Scientific American

— FOUNDED 1845 —

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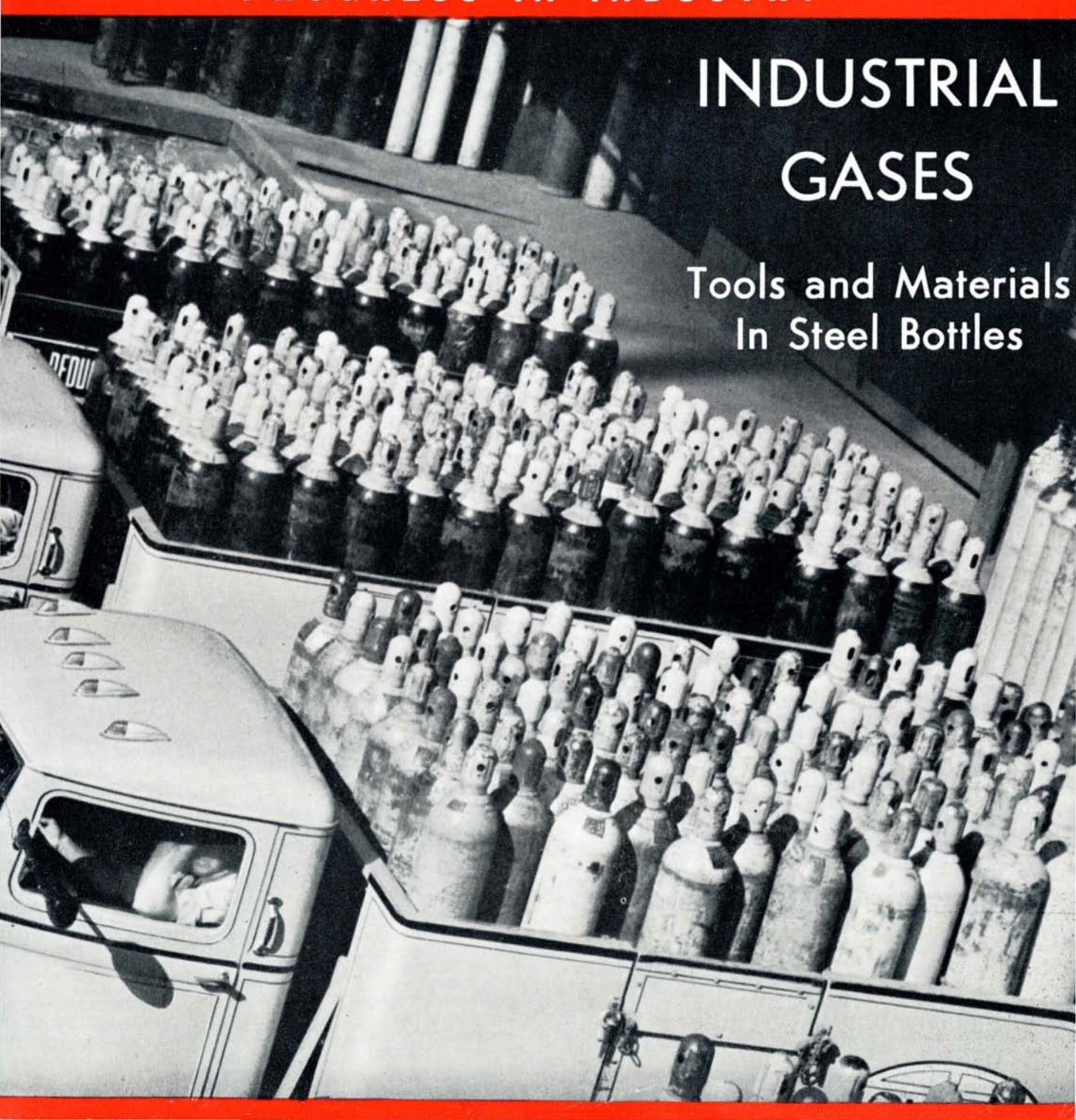
PROGRESS IN INDUSTRY



INDUSTRIAL GASES

Tools and Materials In Steel Bottles

How to give a Bigger Bonus

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SUPPOSE Bill S., one of your employees, is due for a $75 bonus this year. If you give the bonus in U. S. Savings Bonds, Bill will receive—not $75, nor a $75 Bond—but a *$100* Bond.

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Consider, too, that Savings Bonds mean individual security for each Bond-holder—and collective security for all of us, because they help to control inflationary tendencies. You can easily see that you're doing yourself, your employees, and your country a favor by deciding to...

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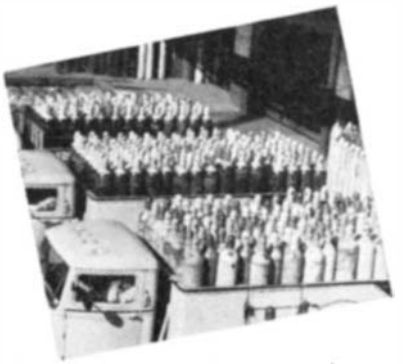

Courtesy Air Reduction Company

ON THE COVER: Bottles of atmospheric gases under high pressure awaiting delivery from the Philadelphia plant of the Air Reduction Company. For story, see page 245.

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In This Issue • December 1947

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50 Years Ago in . . .

SCIENTIFIC AMERICAN

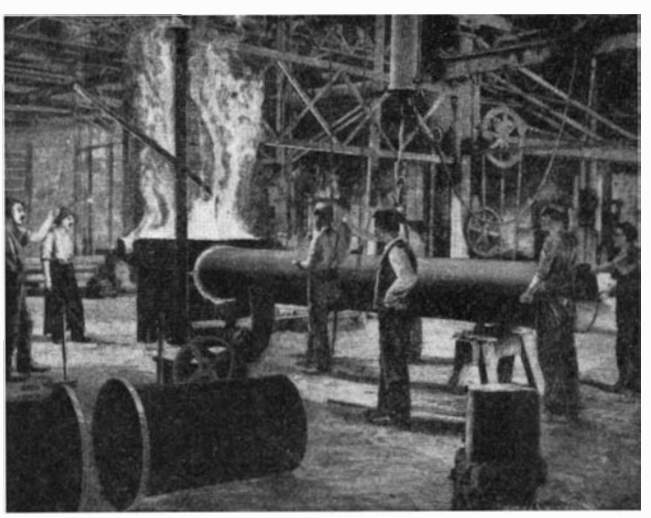
(Condensed from Issues of December, 1897)

TURBINIA — "If the compound steam turbine fulfills its present promise, it is likely that in certain branches of engineering it will hold absolute possession before many years have passed. The present year has seen the advent of a phenomenal little boat, the *Turbinia*. Steam turbines of the type designed by Mr. Parsons, son of Lord Rosse of telescope fame, were submitted for the ordinary reciprocating type of engine, and by driving them at a speed of 2,100 revolutions per minute, 1,576 horse power was realized from an engine weighing only 4 1/10 tons, or 5 1/10 pounds per horse power. It now remains for someone to make as big a reduction in boiler weights as Mr. Parsons has in engine weights. A small and compact boiler capable of instantly generating 1,000 pound steam from small quantities of water supplied to it as required would be the logical counterpart of the turbine running at 2,000 revolutions per minute and expanding the steam to zero, which is what the Parsons triple expansion turbine now accomplishes."

YEAR OF PLENTY — "The yield of winter wheat in Kansas is fifty million bushels, worth thirty-four million dollars, or 160 per cent more than last year. The corn crop totals one hundred and fifty-one million bushels, and the yield of oats is twenty-three million bushels, the two together bringing in thirty-two million dollars. This is the record of a year of plenty. In the presence of such figures one is prepared to believe there may be more truth than jest in the statement that Kansas will 'forward a car load of canceled mortgages' to the forthcoming exposition at Omaha as a token of her returning prosperity."

BRASS SUBSTITUTE — "Aluminum is now so cheap that it is used in many cases as a substitute for brass. Aluminum ingots, guaranteed to be over 99 per cent pure, cost 40 cents a pound in small lots and 34 cents in ton lots. Aluminum guaranteed to be over 90 per cent pure for alloying with iron and steel costs only 31 cents in ton lots."

TUBE TECHNOLOGY — "At the McKeesport works of the National Tube Company flanges are now welded on pipes up to 30 inches in diameter. The job is as perfect as the lap weld in the pipe itself. The flange is pushed on over the end of the pipe, which is then beaded over with a few taps of the sledge hammer to keep the flange from coming off in the furnace. The latter, as shown in the engraving, is gas fired and built in two semi-circular halves, the upper of which is removable. When the work has been raised to welding heat, the top half of the furnace is raised, and the pipe is swung on to a concave anvil, which is stepped to receive both pipe and flange. An L-shaped hammer is struck against the interior surface of the pipe and as pipe and flange are turned round on the anvil the welding up is quickly completed."



NO PEARLS — "The municipal authorities of Paris are just now engaged in the suppression of an altogether novel form of food adulteration: Artificial oysters on the half shell have been invented, and they are so cleverly made that once lemon juice or vinegar has been added, they cannot be distinguished from the real article, especially when white wine is taken in connection therewith. The only genuine thing about these oysters is the shell, the manufacturers buying second-hand shells at a small cost. The municipal laboratory has not yet proclaimed the ingredients of which these bogus oysters are composed, but has announced that they are of a harmful character."

FEATHER EVIL — "When a lovely woman stoops to folly, she stoops very low indeed. Consequently, it is not likely that the insensate votaries of fashion, who disfigure their heads with unnaturally clipped or colored bird feathers, will pay any attention to a paragraph in a scientific journal. The rate at which some of the rarest and most beautiful birds on our planet are being destroyed to gratify this extraordinary taste can hardly be realized. On the 13th of April last nearly half a million birds were sold at an auction in London. It is small consolation to us to think that in a few years the price of these luxuries will be prohibitive, or that unless fashion changes in the direction of seaweeds or turnip tops, there will soon be no more birds to destroy."

100 Years Ago in . . .

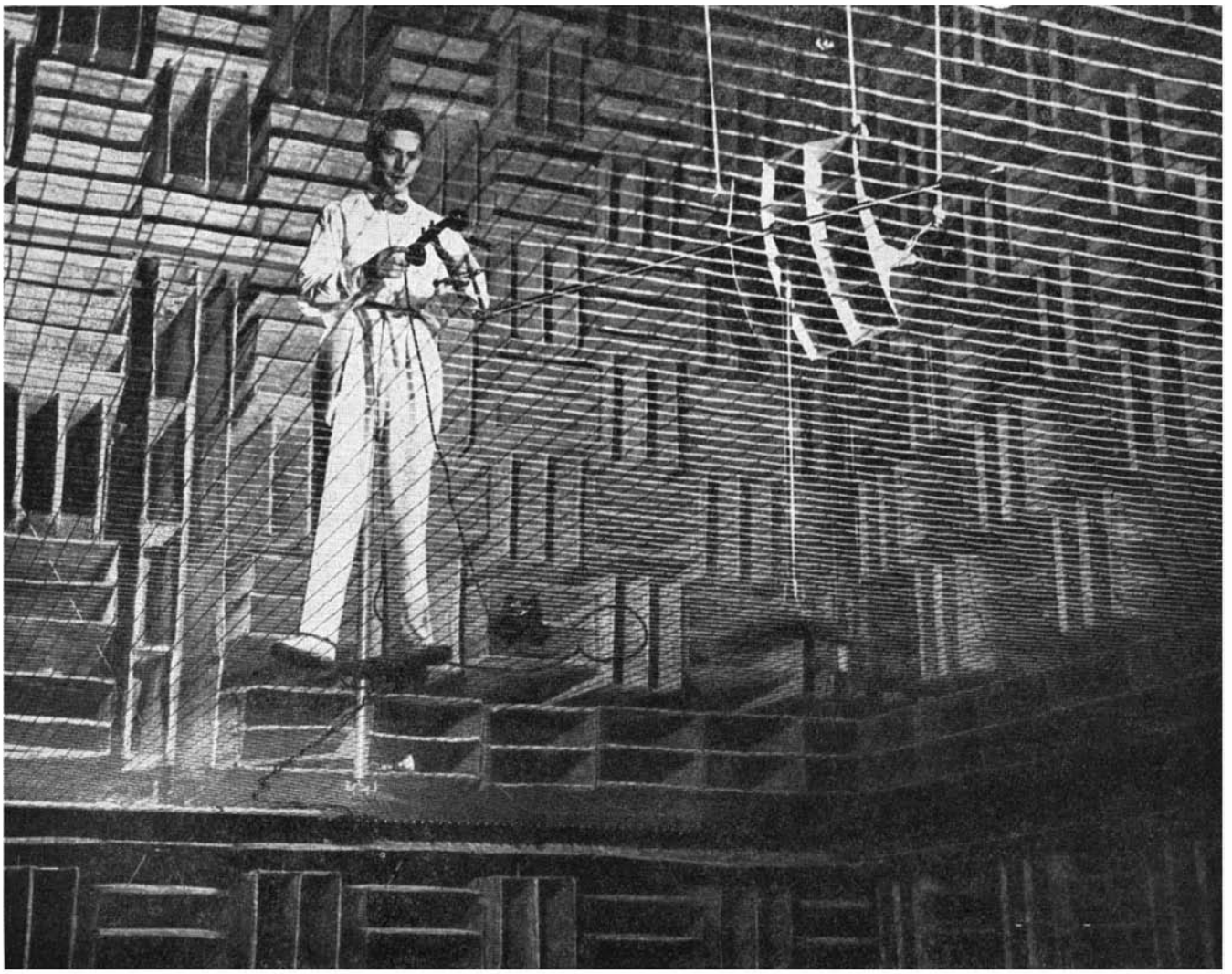
SCIENTIFIC AMERICAN

(Condensed from Issues of December, 1847)

ALLADIN'S PALACE — "The Capitol at Washington is now perhaps the best illuminated building in the world. The Senate Chamber and House look like a scene in Alladin's palace. Above the dome of the Rotunda, towers the great lantern filled with burners, and the chandeliers of both houses are superb. Each chandelier furnishes light equal to 5000 spermaceti candles. The lighting of the chamber is complete, enabling anyone to read with perfect ease on any part of the floor, and the light though so powerful, is yet so soft that it is delightful to the eye."

SCOUNDREL — "Only that some scoundrel cut the telegraph wires on Tuesday morning, the whole of the President's Message would have been circulated in our city printed in full on that evening. As it was we had it in full early Wednesday morning. The electric telegraph has made thought almost omnipresent. It is a most wonderful and invaluable invention."

ACCELERATING PROGRESS — "The field for the chemist yet to explore, is still as boundless as imagination can conjecture. Before 1809 the number of metals known was only twenty-seven, and ten of these has been ascertained in twenty years previous, as many as were discovered during all the middle ages, the ancients knowing only seven, which were compared to the notes of music in the gamut, the number of plants and the color of the rainbow, giving rise to many superstitions. We now know forty-four metals and ten times more acids than the ancients did, and the end is not yet."



A telephone listens to a loud speaker in the new "free field" acoustic test room at Bell Telephone Laboratories. The sound-transparent "floor" is built of steel cables.

Test-tube for Sound

This giant "test-tube" is actually an echoless sound room at Bell Telephone Laboratories. Here engineers seek new facts about sound which will help them make telephone service still better and more dependable.

Bell scientists know a great deal about what happens to sound in electrical systems. This new room will give them a powerful tool to find out more about what happens to sound in the air.

In an ordinary living room, most of the sound addressed to you comes by way of reflections. At 10 feet less than 10% reaches you directly.

Sound that *bounces* at you from walls, ceilings, furniture, and your body is all right for hearing—but it poses questions for scientists who would study it uncontaminated by reflections.

The Bell Laboratories "test-tube" gives telephone people the chance to produce pure sound and analyze it reliably with respect to intensity, pitch, and direction. The entire room is lined with glass wool, contained in wire-mesh cases, wedge-shaped to give maximum absorbing area. Sound bounces along the sloping surfaces, sifts into the soft glass wool, and is gradually stifled.

This is one more example of Bell Laboratories' constant work to learn more about everything which can extend and improve telephone service.

BELL TELEPHONE LABORATORIES

Exploring and inventing, devising and perfecting for continued improvements and economies in telephone service.

AN ANNOUNCEMENT TO OUR READERS

It is sometimes recalled on these pages that the Scientific American was founded in 1845. The intervening century has been a time of profound change for science and the Scientific American.

When the first issue of the Scientific American was published the principal meaning of science was the use of good sense and mechanical ingenuity to improve the convenience of man's daily life. Under the direction of its great editor Orson Desaix Munn, the Scientific American reflected this meaning of science with authority and dignity. It reported the inventions of men like Samuel F. B. Morse and Thomas Edison and the application of their works to the geographical and industrial expansion of the U. S. Today the Scientific American carries on in this journalistic tradition of reporting the practical applications of science, notably in industry.

In more recent years, the Scientific American has often observed, science has acquired a larger meaning than in the elder Mr. Munn's day. Applied science can no longer be held separate from fundamental science—the pursuit of knowledge about the physical world without immediate regard to its application. During the past 50 years, fundamental science has become a central enterprise of civilization. It has moved forward at an accelerating rate, with each discovery opening the way for others. It has given the applied sciences command of natural phenomena which are far outside man's daily experience. Whole industries are founded today in provinces of knowledge which yesterday were occupied by the advance forces of fundamental science. The enterprise of science has assumed an identity with man's aspirations to material and social progress. Recognizing this, responsible citizens have stated their need for information about all of science, fundamental as well as applied.

The Scientific American has accepted this obligation of modern science journalism. To meet it, the magazine is currently entering a period of change. Orson D. Munn, the present editor and grandson of the elder Mr. Munn, has addressed the following message to the readers of the Scientific American:

"The Scientific American, which has been owned and published by my family since its second year, has been purchased by a new publishing company. With this issue I am retiring as editor to devote all my time to the practice of law. I will, however, remain a stockholder in the new Scientific American."

Under a new board of editors, the editorial content of the Scientific American will also change. The new Scientific American will report the development of all branches of science: the physical, biological and social sciences, as well as their more significant applications in medicine, engineering and industry. The new Scientific American will be addressed to the growing community of U. S. citizens who have a responsible interest in the advance and application of science. Among these are the scientists themselves, the doctors and engineers, the executives and managers of industry and those engaged in the non-technical professions of teaching and the law. The common denominator of this audience is the interested layman: the scientific professional, who is a layman in departments of science outside his own, and all others who recognize the bearing of science upon the welfare of themselves and their fellow men.

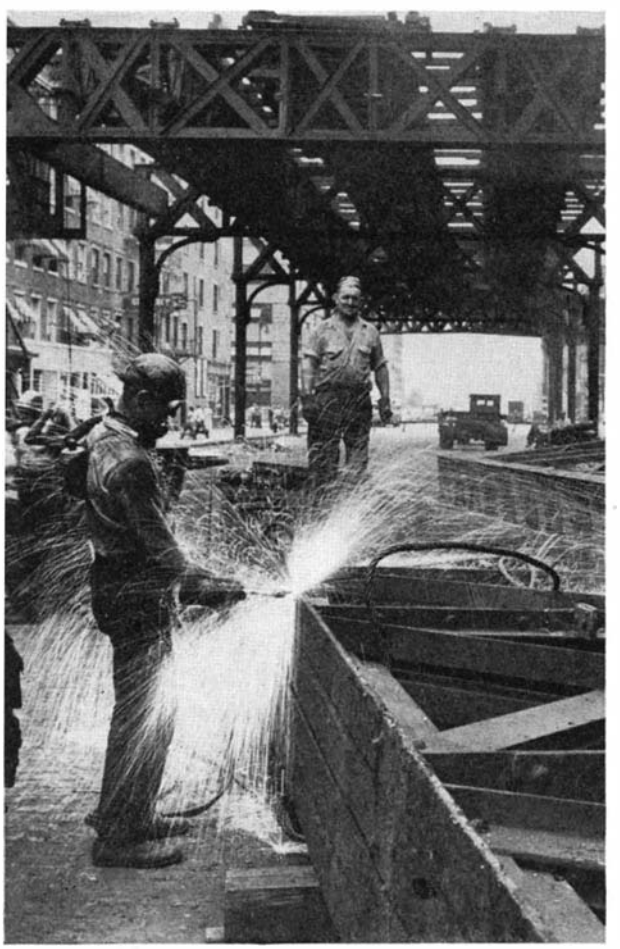
The new Scientific American will solicit articles by scientists. Recognizing, however, that the main business of scientists is science, it will obtain most of its articles from its own staff, journalists whose life work is the reporting of science. The editors of the Scientific American must develop a new creative process in science journalism. At every stage in the production of their articles, they will work in close collaboration with the men whose work they will report. The finished product will be the result of a joint effort, the scientist providing the substance of what is reported and the journalist the art of clear communication.

The new Scientific American will place a large emphasis on the use of the graphic arts. Where its written vocabulary proves inadequate, the Scientific American will employ pictures to communicate the ideas of science precisely and plainly. The magazine will utilize the full range of graphic art: photographs, paintings, drawings, charts, diagrams, maps.

All of these changes will take time. The earliest possible date by which they can be assembled in the new Scientific American will be in the spring of next year. Until then, therefore, the Scientific American will continue its important work of reporting progress in industry.

INDUSTRIAL GASES

Tools and Materials In Steel Bottles



All illustrations courtesy Air Reduction Company

The oxyacetylene torch, one of the basic tools of industry, slices easily and quickly through tough steel

EVERY time we turn on an electric light, listen to a radio, use a telephone, open a can of food, or take a bath, we are benefitting either directly or indirectly from the commercial application of one or more of the industrial gases.

There is hardly a product of industry which has not, either in its own manufacture, or in the making of the tools and machines which produced it, gained something of quality, economy, or efficiency from at least one of the industrial gases.

These industrial gases can be said to fall into two general groups—those obtained from the atmosphere —oxygen, nitrogen, helium, hydrogen, neon, argon, kripton, and xenon—and those produced from other sources—acetylene, chlorine, and carbon dioxide (those gases used exclusively as fuels are not included in this article).

ATMOSPHERIC GASES — If we were to reach into the atmosphere, take out a cubic foot of pure air, and break it down into its various components, we would find that it contained a little more that 78 percent nitrogen, almost 21 percent oxygen, a little less than one percent argon, and infinitesimal amounts of hydrogen, helium, neon, krypton, and xenon.

In order to separate these various atmospheric gases, and get them in usable form, the process known as "air reduction" comes into play. In this process, the air is compressed, purified, liquefied. The gases are then separated by fractional distillation as the liquid air is allowed to rise in temperature.

High-Purity Oxygen. The most familiar of the industrial gases is oxygen. About 30 years ago the commercial production of oxygen from the atmosphere became a reality, and the oxygen industry was born.

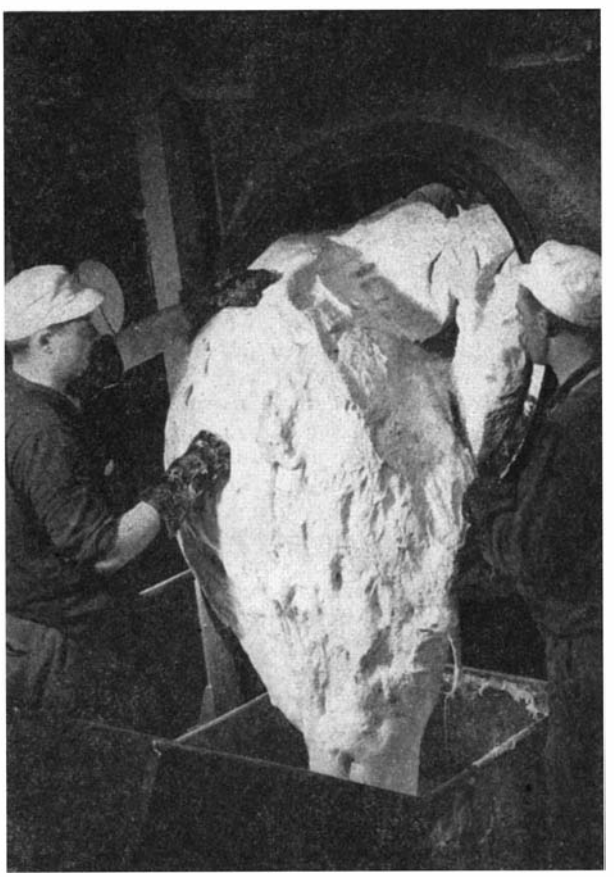
The constantly rising production figures for oxygen, and its declining price over the last 25 years indicate the growth of this new industry. In 1920, for example,

the United States produced about one billion cubic feet of oxygen. Present production is running at an annual rate of some 14 billion cubic feet. During this period, the average price of the gas has dropped about 60 percent. The most widely known industrial use of high-purity oxygen (99.5 percent pure) is in the oxyacetylene processes for cutting and welding metals. When mixed with acetylene, oxygen makes possible flame temperatures in excess of 4000 degrees, Centigrade. It is this intense heat which has made the oxyacetylene cutting and welding torch one of the basic tools of industry.

High-purity oxygen also is used extensively in the medical field, the principal application being for inhalation in cases of pneumonia, polio, and heart conditions. In aviation, the gas is an essential for high-altitude flying. Without oxygen inhalators or "pressurized cabins," pilots and passengers would "black out" at the upper levels of the atmosphere.

Low-Purity Oxygen. There are still new uses for oxygen to come out of the laboratory. War-time economy in Germany led to the use of oxygen as a means of accelerating steel production, and for the synthesis of gasoline from brown coal. The high-purity oxygen required for the oxyacetylene flame and for therapy, is not necessary for these new industrial uses. A less pure, and consequently a less expensive type of gas (85 to 95 percent pure) has been found quite satisfactory.

A greater volume of acetylene is used as a raw material for such synthetics as this neophrene, than is consumed by all of the illuminating and welding applications combined



• LOOKING AHEAD •

Great expansion of industrial gas producing facilities . . . Higher quality steels produced far more rapidly . . . More effective packing of perishables . . . Research bringing new uses and markets for the industrial gases.

In considering low-purity oxygen, we are considering a new product for new markets. Recently, the American steel industry has joined with the industrial gas industry in exploring the use of oxygen in the steel furnace, both for fuel combustion and for refining of the metal. Oxygen-enriched oil flames have brought appreciable savings in steel production time. And experiments in the injection of oxygen directly into the furnace to reduce the carbon content, indicate additional savings in production time and improved quality of the product.

Nitrogen. Unlike the highly active oxygen, nitrogen is a nearly inert gas. Because of this comparative inertness, nitrogen is valuable as a "guardian" in many industrial applications where it protects against such chemical reactions as oxidation. Typical applications are electrical transformers, telephone cable conduits, and food containers.

One of the most promising uses of the very abundant nitrogen is in the protection of special, high-quality steels and other metals during high-temperature furnace treatment. The nitrogen gas is injected into the furnace "atmosphere" to prevent damaging effects which otherwise might occur during the high-temperature heating process.

Nitrogen also serves as a guardian in the production of nylon fiber, protecting the synthetic material from oxidation at the crucial stage of forming the fiber itself. Another application of this gas is found in the so-called vacuum-packing of foodstuffs. Here, nitrogen is injected into the container, driving off the oxidizing atmosphere, and leaving the contents under a protective envelope of inert gas.

With a steady trend toward greater efficiency in packaging and toward more precise quality standards in manufacturing operations, the present uses of this inert gas may be sign-posts to a far wider range of protective functions.

Rare Gases. The rare gases of the atmosphere—neon, krypton, xenon, and argon—are characterized by complete chemical inertness, and by the fact that, when subjected to sufficient voltage, they emit a bright glow, the color of which varies with the type of gas.

Argon is used in large quantities in electric light bulbs, where its inertness protects the filament from burning up, thus prolonging the life of the bulb. Use of this gas also permits a more efficient lamp, which delivers more light for a given current consumption.

Although neon has given tubular display signs their most popular name, the "neon" signs which identify and advertise almost every kind of business

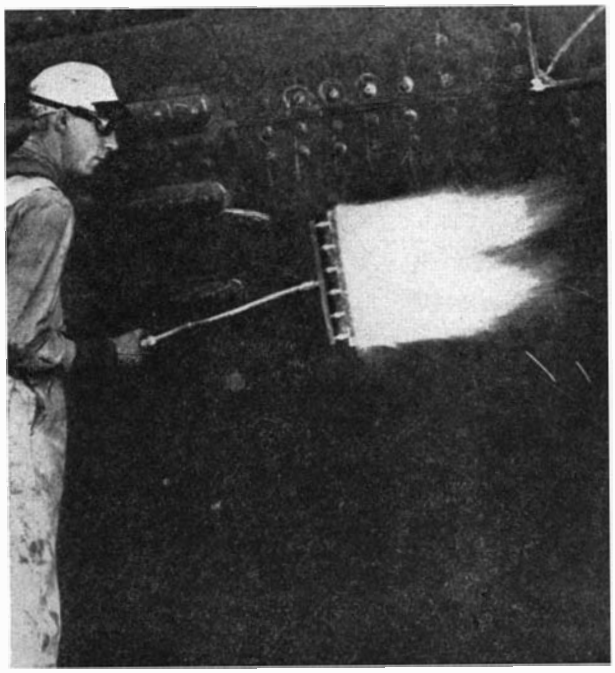
and product are, as often as not, filled with other rare gases, or with mixtures of neon with other gases.

While a wide range of colors can be obtained in tubular displays by coloring the glass, it is only through the use of mixtures of these rare gases that the complete range of eye-arresting colors is possible.

In less spectacular but perhaps more important uses, the electrical qualities of the rare gases make possible many of the miracles performed by electronic tubes, stroboscopic and high-speed flash-lighting, and other highly specialized devices of modern science and engineering.

Helium and Hydrogen. Although they are present in the atmosphere, helium and hydrogen can be produced more economically through other means than air reduction.

Helium is found in the gases of certain natural gas wells, and it is from this source that most of this inert, colorless gas is produced.



The oxyacetylene flame cleaning torch equipped with a multiplying tip rapidly strips paint, dirt, and rust from the ship's hull

An important use of helium is in the medical field, where it is employed with oxygen in treating the "bends," suffered by sea-divers and tunnel-digging "sand hogs." Of course, a more familiar use of helium is as the buoyant filler for lighter-than-air craft. In industry, helium plays an important role as a "shielding gas" in the Heliwelding process, to protect stainless steel, aluminum, and other metals from oxidation during welding.

Hydrogen is obtained largely by separating water into its components by electrolysis. It is used in combination with an electric arc in the welding of hard-to-weld alloys, where extremely high temperatures are required (see Scientific American, page 137, March 1947). Hydrogen is also used in the production of synthetic ammonia, and as a cooling atmosphere in high-speed turbo-generators and similar electrical equipment. In the food industry, it is used in the production of the improved vegetable shortenings.

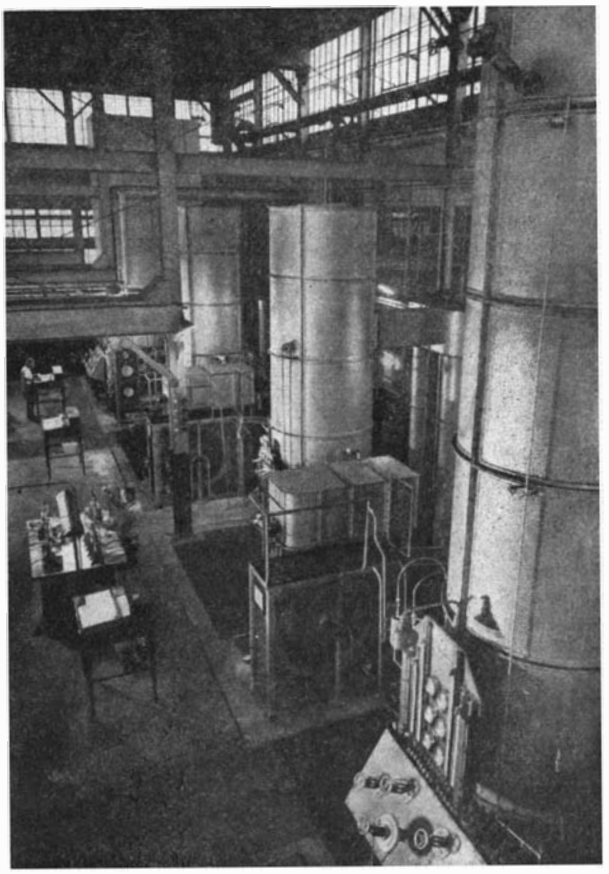
NON-ATMOSPHERIC GASES — The other gases which the industrial gas industry provides for American business are those produced from sources other than the atmosphere.

Acetylene. There have been many ups and downs in the uses of acetylene since it emerged from the class of laboratory-made materials. And there is a good prospect for even more sweeping changes in the future.

Actually, acetylene was discovered in 1856, but it was not until 60 years later that production methods became suitable for manufacturing it in commercial quantities. Carbide, from which acetylene gas is derived, is known chemically as calcium carbide and is formed by the fusion at very high temperature of calcium oxide (lime) with carbon or coke. When carbide comes into contact with water, a chemical reaction takes place and a gas is produced. This gas is acetylene.

Before the era of the electric lamp, acetylene provided much of the nation's lighting. There were carbide lamps in homes and on the early "horseless carriages." As technological progress brought the electric lamp into the home and placed electric headlights on automobiles, the use of acetylene diminished

High-purity oxygen, separated from liquid air by fractional distillation, is produced for welding or inhalation in such air reduction plants



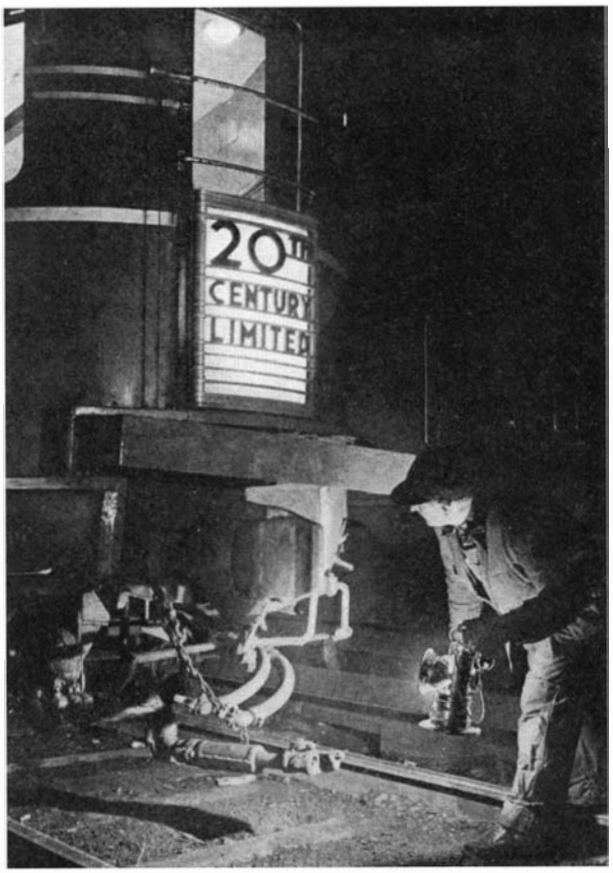
rapidly. But the very technological progress that closed one door to the use of acetylene, opened another, which has led to far more important fields.

The production of many mechanical devices such as automobiles made new manufacturing techniques imperative. Wood, molded metal products, and other construction materials did not have the mechanical strength or durability required in the new machine age. Steel in many instances was the material used, but its fabrication was slow and costly. The very strength that made it desirable rendered it difficult to cut and shape. Riveting or bolting was the accepted method of joining pieces, but such joints slowed the making of assemblies, and added to the over-all weight. To solve this problem a new tool was introduced—the oxyacetylene flame. This flame heats metals to temperatures higher than their melting points, providing a practical means of cutting and shaping varied thicknesses to intricate forms.

Spectacular as the oxyacetylene flame and the work accomplished by it may seem, the role of acetylene as a starting point in organic chemistry gives indication of being even more important. Today, more acetylene is used as a chemical raw material than as a fuel gas. In this connection, acetylene is now used in the production of various synthetics, including neoprene, koroseal, acetate rayon, and chlorinated solvents.

It will take time to show where acetylene will reach its greatest importance, but the future of this gas looks bright.

Although acetylene lighting has disappeared from the home and the automobile, it is still widely used for many types of hand lanterns



Chlorine. One of the two elements in common salt, when released from that compound, is a yellow-green gas having a pronounced choking effect if breathed in any quantities. This is chlorine, an industrial gas of great importance.

Over a million tons of chlorine are used each year. The gas is produced by passing an electric current through a purified solution of common salt. On so doing, chlorine is released at one electrode, while sodium is freed at the other. The chlorine is used directly from the electrolytic cells in some processes, and for others it is dried, refrigerated, compressed into cylinders or tank cars, and then used as required. Chlorine has a powerful bleaching action, and is employed extensively in the bleaching of paper pulp, jute, linen, and cotton. It is also used to purify municipal water supplies where it destroys bacteria. A similar use is that of reducing fungus or marine growths in the raw water supplies of electric power generating stations.

Many of the compounds of chlorine are well known to the public. For instance, there are the insecticides, DDT and hexachlorobenzene; the solvents, carbon tetrachloride, trichloroethylene, perchoroethylene, and ethylene dichloride; and such miscellaneous chemicals as chloroform. The list of uses of chlorine is an uncommonly long one, for the gas is quite reactive.

Carbon Dioxide. The third non-atmospheric industrial gas here discussed—carbon dioxide—is well known by the general public because of its use in carbonated beverages, for fire fighting, and as a refrigerant in the form of "Dry-Ice."

Carbon dioxide, a colorless, odorless gas, is the most common oxide of carbon, and is one of the products of combustion of all carbon compounds.

Although carbon dioxide was first identified as a gas about 1800, it was not produced commercially until 1887. The gas was then obtained principally from the chemical reaction of sulfuric acid and marble dust—limestone—and by extraction from natural carbonated water. These sources were later superseded by the production of carbon dioxide from combustion processes—calcining limestone, burning of coke and other carbonaceous fuels—and from alcohol fermentation.

Solid carbon dioxide, better known as "Dry-Ice," was first produced on a commercial scale in 1925. Up to that time practically the entire carbon dioxide supply was used in the manufacture of carbonated beverages. The introduction of "Dry-Ice" resulted in improved methods of food distribution and in the development of numerous new industrial applications.

The history of the industrial gas industry is comparatively short. But in the time since the first industrial gas became available commercially, the industry has become an essential one. It has helped all American industry to improve the quality of its products, cut production time, and reduce operating costs. Furthermore, without industrial gases, many of today's products could not even exist.

The industrial gas industry recognizes its important position, and is actively engaged in research in new uses for its products, and in expanding manufacturing facilities in an attempt to keep up with the ever-increasing demand.

SODIUM CHLORITE Goes Commercial

By Dr. G. P. Vincent
Technical Director,
The Mathieson Alkali Works, Inc.

Despite the Fact That Sodium Chlorite Emerged Only Recently From the Experimental Laboratory, It Already Has Become an Important Commercial Chemical. With New Speed and Efficiency It is Handling Many Tough Bleaching and Deodorizing Tasks Throughout All Industry

SODIUM chlorite, chemically speaking, is nothing more than common table salt to whose chlorine atom two oxygen atoms are attached. And it is these two atoms of oxygen, clinging to each chlorine atom, that hold the secret of sodium chlorite's success as an industrial chemical of ever-increasing importance. These oxygen atoms, acting with the chlorine atom, provide a highly effective oxidizing agent whose bleaching and deodorizing capabilities are two and one-half times greater than those of chlorine alone. And equally important, this oxygen-chlorine combination is responsible for sodium chlorite's unusual "selective oxidizing" ability (the ability to oxidize some materials without disturbing others). In addition, should the oxygen and chlorine be wanted alone, in a gaseous state (as required for water purifying or fat bleaching, for example), sodium chlorite provides a convenient source of the highly reactive chlorine dioxide gas.

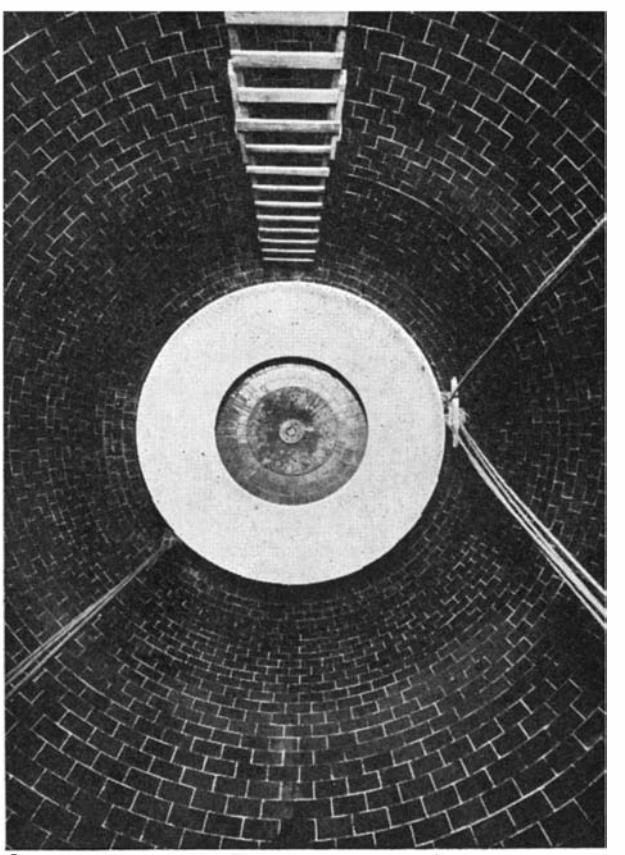
Despite the fact that sodium chlorite was identified as long ago as 1843, its use, until quite recently, has been limited to laboratory experimentation, because no practical method could be found for manufacturing the chemical on a commercial scale. Extensive research, however, finally led to the development of a successful large-scale manufacturing process, and sodium chlorite became available in commercial quantities just before the second World War.

BLEACHES PAPER TEXTILES — The chlorine compound most widely used for bleaching cellulose materials, such as wood pulp or many textiles, has been hypochlorite. However, hypochlorite is not entirely satisfactory for certain purposes.

When cotton goods or rayon is bleached with hypochlorite, a product known as oxycellulose tends to form. This weakens the fiber and causes reversion of color or "yellowing" on storage, and uneven dyeing. Although the amount of oxycellulose produced in bleaching cotton goods can be kept to a minimum by careful control of the bleaching process, especially by preventing it from progressing too far, some oxycellulose is almost inevitably formed.

When sodium chlorite is used, the oxygen in the compound destroys the coloring matter without the formation of oxycellulose. The bleaching process can therefore be carried out without the otherwise necessary rigid control of time, temperature, and concentration; the goods can be bleached to a high brightness; and the resulting product is physically stronger than that bleached by hypochlorite.

Kraft, or high-strength, paper can usually be only



Courtesy Bulkley, Dunton, and Company, Inc.

In such ceramic-lined tanks as this sodium chlorite bleaches paper pulp

partially bleached, because of the fiber-weakening effect of the hypochlorite (hence the brown color of paper bags and wrapping paper). A high-strength white paper is possible, however, if sodium chlorite is used as the bleach. The oxygen-chlorine content of the compound is sufficient to turn the brown, insoluble lignin into a colorless, soluble matter, but insufficient to injure the cellulose.

This same property of selective oxidation possessed by sodium chlorite has made it possible to produce rag paper pulp for high grade paper from the lowest grade of cotton fiber. Such fiber contains coloring matter that cannot be successfully destroyed with hypochlorite without injury to fiber-strength, so that unless sodium chlorite is used as a bleach, expensive cotton clippings and rags must go into the process of producing rag paper.

PRODUCES CHLORINE DIOXIDE — Chlorine dioxide is a yellow to red, dense gas, with an irritating odor. It decomposes with explosive violence. Because it is so extremely reactive, it cannot be manufactured and shipped in bulk, but must be prepared where it is to be used, and then consumed immediately. Early methods for chlorine dioxide's preparation were not commercially practical because the reactions were difficult to control and contaminating substances were formed.

Sodium chlorite now provides a practical source of chlorine dioxide through reaction with chlorine. When chlorine gas is passed through a solution of sodium chlorite or through a mass of sodium chlorite flakes, chlorine dioxide gas is given off. And if the gas is carried off during the reaction, exceedingly high yields are obtained.

The remarkable oxidizing power of chlorine dioxide makes it an excellent bleach for flour, fats and oils, and starch; it has many other potential uses that are still in the development stage, such as checking blue mold in citrus fruits, and aiding in the preservation of vegetables.

For these uses, chlorine dioxide is generated by the dry process; that is, by a stream of chlorine gas passing through a mass of sodium chlorite flakes. Two towers—the size depending on the quantity of the gas desired—lined with a stoneware or glass, are filled almost to the top with flaked sodium chlorite. A stream of air and chlorine is fed into the bottom of the first tower, and chlorine dioxide is formed as the chlorine passes up to the top. Complete reaction is assured by passing the gas mixture through the second tower. The air serves not only to carry the chlorine, but also to dilute the chlorine dioxide below a critical concentration—a very important safety measure. Various control and measuring devices make it possible to produce exactly the quantity of chlorine dioxide required, at the proper rate. Ample safety devices are included to prevent the concentration of chlorine dioxide from exceeding a certain safe maximum.

• LOOKING AHEAD •

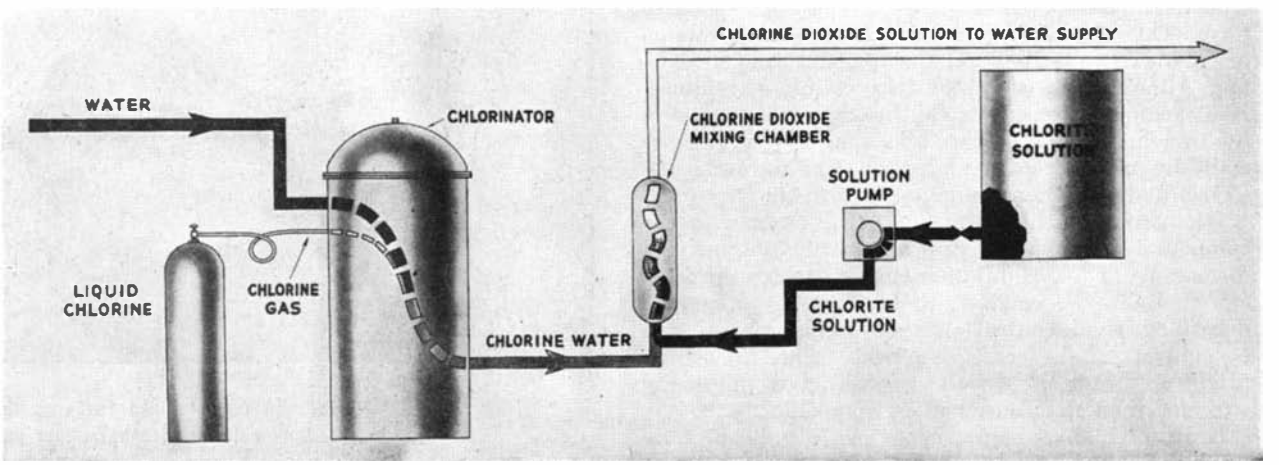
Paper and textiles bleached more effectively with no danger of loss of strength . . . Low quality fats up-graded for successful use in high-quality soaps. . . Fruit spoilage in storage reduced. . . More efficient treatment of drinking water removing all unpleasant tastes and smells. . . High-grade paper made from the lowest grade of cotton fibers.

FLOUR BLEACH — For bleaching flour, chlorine dioxide is very efficient. It takes about twice as much nitrogen trichloride, conventionally used for the purpose, to do an equivalent job. Chlorine dioxide also exerts a maturing action on flours, producing a dry, easily-handled dough, and improving the grain and the loaf-volume of the bread. In the bleaching process, a stream of air and chlorine dioxide, coming from the generator towers, is passed through the flour to obtain the desired degree of bleaching.

Until recently, there was some hesitation on the part of soap manufacturers to use chemical methods for fat bleaching. It was feared that any chemical which would be effective as a bleach would also

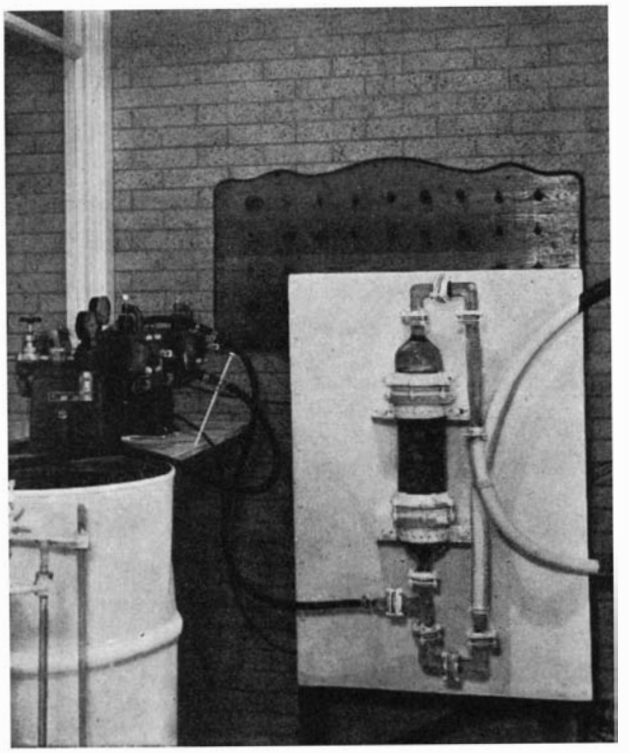
Flow diagram showing generation of chlorine dioxide solution using a chlorite solution and chlorine water

Courtesy Mathieson Alkali Works, Inc.



cause deterioration of the fat. Now it has been demonstrated that fat bleaching with chlorine dioxide affects only the color and odor of the material treated. Crude fats, such as household waste fats, are thus up-graded to a quality that makes them suitable for the manufacture of high-grade laundry flakes and toilet soaps, and the color and odor of refined fats are considerably improved.

As in the case of flour bleaching, the dry process of generating chlorine dioxide is used here. The fats



Mixing chamber in a water treating system. Here a sodium chlorite solution is reacted with chlorine water to form chlorine dioxide

are refined in the usual manner, washed, and allowed to settle. They are then heated to from 180 to 212 degrees, Fahrenheit, and a stream of chlorine dioxide gas and air is passed into the bottom of the kettle and up through the fats.

IN WATER TREATMENT — Much of the unpleasant flavor of water in many areas comes from vegetation, or algae picked up as the water passes through the countryside, especially through forests and swampy areas. Also, factories dump industrial wastes into the water supply, causing similar disagreeable results. Sometimes the water supply is subject to both types of contamination.

In order to destroy bacteria and to make the water safe for drinking, it is usually treated with chlorine gas. But although the chlorine makes the water safe, it does not always destroy its unpleasant qualities, as many long-suffering communities know only too well. And sometimes the chlorine combines with the impurities in the water to form compounds that have even stronger tastes and odors. Chlorine dioxide solves this problem.

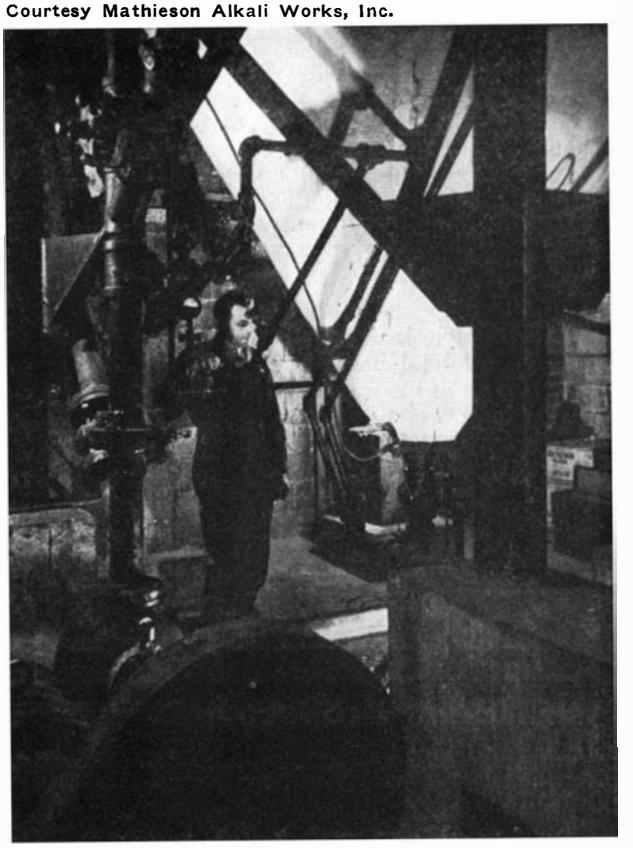
For water treatment, the wet process of generating chlorine dioxide is used. A solution of sodium chlorite is passed into a mixing chamber, into which is passed also the chlorine solution produced by the plant's chlorinator. The chlorine is thoroughly mixed with the chlorite solution to produce the chlorine dioxide solution that is then fed into the system. The chlorine dioxide is usually added after the water has been disinfected with chlorine, settled, and filtered.

Cities and towns in New York, Maine, South Carolina, Ohio, Pennsylvania, Michigan, Kansas, West Virginia, Iowa, Rhode Island, Tennessee, California, and Massachusetts, and communities in Canada that formerly suffered from unpleasant tasting water are now using the chlorine dioxide process. The result is a water supply that is entirely satisfactory.

Recent work by scientists at the University of Michigan's School of Public Health indicates that the bactericidal properties of chlorine dioxide are as great as or slightly greater than those of chlorine. Of special interest was the fact that the bactericidal efficiency of chlorine dioxide is relatively unaffected by alkalinity such as that which occurs naturally in some waters, or in waters that have been treated to prevent corrosion, and also in waters that have been "softened." In such cases, the amount of chlorine needed for disinfection increases by two or three times. If present findings are confirmed, chlorine dioxide may prove to be an even greater aid to good water treatment in many municipalities.

Carbon dioxide, fed in at the bottom of this conical tank, bubbles up through the liquid fat, deodorizing and bleaching it

Courtesy Mathieson Alkali Works, Inc.



THE FOUNDRY OF TOMORROW --Today

Through Application of Modern Machines and Methods to the Ancient Art of Casting, A Foundry's Atmosphere Can Be Cleared of Dust and Smoke, and Much Back-Breaking Work Eliminated. Only Thus Can a Foundry Hope to Meet Successfully the Ever-Increasing Competition for High-Quality Labor, and the Rapidly Growing Need for More and Better Castings

By C. B. Dick
Manager, Feeder Division,
Westinghouse Electric Corporation

FOUNDRY work—the art of casting metal—is one of the oldest and most important of all basic industries. But for many years it was one of industry's toughest and dirtiest jobs. Recently, however, this ancient art has collided violently with the age of push-button machinery and fluorescent lighting.

This collision was brought about by a number of things—competition for high-caliber labor, greater demand for castings, and new emphasis on quality, to name a few.

Whatever the reasons, the results have been fascinating to watch. In spite of the fact that in all too many places, John Jones, foundryman, still wears the tell-tale marks of his trade—dirt and grime—in some foundries he now comes to work in clean clothes, and he looks and feels like a gentleman when he goes home. The job at which he works all day is no longer the back-bending, muscle-mauler it once was. John's morale is higher; his pay is higher; and his work is more efficient.

One example of a foundry "gone modern" is that of the Westinghouse Feeder Division at Trafford, Pennsylvania, which has been dubbed "the foundry of tomorrow." However flattering this reference may be, the Trafford foundry is still enough different from that of yesterday to startle the veteran foundryman who may have lost touch with his trade for a few years.

As you might expect, the basic job is the same today as always. Furnaces must be fired, and metal, melted. Sand must be brought in to form molds and cores. And the cooled metal casting must still be removed from the mold and cleaned.

Replacing the traditional hand shovel, this "sandslinger" hurls 1000 pounds of sand a minute into the mold

A backward look at an imaginary foundry of the old school will show how the job of casting metal was done.

First, railroad cars dumped sand into cellar bins. There began a sand-handling process with the emphasis on the word "hand."

The sand was hand-delivered to the mixing stations where it was mixed with such binding materials as cereal, oil, and water to make it stick together when pressed into form. A workman shoveled the sand into the mixer, added oil and water or other binder-

materials by hand-bucket, and once again the sand was moved by hand methods to the various core-making stations. There hand tools were depended upon to form the sand core.

To form the mold into which molten metal was to be poured, the metal or wood pattern was set in place in a flask or box, and the sand was hand-shoveled in. To pack it down, the workman used the handle end of the shovel, or other ramming implement.

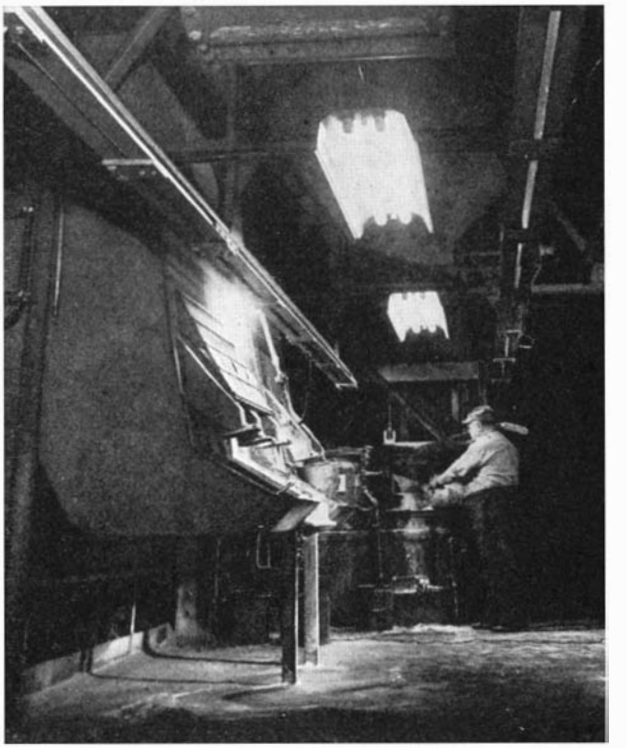
Molten metal was prepared in the big cupola, or furnace, which was fed by a charge containing coke, scrap iron, pig iron, limestone, and other ingredients. These ingredients were shoveled into a dump container. The container was then pushed to the cupola, and upturned.

Once the metal had been cast in the mold, the problem remained to get the solidified casting out of its sand strait-jacket. The old time foundry solved this one easily enough. Men wielding large hammers simply knocked the casting loose from the flask.

It should be remembered that the men doing these "easy" jobs were working in a smoke- and dust-filled atmosphere, probably in bad light. And at the end of the day they trudged home to spend some of their leisure time scrubbing up.

All foundries were not alike, of course. Some were better than others. But by and large, a foundry like the hypothetical one just described was quite typical.

More recently, however, foundries were faced with great competition for labor. Obviously, conditions had to be improved to attract workers. Costs were soaring and the need was evident for improvements in production techniques and facilities.



All pictures courtesy Westinghouse Electric Corporation

Core sand is now processed under the cool brilliance of many fluorescent lamps

FOUNDRY MECHANIZED — Although the Trafford foundry was fairly well equipped, the opportunity was seized to push modernization further when, in 1940, plans were made to increase floor area by 30 percent to meet the great demand for castings. So began a "face-lifting" program involving both mechanization and modernization for which the Trafford foundry still is serving as a working laboratory.

Already the number of electric motors has been doubled; countless manual operations once requiring human strength and endurance are being done with the aid of newly devised machinery; fluorescent lighting and air conditioning have put in their appearance.

First section of the foundry to be tackled was the core room, where small- and medium-sized sand cores are prepared. Here some 75 tons of silica sand are required daily.

Today, a 50-ton, under-floor hopper catches carload lots of sand as it is dumped from the railroad car. A power conveyor moves it to a large revolving drier that dries six tons of sand an hour (in other days, foundries did not dry the sand at all). The purpose of sand drying is to control accurately the core sand mixtures from standpoint of moisture-content, a factor which is critical in the production of high quality castings.

An elevator and distributing belt deliver this sand to large overhead storage bins. The workman standing beside the rotating mixer merely opens an overhead shute to drop the correct amount of sand into the mixer. Handy discharge outlets at the mixer enable him to add core oil and water by simply turning valves instead of lifting buckets. Meters indicate the exact amounts added. Not only is the job now easier; it is far more accurate.

Processed core sand is distributed to the ground floor by electric trucks, and by an electric hoist to a second-floor sand-distributing station directly above the core-making positions. From this station one operator, with the aid of a two-wheel dump buggy, can furnish core sand to overhead bins serving the 40 work positions below.

In forming the larger cores, "roll-over" machines turn the heavy forms, instead of human muscle doing the job. Both gravity- and power-driven conveyors move the cores to the vertical-type baking ovens, where they are lowered to the first floor while the baking progresses—one more way to avoid lost time. To form molds into which the molten metal will be poured, the mechanized sand-handling system once again comes into play, and a machine called the "sandslinger" takes the spotlight. Here, instead of the workman shoveling sand and tamping it down with the shovel handle, the sandslinger does the job faster, better, and more easily.

RIDES MACHINE — Guided by the operator—who in some cases even rides the machine like the Hollywood camerman on his movable boom—the sandslinger receives sand on a belt from the overhead bin and hurls it into the mold flask at the rate of 1000 pounds a minute. The centrifugal force of a 40-horsepower motor packs the sand evenly and quickly.

The metal is rapidly prepared for casting by a two-man crew with the aid of an overhead yard crane equipped with a magnet for lifting metal. The two men stand beside the large charging bucket which moves along a track on a transfer car, collecting its

load. Then a moving crane operated by one man carries the bucket to the cupola and dumps it.

Small "holding furnaces" located near the molding sections provide another means of avoiding unproductive "waits" in the process. Their reservoir of available metal assures a constant supply. Ladles of molten metal are delivered to the pouring stations by electric platform trucks and overhead cranes.

When the metal has been poured and has solidified, automatic shake-out machines quickly clear the casting from the flask, without workmen swinging heavy hammers. The castings then are delivered by conveyor to the cleaning floor.

As for the cleaning and chipping floor, it suffices to say that Trafford has a full complement of automatic equipment.

The introduction of mechanized processes and intricate machinery into the foundry requires high-caliber, technically trained men. And to attract them, tomorrow's foundry has to be clean, comfortable, and safe. Not that any foundry will rival a hospital for spic and span appearance, but the old time dirt and filth cannot be tolerated. And it need not be.

Air-conditioned locker rooms for the foundry workers are not equalled by those of many of the best country clubs. All lockers are continuously ventilated by a stream of air exhausted downward through holes in the locker floor. This keeps work clothes dry and fresh. Light and roomy showers and great circular washbowls provide adequate washing facilities for all. Most of the men shower and dress at the foundry and are given time to do so before the end of the shift, so that they can leave the foundry at the end of the day as clean as they were when they entered.

Dust and smoke, characteristic of the old time foundry, have been suppressed by providing hoods, ducts, exhaust blowers, and filtering equipment, as well as by concentrating the points at which dust and fumes are created. This feature, plus the elimination of heavy-lifting jobs, has resulted in a general improvement in the health of the workers.

Complete safety equipment—goggles (which are sterilized regularly), heavy gloves, knee pads, shin guards—is provided without charge for each workman in accordance with the requirements of his particular job. The employe must purchase only safety shoes.

Although complete safety precautions are taken, a well-equipped first aid station is maintained at the foundry, staffed by a regular doctor, and with a registered nurse in attendance at all times. Here complete X-ray and other medical laboratory facilities are available. Periodic chest X-rays are required for everyone, and studies are made of foundry conditions from the standpoint of health.

RESULTS — In adding up results, it is difficult to produce figures in balance-sheet form. Certain facts have been proved, however. As the result of our foundry program, production is up; absenteeism is down. Workers health is improved; and most important, high-quality personnel is attracted to the jobs.

Even the quality of our output has benefited from the application of 1947 methods to a job far older than the machine age. Metal castings are now produced of greater dimensional accuracy than hand operations ever would permit.

• LOOKING AHEAD •

Basis established for similar improvements throughout the entire industry . . . Better castings of higher dimensional accuracy . . . Worker-morale vastly improved . . . Foundry jobs gaining reputation of good jobs.

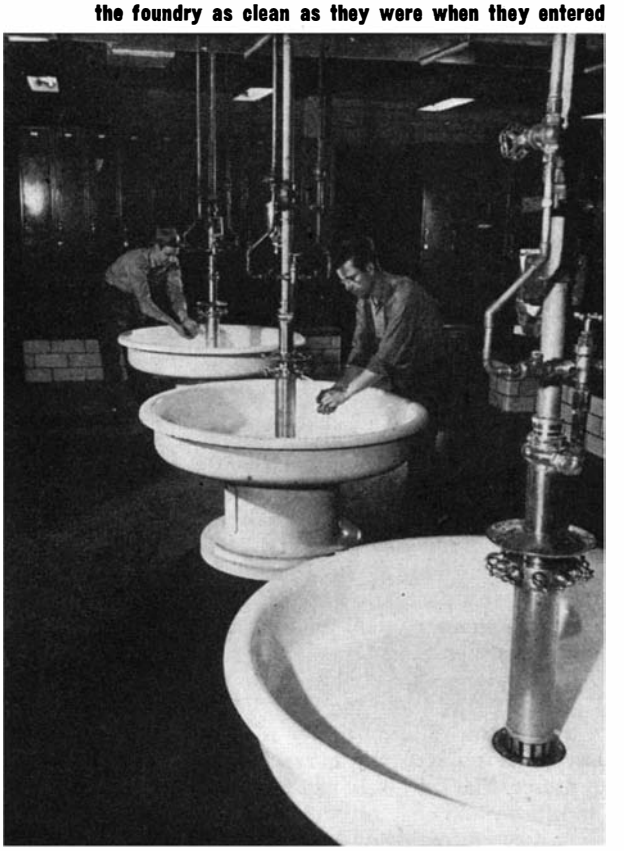
The Trafford foundry, while advanced in many ways, is still only a starting point for what, it is hoped, will be achieved eventually both in this foundry, and in many others.

It has been said that most of the 5000 foundries in the United States are operating at, or near, capacity right now. If this is true, the nation's foundries cannot produce sufficient castings to meet the tremendous, ever-increasing demand.

The efficiency and productivity of foundry operations depend upon the caliber of managers, supervisors, and workmen doing the job. We must face the fact that the old, out-moded foundry will not attract the men we want. A modernized, mechanized foundry will.

Whether America's foundries become a bottleneck or a booster station in the flow of full production depends upon the industry's leadership and its acceptance of modernization and mechanization for the purpose of making the foundry a good place to work, of creating the foundry of tomorrow—today.

Excellent washing facilities enable the men to leave the foundry as clean as they were when they entered



HARD FACES Live Long

By H. R. Clauser
Associate Editor, MATERIALS & METHODS

Applying a Coat of Hard, Wear-Resistant Alloy to a Base of Less Durable Metal Results in Parts That Give High-Alloy Performance Without High-Alloy Costs

GENERALLY speaking, it is the rate at which the surfaces of a part wear, which determines that part's life expectancy. And in order to reduce that wear, to increase that life expectancy, industry more and more frequently has employed a process by which a layer of hard, wear-resistant alloy to spread on top of the softer, less expensive surface that would normally wear rapidly. By this technique, known as hard-facing, it is possible to achieve high-alloy performance without the usual high-alloy expense.

Hard-facing is by no means new. But it was not until a relatively few years ago that the technique came into common practice. In recent years, and particularly during the war, the conservation of many metals became a matter of prime importance. Industry seized upon hard-facing, not only as a means of increasing the service-lives of countless types of tools and parts, but also as a method of reducing the amounts of critically short high-alloys needed in parts demanding the utmost wear-resistance.

Hard-facing can extend the lives of such assemblies as valves, bearings, bushings, sleeves, shovel teeth, and machine tools as much as 25 times. And in addition to promoting conservation of the high-alloys, the process often enables far more economical designs by permitting cheaper base metals in parts to be subjected to heavy wear.

Hard-facing was originally applied on oil well drilling tools and excavating equipment. Its success there prompted its use elsewhere, so that now hard-facing has found applications in almost every field of industrial activity.

HARD-FACING MATERIALS — There are virtually hundreds of different hard-facing alloys on the market today, and new ones are being introduced continually. However, practically all hard-facing materials can be sifted down into a few major classifications, the alloys falling into each of these classifications having many of the same general properties and characteristics.

The first of these groups, and perhaps the largest, is composed of the iron-base materials. The alloys in this group that contain only small amounts of alloying elements (up to 20 percent), are lowest in cost, and are primarily for application by arc welding on large parts, and as a base for other more expensive hard-facing alloys. Their principle characteristics are relatively high hardness along with satisfactory toughness to withstand impact. The chief alloying elements are chromium, manganese, and silicon.

What might be considered a subdivision of this group, is another iron-base group made up of materials having alloy contents ranging above 20 percent. These are, of course, higher priced than the lower alloy materials, but they are usually harder and more resistant to abrasive wear. The chief alloying element is chromium.

Some of these iron base materials are often referred to as "self-hardening," because they are relatively soft when first deposited, but when subjected to impact in service, the surface becomes harder. Below the hardened surface, however, the deposit remains comparatively soft, and so gives good impact-resistance.

Another classification of hard-facing materials consists of non-ferrous alloys that are made up chiefly of cobalt, chromium, and tungsten. These alloys have the quality known as "red hardness;" that is, when heated to high temperatures, they retain most of the hardness they have at room temperature. This property makes these alloys particularly valuable for high-temperature wear-resistant applications. They also have the ability to resist many corrosive agents and oxidation at elevated temperatures.

Those materials comprising a third group are often referred to as diamond substitutes. Their hardness approaching that of a diamond, these materials usually consist of tungsten carbides, and come in the form of rods, as powder, or as solid inserts. The materials of this group are the most expensive. They offer the maximum in wear-resistance at both normal and high temperatures, but have low impact-strength as compared with the alloys in the other groups.

APPLIED BY WELDING — The most widely used method of applying hard-facing alloys is welding, and arc welding is generally most economical. It is rapid and can be used to advantage where thick layers are required. It provides the most intense source of heat, and rapidly melts the hard-facing rod, fusing it to the base material.

Oxyacetylene welding is a very flexible method. It creates a less intense heat than arc welding, and good bonding of the hard-facing alloy is obtained with a minimum of weld penetration into the base material. It also gives a smooth weld deposit.

Besides gas and electric arc welding, atomic hydro-

gen and inert-gas-shielded arc welding methods are occasionally used for hard-facing.

In recent years, in order to speed up hard-facing operations, the welding process has been mechanized, with oxyacetylene methods generally most adaptable to mechanization. In addition to the very obvious advantage of a greatly increased output, mechanized processing also tends to reduce costs, since fewer and less skilled operators are required. In addition, the work is more uniform and there are fewer rejects. Flat, regular pieces and cylindrical objects are best suited to mechanized hard-facing.

The several types of surfacing operations that have been developed include straight-line, cylindrical, and spiral types. In a straight-line operation, for example, a multiple-flame head is fixed with flames directed to bring the base metal to sweating temperature, melt the hard-facing rod, and distribute the molten metal to the desired points. The head is mounted on a motorized carriage, and the rod feed is mechanical.

For parts such as pump rods, bushings, and rolls of all kinds, the cylindrical and spiral methods are used. In the cylindrical method, the entire length of the part is surfaced in one revolution of the work by rotating it slowly while the weld metal is deposited. Multiple welding rods pass through tubes and between converging flames that melt the rods just above the work.

• LOOKING AHEAD •

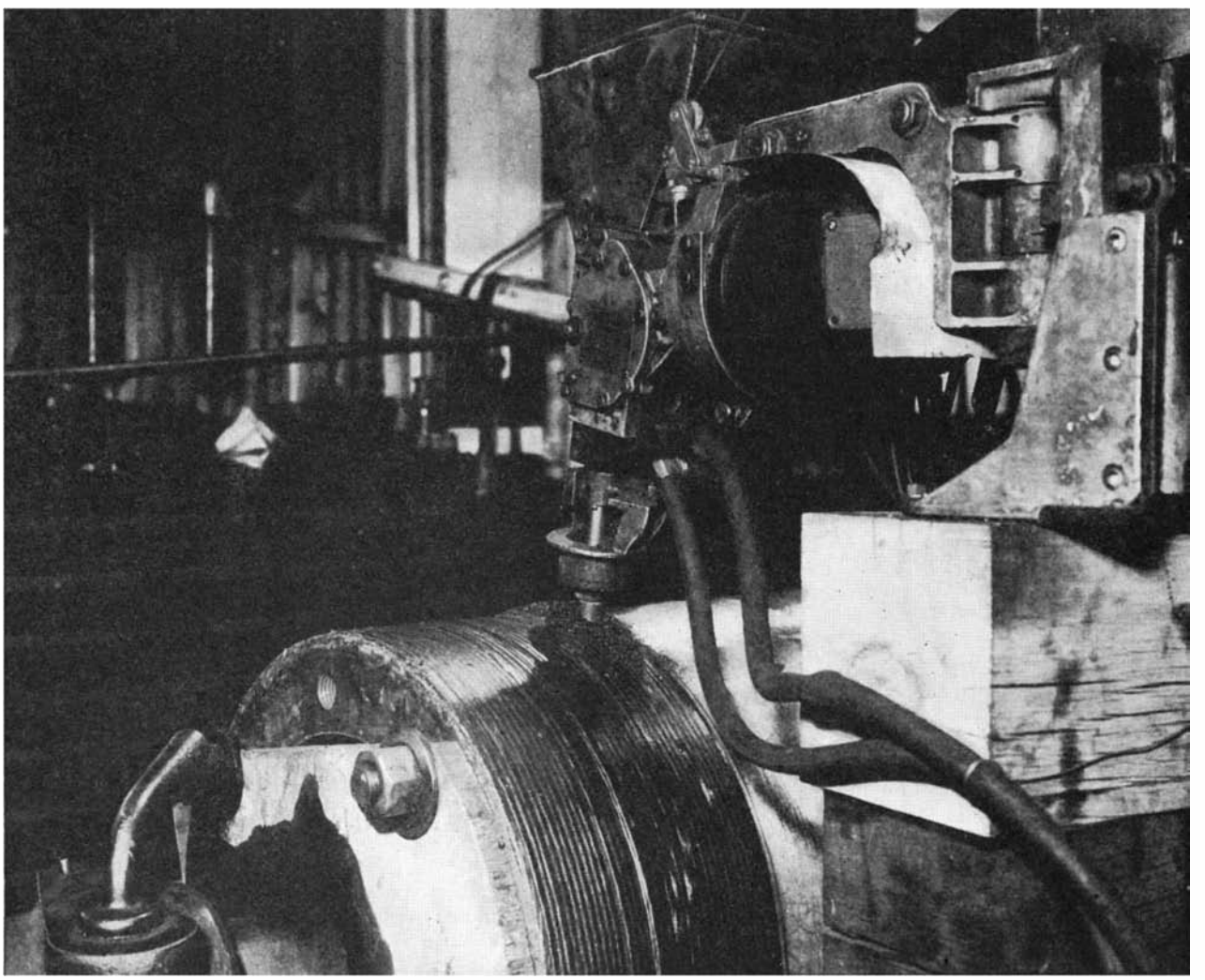
Hard-facing gaining ever-increasing acceptance . . . Service life of metal parts of many sorts greatly lengthened . . . Manufacturing costs cut where quantity of higher alloys is reduced . . . Sharp drop in down-time for repair or replacement of worn parts.

The spiral method is basically like the straight-line method. A narrow ribbon of hard-facing alloy is deposited in a continuous spiral as the welding head moves along the rotating work-piece. Each successive spiral overlaps the previous one to form a continuous surface layer.

Where parts are not adaptable to mechanized hard-facing, as in the case of such parts as gears, drill bits, sprocket teeth, and earth scraper blades, semi-automatic methods have been developed. In one new

Rebuilding a large, badly worn hydraulic plunger by the submerged arc welding method

Courtesy Linde Air Products Company



process, crushed tungsten carbide alloys can be welded superficially on a surface by using a powder dispenser and an oxyacetylene torch. The area to be hard-faced is brought to a sweating temperature, and then tungsten carbide granules are poured from a dispenser onto the sweating surface. In a few seconds, the desired depth of facing material is built up and the flow of granules is stopped.

SUBMERGED MELT WELDING — In recent years submerged melt welding, or hidden arc welding, as it is sometimes called, has aroused considerable interest as a fast and automatic means of hard-facing. In this method, both the arc and the welding rod are completely submerged in a granular flux during welding. Most of the work done by the process has centered about rebuilding worn parts with weld metal of similar composition or of similar wear resistance. More recently, however, surfacing with dissimilar materials has been done. For example, cast steel valves have been faced with stainless materials which gave far better wear- and corrosion-resistance than normally is obtained from cast steel.

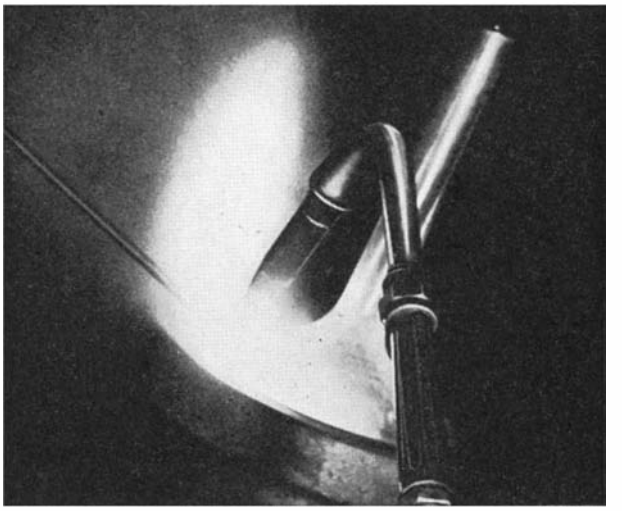
Submerged melt welding has the advantages of a high speed of rod deposition, minimum rod loss, and minimum subsequent machining. Development work on this type of welding for hard-facing is continuing, and will probably see a large increase in its use.

Two new and rather unusual methods of applying hard-facing materials in powder form have been developed, and are now in service. Known as the "Powder-Weld" and the "Spray-Weld" processes, the methods involve spraying a surface with hard-facing alloy, using a regular metallizing gun or a special powder torch, and then fusing this powder overlay with either an oxyaceytlene flame, induction heating equipment, or a controlled-atmosphere furnace. The result is a fusion bond between the powder overlay and the base material similar to that obtained when gas welding is used to deposit the hard-facing rod. Both processes consist of three steps, and the difference between them lies in the second step.

The first step of both methods is to prepare the surface following, in general, regular metallizing practice. The surface should be grit blasted, especially if it is softer than 28 Rockwell C. This blasting improves the mechanical bond holding the sprayed powder until the fusion bond is accomplished.

Next, the powdered hard-facing alloy is sprayed onto the prepared surface. It is here that the two processes differ. With the Power-Weld process, the powder is sprayed through a newly developed metallizing system. The equipment consists of a torch, control box with pressure regulating valves, and a canister holding the powder. The torch is similar to an ordinary gas welding torch. The process normally uses three gases: oxygen, a fuel gas as acetylene or a natural or manufactured gas, and an inert gas such as nitrogen or argon to provide a protecting atmosphere around the powder as it is sprayed. A mixture of flux and the powdered alloy is shot through the flame and onto the work.

PLASTICS-METAL ROD — With the Spray-Weld process, the powdered metal is pressed together with a plastics binder in the form of a rod which is fed through a regular wire metallizing gun. When the rod passes through the flame, the plastic burns, producing a reducing atmosphere to protect the metal particles from oxidation as they are deposited.



Hard-facing with an oxyacetylene torch gives a good bond with a minimum of weld penetration

After spraying, the final step, the same with either process, is to fuse the overlay to the base metal. The Powder-Weld torch or an ordinary gas welding torch is most practical where only a few small pieces are being processed. With greater quantities, or with large flat pieces, it is usually more efficient to use a controlled-atmosphere furnace. And if the objects are cylindrical, induction heating should be considered.

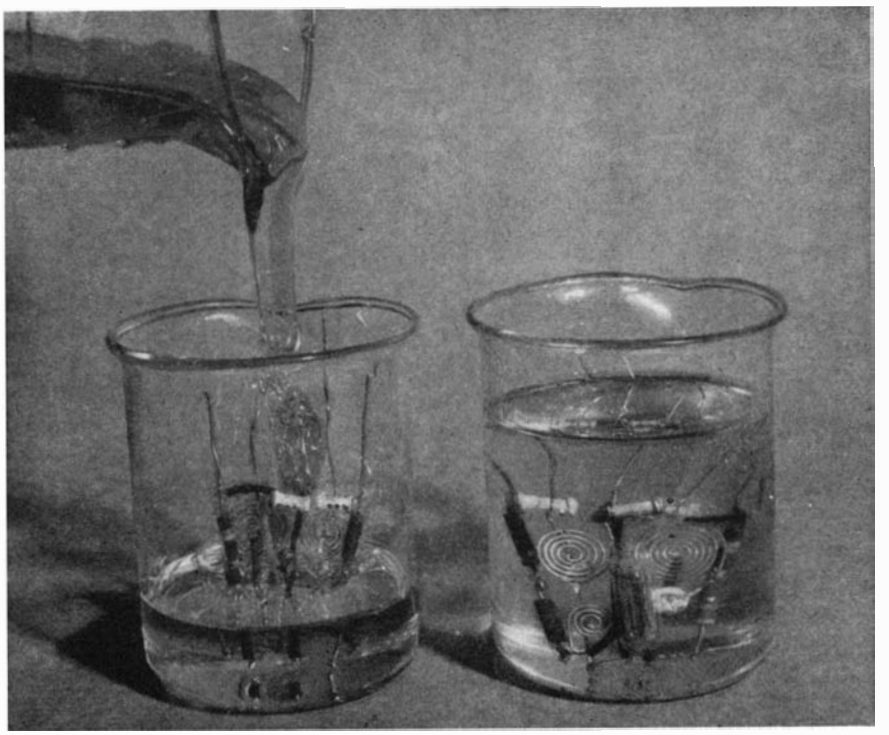
Whatever method is used, the temperature required for bonding ranges from 1850 to 2050 degrees, Fahrenheit. The resulting faced part will have a smooth surface and a hardness of 55 to 60 Rockwell C.

At present, these two processes are limited to one hard-facing material, a nickel-chromium-boron alloy. It can be used to hard-face steel, stainless steels, cast and Meehanite irons, and copper and some of its alloys. It gives a porosity-free overlay with high wear- and corrosion-resistance. The minimum thickness of overlay is 0.010 inch. The Maximum thickness that can be applied with the Powder-Weld process is 0.050 inch and a 0.060 inch maximum with the Spray-Weld process. Any contour may be followed, so the processes are applicable to any pieces whose surfaces can be sprayed, and where any one of the heating mediums for bonding can be used without harm to the part.

A number of other powdered metals and fluxes are under development, and as they become available. the range of hard-facing applications by these processes will certainly expand.

By greatly extending the service lives of countless metal parts, hard-facing reduces the number of otherwise frequent and expensive replacements. It permits the use of a smaller amount of costly high-alloys in the manufacture of many parts designed for heavy wear. And it facilitates production by cutting sharply the hours lost as down-time while parts are being repaired or replaced.

Thus hard-facing, which served so well during the war, promoting conservation of scarce alloys, again serves well in days when costs are critical, and high production is essential.



The free-flowing casting resin is poured into a suitable mold containing the circuit components. When solidified, the resin assures unusually good electrical and mechanical stability

Electronic Preserves

By Embedding Entire Electronic Circuits In a New Casting Resin, They Can Be Given Unusually Great Mechanical Stability, And at the Same Time Proofed Against Moisture and Corrosive Fumes of Many Types

By
P. J. Franklin
and
M. Weinberg
National Bureau of Standards

ELECTRICAL and mechanical stability of a delicate electronic circuit is seldom easy to achieve. But when that circuit is to be subjected to the most violent shock and vibration, to heavy moisture, and to corrosive atmospheres of all sorts, the problem of stabilization assumes Gargantuan dimensions.

Many miniature war-developed circuits—such as those of the proximity fuse—had to function under just these conditions. And it was in search of an answer to the problem of securing the required stabilization for these circuits that the National Bureau of Standards turned to a technique of embedding or "potting" entire electronic circuits in plastics, and developed a new resin for that purpose.

Called the NBS Casting Resin, this new material was developed as a result of extensive experimentation after it was learned that no resin then existing could fill the exacting electrical and mechanical requirements.

Due to the high impedance of the circuits involved, the electrical loss factor—the dissipation of the available energy in the potting compound—became a matter of major importance. While many of the conventional resins supplied the required mechanical stability, and proofed the circuit against moisture and fumes, they were found electrically unsatisfactory. And those few materials with adequate electrical properties were found deficient mechanically. In addition, the applications required a resin of such viscosity that it would quickly encompass all the circuit elements when poured into the container housing the electronic device. And the resin had to harden to a rigid solid without adversely affecting circuit-operation (many resins shrink on gelling, the shrinkage subjecting the electronic components, in some cases, to forces amounting to several tons per square inch).

The new resin, which was developed as a result of experience gained in the proximity fuse program, meets all the requirements of a compound for potting high-frequency circuits: low power loss, good insulating properties, high impact strength, dimensional and electrical stability, low moisture absorption, and

• LOOKING AHEAD •

Complete "plug-in" stages . . . Electronic circuits operation, virtually unaffected by shock, vibration, or contaminated atmospheres . . . Extension of applications of electronic controlling and safety devices as a result.

low volumetric shrinkage during the period of polymerization. In addition to this, the new resin is easily poured through small openings because of its low viscosity and low surface tension.

HOW RESIN IS PREPARED — Preparation of the casting resin is relatively simple. Immediately after putting the components in a suitable mixing vessel, the mixture is placed on a roll mill to prevent clumping, and is rolled until it is viscous.

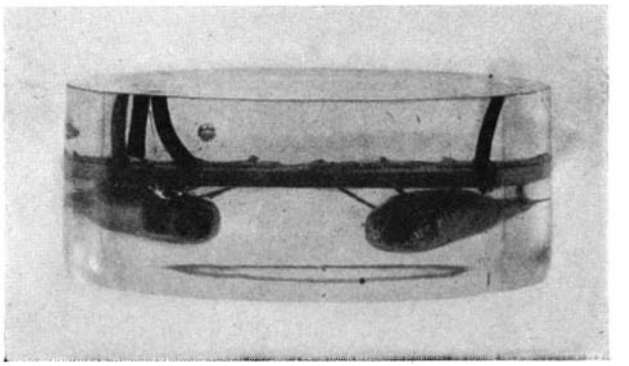
After about 16 hours of continuous rolling, the casting resin is ready for use, requiring only the proper quantity of catalyst to initiate polymerization.

Electrical properties of the resin are affected only to a minor extent by the method of polymerization. The length of time for polymerization of the resin, therefore, should be the minimum required to build up to a point beyond which there is no improvement in mechanical qualities of the plastics. The minimum time, however, varies with the catalyst, the percentage of catalyst used, and the temperatures at which polymerization is initiated and carried out. In addition, the size of the casting must be considered.

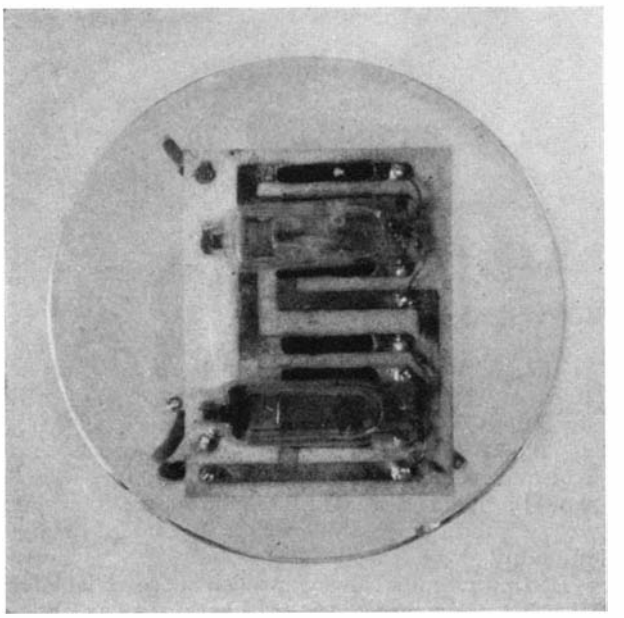
When employing the NBS Casting Resin in devices using glass vacuum tubes, proper protection for the tubes, such as rubber jackets, should be provided to prevent possible cracking from thermal and mechanical shock. All sharp corners should be eliminated from any object to be embedded, because strains set up at these points might cause crazing or cracking of the plastics. In order to eliminate, or reduce, strains, and to obtain maximum hardness and total polymerization, the plastics is cured in an oven for several days after casting.

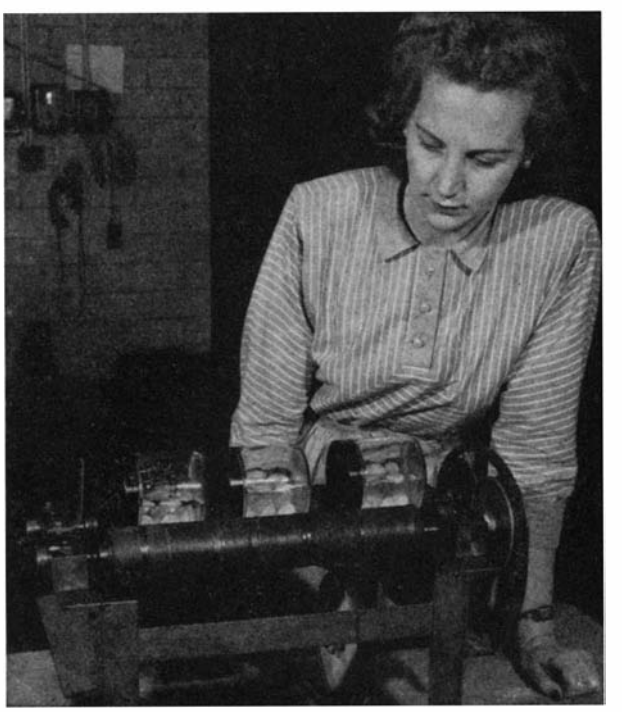
When objects are to be suspended within the center of the casting resin, it is advisable first to gel a portion of the casting resin, and then allow the gelled resin to support the object. The mold is next filled completely with the casting resin and cured, after which the line of demarkation is invisible. Glass and properly lubricated metal molds have been used successfully, and silicone grease is suggested as a lubricant.

EXTENDS ELECTRONIC APPLICATIONS — Various applications at the National Bureau of Standards indicate that, with slight modifications to suit the intended use, the resin can be readily employed in many high-frequency devices requiring such electrical-mechanical insulation. And the special features

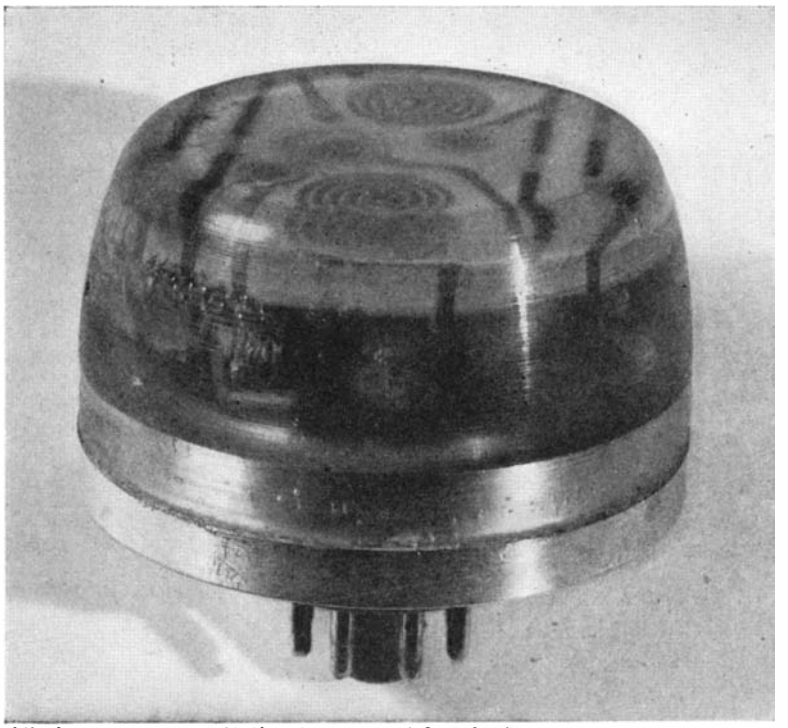


Side view (above) and top view (below) of a potted double-stage amplifier unit





Right: Ingredients of the resin are placed in wide mouth jars and then rolled on a rolling mill for about 16 hours



All pictures courtesy National Bureau of Standards

This plug-in multi-stage electronic control unit, potted in the new casting resin, will operate efficiently and reliably under the most severe conditions

of the NBS resin make feasible many new applications of electronic devices where severe operating conditions have heretofore barred them. The resin should be especially useful in high-impedance control and safety devices in heavy industry, where it would provide adequate protection for circuits against heavy vibration, salt spray, acid fumes, or high-humidity.

Potting circuits can mean even more reliable service from such devices as hearing aids, portable radio transmitters and receivers, radar equipment (especially the smaller air-borne units), and numerous subminiature electronic control devices.

The resin is particularly well adapted for use with the subminiature electronic circuits built by the National Bureau of Standard's circuit-printing technique (see Mass-Production Wiring, page 116, Scientific American, September, 1947). And complete potted plug-in stages for electronic equipment of all types, even standard broadcast receivers, would simplify servicing to a point where it would be little more complicated than changing a light bulb.

The potentialities of the potting process are certainly great. And while many possibilities have yet to appear on the horizon, it is safe to assume that there are few phases of electronics, either industrial or commercial, to which the process could not bring more efficient, more dependable service.

Formula For Casting Resin

COMPOUNDS	AMOUNT BY WEIGHT—%
2,5-dichlorostyrene	33.0
Poly 2,5-dichlorostyrene	21.5
Styrene monomer	21.0
Polystyrene	11.0
Hydrogenated terphenyl (Monsanto HB-40)	13.0
Solution containing 60% divinylbenzene (Dow Q302.4)	0.5

After the components are rolled, as described in the text, a catalyst such as 0.1% benzoyl peroxide is added to initiate polymerization. The National Bureau of Standards warns that, in the preparation of this formula, special treatment must be given the 2,5-dichlorostyrene and styrene, which may contain excessive amounts of inhibitors

Mechanical and Electrical Properties of Casting Resin

Compressive strength, lb./sq. in.	17,100
Coefficient of thermal expansion per ^0C	11 x 10^{-5} (approx.)
Water absorption (24 hours immersion) %	0.01
Volumetric shrinkage on polymerization %	8.0
Power factor (at 100 megacycles and 50% RH)	0.0004 - 0.0008
Dielectric constant (at 100 megacycles and 50% RH)	2.5
Dielectric strength (1/16 in. sample; volts/mil)	610 - 660

Some of the measured properties of casting resin, cured at 50 degrees, Centigrade, employing benzoyl peroxide as the catalyst

Industry Looks to The Screen

The Unparalleled Teaching Abilities of The Sound Motion Picture Have Established for This Medium a Place of Ever-Increasing Importance on Many of Industry's Most Vital Training Programs

By O. H. Coelln
Editor, BUSINESS SCREEN

THE SOUND motion picture, as a means of putting ideas into men's heads, is in a class by itself. No other medium can claim to hold its audience in such rapt attention for so long a period of time, nor present its subject matter with such dramatic impact. And no other medium can hope to develop so close a relationship between the observer and the demonstration. The motion picture's unique ability to reveal graphically many phenomena invisible to human eyes, eliminates hours of involved description and explanation. And other motion-picture techniques such as the animated cartoon reduce many obscure points to readily understood terms in a remarkably short time.

Throughout all industry, the swing is toward training programs in which the conventional lectures, charts, manuals, and so on, are closely integrated with a series of carefully planned training films. So successful have these films been, that they are rapidly building for themselves an importance in industrial education comparable to the importance of the film in the entertainment world.

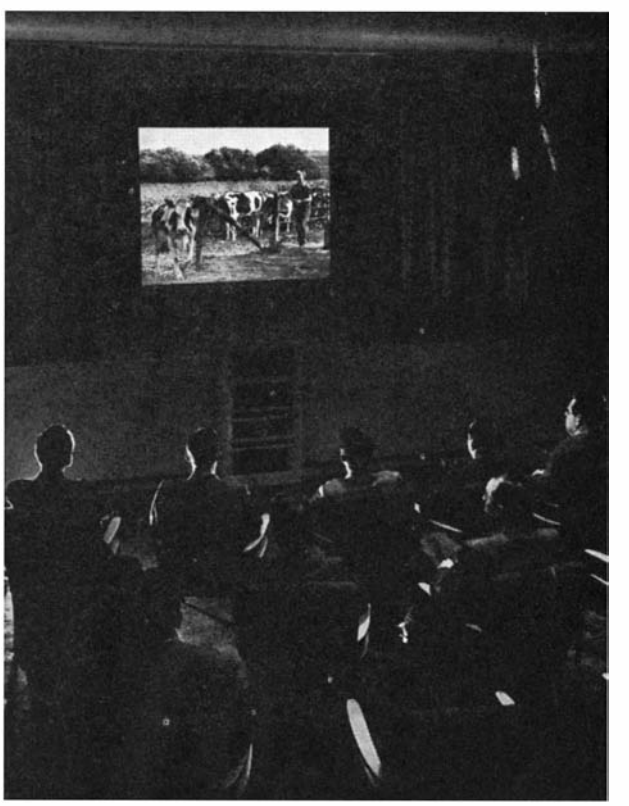
While the industrial training film had gotten off to a good start before World War II, the war gave it a tremendous boost. All branches of service and several of the civilian agencies made extensive use of sound motion pictures to teach specialized knowledge and skills, and to instill attitudes—both of which were extremely important to the successful prosecution of the war.

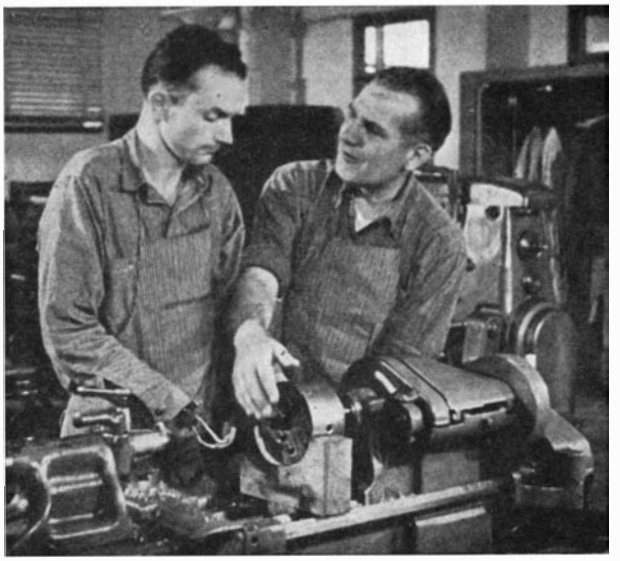
In three years, the Navy alone turned out 1100 training films averaging two reels each, and during the same period of time, produced 2200 slide-films. Motion pictures were used by the Army to teach the recruit how to kill or be killed, and to help him understand the meaning of the war in which he found himself. The United States Office of Education produced a total of 457 sound films. Each of these dealt with a training subject, and about 90 percent of them were "how-to-do-it" films covering all manner of subjects, ranging from how to install a propeller shaft, to how to shear a sheep. Films told war workers and their families how to can vegetables, cut meat, care for the new-born infant, and how to use magnesium welding flux.

EARLY FILMS DEFICIENT — In the earlier days of the training film, a company's entire motion picture training program all too often consisted of a *single* movie of a dull, pompous talk by a finger-waggling sales manager, or a flimsy, threadbare production which possessed all the reality of a high school melodrama.

Consider the difference between such a program, and the present application of visualized training and selling by one national company. In this year the Goodyear Tire and Rubber Company is shooting a total of 173,438 feet of film to make 10 sound pictures and 10 slide-films to be used in conjunction with a number of charts, a series of review quizzes,

The motion picture captures and holds the audience's attention as no other medium can

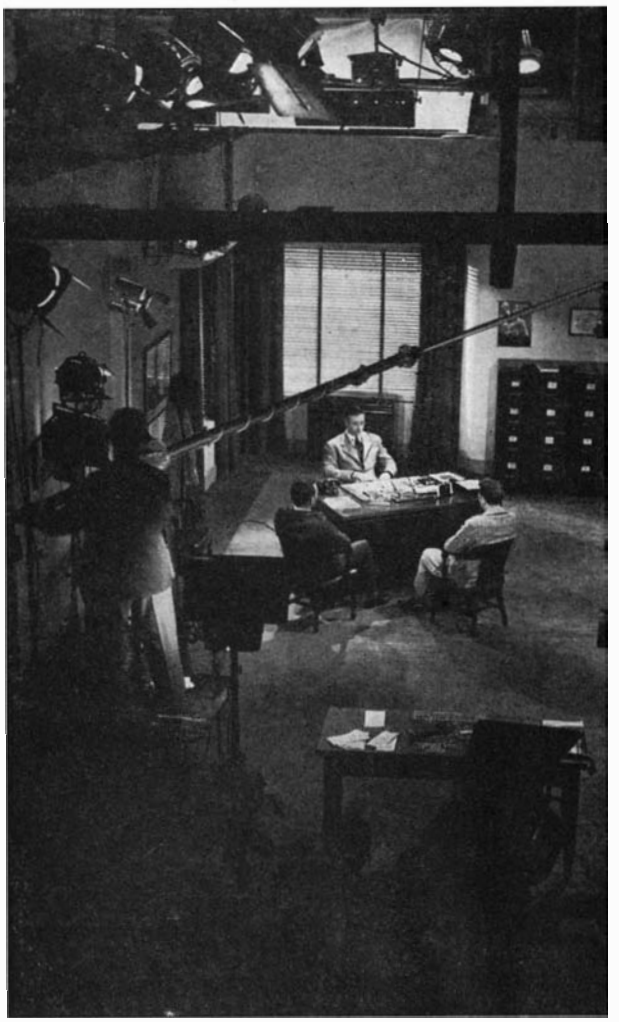




In motion pictures, such as this training film for handicapped workers, an unusually close relationship is possible between the trainee and the demonstration on the screen

A considerable amount of complicated equipment is needed to make the modern business picture

Courtesy Sarra, Inc.



and a considerable amount of well integrated printed literature for a single program consisting of a two and one-half day school clinic for its dealers. Truck-borne projection units will carry all this material to 18,000 Goodyear dealers and their salesmen during the coming months.

SOUND FILM IS CATALYST — If all of this has the aspect of synthetic, projector-fed learning, appearances are deceiving. What has happened is simply this: Industry's training methods have undergone a radical change. Not that there has been a decrease in the time-honored tradition of face-to-face instruction. But more and more frequently, the sound motion picture is being used along with all of the conventional teaching methods to "'catalyze" the training program.

Careful study of the role of the motion picture in an educational program has established these facts:

(1) The interest of the trainees in the subject matter is increased sometimes as much as 40 percent.

(2) Understanding of the subject matter is increased by an average of 25 percent.

(3) Retention of the subject matter is from 35 to 55 percent greater.

Standard Oil of Indiana, United Air Lines, Socony-Vacuum, Sinclair, and others in the vanguard of American industry are far advanced in building the sales and training manuals, illustrated charts, and motion pictures into a single, closely knit program presented by well trained instructors.

TYPICAL TRAINING PROGRAM — Training in many companies begins with historical background films to explain company traditions to new employees. It continues through rather general material on good work habits, company and shop rules, safety education, and similar guidance. The films get more specific in the teaching of skills. Not that you can actually learn to operate a machine tool by watching a motion picture. But controlled experiments show conclusively that trainees who see skill-type films have more confidence in approaching operating stations, and that they are better prepared for personal instruction. Naturally, this results in lower material-loss through spoilage; less time required for learning the machine operation; and fewer fingers poked into fly-wheels.

FILMED IN THE FIRST PERSON — An important feature of the motion picture as a training aid is the fact that the trainee subconsciously sees the hands on the screen as his own. All films, in terms of camera work, are in the first person. As a rule, in an actual shop demonstration, 90 percent of the trainees stand opposite the machine from the instructor, and so they must reverse everything they see him do. By filming the scene from the instructor's side of the machine, however, the motion picture completely overcomes this handicap.

But the abilities of the motion picture are by no means limited to the teaching of manual skills. Says John Shaw, Assistant Vice President of the American Telephone and Telegraph Company:

"We use . . . . films for motivation. We want to create in employees in all departments, the desire to do their jobs better. The motion picture can pack more emotion into a minute than any other medium I know of, or have used. We use them to carry in-

• LOOKING AHEAD •

More and better industrial training films . . . Color rapidly gaining ground . . . Time and materials saved through faster, more effective training . . . Improvements in projection equipment leading toward lighter, simpler projectors.

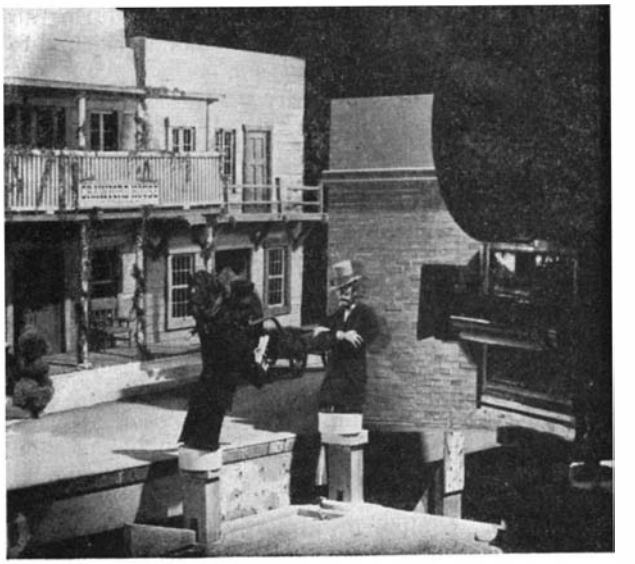
formation . . . . to carry facts to people, to carry basic ideas.

"There is a tremendous barrier existing between the people in whose minds ideas originate and the people to whom the ideas should be communicated. Anything that breaks down that barrier is worth while."

MAKES THE INVISIBLE VISIBLE— The motion picture extends the limits of the trainee's vision as no other medium can. It permits him to observe closely phenomena which are too small, too fast, or too slow to be seen by the unaided eye. Cinema photomicrography; the high-speed motion picture camera, which exposes 3000 frames a minute to capture the flight of objects moving far too swiftly for human sight; and micro-motion pictures, which cram the action of weeks or months (the growth of a plant, for example) into minutes on the screen, are among the techniques that make the invisible visible.

An excellent example of how effectively the motion picture can reveal hidden facts is found in a film on the hatching of chickens by mass-production methods. Produced for an audience consisting largely of poultry farmers, the film contained many of the usual scenes: delivery of the fertile eggs to the hatching plant; preparing the eggs for the incubators; candling of eggs; sorting and sexing; packing; and so on. What "made" the film, however, was the "inside story" of what happens in the egg during the 21 days of incubation. Micro-motion pictures followed the development of the embryo from the first signs of life, to the emergence of the chick on the 21st day—with every stage of formation and activity clearly visible. Obviously, no other medium could have presented such a sequence.

THEY LEARN WHILE THEY LAUGH — The animated cartoon has an almost uncanny ability to reduce and clarify many extremely difficult points to a level where they may be easily grasped. Moving charts and diagrams, and cartooned analogies bring abstract and complicated principles down to simple terms. And by treating a serious and important subject in a light and whimsical fashion, the animated cartoon can often achieve results little short of miraculous. The Army's "Private Snafu" series of training cartoons serves as a classic example. The ridiculous antics of this supposedly mythical character, as he blundered through misfortune after misfortune, brought home vital facts with an effectiveness that hours of lecturing could not equal. Men roared with laughter. But while they laughed, they learned such important lessons as malaria con-



Courtesy Shell Oil Company

Puppets filmed against a table-top set cleverly and forcefully tell an important sales story

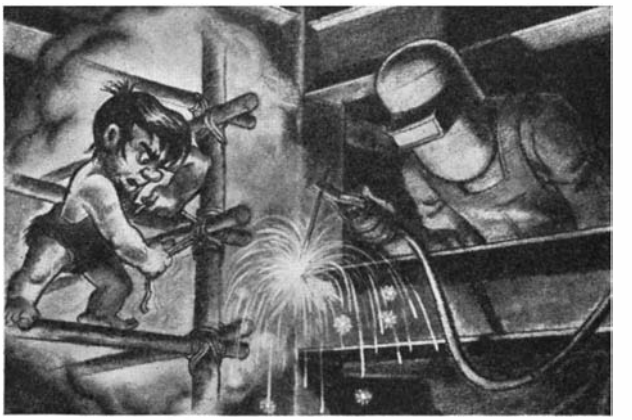
Acres are compressed into a few square feet in this miniature oil-field set

Courtesy Raphael G. Wolff Studios

trol, care of the M-1 rifle, and what to do during an air raid. Industry is now using this same principle to advantage. Animated cartoons, or cartoon sequences in regular motion pictures are achieving great success in lightening the often-heavy industrial education problems.

NO CAMERA NEEDED — Today, a company does not need to have a camera, nor must it hire a studio and photographer, to have an effective motion picture training program. Films, ready-made and waiting, covering literally thousands of training subjects, can be borrowed or rented for a nominal charge. Many of the major companies throughout all branches of industry have films which are available free, except for payment of shipping fees; and the United States Office of Education has a vast number of subjects which are available through regular commercial distributors.

Projection equipment, improved by war-time standards, is more widely available now than at any time in the past five years. The trend is toward lighter, simpler, less expensive projectors, with single case units replacing the larger two-case models. Magnesium, aluminum, and plastics, so evident in post-war projectors means greater portability.



Courtesy Lincoln Electric Company

Whimsical animated cartoons of a serious subject can often lighten an otherwise difficult training task

The sound motion picture for business and industry, as for formal education, is an unfinished chapter in a half-written book. Technogolical advance in motion picture technique is being made, slowly, but more surely. Greater imagination and originality in picture making will once again be foremost to improve even more the sound motion picture—the greatest medium for putting ideas into men's heads that has even come to education.

Films teaching dealers and salesmen how to "sell" are among the most successful types of training pictures

SCIENTIFIC AMERICAN'S Industrial Digest

LIGHT-SENSITIVE GLASS

Forms Three Dimensional Image By Ultra-Violet Exposure

CONTAINING infinitesimal metallic particles throughout its mass, a new type of glass possesses photo-sensitivity to ultra-violet light, and offers new and interesting possibilities as a photographic and decorative material. The images are formed in color and in three dimensions by exposing the glass to ultra-violet light through a negative, and subsequently heat-treating the glass.

This glass, originally crystal clear, is not sensitive to ordinary visible light, and needs no dark room. Exposure naturally depends upon the intensity of the ultra violet and the density of the negative, but apparently is short, being described as "momentary." The exposed glass is subjected to a temperature of about 1000 degrees, Fahrenheit (dull red heat) to develop the image. Once developed, the image is extremely permanent and is free from the graininess encountered with some silver emulsions.

In addition to its obvious value in photographic work, the new glass, a development of the Corning Glass Works, is expected to have important applications in many decorative fields, as well as in making permanent records in a form resistant to both age and fire.—*D.H.K.*

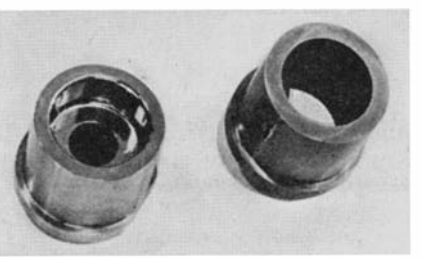
CARBIDE DIES

Cut Maintenance Time in Forming And Blanking Operation

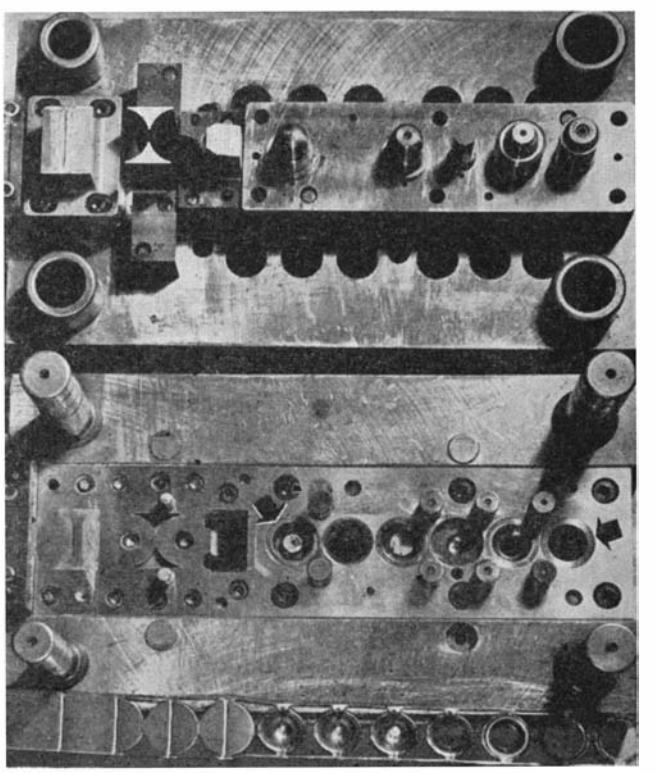
APPLICATION of cemented carbide cut-out and cupping dies in a nine-stage progressive die set has increased runs on the rod bearings for socket tie rod assemblies from 200,000 to 2,000,000 before dies require reconditioning, an auto parts manufacturer reports. Actually, it is claimed, even longer runs could be achieved before the carbide dies become dull.

The cut-out and cupping dies were formerly the most troublesome stages in the progressive set. After about 200,000 pieces were run with the steel dies it was necessary to shut the machine down due to loading up of the cut-out die. The die overhaul required about two hours, during which time the machine was idle. After some three sharpenings, the cut-out die had to be replaced.

To eliminate this bottle-neck, first the cut-out die was changed to Carboloy cemented carbide. Later, the high-speed steel forming die in the fourth station was also replaced with carbide. Both the cut-out and forming dies are of exactly the same design as the respective steel dies; lubricant and machine speed (105 strokes per minute) were not changed.



Above: Carbide forming die (left), after more than 5,000,000 drawing operations, still needs no maintenance. Carbide cut-out die (right) is resharpened only after 2,000,000 operations



Right: Fourth and ninth stations of this nine-stage progressive die set are of cemented carbide (see arrows). The strip at bottom shows the sequence of blanking and forming the tie rod bearings

After more than a year's experience with the new dies, the manufacturer of those rod bearings, Thompson Products Company, now removes the die block for sharpening only after each 2,000,000 operations. Up to the 2,000,000 mark, the carbide cutting-out die is not dulled. They feel however that this practice gives them a longer total service life. For that length of run, says the company, seven steel cut-out dies would have been needed.

The carbide forming die has performed over 5,000,000 operations to date without requiring polishing.

At a conservative estimate, 44 hours of maintenance time have been saved on a year's run of 5,000,000 tie rod bearings, through the use of carbides. This is equivalent to an added production of some 315,000 pieces, according to the Thompson Products Company.

At the first station of the die set, an oil groove is formed. The stock is then successively blanked; given a glancing blow to separate the disks; and then given its first form-

ing draw in the Carboloy die. The fifth station is primarily for locating. At the sixth station, the part receives the final draw, the bottom of the cup being re-struck. Next, the center hole is pierced. The piece receives a re-striking blow at the eighth station. The ninth station is the Carboloy cut-out die. The bearing material is cold drawn S.A.E. 1010 stock, .078 inch thick.

SPECIMENS PRESERVED

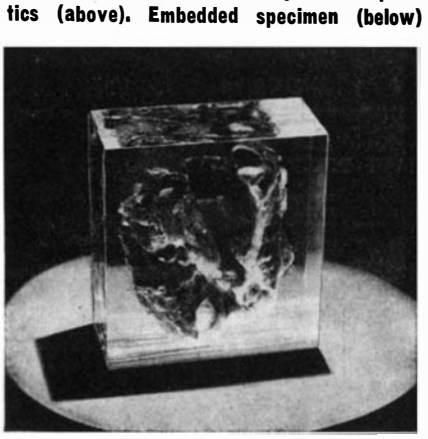
By Embedding In Solid Block of Acrylic

EMBEDDING specimens in acrylic has often been under discussion as a means of preserving animal and soft tissues for long periods of time without their suffering loss of cover or shriveling away. Rohm and Hass Company now offers a process developed by Dr. Max M. Strumia and Dr. J. Ivan Hershey of the Bryn Mawr Hospital in co-operation with this material manufacturer, which promises to meet all the conditions set up by professors, doctors, and students.

The first step in this technique is the freezing of fresh unfixed organs or slices of organs in such a way as to cover them completely with ice. The water is removed (to less than 1 percent) by means of sublimation of water vapor from the frozen state with the aid of a high vacuum and by condensation of the water vapor at −40 to −50 degrees, Centigrade.

The spaces left by removal of the water from the specimens are filled under a vacuum with liquid acrylic monomer. The specimen is then placed on a preformed base of clear acrylic and covered with successive layers of monomer which has been heated until it is partially polymerized. This process is continued until the tissue is completely embedded in acrylic.

The container holding the monomer and specimen is then placed in an oven at 45 degrees, Centigrade until it is completely polymerized into a solid crystal block of acrylic. It only remains to cut the block to the desired shape and size, and polish.—*C.A.B.*



Water in specimen is replaced with liquid acrylic, after which specimen is embedded in successive layers of plastics (above). Embedded specimen (below)

FIRES IN COTTON

Prevented By Dusting Bales With Sodium Bicarbonate Powder

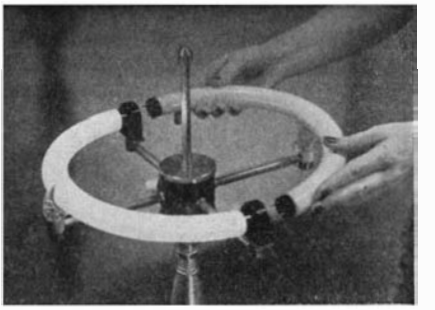
BALED cotton in storage presents a serious protection problem because the fibers are easily ignited, and flame spreads rapidly, eventually producing smoky burrowing fires that are difficult to extinguish. Preliminary tests at an experimental station of the Associated Factory Mutual Fire Insurance Companies' laboratories show that by dusting the surfaces of cotton bales with sodium bicarbonate powder, ignition from small external sources such as sparks or match flames can be prevented. When exposed to heat under such conditions, the sodium bicarbonate powder releases an inert gas that reduces the oxygen content to a point where ignition does not occur.

Cotton bales dusted with sodium bicarbonate are not subject to the characteristic surface flash fires which usually occur and quickly involve all the exposed bales in the storage unit. The powder is not expected to interfere with manufacturing as it will be blown from the fibers in the normal preliminary processing. And it has no abrasive or corrosive action on bearings or machine parts.

CRESCENT FLUORESCENT

Permits Novel Decorative Lighting Effects

PROVIDING more light than a 50-watt incandescent lamp, but consuming only about one third the power, a new semi-circular fluorescent lamp called Circlarc, is designed for table and floor lamps, for wall and ceiling fixtures, and for interiors where the lamp itself will add a decorative dash.



Tubes in tandem form fluorescent ring

This Circlarc will permit unusually great flexibility of uses. For example it now is possible to use a standard curved fluorescent lamp in a convenient pinup fixture over the bed or in a wall bracket. A pair of these fluorescents can girdle a column, and a single tube in a desk lamp tucks neatly under a half-moon shade. When twinned, they will form a circle in floor or table lamps.

The Circlarc, product of Westinghouse Electric Corporation, is an 18-watt tube curved like a crescent. It has a useful life expectancy of 2500 hours at three hours average burning for each start, two and one half times longer-lived than a 50-watt incandescent bulb. Two-pin plastics bases at each end of the crescent connect the lamp to the electric circuit.

PLASTICS ALLOYED WITH SYNTHETIC RUBBER

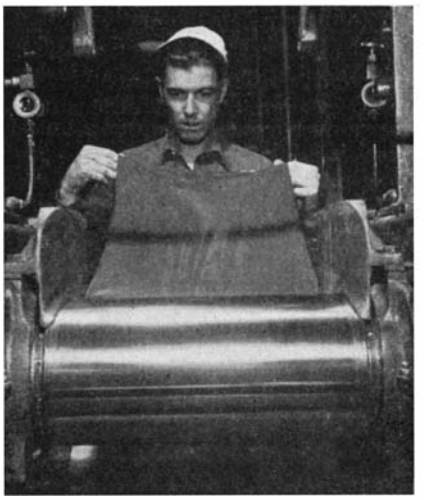
Combines Advantages of Both Materials

GREATER use of synthetic rubber in the manufacture of plastics can be expected to develop new, large-scale production of consumer items in which advantages of both materials are combined. Alloyed with synthetic rubber, plastics can be used to make such new and varied items as kitchen floor tiling so tough, resilient, and resistant to oils and grease that it can serve also for garage floors; tissue-thin, transparent food wrappers that will not crack under freezing temperatures; and fenders that will bounce back to their original shapes after being bumped. So far, the Buna-N types of synthetic rubber have shown far more versatility in connection with plastics manufacture than any other type.

As an alloy for polyvinyl chloride, only one of 30 basic resins used in the manufacture of plastics, 40 to 60 million pounds of Buna-N types of synthetic rubber ultimately will be

required annually, according to *The Lamp,* publication of the Standard Oil Company (N. J.).

In the field of thermosetting plastics, introduction of synthetic rubber not only will toughen the product, but will increase its color range. Heretofore, many of the thermosetting plastics lost their essential qualities when heavily pigmented. Blended with synthetic rubber, it is now possible to produce heavily pigmented thermosetting plastics of good physical characteristics in a wide variety of colors.



This tough film is calendered from a vinyl-Buna-N compound on a rubber mill

TRUE CARBURIZING

In Oxygen-Activated Cyanide Bath

A NEW TYPE of cyanide salt bath for case hardening of steel parts, which overcomes most of the previous objections to cyaniding, has been developed by Park Chemical Company and applied by Michigan Steel Processing Company with excellent results.

The distinctive features of the new bath are gas activation of the bath and complete water-solubility of the salt adhering to the work. Conventional cyanide baths have employed salts of barium, strontium, calcium, and so on, as activators, and these salts produce insoluble compounds in the bath that are difficult to remove from the heat-treated parts.

Although the salt bath is of the cyanide type, the case produced is a true carburized case, rather than a cross between a carburized and a nitrided case as is normally produced in a cyanide bath. Activation of the bath with oxygen gas is responsible for this difference. The same bath can be used for both carburizing and cyaniding, serving the former purpose when operating with the gas activating agent, and the latter without the gas. The salt melts at 1150 degrees, Fahrenheit, and works well within the range of 1300 to 1750 degrees, Fahrenheit.

When operated at 1700 degrees, Fahrenheit, a case of 0.015 inch is produced in the first hour, 0.010 additional the second hour, and 0.005 inch more in each succeeding hour. —*F.P.P.*

NYLON FAUCET WASHERS

Last Longer, Function Better Than Those of Rubber, Fiber

DRIPPING faucets may soon be a nuisance of the past, thanks to new injection-molded nylon faucet washers that offer a number of advantages over the traditional washers of natural and synthetic rubber or fiber.

The advantages of these nylon washers, that are being produced in eight diameters by Atlantic Plastics Inc., are readily seen when the properties of this particular plastics are set up against the operating conditions to which washer materials are subjected.

1. Washers undergo constant intermittent service in both hot and cold water, a condition that nylon is able to withstand because it expands and contracts very little under thermal change.

2. Nylon's toughness resists the cutting and wear to which washer material is subjected when forced against seats roughened by the action of mineral salts.

3. Washers must withstand water pressure against smooth faucet seats. Nylon's coefficient of friction well fills this requirement.

4. Nylon possesses the right balance of flexibility and rigidity for a washer material, which must conform to surface irregularities and permit hard foreign particles to imbed themselves in the washer rather than hold open the valve.

5. Continued exposure to elevated temperatures has been found to shorten the useful life of many rubbers and thermosetting materials that have been used as washer material. Nylon, however, does not suffer in this way, having a high heat-resistance which keeps it from hardening when exposed to high temperatures.—*C.A.B.*

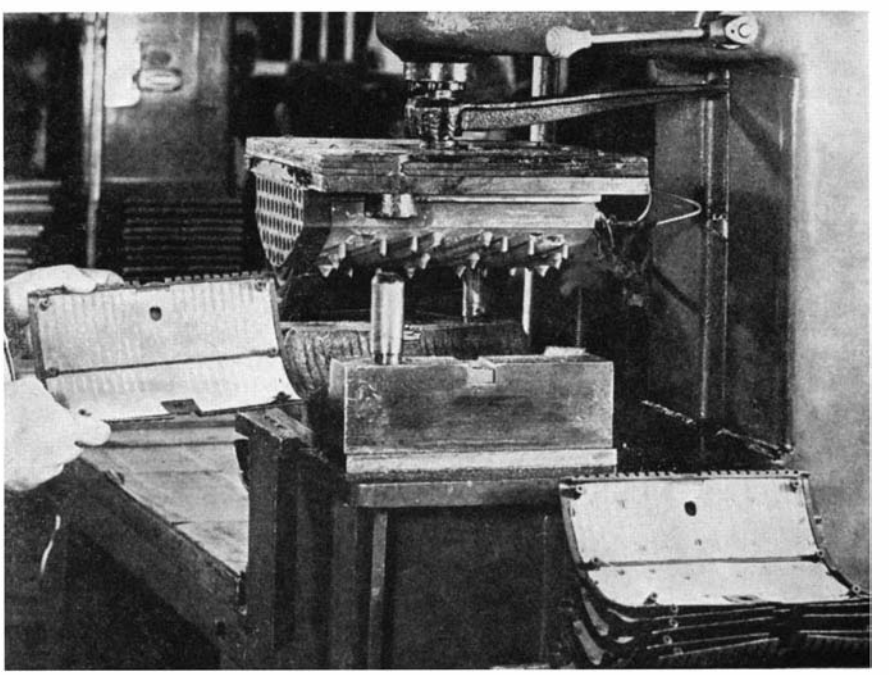
RADIO GRILLS ASSEMBLED

By Electrically Heated Dies On Standard Hydraulic Press

PROVIDING a simple answer to the problem of obtaining high output rates with accurate control and ease of operation in the assembling of metal screens to plastics radio grills, standard hydraulic bench-type presses, as produced by the Colonial Broach Company, are in use at the plastics plant of the Ford Motor Company.

Currently produced are some 300 grill assemblies per hour on three presses, equipped by Ford with special upper and lower dies. The upper die, of cast iron with some 24 projecting "fingers," is electrically heated with a thermostatically controlled resistance coil.

The metal screen is merely laid



One such press can turn out 100 metal-plastics grills per hour

over the plastics grill which is laid in the lower die. The control lever is then thrown on the machine, causing the upper die to move down until the heated fingers have pressed the screen into the plastics to a depth of 1/16 of an inch. The heated fingers plasticize the grill at these points, so that the screen is well embedded.

The head is then retracted and the completed assembly removed, the plastics solidifying to hold the screen securely at the 24 points of attachment.

Important advantage of using a hydraulic press here is that the pressure is "cushioned," protecting the plastics against shock. Also, the stroke of the machine is accurately controllable by means of the standard adjustable stop on the press.

SYNTHETIC ESTERS

Replace Natural Waxes In Many Applications

CASTOR OIL, whale oil, and palm leaf oil are the raw materials for a series of wax-like esters which are now produced in England and will soon be manufactured here.

Abril Corporation, maker of these synthetic waxes, now markets 32 different ones as standard items. They vary in melting point (43 to 285 degrees, Centigrade), acid value, color, and other properties, thereby duplicating the whole range of natural waxes. They are soluble in petroleum solvents, insoluble in water, and compatible with all paraffin and vegetable waxes. They can also be emulsified.

It is as components of wax polishes that they expect to find their widest market. Other applications are as ingredients in carbon-paper coatings, printing inks, cosmetics, candles—in short, practically all wax uses.

Of particular interest is the high-melting wax. Melting considerably above the boiling point of water, this wax may prove ideal in coating paper containers for hot beverages and foods.—*H.C.E.J.*

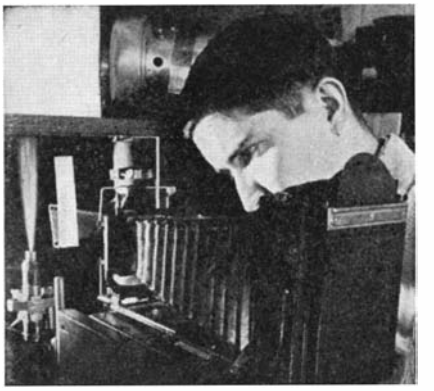
SPRAY PATTERN

Of Fuel Injection Nozzle Studied By High-Speed Photography

ULTRA high-speed photography using stroboscopic light makes possible the study of hitherto unknown fuel spray patterns of injection nozzles in internal combustion engines by "stopping" the fuel particles at any desired point. Revealing fuel spray characteristics, this technique being employed by the Texas Company permits petroleum technologists to determine whether spray patterns are correct for the most efficient combustion. It is anticipated that by directly correlating these patterns with the nozzle designs, more efficient and reliable engine performance can be achieved.

Already, in an analysis of aircraft engines experiencing dilution and hard starting, this method has proved of value, determining that these troubles were due to poor atomization, irregular fuel injection, and thus incomplete combustion. With the new data, it became possible to make recommendations which assure improved combustion.

The fuel spray photographs can be taken in one to two millionths of a second. With this very short exposure time, the rapidly moving fuel spray can in effect be "stopped" at any point and considerable detail is revealed concerning the general shape of the spray and the direction and distribution of the fuel particles. The stroboscopic light is synchronized with the fuel pump and the flashing circuit is arranged



Fuel spray is photographed with an exposure time of one micro-second

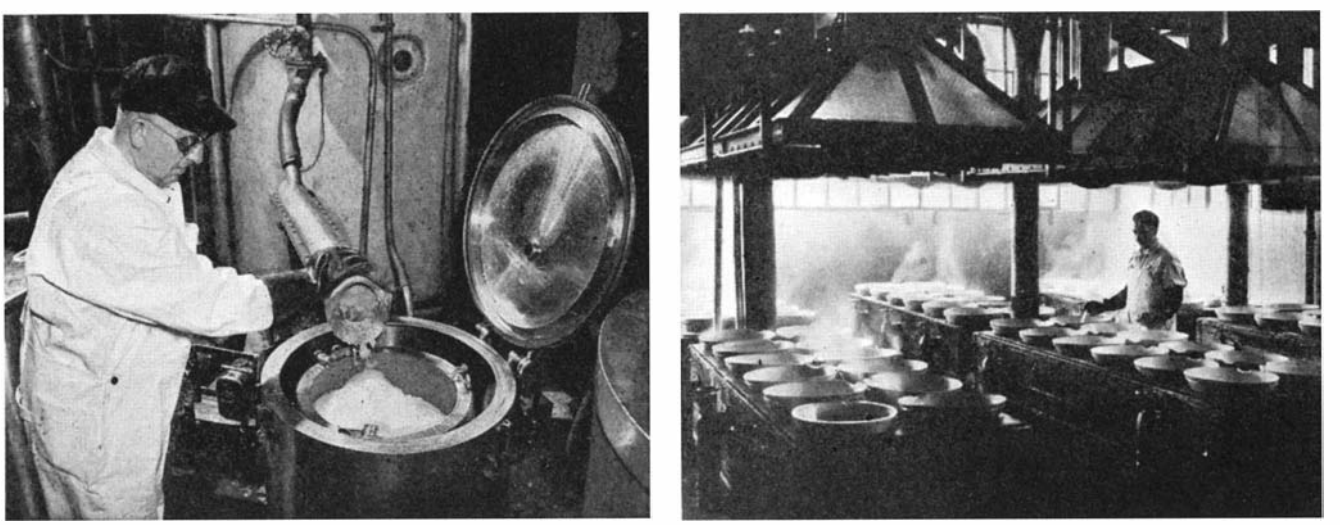
to permit either single or continuous shots. These shots show the spray pattern at any desired stage of its development from start to finish in this injection cycle.

SILVER NITRATE CRYSTALS

Mass-Produced By a New Continuous Process

REPLACING the old and picturesque—but slow—method of producing silver nitrate crystals by evaporation in open porcelain dishes, a new process produces crystals continuously, and dries them in a few minutes.

As the first step of the new process, developed by Eastman Kodak Company, several pieces of silver, 99.97 percent pure, are dissolved in nitric acid. The resulting greenish liquid goes into storage tanks, from which the solution is pumped slowly into crystallizers. In the crystallizers, 1000-gallon stainless steel tanks, the liquid is constantly stirred by circulating pumps. This stirring, and the constant addition of fresh silver nitrate solution re-



Producing a continuous stream of silver nitrate crystals, the new process (left) replaces the slow open-dish evaporation method (right)

sult in the formation and growth of silver nitrate crystals in the lower part of the tank. Soaking wet and resembling salt, the crystals then are drawn from the tank through a pipe and poured into perforated stainless steel baskets.

The baskets, containing from 60 to 70 pounds of crystals, are whirled, to drive off most of the moisture.

The crystals are then redissolved in distilled water, and again they go through the same crystallizing steps. After the wet crystals come from the crystallizers the second time, and have been whirled until they are only slightly damp, they are dumped into a rotary drying drum.

At the other end of the revolving drum the crystals, to be used largely by the photographic industry, pour out completely dry.

WELDED NUTS

Insure Solid and Accurate Assembly of Car Frames

INGENIOUS yet simple, a manufacturing process which not only increases the security of attachment of automobile or truck bodies and steering gear assemblies to chassis frames, but also reduces manufacturing cost and chances of misalinement, consists of projection welding previously threaded nuts to frame side rails. The nuts have four projections formed on the attachment side of the head during the forging process. To attach a nut to the frame, it is placed, with projections up, in the lower die of the platen of a Progressive Welder Company press welder. The side rail is slid along, until a registering hole in the channel drops over the shoulder on the nut. The upper platen is brought down, one shot of current is passed through the electrodes, fusing the projections to the side rail, and the job is finished.

Advantages over the previous method of either arc welding or mechanically attaching such nuts, are greater security of attachment, accurate alinement, and considerable increase in output, particularly since nuts do not have to be retapped after welding.

SCREW-TYPE TRANSMISSION

Enables High-Speed Shifting Without Power Lag

ABLE TO shift into any one of four speeds in one second, and readily adaptable to "push button" control, a new type of transmission was developed during the war for use with a multiple-speed high-altitude supercharger, and is now available for use in ground and marine transport, or in stationary powerplants requiring quick changes in speed.

The transmission, having only half as many parts as present automatic types, may be shifted under any condition of speed or load, without the temporary lag or loss of speed and power now encountered in shifting with a conventional transmission. The mechanism requires little or no adjustment for wear, shifts more easily, and automatically synchronizes gears before each shift. In motor vehicles, it substantially reduces the tendency of wheels to spin on icy or slippery roads.

Known as a "screw shift" type, the transmission, developed by the Curtiss-Wright Corporation, has helical or spiral grooves cut in the main shaft which is the center of the mechanism. Action of the shift lever moves selector gears forward or backward along this spiral until they synchronize with the desired gear. In this way there is a constant torque or twisting force on the drive shaft and all shifting is done in a straight forward or reverse motion, unlike the conventional "H" type shift.

WIRE CONVEYOR BELT

Can Turn Sharp Corners, Is Suitable as Cooling Line

ABLE to turn corners without tipping—describe a complete circle if need be—move a product uphill or down, or horizontally straight ahead, a steel grid conveyor belt has been designed for industrial process lines with special space requirements. The new conveyor's open construction permits the air circulation required for cooling a light-weight product while in motion. A section two feet wide weighs only three pounds per linear foot and is made in bright, galvanized, tinned, or stainless steel wire as may be most desirable to meet special conditions in manufacturing operations. Thus the cooling belt lines of a baking plant, for example, may be designed to hug the walls, turn as many corners as necessary, and to stack flights to ceiling heights with as little as ten inches between loaded faces. There are no lubrication problems and, because steel wire is used, no difficulties result from fats, oils, greases, fumes, or heat. Known as "Flex-Grid," this wire-built belt is manufactured by Cyclone Fence Division of American Steel and Wire Company.

Necessarily, Flex-Grid belts must be assembled to meet the needs of the individual user's design, taking into consideration such problems as service life, speed of transfer, weight, power required to operate, and slippage. As the belt is assembled from individual straight, stiff wires, it is possible to compensate wear factors by replacing one or more links at a time—a simple and easy operation.

The belt is made from nine-gage steel wire assembled on one half inch centers and is available in standard widths, from six inches to two feet, in straight lengths or curved sections. Normal construction involes lengths up to 40 feet.

Open construction of the wire conveyor facilitates cooling of articles in transit

New Products

FLOW PRESSURE FANS

Claimed Sturdy, Compact, And Efficient

DESIGNED for either vertical or horizontal operation, a new line of flow pressure fans are said to have high mechanical and static efficiency against wind and duct systems. Compact in design and sturdy in construction, these new fans, products of the Westinghouse Electric Corporation, feature also low weight, straight air flow, and simplified mounting. Sizes of these fans run from 18 to 72 inches, with displacements of from 2000 to 115,000 cubic feet per minute.

Two basic types of these Axiflo Fans, as they are called, are available: the straight-through type, or the conventional elbow type. Both types can be had with either a three-bladed aluminum wheel, or an eight-bladed steel wheel.

SLIDE PROJECTOR

Casts Clear Image on Screen In Partially Lighted Room

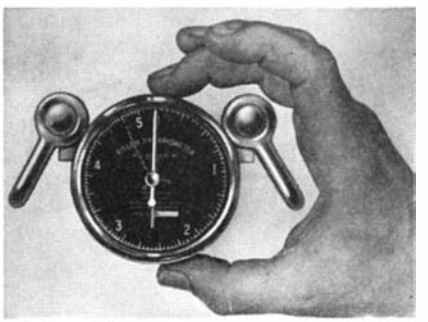
ENDING the need for a completely darkened room during the showing of slides or transparencies, a new slide projector throws a clear image on the screen even when the room is sufficiently well lighted to permit the audience to take notes. Secret of the ability of the Eastman Kodak Company's new Master Model Kodaslide Projector to produce clear screen images under such conditions lies in the fact that the projector delivers more light to the screen than any other projector ever created for two by two inch slides and transparencies. This is made possible through the use of a 1000-watt projection lamp and extremely "fast" lenses, coated with a microscopically thin layer of magnesium fluoride to increase light transmission.

A very "fast" coated lens makes possible the unusually brilliant image

SMALL DYNAMOMETER

Measures Tension in Confined Areas

TO MEASURE tension or forces in those "tight" spots found in many types of mechanical assemblies, a miniature dynamometer has been developed that is said to be the smallest of its kind. The case measures three inches in diameter; the instrument weighs but one pound. Available in 100, 250 and 500 pound capacities, it has an unbreakable lucite crystal and red maximum hand. The dial of the instrument, product of W. C. Dillon and Company, is black with etched silver numerals.



In 100, 250, or 500 pound capacities

WELDED HAND TRUCK

Has Built-In Lift Bar To Simplify Loading

AN ALL-WELDED hand truck, featuring a special prybar which simplifies lifting and moving of heavy crates weighs only 60 pounds and is constructed primarily of steel tubing. Heavy duty, roller-bearing wheels, of as small diameter as possible, are used on the front end of the hand truck where the burden of the load is balanced, and casters are used for the rear wheels.

The truck, known as the Whiting Wheeler, approaches a case resting flat on the floor with the "prybar," pointed toward the floor and it slips under the edge of the case with very little effort. The prybar then is pushed down with one foot, thus raising the case about an inch and a half with a lever ratio of 10 to 1. At the same time the handle of the truck is raised, increasing the lift, and permitting the edge of the case to go over the top of the front set of rollers. At this point it is necessary to give the truck only a quick thrust forward to complete the loading.

It is claimed that the forward movement of the hand truck, a product of the Whiting Engineering and Manufacturing Company, will not noticeably advance the crate, and consequently there is no necessity for backing the crate up against a wall or other immovable object. The truck has a capacity of 600 pounds.

Courtesy Lincoln Electric Company

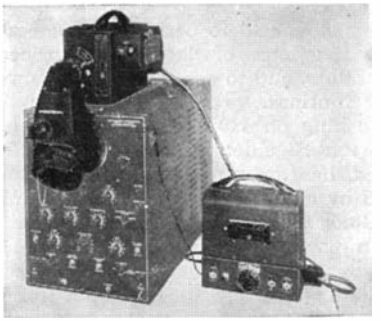
To load, the operator pushes the hand truck under the edge of the case which is held off the ground by the prybar

OSCILLOSCOPE CAMERA

Takes Still or Continuously Moving Film Record of Trace

EQUIPPED for mounting atop standard laboratory oscilloscopes, a 35-mm camera, which makes still or continuously moving film records, photographs high-speed phenomena, as well as very low-speed phenomena (too low for visual continuity). It is also used for quantitative studies of oscilloscope traces for record purposes, and for tests using new multiple-beam tubes. It is said that by using the sweep circuit of the oscilloscope in conjunction with the variable speed drive, the speed of the trace photographed is limited only by the writing speed of the oscilloscope itself. By adjusting the speed of the film, the camera records each successive sweep across the film without the use of a shutter. If desired, the moving film can be used as the sweep, giving a continuous recording along the film. The film rate is continuously adjustable from one inch per minute to 3600 inches per minute (or five feet a second).

Continuously variable oscilloscope photography is the type most desirable for many applications, but provision is made for single exposures by a



The camera, operating through a periscope arrangement, sits on top of the oscillograph. Control unit is at right

shutter with speeds of one second to 1/400 of a second. Its frame size can be adjusted up to double 35-mm size. A positive interlock keeps the shutter open for continuous recordings.

For continuous strip photography, the rate of film movement is governed by an electronic control giving a speed variation of 60 to 1, continuously adjustable throughout this range by means of a calibrated dial. A clutch is provided on the camera for an additional 60 to 1 gear ratio. This clutch, which may be shifted while the camera is photographing, is operated by a simple push-pull knob. Thus it is possible to have the camera running, for example, at 60 inches per minute, and, by means of the clutch, shift it immediately to 60 inches per second.

The Oscillo-Record Camera, as it is called, takes standard 100-foot rolls (a satisfactory length for most applications) of 35-mm film, or film in standard 400-foot or 1000-foot magazines. With the 100-foot rolls, the camera operates from 20 seconds at the maximum speed, to 20 hours at the minimum. A footage indicator shows the number of feet film exposed.

As a solution to the problem of mounting which has hitherto handicapped the use of a camera with an oscilloscope, this camera, manufactured by the Fairchild Camera and Instrument Corporation, is easily set up on top of the scope, out of the way of the controls, with a simple mounting arrangement which also automatically insures correct focus. Provision is also made for tripod mounting. The unit is designed to fit five-inch ray tubes, and an adapter is available for three-inch tubes. The operator may view the readings of the scope while they are being photographed for permanent record.

Provision is made for recording on the film any hand-written data, by means of an illuminated card supplied with the camera. Thus, the data becomes a permanent part of the film record, and danger of loss or mixup is obviated.

SCREW ANCHOR

Of Pleated Plastics Holds Screw Firmly in Stone or Plaster

SIMPLIFYING the anchoring of screws in such materials as plaster, brick, stone, concrete, glass, and so on, a new type of plastics screw anchor may be used with either wood or lag screws. Overlapping internal and external slits along the length of the anchors result in a "concertina-type" expansion which develops holding power far beyond the requirements of most applications.

The anchor is slightly larger than the hole into which it is to be inserted. Thus, when it is forced into the hole, those "concertina" slits compress; when the screw is driven into the anchor, the slits expand, firmly holding the screw in the hole. Produced by Holub Industries, Inc., the anchors are available in seven common sizes and in various lengths.

The plastics of which the anchor is made has great impact and tensile strength, and is unaffected by weather, water, or acid. It will withstand temperatures from 78 degrees below zero, to 180 degrees above zero, Fahrenheit, and has good electrical insulating properties.

PLANT LAY-OUT TEMPLATES

Of Acrylic, Serve as Negatives in Blue-printing Arrangement

PROVIDING permanent facsimilies, accurately scaled, of machines and equipment, new acrylic templates for plant lay-out are made from sheet-Plexiglas, one surface of which is coated with a photosensitive emulsion. Scaled drawings of machinery and equipment are reproduced as negatives on this emulsion. Then, by carefully cutting the plastics around the outline of the reproduced drawings, accurately scaled templates are produced, on whose under-sides are diagrams in negative of the machines which they represent.

These templates are used in conjunction with a thin, transparent plastics mat which is ruled off into quarter-inch squares (each square representing one square foot). On this mat the outlines of the plant area, along with locations of conduits, traffic aisles, tool cribs, material bins, and so on, are drawn with grease pencil.

To make a blue-print of a proposed or final lay-out, a smooth magnetic-metal sheet is overlaid with a special printing paper. On top of this is placed the mat representing the plant area. The templates of machines and equipment are then set on the mat. The attraction for the metal plate of small, circular Alnico permanent magnets fixed to each template, hold the template securely in any desired position.

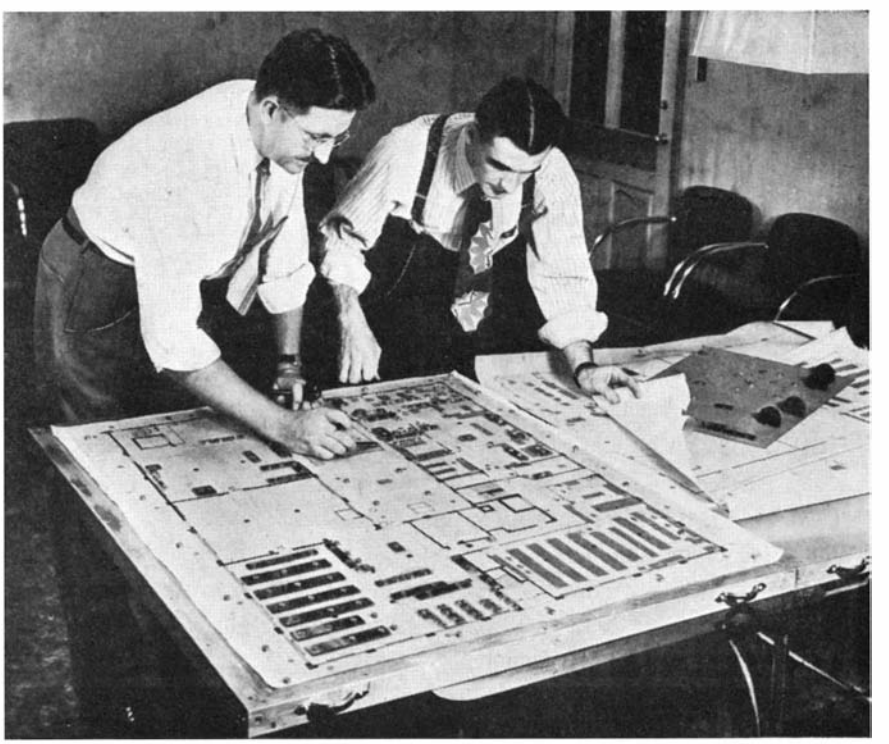
According to the overall size of the lay-out one or more quad-lamps with reflectors are used to expose the paper. Development of the pattern is accomplished in about three minutes over an ammonia vaporizer. The resulting print shows, in blue on white, a positive reproduction of each piece of machinery and of the other floor-plan details, super-imposed upon the scaled floor area.

This set-up, developed by John Hill Layouts, can conveniently accommodate more than 40,000 square feet of floor area to the quarter-inch scale.

CARTON MARKER

Features High Rate of Speed And Simple Operation

AUTOMATICALLY imprinting flat-folding cartons with code-dates, control numbers, or any similar data, a new coding machine is said to mark as many as 4500 cartons per hour. Called the Cartoncoda, this machine is adjustable to accommodate a wide range of carton sizes, and requires no skill to operate. The operator simply loads unmarked



Small circular magnets hold the plastics template fast to the lay-out mat

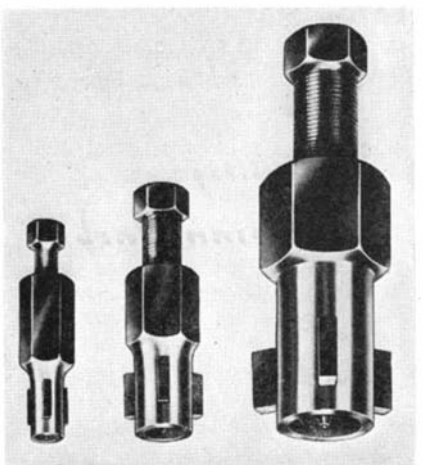
cartons onto the infeed magazine, which accommodates a stack 12 inches high. Each carton is fed to a conveyor belt which carries it to the marking stations where the code is imprinted. Then the marked carton is deposited on a return conveyor belt which leaves the carton within easy reach of the machine operator.

This machine, which is a development of Adloph Gottscho, Inc., uses ribbed-base rubber marking dies which are easily changed when a new imprint is wanted. The unit is small and compact, occupying a floor space only 18 by 40 inches. It is powered by a ¼ horsepower motor operating on 110-volt, 60 cycle A.C.

INTERNAL PIPE WRENCH

Sturdily Built, Removes Broken Pipe or Close Nipples

CLAIMED to have sufficient strength to strip a thread without losing its grip, a new type of internal pipe wrench is designed for quick and easy removal of broken pipe, close nipples, and gate and globe valve seats. It consists of a screw-type mandrel that forces outward three gripping dogs until they



Turning mandrel forces out gripping dogs

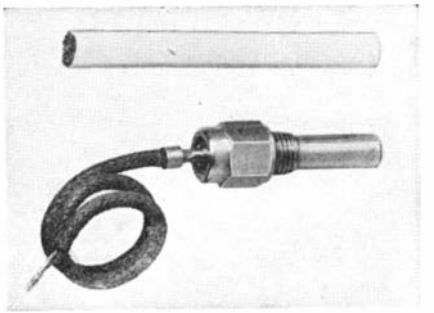
bite firmly into the inside of the pipe. Then, with the application of any standard wrench, the pipe or nipple is quickly turned loose and removed.

Marketed as the B and D Internal Wrench, it is designed for speeding up and simplifying maintenance work wherever pipe is used. It may be used on nickel, chrome, or brass fittings. The gripping dogs are made of hardened tool steel and body is high tensile steel alloy.

THERMAL LIMIT SWITCH

With Wide Control Range Operates Under Severe Conditions

GIVING warning when excessive temperatures are reached in automotive gear boxes, railway journal boxes, or other similar units, a new thermal control and limit switch is easily installed. The switch serves also as an indicator of high or low temperature in fluids



Thermostat is smaller than a cigarette

under pressure, or of temperatures of static fluids, such as oil in crank cases and water in cylinder blocks, or of exhaust stack temperatures. Its thermal control range lies between —60 degrees and +600 degrees, Fahrenheit, and its amplitude of operation is plus or minus 3 degrees, Fahrenheit. The device, called Plug-Stat, operates on 28 volts, two amperes, either A.C. or D.C., and is available with either normally open or normally closed circuit. Manufactured by Control Products, Inc., the switch weighs .67 ounce and is hermetically sealed. It is said to be the smallest thermal limit switch now in production, and is designed to operate under conditions of severe vibration, dirt, and abuse.

DIELECTRIC HEATING TUBE

Features Rugged Construction And Easy Installation

DEVELOPED for industrial heating applications, a 2500-watt oscillating tube is designed for use in dielectric heating of plastics preforms, electronic bonding or gluing of laminated plywood, and sealing of plastics materials such as synthetic rubber and cellulose acetate. Two tubes in a coupled circuit will give a power output of four and one half to five kilowatts at frequencies up to 50 megacycles.

Radial cooling fins with large surface areas and unrestricted air flow combine to provide highly efficient forced-air cooling of the anode. The minimum air flow for cooling the tube, designated type 7C25, is 150 cubic feet per minute. Ruggedly constructed, with flexible leads allowing safe and easy installation, these tubes, developed by the Federal Telephone and Radio Corporation, have a maximum plate voltage of 4500 volts. With a thoriated tungsten filament the tube operates with a filament voltage of 11 volts and current of 27.5 amperes. The tube measures three and one half inches in diameter and seven inches in height with flexible tube leads six inches in length.

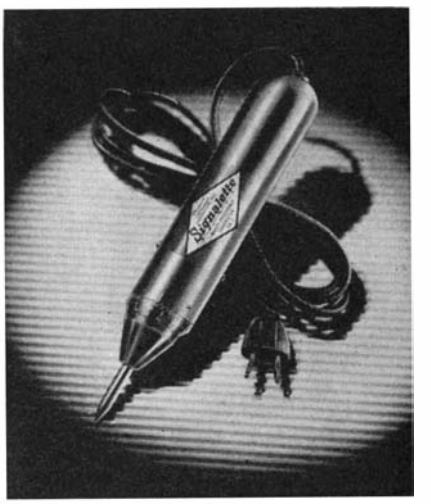
POCKET SIGNAL GENERATOR

Has Wide Frequency Range Output To Speed Radio Servicing

PRODUCING radio, intermediate, and audio frequencies (from approximately 2500 cycles through 20 megacycles) simultaneously, a pocket-size signal generator is said to perform the necessary functions of large, high-priced generators, and to speed up radio servicing routines.

Working on 110 volts, either A.C. or D.C., the Signalette, as the device is called, has an output which is modulated by 60 cycle supply when used on A.C. line; the modulation is not present when used on D.C. supply. Checking receiver sensitivity; alining intermediate frequency stage; alining radio frequency stage; peaking auto radio antenna; checking auto radio shielding, locating breaks in concealed wire, checking audio amplifier gain; and localizing trouble in receivers (signal tracing) are among the instrument's functions.

Approximately 9¼ inches long, 1½ inches in diameter, and weighing only nine ounces, the instrument has an adjustable output attenuator and is



Signal generator is 9¼ inches long

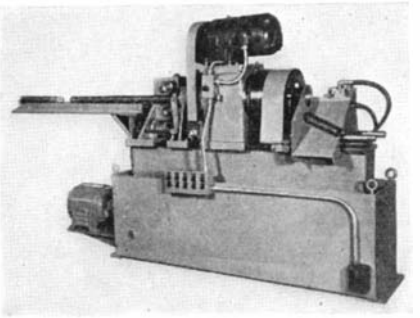
completely isolated from power source for use in testing A.C.-D.C. type receivers.

The signal generator, product of Clippart Instrument Laboratory, Inc., uses a fundamental frequency of approximately 2500 cycles, with a separation of 2.5 kilocycles per second between successive harmonics. When the multivibrator output is listened to on the loudspeaker of a receiver under test, the successive harmonics tend to blend together into a continuous harsh, raspy tone, which can be easily identified.

PIPE CUTTING MACHINE

Automatically Cuts Precision Lengths at High Speed

HIGH PRODUCTION and accuracy of cut lengths of pipe and tubing are claimed as the features of a new, fully automatic cut-off machine. The work is fed to the machine by motor driven rolls through a hollow spindle, and against an adjustable receding target stop. A rotating head automatically cuts the work to required length producing a square face and holding end-to-end dimensions within a few thousandths of an inch of requirements. The head



Cuts up to 1500 pieces of pipe per hour

is tooled to produce a clean cut with a minimum of burrs raised.

Production of up to 1500 pieces per hour is possible, depending on composition of the stock, wall thickness, and diameter. The fast operation of this machine is due to the rapid continuous machine cycle. Once the machine is started, the operation is continuous until the machine runs out of stock. The time to complete an entire machine cycle is only one and one half seconds.

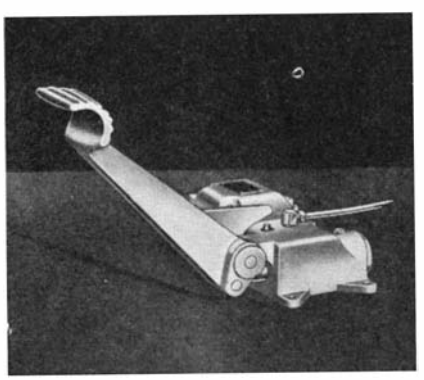
Fully automatic, the machine, produced by the Pines Engineering Company, Inc., is designed for general duty, and is quickly adjusted to produce cut-off pieces to suit length and diameter requirements. The spindle inserts and collets may be changed in a few minutes, and the tool holders permit rapid adjustment to meet conditions of diameter. Either parting tool bits or rotary cut-off disks may be employed depending on the job.

Uncut stock may be manually placed on the feed rolls or a power driven conveyor with selector may be furnished to supply the feed rolls direct from storage rails. One operator can attend several machines.

HYDRAULIC FOOT PUMP

Small and Light-Weight, Exerts Pressure of 1500 Pounds

COMPACT and small, a new lightweight hydraulic foot pump has a usable oil capacity of 15 cubic inches, and a working pressure of up to 1500 pounds per square inch. The oil is contained in a sealed reservoir requiring no vent, thus allowing the pump, produced by the Lyon-Raymond Corporation, to be mounted in an offset position if desired. The pedal return spring is built inside the pump body, and the release is controlled by slightly raising the single pump pedal. Total weight of the pump is only 13¼ pounds.



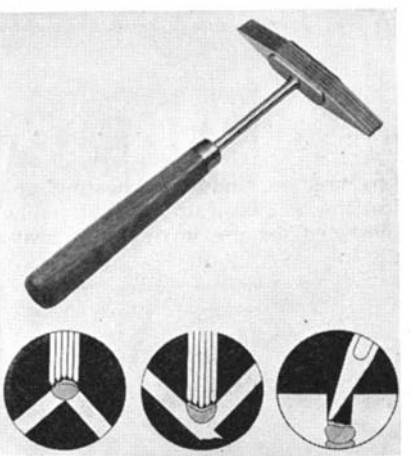
Pressure released by raising pump pedal

WELD CLEANING HAMMER

Has Five-Segment Head For Equal Impact Over Uneven Surface

SAID TO give cleaner welds, faster cleaning time, and greater all-around efficiency than the common single-head slag hammer, a new weld cleaning hammer works on an entirely new principle. Five separate pick-pointed hammer heads—each free to slide ⅜ inch—are mounted on a single hammer handle. When a blow is struck, each of the five head segments strikes with equal impact at five different points, regardless of surface contour. These free-sliding head segments actually wrap the force of a blow around a convex weld bead or follow the contour of a concave weld fillet or the irregular surface of the hard-to-reach crevices such as are found in weld bead craters and deep groove multi-pass welds.

The head segments are of tool steel, hardened and tempered throughout. They can be resharpened on a grinding wheel in the same manner as an ordinary chisel. The shank is of ⅜ inch hard drawn mild steel. Both head segments and shank are plated with cadmium to retard rusting and to keep weld splatter from fusing to these parts. The extra-long hickory handle of this tool, called the Multi-Pic by its manufacturer, the Bernard Welding Equipment Company, assures perfect balance and insulation against shock. The handle is fitted with a lock-pin to prevent turning under heavy usage.



For faster, more efficient weld cleaning

PHOTOELECTRIC RELAY

Operates Over Long Distances In Spite of Rain, Fog, or Snow

EVEN when operated at distances up to 1000 feet, a new photoelectric relay and light source operating on the modulated light principle has sufficient sensitivity to prevent false operation due

to rain, fog, or snowfall. Applications include traffic control, counting and limiting, and protection of restricted locations.

The light source contains a lamp, transformer, and motor-driven slotted disk which interrupts, or modulates, the light beam at about 900 cycles per second. The photoelectric relay, a product of the General Electric Company, has a tuned circuit which allows the relay to be responsive only to a light beam modulated at this frequency. It is not sensitive to changes in natural or artificial illumination. The light source has an infra-red filter which removes most of the visible light from the beam.

SOAP DISPENSER

Operates Automatically When Hands Break Beam of Light

POURING soap automatically into hands as they are brought beneath the spout, a liquid soap dispenser is especially

Hand at spout starts flow of soap

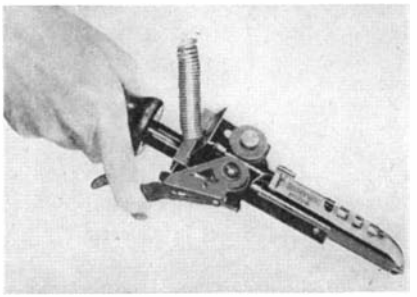
well suited for use in hospitals and aid stations. Operating by means of a photoelectric relay, the dispenser has no valves or handles to be worked. Hands placed beneath the spout interrupt a light beam, activating the relay which controls the pouring mechanism. The flow of soap ceases as the hands are withdrawn.

The unit, manufactured by E. J. Scarry and Company, measures 8½ by 7¼ by 18 inches, and operates on a regular 110-volt, 60 cycle power line.

SOLDER FEEDER

Attaches to Standard Soldering Iron to Free One Hand

CLAMPING on to any standard electric soldering iron, a device which smoothly feeds solder at the touch of the fingertip, frees one hand to manipulate parts, pliers, or screw driver. By feeding the proper amount of solder at the right time and place, the Solder-Matic, as the device is called, eliminates molten solder drippage, improving quality of workmanship, and enables the operator



Solder is fed at touch of finger

to do a better job in crowded spots or awkward positions.

Solder in short lengths, in small coils, or fed from a spool as large as 25 pounds can be handled by the new attachment, product of the Nelpin Manufacturing Company. It takes solder from 1/16 to 3/16 inch in diameter, and feeds up to 3/16 inch per stroke. Screw adjustment of the stainless steel nozzle guides solder where it is needed, regardless of the size or shape of the particular soldering tip being used.

SAFETY POWER CABLE

Non-Sparking in Short Circuit to Lower Mine Explosion Danger

To aid in the prevention of coal mine explosions, a new cable that will not spark when short circuited has been developed by electrical engineers. The new feature of the cable is a fine strand of copper wire embedded between the inner and outer layers of insulation. In the event of damage to the insulation the fine wire catches incipient current leakage before an arc can occur, and carries it to a sensitive circuit breaker which cuts off the power.

The cable was developed jointly by engineers of United States Rubber Company and Leonard Wilson of Kenilworth Mines. It is expected to eliminate a common source of danger in coal mines. This type of cable is used to carry power to heavy equipment employed in digging and transporting coal. The cable, trailing on the ground, is in constant danger of being damaged.

TEMPERATURE RECORDER

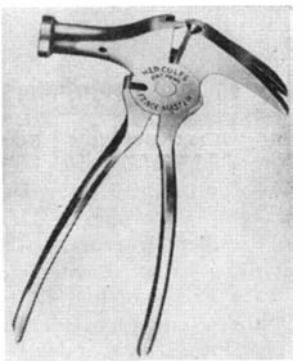
Is Small, Light Weight, and Shock-Resistant

Intended for use in the many applications where an easily portable temperature recording instrument is necessary, a miniature shock-proof temperature recorder is particularly suitable for use in trucks, railroad cars, and airplanes in transit, as well as in other operations where vibration is encountered. Because of its small size and portability, it is also useful for checking refrigerating, heating, and air-conditioning equipment. The instrument is available in two forms: the single-pen recording thermometer for recording temperature only, and the two-pen temperature and time-operation recorder, which charts the running time of refrigeration motors, for example, in addition to recording temperature. Simplicity of design and construction ensures accuracy in recording. A special transparent, unbreakable plastics front permits full view of entire chart and pen-arm. Pen-arm is "jiggle-proof," and thus temperature record is unaffected by vibration. The instrument, developed by the C. J. Tagliabue Manufacturing Company, is available in models to operate in a wide variety of ranges. Chart drive is a seven-day spring-propelled mechanism with charts of 24- or 72-hour duration. Each recorder is enclosed in an aluminum case and the overall dimensions are: 5¾ inches square, 4¼ inches deep, and total weight is less than 3½ pounds.

FENCE TOOL

Combines Hammer, Ripper, and Pair of Pliers

Eliminating the inconvenience of carrying a heavy bag of tools through the fields, a light, compact implement is no larger than a small hammer, yet it splices, cuts, and stretches wires, and pulls nails and staples. It is a combination hammer, ripper, and pair of pliers. Easier to use than ordinary fence tools, the manufacturer, the Hercules Forge



Weight—1½ pounds

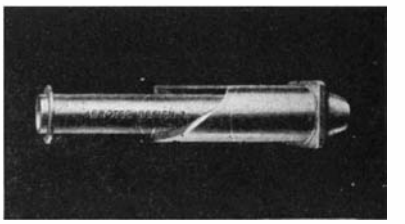
Corporation, also claims that it does a neater, stronger, and more permanent job than heretofore possible.

In appearance, the Fence Master, as it is called, is much like a combination claw hammer and pair of pliers. It is made of heat treated, drop forged chrome-molybdenum steel. Finish is nickel plate, weight is 1½ pounds, length 10¼ inches, width at hammer and claw end, 5⅛ inches.

FLY ASH COLLECTOR

Of Aluminum Tubing Features Small Diameter For High Efficiency

A departure from conventional tubular-type dust collectors, a new unit uses a cast aluminum tube only three inches in diameter. As a result, efficiency is high because of increased centrifugal forces. Small diameter and flush inlets of this unit, product of the Aerotec Corporation, permit closer



Only three inches in diameter

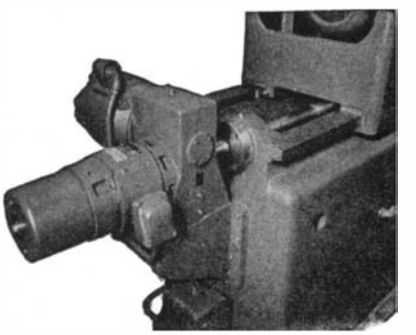
spacing of the tubes, and reduce eddy currents normally present with protruding wing-type inlets.

An interesting side light on a similar Aerotec tube, is the fact that it serves as the fly ash eliminator between combustor and turbine in the latest developments of gas turbines for locomotives. As a result of this performance, tests were run to determine the resistance of the cast aluminum tubes, developed in co-operation with the Aluminum Company of America, to fly ash, compared to steel and cast iron tubes, with a view toward power-plant applications. Surprisingly, the aluminum tube was comparable to cast iron on identical abrasive tests. This lighter tube, a permanent-mold casting, is produced to closer tolerances than any other method will permit.

FEED-TRAVERSE DRIVE

Affords Stepless Speeds With Close Control

COMPOSED of an A.C. traverse motor and a D.C. feed motor packaged into one unit, a new feed-traverse drive for machine tools has been developed by



Drive unit installed on combination drilling, milling, tapping, and boring machine

General Electric engineers. The new drive is completely factory assembled, and produces a wide range of stepless feed and traverse speeds with close speed control. Two developmental units have been applied to machines, and surveys are now being made to determine other important applications. Both motors in the unit drive into a differential gear which has a single output shaft.

Individual mounting of the parts is not necessary, since the component parts are all assembled as a unit at the factory. To install, the gear end of the unit is simply mounted on the machine to be driven. The unit can be easily inspected and oiled without removing it from the driven machine.

Control for the motors is standard and it may be mounted wherever convenient.

On the developmental units, a traverse speed of 405 revolutions per minute was provided, and a feed speed range of 63 to 6.3 revolutions per minute. Feed speed ranges of 20 to 1 or greater can easily be provided.

REVERSE ELECTROPLATING

Forms Better Distributed Coat Of Greater Density

REDUCING polishing costs as well as providing an electro-deposit of great smoothness, increased density, and decreased porosity, a process for electroplating involves a periodic reverse plating cycle in which the plating current is reversed briefly at short intervals. Better plate distribution and thicker than normal deposits are obtained at higher current densities than are used in conventional processes.

Laboratory study has shown that excellent results may be obtained with high-speed copper cyanide baths using a five-second plating to one-second deplating cycle. However, in commercial practice it has been shown that a 20 to 4 second cycle, as well as cycles intermediate between this and the 5 to 1 second cycle, are quite satisfactory. The PR Process, which is an engineering development of the Westinghouse Electric Corporation, has also been found to have advantages when applied to the Hanson-Van Winkle-Munning Amine Copper Process to the extent that higher current densities may be used and improved deposits may be obtained. Early experimental work indicates that the process is also applicable to acid baths such as the conventional nickel baths.

Equipment manufactured by the Hanson-Van Winkle-Munning Company which is available at the present time for use in periodic reverse plating consists of an electronic time-contactor unit capable of handling up to 50 amperes with a range of a fraction of one second to 25 seconds for each portion (anodic and cathodic) of the time cycle.

BINOCULAR MICROSCOPE

Affords Three-Dimensional Vision For Minute Industrial Tasks

MAGNIFYING objects in their normal three dimensions, a new industrial microscope is the outgrowth of experience gained in World War II when a special type of microscope was needed to perform many precise operations, such as the drilling of microscopic holes in Diesel engine fuel injection jets, the assembly of miniature radio and radar tubes, and the production of hundreds of other top priority war materials.

As industrial microscopes were not available to meet the urgent demand, it became necessary to convert for war production work a binocular stereoscopic microscope developed by American Optical Company for medical and biological use. Very shortly this type of microscope became one of the scarcest of all optical instruments, and carried one of the highest priorities.

Three-dimensional image is right side up

In many operations, special fittings had to be designed to utilize the microscope, but there was no time during the hectic war days to redesign the instrument for industrial operations.

The new industrial microscope, however, is specially designed and built to expedite numerous operations where minute details must be closely observed. Work can easily be performed under the instrument because the magnified image is seen right side up and not inverted, while the optical system with converging objectives, achromatically corrected, clearly shows length, width, and depth with enhanced perspective.

The microscope's two eyepieces are also mounted according to the normal convergence of the eyes for close work, are adjustable, reducing eyestrain when the instrument is used for long periods of time.

The instrument can be used conventionally or bolted to a machine through a hole provided in the base. It may also be attached to specially designed brackets on machines.

ROTARY HAND PUMP

Measures and Dispenses Liquid at Rate of 10 Gallons Per Minute

BUILT with a meter registering eight gallons, and equipped with a 9999 gallon totalizer, a new rotary hand pump is intended for fueling or dispensing liquids up to 10,000 S.S.U. viscosity. The unit, manufactured by Bowser, Inc., includes a 40-inch suction pipe with bung attachment, an eight-inch oil-resistant discharge hose, and an aluminum nozzle. The 10-gallon-per-minute pump also features an aluminum rotor, graphite-carbon vanes, cadmium plated packing nut, and stainless steel springs.

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.)

TENITE. This revised edition contains 32 pages and 100 illustrations of cellulose ester thermoplastics. In addition to describing what Tenite is, how it is made, and for what kinds of applications it is suited, this booklet also enumerates its physical properties and then lists them in tabular summary form. *Tennessee Eastman Corporation, Kingsport, Tennessee.—Gratis.*

COMPRESSED AIR HANDBOOK is a 400-page reference on applications, installation, operation, and maintenance of compressing equipment and air-powered tools of all types. Much new and original data have been added to definitions, test standards, and basic tables and formulas formerly published as "Trade Standards." *Compressed Air and Gas Institute, 90 West Street, New York, New York.—$3.00 in the United States, $3.50 elsewhere.*

DESIGNS FOR HELICOPTERS, by I. B. Laskowitz, M.E., is a 24-page booklet containing specifications and patent drawings giving details of three different designs for helicopters with manual and automatic blade pitch angle changing means. Also included are six outline drawings showing the application of the principles set forth in specifications and patent drawings. *I. B. Laskowitz, 284 Eastern Parkway, Brooklyn 25, New York.—$2.00.*

How To SELECT BINOCULARS. For those looking for guidance in selecting proper binoculars for type and excellence, this 24-page well-illustrated booklet gives a layman's version of the fundamental principles of optics as they are related to binoculars. Essential requireqments in specific types of binoculars (for theater, general daylight sports, magnified night vision, and so on) are related to magnification, field of view, brilliance of image, and quality of image. *Sard Binoculars, Kollsman Instrument Division of Square D Company, Elmhurst, New York.—25 cents.*

THE OBSERVER'S HANDBOOK FOR 1948 contains data on the planets and other astronomical phenomena, month by month; also lists of double and multiple stars, variables, four star maps, an ephemeris of the Sun, and miscellaneous astronomical data. Most amateur astronomers obtain this booklet each year. *Royal Astronomical Society of Canada, Three Willcocks Street, Toronto, Ontario, Canada.—25 cents.*

MANUAL OF UNDERPASSES AND SERVICE TUNNELS. Describing and illustrating shapes and sizes of openings, this 24-page manual shows how underground passageways for people, livestock, mer-

CHANDISE, and utility lines can be efficient and economical. Suggestions are given on floors, drainage, lighting, brackets, and end treatment. *Armco Drainage and Metal Products, Inc., Middletown, Ohio.—Gratis. Request this manual on your business letterhead.*

GREAT IDEA. This is a single sheet showing the advantages of self-adhesive labels. It is one of a series of illustrated sheets which are available for production, for carrying instructions, or the electrical industry. *Avery Adhesive Label Corporation, 36 West Union Street, Pasadena 1, California.—Gratis.*

HOW TO SOLVE COMMUNICATION PROBLEMS is an eight-page booklet describing some available types of intercommunication installations, stressing their time-saving applications. Also mentioned are voice-paging and industrial music systems. *Executone, Inc., 415 Lexington Avenue, New York 17, New York.—Gratis.*

FIFTEEN BUILDING MAINTENANCE PROBLEMS. Of interest and value to plant owners, engineers, and maintenance men, this folder points out solutions to such problems as leaky roofs, worn flashings and gutters, rough concrete and wood floors, concrete dust, spalled walls, and loose pointing. *Stonhard Company, 403 North Broad Street, Philadelphia 8, Pennsylvania.—Gratis.*

REMPE ENGINEERING DATA BOOK. Prepared for design engineers, this 34-page booklet contains the fundamentals of pipe and fin coil calculations. And in addition to design and reference sections, the booklet also covers such subjects as inspecting, testing, and finishing of coils, calculations of heating and cooling coils, methods of computing fin coil surfaces, application of coils to particular types of heating and cooling units, and properties of saturated steam. *Rempe Company, 340 North Sacramento Boulevard, Chicago 12, Illinois. —$1.50.*

CORROSION-RESISTANT MATERIALS AND EQUIPMENT is a 16-page booklet prepared to aid in the selection of proper or suitable corrosion-resistant materials or equipment and to point out how they are used for combating corrosion. Request Bulletin K. *United States Stoneware Company, Attention: Mr. R. W. Grace, Akron 9, Ohio.—Gratis.*

METRICATOR AIR GAGE. In 12 pages this bulletin outlines the simplicity and characteristics of this air gage. Illustrations and sectional views show how the method of gaging can be used in inspection. *Federal Products Corporation, 1144 Eddy Street, Providence, Rhode Island.—Gratis.*

THE IONOTRON. Giving design specifications, installation data, and performance reports, this booklet shows how the Ionotron static electricity eliminator is applied to printing presses in all printing processes. *United States Radium Corporation, 535 Pearl Street, New York 7, New York.—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.

ADVENTURES IN MAN'S FIRST PLASTIC

By Nelson S. Knaggs

THIS BOOK is an adventure book, but it is a great deal more than that. It includes, with the adventures of the author and others seeking natural waxes, a huge amount of information regarding these important industrial raw materials. Waxes gathered from the remote corners of the world serve industry and mankind in many diverse ways, and the whole picture of their origins, collection, history, and applications form the subject matter of this fascinating book. Whether you are interested in romance, in industry, or in both, this book has much of interest and value for you. (329 pages, 6 by 9 inches, illustrated.)—$6.85 postpaid.—*D.H.K.*

YOUR HOME AND HOW TO BUILD IT YOURSELF

By Wayne C. Leckey

PERHAPS only a genius without a substantial mechanical background could learn all about the construction of a home from a single book; nevertheless this comprehensive volume will go a long way toward instilling fundamentals in the beginner's mind, or assisting the advanced amateur carpenter in carrying out a project of such magnitude. Most of the story is told in excellent drawings and equally good photographs, and the subject is covered from preliminary layout through excavation and masonry work to framing, sheathing, plumbing, electrical wiring, and all of the thousands and one details which go into house construction. (9 by 11 inches, permanent plastics binding, paper covers.)—$3.10 postpaid.—*A.P.P.*

FOOTNOTES ON NATURE

By John Kieran

THOSE who like to endure all sorts of weather in order to enjoy the birds, the plants, the insects, and other wild life will find this book thrillingly informative. Those who do not like such things will find themselves wondering how a brilliant mind like John Kieran could become so insipid. And those who have the temperament for this sort of hobby but never have tried it will find John Kieran plunging them head first into a life time of enjoyment. John Kieran, as almost everybody knows, is a past master at using words to make scenes come alive, and the wood engravings by Nora S. Unwin are excellent. (279 pages, 8½ by 5½ inches, 17 illustrations.)—$3.10 postpaid.—*E.L.C.*

SCIENCE IN PROGRESS—FIFTH SERIES

Edited by George A. Baitsell

AS WITH the previous books of this series, the present one contains recent lectures by outstanding scientists, bringing their particular specialties up to date. The lectures were originally prepared for the Sigma Xi National Lectureships. The present volume contains 11 chapters, each by a different scientist and on a different subject. These include: Jewett on the future of scientific research; Macelwane on geophysics; Kerst on the betatron and high energy radiations; Taylor on catalysis; Michaelis on oxidation and respiration; Beadle on genes; Rous on cancer; Stakman on plant diseases; Speidel on cell metabolism; and Evans on anterior pituitary hormones. An important scientific work possessing interest for the well-informed layman. (353 pages, 6 by 9 inches, illustrated.)—$5.10 postpaid.—*D.H.K.*

SOILLESS GROWTH OF PLANTS

By Carleton Ellis and M. W. Swaney

Second Edition Revised and Enlarged by Tom Eastwood

THE FACT that vegetables and flowers can be grown in tanks of chemicals and without the use of soil has stimulated many imaginations. But the general impression has been that such farming is a hobby only, liable to weird results in the hands of the amateur, and of commercial interest only in barren lands where ordinary farming is not feasible. This book corrects all that. It shows that soilless farming (hydroponics) can be commercially profitable right in the richest of farm-

ing districts. It is a second edition, amplified to add information not found in the first. It contains page after page of scientific analysis, case history, discussion of further lines of research, suggestion for commercial development. This is, then, a "know how" book for the reader who intends to make money out of soilless farming. (283 pages, 9¼ by 6½ inches, about 150 illustrations and tables.)—$4.85 postpaid. —*E.L.C.*

HOW TO MAKE FRIENDS WITH LABOR

By Dr. Herbert S. Minot and Louis Zasloff

PUT forth as a guide to executives, this multigraphed paper-covered book focuses attention on the cardinal principles of effective labor-management relations. It covers underlying causes of labor problems, how to deal effectively with organized and unorganized labor, bargaining strategy, prevention of trouble at the source, public relations, labor relation laws, and so on. (86 pages, 8 by 11 inches, unillustrated.)—$2.60 postpaid.—*A.P.P.*

RAW MATERIALS FROM THE SEA

By E. F. Armstrong and L. M. Miall

CONCEIVING the oceans to be a mine of some 300 million cubic miles of sea water, each weighing 4000 million tons and containing 166 million tons of dissolved salts, this little book further conceives them to be sources of all the elements in greater or less proportions, even including radium at a rate of about 5 grams per cubic mile. All of these potential values of the oceans are surveyed and the several important industries utilizing sea water as raw materials are described in some detail: salt, bromine, magnesium (metal and compounds), iodine, potash, and the freshening of salt water. An interesting and useful reference book. (196 pages, 5½ by 8¾ inches, illustrated.) —$3.85 postpaid.—*D.H.K.*

LUMBER—Manufacture, Conditioning, Grading, Distribution, and Use

By Nelson C. Brown

NEW significance is being attached today to lumber and lumber products. Housing problems alone account for much of this, and wood is finding new uses in many fields of technology. Here is a complete analysis of manufacturing procedures for converting logs into lumber, including a discussion of equipment, sawing methods, power requirements, and the use of by-products. Conditioning of lumber is explained in theory and practice, as is also the grading process. Stress is placed upon the outstanding need for efficient and economical methods in all stages of lumber production, from the standing tree to the end uses. Obvious purpose of this volume is to deal thoroughly with the opportunities available to the lumber industry and to point up the advantages that can be had through the application of technological advances. (344 pages, 6 by 9 inches, well illustrated with photographs and drawings.)—$4.35 postpaid.—*A.P.P.*

Because of increased production costs of books, publishers' retail prices today are subject to constant change. It may be necessary, therefore, for our Book Department to advise book purchasers of increased costs, even when orders sent are based on current quotations.

The Editor

PHOTOGRAPHIC GIANTS OF PALOMAR

By J. S. Fassero and R. W. Porter

BOOK of 20 full-page drawings of the 200-inch telescope reproduced from Porter's 30- by 40-inch originals in pencil, showing the big telescope and details of its parts such as the observer's coop, the 36- by 51-inch elliptical coudé mirror and its crane, detail of the oil pads, R.A. drive and computor, big aluminizing bell jar; also the 48-inch Schmidt telescope, and a close-up of Porter with a Schmidt. Eight full-page astronomical photographs are included since this book is for distribution to the general public at the new observatory. Detailed explanations face each illustration and all the illustrations are on coated paper, full-page, suitable for framing. (60 pages, 8½ by 11 inches.)—$1.60 postpaid.—*A.G.I.*

HENRICI'S MOLDS, YEASTS AND ACTINOMYCETES

Second Edition, by C. E. Skinner, C. W. Emmons, and H. M. Tsuchiya

THIS second edition of the late Prof. Henrici's "Handbook for Students of Bacteriology" continues and brings up to date the subject matter of the original edition in as nearly the manner of the original author as has been possible for others following after. The present book is addressed to students not in the narrow sense of those pursuing their studies in classrooms but rather in the sense of all those who still seek to learn. This volume is a standard work in its field and is the principal and constant reference work of those interested in the broad classes of organisms embraced within molds, yeasts, and actinomycetes. (409 pages, 6 by 9¼ inches, illustrated.)—$5.10 postpaid.—*D.H.K.*

FABRIC STRUCTURE

By John H. Strong

READERS connected with textile industries, also amateur weavers of some experience will find this a valuable store of professional information on weaving fancy goods. Its author is an

English weaver of 50 years' experience who lectures, teaches, and writes. The totally uniformed tyro at the textile arts probably would find this book a bit mystifying. (241 pages, 5½ by 8½ inches, 411 illustrations.)—$6.10 postpaid.—*A.G.I.*

WIND-TUNNEL TESTING

By Alan Pope

EVEN before the Wright Brothers, the wind tunnel played an important part in airplane development, and in aeronautical education. Today the tunnel is as indispensable as ever. Professor Pope has made good use of the vast amount of knowledge now available. He has described the wind tunnel and its auxiliary equipment clearly and completely, and presented its design accurately and skilfully. The chapter on Testing Procedure will help everyone who has to use the tunnel, whether student or advanced research worker. It is invaluable to have wind tunnel wall corrections and practical rules for extrapolations to full scale within the covers of one book. With a clearly written and well-illustrated book, Professor Pope will earn the gratitude of many types of readers. (319 pages, 5⅝ x 8⅝ inches, illustrated.)—$5.10 postpaid.—*A.K.*

AMERICAN OIL OPERATIONS ABROAD

By Leonard M. Fanning

WITH a total investment in foreign countries of nearly two and one-half billion dollars, American oil interests abroad are here described comprehensively as to their importance and magnitude. The text traces the fascinating diplomatic and operational history back of these huge investments and draws a clear picture of the way in which American companies have been of substantial material aid to whole communities in foreign lands. It will serve as a valuable reference source against which to view the daily news of events in foreign oil fields. (270 pages, 6 by 8 inches, 96 pages of photographic illustrations.)—$5.10 postpaid.—*A.P.P.*

ONE TWO THREE . . . INFINITY

By George Gamow

THIS is another "fun with figures" book, and a very good one. Differing from the usual course, the author has chosen to present highly complex (to the average layman) mathematics first and then go on to what is understandable, simple, and fascinating. Thus the reader who is habituated to picking up scraps of entertaining information from the first halves of chapters and skipping the complex explanations in the last halves will need to reverse his reading procedure and study the last halves only. In fact, the further the text progresses the simpler and more interesting it becomes. (340 pages, 8½ by 6 inches, illustrated.)—$4.85 postpaid.—*E.L.C.*

SMALL TELESCOPE

Is a Deceptive Little Giant

FULLY portable, either by shoulder or car, the neat little four-inch reflecting telescope shown in the illustration was made by an amateur who had already made and used one ten inches in diameter. He found that, for its size, the smaller one actually paid better satisfaction dividends than the big one. Such an instrument can be made complete for as little as $10 though $15 is perhaps more nearly average.

A widespread belief that a four-inch telescope is too small to reveal much of the heavens vanishes on investigating the serious astronomical observing of a dozen decades, done by amateur astronomers, some with even smaller instruments. Standard books like McKready's "A Beginners' Star-Book" contain long lists of sights for several sizes of telescopes, even three- and two-inch. The much-talked-of huge

A very good little one

telescopes are not used visually but photographically. When they want to take a visual peep at Mars or other objects astronomers deliberately choose smaller telescopes. For this there are sound reasons not easily explained in short space.

A talking point for moderately small telescopes like the one shown, versus larger ones, is the same as for small versus big dogs. A four-foot dog is eight times as bulky and hungry as a two-foot dog but he isn't twice as good a dog. Benton A. Wheeler, Little Rock, Arkansas, who made this telescope found his ten-inch instrument too bulky for his apartment. The smaller one which resulted is as well equipped as a big one—has axes in two directions to point and control it. Such a telescope, dissected into two or three main parts, will easily fit into a car without crowding out a mother-in-law. Not dissected, it may (repeat may) do even this. Numerous other amateur telescope making and using addicts have added special purpose telescopes to their collection.

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"

PORTABILITY is a relative term. Many articles described as waistcoat or "vest-pocket" size are that, especially if the vest pocket is an overcoat pocket, but still they feel so bulky that after the novelty has worn off the acquisition you find yourself leaving them home till some other day.

Horace E. Dall, 166 Stockingstone Road, Luton, Bedfordshire, England, has spent much time seeking such true lightness and portability—actual, not mere assertive portability—in vest-pocket telescopes that you will really carry them daily without a frown. He has built four such telescopes, de-

Figure 1: Dall and his vest-pocket folding telescope. Magnification ×30

scriptions of which follow. Of the four, two were successes and two were partial failures, a score that runs about average for TN optical projects. There is almost as much value in describing failures as successes, so these will not be omitted.

The first is a so-called spherical secondary "Cassegrainian" (actually the Dall-Kirkham telescope) of 3¼" aperture, a little gem of fine craftsmanship. Figures 1, 2, 3, 4.

"This outfit," Dall writes, "was made

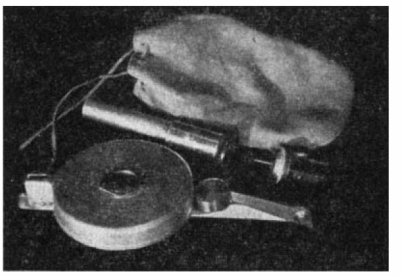


Figure 2: As taken from a chamois bag

to carry about with me on rambles, mainly for terrestrial views but it will resolve stars down to Dawes' limit with a high-power eyepiece. The entire outfit goes into my waistcoat pocket without jutting out more than a fountain pen. It weighs eight ounces including a half-ounce portable stand (Figure 1) with tempered steel woodscrew end for quick attachment to the nearest gate post, window frame, or what you like.

"The power is ×35 to ×80, being continuously variable (pancratic) by pulling out the eyepiece an inch or so. Other eyepieces may be used to give changes of power but each one gives the same range, about 2:1. The eyepiece is of the comfort type—large eye lens and eye point ¾" clear of the lens.

"No instrumental scattered light is visible even near the sun.

"The light grasp is decidedly better than that of a 3" refractor and the tele-

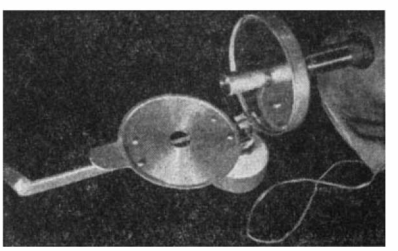


Figure 3: As screwed to fence post

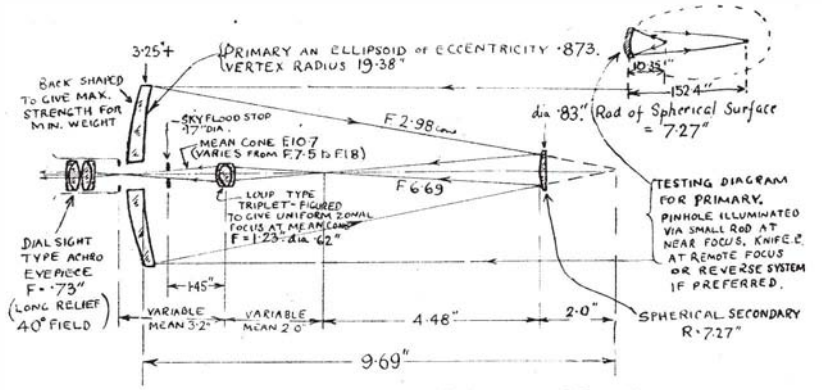


Figure 4: Optical data for 3¼" Cassegrainian. No other data or instructions for building are available

scope will do all that a 3¼" is capable of. Figuring was carried to the limit and definition is excellent.

"The mirror is supported without strain or shake, and three flush ad-

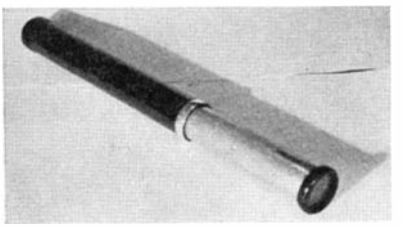


Figure 5: 1½-oz. pocket refractor

justing screws with spring follow-up make adjustment easy and it stays put. The airtight covers for the two mirrors are a part of the framework and don't have to be put back on after use.

"The main ingredients of the mounting are duralumin and aluminum but some steel and brass parts are included where construction and strength demand.

"The spherical secondary Cassegrainian is merely a means of saving figuring time without any improvement in performance but if the spherical secondary Cassegrainian is combined with the intermediate erecting system (Figure 4) adopted on my 15½" telescope described in Scientific American, May 1939, and for all my Cassegrainians since 1931, there is combined with simplification a very important improvement in general performance and an erect image.

"This outfit is many times lighter than anything that has been made, of comparable performance. A fair amount of work was involved, of more than usual precision. Next letter, I'll send a photograph."

All this was written by Dall just before World War II broke out, and the promised photographs were delayed for

Figure 6: Hip-pocket Gregorian

the duration. Reminded recently of the photographs Dall writes, "The vest-pocket 3¼" has been a great source of pleasure and has been carried and used on all holiday journeys since 1939. The Devon and Cornish coasts were our chief holiday centers during the war and I carried this 3¼", watching convoys sailing up and down the Channel. Once, in 1941, during an air raid alert, a Czech refugee saw me using it and fetched a policeman who arrived with a screech of car brakes. Fortunately for me, regulations were not so tight in 1941 as they became later and pocket spy glasses were permissible, and I escaped the clutches of the law and did not lose my telescope."

In 1940, the war young, Dall made

two more portable telescopes for watching aerial dogfights. One (Figure 5) consisted of a 13/16" two-lens achromatic objective, a four-lens erector giving flat, wide field, and a four-lens, long eye relief eyepiece—the whole a small but carefully designed piece of

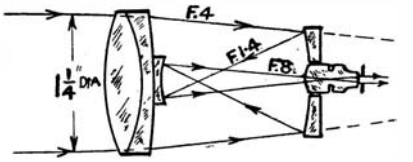


Figure 7: Optics of the early effort

optics. The eyepiece plus erector alone serve also as an ×30 compound microscope. Total weight, 1½ ounces. This telescope is so successful that Dall carries it at all times. It is high grade optics not to be confused with low-cost pocket telescopes of not very dissimilar external appearance. The general public would not pay what such a telescope as this is worth.

The remaining two telescopes that were not complete successes are even more interesting. They came near being successes and their description may challenge others to try to leap the same hurdles. Descripton also offers free experience to others who plan similar designs, the wise being able to assimilate others' experience and profit by it, the not wise having to re-manufacture their own from scratch.

Figures 6 and 7 show a 1¼" Gregorian 2⅝" in length, ×20, made in 1928. "Disadvantages," Dall states, were: "Although good objective lens, secondary spectrum was very evident at ×20 owing to short focus (about 5"). Figuring done well but telescope highly critical to squaring on. Difficult to hold steady owing to shortness. Field only 32°. Close eye point and small hole."

Other details: 1¼" achromatic objective; hyperboloidal ¾" primary; ½" Tolles eyepiece ¼" diameter; ellipsoidal

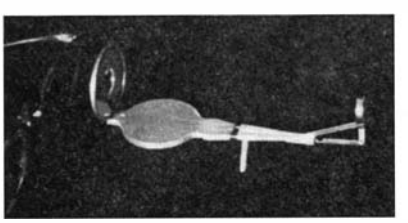


Figure 8: Greg for specs, 6/10 oz.

secondary 1/3 diameter of objective lens cemented to the latter; screw focus; erect image. In Figure 7, drawn by Dall, F.4, F1.4, F.8 refer to foci these many apertures distant. Partly related observations: It is believed that some American amateurs have worked on reflecting binoculars. Porter tried it as mentioned last month. Wm. Buchele, former amateur, Toledo—20" reflector described this department 1939, October, 7500 roof prisms in amateur roof prism program in war time, now Modern Optical Co.,—applied, 1943, for patent granted last December (U. S. Pat. 2,413,286) on a Schmidt binocular

but in most such designs the mirrors are too hard to anchor in collimation.

The other Dall partial success is the miniature 1½", × 12, 6/10-ounce Gregorian shown in Figures 8, 9, 10. This was designed for attachment to the spectacles also shown. To close it the primary mirror (into which the eyepiece is fixedly set) is folded down to right and the secondary mirror to left.

Other details: Eyepiece is an achromatic of 0.90" f.l., 0.57" diameter. Little "handle" seen projecting apparently

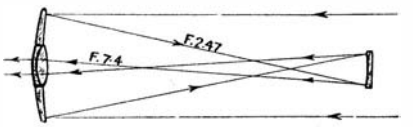


Figure 9: Optics of specs Gregorian

downward projects actually to right and is a lever of the second class for focusing; it causes the respective halves of the telescope to move apart or together on two rod sliders.

Troubles: "But I couldn't get a proper cutting out of sky flooding," Dall writes, "with the system of quick hitching on to my 'specs' that I had in view. (When the photographs were taken I hadn't yet designed hitching-on clip.) The Ramsden disk, at ⅛" diameter, would, I first thought, just about fill my daylight pupil and eliminate the necessity

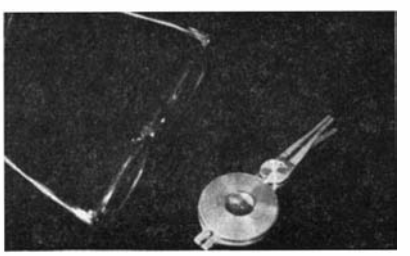


Figure 10: Specs Greg folded up

for a sky-flood stop. In practice it was too difficult to get the eye sufficiently well located coaxial and coincident with the Ramsden disk."

Score: Two bull's eyes and two on the target.

GEAR TRAIN for telescope drives, supplied by E. B. McCartney, 1205 W. Minnehaha Parkway, Minneapolis 9, Minn., is a simple one. It is: 1 r.p.m. of Telechron motor drive shaft with 8 tooth pinion on it; 52 teeth in gear on end of worm; 221 teeth in worm gear around polar axis. (Make worm gear on lathe with tap. Using 10-pitch, sharp V-thread tap, gear will be about 7" diameter.)

Gear reduction is then 1/6.5 × 1/221 = 1/1436.5, and polar axis will turn once in 1436.5 minutes.

To detect pits in fine grinding, McCartney allows the gunk to dry, then wipes off with the hand. The remaining white spots are pits.

RUSTING of cast-iron grinding tools may be inhibited by using water mixed with Oakite, 10 teaspoonfuls per gallon. Says Dr. G. Dallas Hanna, San Francisco.

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Out of some cold figures, came a story to warm America's heart

NOT LONG AGO, the Secretary of the United States Treasury studied a figure-covered sheet of paper.

The figures revealed a steady, powerful upswing in the sale of U. S. Savings Bonds, and an equally steady decrease in Bond Redemptions.

But to the Secretary, they revealed a good deal more than that, and Mr. Snyder spoke his mind:

"If you give them the facts," he said, "you can always depend on the common sense and long-range judgment of the American people.

"The last few months have given us heart-warming proof of that.

"After the Victory Loan, sales of U. S. Savings Bonds went down—redemptions went up. And that was only natural and human.

"It was natural and human—but it was also dangerous. For suppose this trend had continued. Suppose that, in this period of reconversion, some 80 million Americans had decided not only to stop saving, but to spend the $40 billion which they had *already* put aside in Series E, F & G Savings Bonds. The picture which *that* conjures up is not a pretty one!

"But the trend did NOT continue.

"Early last fall, the magazines of this country—nearly a thousand of them, acting together—started an advertising campaign on Bonds. This, added to the continuing support of other media and advertisers, gave the American people the facts . . . told them why it was important to buy and hold U. S. Savings Bonds.

"The figures on this sheet tell how the American people responded—and mighty good reading it makes.

"Once more, it has been clearly proved that when you give Americans the facts, you can then ask them for action—and *you'll get it!*"

What do the figures show?

On Mr. Snyder's sheet were some very interesting figures.

They showed that sales of Savings Bonds went from $494 million in last September to $519 million in October and kept climbing steadily until, in January of this year, they reached a new postwar high: **In January, 1947, Americans put nearly a billion dollars in Savings Bonds. And that trend is continuing.**

In the same way, redemptions have been going just as steadily downward. Here, too, the trend continues.

Moreover, there has been, since the first of the year, an increase not only in the volume of Bonds bought through Payroll Savings, but in the number of buyers.

How about YOU? The figures show that millions of Americans have realized this fact: there is no safer, surer way on earth to get the things you want than by buying U. S. Savings Bonds regularly.

They are the safest investment in the world. They pay you $4 for every $3 at the end of 10 years. And you can buy them automatically, almost painlessly today, through either of two plans:

If you are eligible for the Payroll Plan, for your own sake and your family's sake, get on it . . . and watch your savings mount up.

If you are not eligible for the Payroll Plan, but have a checking account, see your banker and get him to tell you about the new Bond-a-Month Plan.

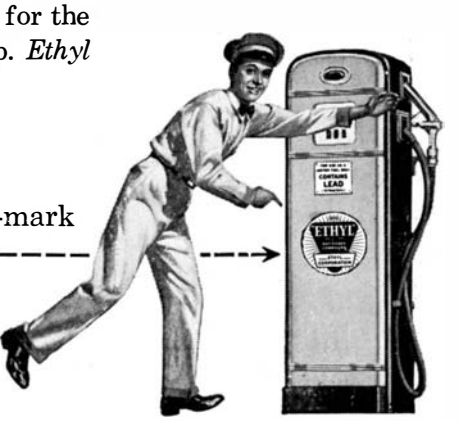
Either of them will set you on the road to financial security, and the happiness that comes with it.

Save the easy, automatic way—with U. S. Savings Bonds

if gasoline came on spools . . .

all the information you'd like to have about ingredients could be printed and pasted right on the spool. However, gasoline can't be labeled that way. So oil companies everywhere put "Ethyl" trade-marks on their pumps, to show you at a glance that their best gasoline contains "Ethyl" antiknock fluid. This important ingredient, which is made by the Ethyl Corporation, is mixed with gasoline to step up power and performance. Motorists who want to get the best out of their cars—new or old—look for the familiar yellow-and-black "Ethyl" emblem on the pump. *Ethyl Corporation, New York.*

look for the **"ETHYL"** trade-mark



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