder to the point of application. Excess heat is dissipated before it can reach the handle.

ADHESIVE

Exhibits High Strength When Cured at Room Temperatures

ANOTHER room-temperature-setting, durable resin adhesive is the most recent development in resorcin based adhesives and is another result of research by Pennsylvania Coal Products Company, which produced the earlier Penacolite adhesives G-1124 and G-1131.

The new member of the Penacolite family, G-1215, is characterized by a 3½ hour working life at 75 degrees, Fahrenheit, yet develops extremely high early strength in wood joints glued at that temperature. Strengths as high as 3000 pounds per square inch have developed in maple blocks 17 hours after gluing. When fully cured, such joint strengths may reach 4500 to 4800 pounds per square inch with complete failure of the wood. In general, this new adhesive shows outstanding strength and durability properties when cured at room temperature; when elevated temperatures are employed, considerably accelerated cures are obtained. For example, at 180 degrees,

Fahrenheit, glue line temperature, cures may be obtained in two minutes.

In addition to being an excellent adhesive for wood, Penacolite G-1215 produces durable high-strength bonds with phenolic laminates and moldings, many other plastics, fabrics, leather, and rubber.

COMPACT MOTORS

Deliver Continuous Fractional Horsepowers

SMALL fractional-horsepower motors for industrial use, designed for optimum cooling with maximum power, are now in quantity production. Constructed for continuous duty at 125 volts, A.C. or D.C., with an output of 1/100 horsepower at approximately 7500 revolutions per minute, the motors are non-reversing, with clockwise rotation of the shaft at the fan end. As described by Lear, Incorporated, motor dimensions, with a ½ inch stack, are 2⅛ inch diameter. Standard motors accommodate a 15/32 inch pulley, although special shafts or pinions may be specified.

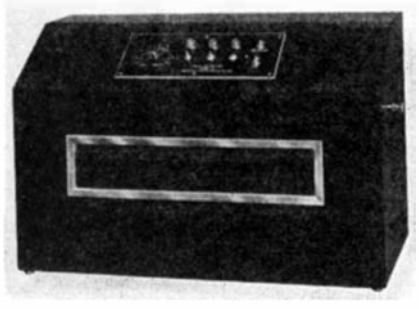
Motors rated at 125 volts, A.C. or D.C., with an output of 1/30 horsepower at 7500 revolutions per minute are also available with an overall length of 4⅜ inches and a 3 inch diameter.

Although slanted toward the electrical appliance field, these fractional horsepowers may find application in many industries.

PHOTO COPYING

Device Uses Green-Sensitive Paper

DUPLICATE photo copies of any drawing or manuscript can be made in a normally lighted room with the compact Peerless Photo-Arc Printer. This new rotary printer incorporates green fluorescent tubes as the light source.



No dark room needed—copier may be used in normally illuminated rooms

The sensitized Photo-Arc paper, transparent vellum, or cloth, on which the copies are made, is photographically sensitive to green light, but has remarkable tolerance to ordinary electric light. Thus, black and white photo copies of drawings or letters can be made right in any room or office.

The Photo-Arc Printer also employs a new mechanical method of rotary printing which is said to maintain unusually fine contact between the original and the copy.

The printer operates at a fixed speed of six feet per minute. Variation of light intensity for different types of work is obtained by rheostat control and the choice of one, two, or three tubes.

This flexibility of light control provides for any type of copying work, making it possible to reproduce from old yellowed original drawings or blueprints, as well as from letters or even printed matter having copy on both sides.

ACID COOLERS

Use Cast-Iron Hairpin Elements

USING experience gained during the war in producing units that cooled highly concentrated sulfuric acid from 475 to 175 degrees, Fahrenheit, or lower, in making high explosives, the National Radiator Company has developed its U-cast hairpin cooler element for peacetime applications. The new unit is used for cooling any liquid, but is especially adapted for cooling acids or strong alkalies under extreme conditions that usually result in the solutions quickly attacking other metals.

The new elements in these applications are submerged in the solution; the coolant, usually water, is passed through the element itself. The sections of the unit are cast of gray iron that is highly resistant to attack from both the solution and its fumes.

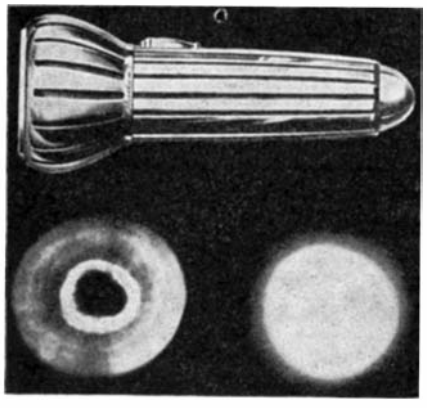
The coils formerly used in the acid cooling vats of munitions manufacturers had to be completely replaced at least every three months, resulting not only

in high replacement costs, but in loss of time as well. After months of service in the same vats the cast-iron elements showed no corrosion either above or beneath the liquid line. In some cases, a small amount of sulfate deposit formed above the liquid line, but a coating of acid-resistant paint eliminated this.

REFLECTOR FACETS

Provide Solid Beam of Light

FOR USE in flashlights, searchlights, lanterns, spotlights, and floodlights of all sizes and types, a new reflector makes use of a new conception for such reflecting surfaces. In place of a smooth wall finish which causes light beams to clash with one another, this reflector, announced by General Detroit Corporation and General Pacific Corporation, has a surface broken into



Lower right: Spot from diamond type reflector; left: ordinary beam spot

multiple diamond shapes to reflect all of the light and eliminate the "dark spot" common to ordinary reflectors.

A special flashlight called "Floodbeem" incorporates the new reflector.

RUBBERIZED APRON

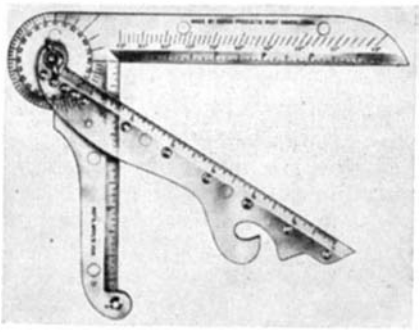
Protects Workers from Industrial Liquids

DESIGNED to give maximum protection against oil, a synthetic rubber industrial apron, which is also acid-, caustic-, and water-proof, is offered in two sizes with hemmed edges and attached neck and waist tapes. Suitable for light work in machine shops, tanneries, dairies, chemical plants, laboratories, and other applications requiring a lightweight protective garment, the Ameripol coated apron was developed by The B. F. Goodrich Company to resist nearly all industrial liquids, including gasoline and benzole.

COMBINATION SQUARE

Is Multi-Purpose Drafting Device

VIRTUALLY eight instruments in one, a new drawing and measuring device is designed and calibrated to serve as a square, dividers, protractor, triangle, ruler, compass, french curve, or miter. Called the Parva-graph, the tool consists of two parts: a combination square and a removable miter arm which can be mounted on the square through either of two mounting holes. By varying the position of the miter arm, angles of any degree can be formed, and right angle triangles can be made with acute angles of any degree desired. Removing the miter arm entirely allows its use as a radius with which circles from ½ inch to 14 inches in diameter can be scribed. Made of tough, transparent plastics, the Parva-graph was recently introduced by Parva Products Company.



Reduces need for elaborate equipment

CONCRETE SCRAPER

Renovates Floors by Removing Embedded Dirt

RE-SURFACING of hard-wood floors was greatly simplified and speeded a number of years ago by the development of mechanical rotary floor scrapers and sanders. Now there has been developed a mechanical floor-scraper that does the same thing for concrete floors. The device, developed to remove embedded accumulations of dirt, oil, and chips from concrete floor in plant aisles and around machinery, is mounted on a hand truck which is just pushed around wherever the floor needs renovating.

The fact that it can re-surface a concrete floor is due to the use, on its horizontally revolving cutter, of tips of Carboloy cemented carbide, which is vastly harder than any steel and thus able to resist the abrasive wear of chips, dirt, and concrete.

SOFT FLUX

Leaves No Harmful Residue After Soldering

AN ORGANIC soft solder flux, described as more effective than common rosin fluxes, and which does not normally leave a corrosive residue on the work, is known as "Superior No. 30 Supersafe Soft Solder Liquid Flux."

Because of its activity in effecting the wetting of the joining surfaces, this flux, in many cases, contributes to easier soft solderings of metal combinations which heretofore have been considered difficult to solder.

Another advantage in many soldering operations, as on electrical and radio equipment, is the absence of injurious deposit at the joint. The acid action of the flux as it comes from the container is neutralized at ordinary soldering temperatures, when properly used, leaving a residue that is normally non-corrosive, non-conductive to electricity, non-hygroscopic, and easily soluble in water.

The manufacturer claims that if the work piece is well washed with water all corrosion-forming residues will be permanently removed.

This new flux is recommended by its manufacturer particularly for applications where rosin-alcohol is unsatisfactory or where zinc chloride or similar strong acid fluxes cannot be used because of the corrosion factor. It may be used in soldering copper, steel, silver, brass, various alloys, and electroplated parts.

BRUSH HOLDERS

Raise Utility of Small Wire Brushes

RELATIVELY small, versatile brushes, that hold promise of easing manufacturing bottlenecks by speeding up hard-to-get-at jobs utilize the principle of wire suspension under pressure. Equipped with a variety of holding tools for use in drill presses, bench grinders, and special production and deburring tools, the crimped wire Situft power brushes are available in a variety of sizes. Outside diameters range from 1/4 inch to 1 1/4 inches, brush face lengths from 9/16 inch to 5/8 inch, stem sizes to fit 1/16, 3/32, and 1/8 inch chucks, and overall lengths from 2 1/8 inches to 2 1/4 inches. The gage of wire used ranges from .003 to .005 inch.

Special holders, designed for these brushes, increase their adaptability and frequently permit stock brushes to be used so as to contact definite surface areas regardless of their shape. The

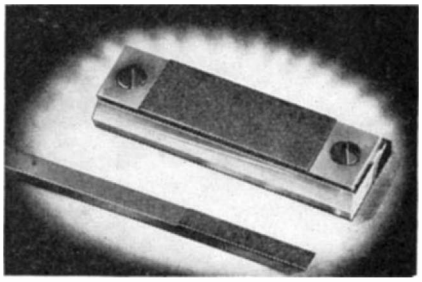
Above: Simultaneous brushing of two inside diameters. Below: Removal of drilling burrs from intersecting holes in "hard-to-reach" spot in small part

variety of applications is suggested by the range of motor speeds—500 to 25,000 revolutions per minute—recommended by the developers, The Osborn Manufacturing Company. Some typical uses for the brushes are removing insulation, rust, mold marks, and heat scale in addition to production operations requiring deburring, cleaning, or finishing small diameter inside surfaces.

FILES AND HONES

Impregnated With Diamonds In a Metal Bond

DIAMOND files and hones, as produced by Wendt-Sonis Company, for dressing carbide cutting tools without removing them from the machine, contain a concentration of diamonds in a new metal bond. This bond assures that they will maintain a flat surface throughout their service life. As a result, the tools sharpened do not become "grooved." It is claimed that these diamond impregnated files and hones can be used on high speed steels without loosening the diamond particles.



Hones stay flat without grooving

The file shank is made of drill rod stock and the hone is mounted on a lucite base.

PLASTICS LENSES

Offer Advantages Over Glass

LENSES, prisms, and other optical elements of plastics instead of the customary glass, are now mass-produced by pouring fluid plastics of molasses-like consistency into precisely surfaced glass molds. An oven-baking operation then hardens the plastics which reproduce exactly the surface precision of the molds in which they are cast. When removed from their molds, the plastics elements are ready for use, without extensive polishing operations.

Unlike glass optics, the new materials and production techniques are suited for large, non-spherical optical parts, usually employed in optical systems where the light lost in transmission must be kept to a minimum. Of 140 organic plastics investigated by the Polaroid Corporation in plastics optical research, two were standardized and put into manufacture. One was methacrylate, corresponding in its optical characteristics to crown glass, and the other was polystyrene, used for elements ordinarily made from flint glass. Lenses, prisms, and mirrors from these homogenous, tough materials, although more easily scratched than glass, weigh only about half as much as glass and are easy to produce rapidly and in large quantities; substantially free of color, haze, and strain; and stable under extremes of temperature.

HIGH-STRENGTH MAGNETS

Boost Performance; Lower Power Needs of Many Devices

MAGNET steels, including all types of "hard" and "soft" magnets, magnetic and non-magnetic alloy steels, and permanent magnets in every practicable shape and size will be available to manufacturers and engineers as the result of new manufacturing facilities added by the Allegheny Ludlum Steel Corporation.

In announcing the magnets, the company stated that the advantages to be gained in using high-strength magnets in preference to magnets of lower residual magnetism and coercive force are: improvement in operating performance of equipment; reduction, or sometimes avoidance, of energizing coils and current; and reduction in size and weight of equipment, which often results in substantially reduced costs. Alnico and other strong magnets are also many times more stable than lower strength magnets under the influence of heat, vibration, stray magnetic fields, and time.

In aircraft, permanent field magnets are used on many remote-controlled motors, thus not only reducing size and weight of motors but also reducing or

eliminating the electric power required for energizing the field magnets.

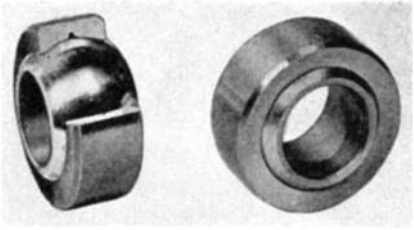
Similar advantages are gained in portable radio loud speakers and hearing aid receivers, for example, where strong magnets can be utilized to reduce the battery power required, as well as the weight and size of these products.

Although the greatest demand for "hard" permanent magnets will be by manufacturers of electrical and electronic equipment, they have become increasingly useful in non-electrical products. These now include magnetic chucks, holding devices, clamps, damping devices, clutches, magnetic separators, coin operated machines, lubricating oil filters, and so on.

SPHERICAL BEARING

Meets Alinement and Rigidity Demands

A TWO-PIECE self-alining bearing, intended to provide extremely high load capacity, a high degree of mis-alinement, and a large projected bearing area, is now being manufactured from a one piece bronze outer race into which is pressure-inserted a hard-



Steel ball rides in bronze outer race

chrome plated steel ball. The Halfco spherical bearing can be used for engine controls, aircraft, or in similar installations where alinement is costly or impossible to attain, or wherever rigidity is essential.

ENAMEL STRIPPER

Removes Various Types Of Surface Coatings

SYNTHETIC enamels such as alkyds, melamine, urea formaldehyde, and other coatings are readily stripped with Enthone Enamel Stripper S-300. The product can be used full strength at room temperature or diluted with water and the mixture heated in the temperature range of 150 to 180 degrees, Fahrenheit.

Enamels are stated to be removed cleanly by a wrinkling action, leaving the work clean and bright. There is no attack upon the base metal and such active metals as aluminum, zinc, and tin are unharmed. Phosphate and anodized coatings are not cut by this stripper.

"A" BRACE

Weighing 7½ Pounds Supports Two Tons

WEIGHING only seven and one half pounds, a new "A" shaped brace can support two tons, is chemically inert,

Bonded glass cloth brace

radio transparent, and fungus resistant. Composed of layers of glass cloth bonded by American Cyanamid Company's Laminac and manufactured by Fibremold, Inc., the brace is used in the construction of heavy radar installations. Other requirements called for in the radar brace are shock and vibration resistance and high flexural and tensile strength.

DRY-ICE LIQUEFIER

Has a Capacity Of 1000 Pounds

SOLID carbon dioxide is transformed into liquid form in a new unit developed to assist bottlers of carbonated beverages, users of carbon dioxide fire extinguishers; and other carbon dioxide consumers. Known as the "Jumbo," and developed by the Mathieson Alkali Works, the liquefier consists essentially of a tank, 80 inches high and 34 inches in diameter, made of special steel and welded throughout. It has a capacity of 20 full-sized blocks, or 1000 pounds, of dry ice. The use of uncrushed blocks of dry ice saves labor and reduces evaporation loss, it is claimed.

To charge the liquefier, the blocks of dry ice are dropped through the 15-inch circular opening at the top. It is then closed, water is run down the outside surface from a perforated ring near the top, and the liquefier is ready for operation.

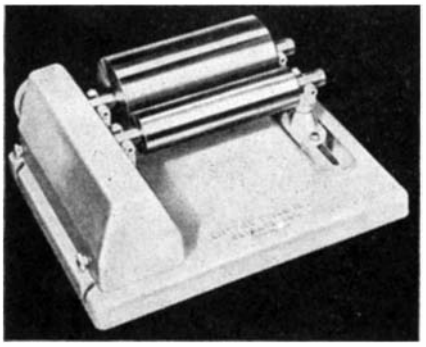
In addition to its large capacity, special features claimed for the Mathieson liquefier are: absence of moving parts; long life of the special molded gasket due to the easy operation of the closure head; and operation without compressor and refrigeration unit, electric heating coils, or sensitive control equipment.

PIN LAPPING

Simplified by Two-Roller Machine

SIMPLIFYING and speeding up the heretofore slow and tedious job of lapping and polishing round plugs, pins, or rods, the "Spitfire" roller lapping machine does the job accurately and with a minimum of rejections, reportedly turning out finished jobs in approximately one third the time necessary with the old "ring lap" method. The machine consists of two precision ground cast iron rollers which revolve in self-alining and adjustable bearings. One roller is approximately three inches in diameter and the other roller is approximately six inches in diameter. Both rollers rotate in the same direction (away from the operator at the top of the rollers) at the same speed. They are easily adjusted to accommodate work up to six inches in diameter.

In using the Roller Lapping Machine, the most economical procedure is to grind the plug or pin within .0002 to .0004 inch of the desired size and then lap to size. Abrasive compound is placed on the rollers with the fingers or a brush and spread evenly over both surfaces. The work is placed between the rollers; then a notched fiber stick is pressed down on it and moved slowly and evenly from side to side across the



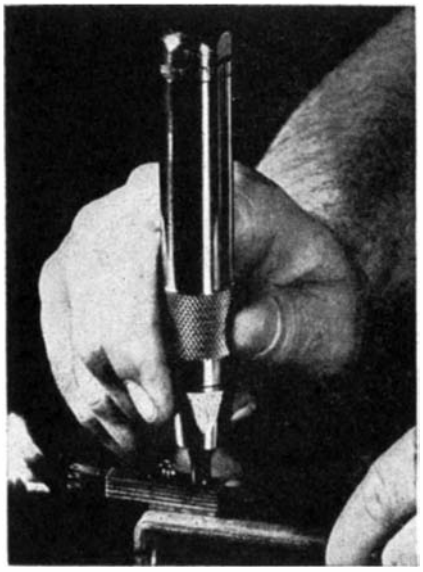
Speed-difference gives lapping action

plug or pin. If it is necessary to lap a small amount off any particular section of the plug or pin, the fibre stick is merely kept longer on that section. Friction of the rollers on the plug causes it to revolve and the difference in the surface speed of the rollers brings about a lapping or polishing action. Tapered plugs or plugs with shoulders are handled with equal ease.

POWER SCREW DRIVER

Sets Small Screws or Nuts

NEWEST addition to the Aro line of pneumatic production tools is the Midget Pneumatic Screw Driver. This tool, said to be the first power screw



Starting and stopping are automatic

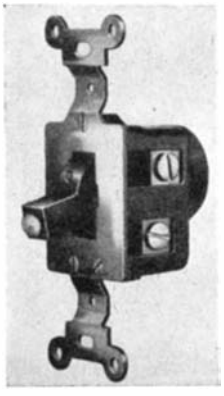
driver designed especially for driving small screws, is about the size and shape of the average cigar. Its capacity includes screws from No. 1 to No. 6. It weighs only eight ounces, is 4⅞ inches long and ¾ inch in diameter, and is fully automatic; it starts automatically when tool is applied to the work and adjusts itself to every driving condition.

It has a rotary four-blade motor, with ball bearings throughout, and a hardened and ground steel rotor and cylinder. This tool is also available with adapter socket for nut setting.

DELAY SWITCH

Cuts Power or Light After Set Interval

A TOGGLE-LEVER all-purpose light or power switch which offers both delayed-action and instantaneous "off," plus a time-selector for the delayed action, can be set at any interval from zero to three minutes. Featuring a phosphorescent lever tip, the new switch, called Tymzit and developed by the T. J. Mudon Company, provides light for almost any interval after actual movement of the toggle to the "off" position. Yet whenever desired,



Fits standard box; has no clockwork

power or lights can be turned off instantly by a slight continuing downward push of the lever. No clockwork or electrical elements are used in the set-screw-adjusted action-delay.

Filling a wide range of needs, the new switch could, for example, be located in the garage so as to provide time to walk into the house before the lights go off.

Described as conforming to Underwriters Laboratories specifications, the switch fits any standard wall box; is offered in single and double pole assemblies; and is rated at 10 amperes at 125 volts and 5 amperes at 250 volts.

HOOD SEALER

Caps Bottles of Various Sizes

CELLOPHANE or parchment bottle hoods, printed in different colors, are sealed over the tops of both square and round milk bottles at the rate of 90 per minute by an automatic machine that incorporates a variety of mechanical improvements. Included in the developments is a star wheel which

The Editors Recommend

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

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

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

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

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

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

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

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

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

EXPERIMENTAL ELECTRONICS — *By Ralph H. Muller, R. L. Garman, and M. E. Droz.* A solid book of eminently practical information on the characteristics and non-communication applications of electron tubes. The text describes experiments and presents results. For students, radio engineers, communications experts, and the serious general reader. **$4.75**

THE MEANING OF RELATIVITY —*By Albert Einstein.* Second edition with added chapter describing advances since publication of first edition some 25 years ago. Requires knowledge of advanced mathematics and physics; not a popular exposition. **$2.10**

THE MODERN GAS TURBINE — *By R. Tom Sawyer.* Fundamental treatment, yet comprehensive in scope, covering industrial, marine, railroad, and turbo-supercharger applications of the gas turbine. Up-to-the-minute data on jet propulsion are included. **$4.10**

A PRACTICAL COURSE IN HOROLOGY — *By Harold C. Kelly.* Definite, outright, practical instructions on watch making, repairs, and adjustment. **$2.85**

Best Sellers In Science

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

MEET THE ELECTRON — *By David Grimes.* Readers who lack specialized knowledge can inform themselves thoroughly from this book as to what electronics is and what it can do in specialized applications. **$2.10**

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

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

PLASTICS, PROBLEMS AND PROCESSES — *By Mansperger and Pepper.* The whole story of plastics, including a resume of manufacturing processes and a number of thorough-going chapters devoted to plastics uses. **$3.10**

THE FUNDAMENTALS OF CHEMISTRY — *By Monroe M. Offner.* This text introduces the reader to elements, electrons, acids, alkalis and so on, and then covers chemistry and its relationship to everyday life. **80 cents**

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

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

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

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

TRIGONOMETRY FOR HOME STUDY — *By William L. Schaaf, Ph.D.* Extensive and detailed, giving explanations as the text progresses, together with numerous practical applications of trig, such as machine shop problems, surveying, navigation, and so on. **80 cents**

COMMERCIAL WAXES — *Edited by H. Bennett.* Solid treatise on the commercial use of both natural and synthetic waxes, made up of contributions of many leading individuals and firms. All classes of waxes and their properties, sources, and uses are discussed. **$11.10**

• **(The above prices are postpaid in the United States. Add, on foreign orders, 25¢ for postage on each book, except as noted.)** •

(All prices subject to change without notice.)

For Sale by: **March, 1946**

SCIENTIFIC AMERICAN, 24 West 40th Street, New York 18, N. Y.

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separates the bottles as they are conveyed from a filling machine and places them in individual pockets for a feed wheel at the correct time.

New also are a paper feed unit and the tape applicator which gives more clearance for various size bottles. The machine, made by Package Machinery Company, automatically takes bottles of minor variations and is easily adjusted to half-pint, pint, quart, and two-quart sizes.

BLADE HOLDER

Accommodates Hack Saw Blades or Thin Files

DESIGNED to cut down the discard of broken lengths of hack saw blades, the Super Blade Holder, distributed by A. D. McBurney, also accommodates thin flat file sections. By using the Super Hack Saw Blade Holder, workmen of all kinds can find a multitude of uses for their old or broken cutting blades.

Blades are gripped firmly

The holder is a single unit tool composed of a tubular handle with an extended positive grip nose for securing the working point of the blade or file. The ends of the handle are slotted to receive inserted blades. Almost any length blade can be held securely.

Many workmen make their own knives or scrapers by grinding old blades to shape. The Super is an ideal handle for these tools. In addition to saving expensive material, the Super simplifies many operations and is suited for tool and die making.

CIRCUIT TESTER

Can be Carried in Vest Pocket

FOR ALL who have to do with electricity, an all-purpose circuit tester which can be easily carried in a vest

Provides quick check on circuits

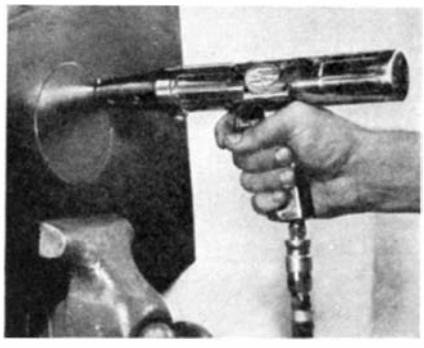
pocket will prove handy when testing radio plate circuits, screen grids, spark plugs, meters, electrical appliances, fuses, and so on. Made by Amerline, it indicates voltages from 90 D.C. and 60 A.C. to 500 volts A.C. or D.C. A neon lamp on top glows in varying intensities, indicating circuit conditions.

AIR-OPERATED SAW

Performs Difficult as Well as Simple Jobs

DESIGNED to simplify and speed-up most sawing and filing operations, a new Air-Speed tool can be worked advantageously in awkward or cramped quarters or from difficult positions. An adjustable barrel readily permits circular sawing in metals or woods, as well as difficult "dead end," keyhole, or scroll work. Perfectly balanced for ease of handling, and weighing only 3½ pounds complete, the new tool features finger-tip speed and power control, and a simple cutting stroke adjustment of from ¼ to 1¼ inches.

No gears, adaptors, or power take-off



Finger controls saw speed and power

devices are used in the construction of the Air-Speed saw, and since only two internal operating parts are movable, long, reliable, trouble-free service is assured. The saw operates best with approximately 85 pounds pressure maintained at the tool.

SHIP MOTORS

Assured Pure Cooling Air with Electronic Unit

AN ELECTRONIC moisture detector that offers protection against salt water attack for the electrical driving motors of ships appears to solve an old problem involving the enclosed cooling systems for the driving motors. Ventilating air in these systems is cooled by passing over steel pipes through which cold sea water is flowing. Occasionally, these pipes develop leaks, and since the system is enclosed the leaks go unnoticed until the salt water damages the motor windings.

The electronic moisture detector, credited to General Electric Company engineers and said to have stemmed from experiments with a pipe cleaner, consists of porous glass tape wrapped around a metal tube with stainless steel wire wound around the tape so that an interval appears between each turn of the wire. Connected to an electrical relay, the circuit is energized

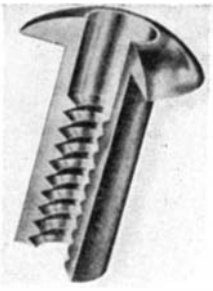
whenever moisture to a predetermined degree is absorbed by the glass tape.

The device will be installed on ships in such a manner that any leakage from the cooling system's water pipes will collect on the glass tape. When a certain degree of saturation is reached, the circuit will close and a warning will be sounded outside the enclosed cooling system.

RIVNUTS

Made of Steel to Broaden Applications

A ONE-PIECE internally threaded and counterbored tubular rivet which can be upset or headed from one side with a simple tool and can be used as a blind rivet, nut plate for attachment,



Section of brazier-head Rivnut

or both, is now being made in steel. Originally made only in aluminum, and then also in a brass alloy, extension to steel will allow much greater utilization of the product. The aluminum Rivnut, as it is called, was initially used for airplane industry applications, but the field has been broadened to include many other services.

The new standard steel Rivnuts, developed by The B. F. Goodrich Company, are made in 6-32, 8-32, 10-32, 12-24, ¼"-20 thread and 5/16"-18 thread. They can be made in special sizes on order.

PHOTO CELL

Protects Operator of Boring Machine

THE BORING tool shown at the right in the accompanying photograph won't move in to finish bore the inside diameter of the blank for a high-precision Cone-Drive gear mounted on a universal faceplate in a Simplex Boremetic at Michigan Tool Company, as long as the alining plug is in position or even while the operator is removing the plug. The light beam to the photoelectric cell is interrupted by this plug, the circuit being so arranged that the machine cannot be started while the plug is in place. The arrangement prevents possible injury to both hands and equipment through accidental starting of the machine.

Safety promoted by photo cell

AIR DUCTING

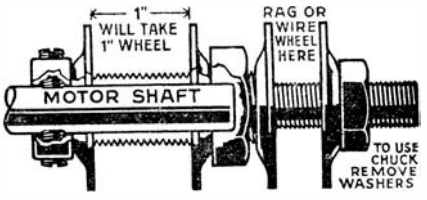
Resists Vibration and Temperature Changes

GLASS cloth and rubber are combined to provide high insulation qualities and unusual flexibility in a ducting material developed for use where vibration is present. Capable of withstanding temperatures from minus 60 degrees, to plus 300 degrees, Fahrenheit, and of working at over 50 pounds per square inch internal pressure, Airtron ducting is unaffected by air, light, water, gasoline, oil, and all but concentrated mineral acids. Manufactured by Arrowhead Rubber Company in tubes from one inch to six inches in diameter and in any length or specialized shape, the ducting is adaptable to many uses involving the transfer of hot or cold air such as in plane, train, or automobile heater installations.

MOTOR ARBOR

Gives Firm Support for Grinding Wheels

FOR half-inch electric motor shafts, a combination attachment arbor designed to take grinding wheels with



Two shaft sizes in one arbor

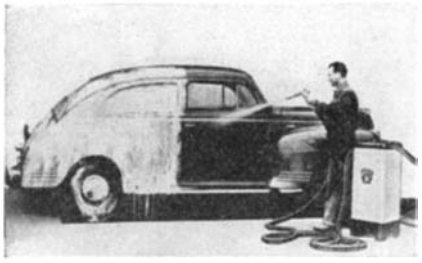
¾ inch holes on the main shaft, or ½ inch holes on the small end, can also be used for rag or wire wheels, circular saw blades, or ½ inch 24-thread drill chucks.

The main advantage of the super Arbor is that it fits well over and onto the main motor shaft. A one inch grinding wheel is thus mounted directly on the main shaft and not out on the arbor extension which eliminates the possibility of "whipping" and dangerous disintegration of the grinding wheel. Super Arbor is made by A. D. McBurney.

CAR SHAMPOO

Speeded by New Pressure Unit

DISPENSING Turco car shampoo—a rich, non-soap foam with an outstanding cleansing action—pressure units are



Unit at right dispenses shampoo

now available in an improved Senior Deluxe Model, as well as a specially designed unit for fleet operators, which greatly increases wash-rack output and at the same time provides a scientific cleaning method that gives a brighter finish to a car than the ordinary wash job.

Built into the cabinet of the Turco Shampoo Unit is an automatic proportioning and mixing device which blends the shampoo with water and air to produce a rich, effective foam. Turco Trigger Action Control supplies either light or heavy cleaning foam, or air and water rinse, from a single nozzle.

WAX IN PLASTICS

Aids in Manufacture and Improves Quality

ADDED in small percentages to plastics, synthetic rubber, and like compounds, a high-melting synthetic wax is reported to improve anti-tack, anti-block, and mold-release characteristics. Similar results are also said to be obtained in coating operations involving such substances as vinyl chloride-acetate co-polymers, polyvinyl butyrals, and nitro-cellulose.

Called Acrawax C by its manufacturers, Glyco Products Company, Inc., the wax is used in finely powdered form. A raised melting point for hot melts of sealant, impregnating, and potting compounds, and increased moisture resistance in the final product are listed as other advantageous features of the synthetic wax additive.

DRAFTING PENCIL

Holds Lead in Rubber Grip

A REFILLABLE draftsman's pencil, designed to eliminate the annoyance of broken lead, is constructed on an entirely new principle. A clutch holds the lead firmly in a non-slip rubber grip that prevents the usual knicking and scoring of lead which cause breakage.

Lead is protected by rubber clutch

Light in weight and properly balanced, this new Bruning refillable draftsman's pencil has a long barrel which permits the use of any full length standard drafting lead, from .079 to .070 inch in diameter. The grip is knurled to provide a firm hold. The tapered point and grip merge smoothly with the lead, offering greater finger comfort. An adjustable cap provides easy identification of the degree of lead used.

MAGNIFIER

Gives Binocular Vision; Fits in Pocket

LIGHT in weight, a new binocular magnifier, known as Twin-Reader, may be carried in the pocket or purse. The matched and balanced lenses, of fine optical glass, afford third-dimensional vision with true perception of depth and triple the field of observation over the old type one-lens "readers" or other magnifiers.

Pocket binocular reading glass

The Twin-Reader is made in four different powers of magnification and focal lengths.

KNURLING TOOLS

Use Carboloy Pins To Advantage

USE OF small Carboloy pins, in place of the conventional steel pins formerly employed to mount knurling tools in their holders, has enabled one manufacturer to virtually eliminate tool maintenance on a knurling operation, in addition to increasing tool life at least 100 times. Originally the pins which held the knurl rolls in place in the knurl holders were made of either high speed steel, S.A.E. 3140, or drill rod, but extremely high starting pressure caused the steel pins to wear rapidly and sometimes to jam and ruin the workpiece. Standard precision boring bit blanks of Grade 883 Carboloy, which combines high wear resistance with toughness, were substituted for the original pins with the result that no further trouble was encountered from rapid wear.

CURRENT BULLETIN BRIEFS

Conducted by K. M. CANAVAN

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

ENCYCLOPEDIA OF BUSINESS INFORMATION SOURCES. Covering every important phase of industry, government, agriculture, and commerce, this encyclopedia contains over 7000 listings of basic information sources under 222 classifications as an aid to executives in locating business information sources quickly. This encyclopedia comes in two volumes, loose-leaf, is master-indexed, and arranged under 24 major classifications. *The National Research Bureau, Inc., Department SA-3, 415 North Dearborn Street, Chicago, Illinois.—$60.00.*

EVERYDAY PLASTICS, a 32-page consumer guide, tells the story of the plastics industry. Simply written, it tells what plastics are, how they are made, and for what they may be used. *Modern Plastics Magazine, 122 East 42nd Street, New York 17, New York.—Gratis.*

FOREST PRODUCTS RESEARCH GUIDE. Aimed at coördinating forest products research, this 142-page catalog lists 460 types of fundamental and applied research. Types of investigations are described and the names and addresses of individuals and organizations conducting them are given. Foreign agencies are also listed. *American Forest Products Industries, Inc., 1319 18th Street, N. W., Washington 6, D. C. —$2.00.*

FROZEN FOOD LOCKERS is one of a series of leaflets describing opportunities, training requirements, entrance, advancement, advantages, and disadvantages in various occupations. *Occupational Index, Inc., New York University, New York 3, New York.—25 cents.*

WHERE DO WE GO FROM HERE? is a 16-page outline of an engineering graduate training course which coördinates shop and office work in a program designed to fit individual aims and abilities. Request Booklet E6085-A. *Allis-Chalmers Manufacturing Company 569, Milwaukee 1, Wisconsin.—Gratis.*

ELECTRICAL INSTRUMENT CATALOG. This 28-page booklet presents descriptions of standard and hermetically sealed electrical indicating instruments, with a special section to guide prospective purchasers. *Marion Electrical Instrument Company, Manchester, New Hampshire.—Gratis.*

PLANE PORTRAITS. This 28-page booklet outlines the chemical processes and materials which are available for solving the following industrial problems: corrosion prevention, paint removal,

preparation of aluminum surfaces, engine overhaul, surface coatings, and the cleaning of transparent plastics. *Turco Products, Inc., 6135 South Central Avenue, Los Angeles 1, California.—Gratis. Request this booklet on your business letterhead.*

THE ATOM OF BERYLLIUM, a four-page folder, outlines the advantages of industrial applications of beryllium. Also described are beryllium metal, beryllium copper alloys, beryllium nickel alloys, special beryllium alloys, and beryllium oxide as a high-temperature refractory. *The Brush Beryllium Company, 3714 Chester Avenue, Cleveland 14, Ohio.—Gratis.*

SPOT CONVEYING is an eight-page bulletin discussing the new improved power-flex unit system, its details, complete specifications, and data. *Island Equipment Corporation, 101 Park Avenue, New York 17, New York.—Gratis. Request this bulletin on your business letterhead.*

CONTRACTOR'S PUMP MANUAL contains information on portable pumps, serves as a guide to pump users in construction, mining, and industrial fields, and describes four types of portable pumps. *Associated General Contractors of America, Munsey Building, Washington 4, D. C.—50 cents.*

SPECIAL MACHINE TOOLS FOR DIESEL ENGINE METAL WORKING OPERATIONS, a 48-page booklet, was written primarily for the Diesel field, but will be of interest in other fields using metal working operations. Illustrations and cross-sectional views show machines built for multiple machining operations on Diesel engine components. *W. F. and John Barnes Company, Advertising Department, Rockford, Illinois.—Gratis. Request this booklet on your business letterhead.*

SPEED-UP TOOLS AND EQUIPMENT illustrates and describes, in 88 pages, a wide range of industrial products, including motor maintenance equipment, industrial electrical equipment, variable speed transmissions, machine tool accessories, and wiring devices and tools. Request Handbook Number 143A. *Ideal Commutator Dresser Company, Sycamore, Illinois.—Gratis.*

RESISTANCE WELDED is an illustrated booklet which outlines in 16 pages various equipment for steel container making. A two-page sketch shows the Federal plant with various departments and their relation to each other. *The Federal Machine and Welder Company, 212 Dana Street, Warren, Ohio.—Gratis.*

CONE-DRIVE IN MACHINE TOOLS, an eight-page bulletin of special interest to men engaged in designing and purchasing tools, is based on the advantages of cone-drive double enveloping gearing and how it is used to take advantage of its high load capacity and greater compactness. *Michigan Tool Company, 7171 East McNichols Road, Detroit 12, Michigan.—Gratis.*

Our Book Corner

THE BOOK DEPARTMENT of Scientific American is conducted with the cooperation of the Editors, to make available for you a comprehensive book service. Each month the Editors select and review in these columns new books in a wide range of scientific and technical fields. In addition, they are ready at all times to advise you regarding the best available books on any subject. You are invited to use this service freely. Tell our Book Department what kind of books you want, and you will be furnished with the names of available books, including prices. When inquiring about books, please be specific; remember that we can be of the greatest help only when you tell us just what you are looking for. Books listed in these columns may be ordered from our Book Department. Add 25 cents per book for mailing outside U. S. All remittances are to be made in U. S. funds. Prices given are subject to change without notice.

TO MAKE CERTAIN that books ordered by or for men in the Army, located in the United States, or men in the Navy, Marines, or Coast Guard, located anywhere, will be delivered, insurance fees should be sent with orders, as follows: To $5 in value, 3¢ additional; from $5 to $25, 10¢; from $25 to $50, 15¢.

MAJOR INSTRUMENTS OF SCIENCES AND THEIR APPLICATIONS TO CHEMISTRY

Edited by R. E. Burk and Oliver Grummitt

FOURTH member of the Western Reserve University series, Frontiers in Chemistry, this book provides an easy and practically painless method of bringing oneself up to date on the latest contributions of instruments to the science of chemistry. The extraordinary impact of each new instrument on the advance of our knowledge in any field has been often remarked and frequently emphasized. Recent additions to our scientific armamentarium of electron diffraction, the electron microscope, X-ray diffraction, and the various modern divisions of spectroscopy have left many chemists, deeply involved in other things, far behind the advancing front of their science. This little book contains six papers by five outstanding leaders in this important field overlapping between physics and chemistry. The authors are: L. H. Germer, Bell Telephone Laboratories; L. Marton, Stanford University; Maurice L. Huggins, Eastman Kodak Co.; Wallace R. Brode, The Ohio State University; and R. Bowling Barnes, American Cyanamid Company. (149 pages, 6 by 9 inches.)—$3.60 postpaid.—*D.H.K.*

OPTICAL INSTRUMENTS

By Earle B. Brown

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Telescoptics

A Monthly Department for the Amateur Telescope Maker

Conducted by ALBERT G. INGALLS
Editor of the Scientific American books "Amateur Telescope Making" and "Amateur Telescope Making—Advanced"

NOT, as a reader once assumed in a letter, merely to tickle the vanity of their builders, have descriptions of telescopes made by readers of this department and of the two "A.T.M." books been published for years in this department, but because such descriptions offer original or interesting design features from which other builders may glean practical ideas. An advanced amateur (H.P.) recently wrote this department: "Looking back, my biggest help has been from the close study of a wide variety of clear photographs of other amateurs' work." Another amateur (S.L.) writes, "I like a plentiful supply of new ideas, wrinkles, and descriptions of all kinds, with many photographs." And W.W., whose telescope was described in this department last month, writes: "During its construction I often thought how helpful it would have been to have seen a collection

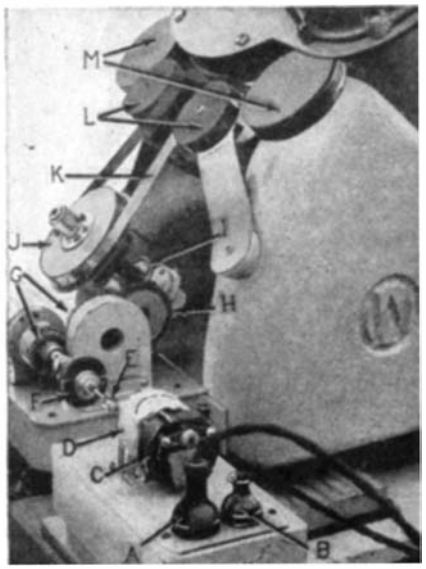

Figure 1: Inexpensive telescope drive

of photographs of instruments as built by other amateurs. I have wondered whether there might not be a place for a book containing reprints of such descriptions, from other numbers of 'Telescoptics' than I have seen, so that the various ingenuities could suggest possibilities to those who were in the process of planning."

"W.W." is Warner Williams, Culver, Indiana, and at our suggestion he has now prepared a close-up photograph (Figure 1) of the driving mechanism of his telescope. "For the amateur," he writes, "this type of drive seems ideal because it does not require special cut gears to obtain a precise speed, this being taken care of through the ability to choose any desired speed by making the wooden pulley *J* of required size, simply by turning it down to that size on a lathe." Williams' drive might most aptly be characterized as: (1) made from odd gears and elements picked up around home rather than sent away for, and (2) inexpensive.

A is the current supply.

B is the control cable leading to the hand. Switch at end.

C, motor, 3500 r.p.m., Dayton Electric Co., Chicago.

D, back gear. Reduces speed to ½ r.p.m.

E, universal joint. Dispensible.

F, leather coupling.

G, 2-to-1 spur gears from an old magneto.

H, 2.2-to-1 spur gears. The smaller of these is behind and attached to the larger gear at *G*.

I, worm gear, 50-to-1. From an old airplane carburetor.

J, drive pulley (wooden) turned to the size which gives final desired speed.

K, steel driving tape sliding on this pulley serves also as a friction clutch. This is especially convenient because it requires no manipulation at any time. The tube may be turned at will, without stopping the motor, yet when released by the hands it starts following at once.

L, idler pulleys to carry steel tape around the roller bearings, *M*, which carry the expanded polar axis. These are held in tension by means of a spiral spring attached to the respective pivoted arms which carry them.

THOUGH at first glance the telescope shown in Figure 2, made by Arthur W. Sear, 550 Windsor Ave., Stratford, Conn., appears conventional, it embodies eight interesting features to which ye ed will call attention by italicizing their key words in Sears' description, which follows: "Optically, the telescope is a conventional 6", *f*/8 Newtonian. My son is shown posing at the ocular and is holding the *control box* in his hand. The boy is nearly six feet tall, which will give a measure of the mount.

"*Detachable handles*, inserted through openings and guides, are used to wheel the telescope, wheelbarrow fashion on its 10" rubber-tired wheel, from the garage to a convenient location. Removing the handles after the telescope is adjusted eliminates the danger of tripping over them in the dark. The power cord is long enough to permit setting up the telescope in *any part of the lawn*. The mounting is not excessively heavy and has a high degree of rigidity. The *leveling screws* could easily be a source of lateral wobble but this has been prevented by having the screws push down against a sturdy A-frame which is hinged along the base of the triangle, thus giving *diagonal bracing*.

"In order to point the telescope accurately it is essential to have the polar axis properly oriented. To permit setting it up quickly I have permanently attached a small *auxiliary telescope* just above and parallel to the polar axis This auxiliary telescope has a special home-made reticule with a small circle 1° away from the center of the reticule. The offset is very nearly equal to the declination of Polaris. A long-focus ocular permits insertion of a prism diagonal between reticule and eyepiece. This makes for easy use without inverting the image at the reticule If the reticule sleeve is turned so that the markings on the sleeve indicate local sidereal time, it is only necessary to jog the mounting around and adjust the leveling screws until Polaris appears in the center of the offset circle The accuracy of alining the telescope by this method is perhaps within 5 minutes of arc, so that the probable error is well within practical limits Setting up the telescope requires only a couple of minutes and the method permits accurate orientation of a portable telescope.

"A type CZM Telechron motor housed in the square box drives the polar axis at sidereal time and works with negligible error through a gear combination of (51x79)/(49x82), which is equivalent to the ratio given on page 322 of 'A.T.M.A.' The polar axis drive includes a differential gear so that a small reversible motor can be switched on and off to move the telescope slowly in right ascension, for *scanning slowly over an area of the sky*, without interfering with the sidereal drive. The box mounted on the declination axis contains a similar reversible motor for scanning north and south. The scanning motors drive the telescope at approximately 6° per minute. This speed is a little fast for the highest power eyepieces but is perhaps a good com-

Figure 2: Sears' semi-portable mount

promise when the low powers are considered. Friction clutches on both axes slip when the tube is pushed by hand from one part of the sky to another. The scanning motors are controlled by switches in a small box at the end of a 6' cable. A small electric lamp with a red lens is located *in the end of the control box*. This lamp is convenient when reading the scales or making notes. The red light does not seem to disturb the adaptation of the eyes to darkness.

"The floating R.A. circle sidereal drive system ('A.T.M.', page 145) simplifies the problem of finding a sky object. The right ascension circle is mounted on a sleeve that is free to turn on the polar axis. The sleeve and circle are driven through an independent worm gear at sidereal time. If the right ascension circle is once set so that its position is correct it will follow the stars as long as the power is turned on. Two pointers, 180° apart, are rigidly attached to the polar axis and are adjusted so that when the telescope is pointed straight up one of the pointers will indicate local sidereal time on the R.A. circle. Or, if the telescope is turned to any part of the sky, the pointer will indicate the R.A. of that direction.

"The oculars are individually mounted in adapters which *plug into* the main fixture, similar to automobile lamps. Each eyepiece is focused by sliding it in its adapter where it is clamped in place. The eyepieces can be changed quickly and they are *automatically in focus* when they are plugged in—parfocal is, I believe, the correct word for the arrangement. A micrometer screw on the main fixture permits the user to adjust the focus for his individual eyesight.

"The polar and declination axes run in ball-bearings. The big-end bearings are 1¼" in diameter, the small-end bearings approximately ¾". The housings are of cast bronze.

"I polished and figured the mirror several times and it is as nearly perfect as I can make it. With a 1/3" eyepiece the out-of-focus rings of a bright star look very much like Figure 23 on page 429 of 'A.T.M.', excepting that the diagonal covers the center. Once, on a good night, I easily split a 1.2" double and believe that I could almost reach the theoretical limit of .75" for this sized mirror, under perfect conditions.

"The tube of the telescope does not show up well in the illustration but is quite handsome. It is a 7" inside diameter plywood tube obtained from the Plymold Corporation, Lawrence, Mass. It is light, strong, easily worked with wood-cutting tools, and has a *beautiful natural wood finish*. The low heat conductivity of plywood is also desirable. I installed a small door in the side of the tube near the mirror so that I can place a dust cover over the mirror when it is not in use."

SILVERING is not extinct and quite a few independent-minded users of reflecting telescopes still silver their mirrors. The old types of lacquers for protecting them did not meet with wide acceptance but now, in *The Journal of the British Astronomical Association* (Vol. 54, No. 7) F. J. Hargreaves describes experiments with a lacquering solution of Perspex, a synthetic resin plastic. This was found to be soluble in butyl acetate and excellent results were obtained with a 0.5 percent solution. The Perspex was added little by little, in finely divided form (fine filings), and stirred often to prevent agglomeration. It swells up till it occupies the whole volume of the solvent, several days being required for the solution. Attempts with amyl acetate as a solvent gave too gelatinous a solution.

The mirror was set on a phonograph turntable, flooded with the solution and kept turning until dry, the ridge of fluid at the edge being kept blotted up with a dab of blotter during rotation.

Perspex is British and, so far as is known, is not easily available in this country, but the methyl methacrylate resin Lucite is suggested as an equivalent.

Hargreaves states that the coating he obtained with Perspex had no adverse affect on mirror performance after some months. On the other hand, your scribe learns that one large American laboratory, attempting to find a lacquer for protecting silver mirrors, ran into such difficulties with black spots on the silver coating caused by the reaction of sulfur or sulfur compounds in the film-forming material used, or else in the solvent, that the investigation was abandoned. Unless there is some other answer, this seems to leave F. J. Hargreaves of England smarter than the Yankee laboratory in question, and some reader therefore may wish to appoint himself a committee of one to dig farther into the matter and report findings. There must be some lack of equivalence somewhere.

ADVERSITY has sharpened the wits of two amateurs, one a youth of 17 with a non-functional arm (polio) who made a mirror with one arm, the other who has pushed his mirror disk back and forth interminably by means of his shoulder muscles working against boards tied to his non-functional arms (polio) as stiffeners and pushers.

Several advanced amateurs recently presented the first with an RFT made jointly but still he goes ahead, one-armed making a 4" mirror because he wants to have a variety of telescopes the same as others and because he wants to succeed. Mountings are more of a problem.

One hesitates between the probably rational advice of a TN friend who has had experience with the handicapped and says it is not altogether bad for them to work out their own salvation, and the belief that dark and dusty corners the nation over must hide telescopes more or less set aside because they have been superseded by the latest loves.

INQUIRY RECEIVED—"Do you know of anyone who might care to discuss by mail the construction of a driving clock such as is described in 'A.T.M.A.' by Dr. Young (19" reflector, page 376)."—B. L. Souther, 24 Harrison Ave., New Canaan, Conn.

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