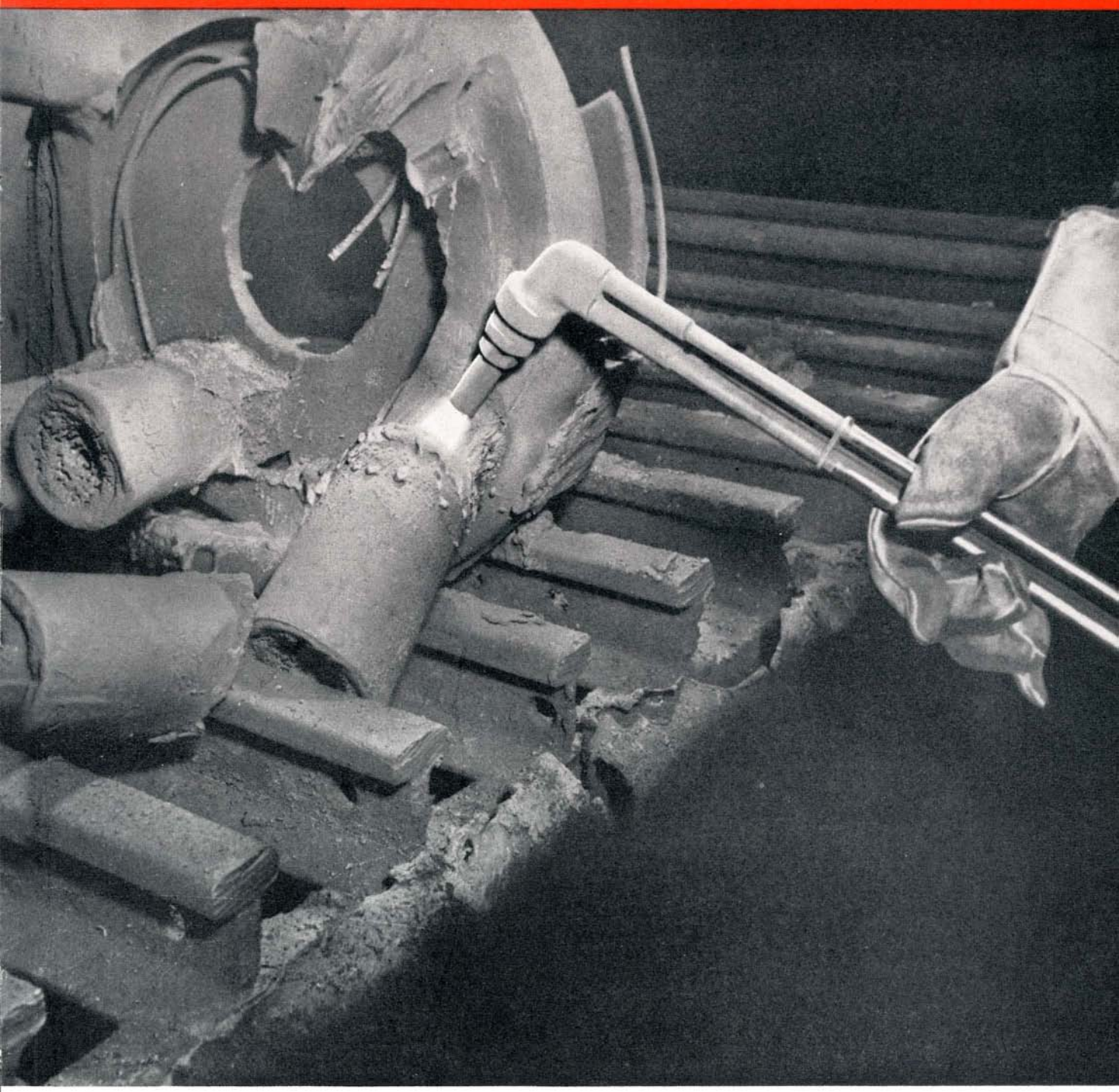
Scientific American

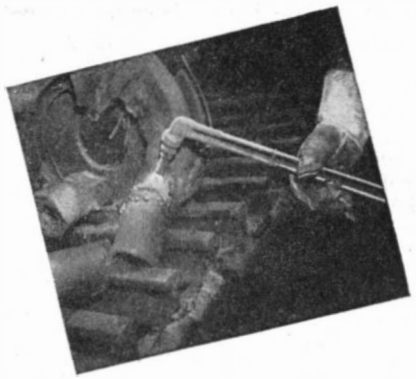
APRIL
1947

35 Cents
a Copy

REPORTING THE PROGRESS OF SCIENCE AND INDUSTRY



Iron Powder Speeds Torch Cutting . . . See page 145



INDUSTRIAL DRAMA: Iron powder burning in the oxygen stream of a Linde powder-cutting torch rapidly removes risers from a heavy casting. How new flame-cutting techniques are speeding operations in various metals industries is told in the article starting on page 149.

ORSON D. MUNN, Editor

A. P. PECK, Managing Editor
ALBERT G. INGALLS, A. M. TILNEY,
JOHN P. DAVIS, K. M. CANAVAN,
NEIL H. UPTEGROVE, Associate Editors

CONTRIBUTING EDITORS: CHARLES A. BRESKIN, Editor of "Modern Plastics." EDWIN LAIRD CADY, Contributing Editor to "Mill and Factory." KEITH HENNEY, Consulting Editor of "Electronics." D. H. KILLEFFER, Chemical Engineer. ALEXANDER KLEMIN, Aeronautical Consultant; Research Associate, Daniel Guggenheim School of Aeronautics, New York University. FRED P. PETERS, Editor-in-Chief of "Materials & Methods."

CORRESPONDING EDITORS: A. E. BUCHANAN, JR., Assistant Manager, Technical Division, Rayon Department, E. I. du Pont de Nemours and Company, Inc. L. WARRINGTON CHUBB, Director of Research Laboratories, Westinghouse Electric Corporation. MORRIS FISHBEIN, M.D., Editor of "The Journal of the American Medical Association" and of "Hygeia." IRVING LANGMUIR, Associate Director, Research Laboratory of the General Electric Company, Schenectady. M. LUCKIESH, Director, Lighting Research Laboratory, Lamp Department of General Electric Company, Nela Park, Cleveland. RUSSELL W. PORTER, Associate in Optics and Instrument Design, California Institute of Technology. VLADIMIR K. ZWORYKIN, Associate Director of RCA Laboratories, Princeton.

ADVERTISING STAFF: F. CLEMENT SCOTT, Eastern Advertising Manager. Western Advertising Representatives, HARLEY L. WARD, INC., 360 North Michigan Ave., Chicago 1, Ill. JOSEPH W. CONROW, 1175 Woodbury Rd., Pasadena 6, Calif.

Subscription Rates:
ONE YEAR—$4
TWO YEARS—$7
THREE YEARS—$10
Canada 50¢, foreign $1 per year additional.

WHEN you change your address, please notify us immediately, giving your OLD as well as your NEW address. Postal requirements are such that our subscription files are arranged geographically, not alphabetically. Because of this, failure to give your old address may result in delaying receipt of copies.

Scientific American

Founded 1845

In This Issue • April 1947

SCIENTIFIC AMERICAN, April, 1947. Vol. 176, No. 4. Owned and published by Munn & Co., Inc. Orson D. Munn, President; I. Sheldon Tilney, Vice-President; John P. Davis, Secretary-Treasurer; A. P. Peck, Assistant Secretary; all at 24 West 40th Street, New York 18, N. Y. Entered at the New York, New York, Post Office as second-class matter June 28, 1879, under act of March 3, 1879. Additional entry at Orange, Connecticut. Published monthly by Munn & Co., Inc., 24 West 40th Street, New York 18, N. Y.

50 Years Ago in . . .

SCIENTIFIC AMERICAN

(Condensed from Issues of April, 1897)

NIAGARA BRIDGE — "On Sunday, March 28, the last panel of the great new steel arch bridge across the Niagara gorge was put in place and the arch proper finished. . . The length of the main span of the arch is 550 feet between the centers of the end pins. This span is connected to the cliff on either side by a trussed span 115 feet in length. . . All told, there will be in the arch when completed over 6,000,000 pounds of steel. Of this amount it is estimated that there will be about 5,560,000 pounds of steel plates and angles, 218,000 pounds of steel castings, 182,143 pounds of eye bars and pins, and about 30,000 pounds of wrought iron rods, etc."

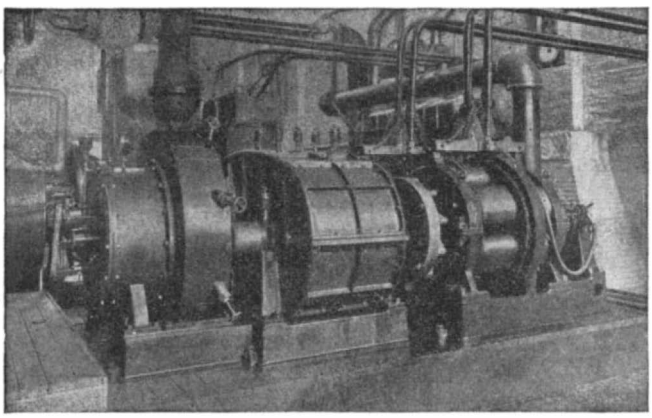
SUBWAY — "The street railroad commission of New York has granted the application of the Metropolitan Traction Company to operate its lines by the underground trolley system—a change which will affect some forty miles of railroad lines in New York City."

PRE-BYRD — "A German antarctic meteorological station will shortly be established in Victoria Land. The station will be run in connection with the German South Polar Expedition, which will have for its object the determination of meteorological conditions during the severe antarctic winter."

POWER TRANSMISSION — "Heretofore there has been some doubt in the minds of engineers as to the practicability of long distance transmission, because it was doubted whether an electrical pressure sufficiently high to reduce the cost of copper in the conducting lines could be used successfully, but it has been shown . . . that there is no difficulty to be encountered in this direction. In a large number of cases the pressure of the line current is 10,000 volts, and in Ogden, Utah, 15,000 will be used. With such pressures, the cost of transmission lines can be reduced to a point well within permissible limits."

WIRE MAKING — "According to a contemporary the English manufacturers of wire rods, wire, and wire nails are threatened with the loss of their business in consequence of the successful competition of Germany and other Continental countries and of the United States. The rivalry of Germany is of long standing and has become an accepted fact; whereas that of the United States is a more recent and has grown to be a much more formidable feature."

STEAM TURBINE — "The closed cylinder steam engine is finding a formidable rival in these later days in the steam turbine, or rotary impact engine. In these machines the energy of the steam is utilized by discharging it at an enormous velocity against the buckets of a wheel. . . The accompanying illustration shows a three hundred horse power De Laval steam turbine which is running very successfully at the Twelfth Street station of the Edison Electric Illuminating Company, New York City. The steam is led into a circular steam tight casing in which is located the turbine wheel. This wheel has a diameter of 29½ inches, and runs at 9,000 revolutions per minute, the speed of the buckets being 1,160 feet per second. The blades are arranged around the periphery and are milled out of the solid steel spokes with which the wheel is built up. They are made very thin at the edges and are of a curved cross section."



DEEP HOLES — "The deepest bore hole in the world, says Mr. C. Zundel, in a late communication to the Industrial Society of Mulhouse, is one of 6,571 feet below the surface of the soil, made at Parnschowitz, near Rybrick, Upper Silesia. The previous record for depth was the 5,733 foot hole drilled some years ago at Schladebach, Leipzig."

RAIL MEASUREMENTS — "An ingenious device has been gotten up by Mr. P. H. Dudley for the purpose of learning the amount of depression of railroad rails under moving trains. It is an electrical contrivance which is firmly attached to the base of the rail in such a way as to register automatically the elongation and compression of the rail as the train passes over it. Experiments with this little instrument prove that the deflecting pressure on a rail from a moving train is from ten to twenty times as great as was calculated from theoretical considerations."

CARBORUNDUM — "The Carborundum Company reports that its works have produced during the year 1896, in round numbers, 1,191,000 pounds, or 595¼ tons, of crystalline Carborundum."

BALL TESTING — "The following method has been adopted for testing the hardness of steel balls. A plate of glass is inclined to the horizontal and the balls dropped on this one by one from a definite height. The rebound of the ball, if properly tempered, is sufficient to carry it into the hopper, where the hard balls are thus automatically collected. Soft balls, rebounding less, fall into another receptacle."

100 Years Ago in . . .

SCIENTIFIC AMERICAN

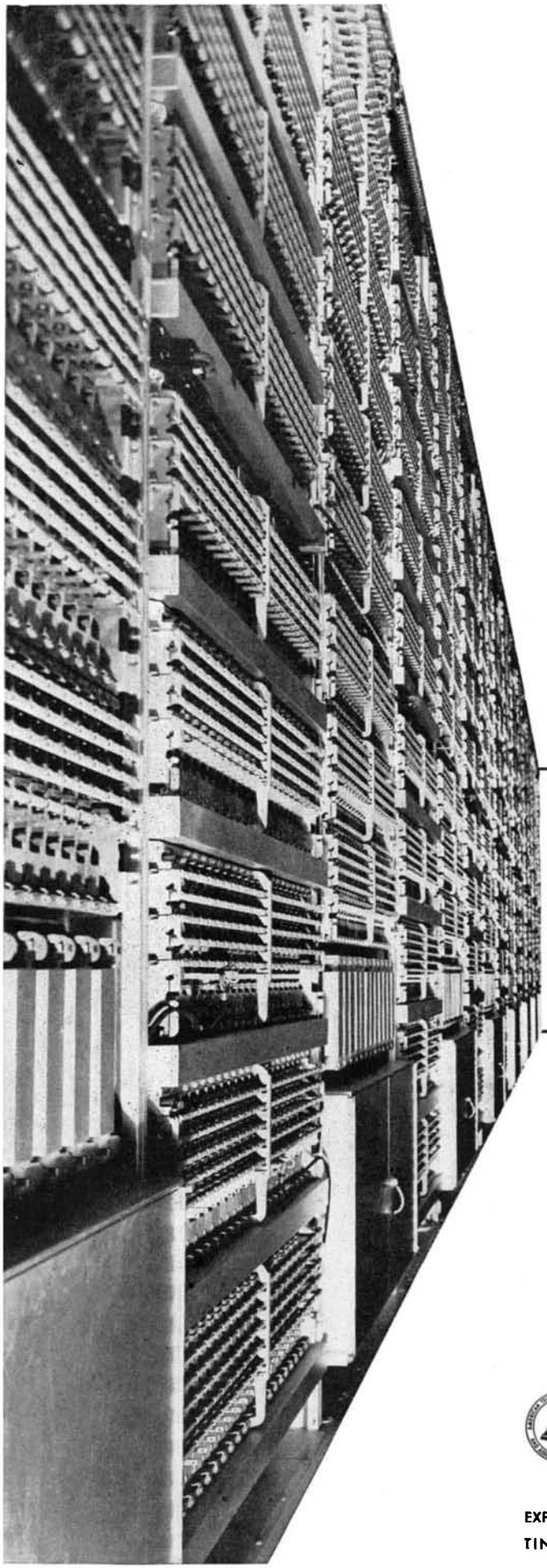
(Condensed from Issues of April, 1847)

MODERN MILLS — "In the new Prescott Mills, Lowell, the rooms are all heated with hot water pipes, and hot and cold water are constantly supplied to the hands by means of pipes when required for washing or cleaning. The rooms are large and airy; the looms are propelled by steam, and this is the only mill in the city where steam power is used for weaving."

BLASTING — "It was stated by Mr. Mould, on the occasion of the opening of the Lancaster and Carlisle railroad, that no less than 4800 barrels, or 200 tons of gunpowder has been used in excavations on that road."

CASTING — "Jagger, Treadwell & Perry of Albany, made one day last week for Messrs. Corning, Horner, & Winslow's new rolling mill, a casting which weighs twelve tons. It was the rim of a wheel—the arms of which will weigh six tons—making eighteen tons for the wheel."

RUBBER BOATS — "The War Department has sixteen factories employed in working Goodyear's patent India rubber into pontoon boats and other military articles. These boats or floats, though light and portable, are capable of carrying sixteen men each."



WHEN you spin the dial of the latest type of telephone system—known as "common control switching"—you order into action a giant nervous system. It sends electrical impulses through an intricate maze of circuits: more than 10,000 contacts can be opened or closed in a single dial call.

This system takes your order, remembers it, translates it into its own electrical language, throws out sensitive "feelers" to find a through route, plans how to make the connections, makes them, puts through the call—and, if the preferred paths are busy, finds an alternate route to take the call.

The complex art of telephone switching is brought to a high state of development at Bell Laboratories to serve the Bell System. Some day through "common control switching" a dial in San Francisco may set up a connection through to a subscriber in New York.

Left: Backstage on your dial telephone call—some equipment in a typical "common control switching" office.

Bell Telephone Laboratories

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

Previews of the Industrial Horizon

By A. P. Peck

MACHINES DO MAKE JOBS

EVEN today, despite ample proof to the contrary, there are people who still feel that technological advances result in unemployment; that new machinery and more efficient tools throw men out of work. Disregarding the temporary and short periods of local unemployment which can follow replacement of manual labor with machinery, a few facts will serve to point up the true situation. For example: A hundred years ago the average weekly wage of American workers was less than $5 while the investment in machinery for their use was less than $500 per employee; today the average wage has climbed more than 1000 percent and the investment per worker has increased to $7000.

Results can first be exampled in dollars. Thus, an automobile tire cost about $50 a quarter of a century ago; today a tire that will give ten times more mileage can be bought for half that price. Again, electric light bulbs that cost 60 cents or more only a few years ago can now be purchased for 10 or 15 cents.

But dollars do not tell all the story. New machines, new methods, new tools make it possible for more people to be employed because, through these technological advances, the workers can turn out more and better products at lower cost, thus enabling more people to become consumers. More products, more consumers, more workers, more products . . . it's an endless chain.

This whole problem of machines *versus* employment is neatly summed up by A. M. Sargent, president of the American Society of Tool Engineers, in the following statement: "Tool engineering, coupled with top-efficiency machines, are the only levers which can further increase our national income. While accomplishing this goal, they will continue to lower consumer prices and step up employment, yet yield a satisfactory profit to stockholders . . . for such a system invariably encourages production."

ENERGY FROM NUCLEAR FISSION

POWERFUL electrostatic forces which bind atoms together may someday be utilized in the direct production of electrical energy for industrial uses. This is the opinion of John G. Trump, Associate Professor of Electrical Engineering at Massachusetts Institute of Technology. Pointing out that most present plans for utilizing nuclear energy involve heat and heat engines, Mr. Trump predicts that perfected electrostatic machines "may be uniquely able to utilize directly the energy of nuclear fission without the intermediate heat cycle."

BIG ONES FROM LITTLE ONES

LAMINATED wood beams, while not exactly new as structural units, are currently offering new use for scrap lumber. Such beams, properly designed and put together with the correct adhesive, can utilize a lot of the 60 percent of every felled tree which is now waste—burned as fuel or simply discarded. They are made with good clear lumber on the outside only; the inside of the beams may be filled with lower grade wood, even with scrap. Despite this seemingly "jerry-built" construction, the resulting laminated beams are stronger than beams of similar size sawn from straight, sound—and therefore relatively rare—trees.

Answer to the strength of these composite beams is two-fold: Modern adhesives can be made stronger than the wood itself; by placing the grains of the pieces which make up the beams at angles to each other, stresses can be spread over the entire beam instead of being concentrated.

MOLY AT WORK

SIGNIFICANT to high-temperature fields—such as internal combustion engines, jets, rockets, and electrical circuit breakers—is the recent development of a process of producing ingots of molybdenum weighing more than 150 pounds. Moly, with a melting point only a little under 5000 degrees, Fahrenheit, has up to now been one of the bad boys of metallurgy. However, because of its corrosion resistance and good wearing qualities at elevated temperatures, moly has offered a challenge to research which appears to have been successfully met. Production details are still held secret.

BATTLE OF THE MOTOR CARS

BIGGEST industrial disappointment to the public has been the failure—on the surface—of the motor-car manufacturers to live up to the glowing promises of post-war vehicles that would be out of this world in performance, appearance, and price. But under the surface—and quite aside from the familiar problems of materials and labor—there is a real struggle going on that should redound to the public's benefit within six months after these lines appear in print.

Ford is going after General Motors' leadership and, it is reliably rumored, will have a real "Car of Tomorrow" on the market before the end of 1947. Outstanding innovation, it appears, will be an extremely simple automatic transmission which will be inexpensive to manufacture.

But don't think that General Motors and others will take a licking without fighting back. They *will* fight. And John Q. Public, along with the entire motor-car industry, will profit by this competition.

STRAWS IN THE WIND

WHISKEY may become a by-product of the distilling industry; present wastes are high in potential value as live-stock feed. . . Improved anti-knock gasolines will give 50 percent more mileage. . . A vinyl resin plastics is challenging linseed oil as basic ingredient of linoleum.

Scientific American
APRIL • 1947

Tough Alloys Cut Like Cheese

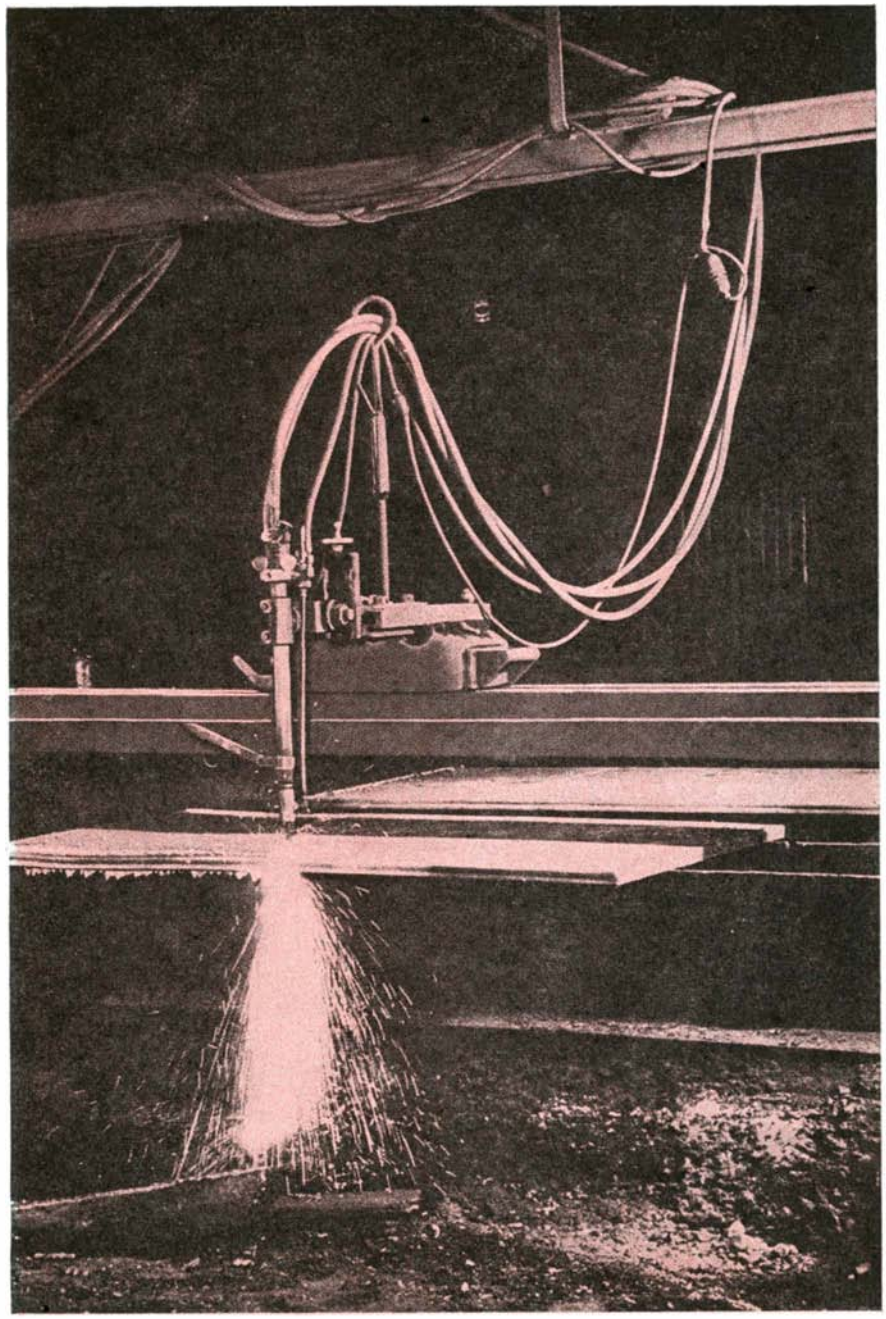
Until Recently, All Attempts to Apply Conventional High-Temperature Cutting Techniques to the More Refractory Metals Resulted In Slow, Ragged Cuts. Now, However, With Newly Developed Methods, Many of These Metals Can Be Cleanly Cut on a Real Production Basis

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

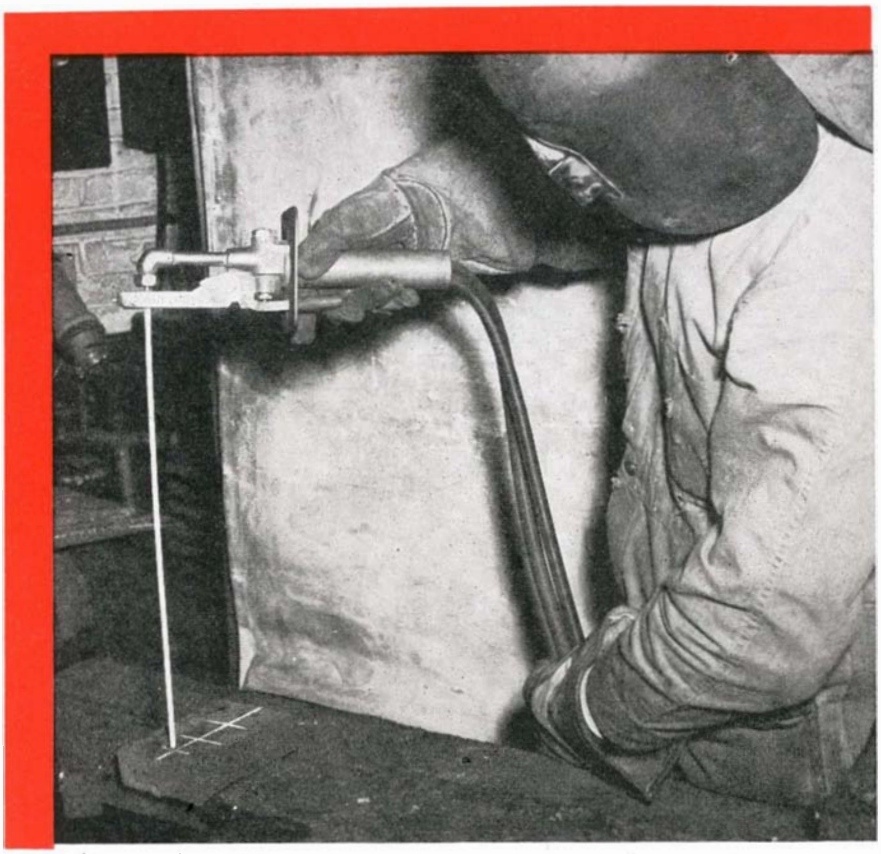
THE PAST 15 years have witnessed remarkable advances in the cutting of metals at high temperatures. Oxyacetylene cutting (also called the oxygen lance) and carbon or metallic arc cutting have been applied to hundreds of different metal shearing, piercing, cutting-off, scarfing, routing, and shaping applications in sheet and plate metal shops, foundries, steel mills, ship yards, construction jobs, and so on. The process has been mechanized and pantographed, subjected to wizard-like electronic control, applied to the cutting of stacks of sheet in one operation, and employed to cut metal underwater.

Most high-temperature cutting, however, has been applied to plain carbon steel and a few other non-refractory metals. For these, the process—primarily one of rapid oxidation of the metal being cut along a thin line—has been ideal because the melting temperatures of the oxides formed are lower than the melting points of the base metals used. In such situations, the iron oxide, for example, melts off as fast as it is formed and, if anything, helps rather than hinders the operation.

Attempts to cut more refractory materials such as stainless steels, Hastelloy-type alloys, aluminum bronzes, and so on usually came to grief (or at best were slow and produced a ragged cut) because the oxides formed were pasty or even solid in the reaction area, and protected the base metal against further oxidation as fast as they were



Right: Linde powder-cutting torch making a cut in a one-inch stainless steel plate



The Arcos cutting tool ready to pierce a heavy piece of alloy steel

• LOOKING AHEAD •

Many alloys finding wide application in places from which their cutting difficulties had formerly barred them. . . Cost-cutting fabrication of these metals. . . Greater efficiency in many construction jobs, with the better materials more readily available.

formed. Continuous cutting was thus virtually impossible and, to carry out the operation at all, much preheating of the metal and very slow passage of the oxyacetylene flame or the cutting arc were required.

Within the last year, however, three new and different processes for rapidly cutting stainless steels and other tough alloy materials have been developed and placed in use. Engineers and fabricators who are using them are glowingly enthusiastic and believe that, in addition to simplifying and lowering the cost of established stainless steel fabrication, the new processes will open to stainless steel many applications now denied to it because of the previous difficulty in rapidly making clean cuts in the material.

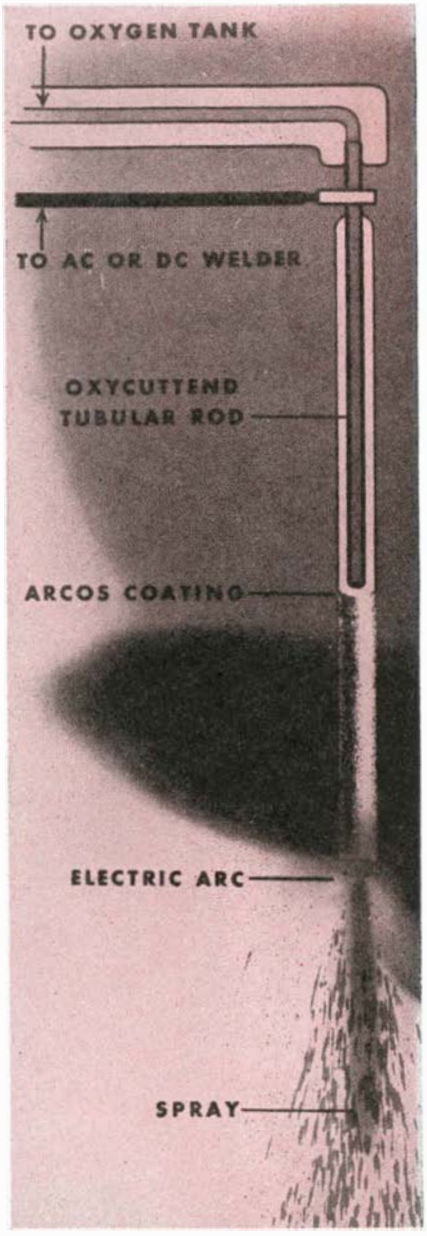
The three companies who have developed these new processes are Linde Air Products Company (a division of Union Carbide and Carbon Corporation), Air Reduction Company, and the Arcos Corporation. The three processes have one principle in common: the fluxing away of the high-melting oxides produced, either with molten iron, molten iron oxide, or an inorganic salt.

POWDERED IRON USED—Linde's process is called the powder-cutting method, and uses a finely divided iron (or iron-rich) powder, which is ejected into the oxygen stream and burned; the resulting high-temperature reaction cuts the material. The iron powder is heated to ignition temperature by the oxyacetylene flame. The equipment comprises a powder dispenser and a powder blowpipe, especially designed to feed the powder into the oxygen stream. Machine-cutting attachments are also available so that standard oxyacetylene cutting equipment can be adapted to powder cutting.

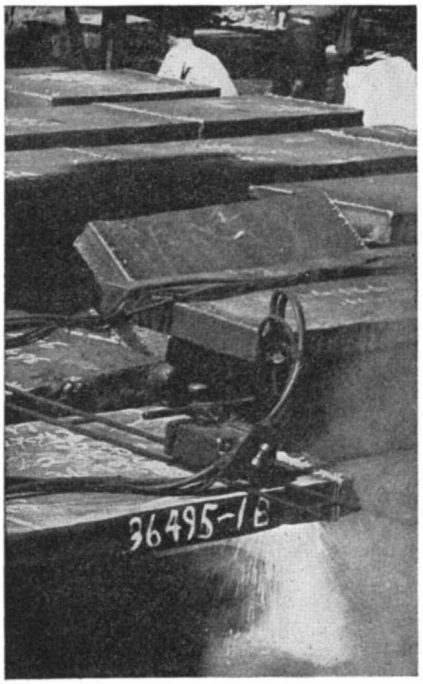
In the method developed by Air Reduction, specifically for stainless steel, a chemical flux is fed through the oxygen stream of an oxyacetylene torch to react with the refractory oxides of chromium and nickel. These oxides are thereby fluxed away and cutting can proceed apace.

The third method, developed by Arcos, is called the Oxyarc process and uses a fine-point concentration of heat generated by an electric arc and a stream of oxygen. The arc is established between a coated tubular mild steel rod (consumed in the operation) and the metal being cut. The oxygen flows through the tubular cavity in the rod, and the still-reacting molten rod-metal literally cuts its way through the material being fabricated.

THICK SECTIONS CUT — The Linde powder-cutting process seems to have no upper limit on the thickness that can be cut, 26-inch sections having been successfully cut to date. For sections smaller than ¼-inch, however, stack cutting is desirable if maximum quality of cut is sought. Tight clamping is not necessary when stack-cutting with the powder process, because the high heat of the reaction easily jumps across gaps between the plates.



Drawing of the Arcos cutting rod



Iron powder burning in an oxygen stream slices through an alloy plate

Cutting speeds with the powder process are good. On a one-inch stainless steel plate the cutting speed is 14 to 16 inches per minute; on ½-inch stainless the speed is 20 to 24 inches per minute. At the other extreme, a 20-inch stainless steel section can be cut at two to three inches per minute. These speeds are comparable to those attained in oxyacetylene cutting of plain carbon steel.

In addition to its many stainless-steel applications, powder cutting has also been used for removal of risers prior to sand-blasting in carbon steel foundries, for cutting cast iron, and on some high-alloy steels and certain nonferrous metals. Costs are difficult to estimate at present because of the variety of conditions encountered. In general, however, powder cutting of stainless steel costs about twice as much as ordinary oxyacetylene cutting of an equivalent-size carbon steel job; the powder amounts to 25 to 50 percent of the total cost. Powder cutting of cast iron is just about twice as expensive as powder cutting of stainless steel, because the cutting speed for cast iron is about half that for stainless.

The Linde and Air Reduction processes appear to have their greatest economic utility in stainless-steel producing plants and foundries, although the powder cutting process is being used increasingly for shape cutting of stainless steel in fabricators' plants and for such other materials as nickel, Monel, Inconel, Hastelloy, and so on.

Typical of the applications the powder cutting process has received are the scarfing of stainless-steel ingots, cutting off hot tops from ingots, removing risers from stainless steel castings, and so on. For example, a six-inch diameter riser can be removed by powder cutting in one and one-half minutes overall time, whereas the same riser removed by the old carbon-arc process would require 25 to 30 minutes cutting time. The process is also used for shape-cutting stainless-steel sheet, beveling plate edges, and for grooving out weld defects.

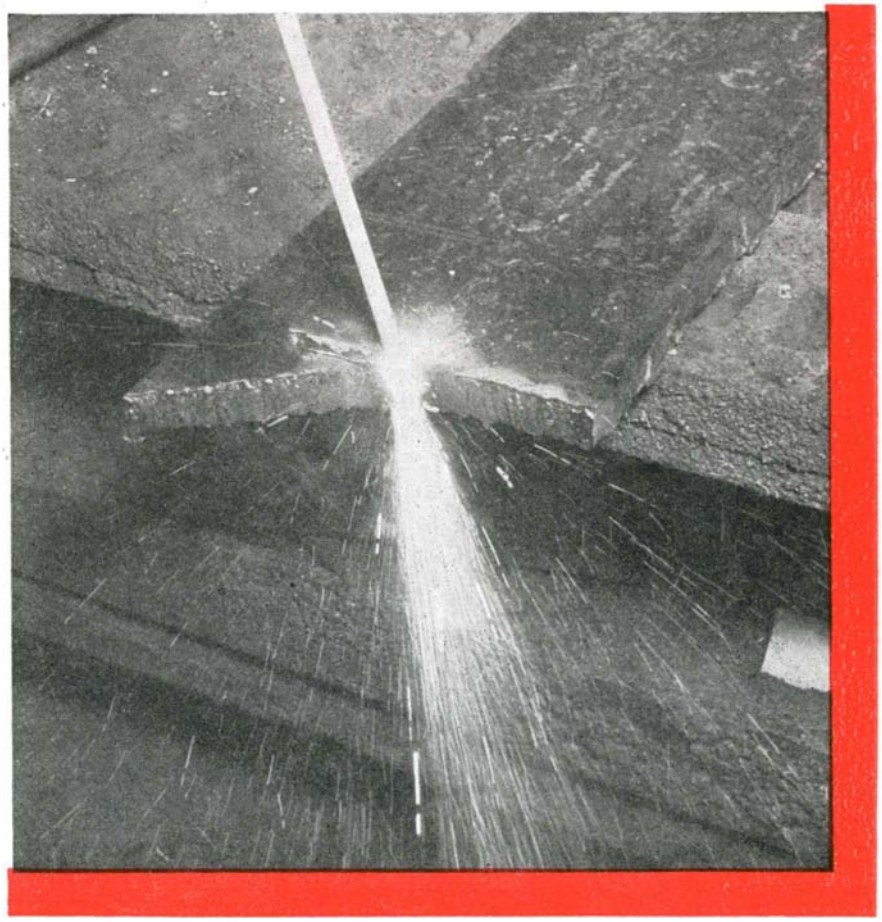
ARC PLUS OXYGEN—The Arcos Oxyarc process was originally developed by an Arcos Corporation affiliate in Belgium, where it was used for war-time cutting of mild steel. It is in many respects an adaptation of the American Navy's underwater cutting method employing an electric arc-oxygen stream. The tubular rod used is coated, 18 inches long and 3/16 outside diameter, and is made of mild steel. The rod coating helps to maintain arc stability and forms a small crucible which directs and confines the arc. It also acts as an insulator to prevent striking the arc at any other point except the end, and serves as an "insulated heel" on which to drag the rod along the line of cut.

At the present time the Oxyarc process is economically advantageous for cutting thicknesses up to three inches and for piercing up to 12 inches. It is a distinctly general purpose alloy-cutting process, being especially useful on thin-section work and for the scores of odd cutting jobs continually arising in sheet metal fabricating plants. As with the other processes, speeds are a function of the material and its thickness, ranging for example from two inches per minute for two-inch cast iron up to 23 inches per minute for quarter-inch copper.

As to costs, it has been found that 18 to 22 percent of the cutting costs with the Oxyarc process is labor; 65 to 72 percent is the cost of the rods; and the remainder is oxygen and electricity. The Arcos Corporation has provided the accompanying table which gives the speeds and costs when using the process on different materials.

The widest application for the oxygen-arc process is in cutting alloy steels, particularly stainless. Other metals which have been successfully cut include nickel, Monel, copper-nickel, aluminum, copper

The Oxyarc process, employing an electric arc supplemented by an oxygen stream, is another method of cutting many hard-to-cut alloys quickly and accurately



Cutting Speed and Costs for Oxyarc Cutting

MATERIAL BEING CUT	THICKNESS, INCHES	CUTTING SPEED IN. PER MIN.	TOTAL COST PER FT. OF CUT (LABOR AT $1.50 PER HR.)
Aluminum	3/8	15	$0.12
Monel	1	2.7	0.68
Hastelloy B	3/8	9	0.25
Bronze	1	3.3	0.43
Copper	1/4	23	0.13
Stainless Clad	5/8	22.5	0.12
Cast Iron	2	2	0.71
Nickel	1/2	5.5	0.24
Stainless Steel (type 347)	1/4	10	0.15

alloys, cast iron, and plain carbon steels. Clad materials such as stainless-clad and nickel-clad steel are readily cut. The process is also applicable to stack-cutting, especially for thin plate, and no clamping is required even though the plates in the stack be separated by as much as 1/8 inch.

Applications have been reported for the Oxyarc process ranging from those in small job-shops to large metal-fabricating plants. Savings of time and money have been scored in the fabrication of complicated shapes where holes for flange connections, manholes, and so on, must be cut in the part after forming. For example, in the construction of a five-foot diameter stainless-steel tower four holes—two four-inch diameter and two two and one-half-inch diameter—were cut in the side of the structure in 15 minutes. This job would have required 24 man-hours by the usual method of drilling and chipping out similar holes with a hand chisel.

AVOIDS LAYOUT — Layout of sheet and plate for fabrication is a time-consuming operation in many industries. Using the Oxyarc process as a rapid means of making cut-outs after the part is formed, the complicated layout before forming can often be eliminated. Another interesting use of the process is for rapidly piercing carbon steel to provide a starting point for an ordinary oxyacetylene cut, when the cut is not designed to start at an edge. Other special advantages are the process' thin rod, which provides a means of cutting in places that are inaccessible to the regular torch, and its special utility in cutting through pipe from one working position and without turning the pipe.

All these processes are new, and further developments and improvements in them are foreseeable. But already they have demonstrated not only their cost-cutting advantages, but also their ability to extend widely the applications of some of our tougher alloy materials.

⊕ ⊕ ⊕

GALLIUM THERMOMETER

Measures High Temperatures Directly

A THERMOMETER has recently been developed for use in the metal, ceramic, and similar industries whose operations involve temperatures around 1000 degrees, Fahrenheit. It consists of a quartz capillary tube inside a quartz envelope; the capillary is filled with pure gallium (containing a slight trace of iron), which is liquid above 100 degrees, Fahrenheit. The new thermometer can be used (just as a mercury thermometer is used for ordinary temperatures) for direct temperature readings up to 1200 degrees, Fahrenheit, and is intended chiefly for the range of 950 to 1000 degrees, Fahrenheit—temperatures which could otherwise be measured only with thermocouples, optical pyrometers, or other "indirect" means.

FLAT WIRE

Cut from Centrifugally-Cast Metal Disks

A MAKER of metal screening from copper and its alloys has developed a novel method of making flat wire of brass, phosphor bronze, and nickel silver, which may well be followed by others. The molten metal is cast centrifugally into thin disks. Then cutting machines snip off the flat wires from the outer edges of these disks. Advantages are sounder metal, free from flaws and gas holes, hence with lower scrap loss. The three metals used do not require heat treatment.

BRIGHT PLATING

With Cyanide Copper Is Fast and Inexpensive

THROUGH the development of a new bright copper plating process, it is now possible economically to copper-, nickel-, and chromium-plate zinc die castings and other metal parts without any intermediate buffing operations. The process, developed by MacDermid, Inc., employs a simple cyanide copper bath containing a proprietary brightener, and functions over a broad range of operating conditions.

Zinc die castings are said to be electroplated more successfully by this process than by any other. The denseness of the copper deposit obtained minimizes the appearance of black streaks during subsequent nickel plating of these parts.

Reasonably high plating speeds are obtained with the new process. For example, at 20 amperes per square foot, a commonly used current density, a 0.001 inch copper plate can be deposited in one half hour. Modifications in bath and practice can be employed to achieve even higher speeds. Costs are described as extremely low, the low rate of cyanide breakdown more than off-setting the cost of the addition agents.

A special feature of the solution is its ability to plate smooth deposits even in comparatively dirty solutions. Others are its adaptability to simple steel tanks and other conventional equipment, and the fact that any conventional copper anodes can be used with it.

FINE STEEL WIRE

Being Produced to Close Tolerances

STEEL wire today is an even more important raw material than in former years. Great quantities of fine wire are now produced to tolerances of ±0.0002 inch, some of it with tensile strengths above 300,000 pounds per square inch.

An important current application is the use of 0.0059-inch diameter wire in heavy duty tires, to provide a core for the bead holding the tires on their rims. Another war-time development which is here to stay is the availability of a high-grade American valve spring material, which before the war could be obtained only from Swedish manufacturers.

Batching by Electronics

Overcoming Many of the Limitations of Purely Mechanical Counting Methods, Electronic Devices Can Sort Count, Batch, and Totalize at Speeds as High as 15,000 Units per Minute with Incontestable Accuracy

By VIN ZELUFF
Associate Editor, *Electronics*

• LOOKING AHEAD •

More economical packaging through elimination of short- and over-counts. . . Precise control of processes involving large numbers of identical parts. . . Electronic "memory" units which keep tabs on groups of machines operating at different speeds.

MODERN high-speed machines are inefficient when the methods used in batching, sorting, filling, and packaging do not keep pace with the output of the machines. Then, to keep production in step with the processing machine, several operators are required to handle the product, fill containers with the proper quantity, or do other costly hand operations.

In some plants, such old-fashioned methods as the use of hand scoops and ratio weighing are used as a volume or weight indication of quantity, for small items such as pills, buttons, washers, and bolts. With hand scoops, consumer dissatisfaction is frequently caused by the inaccuracy which results in a short count. On the other hand, prices are often pegged higher than necessary to offset such possibilities because the manufacturer adds about 3 percent overage to insure a minimum correct count in the finished package.

Ratio weighing—the use of a fixed quantity to determine by scales the count contained in a larger weight—may also be inaccurate and costly when variations occur in the density of the sample. Objects which absorb moisture, as well as stamped metal parts where the gage of the metal stock is not held to close tolerances, are particular offenders in this respect.

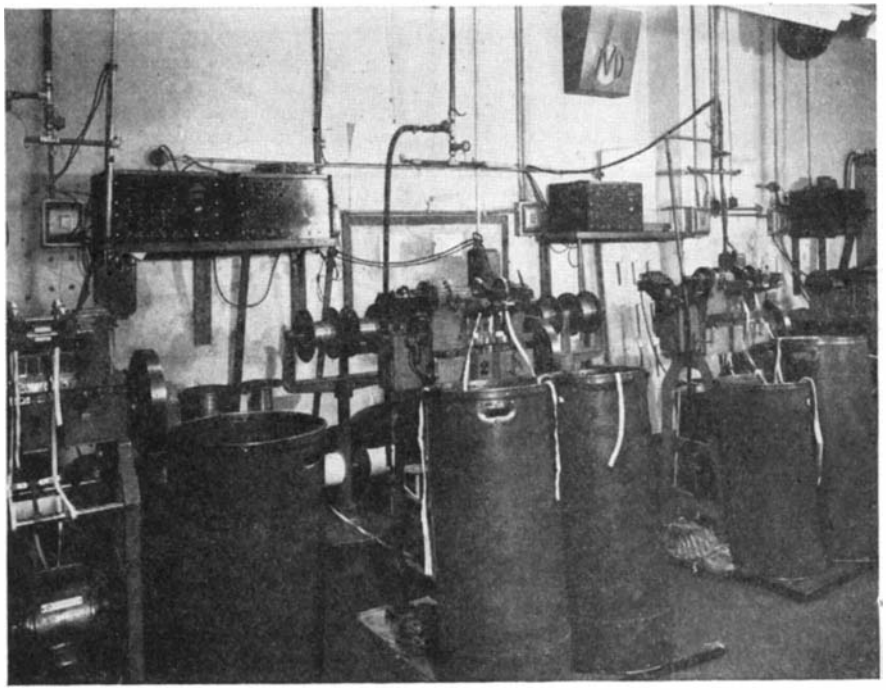
A partial answer to this problem is the use of mechanical counters. These are usually limited to a maximum speed of less than ten per second and have the additional disadvantage that they are frequently actuated by the operation of a machine part rather than by a processed item. Thus the counter continues to register even if the machine runs out of stock or fails to operate correctly.

HIGH-SPEED COUNTERS — Preset electronic counters are now finding wide usage in high-speed packaging and sorting applications, as well as in high-speed manufacturing processes which require split-second actuation of controls. This type of counter is being used in control of tin-plate processing, the manufacture of "zippers," packaging of many different types of small items, and hundreds of other industrial applications.

With the electronic counter, counting, sorting, or grouping for packaging any small or large items can be done at rates up to 15,000 per minute in pre-set quantities from 1 to 10,000 or more pieces. Pills, buttons, screws, washers, caps, sheet steel, machined parts, and even liquids can be batched in this manner.

One of the drawings shows how a pre-set counter is used to count a definite number of pills and accurately channel the quantities into two lines of bottles on a moving conveyer belt. Pills to be packaged are placed in a hopper and are fed to a rotating disk and belt arrangement which is designed to emit pills in single file at rates of approximately 250 per second. As each passes through the light beam it causes an electrical impulse to be injected into the input of the pre-set counter.

The electronic circuit of the counter is set by means of dials to actuate a self-contained high-speed single-pole double-throw relay each time the proper count is reached. Thus if the quantity of pills required in each bottle or box is 100, the output of this relay actuates a solenoid which moves a deflector plate and thereby channels the pills in quantities of 100 alternately through two



By varying the dial settings on this battery of dual counters, both the length of the "zipper" and the space between single elements can be easily changed

ducts. The conveyor belt carries the empty bottles in two lines to gates which are directly under the ducts. These gates are actuated alternately by the same impulses that control the deflector plate. When the bottle has been filled with the correct quantity of pills, the respective gate is opened and the bottle is permitted to travel along the conveyor to the capper. Meantime a second bottle is filled and the operation proceeds.

FROM ONE TO NINE — The basic unit of the pre-determined counter is a four-tube electronic counting circuit that registers a count from 1 to 9 on neon bulbs and then resets to 0, and provides one electrical output pulse for every 10 injected. This is accomplished in a binary progression using a 1-2-4-8 series.

The complete counter contains four such circuits in tandem, four switches for setting the count, and an electronic switch which is used to actuate a relay. By using the four circuits, a count of 0 to 10,000 can be arranged simply by setting the four dial switches, each having ten positions numbered 0 to 9. These are set by subtraction from 10,000, the maximum count obtainable. In the case of the pill counter, the count of 100 is achieved by setting the dial switches to 9900. When the counter reaches 10,000 the output relay then operates.

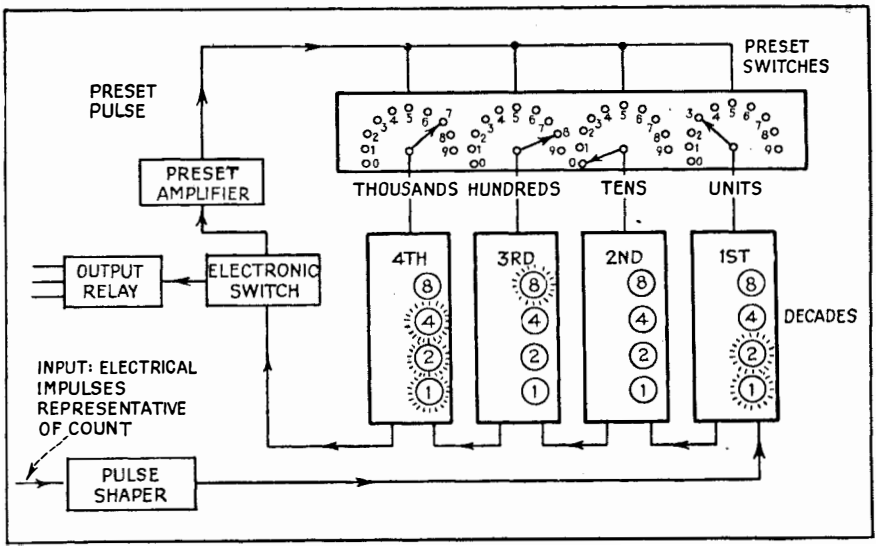
The dial switches make connections to the proper grids of trigger tubes, for injection of the pulses needed to give a pre-set starting count. For automatic repetition of the count as used in putting pills into bottles, the pre-set combination of pulses is applied automatically at the end of each count to the common terminals of all switches. For some operations, manual starting of the cycle is required and a button is located on the front panel for this purpose.

When automatic pre-set is used, the output pulse from the last circuit triggers an electronic pulse generator which supplies a positive pulse to the required tubes for starting a new count, as determined by the setting of the pre-set switches.

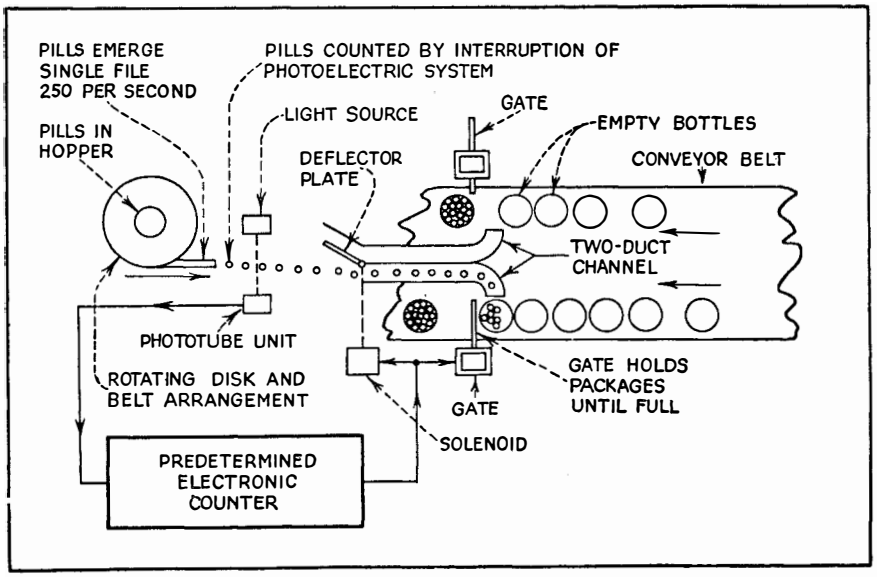
All types of operations and processes requiring split-second control can use this pre-set counter. The electrical input impulses can be produced by shaft rotation, the interruption of a photoelectric light beam, reciprocating member motion, contact closures, electromagnetic field disturbance, and many other actions which are representative of counts. The fast-acting output relay can readily be adapted for solenoid control.

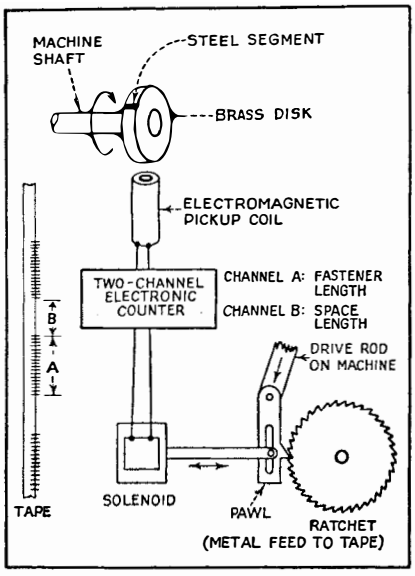
Double counters may be used for controlling processes which consist of two different operations. An example of this type of application is high-speed control of "zipper" manufacture. Here accurate control of the number of metal elements and the spacing between groups of elements inserted in the continuously moving tape is required. These two operations are normally controlled by cams or gears, which frequently cause errors and limit the maximum speed of operation.

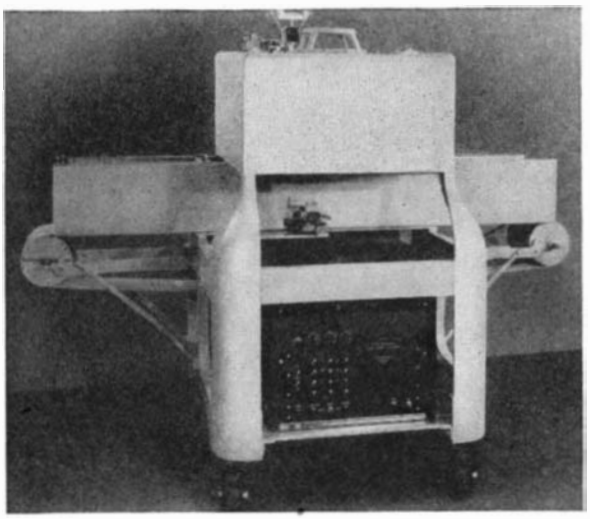
SUBSTITUTE FOR CAM — The double counter provides alternate switching of the output relay at the completion of each of two different pre-determined counts and it can be readily substituted for the cam or gear control in this application. In practice, the number of "zipper" elements desired is set up in one channel of the counter by means of the dial switches, and the spacing between groups of elements set up in the other counter channel by means



The diagramed four decade single pre-set counter (above) is set for a starting count of 7803 as required for batching 2197 units. Also diagramed are the mechanical and electronic features of pre-set counters as applied to pill-packaging machines (lower left) and to slide-fastener machines (lower right)







The pre-set electronic counter enables the pill-packaging machine to bottle up to 15,000 units per minute with absolute accuracy

Courtesy Potter Instrument Company

of a second row of dial switches. The electrical input to the counter is derived from a shaft rotation which corresponds to the insertion of a "zipper" segment or to an equivalent space on the fastener tape.

Conventional "zipper" machines require the changing of gears or cams each time a new length is desired. The double counter eliminates this time-consuming operation. To change "zipper" length with the electronic control it is necessary only to change the dial switch settings. This can be accomplished without stopping the machine. Normally this model controls at rates up to 12,000 per minute. Equipment suitable for higher rates of operation is also available. For accurate counting at high speeds, standard electronic counters will operate at rates up to a million per second in response to interruption of a photoelectric light beam or other form of actuation.

The counting device can also be used as an interval timer. In this case, a crystal-controlled oscillator is fed into the counter by an electronic switch which is operated by the initiating and terminating pulses from a time interval. If a 100-kilocycle quartz crystal is used as the standard, the accuracy of measurement will be 0 and −10 microseconds for an interval as long as desired. Interval timers of this type are now used by the armed services for projectile velocity measurements. Pre-set interval timers using the same principles are also being supplied for the generation of precise time intervals.

TOTALIZING POSSIBLE — Development of the basic electronic counter principle has resulted in an instrument which is capable of totalizing the individual outputs of many sources occurring at random times. This system has been applied to a pari-mutuel betting machine at a race track for recording the amount of money bet on each horse at the ticket machines. Since this equipment must also convert the $2, $5, $10, and $50 bets into equivalent dollars for totalizing, it was necessary to develop circuits which would add and multiply electronically. Such totalizing equipment is useful in a manufacturing process where many machines are making the same product at varying rates. In this instance, it is often desirable to know the total output or the average rate per machine. The totalizing equipment can be readily used for this purpose even where the outputs occur at random rates and counts occur simultaneously.

Newspaper plants can use this system for obtaining an up-to-the-second count of the various press outputs. It can also be used to record total fluid output by totalizing the outputs of the individual flowmeters. Power-plants can use such a device for recording the total output from several generators by totaling the readings of individual wattmeters. These are but a few of the thousands of possible applications of totalizing equipment.

⊕ ⊕ ⊕

FOUNDRY CORES

Baked Uniformly by Electronic Method

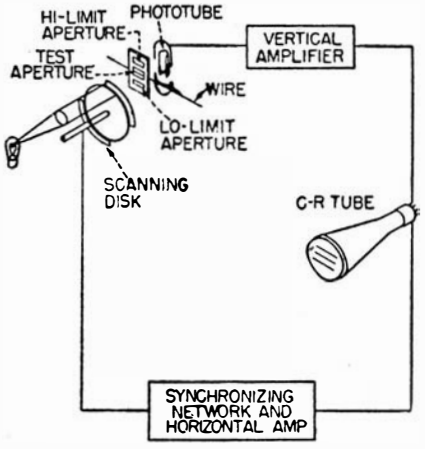
ELECTRONIC heating has reduced to 30 seconds the baking time for foundry sand cores that required hours of time by the old oven method. The wet cores are now carried through a dielectric heating tunnel by belt and timing is thus removed from the responsibility of the operator. It is impossible to burn the cores even by repeated passes through the tunnel. Cores are uniform, with ideal color and texture, whereas oven-baked cores were irregular in texture.

It has been found possible to pour Alnico and Stellite around cores produced by the electronic process. The reported cost for power is about $1.25 per ton of sand treated and tube cost is eight cents per hour. The equipment used is made by Induction Heating Corporation.

CONTINUOUS WIRE MEASURER

Checks High and Low Limits By Shadow on Tube

AN ELECTRONIC micrometer for thin materials speeds continuous-production measurement of wire diameter and strip thickness by using a phototube to measure the shadow of the material under observation. Significant savings are claimed when the instrument is used in the manufacture of plastics-covered wire, razor blades, rod, bar, and tube



Using light-to-shade ratios as a guide, tolerance can be checked to .0004 inch

stock, and coated or bare filament wire.

A measuring head contains an aperture across which is fed the material to be measured. This is illuminated by a lamp that casts a shadow of the object on the cathode of a phototube located behind the measuring aperture. The area on the surface of the cathode that is not in a shadow produces a voltage signal in the phototube.

Two other openings, one on each side of the measuring aperture, represent the positive and negative tolerance limits to which the material must conform.

A scanning disk rotates between the phototube and the apertures, exposing each of the three in sequence so that the signal level changes only in proportion to the tolerance of the material under measurement and does not change with respect to the absolute dimension of the material. The sensitivity

of the instrument, developed by Wilmotte Manufacturing Company, is such that it is possible to measure dimensions in ranges up to 0.6 and up to 0.005 inch, in both cases within an accuracy of 0.0004 inch.

EMERGENCY CONTROL LINE

Uses Commercial Channels For Signal Impulses

SHOULD flood or storm knock out railroad switching or signaling pole lines, the commercial message channels could be used to actuate the vital equipment. In a recent test, the Pennsylvania Railroad successfully used an emergency 900-mile link that replaced a 53-mile wire line from a traffic control tower near Red Bank, Pennsylvania, to Oil City, Pennsylvania. For the test, the impulses were flashed from the Red Bank tower to Pittsburgh over Pennsylvania Railroad wires, then via Western Union wire and cable circuits to Washington and Philadelphia. A Western Union radio beam circuit carried the impulses from Philadelphia to New York, and they returned to Pittsburgh over telegraph wires. Transmission was over railroad wires back to the control tower, when the impulses entered the regular wires to throw the switches and set the signals.

ELECTRON-BEAM COMPASS

Serves Also As Magnetometer

CAPABLE of precise readings unattainable with conventional magnetic compasses, a west-seeking compass uses an electron beam which is focused at four target plates in a special vacuum tube. The beam is equally divided between the plates when pointed in the direction of the earth's magnetic field. In any other position, the earth's field bends part of the beam so that it strikes the targets unevenly. Combined with an electronic amplifier, the instrument, a product of the Minneapolis-Honeywell Regulator Company, measures the different electron currents on the plates and then translates the difference into energy sufficient to move indicator needles or to control the auto pilot used in aircraft. It will also be possible to use the instrument to control ships automatically, and as a magnetometer in prospecting for oil, ores, and other subterranean deposits.

INVISIBLE TALKING

Made Possible by Use of Cesium Lamps

WHEN there is urgent need for communication between two points several miles apart, yet wire lines are down and radio cannot be employed for reasons of secrecy, a new talking lamp developed by Westinghouse steps into the picture. This cesium vapor lamp (see also page 28, January 1947 Scientific American) alternately dims and brightens thousands of times a second when connected to an amplifier and microphone. The resulting strong yet invisible beam of infra-red light can be picked up by a phototube several miles away and converted back into sound by a conventional amplifier and loudspeaker.

Infra-red beamcasting is unaffected by static, and gets through in all weather except extremely soupy fog or smoke. It has possibilities for conversations between planes flying in formation, where radio equipment on board is needed for other purposes, and has maintained contact between ship and shore even during high-speed maneuvering. Although developed too late for use in combat in World War II, it is now ready for future use by the Navy in convoy duty and for issuing troop landing instructions immune from jamming or eavesdropping.

No static, jamming, or eavesdropping

ELECTRONIC TRAINING PLANE

Simulates All Air Maneuvers, Incorporates Complex Instruments

FLIGHT characteristics of an AT-6 airplane in the air are simulated by a new electronic flight trainer, complete with automatic radio range.

A complex electronic computing system solves differential equations expressing the motion of an airplane in space and is the basis of the unit.

All the interacting effects between lift, drag, thrust, and the various other moments and forces causing the airplane to maneuver, stall, or spin in space are developed as electrical voltages when the controls are operated. These voltages are sent as signals to the computing system of the trainer, which delivers the correct answers and translates them continuously and smoothly into instrument indications in the cockpit of the trainer, into variations in engine sound effect and control loading, and into actuation of the course-plotting unit and radio-navigation aids.

In appearance the Curtiss-Wright Dehmel trainers resemble a single-seat airplane fuselage, minus wings and tail section. Because it can be adapted to the instruments and flight characteristics of any type airplane, the trainer offers many possibilities in the field of flight training. By alteration of the components of the electronic computing system and insertion of the appropriate instrument panel in the dummy cockpit, changing requirements of new types of aircraft can be duplicated in the trainer accurately and satisfactorily.

Computer reduces "motion-in-space" to readings on trainer's instrument panel

Chemists Fight for FOOD, FORAGE, FIBER

How Can Full Use be Made of Available Agents for Protection of Crops Against Destruction by Insects and Disease? Can Government-Sponsored Research Give the Answer?

By D. H. KILLEFFER
Chemical Engineer

• LOOKING AHEAD •

Complete eradication of whole families of insect pests. . . Doubling of available timber supply. . . "Crop pest attack" forecasts to make victory more sure. . . Co-operative surveys to benefit all American agriculture. . . Chemical industry back of it all.

WITH ALL of today's modern improvements and with all the new things available for our bright new world, we are still curiously anxious to seek out more novelties, although we are yet far from fully utilizing many of those we have had for several decades. We are ready to embark upon weighty and protracted researches to be subsidized by us through our government and to be directed toward laying more and greater potential blessings at our feet when we have done practically nothing about a number of those already in our possession. That is the serious charge made against the people of the United States by the industry which produces agricultural insecticides and fungicides.

That industry has spoken out boldly about the directions which research of the future should take to accomplish the greatest good for the greatest number. It has also called upon all concerned with the production of food, fiber, and forage crops to utilize fully the chemical weapons already available to us in conquering the pests which now consume and destroy large shares of the output of our agriculture. While any other industrial group might well have made such charges, the universal dependence of all of us on agriculture and on the efficient production of crops gives this industry's charges particular pertinence.

PENETRATING SURVEYS — The need in the field of crop protection today, the industry says, is for penetrating surveys of pests, which can be supplied only on a far broader basis than is possible through the investigations of any small group or aggregation of such groups. The industry already possesses facilities for conducting research into new materials for use in controlling pests and for producing any new agents that may be needed. The testing of chemical compounds that may be suspected of having value in crop protection and pest control can be done with reasonable efficiency with no more than enlargement of existing facilities. Furthermore, the industry points out, both materials and methods are already amply available to accomplish immensely more than has yet been attempted in the field. Thus, the president of American Association of Economic Entolmologists has lately issued a statement to the effect that we already have in our possession means in both materials and methods to eradicate, once and for all, whole families of insect pests. He backs up his argument by naming a number of eradications already achieved in this field. In the field of methods, the effectiveness of spraying and dusting large areas from the air has reached the point where an acre in a large farm can be treated effectively in two to four *seconds* and at a progressively falling cost already well within reason.

It is worth while, then, in the face of the general clamor for scientific research by government, to take stock of the pest-control and crop-protection problems in order to see which way we should go. Their complete solution possesses an economic importance of the first magnitude.

The general effect of the war on this segment of the chemical industry has been no less and no greater than elsewhere. Research during the war years has provided several important new materials, and the urgency of war demands has hastened the development and adoption of a few new methods. Notable among the new agents for controlling pests are: DDT, proved effective against many types of insects; 1080, sodium fluoroacetate, powerful rodent poison; 2,4-D, which controls weeds; hexachloro-cyclo-hexane, valuable insecticide; ANTU, alpha naphthyl thiourea, whose value against rodents has been proved; dimethyl phthalate, effective against mosquitoes; and a number of other new materials, including the related plant hormones, having valuable properties. In the method category are aerosol bombs which effectively atomize liquids or solutions; improved techniques for airplane and helicopter applications of control materials to large areas; and the several varieties of synergetic mixtures in which the potency of the whole is greater than that of its separate parts; these among others. Moreover, the industry itself is physically equipped to produce the needed chemicals in satisfactory volume, since it has avoided generally the troubles which grow out of both over-expansion and reconversion from other lines of production.

POTENTIAL BENEFITS — Despite this, the situation seriously reflects upon our utilization of these potential benefits. Barely one eighth of the acreage in the United States devoted to crops is under protection already proved to be beneficial. While it is true that protected crop areas now produce about one third of the total value of our crops, the potential improvement in the pro-

ductivity of other areas now untreated could be expected to change this ratio by bringing up the value of the output of present low-rate producers. This presents a far more lucrative field for research at the general expense than more particularized fields, where industry and scientists, both independent and captive, are already at work seeking new materials.

Methods of using insecticides and fungicides have undergone tremendous progressive improvement during recent years. The application of these substances and of the plant growth regulators (hormones) to large tracts by airplane sprays, and more recently by the use of slower, but better controlled, helicopters, leave very little to be expected in the treatment of large areas. Rates of dusting and spraying by air range up to 20 to 30 acres per minute as compared with a maximum rate of coverage by the fastest modern ground equipment of four to five acres per hour. Both methods necessarily have advantages for particular circumstances and both will unquestionably be widely used in the future. An important advantage of air-borne treating equipment, particularly hovering helicopters, is the possibility it opens of applying weed killers to the vast stretches of wheat farms, sprays to prevent premature dropping of apples in large orchards, treatment of forest areas to control destruction by insects and fungus diseases, and even the dusting of cattle on the range with insecticides.

Clay Lyle, retiring president of the American Association of Economic Entomologists, recently pointed out that advances in both insecticides and methods of using them have already potentially doomed the house fly, horn fly, cattle grub, cattle louse, sheep tick, and others of the same classes. "We have the technical knowledge and equipment in each case," he said, "but we must secure a high degree of control through voluntary co-operation before public sentiment will compel final eradication by law."

To prove his point, Dr. Lyle cited success in fighting in the past the gypsy moth, the cattle tick, date palm scale, sweet potato weevil, citrus white fly, Mediterranean fruit fly, citrus black fly, and the legume weevil. Control and near eradication of various types of mosquitoes similarly point to probable success of attacks on other similar pests. Results, too, of treating large areas in Zululand with DDT by air suggest the possibility of exterminating the tsetse fly, responsible for the spread of African sleeping sickness, from large sections of Africa, if not indeed from the whole continent.

POLITICAL BARRIERS — Dr. Lyle further stated that while the eradication of many pests is now technically possible and even simple, political considerations prevent compulsory adoption and use of known measures. Cotton boll weevil could be easily exterminated within five crop years "without much disruption of total production by means of a succession of non-cotton zones gradually extending across the cotton states." But to carry out such a program would require legislation by the several states involved that would compel all cotton farmers to conform to the general scheme. Such legislation could not be enacted now and probably could not in the future without tremendous preparation.

The great need of all concerned to make full use of available materials and methods for controlling pests and diseases of crops is pointed out by the industry to be a more effective and inclusive reporting and forecasting service. The objective is to warn of outbreaks in time to meet them before they become major catastrophes. The basic scheme would resemble that now supplying the basic information for weather forecasting. Collection of information from all parts of the country to be correlated in a central bureau would soon enable researchers to discern patterns on which forecasts could be based.

"Even now a limited amount of forecasting is possible with certain insects," says Dr. P. N. Annand, chief of the United States Bureau

Courtesy Bell Aircraft Corporation

Carrying 400 pounds of dusting powder, a helicopter can treat 4.8 acres per minute. Method of application insures that both upper and under sides of leaves are treated, protecting forests from insect-caused losses greater than those from fire

In large scale tests, spraying five cents' worth of DDT on cattle increased the average production of beef by 50 pounds per animal, in addition to improving the condition of the hides

of Entomology and Plant Quarantine. "We can tell fairly accurately, considerably in advance, the population prospects of certain insects: grasshoppers, cinch bugs, beet leaf hoppers, cotton boll weevils and others. Added information might make possible forecasts of great value and increasing long-range accuracy."

As an example of the value of learning of outbreaks early, Dr. Annand states that the loss of 3 to 3½ billion board feet of spruce lumber in Colorado from a bark bettle could have been prevented if known control measures had been applied in time. Control, he says, is usually economically feasible only on small areas and the attack must be made early before infestation has spread to areas too large to be handled. "The annual loss from forest insects exceeds that from fire, and in many areas exceeds annually the volume cut for lumber." Obviously the reward for successful control is tremendous and well able to pay the cost of a surveying and reporting service.

URGENT CRY — Summing up the situation, A. I. F. News, official organ of the Agricultural Insecticide and Fungicide Association, says: "Now, as never before, the interests of farmers and consumers alike cry urgently for substantial enlargement of scientifically conducted surveys to develop information leading to increased efficiency in production of food, fiber, feed, and fats, through fuller and more effective use of economic poisons and related materials.

"This calls not merely for continuance of the insect and other pest surveys that have been valuable contributions of our Federal and State agricultural agencies for many years. . . The needs of today call for much more than mere maintenance or even normal enlargement of existing surveys. We should re-examine the purpose of these surveys, relearn the lessons they teach, and give thoughtful consideration to their possibilities for advancing the general economic welfare.

"More than anything else, these surveys should be evaluated in terms of their potential value to American agriculture as a whole and not to segments of it. On this basis the conclusion is inescapable that survey work should be placed on a vastly broader and more efficient basis.

"Initiation of effective control programs on the desired broader basis awaits development of more fundamental information. We need to know what insects, weeds, fungi, livestock parasites, and other pests are now causing serious economic losses and are not now being controlled. We need more information about the crops that lack adequate protection, the weeds that should be eradicated, the acreages of crops infested, and for a multiplicity of crops we need facts on the extent to which protection may be expected to prove economically feasible."

Clearly this segment of the chemical industry has adopted a constructive attitude toward the problem of tremendously enlarged government controlled and sponsored research. By thus outlining, in advance and publicly, the research needs of its field of expertness and special interest, this industry provides at least a partial basis for the development of a program which will supplement and benefit existing activities rather than duplicate and compete with them. Other industries could benefit not only themselves, but the people at large, by similarly analyzing the problems of their respective fields to find similarly valuable directions for government research to develop.

COTTON PRODUCTION

More Efficient Because of Machinery-Chemical Teamwork

THE foundation for the revolutionary mechanization program now under way in the production of cotton has been laid by chemical developments. While mechanical devices have been invented to do many

of the tasks involved in growing and harvesting cotton economically, they depend for their effectiveness on the assistance of chemical agents. Effective insecticides applied over wide areas mechanically by dusters or airplanes minimize faulty bolls that machines have difficulty in sorting out and at the same time greatly increase the crop yield.

The vexing problem of controlling weeds has been at last solved by an adaptation of chemical-warfare methods. Now a "flame cultivator," so adjusted as to be hamless to the cotton plants, suppresses unwanted growth by flames. This machine cuts the cost of weeding cotton from about $5 per acre by hand to a new low of 50 cents per acre.

Mechanical pickers of several types are under practical test but all prove efficient only when chemical defoliants have previously caused the leaves to drop off the plants and expose the bolls to the action of the machine. Large scale experiments now under way at the Delta Experiment Station, and on large cotton farms, foreshadow a significant revolution in American production of cotton.

TEXTILE DRESSINGS

Prevent Shrinkage, Provide Permanent "Starch"

TWO NEW chemicals, one a permanent "starch" for cotton and rayon, and the other a shrink preventive for wool, promise to improve tomorrow's fabrics.

The shrink-proofing agent, called Koloc, is a synthetic resin which reduces shrinkage of wool from the range of 30 percent to as little as 2 or 3 percent. It is claimed that it actually increases the strength of the fabric, tests having shown treated samples to be approximately 10 percent stronger than untreated materials. Also, up to 50 percent greater abrasion resistance is obtained, promising longer wearing garments.

Kandar, the permanent starch, is a thermoplastic resin which is applied to cotton and rayon in the same way that Koloc is applied to wool, with the exception that the cloth is dried at 250 degrees, Fahrenheit, for one half to three minutes. In addition to imparting a permanent crispness, Kandar also brightens fabric colors. As a result, dresses, curtains, draperies, and other articles can undergo repeated launderings without becoming noticeably dulled or wilted. The desired draping qualities are permanently maintained. Cotton and rayon, especially, stand to benefit from the new treatment, but it is equally applicable to wool, nylon, and silk.

Sweaters, originally same size, were laundered in same manner; untreated one shrunk, Koloc-treated one did not

Both of these products, developed by the United States Rubber Company, are invisible after application and are insoluble in laundering or dry-cleaning solutions.

SWEETENING AGENT

New Synthetic Compound Is 4000 Times Sweeter Than Cane Sugar

REPORTED BY Professor Pieter Eduard Verkade of Delft Technical University, Holland, a new chemical compound, 1-*n*-propoxy-2-amino-4-nitrobenzene, is said to be 4000 times as sweet as cane sugar. It is already being manufactured in The Netherlands and has been used with success as a sweetening agent there and in other European countries where it has been patented. Application has been filed for an American patent.

In comparison with saccharine and dulcine, the only synthetic sweetening agents in practical use until recently, the new substance suggests many industrial potentialities. For example, saccharine is only 200 to 700 times as sweet as cane sugar, while dulcine is 70 to 250 times as sweet.

The new benzene derivative is a powder-like substance produced in the form of orange crystals. It is one of the group designated as the 1-alkoxy-2-amino-4-nitrobenzenes. The members of this group range in sweetening power from 120 to 2000 times that of ordinary sugar and are characterized by a purely sweet taste with no secondary or aftertaste.

The *n*-propoxy compound is perfectly stable in boiling water and in not very strongly acid mediums. Its solubility in water is 136 milligrams per liter at a temperature of 20 degrees. The sweetening power of the saturated solution is equal to that of approximately 50 percent cane sugar solution. Diluted with some suitable substance, such as lactose or milk sugar, this compound provides a product which may be used as a sugar substitute at the dinner table.

WOOD YEAST

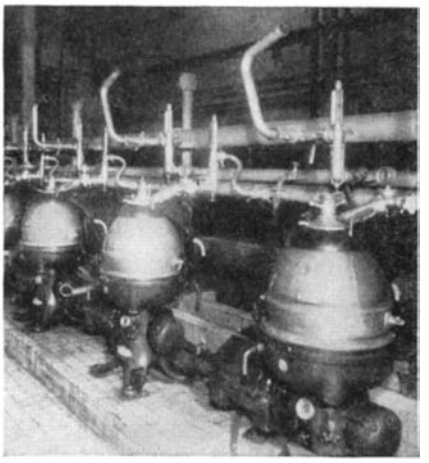
Is Made From Salvaged Waste of Paper Mill

FOR the manufacture of yeast from the waste sulfite liquor of Wisconsin's paper mills, a plant will be constructed shortly by the Lake States Yeast Corporation at a cost of $400,000.

The production of yeast from sulfite liquor is new to this country, although several similar plants are operating in Germany and one is working in Ontario, Canada.

In this process the waste liquor, which contains from 2 to 3 percent wood sugar, is neutralized by lime, clarified and fortified with nutrient salts, and fermented. The yeast emulsion is defoamed and separated in centrifuges, and the resulting cream is filtered and dried.

Wood yeast contains 1.6 percent more digestible protein than other concentrates now used for cattle rations.



Centrifuges in a German yeast plant

The taste of wood yeast is pleasant enough so that it can also be used to satisfy human nutritional requirements. Added to such foods as soups and spaghetti, it can replace a similar amount of more expensive animal protein. In addition to protein, yeast is an excellent source of the vitamin B complex and minerals.

Not only is a valuable food obtained, but the primary objective—elimination of stream pollution by processing of the objectionable waste—is also realized.

The waste sulfite liquor on the North American continent represents a potential source of about 75,000 tons of yeast annually.

PLASTICS in SHEETS

A New Method of Producing Low-Pressure Thermoplastics Laminates, Plus Relatively Low Overall Costs, May Point the Way to Expanded Uses for these Colorful, Durable, and Easily Formed Materials

By CHARLES A. BRESKIN
Editor, *Modern Plastics*

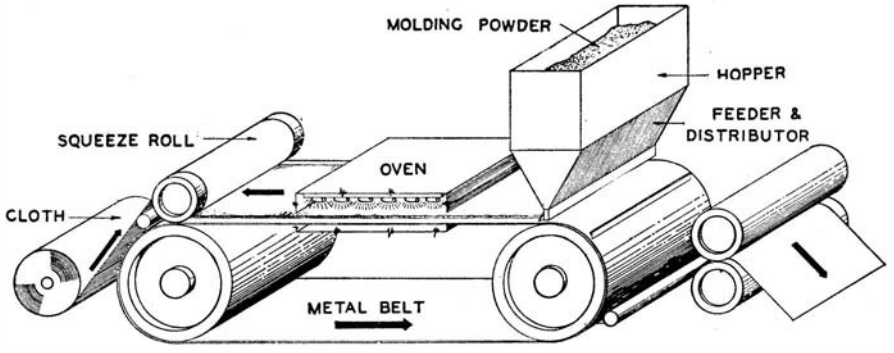
CONSIDERABLE speculation still revolves around the future of low-pressure plastics laminates—compositions of plastics plus paper, cloth, or other continuous supporting media, formed into sheets with a minimum of pressure and heat. Some of the principle end-products to date include suitcases, lamp shades, sales kits, loud-speaker housings, and the like, with others looming in the distance.

Among the issues involved in the current speculation are the relative values of laminates of different compositions, their durability and suitability in certain uses when in competition with non-plastics materials, and the present speed of producing low-pressure laminates, which can be accelerated by processes now being perfected.

There are many authorities in the plastics industry who point to the greater toughness of thermoplastics laminates (in which the plastics used will soften under heat and harden when cooled) as an outstanding advantage in their favor. This toughness, they say, is greater than that of thermosetting laminates (which, when once set, cannot again be softened by heat) and enables processors to make strong and deep draws. Also to be considered on the credit side of thermoplastics laminates—a combination of cellulose derivatives and fabric—is the fact that they offer great color possibilities, since almost any colored or figured fabric can be used as a base and, in some cases, the completed laminate can be covered with a solid color thermoplastic sheet.

• LOOKING AHEAD •

Perfection of a continuous laminating process . . . Laminating and forming on the same production line . . . Further lowering of already low costs.



Courtesy Hercules Powder Company

Thermoplastic molding powder, sprinkled from the hopper to the constantly moving stainless steel belt, is melted in the oven, after which it picks up the fabric at the squeeze roller. Cooling on the return trip, the impregnated cloth, easily stripped from the metal band, is ready for laminating in a conventional hydraulic press

Admittedly, there are factors militating against the use of thermoplastics in many applications. Their inability to withstand continued outdoor weathering is a disadvantage. And the wastage of material in trimming the flare from the edges of the mold is considerable, even though the loss can be somewhat offset by using the scrap as filler material for laminates of different construction.

COMPARE ALL COSTS—Whenever the relative costs of materials are compared, misconceptions are apt to develop if nothing more than the price of the raw material is considered. Some manufacturers and designers at times resist the adoption of plastics on the basis that it is more expensive per pound than sheet steel. Yet, if steel is to be colored, for example, it must be cleaned, surfaced, and primed before the finish coats can be applied. This adds to overall cost. If the surface of a finished metal part is scratched, it must be returned to the finishing shop for touch-up. More cost. On the other hand, a piece of plastics, colored in manufacture, can have such damage quickly and cheaply repaired on a buffing wheel.

Attractively designed, this sturdy vacuum bottle carrier, made of low-pressure laminate, is easily washed

Cellulose-derivative laminates also have the advantage of easy, rapid fabrication; they lend themselves to straight-line production processes. Plastics from laminating equipment can be fed directly to drawing equipment, thus making

An architect's kit containing model kitchen layouts to aid in home planning is housed in a rigid, waterproof case of thermoplastic laminate

possible fast, low-cost production processes. One manufacturer has reported cycles as fast as ten seconds for the laminating of flat sheets. Since only 100 pounds per square inch is required to laminate the plastics and only 10 pounds per square inch to draw it, expensive equipment is not necessary. When this rapid cycle is added to the low equipment investment, it is clear that the investment cost per pound of finished material is relatively small.

PRODUCTION METHODS — Both the Textileather Corporation and the Hercules Powder Company have worked out somewhat differing methods for the coating of fabric with thermoplastics molding powder, which promise to be applicable to mass-production operations.

The equipment of the Hercules Powder Company, now in operation, is used in a process of hot-melt coating without a solvent. It consists principally of an oven through which an endless stainless-steel belt moves. Very fine ethyl cellulose or cellulose acetate molding powder is distributed evenly over the belt by a vibrating feeder, and is carried through the oven where its temperature is raised to 450 degrees, Fahrenheit. Instead of passing through the oven, the fabric is brought down through squeeze rollers into contact with the molten thermoplastics on the belt. The textile is picked up by the hot plastics adhering to the metal band, producing a three-layer structure consisting of fabric, plastics, and steel belt. This loaded metal belt continues over a roller and back under the machine to the other end of the unit. During this time the steel band cools so that the coated cloth can be stripped from it quite easily and either wound up or cut to sheets of the desired length.

At present the coater is capable of turning out three feet of coated fabric a minute. It is expected, however, that at a later date speeds up to ten feet of coated cloth per minute will be feasible, depending on the kind of molding powder used and the end products for which the job is intended.

This method of coating differs from that of the Textileather Corporation which is a modified dry resin process. The final results, however, are the same.

Coated by either method, the fabric is ready for the laminating press as it comes from the machine. Only 100 pounds per square inch is required in this work, and the same type hydraulic press used in any laminating plant can be employed. Since the products are thermoplastic, the laminating cycle is simply a heating and cooling operation rather than a curing operation. It is this which makes it appear that a continuous laminating process is possible.

After a sheet has been laminated —the thickness being governed by the number of plies—it can be drawn into a large variety of shapes. Again the sheet is heated, this time to a temperature of 325 degrees, Fahrenheit, and then formed. This heating before forming represents the third time the thermoplastics has been heated in the processing of the material. The first heating was for the coating operation and the second heating for laminating. Thus, it is evident that a continuous process from the raw material through to the formed article would conserve heat. On the basis of work that has been done thus far, it is believed that such a continuous operation may be feasible at a future date.

Plastics Compounded—While You Wait

Using a Recently Developed Process, a Fabricator can Prepare His Own Molding Materials in a Single Operation, Without the Aid of a Chemist

THE RESULT of more than four years' research and development, a new process for compounding molding powders requires only one compact machine, from which the plastics emerges ready for molding. Markedly different from other methods, this process permits wide flexibility of formulation and color with a comparatively small raw-material inventory; companies that formerly had to purchase all of their molding powders can now compound the materials themselves at considerable savings in cost.

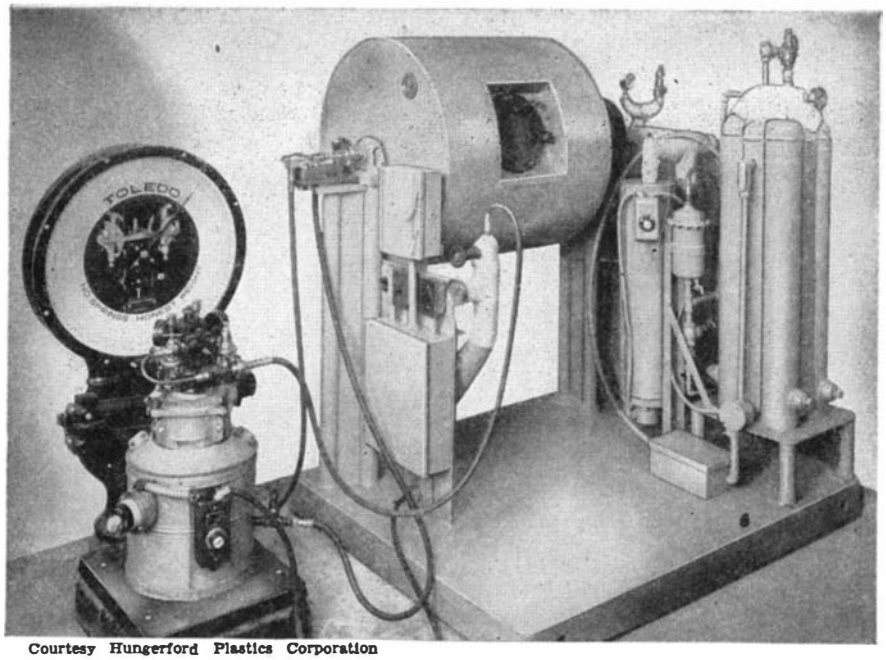
The plastics flake or resin, the pigment, stabilizers, fillers, and so on, are charged into a compounding chamber mounted so it can be rotated. While this chamber is rotating the plasticizers and other liquid additives are injected into the chamber by means of a spray. After this processing is complete the mass of resulting material is dehydrated. It is then discharged into a drum ready for molding.

According to the Hungerford Plastics Corporation, who developed the process, it is not even necessary for the companies using this system to have a chemist. And as for space, the Plastimaker, as the machine for this compounding is called, and the stock of molding granules is said to take less floor room than is usually needed for inventory stocks of molding powders.

The compounding machine is now being produced in 40- (laboratory), 150-, 300-, 600-, and 1000-pound sizes, and licensing of the process has been started. It is suggested that before a molder considers putting in the equipment and undertaking to do his own compounding, he should be using at least 200,000 pounds of material per year or about 4000 pounds a week.

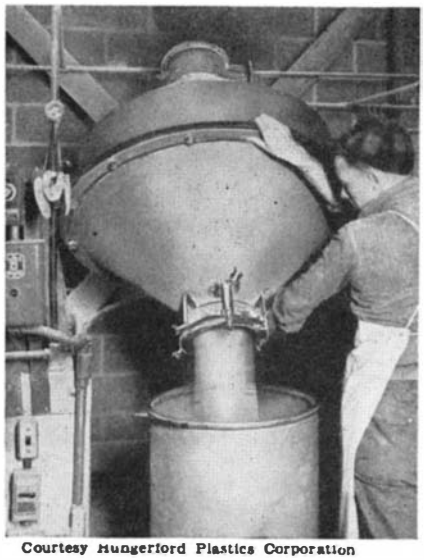
There is not, however, much limitation on the types of plastics material he should be using to adopt this method. Thus far the process has proved successful for compounding cellulose acetate, ethyl cellulose and other cellulosic materials, polyvinyl acetate chloride, polyvinyl chloride, polyvinyl acetal, and polyvinyl butyral. In fact, so far as the Hungerford people know, any plastics material requiring the addition of an external plasticizer can be compounded in this way.

HOW IT WORKS—Probably the best way of understanding the operation of the Plastimaker is to fol-



Courtesy Hungerford Plastics Corporation

Laboratory model of plastics compounding machine has a capacity of 40 pounds



Courtesy Hungerford Plastics Corporation

The batch of compound being poured from the mixer is ready to be molded

low through the preparation of a batch of material—say 1500 pounds of cellulose acetate. First, 1000 pounds of cellulose acetate flake and the colorants are charged into the compounding chamber while approximately 500 pounds of the plasticizer are run into the jacketed liquid reservoir. The compounding chamber is then revolved for approximately five minutes at low speed. It is at this point that the atomized plasticizer injection cycle is started. This takes approximately 40 minutes, and the compounding chamber continues to revolve at the same rate of speed throughout the plasticizer cycle.

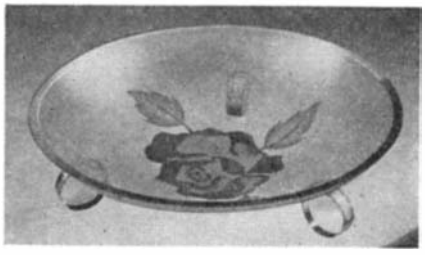
After the completion of this phase, the dehydration cycle is started. Dehydration is accomplished by filtering a volume of dry, hot air through the material. This air is automatically and continuously exhausted to the atmosphere throughout the cycle which takes about 30 minutes. The compounded material is ready for molding at the end of this operation. Power consumed in the hour and a half required to compound a 1500-pound batch of material is approximately 50 kilowatt-hours, or only about .033 kilowatt-hours per pound.

PLASTICS DECORATING

Accomplished by Sand-Blast And "Wiped-In" Colors

A NEW approach to the decoration of transparent plastics has been developed in which the pattern is applied only to the underside of articles. A stencil of the portions of the design to be deeply colored is laid over the finished article and the acrylic thus exposed is sand-blasted. After a few minutes the pattern is switched, the second pattern exposing all of the design whether it is to be lightly or heavily colored.

When all areas are blasted to a suitable depth the desired colors are wiped in. There is no danger of the pattern being ragged from smeared paints since the color sticks only to the blasted areas. The method was worked out by the Venus Glass Company, Inc.



One method of decorating transparent plastics objects is exemplified by this fruit dish. The design to be colored is sand-blasted, through a stencil, into either surface of the plastics. The depth to which the sand is permitted to etch determines the color strength, since it is the measure of thickness of the applied paint film

PLASTICS-COATED MESH

Proves Versatile In Home and Industry

A CELLULOSE acetate coated mesh —either wire or plastics—is constantly finding new applications in agriculture, industry, business, and home. No new-comers, the plastics-coated materials date back to the early days of aviation when cellulose nitrate dopes were applied to paper as a cover for glider wings. But their applications in some of these newer fields is a departure.

The cellulose dopes have, from the point of view of the farmer, the particular advantage of invisible ray transmission. When applied as a glazing material on the farm, they give the live stock the benefit of covered exposure to ultra-violet rays, a feature which regular glass does not possess.

The plastics mesh, known as Vimlite, was an outgrowth of the war when it was employed as a glazing for Army barracks, hospitals, and similar installations. It has now been transplanted directly into business and industry. For example, it can be tacked on a very light wooden frame and used to separate adjacent machines and processes where the possibility of contamination from flying particles would mean spoilage losses. Here the use of glass is very often ruled out by the danger of cracking as a result of the vibration of the machines. The cellulose acetate coated plastics mesh, however, is light, tough, and nonflammable—all important characteristics of a partitioning material.

Vimlite, a product of the Celanese Plastics Corporation, can be used in a similar manner in stock rooms and can be employed in place of glass in factory and office windows.

With lighter weaves of plastics mesh, Vimlite is being used in table mats, lamp shades, luggage coverings, and even wall coverings, its high abrasive-resistant qualities making it particularly well suited to the last two applications. The material is also available in the form of roller shades, being coated with either clear or colored acetate.

Salt Baths

• LOOKING AHEAD •

Wastage of metals in processing considerably reduced by elimination of scaling. . . Harder but less brittle steel produced at a lower cost. . . Perfection of uniform case-hardening. . . Soldering in molten salt. . . Thicker metal sections quenched.

By EDWIN LAIRD CADY

RED HOT knife blades were plunged into cool water. They came out crooked, wavy, and brittle. Others were plunged into oil. They were less crooked and wavy, but were as brittle as any whittler is accustomed to find them.

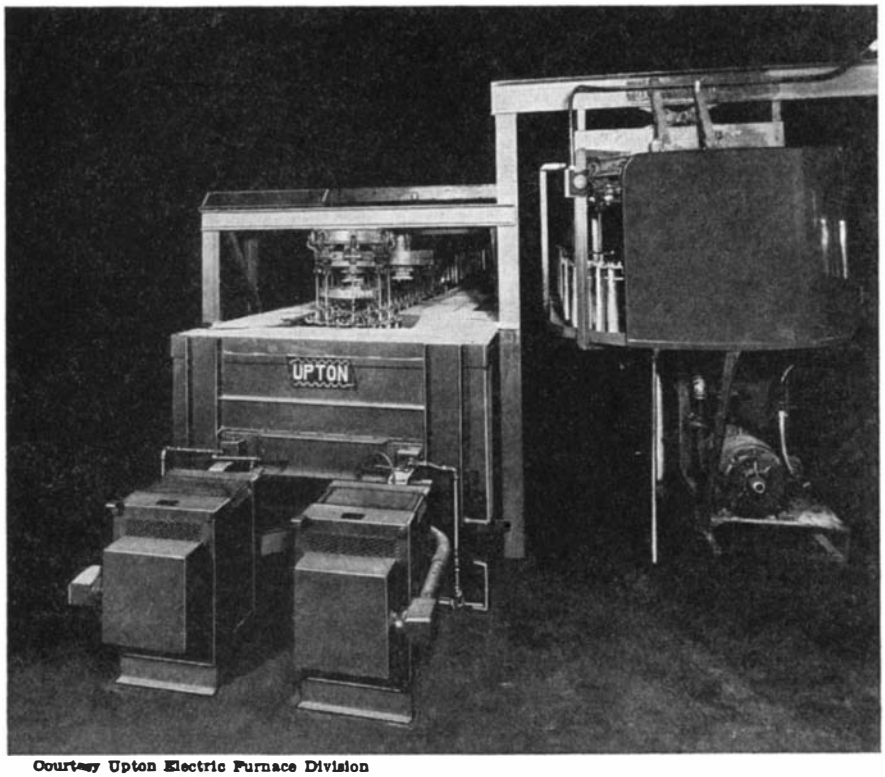
A third batch was plunged into a bath of molten salt which had a temperature of 400 degrees, Fahrenheit. They were left in the bath for about three minutes, then were taken out and allowed to cool in the air. These blades were straight, and they were hard—as knife blades must be. When given a severe bending test, they showed no brittleness.

The waviness could be taken out of the water- and oil-quenched blades by further processing, of course. But taking out the brittleness without reducing the hardness would be very difficult. And the blades had to be quenched or they would not be hard enough.

Here, then, was a way to produce better knife blades just by temporarily interrupting their descent from the hardening temperature of about 1450 degrees, Fahrenheit, to the room temperature at which they would be sharpened and used. The process, called "Martempering," is used for hardening thousands of different steel products; it is just one of the reasons why molten salt baths are moving out of the tiny corners of heat treating rooms, taking over large areas.

The hard but non-brittle blades also had been heated in a salt bath. Molten salt would keep all air away from them, prevent oxidizing and scaling. More than that, a cold blade when placed in this bath would form a coating of frozen salt about itself, and the coating would melt slowly enough to prevent heat shock to the metal. Once this melting was complete, the molten salt would get at every bit of the surface, heating it evenly, and preventing heat strains. The speed of heating would be high—higher than any other commercial method with the possible exception of induction heating. The higher this speed the faster the production line could move.

Martempering is only one of the interrupted quenching processes for steel. And these processes, nearly all of which are quite new, are causing tons of chemical salts to be used where not even pounds were used before the war. Indeed, many of the interrupted quenches are just receiving their first commercial-scale try-outs.



Courtesy Upton Electric Furnace Division

Many baths are fully mechanized

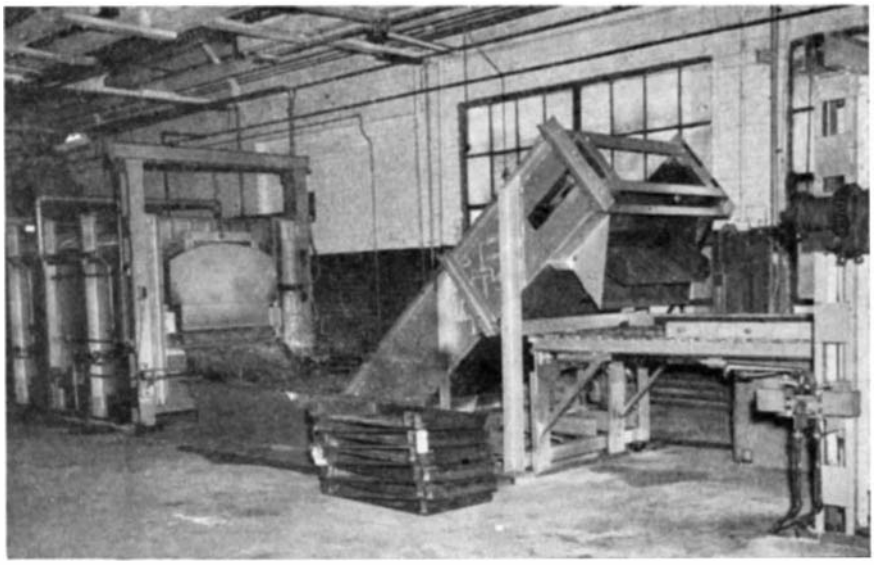
HOW STEEL CHANGES — Let a metallurgist talk and he would say that those knife steels had been converted from austenite, which is an interior grain structure that steels have at hardening temperatures, to martensite which is an extremely hard structure existing at room temperature. For many purposes the steel would be reheated in salt or oil baths to temper it. This would change the grain structure to pearlite, so called because under the microscope the grains look somewhat like pearls.

Sometimes pearlite is wanted without first going to the martensite stage. Then the steel is quenched in a salt bath at about 550 degrees, Fahrenheit, and is allowed to stay there for at least an hour while the austenite changes directly to pearlite. This process, known as austempering, produces a hard steel which is quite free from brittleness, cracks, and internal strains. Austempered steels are far tougher than their counterparts which are quenched and tempered to the same hardnesses in the ordinary way, and they make superlative dies or other items which must be hard but withstand shocks.

Up to a few months ago it was thought that neither martempering nor austempering could be performed on metal parts having sections greater than two inches thick. The reasoning was that such parts would conduct the heat from their own interiors to their surfaces so slowly that the salt baths could not hold them at the required even temperatures.

For Metals

While Industrial Potentialities Are Still Being Constantly Probed, the Salt Bath in Several Forms Has Already Provided the Means for Achieving Many Otherwise Impossible Results in Metal Processing



Courtesy Vulcan Corporation

Work, carried on trays through the hardening furnace (extreme left), is spilled into the tank of salt solution for quenching, after which it is automatically conveyed to trays on the loading platform shown at the extreme right of the draw furnace

This reasoning undoubtedly is accurate. Nevertheless, interrupted quenching is being used for sections thicker than six inches and with great success. The grain structures obtained in the steels are neither true martempering nor austempering, but are mixtures of the two, and of other structures—mixtures so complex and involved that no metallurgist seems to have tried to name them. All that is known about them is that such tremendously stressed parts as huge jaws for rock crushers, when heat-treated by interrupted quench methods, are showing at least double the service lives of similar parts made of the same steels but heat-treated by traditional methods.

Steel alloys vary in the changes which take place in their grain structures when being cooled from high temperatures. Interrupted quenchings can be carried on at any desired temperatures, and can hold their temperatures at any desired points while the structures complete their changes. Hundreds of salt-bath delayed quenches for alloys are under experiment, and dozens of these will probably prove useful.

ROLLING MILL TROUBLES—The use of salt baths for the heating of steels is much older than the delayed quench process, but it also is achieving some of its most important advances right this minute. In one of the largest alloy steel mills, salt baths were tried for heating billets in order to roll them; the rolling mill superintendent soon found himself in a brand new kind of trouble. The scale which former heating methods had produced on the steel had helped the rolls to take hold of the billets. This scale was high in friction and once the rolls bit into it, they could start the steel going through them and keep it moving.

Preventing the formation of that scale was one of the primary reasons for trying the salt baths. The scale often amounted to 10 percent or more of the steel, which sells for as much as $3.00 a pound. But not only did the salt-protected steel have a lower friction surface for the rolls to grab; even worse, the salt coating which adhered to the steel was slightly lubricating.

Man-power troubles entered the picture, as they so often do when anything new is tried. One shift was able to roll 100 salt-bath heated billets, the next shift could roll only four. The superintendent believes that he will have to use rolls of a diameter at least fifty percent larger, so as to get greater friction contact with the steel, then train a whole crew of men who never have used the old heating methods, and after that he will be able to roll salt-bath heated steel and get a much better product at less cost.

Problems like this one are being solved rapidly, and salt baths are taking over one task after another in the steel mills. Soon to be installed are baths which will anneal thousands of tons of steel, eliminate the waste of hundreds of tons of scale, and permit the steel mill metallurgist to segregate heats for special annealing treatment instead of annealing large tonnages in huge furnace loads and being content with average results as he usually does with present methods. The result will be better steels, with lower net costs highly probable.

BRAZING BATHS — Brazing also is being done in salt baths. The parts to be joined are fastened together, with wires or clamps if necessary, but with force fits if possible. The braze metal thus is held between them. This assembly is immersed in the molten salt bath, and the salt, as usual, reaches and heats every surface. Molten salt will pass through tiny apertures, for example through the pores of porous castings, and it gets to the surfaces on which the braze metal is to flow. But the braze metal pushes it aside and completes the joining, after which the parts are withdrawn from the bath and the film of adhering salt is washed off.

Copper brazing was considered easiest for salt baths, silver soldering more difficult, and soft or lead-tin soldering impossible. But with more knowledge of salt chemistry and soldering techniques, silver soldering has become as easy as the copper brazing, and the first commercially successful bath for soft soldering will be in operation before this month is over.

Molten salts can give off elements and compounds which will enter the surface of the hot steel, some of

Courtesy Morse Chain Division, Borg Warner Corporation

A battery of salt-bath carburizing furnaces

which could be harmful. Nitrogen, for example, could lessen the corrosion resistance of stainless steel. Carbon could have the same undesirable result. But there are plenty of parts for which it would be valuable to add nitrogen compounds and nitride their surfaces, add carbon compounds and carburize their surfaces, or even do both. And other salts which have only neutral effects can be found for the stainless steels.

THIN, HARD CASE—The use of cyanide for hardening is old. It gives an extremely thin case, seldom deeper than 0.010 inches, and usually shallower than that. But that cyanide case adds the hardness of nitriding to that of carburizing. It is extremely hard—much harder than that usually obtained by deeper carburizing alone.

And that thin but extremely hard case is best for some products. An automobile timing chain, such as the ones made by the Morse Chain Company Division of Borg Warner Corporation, is an example. Such a chain when measured over two 20-tooth sprockets, one of which can be moved for measuring the chain length, can have no length variation which will cause the center-to-center distance of the sprockets to vary more than plus or minus .005 inch. This means an average tolerance per joint or pitch of the chain of only .00035 inch. Wearing a chain part down as much as .001 inch would throw this tolerance way off. The best way to harden such parts is to have the hardest case obtainable so as to prevent even the slightest wear, and not to bother about having that case very deep.

Originally, cyanide hardening was done with either potassium or sodium cyanide, but the strengths of the mixtures and therefore the depths of the cases were hard to control. By making mixtures of 25 percent cyanides and 75 percent other salts the baths became so easy to control that cyaniding now is done on a continuous flow basis, the parts being automatically carried into and out of the baths and to the quenching and washing tanks.

Salt baths were found which would nitride steels, especially the aluminum alloy steels, without carburizing them at all. The nitriding can be done at lower temperatures, 960 degrees, Fahrenheit, being enough—as contrasted to at least 1600 degrees for carburizing. This solves temperature strain problems for some parts.

Other processes have gas bubbled up through the salt baths. Chapmanizing, for example, bubbles dissociated ammonia through the cyanide salt bath, adding more nitrogen to the case than will cyaniding alone.

One of the late comers is the salt-bath descaling of metals. The metals are plunged cold into sodium hydride mixtures and then quenched in water. The sodium hydride at 700 degrees, Fahrenheit, takes the oxides out and so loosens the scale; then the water forms steam beneath the scale and blasts it off. Other processes use special mixtures of caustics and of salts into which forgings, at forging temperatures, are plunged to simultaneously quench and descale them. And although these descaling methods are in their infancies, many new developments of them are to be expected.

No one knows how old the salt bath for metals treating is, nor how new it is going to be. It undoubtedly was used by the ancient Egyptians. But it is as new as the age of chemistry.

⊕ ⊕ ⊕

PLUG WELDING

Found Profitable When Casting Defects Are Planned

UP TO comparatively recent days, the plug welding of a casting to fill its cavities and make it useable was considered a confession that something had gone wrong in the foundry. Intense studies were made to improve casting designs and foundry practices to eliminate the defects. And these studies still are a good idea.

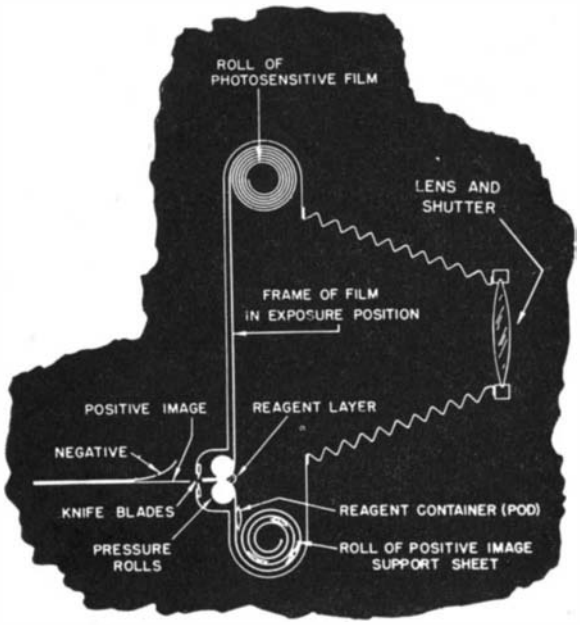
With the improvement of welding rods and procedures, however, an opposite course often has proved profitable. Castings are planned to save foundry costs by having predicted types and locations of defects. The defects first are studied with production X-ray equipment, and then the welding corrects them. Gains are in savings of overall costs, and in the fact that the X-ray searching for hidden defects is a valuable safeguard which now can be paid for by charging it to the overall savings.

FAST-ACTING FURNACES

Essential to High Production With Shortening Work Week

DEPRECIATION and obsolescence of factory equipment go on day and night, whether the equipment is at work or not. If those factors are to be paid for and profits made in the modern short work weeks then more must be done by the same equipment within the fewer production hours. This means that power and steam response must be instantaneous when called for. Neither men nor machines can wait while a slowly acting boiler gets up more steam.

Pulverized coal plants, Diesel plants, gas fired equipment, and central station electrical power all are quick in responsiveness, and are replacing slowly-acting coal furnaces as rapidly as they can be obtained. And the shorter the work (or production) week becomes, the greater will be the necessity for these installations.



Simplified sectional drawing of a camera using the new Land process

PICTURES in 60 Seconds

By Violating One of the Basic Rules of Photo-Finishing, a Method has been Perfected for Exposing a Photographic Film and Obtaining a Finished, Dry Print Within One Minute. No Darkroom is Needed. Printing Operation, Performed Without Light, is Entirely Chemical

By HARLAND MANCHESTER

• LOOKING AHEAD •

A whole new photographic industry based on the first big advance in the art since the dry plate . . . Millions of existing cameras outmoded . . . Sharp increase in "snapshooting" as a result of new convenience and simplicity . . . Application of revolutionary principle to movies, industrial photography, X-ray work.

A FEW summers ago a young scientist of Cambridge, Massachusetts, managed to snatch a brief vacation trip with his family. He took along his camera and several rolls of film. As he snapped his two small daughters at play, he wondered, as we all do, how his pictures were going to turn out.

One day he remarked that it would be a fine idea if someone would invent a camera that would do the whole job at once and produce a dry, finished print every time you snapped the shutter. Others may have speculated in like vein, but this man was Edwin H. Land, one of the country's most brilliant innovators in the optical field. Having posed the problem, he proceeded to think out a completely new photographic process which would eliminate the darkroom, the developing and fixing baths, the printing paraphenalia, the washing, the drying, and so on, and telescope the whole fussy, time-consuming business into one simple, sure operation performed quickly in the camera itself.

When Land returned to work at the Polaroid Corporation, of which he is founder and president, he had the answer in his head. But his firm was heavily occupied with other matters, and for many months the new method remained a personal project for which he could devote only a part of his time in his private laboratory at the plant. Despite this handicap, he proved in a remarkably short time that his theory was correct.

THEORY TO PRACTICE—Soon he was taking pictures, first in his laboratory, and later on Cambridge streets, with a camera which he had improvised from a folding Kodak. If you examined it closely you could see that it had a roomier back and a small crank on the side. After he snapped an old doorway or a child at play, he gave the crank a few twists. You would have said that he was winding the film. Actually he was developing the negative and making the print simultaneously, and in 60 seconds he could have shown the finished picture. The roomy back concealed the secret until he returned to his laboratory. There he opened it and found good, clear prints, indistinguishable from snapshots developed and printed in the ordinary way. His basic idea proved to be absolutely sound, but there were still plenty of details to be cleared up.

As soon as war orders eased off, Land opened a special department and assigned a staff of technicians to help him in the secret project. which was given the code name of "SX70." Innumerable experiments were made before he felt ready to announce the discovery. Now this new process, announced only a few weeks ago at a meeting of the Optical Society of America, is appraised by experts as one of the greatest advances in the history of photography. Production plans are yet to be completed, but in due time the new idea should be available to everyone who snaps a shutter. The process is mechanically simple, and can be applied in producing cameras of all sizes and prices. Its appeal to the amateur is immediately apparent, and in many industrial, scientific, and military uses it can save time and money.

THE MECHANISM—I have seen scores of pictures taken by the new process, and find them perfectly satisfactory. The mechanism of the Land roll-film camera which I saw is similar in many respects to that of the ordinary camera. There are the usual lens, bellows, and cylindrical film cartridge for the unex-

posed negative. Loading it, however, is a double operation, for at the lower end of the camera, where the exposed film is usually wound, you insert a roll of printing paper. Above this paper cartridge is a pair of steel rollers located in the rear wall of the camera, and you thread the ends of both film and paper through these rollers. After you snap your picture, exposing a section of film in the ordinary way, you turn an outside knob which rotates the rollers and pulls the necessary length of film and paper through a slot to the outside of the camera. Glued across the paper, at intervals representing the length of one print, are a series of narrow, metal-foil envelopes, or "pods," each containing a carefully measured quantity of a thick, sticky paste. As you turn the knob, the little "clothes wringer" squeezes open one of the pods, and the paste is spread evenly between the negative and the paper, forming a tightly compressed sandwich. When the sandwich has emerged from the camera, you cut it off by means of opposing knife blades mounted in the slot.

The sandwich now in your hand is a miniature darkroom, for both sides are protected by light-proof layers. You wait for about one minute, and during this time the paste, chemically known as a reagent, simultaneously develops the negative and makes the print. No exposure to light is required for printing. Then you peel them apart and there is your finished picture, neatly framed in a white border. It does no harm to leave them attached longer, for the chemical process goes to completion and then stops.

This much, which you can see, appears simple enough. Standard films may be used, and up to the point where the sandwich is made, there is no deviation from ordinary camera procedure. Even the operation which takes place after the sandwich is formed may use standard chemical tools, but in other respects it departs radically from all previous photographic processes.

To review what happens in ordinary photography: the film is composed of a base on which is coated an emulsion of light-sensitive silver bromide crystals suspended in gelatin. Each crystal, according to the accepted theory, is equipped with a "trigger"—a tiny speck of silver sulfide—which is "set" for development when light falls upon it in taking the picture. When the film is exposed to the lights and darks of the scene photographed, the triggers are set in the white areas but not in the black. So in the developer, the crystals in the prepared areas are chemically converted into metallic silver, forming the black of the negative. The solvent bath gets rid of the unexposed crystals by dissolving them to leave areas of transparency. The result is the familiar black-and-white negative. In making a print, the paper is exposed to light passed through this negative, then the two bathing operations are repeated to develop the blacks and clear the white areas in the final picture. Washing and drying conclude the job. After you snap the shutter, eleven separate and distinct operations must be performed before you can see the finished dry print.

RULES VIOLATED—Land combines all these operations by violating a basic rule dinned into all amateurs: *Don't let your hypo get mixed with your developer!* He puts them together in his reagent and gets away with it. This reagent may contain commonly used photographic chemicals. In one of his successful recipes, the developer is hydroquinone in the presence of sodium hydroxide; sodium thiosulfate is the solvent, and sodium sulfite is used as an antioxidant and for other purposes. These chemicals are mixed with a soft plastics which distributes them evenly, gives the mixture just the right stickiness, and acts as a spacer to keep the two sides of the sandwich a few ten-thousandths of an inch apart.

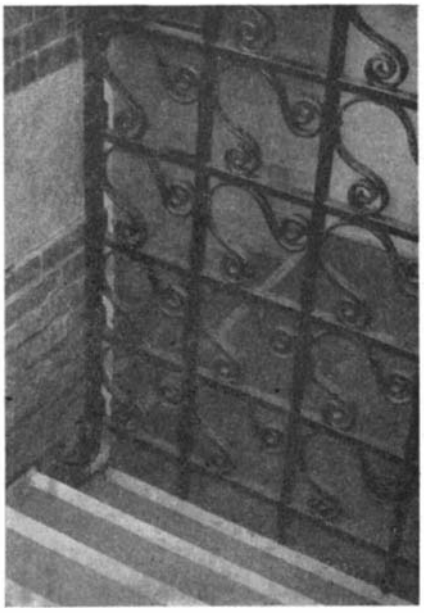
Inside the sandwich, the developer first goes to work on the negative, converting the light-triggered crystals of silver bromide into black, metallic silver. After a slight time-lag, the solvent goes to work on the areas where no light has fallen, converting the untriggered silver bromide into silver ions and free bromine. In standard developing, these silver ions are thrown away in the washing, but in Mr. Land's sandwich, most of them migrate to the positive side through a chemical one-way gate and are built up into black silver deposits on the surface of the print. So while the unexposed areas of the negative become transparent, the opposite areas in the printing paper become black, as they were in the object photographed. The reagent paste is nearly all used up in the process, the residue is automatically disposed of, and you have a dry, finished print.

Land has tried other methods of making the sandwich, among them: packaging the paste in tiny, breakable cells imbedded in the surface of film or paper, and attaching it as a coating to the printing paper, which is then rolled up to protect it until it is used. One of these variations may turn out to be suitable for specialized photographic uses.

Few modern inventions are so completely new. Back in 1889, W. D. Richmond devised a method for developing and fixing a negative in the same bath, but it took twenty minutes and was no real improvement. In 1927 a group headed by Henry Morgenthau, Sr., paid Anatol Josepho $1,000,000 for his patents on the Photomaton, the bulky machine seen in amusement places, which develops and prints a portrait in a few minutes by automatically copying the wet darkroom process. Two years ago, Vannevar Bush speculated in a magazine article on the advantages of snapping a camera and seeing the dry picture at once, but offered no ideas for inventing such a process. Then in a Warner Brothers' film, "The Horn Blows At Midnight," a celestial photographer snapped Jack Benny and pulled the finished print from his camera. Only these remote relatives of the Land process can be found in fact or fiction.

INVENTOR LAND—No one who is familiar with this 38-year-old scientist's career is surprised that he should make such a revolutionary invention. When he was a boy of 15 working in his home laboratory in Norwich, Connecticut, he got his teeth into an apparently insoluble scientific problem which had baffled able physicists for a century—how to make light-polarizing crystals in sheet form. Eight years later he announced the answer before a meeting of Harvard scientists. Others had tried to "grow" large single crystals to regiment light—his solution was to imbed vast numbers of tiny crystals parallel to one another in a cellophane-like sheet, so that they would govern light like one huge crystal. Light waves, which normally vibrate helter-skelter like a Fourth of July sparkler, are combed out as they pass through the sheet's invisible "slots," and proceed in orderly parallel rows.

Leaving Harvard, Land set up a plant to manufacture the sheets, and nearly all the light-polarizing articles now popular in many fields stem from his discovery. Among these are sun glasses, camera filters to cut the sun's glare, the circular light-controlling windows used on crack trains and airplanes, startling three-dimensional motion pictures which have been seen by many audiences, the three-dimensional vectograph films used by aerial reconnaissance men during the war to gage surface contours, and, perhaps most important of all, polarizing lenses and windshields, which,



Examples of photographs made by the new "instantaneous" method described

if they are adopted, will eliminate dangerous headlight glare in night driving.

Now it looks as though Land's photographic invention will eclipse all his other accomplishments in the public mind. He is confident that all the "ifs" have been dealt with by the innumerable experiments and tests which have been going on in his laboratory for many months.

PROOF TESTED — Since he built his first camera, he and his helpers have made approximately 20,000 photographs by the new process. These include indoor and outdoor shots, portraits and landscapes made under all imaginable conditions. He has subjected thousands of photographs to gruelling accelerated tests in equipment designed for the purpose. In a rotating device resembling an enclosed ferris wheel the prints are exposed to intense simulated sunlight in attempts to fade them. In artificial weather rooms they are tested in frigid and torrid temperatures and high humidity.

All tests support Land's belief that the pictures are as satisfactory for most purposes as those made by the conventional process, but there are certain differences in behavior. Land recommends that his camera be used within the temperature range of 30 to 100 degrees, Fahrenheit, although he has taken good pictures at temperatures as high as 110 and as low as 15 degrees, Fahrenheit. These limitations, which may be removed by research now under way, would not seriously hamper most camera-users. On cold days, a winter sports photographer could slip the sandwich beneath his coat to keep it warm during the sixty-second period of developing and printing.

The process requires more accurate exposure than does the conventional method. Correct exposure lies within a range of about two stops—that is, you can give it twice as much light as it should get for best results, or half as much. This is about the care you would take in making a Kodachrome picture. On the other hand, this process yields higher speed for the grade of film used than does the present process, Land points out. It makes Verichrome film behave like Super-X. Actually, you don't need transparent film at all in some forms of the new process. The light doesn't have to pass through the negative in printing, so a roll of sensitized paper will do just as well at a fraction of the cost.

OVERALL COST—That brings up the important question: Can the average amateur afford to use the new process? The answers are reassuring. In the camera described, two small steel rollers, a slot, and the built-in knife blades are the only parts added to the standard camera. The reagent is not very expensive, but of course it has to be packaged in the little pods and accurately glued to the printing paper. Land has designed an automatic machine to do these jobs. The paper itself is somewhat less expensive than that commonly used. To sum up, both camera and materials will cost something more than their standard rivals until they get into the mass-production stage. After that, Land believes that photography will cost less per finished print than it does now. He also points out that he is setting his sights for the millions of amateurs, and he wouldn't be thinking that way unless he could put the price within their reach.

The great appeal of such a camera to amateurs is apparent. Vacationers and groups at reunion can exchange snapshots wherever they are, instead of trying to remember to mail them. Names and other data can be written on prints before they are forgotten. The process is self-correcting: If you make a mistake in taking the first picture, you can take another at once. The process can be used with either the roll or the film-pack type of camera. For the latter, there can be a storage

compartment so that, if you wish, you can let your photographic sandwiches accumulates and peel them at leisure. The process can be used, not only with standard lenses, but with any special-purpose lens or filter, for it is identical with standard photography up to the point where the simultaneous developing and printing takes place.

Amateurs will probably discard the negative after they have peeled open the sandwich, and will obtain copies either by taking another picture or by having the first print copied. In some variations of the Land process, the negative can be used to make additional prints by the ordinary method.

WHAT IT CAN DO—Anyone can write his own list of practical jobs for the new process. During the war, when portable tent darkrooms were used for rapid processing, Land's method would have been much faster and less cumbersome, especially in reconnaissance planes. The infra-red pictures of enemy installations which were taken in the dark could have been developed and printed at once, greatly increasing their value. News photographers can return to their offices with finished prints, saving several minutes at edition time. Photographic copies of documents can be made at once, eliminating the delay now imposed by photostating. In many cases the process may bring about faster police identification of suspects and victims.

X-ray prints have been turned out by the Land process in about a tenth of the time needed to develop a film by current methods. The prints made so far are not as detailed as the X-ray negatives commonly used, but they may be of great value where speed is essential. They can provide a quick look at a fracture, and in factories they may hasten the job of locating flaws in castings.

News of the Land process has aroused tremendous interest among experts and amateurs alike. It is roughly estimated that more than a billion and a half still pictures are taken every year in the United States. If even a fraction of this work is done by the Land camera, the time saved in darkrooms and in trips to the drugstore will be impressive.

ONLY IN NEW CAMERAS—While it would be simple to adapt the new process to some expensive cameras by means of a special back, adaptation of all types would be impractical, so we may expect to see the process marketed in a new camera.

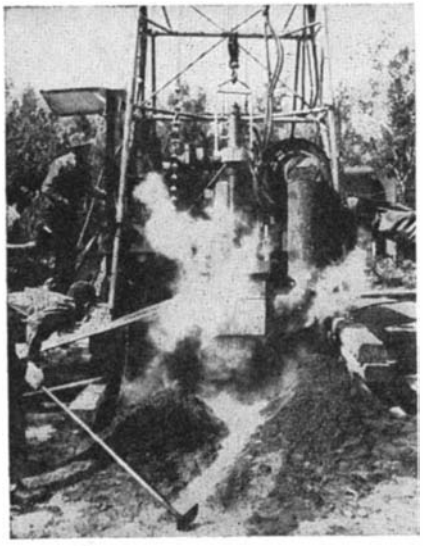
The Land process is described by Arthur C. Hardy, Professor of Optics and Photography at M.I.T. and secretary of the Optical Society of America, as "revolutionary as the transition from wet plates to daylight-loading film." In Prof. Hardy's opinion, the prints compare favorably with those made by the standard method. He points out that since the Land process automatically reproduces contrasts correctly, it may be too faithful for the "creative" photographer who introduces distortions in the darkroom in order to obtain special effects. But this will not concern the average man who wants to take pictures, nor the industrial photographer.

Mr. Land is now concentrating on the use of his process for black-and-white photography, and we may expect an announcement of manufacturing plans before the end of the year. Looking toward the future, he can see no inherent reason why it cannot be adapted to color photography. Still farther ahead lies the motion picture field. It is no wild speculation to say that movie film can be processed rapidly in much the same way if there is a demand for such speed. In television, for instance, it might be useful for taking spot movies of newsworthy events and rapidly putting them on the air. There would be a great deal of engineering to do, but it is entirely possible that in a few years we will be taking home movies and showing them on the screen a few minutes later.

Rock Drilling With Flame

High Temperatures, Produced by Burning a Flux-Bearing Fuel in Oxygen, Melt Rock or Cause it To Spall or Flake. Process Reduces Mining Costs

INCREASING drilling speed ten times over that of older methods, a new process for making vertical blast-holes in hard, low-grade iron ore is known as fusion piercing. In this process, developed by The Linde Air Products Company, a flame, produced by burning oxygen and a flux-bearing fuel in a special blowpipe, is directed against the surface of the rock or ore. The high flame



Blast-hole blowpipe approaching a full-depth pierce. Expelled granulated slag is piled around the hole

Above: Blowpipe coming out of hole at end of run. Below: A six-inch blast hole produced by fusion piercing

temperature—about 4000 degrees, Fahrenheit—causes some kinds of rock to spall or flake off, and the flux in the fuel causes other kinds of rock to melt. Pressure of the burning gases forces the molten material past a water spray where it is quenched and broken up. In the quenching process water turns to steam and the steam helps the gases force the quenched material out of the hole. Equipment for commercial use is still in the development stage. For field tests, however, a truck was equipped with a portable oil-field drill rig—a 30-foot special blowpipe replacing the "kelly"—and with pumps, tanks, motors, and special recording instruments. A more compact and less complicated commercial machine will result when the apparatus that is on the experimental rig solely for the purpose of collecting data is eliminated.

Field tests were made on Minnesota "taconite"—an extremely hard, tough, abrasive, low-grade iron ore. Six-inch diameter holes up to 30 feet deep were fusion pierced at an average rate of 10 feet per hour, with rates as high as 17 feet per hour for short periods. This compares with an average speed of about one foot per hour for drilling holes of similar diameter in this ore.

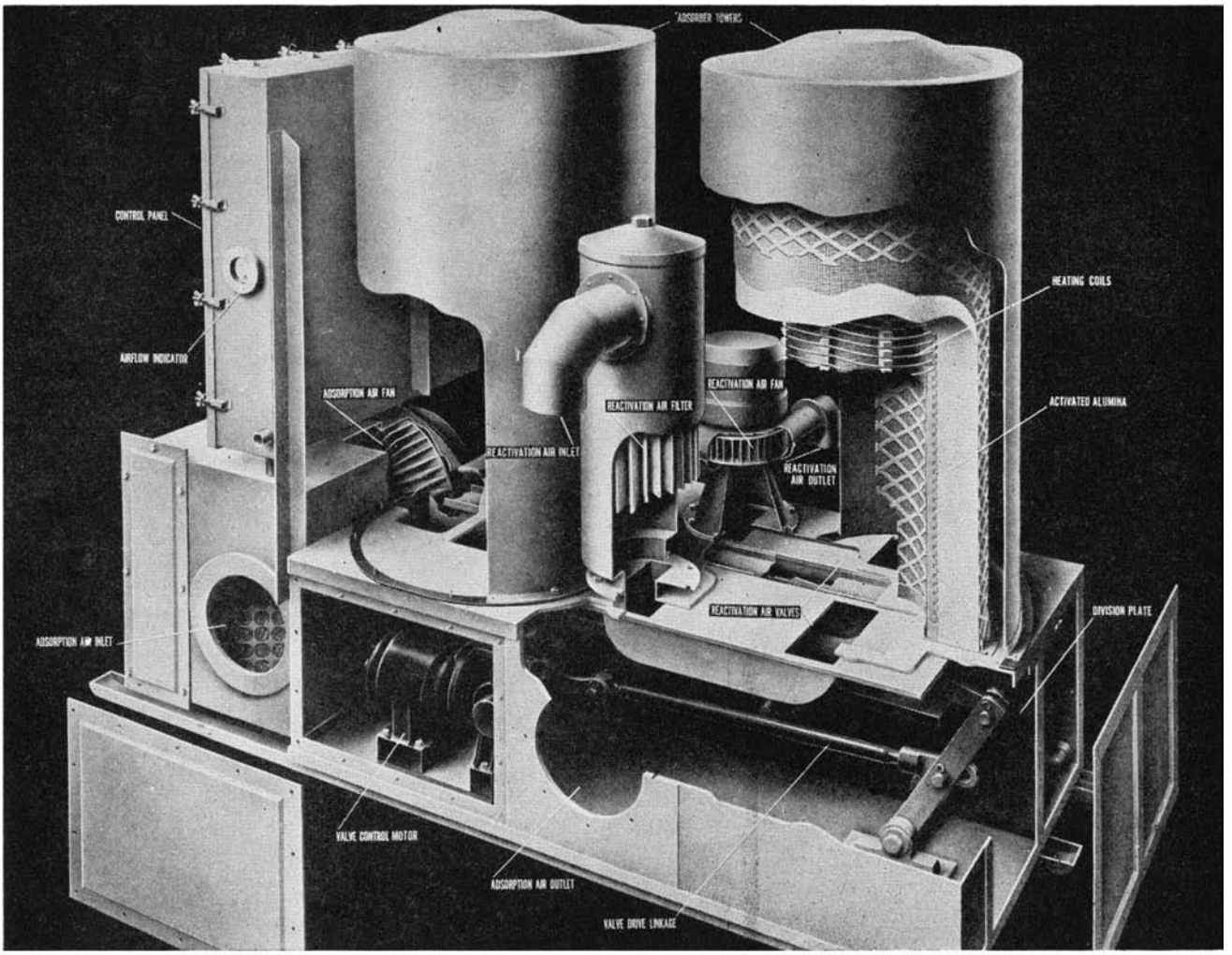
Speed in making blast holes helps reduce mining costs in large-scale operations. In addition, it has been found that the high-temperature piercing flame produces stresses in the surrounding ore which causes better fragmentation during primary blasting, further reducing costs. Mining men who saw the tests say that fusion piercing will have many advantages in the mining of low-grade ore.

Air Drying For Preservation

Storage of Materials and Equipment, Without Loss Through Corrosion or Other Moisture-Caused Deterioration, Now Possible Through Use of Equipment Originally Designed for Protection of Inactive Naval Vessels

MACHINES which made possible the major portion of the Navy's fleet preservation program, popularly known as "Operation Zipper," are now available to private industrial and commercial users.

Although pre-war dehumidification equipment found its widest use in the metallurgical, chemical, and pharmaceutical fields and in the oil and gas industry, its successful use in the fleet preservation program has opened new and potentially greater markets. The principal problem solved by the Navy in the preservation of a ship and its machinery and contents is much the same as that which any number of industrial and commercial organizations are facing today in the preservation of materials and equipment



Handling 500 cubic feet of air per minute, the dehumidifier operates on the "solid adsorption" principle

held in storage. The problem is: How to prevent airborne moisture and atmospheric conditions from causing the corrosion of metals and mold, mildew, and general deterioration of materials ranging from bedding to a box of chewing gum.

In protecting machinery, equipment, and materials from the corrosive effect of humidity the Navy, long before World War II, found that preservation by means of coatings alone was not effective. Therefore they came to the conclusion that the atmosphere within the vessels of its inactive fleet must be maintained at a relative humidity of 30 percent or less, for at this point general deterioration is inhibited for indefinite periods.

In the application of dehumidification equipment to private use, the cost of installed equipment and power cost is, perhaps, of first consideration. The Navy found that the installed equipment cost is less than one cent per cubic foot of ship's volume in the majority of cases. It also found that power cost runs well below 15 cents per 100,000 cubic feet of volume per day with power at one cent per kilowatt-hour. Or, to put it another way: The dehumidification power cost for a destroyer having a volume of approximately 250,000 cubic feet is about $110 per year on a $7,000,000 investment.

These dehumidification machines, manufactured by Lectrodryer Corporation, remove moisture and gases from the air by the physical phenomenon known as solid adsorption. Even though solid adsorption is not completely understood, it has been demonstrated that a distinct affinity exists between certain types of surfaces and the molecules of certain gases which causes the gases to attach themselves to the surface of the solid. Actually, in effect, the gas is condensed to a liquid and, in so condensing, latent heat is given off. It has been found that temperature is an important factor in affecting the affinity of certain gases for attaching themselves to solid surfaces. The application of heat to the solid will cause a release of the adsorbed liquid. This application of heat is known as reactivation and is the basic principle through which Lectrodryer equipment operates.

GERMICIDAL LAMPS

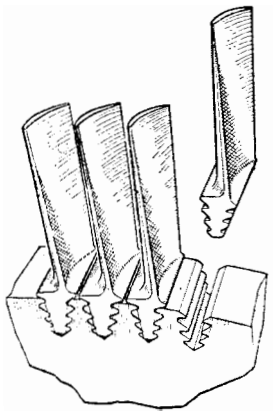
Installed in Schools, Cut Rate of Absences

WHEN bacteria-killing ultra-violet lamps go to school, the absenteeism of the pupils declines, averaging up to 50 percent in test results. Summarizing results of a continuing study of ultra-violet's effectiveness, a spokesman for the Westinghouse Electric Corporation stated that sharp decreases were reported during the past three years in the absences of both pupils and teachers in classrooms protected by lamps emitting air-purifying rays, compared with absences in unprotected rooms. Although more data are needed, evidence already accumulated points to a good possibility that ultra-violet ray treatment of indoor air can reduce considerably the incidence of "pass on" respiratory diseases.

TURBINE BLADES

Require Many Complex Operations in Making

TURBINE blades for the British De Havilland Goblin II, turbo-jet engine are in themselves symbolic of the production problems often encountered in present-day manufacturing. The turbine part of the Goblin II has 83 rotor blades arranged around the periphery. Directly in front of this is a fixed-disk stator having 77 blades. The moving turbine wheel, secured by studs to the flange of a substantial center shaft, is approximately 27 inches from tip to tip and comprises a solid disk with the blades held in slots broached to a "fir tree" form. The root of each blade must be accurately machined to a similar form, inserted by light blows from a rawhide hammer, and secured by peening-over at each side. The rotor blades are of airfoil form and taper slightly in width from tip to root.



"Fir tree" roots on turbine blades

To withstand the high temperatures and stresses encountered in service, the blades are made of hard, tough alloys, with a high nickel content. The use of this material, however, gives rise to many problems during manufacture, especially as the blades are completely machined on all surfaces. The operations include milling, drilling, and broaching to very close limits.

As received at the factory the stampings are of approximate blade form, with a rectangular-section club at each end. One end provides material for the fir tree root, the other is a dummy end to facilitate holding during various machining operations. In fabricating the blades there is a long and careful sequence of operations and each stage must be done meticulously. Also, each stage demands the best machine-tool equipment plus ingenious fixtures and so on.

Thus, the question arises as to whether, as gas turbines come into more frequent use, such a multiplicity of operations will continue to be necessary. It appears likely that forgings or castings much nearer final form will be demanded or else one or two special machines will be built to accomplish what at present appears to be 54 operational sequences.

COLORIMETER

Aids in Standardizing Fluorescent Light Quality

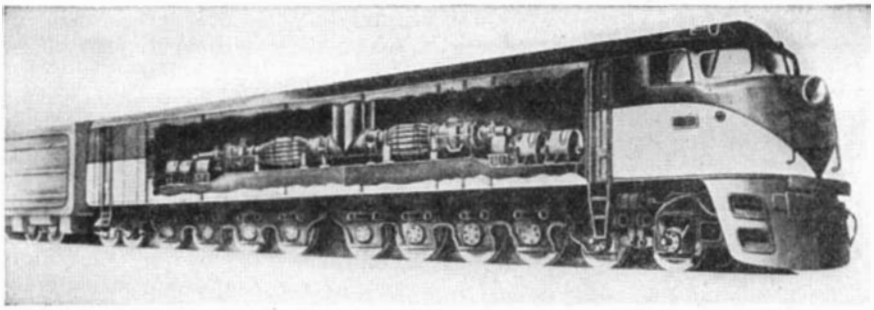
ELECTRONIC "eyes," able to describe color far beyond the ability of the naked eye, are now being used to standardize the radiated colors of fluorescent lights and of cathode-ray tubes.

Applied to fluorescent lighting, the photoelectric colorimeter insures that all lamps in one color line will be within the limits of one single shade, with no "off shades" occurring in the line. Thus, when a number of lamps are in use and a replacement lamp is needed, trial and error in selecting the identical shade is eliminated.

Used in television receiver manufacture, the colorimeter, ensures a standardized intensity of "desirable" white light on the television screens of various sets.

The colorimeter uses a system of color filters linked to photoelectric cells to read color. Each of the filters shows the amount of their color that is emanating from the radiating color being tested. For example, if a white fluorescent lamp were being tested, the red filter would tell how much red light the white light source was emitting, the blue filter would tell how much blue light was being emitted, the green filter would tell how much green light was being emitted, and so on.

Meantime, the photo cells, which transpose light into current pulse, send out different pulses for each of the colors in ratio to the strength or amount of these colors. The pulses register on an indicator dial, and the readings then can be checked against a color graph or chart to determine if the light being



One half shorter and one third lighter than conventional Diesel-electrics

tested meets the standard set. The colorimeter is used by General Electric Company in manufacturing fluorescent lights and television receiver-screen tubes.

DIESEL SMOKE

Controlled by Use of Good Fuels, Prevention of Overloading

SMOKE from Diesel engines, long a cause of public complaint, is an unnecessary evil which can be eliminated by keeping engines in good repair, operating on good fuels, and by preventing overloads, claims Professor P. H. Schweitzer, of Pennsylvania State College. Unfortunately, he adds, smoke is eliminated at the cost of engine efficiency since, with current injection equipment, prevention of overloading throughout the entire speed range involves reduction of low-speed torque, or lugging ability. He says, however, that experiments indicate that normal engines burning normal fuels have smoke-free exhausts between one quarter and three quarter loads. Light loads may cause cold smoke; overloads increase smoke density. Belated injection timing, poor fuel mixing, low fuel volatility, and low cetane number are also said to contribute to smoking tendencies.

TRUCK-BORNE LABORATORY

Gives Speedy, Non-Destructive Analysis of Scrap Steel

ON-THE-SPOT steel analysis is now routine at the Rouge plant of the Ford Motor Company, thanks to a mobile laboratory unit designed and developed by the company's chemical and metallurgical research department.

The new unit, already paying dividends as a time saver, is used mainly for the rapid semi-quantitative analysis of incoming carloads of steel scrap and kindred operations in which time is of the essence. This technique eliminates the necessity of transporting the samples of steel scrap to the chemical laboratory, obtaining drillings, and analyzing them chemically.

The laboratory consists of a spectroscope, chemical spot testing and color carbon test equipment, a portable grinder for spark testing, and a gasoline-driven generator as a source of power, all of which is mounted on a panel delivery truck.

Still another important function of the mobile unit is its usefulness in the non-destructive identification and sorting of finished production parts of identical appearance but different chemical analysis.

GAS TURBINE LOCOMOTIVE

Seen as Possible Result of New Tests

A MAIN-LINE locomotive of 8000 horsepower, but only half the size of a conventional Diesel-electric design, powered by four 2000 horsepower oil-burning gas turbine engines of a type now undergoing performance tests in the Westinghouse laboratories, has been predicted by an engineer of that company.

Designed to burn heavy (bunker C) fuel oil, so that its power output can be economically competitive with conventional rail "prime movers"—Diesels and the familiar coal-burning steam locomotive—the light, compact new gas turbine generator occupies a space only three-and-one-half feet wide, 26 feet long, and six feet high. It has the additional advantage of quick starting, a long-suffered handicap of steam locomotives.

This gas turbine, which has been under development since the latter part of 1943, and has been running on the test stand since early August of last year, was not designed specifically for locomotive use, but rather is intended to provide basic operating data and to define design problems for a simple, efficient power plant with many possible applications.

Although dimensions were intentionally held to those which would be practicable for locomotive drive, such a unit might also be used to advantage in marine, central station, and industrial applications.

The power plant now on test is a simple axial-flow unit of the "open cycle" type, in which air from the atmosphere is sucked into one end, compressed and mixed with fuel oil, which is then burned to bring the air temperature to 1350 degrees, Fahrenheit, and finally exhausted back to the atmosphere after the turbine has extracted the useful power from the air's heat.

HORIZONTAL FURNACE

Burns Low-Grade Coal With No Slag Troubles

DEVELOPMENT of a new method of burning crushed coal by using a horizontal cyclone burner has as one of its features its ability to burn low-grade coal having low fusion-point ash, with the removal of better than 80 percent of the ash in molten form as slag tapped from the furnace. This results not only in relatively clean gases passing over the heat-absorbing surfaces of the unit, but also in much cleaner stack gases than is the case with other methods of coal firing.

The performance of this horizontal cyclone burner has definitely proved the principles involved to be sound, providing a simple, reliable, and efficient means of burning coals, particularly of the poorer grades having a high percentage of ash with low burning temperature.

Some years ago, the Babcock and Wilcox Company approached the problem of utilizing advantageously the generally considered undesirable characteristics of the ash in coal. It was felt that if the ash liberated from the coal upon combustion could be kept in the furnace, it would be possible not only effectively and efficiently to use poorer grades of coal, but at the same time to eliminate largely the slag-cleaning problem so prevalent in both stoker- and pulverized-coal firing. And by increasing the rate of burning of the coal, the size of the furnaces necessary for a given capacity could be reduced. This would result in a reduction in the cost of making steam, which would be attributable to decreased capital expenditure for the equipment involved, as well as savings in its operation and maintenance.

If crushed coal is admitted tangentially to a cylindrical burner in a stream of air at a sufficiently high velocity, the particles of coal will be thrown to the surface of the cylinder and will be carried in the air stream along the wall of the cylinder in the form of an increasing-pitch helix until the energy of the entering stream of air has been dissipated.

If, in addition to the primary air, sufficient secondary air for complete combustion of the coal is admitted in a path parallel to the primary air

and coal, and at a correspondingly high velocity, and if at the same time the temperature is sufficiently high to promote and maintain combustion, the volatile matter in the coal will first be distilled and burned; then the remaining carbon will be burned, and finally the ash will be left.

Provided the fusing temperature of the ash is lower than the temperature obtained on combustion it will be in a molten state as slag. This resulting slag, due to the energy in the stream of products of combustion, will be in contact with the surface of the burner, so that it becomes entirely coated with molten slag.

By inclining the axis of the cylindrical burner, the molten slag will drain toward its low point, from which it can be removed continuously. As this molten-slag surface of the burner is established, further crushed coal admitted with the primary air, on being thrown to the surface of the burner by the energy of the conveying air, will be caught by the slag.

The movement of the slag on the surface of the burner, due to its viscosity, is very much less than the velocity of the entering air, and this provides an intense scrubbing action of the high-velocity air on the combustible particles of the coal entrapped and moving with the slower moving film of molten slag, with resulting extremely high combustion rates.

METAL STRENGTH TEST

Reveals Durability Under Operating Conditions

BREAKING, twisting, and bending hard metals with compressed air is the new method recently developed to determine the strength of metals and alloys.

An air-pressure machine, the operating principle of which is similar to that of a slide trombone, is used to vibrate metals and alloys at their natural frequencies until they crack or break under the stress and strain, thus determining their durability for actual operating conditions. This is declared to be the most rapid method of fatigue testing known and is expected to bring radical changes in that field.

Originally developed to test gas-turbine buckets, the device has proved so efficient and adaptable that, according to F. B. Quinlan, General Electric engineer who designed the new machine, it will undoubtedly have wide industrial application.

The operating mechanism consists of a tuned air column in which the

Tuned air column can produce stresses up to 100,000 pounds per square inch

tuning is accomplished by decreasing the length of the air path, much as a trombone player changes the tone of his instrument by moving the slide.

Metals or parts of equipment to be tested are attached to a piston, which fits loosely into two cylinders. Air pressure is directed through the cylinders so that it vibrates at the same natural frequency as the metal being tested. An optical system is used to measure the amount of vibration, while an electric meter at the base of the machine records the resonating frequency of the piece being tested. Charts are kept to determine the number of stress reversals the metal can withstand before it fatigued.

The machine has produced stresses as high as 100,000 pounds per square inch, with no more air being used than that supplied by the average vacuum cleaner.

The fatigue-tester has no moving parts to wear out, as nothing moves but the piece of metal under test.

STARCH AND ALCOHOL

From Potatoes Boosted by Use of DDT

POTATOES of finer flavor and more alcohol for industry are promised by using DDT on the potato crop, according to a report by Dr. Charles A. Brautlecht of the University of Maine to the American Chemical Society's Division of Agriculture and Food Chemistry.

A spray or dust of DDT at little cost to growers, will, says Dr. Brautlecht, protect the potato plants from diseases and permit Maine farmers to return to growing the once popular and better tasting Green Mountain potato, which lost its popularity in recent years because of its susceptibility to insect-caused diseases.

Not only do Green Mountain potatoes taste better, Dr. Brautlecht points out, but they have a 2 percent higher starch content than the Katahdin variety, now largely grown in Maine, which leads all other states in potato production.

Increased starch content has great significance for modernized starch factories and the potato alcohol industry, the report explains. Although production of potato alcohol will not be able to compete with industries producing denatured or power alcohol from low grade corn, waste petroleum, or acetylene, it will have many uses, Dr. Brautlecht predicts.

Potato alcohol will improve certain alcoholic beverages by blending and will also be utilized in hospitals where high quality alcohol is needed, in druggist's preparations, and in French type perfumes, he declares.

The manufacture of potato starch in the United States is reviving, and the new potato alcohol industry is getting well under way, as a result of modernized equipment.

ACRYLONITRILE

Aids In Making a Wide Variety of Products

A GREAT diversity of articles, ranging from drugs and insecticides to plastics and lubricants, can now be made from acrylonitrile, a component of Buna N synthetic rubber, according to Dr. H. A. Bruson of The Resinous Products and Chemical Company.

Important during the war in the manufacture of synthetic rubber and of the synthetic drugs which took the place of quinine in the treatment of malaria, acrylonitrile was also the basic raw material for acrylate plastics.

Acrylonitrile will react with thousands of compounds containing hydrogen. With starch or cellulose it forms transparent films like cellophane and tough synthetic fibers like rayon, and another compound which is especially poisonous to the destructive Mexican bean beetle. Other reactions produce drugs, solvents, sizing materials for textiles, lubricants, and softening agents for plastics, Dr. Bruson declares.

RADIATION METER

Portable for Agricultural, Weather, and Other Research

SMALL and portable, a new, completely self-contained radiation meter provides a direct indication of radiant-energy intensity and is intended primarily for measurement of

solar radiation. Thus, the instrument can be used for the investigation of the effect of solar radiation on agriculture; studies concerned with the weather; laboratory tests of the absorption or transmission properties of materials through the visible, and into the infra-red, spectrum; and for general use by government agencies, industrial laboratories, and advanced educational institutions.

The meter consists of two major components — a radiation receiver, which is mounted in a metal enclosure on the top of the case, and a D'arsonval-type indicating instrument which is connected to the receiver output leads.

The radiation receiver is a sensitive thermocouple of the total radiation type. It is sensitive to radiation of wave lengths from 0.3 to 3.5 microns.

The indicating instrument is a permanent-magnet, moving-coil millivoltmeter. The scale length is 1.5 inches and the range of the meter is zero to two gram-calories per square centimeter per minute. Accuracy is within 5 percent of full-scale value. Net weight of the General Electric meter is six ounces. Calibration is accomplished by exposing the instrument under test, and a standard precision radiation meter, to a source of radiant energy.

METEOROLOGICAL RADAR

Provides Forecasters with New Weather-Eye

MORE accurate weather forecasting is promised by radar techniques developed by the Aircraft Radio Laboratories at Wright Field. In one method, a 450-pound radar set is carried aloft in a weather reconnaissance plane. The radar operator scans the surrounding air and observes a picture of cloud formations on a special cathode-ray tube that indicates approaching storms at a distance of 100 to 200 miles. Ground radar sets also are used to locate storm thunderheads.

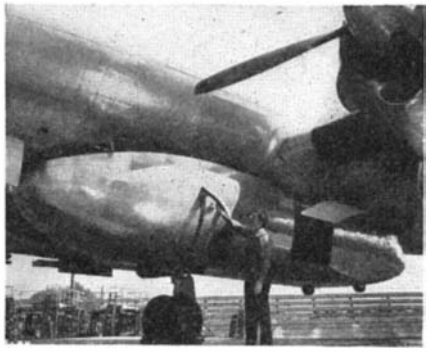
To obtain data on wind velocity and direction at various altitudes, ground radar is used to track balloon-borne metal foil reflectors. These can be traced in their ascents to as high as their bursting point, about 100,000 feet above the ground. Visual observation of the balloons, the technique usually employed, is impossible at this altitude and wind data in the stratosphere cannot thus be obtained. With the radar method, the pulsed beam transmitted by the radar is reflected by the metal foil back to the receiver on the ground. The distance of the target is shown on the cathode-ray tube and the direction is obtained from the elevation and azimuth bearing of the radar antenna. Speed and direction of the wind can then be computed.

CARGO CONTAINER

Adds Four Tons to Transport Plane Capacity

THE Lockheed Constellation ordinarily carries a better than "respectable" passenger and cargo load at its cruising speed of 300 miles per hour. Now with a so-called Speedpak mounted under the fuselage, it will be able to carry an additional four tons of cargo for flights up to 1500 miles in length. The Speedpak is a sleek, streamlined, all-metal cargo container with a built-in electric hoist, which fits snugly on the under side of the fuselage, and which can be lowered to convenient height for loading.

At terminals the Speedpak can be loaded with baggage or cargo within the terminal, rolled into position prior to flight, and quickly raised and locked into position. The cargo container is 33 feet long, 7 feet wide, and 3 feet deep with a total volume of 395 cubic feet. Weight empty is 1700 pounds, while with top cargo load its gross weight is 10,000 pounds.



Ten mile per hour speed decrease is the only effect on the plane's performance

Cruising speed is not decreased more than 10 miles per hour when the container is in place and the interior capacity of the fuselage for either passengers or cargo is in no manner disturbed. Conversion from service with the Speedpak container to normal operation without only takes two minutes.

METAL FATIGUE

Is Caused by Crystal Juncture, Metallurgist Claims

A NEW CONCEPT of the fundamental reason why certain metals get "tired" and fail from fatigue—one of the oldest and most baffling problems in mechanical science—has emerged from research conducted by H. O. Walp, chief metallurgist for SKF Industries.

The fatigue phenomeon—the strange behavior of metals that results in their break-down under repeated stress—accounts for more failures in modern engineering practices than any other single factor. No fundamental theory of fatigue is yet universally accepted, despite the fact that research on the problem has been going on for generations.

The puzzle, Walp explains, is this: What happens to the properties of a steel object, like an automobile axle or ball bearing, that causes it eventually to crack in a certain spot when placed under repeated stress?

The metallurgist believes he has found the answer, at least with respect to extremely hard steel normally used in the manufacture of high-precision bearing. He explains it this way:

"Steel, like all metals, is crystalline. In the carefully heat-treated parts of bearings these crystals are extremely minute, but they are still crystals.

"The cohesive forces are stronger within any one crystal than they are across the boundaries of adjacent crystals. It seems reasonable to conceive points where two, three, or more crystals meet and where the cohesive forces are particularly weak.

"In a running bearing, the maximum resultant stress is a little beneath the surface of the race, or rolling member. If such an unfortunate crystal juncture happens to be in this area of maximum stress, it may furnish the starting point for a fatigue crack."

LOW-COST OXYGEN

May Soon Be Available In Great Quantity

NEW PLANTS for the conversion of natural gas to liquid fuels will create new demands for huge quantities of oxygen at high concentration, yet not quite so pure as the cylinder and liquid oxygen now regularly produced. The need for oxygen in this Synthine process is giving first impetus to the construction in this country of plants to produce oxygen of 95 percent purity at a rate of several-score tons per hour. The first two units are each expected to produce some 42 tons per hour (more than a million cubic feet), at hitherto unattainable low costs.

Success of this first installation now planned for Brownsville, Texas, will be watched with special interest by blast furnace operators and producers of sulfuric acid, since concentrated oxygen available at the expected low costs would materially enlarge outputs of their plants and thus reduce their costs.

New Products and Processes

SALVAGE TOOL

Enables Split-free Reclamation of Lumber

EXPECTED to find special favor with contractors and builders is a tool for use in the redemption of old lumber in razing jobs. Thus far, in tests to which it has been subjected, it has proved successful in the split-free removal of sheathing, siding, flooring, and other lumber. Known as Bord-Pri, the tool lifts lumber with such care that no cracks, splits, or breaks occur to lower its re-use value. Even adjoining pieces of tongue-and-groove flooring and shiplapped siding can be picked up without damaging them.

When butted against the boards to be removed, this tool, produced by the

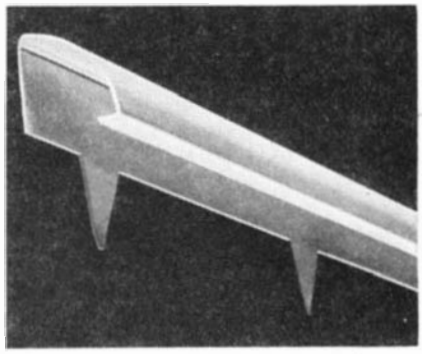
Lumber salvaged with minimum effort

Maco Corporation, hugs adjacent studding and the extended lip supports it for positive leverage when pressure is applied to the handle. The equal distribution of pressure by this leverage action lifts the entire end of the board with no splitting or cracking.

STEEL BASEBOARD TRIM

Is Decorative Raceway For Low Potential Wiring

A STEEL quarter-round, ¾ inch by ¾ inch, which serves as a baseboard trim, as a raceway for low potential wiring, or as trim for standard Plug-In Strips, is installed without the use of nails, screws, or fasteners. Projecting down from the back of the quarter round at three-inch intervals are integral steel prongs. When installed, these prongs are pushed down behind the baseboard or the Plug-In Strip, their design and positioning exerting a tension that holds the quarter-round snugly in place. Known as Lopo-Trim,



Quarter-round conceals wires

it is produced by National Electric Products Corporation in six-foot lengths; for rounding external or internal corners, eight inch by eight inch two-piece matching elbows are available.

Lopo-Trim has been approved for use as telephone wire raceway. It can also be used as a raceway for such other low potential services as buzzer and inter-communication wiring.

ELECTRONIC ALARM

Can Sound Warning at Many Points, Simultaneously

PREVENTION of loss of life in hotel and other fires is possible through the use of an electronic means of transmitting emergency warnings to all necessary locations instantly. This communication system, known as Comtone, which utilizes the electric light wiring to carry music, announcements, or fire alarms to each room of a hotel or similar building, is wired to reproduce the radio programs of four major networks, and also to provide a fifth "silent" channel which is always kept open and instantly available for emergency warnings or other messages. Even when the receiver is apparently turned off, this fifth channel is actually open, and through it can be broadcast a fire warning, giving the guests directions for escaping. In the time it would take a switchboard operator to telephone an alarm to one room, the entire hotel could be alerted to the fire danger by the use of Comtone.

PETROLEUM RESIN

Forms Quick-Drying Coat on Hard-to-Paint Surfaces

KNOWN as A-resin, a new synthetic surface-coating which can be successfully applied to iron, brass, bronze, aluminum, and highly polished metal, in addition to wood and steel, has excellent qualities of adhesion, flexibility, and wetting power which particularly fit it for use on surfaces difficult to coat with ordinary paint. As a baked priming coat on automobiles it is hard, durable, light-fast, and chemically resistant. An A-resin can-coating that is only 2/10,000th of an inch thick remains unbroken even when the metal sheets are stamped and punched. This petroleum derivative withstands the pasteurization treatment of 20 minutes under 15 pounds of steam pressure at 250 degrees, Fahrenheit, and is unaffected by the extremely high acidity of grapefruit and certain other canned fruit and vegetable juices. A-resin pigmented films air-dry quickly, have good light stability, and retain a high and lasting gloss.

It also promises good results if used as a base for textiles, footwear, and rubber adhesive.

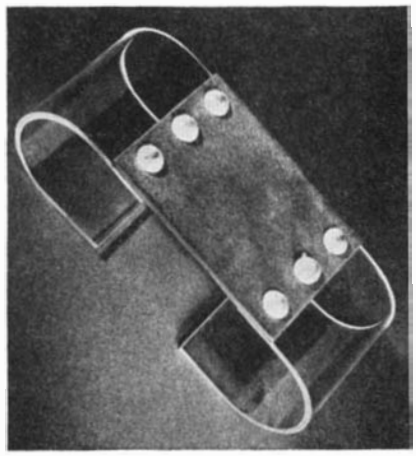
A-resin was developed by the Standard Oil Company (New Jersey) to sell at prices that compare most favorably with other synthetic resins. It is a short-oil-length resin, which means economy of drying oil.

There are several types of the resin, and a fair-sized plant soon will be producing the new material in commercial test quantities.

PLASTICS RIVETS

Are Clinched Without Shock

WHEN used on fragile materials, acrylic fasteners, developed by the Douglas Aircraft Company, can be clinched without shock by simply heating and expanding the rivets with air pressure. After forming a strong, durable bond, the exposed parts of the rivet may be turned into novel decorative effects by further heat application and forming the plastics into a variety



Available in a wide variety of colors

of shapes. Both solid head and hollow shank rivets can be made by the new process. The heat-expansion method of insertion allows the shatter-resistant rivets to be used as "blind" fasteners where only one side of the assembly is accessible. If a rivet is found defective after fastening, it may easily be withdrawn by heating the flattened end with a hot rod, reducing the end to the original shank shape. If desired, rivets may be redriven.

Since the new Plexiglas rivets will not rust or corrode, they are ideal for use in radio or high-frequency apparatus or in food containers where metal cannot be used. Their feather-lightness (half the weight of glass) plus their clarity offers a new type bonding in decorative applications. Plexiglas rivets are available in a wide variety of colors, ranging from light tints to deep tones, permitting manufacturers to match product colors.

ROUGHNESS TESTER

A New Aid in Rubber Production

SCIENTIFICALLY measuring roughness, a property left previously to visual estimation, a device called the Rugosimeter is a development which promises to be of great use to the rubber industry. When sheets of rubber are rolled out for production of rubber footwear and other products, their surfaces are often too rough and buckled for use. The Rugosimeter, by giving a measure of this processing defect, will help determine and eliminate the causes.

Guesswork eliminated by the accurate evaluation of sheet surface-textures

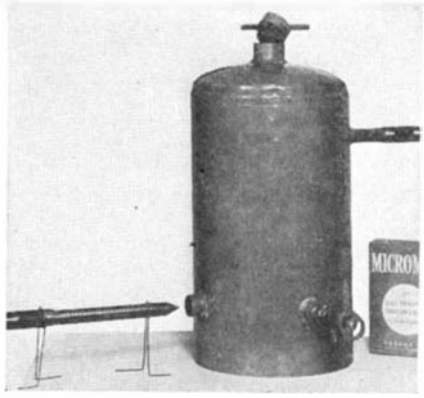
After many years of developing rubber testing devices, the United States Rubber Company presents the roughness tester as a new step toward making rubber technology a precise science.

It operates by measuring the resistance to the passage of a stream of compressed air between the rough surface being tested and a smooth plate resting upon it. If the rubber surface is rough, the air passes easily through the "valleys." If the surface is nearly smooth, the air has difficulty in getting through. The resistance to the passage of air through these irregular channels is measured by comparison with the resistance offered by an adjustable needle valve.

CHEMICAL FEEDER

Reduces Troubles In Water Systems

COMMERCIAL, institutional, or industrial establishments having corrosion or scale difficulties in their hot-water or cooling-water systems—whether using 13,000 or 1,000,000 gallons per month—will find an answer to their problems in one of a series of feeders by which Micromet, a scale- and corrosion-control chemical, can be fed into the water lines with simplicity and low cost. The feeders hold up to 20, 50, or 100 pounds of Micromet at one charge. The chemical dissolves slowly, at a rate of 25 percent per month, so that only that much of the initial charge needs to be renewed each month.



Water treatment unit disassembled

The amount of chemical required, and the size of feeder, depend on the type of water trouble encountered and the amount of water to be treated. For corrosion, the 50-pound feeder, for example, will handle up to 150,000 gallons of water per month. For hard waters producing lime-scale it will handle up to 300,000 gallons. The larger feeder, according to Calgon, Inc., will handle up to 1,000,000 gallons of scale-producing water per month, while the smaller type of feeders will handle as low as 3000 gallons per month.

RADIUS BRAKE

Forms Low Ductile Materials Without Danger of Fracture

DESIGNED specifically for the precision-forming of duraluminum, chrome molybdenum, rust-resistant and spring alloys, and various other low ductile materials, a newly developed radius brake reduces the possibility of fracture or disintegration at the line of forming. Easily-changeable forming bars with established radii of 0, 1/16, 3/32, 1/8, 5/32, 3/16, and 7/32 inch are available with this unit.

With great versatility of operation, this brake, developed by the O'Neil-Irwin Manufacturing Company, can be easily adjusted to produce an almost unlimited variety of shapes; improved gages, supports, and clamping devices insure precision of forming. With all levers conveniently located, and with roller-bearings installed, operator fatigue is kept to a minimum.

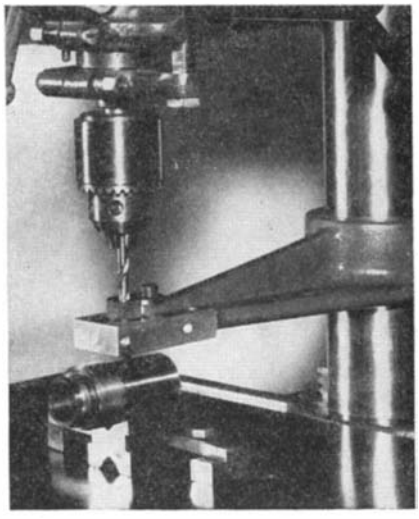
Easily adjusted for increased versatility

When this newly designed brake is used with the manufacturer's shears and benders, complex precision parts may be formed out of plain sheet metal on a production-line duplication basis, without the use of dies. The shears, benders, and brakes are all available in a wide variety of sizes and capacities.

DRILL PRESS ADAPTER

Permits Accurate Drilling Without Jigs

ADAPTABLE to the column of most small, popular-make drill presses, an aluminum alloy attachment displaces all but the most complex drill jigs inasmuch as it firmly and accurately holds interchangeable drill bushings close to the work. Perfect alinement of spindle, column, and adapter is accomplished through an eccentric alining bushing in the adapter head which when once set needs no further adjustment. Filler bushings cover the range up to ½ inch.



Will fit most small drill presses

Stops to locate the piece to be drilled are attached to the press table or directly to the adapter. As the work is not enclosed, chip interference is entirely avoided. This tool supplies a rigid bushing support to the drill or end mill in addition to the spindle chuck, thus preventing any inclination of the drill

to drift, before or while drilling. Chattering in milling operations is eliminated for the same reason. Such accurate control of drills is attained with this attachment, made by Aetna Manufacturing Company, that overlapping holes can be drilled without punch marks and without any indication of run-out. This has been done with a drill as small as 1/32 inch in diameter, and 1/4 inch holes can be drilled more than six inches deep with as little as .006 inch drift.

PAINT BRUSH LAUNDRY

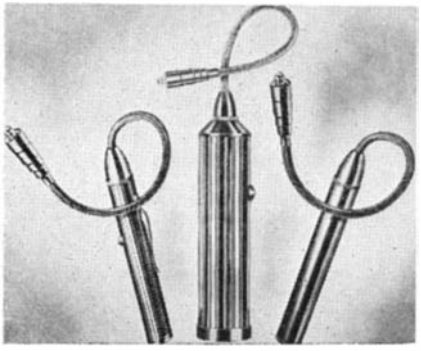
Reconditions Brushes Without Chemicals

REMOVING all caked paint from bristles and heels, refinishing handles and ferrules, and reshaping bristles, a paint brush reconditioning service claims to be able to restore even the most hopeless looking brushes. The process used in restoration by the Strauss Paint Brush Laundry, originator of the service, envolves no soaking or harsh chemicals, and each brush is marked to prevent mixup. Repairs on brushes with loose bristles, or damaged ferrules or handles, are done at a slight extra cost, and brushes mailed to the plant (pick-up service is available in the New York metropolitan area) will be returned, reconditioned, in approximately two weeks.

FLEXIBLE FLASHLIGHT

Illuminates Work, Leaves Hands Free

WITH its bulb mounted on the end of a flexible metallic tube, a new flashlight throws a brilliant, uniform light into otherwise inaccessible areas. The



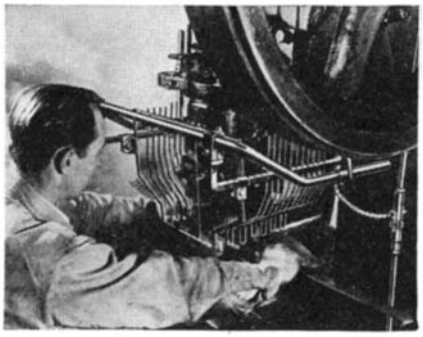
Holds position to which it is bent

tubing can be bent at any angle and will remain in the adjusted position, or it can be wound around a pipe or rod, leaving hands completely free. The flashlight, made by the Holub Industries, Inc., uses standard bulbs and batteries, and is available in three sizes.

PRESS SHIELD

Protects Operator, Does Not Obstruct Work

CUSTOM built to fit power presses used in blanking operations, a new safety guard, has a transparent Plexiglas shield located near the front to provide the press operator with an unobstructed view of the blanking operation. Since the plastics shield is shatter-resistant and splinter-proof it also protects the operator from flying metal particles. Called the Junkin Swinging Die Closure, the guard is mounted in



Guard in operating position

an adjustable frame permitting horizontal movement to accommodate any change in power press operation. If necessary, the plastics shield may be swung up and out of the operating position to allow adjustment of the power press. The guard also permits easy, safe access to the dies when necessary.

CASEIN BRISTLES

Look Like Nature's, But Cost Less

SUCCESSFUL commercial application of its development for making bristles from casein, has been announced by the United States Department of Agriculture. Research on the new product was initiated four years ago to find a suitable substitute for imported natural bristle.

The artificial bristle is made by extrusion of a mixture of casein and water through a suitable die, and then subjected to finishing operations. The final product is round in cross section and has a black color comparable to that of horsehair or pig bristle. Like other artificial fibers, it can be produced in any length desired and in a range of diameters. Of many possible uses, the low-cost bristle is particularly adapted to the construction of paint brushes since it is resistant to oils and organic solvents.

Casein from waste skim milk is the main constituent used in making the bristle product, but it is possible that other protein materials derived from agricultural commodities may also be employed.

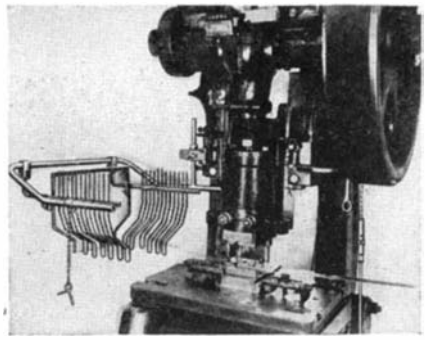
WELDING ELECTRODE

Makes Welding of Special Steels Practicable

TO SIMPLIFY the welding of high-sulfur, free-machining steel, and of certain high-tensile, low-alloy steels, a new electrode, known as Shield-Arc LH-70, has a low-hydrogen, low-moisture coating and is designed for use with D.C.

Welding currents used are high in comparison with other all-position-type electrodes, and the electrode makes possible a weld in less time, according to The Lincoln Electric Company. Pre-heating of high-tensile, low-alloy steels can be eliminated or largely reduced, it is said, and welds of exceptional toughness can be made on high-carbon and other steels which tend to show under-bead cracking when welded with the usual type of electrodes. Also, welding high-silicon electrical sheet steel is practicable with the new electrode and high-sulfur steels can be welded as readily as low-sulfur mild steel.

An interesting application for the electrodes is seen in the arc welding of materials to be enamelled. Where it was formerly necessary to heat-treat the vessels after welding to drive out the hydrogen in order that the enamel would not bubble and peel, enamelling may now be done without heat treating.



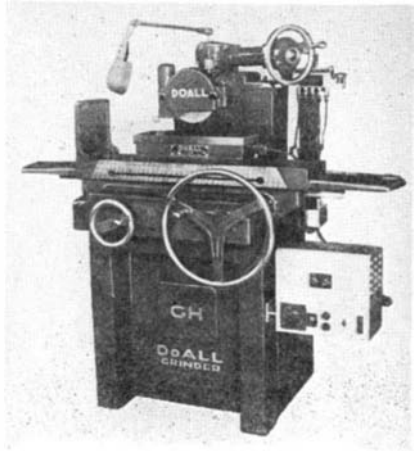
Shield swings, gives access to die

SURFACE GRINDER

Is Manually Controlled for Working to Close Tolerances

HAND operated and featuring smooth, easy table action, a new grinder has hardened gears running in needle-bearings and driven by a 16 inch hand wheel. The one-inch cross-feed screw located in the center of the saddle assures smooth, accurate, cross-feed action. The grinder has heavy, deep "V" ways between the saddle and base, and one flat way between the table and saddle. All ways are hand scraped and a gravity feed oiling system lubricates them.

Another feature of this grinder is the cartridge type direct-drive spindle as standard equipment. This spindle has precision ball-bearings throughout,



For precise specialized grinding

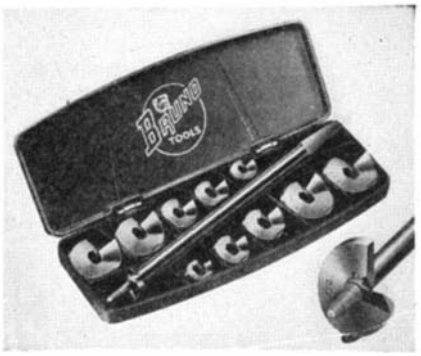
with automatic take-up for wear. The direct coupled one horsepower motor and the spindle itself are statically and dynamically balanced, and are totally enclosed. This hand operated grinder, a product of the Do-All Company, is designed for tool rooms requiring special grinding operations to extremely close tolerances.

QUICK-CHANGE BITS

Employ Same Shank For All Size Borings

SPEEDING and simplifying the process of changing bits, a new set of wood-boring tools consists of one shank and a number of changeable boring heads. In use, the operator simply loosens a set screw and inserts the desired size quick-change boring head. The head locks securely with a positive-seal precision fit, the set screw acting merely as a safety lock.

Even when boring the hardest woods the new-type bit requires no forward pressure. This is made possible by the extra long cutting edge of the boring head and by the specially designed lead screw which actually pulls the tool



Boring heads are changeable

through the wood. There are no flutes to bind or clog. The boring heads are made of high carbon tool steel, heat-treated to assure long life, and are easily sharpened. The smooth, fluteless shank of heat-treated chrome-moly steel permits drilling of exceptionally deep holes, and the long lead screw with its diamond point eliminates splitting. This new bit, made by Bruno Tools, bores easily on an angle and is particularly well suited for cutting dowel and bolt holes.

FORMALDEHYDE POLYMER

Serves as Plasticizer, Solvent, or Fuel

TRIOXANE, a polymer of formaldehyde useful in a wide variety of present-day industrial applications, is now available for commercial distribution. Although discovered in 1885, it wasn't until very recently that a practical process for its manufacture on a commercial scale was developed. Trioxane, now produced by E. I. du Pont de Nemours and Company, Inc., is a colorless, plastic, crystalline solid. A sweet odor, resembling that of chloroform, is a distinctive characteristic of trioxane, with no trace of the formaldehyde odor remaining. It ignites instantly and burns with a very hot, non-luminous, clean, odorless flame, a property which suggests its utility as a packaged fuel for campers, picknickers, and hunters.

Readily soluble in alcohols, ketones, ethers, esters, chlorinated hydrocarbon solvents, and aromatic hydrocarbons, trioxane, in molten state, is itself an excellent solvent for many organic substances, including phenol, naphthalene, vegetable oils, fatty acid amides, urea, and, in the presence of water, the protein, zein. These properties indicate the usefulness of trioxane as a plasticizer of other materials in cases where its volatility is not objectionable. Trioxane-zein compositions, for example, are believed to present many potential applications in coatings and as plastic aggregates.

Its solubility in most types of organic materials makes possible the use of trioxane as an intermediate in organic reaction media. In such anhydrous media, trioxane is stable if the system is neutral or alkaline. Small amounts of strong acids or acid-forming substances cause the compound to depolymerize to monomeric formaldehyde at a rate that may be readily controlled by regulating the amount of catalyst and the temperature.

By this means, trioxane added to a reaction mixture forms a system that is stable until the required catalyst is added to cause depolymerization. The properties of this new product make

possible its use as a source of formaldehyde for reaction with various materials. In many cases trioxane gives more positive control of reaction, improved quality and uniformity of the end product, better yields, shorter reaction time, and a generally smoother overall reaction than can be obtained by the use of aqueous formaldehyde solutions or other formaldehyde polymers.

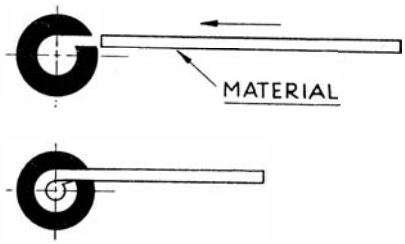
LONG-LIFE DIE

Turns Out Loops With Minimum Wear

A FORTY-FOLD increase in die life and the elimination of practically all maintenance is reported to have resulted from the use in one plant of carbide dies for the forming of loops on small hinges. The forming die is a simple bushing of Carboloy Grade 883, a carbide combining toughness with high resistance to abrasion and wear. A slot, sufficiently wide to clear the thickness of the work piece, was cut in the bushing, as shown.

The hinge blanks—of cold rolled steel—are fed into the die by a press, forming the loop on one end of the hinge, inside the die. The finished piece is ejected sideways out of the die, and the cycle repeated.

The particular Carboloy die used has turned out more than 1,000,000 looped hinges without exhibiting any detectable signs of wear, according to latest production reports. Hardened steel dies of similar design formerly used for this operation had to be completely re-built after looping an average of 25,000 pieces.



Cold rolled steel blank is shaped to loop on a wear-resistant carbide die

VINYL PLASTICS

Offers Durability, Long Life for Coated Fabrics

ONE of the co-poly vinyl compounds, a new plastics is adaptable to use on any woven fabric, or for coating leather and other smooth finish, flexible materials. Odorless and slow-burning, the plastics, called Texflex, has a high resistance to salt solutions, acids, alkalis, heat, light, and aging. For this reason, it is believed to have a wide application potential in both industrial and home use.

The compound may be applied by dipping, roller coating, knife coating, brushing, or spraying. Its minimum tendency to string or cobweb makes it possible to obtain a relatively uniform surface with any method of application.

The best results, however, have been

obtained by spreading Texflex on the material and wiping off the excess with a "doctor blade." Both waterproof and washable, the vinyl is manufactured in a wide range of colors by the H. V. Walker Company. A clear compound is also available. Adaptable to flash or infra-red baking, the material combines a wide range of flexibility with excellent strength. It can be punched, cut sewn, or creased without breaking the vinylite seal.

PNEUMATIC SCREW DRIVER

Drives Screws Rapidly, With Little Effort

DESIGNED especially for fast driving of small screws, a pneumatic screw driver is valuable wherever driving is to be done on a production basis. Weighing only eight ounces, the screw driver fits easily into the hand, and operator fatigue is extremely low. A special feature is the pneumatic pick-up, which enables the operator to pick up screws and drive them directly into the work,

Fumbling with tiny screws eliminated

eliminating entirely the time lost by the operator fumbling with small hard-to-hold screws.

The screw driver, manufactured by the Keller Tool Company, is available in two models, one of which drives free running-screws up to Number Three, and very small wood and self-tapping screws; it operates at 2500 revolutions per minute. The other accommodates screws from Number Three to Number Six and operates at 10,000 revolutions per minute.

MIDGET HYDRAULIC PUMP

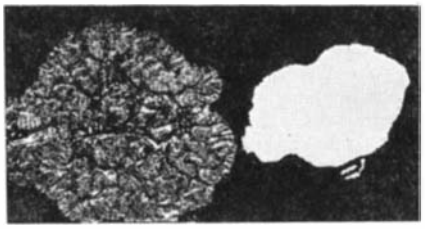
Is Light and Small, Yet Has High Efficiency

DEVELOPING 5000 pounds per square inch, yet small and light enough for a boy to handle, an hydraulic pump has a single bank of plungers which deliver three gallons per minute at 1800 revolutions per minute, and two gallons per minute at 1200 revolutions per minute. Manufactured by the Superdraulic Corporation, the pump has a high volumetric efficiency—95 percent with the lightest hydraulic oils—and should prove a convenient means of hydraulic power application to machinery where space is at a premium, and yet where the flexibility and perfect control afforded by hydraulic power is desirable. It is particularly adaptable as a holding pump for presses and plastics injection-molding machines, although it may also be used as a powerful reversible hydraulic motor.

ENAMEL REMOVER

Strips Synthetic Finish Without Damage to Surface

SLIGHTLY viscous, a preparation that can be brushed, sprayed, or applied by dipping, will remove synthetic enamel from all types of surfaces, including wood and metal. It contains a non-waxy evaporating retardent that keeps the remover on the work until its stripping action is completed. Stripping is accomplished by a wrinkling action so that the enamel can be brushed, wiped,



The remover's wrinkling action is apparent after only 30 seconds' application on an alkyd enamel coat (left). Stripped surface (right) needs no further finishing before being re-painted

or scraped off. No waxy residue is left to interfere with adhesion of subsequently applied finishes.

The remover, a product of Enthone, Inc., will strip certain nitrocellulose coatings, but it is not satisfactory for linseed oil paints, phenol-formaldehyde enamels, or vinyl type coatings. Modified urea-formaldehyde, melamine, and alkyd coatings are rapidly stripped, however, and the remover, known as Enamel Stripper S-45, has no harmful action on metals, plastics, or wood.

VARIABLE-SPEED LATHE

Is Easily Controlled Without Interrupting Operations

A SINGLE spindle buffing lathe—suitable for color buffing, light cut buffing, and polishing—features a variable speed control which permits instant change of speeds within a range of from 1500 to 3000 revolutions per minute, while the lathe is running. The speed change is accomplished by turning a dial which raises or lowers the motor, and causes the movable disk on the variable-speed pulley to slide laterally, thereby increasing or decreasing its pitch diameter and changing the spindle speed. A single wide V-belt is used for drive from motor spindle, and the spindle overhangs the base eight inches to permit handling bulky parts.

Standard equipment with the lathe, manufactured by Hammond Machinery

Speed is changed by turning dial

Builders, Inc., includes a three-horsepower, 60-cycle motor, although motors of other specifications can be supplied on special order.

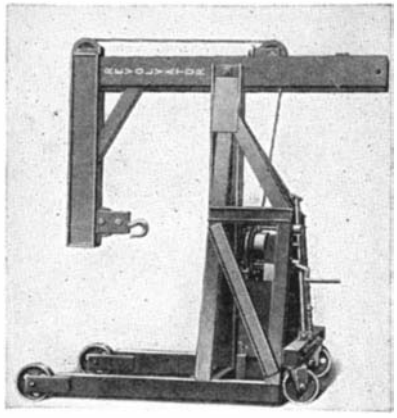
PORTABLE CRANE

Has Folding Feature, Clears Low Overhead

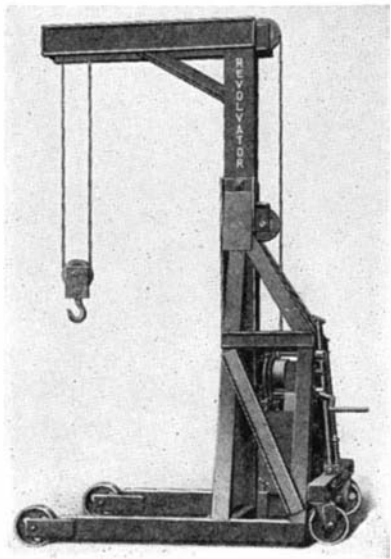
So DESIGNED that the upper part may be folded down to permit moving it under low doorways or other overhead obstructions, an ingenious portable crane is being produced by Revolvator Company. The folding feature, which also facilitates shipping in more compact form, is effected by the same crank and cable that is used for hoisting material. To place the crane in upright or extended position ready for operation, it is only necessary to wind the cable on the drum by means of the crank till the pulley at the lifting hook is against the frame, and then keep on winding until the crane assumes its upright position. Pins are inserted through the stationary and movable frames to lock the parts in place. To lower the crane, the hook is first raised to the top; then the interchangeable crank handle is placed on the brake shaft, the locking pins are removed, and the crane is lowered to the folded position slowly and gently by relieving pressure on the brake drum through the crank.

The crane is equipped with a low gear for lifting very heavy loads; the crank handle is placed on the center shaft or lower shaft according to the weight to be lifted. Maximum capacity of the Revolvator portable crane is 4000 pounds.

The Revolvator crane is equipped with a floor lock and the steering handle is geared to the front wheels which turn easily on Timken roller bearings.



Folded frame facilitates moving

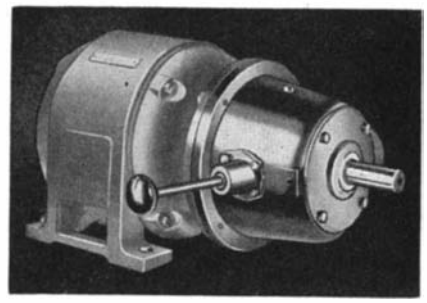


Upright position of folding crane

TRANSMISSION UNIT

Gives Ratios Not Available In Two-Speed Motors

OFFERING special ratios not obtainable with regular two-speed electric motors,



Three mounting angles possible

a new transmission unit provides direct motor speed, a neutral point, and one reduction. Standard reductions are 1½ to 1; 2 to 1; 3 to 1; and 4 to 1, although reductions up to 6.25 to 1 are available. Units can be swiveled about on the mounting flange so that the automotive-type gear shift lever may be in any one of three different positions, 90 degrees apart (two horizontal and one vertical). In the larger sizes these transmission units, produced by the Western Manufacturing Company, are made with modified base mountings, corresponding with the legs of the motor frame.

PLASTICS BOTTOM-PAINT

Emits Poison, Prevents Marine Growths

CAPABLE of saving annually an estimated $4,500,000 on hull repairs, dry docking, and painting costs for ship and boat owners in the United States alone, a cold-plastics bottom-paint has been developed which effectively prevents the growth of marine life. After two years of extensive research and large-scale testing, Manning-Mitchell, Inc., have presented evidence that the paint will completely eliminate all forms of marine growths for from 18 months to two years. The outstanding feature of the cold-plastics paint is the controlled leaching whereby its poison content is emitted at such a rate that development of marine growths is impossible.

SYNTHETIC-COATED CORD

Possesses Unusual Strength And Resistance to Weather

MADE of a flexible synthetic, a recently developed Koroseal cordage is composed of 19 strands of low-stretch cord rayon with high tensile strength,

jacketed with a generous coating of white Koroseal. The product has all the good characteristics of the best quality cotton cordage of .150 inch diameter, plus a number of advantages.

According to the manufacturer, The B. F. Goodrich Company, these features include tensile strength of 150-200 pounds; non-kinking and non-twisting; wipes clean with damp cloth; excellent resistance to abrasion; no reduction in tensile strength after 200 hours water spray and weathering test at 125 degrees, Fahrenheit; no significant change in characteristics after oven test for 48 hours; very slight shrinkage in water boiling test of 24 hours; withstands sub-zero weather if not abruptly kinked; ties and knots same as cotton cord; jacket withstands clinching or bending pressure with all types of hooks or fasteners.

SAFETY GLOVES

Have Built-In Non-Skid Surfaces

A ROUGH finish on the fingers of synthetic rubber gloves, known as Griptite, prevents wet slippery materials from skidding out of workers' hands. Developed by the Surety Rubber Company, the finish is a part of the glove, and cannot rub or peal off, nor will particles drop off in liquids. Rubber gloves with Griptite finish are available in the standard sizes and styles with either curved or straight fingers.

Available in standard sizes

BOTTLE CARRIER

Prevents Injury from Splashed Chemicals

LIGHT-WEIGHT and shock-proof, a new bottle carrier is designed to prevent accidents and severe burns caused by dropping glass bottles containing harmful chemicals, as well as cuts from flying glass.

The protective bottle carrier, a product of the United States Rubber Company, is available in a gallon size and a five-pint or two-liter size. The outer bag is made of heavy duck, impregnated on both sides with chemical-resistant synthetic rubber. All seams are vulcanized. Carrying straps of double thickness run completely under the carrier so that the load is properly distributed and supported. A locking device on the drawstring keeps the carrier closed and prevents splashing.

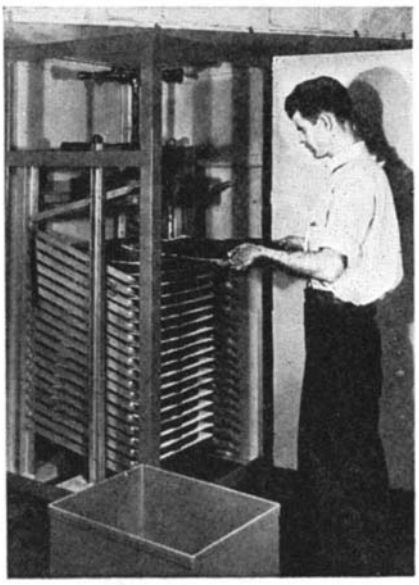
Other safety features include a firm disk base, a sponge rubber pad to protect the bottom against blows, and tubular sponge rubber side padding which completely surrounds the bottle. All are removable for cleaning.

Acid-proof and fully padded

FILTER PRESS

Stands Vertical, Is Easily Cleaned

COMBINING plate and frame in one casting, a stack filter press of cast iron, developed by the Youngstown Miller Company, enables quick and easy cleaning and removal of cakes through an individual latching arrangement of each frame. Starting with the top frame, each section is individually latched in an elevated position to permit the filter paper and cake to be pulled forward out of the press. The cake is quickly removed and the filter paper replaced. Frames are then relowered into position and tightened by a hand screw, forming a tight press.



Each frame individually latched

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.)

AMERICAN STANDARDS. This revised price list, covered in 24 pages, contains listings and prices for 864 standards approved for national use of industry by the American Standards Association —many of them developed under war procedure and approved for peace-time use. This list includes specifications for metals and other materials, methods of work, and methods of test for finished products. Also included are listings for public and industrial safety, industrial medicine, and a wide variety of consumer goods. *American Standards Association, 70 East 45th Street, New York 17, New York.—Gratis.*

MORE POWER TO THE U.S.A. In 32 pages this bulletin presents the Allis-Chalmers products commonly used on generating, substation, transmission, and distribution systems. *Allis-Chalmers Manufacturing Company, 708, Milwaukee 1, Wisconsin.—Gratis.*

TRANSPORT COORDINATION IN THE UNITED STATES, by P. Harvey Middleton, Executive Vice President, Railway Business Association. A scholarly, concise, and clear report on the subject of transport coördination. In 72 pages Mr. Middleton defines coördination as now permitted by law, describes many coördinated services, and discusses dispassionately what further coördination of rail, bus, air, and truck might be desirable for the national economy, without danger of monopoly. *Railway Business Association, 38 South Dearborn Street, Chicago 3, Illinois.—Gratis.*

A BETTER KIND OF LIGHTING. In this four-page bulletin nine types of reflector lamps for industrial, commercial, store, theater, and display use are described and illustrated. Size, beam-spread, and application are listed for each type. *Lustra Corporation of America, 40 West 25th Street, New York 10, New York.—Gratis.*

RADIOMARINE SHIPBOARD RADAR. In 12 pages this brochure describes model CR-101, which is designed for commercial ships and large pleasure craft. This model features the 3.2 centimeter super high frequency band and a compact antenna structure which gives 1.6 degree horizontal beam, resulting in pictures of exceptional clarity and sharpness on the 12 inch diameter cathode ray scope. *Radiomarine Corporation of America, Department AP-10, 75 Varick Street, New York 13, New York.—Gratis.*

INTERNATIONAL SHIPPING DOCUMENTS. This is a four-page quick-reference publication designed to provide air-freight shippers to points outside the United States with a handy chart on documents required by various nations. The first section describes documents required by the United States Government for export, including data on shipper's export declarations and export licenses. The second section covers the import documents of 42 countries of destination, with information on consular invoices, certificates of origin, commercial invoices, and other special certificates. *American Airlines, Inc., Cargo Sales Division, 100 East 42nd Street, New York 17, New York.—Request this publication on your business letterhead.*

DIE-LESS DUPLICATING. This 40-page profusely illustrated catalog gives complete information on equipment for producing, with die accuracy, sheet metal parts to individual specifications. Much of the equipment described has been redesigned for even better and more accurate production. It is useful in model-making shops, experimental laboratories, and production departments, where it replaces dies for both simple and complicated forming operations. Request Catalog Number 46-11. *O'Neil-Irwin Manufacturing Company, 347 Eighth Avenue, Lake City, Minnesota.—Gratis.*

NEW IMPROVED UNITABLES. This eight-page bulletin describes and illustrates several types of all-purpose conveyors which are really mechanized work tables for assembly, inspection, or packing operations. *Island Equipment Corporation, 101 Park Avenue, New York 17, New York.—Request this bulletin on your business letterhead.*

HARNESSING THE RAINBOW FOR YOU. Published for teachers, students, and others with special interest in dyes and textiles, this 12-page booklet—in question and answer form—gives a short history of the synthetic dyestuffs industry and discusses the nature and uses of various types of dyes. Methods of application and color fastness are included. *E. I. du Pont de Nemours and Company, Inc., Advertising Department, Dyestuffs Division, Wilmington 98, Delaware.—Gratis.*

HYDRAULIC PALLET LIFT TRUCK is an illustrated folder containing a diagram for recommended pallet construction, and information on methods of operation with pallets, showing the adaptability of various materials to palletizing. Request Bulletin 220. *Lyon-Raymond Corporation, 3154 Madison Street, Greene, New York.—Gratis.*

KRISTON THERMOSETTING RESIN is a 12-page bulletin, punched for ring binder, which deals with properties and processing information on a thermosetting allyl ester casting resin. *B. F. Goodrich Chemical Company, New Products Department, Rose Building, Cleveland 14, Ohio.—Gratis.*

CONCRETE FLOOR MAINTENANCE PAYS DIVIDENDS is a folder describing the results obtained by the use of Stontop, a surfacing compound which, it is claimed, will stop floor "dusting," and protect against the action of acid, grease, oil, and abrasion. *Stonehard Company, 403 North Broad Street, Philadelphia 8, Pennsylvania.—Gratis.*

Our Book Corner

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

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

APPLIED ATOMIC POWER

By Smith, Fox, Sawyer, and Austin

IF YOU would like to have a preview of the possible forms in which power from split atoms may be applied to industrial purposes, the pages of this compact and concise book will furnish just the information needed. The text, divided into five interrelated parts, deals with natural radio activity; the basis of atomic energy production; the developments leading to the atomic bomb; possible methods of converting atomic energy into mechanical power; and the industrial benefits which have already accrued through the research on U-235. The first three sections are essentially in the nature of a review; the fourth section is perhaps most important because it spearheads into the future. Here are described the uranium pile, production of power direct from uranium or plutonium, the construction of a 35,000-horsepower atomic-power gas turbine plant, atomic-powered locomotives, and the possibilities of applying atomic energy to marine power plants. Appendices review the work on the atomic bomb and give conversion tables for energy units as well as tabulations of the nuclear and atomic masses of isotopes. (227 pages, 6 by 9 inches, 31 illustrations.)—$4.10 postpaid. *A.P.P.*

FUNDAMENTALS OF INDUSTRIAL ELECTRONIC CIRCUITS

By Walther Richter

TAKING a subject as technical as electronics and simplifying it to the point where it can be easily understood by the reader with no specialized background, is at best a difficult task. In preparing this volume, however, the author has succeeded admirably in doing just this. Beginning with the most basic principles of electronics, he gradually works into detailed descriptions of the more common circuits. Throughout the book, difficult mathematics has been avoided; clear, easily followed diagrams have been inserted where the text alone might become confusing. Here the non-technical reader can find a thorough working knowledge of the latest in industrial electronics. (569 pages, 6 by 9 inches, many diagrams.)—$4.60 postpaid.—*N.H.U.*

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

THE SOCIAL EFFECTS OF AVIATION

By William Fielding Ogburn, assisted by Jean L. Adams and S. C. Gilfillan

A WELL-WRITTEN and thoughtful book which deals with many aspects of aviation and their impact on the life of the nation. The book is unique because it is the first comprehensive effort to evaluate the social effects of aviation today and in the immediate future. A few of the chapter titles will serve to indicate its scope: Technology Brings Social Changes; A New Transportation System; On Predicting the Future; On Predicting the Social Effects of Invention; Technological Trends in Aviation; Schedule Transportation of Passengers; The Transportation of Goods; Landing Places; Flying Service to Small Places; Private Flying; Air Routes; International Travel; Social Effects. (755 pages.)—$5.20 postpaid.—*A.K.*

PLASTICS BUSINESS

By Herbert R. Simonds and Joseph V. Sherman

CONSTITUTING a keen analysis of structure and trends of the rapidly expanding plastics industry, this book deals chiefly with business and statistical aspects. Sales, profits, costs, production rates, methods, and many other intimate facts on the major plastics

companies are set forth in well over a hundred tables. The more technical phases of the industry are presented in language readily understandable to the layman; compounding and fabricating processes are treated simply and concisely. To prospective investors or manufacturers, or to anyone interested in the field of plastics, this volume will be an invaluable guide. (439 pages, 6 by 9 inches, illustrated.)—$5.10 postpaid.—*N.H.U.*

PRACTICAL OPTICS

By B. K. Johnson

BASED on an earlier work of similar title, this book covers reflection and refraction experiments, 15 pages; the telescope, 33 pages; the microscope, 32 pages; photographic lenses, 25 pages; optical glass, working and testing, 43 pages. No how-to-make instructions are given but there is little theoretical matter. Mainly it is about practical things in optics. Most of the telescope part is in works like Jacobs; some of the microscope material is in Gage and others; part of the photographic lens data are in Jacobs; much of the optical glass material is in "A.T.M." and others. What is left? Buyers who rejoice to find even a number of unfamiliar things in a purchased book will feel satisfied. It also is an excellent book. Other buyers might feel disappointed. The author is connected with the Imperial College of Science and Technology, London. (189 pages, 5½ by 8½ inches, 194 illustrations.)—$5.10 postpaid.—*A.G.I.*

METALLURGY

By Carl G. Johnson

IF THIS book could have been titled "Starting Points In The Study of Metals," or "Refresher Points In Metallurgy," its content would have been made clear. Every engineer knows that on hundreds of occasions during the course of a year he has to stop and ask himself: "Now, what was it that I learned about that matter?" This is the book to refresh his memory, to give him simple but adequate starting points for further research, and on most occasions to give him all the information he needs about metals and metallurgy. In addition, this is an excellent book for the student. (416 pages, 5½ by 8½ inches, 225 illustrations.)—$5.10 postpaid.—*E.L.C.*

ADVENTURES IN TIME AND SPACE

Edited By Raymond J. Healy and J. Francis McComas

AN ANTHOLOGY of 34 science-fiction stories of the highest type, this volume contains many an evening of stimulating and entertaining reading—providing the reader has a taste for writing of this nature. By and large, the science-fiction yarn is recognized as a notch above most magazine "story" writing, and the intellectual ramifications of most of the tales combine pleasantly with enough fast adventure to hold reader's interest at a peak. An anthology, such as this one, is an ideal way to treat such material since it makes it permanently available for those who have a spare hour or so to read. As a steady reading diet, the material cloys. (998 pages, 6 by 8½ inches, unillustrated.)—$3.10 postpaid.

DIESEL OPERATION AND MAINTENANCE

By Orville L. Adams

EXPERIENCED diesel engine operators will find that this new book contains much valuable information on the scientific and technical problems encountered in their work; others interested in the subject will find it equally informative and valuable. Basic principles are covered—and used as stepping stones in tracing all types of engine problems which may arise under service conditions. Trouble-shooting is emphasized. (366 pages, 7 by 10 inches, well illustrated with drawings and photographs, three appendices including a glossary, well indexed.)—$5.10 postpaid. —*A.P.P.*

VICTORY OVER PAIN

By Victor Robinson

THE SUB-TITLE of this book is "A History of Anesthesia." This it treats from the most primitive use of forest herbs by our remote ancestors to the most modern applications of curare for the alleviation of pain. The presentation of the subject matter is fascinating even for a lay person but without sacrificing in the least the accuracy essential to the discussion of a scientific subject. It is interesting to note that ether was used first by Morton on Dr. Warren's patient in the Massachusetts General Hospital on October 1, 1846. (338 pages, 6 by 9 inches, illustrated.) —$3.60 postpaid.—*D.H.K.*

FREE LANCE PHOTOGRAPHY

By Townsend Godsey

WRITTEN with the very worthy intention of providing a guide for those desiring to make a profitable hobby, or business, of photographing for sale, this book overshoots its mark. In addition to the "inside" story of markets, public relations, rights and copyrights, editorial whims, and so on, this very readable little volume contains a gold mine of information for the amateur photographer. Techniques of picture taking, equipment selection, processing, and a multitude of valuable tips are all between its covers. Profusely illustrated with half-tones and replete with tables, formulas, and listings. (246 pages, 6 by 9 inches, index and bibliography.)—$4.10 postpaid.—*E.F.L.*

AIR TRANSPORT AT WAR

By Reginald M. Cleveland

A VIVID and accurate story of the splendid work done by the Air Transport Command, the Naval Air Transport Service, and the Commercial Airlines of the United States in carrying equipment, men, and supplies to every combat theater the world over. Miracles of courage and ingenuity sup-

plemented the splendid equipment and the experience of our aviation operators, pilots, mechanics. Some of the chapter titles are indicative: Airlines-Armed Services Team, Wings for the Fleet, The Very Bones of Victory, Life Line to China. Mr. Cleveland has made a fascinating and valuable addition to the history of the war and to the history of American aviation. (324 pages, 6 by 9 inches, 47 photographs.)—$3.60 postpaid.—*A.K.*

THE ANCIENT MAYA

By Sylvanus G. Morley

GENERAL round-up of information about the Mayan civilization, by a noted Mayan archeologist after 40 years of study and excavation. The country, people, origin, history, agriculture, government, life of the common people, religion, writing, arithmetic, astronomy, architecture, sculpture, ceramics, arts —all these are covered in readable style neither superficial nor heavy. Author is an associate of the Carnegie Institution of Washington and a recognized scientific authority. (520 pages, 6 by 9 inches, 95 plates, 57 figures, maps.)—$10.20 postpaid.—*A.G.I.*

HANDBOOK OF CHEMISTRY

By N. A. Lange

SIXTH edition of a well-known handbook of chemical information. The editor is proud that it is not enlarged; but it has been greatly corrected and reset, particularly the vital table of properties of inorganic compounds. Some 14 new tables have been added to increase the usefulness of the volume, which retains its original convenient form and style. (2092 pages, 5½ by 8 inches.)—$7.15 postpaid.—*D.H.K.*

ENCYCLOPEDIA OF PSYCHOLOGY

By Philip Lawrence Harriman and over eighty collaborators

COVERING a tremendous range of psychological and psuedo-psychological subjects and comment, this volume is as impossible to review as a mail-order catalog. Text material is drawn from the works of a large number of workers in this field. The individual quality of the workers' achievement is, of course, reflected in the quality of the selection. Hence, the book has highs and lows. To a reasonable extent, an extent limited by the mirage-like nature of the not-yet-a-science field of psychology itself, this book fulfills its purpose of offering supplementary data on subjects ordinarily skipped over in academic treatments. (897 pages, 6½ by 9½ inches, unillustrated.)—$10.20 postpaid.—*E.F.L.*

PRECISION HOLE LOCATION FOR INTERCHANGEABILITY IN TOOLMAKING AND PRODUCTION

By J. Robert Moore

PRESENTED after two years of writing and exhaustive research, this work on precision hole location makes available to the toolmaker, for the first time, a complete and authoritative text on this vital phase of his work. It is a thoroughly comprehensive review of all hole-location procedures and their evolution up to the point where the toolmaker can now apply the principle of interchangeability to his operations, enabling him to mass-produce special tools, dies, fixtures, gages, and molds under stringent accuracy requirements. There are 184 pages devoted to the Woodworth Hole Location Tables, which convert holes on circles to rectangular coördinates that are available nowhere else and which alone are worth the price of admission. (448 pages, 7½ by 10½ inches, 500 illustrations and diagrams.)—$5.00 postpaid.—*N.H.U.*

GALVANIZING HANDBOOK

By J. R. Daesen

BASIC principles of coating iron and steel with molten zinc to provide a protective surface coating are here presented graphically and in highly useable form. A large number of photographic examples supplement the text and show clearly the effects of various operations and the end results. Every phase of the work is dealt with in detail, including variations in the base metal, changes in the galvanizing coat after dipping, heat treatment, cleaning and pickling, fluxing, and various types of kettles used. (166 pages, 7½ by 10½ inches, 78 illustrations, 4 appendices.)—$5.35 postpaid.—*A.P.P.*

SEX EDUCATION

By Cyril Bibby

SOUNDLY written for the vital purpose of guiding parents, teachers, and others faced with instructing children and young adults on sexual matters, this book was originally published in Britain and has been slightly edited for American publication. Deletions are only those items concerned with the functionings of the English school system. All the common situations are met in a healthy, frank, and open-minded manner without resorting to literary meanderings. Should be a practical handbook for all parents. Appendix material offers a tentative plan for sex education, specimen lectures, and a reading guide. (311 pages, 5 by 7½ inches, unillustrated.)—$2.60 postpaid.—*E.F.L.*

APPLIED PLASTIC PRODUCT DESIGN

By Robert L. Davis and Ronald D. Beck

CAREFULLY considered here are the possibilities and limitations of plastics as a material in its own right—not as a mere substitute for metals, glass, or wood. This is the correct approach to the whole problem of plastics. Properly used, they are highly valuable; incorrectly used, they can often give a figurative black eye to the whole industry. The volume first presents an introduction to the plastics industry, then to design of plastics parts, and proceeds through a consideration of plastics machining, molding, thread cutting,

The Editors Recommend

Best Sellers In Science

PROCEDURES IN EXPERIMENTAL PHYSICS— *By John Strong, Ph.D.* A wealth of useful data of a practical kind for the constructor, experimenter, and skilled craftsman. **$7.45**

HIGH FREQUENCY INDUCTION HEATING — *By Frank W. Curtis.* Answers many questions concerning induction heating and its utility in industrial processes. Thoroughly practical in scope. **$3.10**

TOOL MAKING — *By C. M. Cole.* Instructions for making and using all kinds, from personal tools to arbor presses, lathes, planers, etc., in different metals. **$4.10**

POTTERY PRODUCTION PROCESSES — *Edited By J. J. Svec.* For amateur and professional alike, this compact volume gives specific instructions. Particular attention is called to troubles most likely to develop. **$2.10**

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

NORTON'S STAR ATLAS AND TELESCOPIC HANDBOOK—*By Norton and Inglis.* New tenth edition of a standard work, with main charts redrawn for epoch of 1950. Standby for amateurs past the cradle roll. **$5.10**

PLASTICS — *By J. H. DuBois.* Third edition, again revised and enlarged, with two four-color plates. This is an important book on the whole general subject of plastics, plus much brand new material on synthetic rubber, manufacturing processes, and plastics moldings. **$5.10**

REVISED LAPIDARY HANDBOOK — *By J. Harry Howard.* Practical instructions in gemstone cutting and polishing, for both beginner and the advanced hobbyist. **$3.10**

SIMPLIFIED PUNCH AND DIE MAKING — *By Walker and Taylor.* Comprehensive reference book for tool engineers as well as those just getting started. Emphasis is on what-to-do and how-to-do-it, from the simplest to the most complex dies. **$5.10**

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

TECHNIQUE OF GLASS MANIPULATION IN SCIENTIFIC RESEARCH — *By Julius D. Heldman, Ph.D.* Text covers properties of glass, glass-working equipment, basic operations, seals (including metal-to-glass), and exercises aimed at perfecting technique. **$3.70**

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

SLIDE RULE SIMPLIFIED — *By C. O. Harris.* How to use a slide rule, without any of the mystification that often surrounds this important tool of the engineer. Excellent illustrations make everything clear. **$4.10** including a slide rule; for book alone. **$2.85**

ELECTRIC MOTOR REPAIR — *By Robert Rosenberg.* Practical instructions, with excellent drawings and text separately bound so that book can be left open to a certain drawing while following the printed instructions. **$5.10**

MACHINERY'S HANDBOOK — *13th Edition.* "Bible of the mechanical industry." 1911 pages of latest standards, data, and information required daily in shop and drafting room. **$6.10**

THE EINSTEIN THEORY OF RELATIVITY — *By L. R. and H. G. Lieber.* An intermediate book from which engineers and the like can get close to an understanding of relativity. Partly in language but largely in mathematics of college grade, mainly calculus. **$3.10**

ATOMIC ARTILLERY AND THE ATOMIC BOMB — *By John Kellock Robertson.* Standard best seller for years, describing electrons, protons, positrons, photons, cosmic rays and the manufacture of artificial radioactivity—now with a chapter added on the bomb and the difficulties of its production. **$2.60**

FINISHING METAL PRODUCTS — *By Simonds and Bregman.* Stress is directed toward commercial aspects of product finishing from the standpoint of sales, costs, and product function. Specific guidance for those faced with selecting finishing methods, materials, and equipment. **$4.10**

PRINCIPLES OF PHYSICS, VOL. III—OPTICS — *By Francis Weston Sears.* One of the most modern works on physical optics available today. At college level, it covers the subject with emphasis on physical principles rather than practical applications. **$5.10**

MEN, MIRRORS, AND STARS — *By C. Edward Pendray.* Third edition, with much new material, including a chapter on the Schmidt camera. Treats telescope evolution, famous American telescope makers, telescope uses and accessories, and so on. **$3.10**

EXPERIMENTAL PLASTICS AND SYNTHETIC RESINS — *By G. F. D'Alelio.* Explicit directions for making most of the well-known plastics and resins, using a minimum of laboratory equipment. Many of the processes can be translated directly into industrial applications. **$3.10**

FUNDAMENTALS OF OPTICAL ENGINEERING — *By Donald H. Jacobs.* This work starts out at the very beginning, is mainly non-mathematical, and is probably the best suited of all existing books as an introduction to optical design. Author is a physicist at Bureau of Standards. **$5.60**

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

THE PROLONGATION OF LIFE — *By Dr. Alexander A. Bogomolets.* Competent evaluation of present knowledge of the mysteries of human aging, including full discussion of ACS—anti-reticular cytotoxic serum. **$1.60**

FEATURES OF THE MOON — *By J. E. Spurr.* New volume that includes all of the former "The Imbrium Plain Region of the Moon," plus an extended study of the whole Moon. 453 large pages, 14 Mt. Wilson photographs, 95 drawings. **$5.10**

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

(All prices subject to change without notice.)

For Sale by: **April, 1947**

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

I enclose $..... for which please forward at once the following books:

.....

.....

Name .....

Address .....

Write us for information on books of any subject. We can supply any book in print.

decorative treatments, extrusions, laminates, sheets, rods, and tubes. A chapter deals with the economics of plastics use. (285 pages, 6 by 9 inches, well illustrated with photographs and drawings, 8 tables of useful data, a glossary, and a comprehensive index.)—$6.10 postpaid.—*A.P.P.*

APES, GIANTS, AND MAN

By Franz Weidenreich

LINKS in man's ancestry have been filled in even during war years. This book, by a noted paleoanthropologist, describes the newer finds mainly from Java, the new *Pithecanthropus robustus,* the gigantic *Meganthropus paleojavanicus* (bigger than a gorilla yet human), and *Gigantopithecus blacki,* even larger than Meganthropus and twice as big as a male gorilla. "The human line leads to giants, the farther back it is traced," says the author. More finds are imminent. (122 pages, 6 by 9 inches, 90 illustrations.) —$2.60 postpaid.—*A.G.I.*

INTRODUCTION TO THE CHEMISTRY OF THE SILICONES

By Eugene G. Rochow

RECENT developments in the industrial applications of the organic compounds of silicon have stirred tremendous interest in this alluring field of chemistry. Previously, knowledge of these interesting compounds had been confined to little more than a hasty smattering for most chemists. Now, this volume provides the basis on which most of us can learn the facts of silicon chemistry from the ground up, from both the practical and theoretical viewpoints. (137 pages, 6 by 9 inches.)—$2.85 postpaid.—*D.H.K.*

THE HOME FREEZER HANDBOOK

By Gerald J. Stout

IN THIS altogether practical book the Associate Professor of Horticultural Manufacturing at the Pennsylvania State University comes to full contact with the realities involved in building and running your own home freezer, small or large, so that a reader who knew practically nothing about freezers would have a right to feel he knew the subject all around. Analysis of the economics reveals that the freezer you build, while not so beautiful as the one you buy, beats it by six to one on first cost and four to one on wattage (because much thicker, also cheaper, insulation—planer shavings—may be used since the freezer need not have to pass through doorways and many be bulkier). Building instructions for several types are given (plan for a chest-type home-built freezer; framing the top and openings, and building the lids; installing the machinery and coil; impractical types; don'ts; larger types). Second part of the book tells about preparation of the many kinds of foods. A lot of people will use this book. (345 pages, 5½ by 8½ inches, 142 illustrations.)—$4.10 postpaid.—*A.G.I.*

Telescoptics

A Monthly Department for the Amateur Telescope Maker

Conducted by ALBERT G. INGALLS

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

CERIUM OXIDE and its relative, Barnesite, are now largely doing the work formerly done by rouge in the precision optical industry, though it is not likely that rouge will ever be abandoned. The new materials are used mainly like rouge but there are some minor differences in working technique. One reader of this department, Jacques Labrecque, 860 Dunlop Ave., Montreal 8, P.Q., Canada, writes: "I have hit a problem. Every time I try cerium oxide it slowly regrinds my mirror. What is the cause of this?"

This inquiry was referred to Fred B. Ferson, Ferson Optical Co., Biloxi, Miss., who has used much rouge, cerium oxide, and Barnesite, and who offered the following suggestions: "Maybe this worker has been putting too much cerium oxide on his lap with too little water and this use of too dense a suspension has caused the cerium to roll and enamel the glass. This happens when there is too much cerium oxide (or, for that matter, any other polishing agent) either to become embedded in the lap or pushed off from it. The enameled surface then has the appearance of a very fine, iridescent grind, the iridescence being caused by interference of light reflected from layers of different thicknesses. An enameled spot on a mirror or lens is clearly visible in the Foucault test, both in outline and thickness. The enamel is on the glass, not of it, and is only of the order of one wavelength in depth."

Cerium oxide is more likely to enamel than rouge, but not if properly used. Therefore, the question of how much water and how much polishing material to use on a pitch lap may be treated as a single, general question of basic interest and usefulness to all glass pushers, amateur or other.

As Everest has pointed out in "A.T.M.A.," if too much rouge is applied to a lap the mirror gets a long, free ride but not much polish. Many beginners and not a few others slap on rouge much as a green mechanic squirts oil on and all over a bearing: if a little is good, he thinks, a lot must be better. However, it really is difficult to believe that a very little polishing material can do the work it actually accomplishes.

Regarding the amounts of water to use in polishing there are two parties, the Wets and the Drys and, between them, a third party, the Moists. "One way to polish," Ferson points out in describing the Wets, "is to use considerable water, weight the lap (I refer to machine system using sub-diameter polisher, lap on top), and accomplish the polishing by means of the weighting. The opposite is to use a minimum of water and permit natural drag to take place, as it will do whether the work is weighted or not. This develops squeals and some lens shops sound like a penful of pigs. The main disadvantage of this Dry method is probable overheating of the surface, so that this method is not suitable for fine figuring, and another is the likelihood of producing sleeks (hairline scratches). These effects can, of course, be quickly adjusted at the end of the run by applying more water and continuing polishing a few minutes.

"In production work," Ferson continues, "where many jobs are in progress at one time, one man can give attention to more laps where the wet method is used, since the dry method calls for addition of water and polishing agent drop by drop. Once, in watching work in a spectacle-making shop, I saw the operator standing with a pail of rouge and a huge brush with which, after dipping it in the pail, he would flip rouge on the many spindles without moving from the spot—of course with great loss of rouge and the whole place painted red.

"The enameling mentioned by the inquirer may also occur when the lap is not quite in contact at some point."

Standing between the Wets and the Drys are the Moists. Your scribe once helped Dave Broadhead, Wellsville, N. Y., a Moist, by doing the heavy looking on while he parabolized two 10" mirrors face up using a 5" lap on a modified Draper machine with Barnesite as the abrasive. Having made several thousands of roof prisms in wartime, Broadhead must have learned a few things optical, so his methods may be worth studying.

He put a spoonful of Barnesite in a drinking glass of water.

With a fine artist's brush having only a few hairs he stirred this up.

Then he shook the brush a little in the top of the still roily water to shake out possible grit.

Next he brushed a little of this mixture on the lap, which was a new one just made, and *this was to be the total polishing material used for the one or two hours of figuring spells.*

He washed the mirror and set it on the machine, then washed his hands with soap, to avoid possible grit.

Using his dried hands as a towel, he rubbed off nearly all the water adhering to the mirror, placed the lap on it, and started the machine.

Soon a tendency to squeal developed; he was working as a Moist. He worked throughout as a Moist, not a Wet. He sat beside the machine like a nurse at a bedside and, each time the pig showed first signs of squealing, he dabbed on a tiny droplet of water from the top of the now well-settled water in the tumbler.

Here was a constantly maintained nice balance between squeal and not-squeal—diligently keeping in Moist territory all the time. To accomplish this the little droplets were added about once in 10 or 15 seconds on either side of the moving sub-diameter lap. If you fall asleep at it the pig wakes you up.

Maybe faster ways could have been found to parabolize. But isn't it better to find ways to stretch out the action? You are not so likely to barge into a bad situation and aggravate it before discovering what you have done. Case of feeling your way and remaining always in full control. What's an hour or two for parabolizing a 10" mirror?

The lap backing was the stiffest possible, made of 5/16" steel plate with welded radial ribs and driven by a central pin having a bulbous head exerting its sidewise force deep in a hole near the working level. It also was light—pound or two. Since the driving pin rode free in a vertical hole in the main arm—could rise or fall freely—no weight could be added to it, even if desired; but it wasn't.

"My theory," Broadhead comments, "is to keep the lap and the work in extremely intimate contact. This cannot be achieved by adding whole gobs of water on one side, with the lifting and tilting thus occasioned. The aim is to maintain an unvarying and strong suction (attraction). Then, with an extremely stiff lap backing, great pressure is automatically exerted on the high zones. The lap may squeal loudly at first but this subsides as the zones disappear."

A Wet uses much water and then adds much weight to squeeze it out. The Moist lets the forces of adhesion take care of this—and they are strong.

Shown copy on all the above and invited to correct any errors in it, Broadhead finds none but adds: "My only criticism is that the reader may get the impression that the technique is advocated principally for small-tool parabolizing; whereas it is of greatest efficacy in getting the desired starting sphere, and is later helpful in obtaining a smooth and comparatively zone-free paraboloid."

Considering the number of optical Wets there are, the above discussion should have important impact on amateur optics.

The Dry, or squealing porker, method may develop unexpected heat elsewhere. Your scribe, in polishing a mirror by hand with Barnesite, so highly perfected the "eeeeeeeek" technique that feminine feet were wont to register violent objection by thumping on the floor above. The pig kept it up—he had a devilish glint in his eye—and the cellar door next flew open and a large tin wastebasket came hurtling down the stairway. A housebroken, domesticated pig, not a pigheaded pig, might have taken this as a faint hint, but this pig was trying to figure out just exactly what vibrates, and why, when a pig gets into a mirror. Probably every mirror maker has discovered pigs in his mirror and wondered whether harm would result. None, except on final figuring, where it makes too much heat. Don't let it go that far. Don't, even,

hurry the moist technique; be deliberate.

With Barnesite, on its first try-out by your scribe several years ago, a 10" mirror polished out in just two hours. It is only fair to state, however, that it had received finings with Garnet Fines (Nos. 1, 4, 7) and would have polished out in fewer than normal hours even with rouge. It happened thus: Examination was made to see how the polish was coming up but it had already come up and was complete. Your scribe exclaimed: "Well I'll be damned!" (This, no doubt, is true.)

Cerium oxide is pink, in water suspension approaching white. It has long been known to be a possible abrasive but lay practically undeveloped commercially until the Barnes Company and other companies developed its application. Barnesite, which is even faster and, in fact the fastest known, is a special material developed exclusively by the Barnes Company beginning in 1941. It is a mixture of cerium oxide with other rare earth metal oxides. Barnesite is red-brown and costs a little more than rouge but what are a few cents' saving when a frogskin will buy enough cerium oxide and Barnesite to polish a dozen mirrors (many more, if the user will avoid the technique of the green mechanic with the diuretic oilcan).

"The general rule for any polishing materials," Ferson emphasizes, "is to apply only a small amount of polishing agent in a larger amount of water (a teaspoonful or tablespoonful in a glass of water); to forbear from adding more of the agent than the lap will handle; and not to try to hurry the action by adding more and more because this will not work.

"Just how much the lap will take up," he continues, "will depend on its hardness—the harder the less, until a very hard lap will take up none at all and will grind instead of polishing. Even a very soft lap will take up only so much in a given time. Toward the end of polishing, only water from the top of the glass, which contains the finest rouge, should be added."

LAST September this department announced that if as many as twenty five 16" Pyrex telescope mirror blanks could be ordered and molded at one pouring, the purchase price per blank would drop by about $100. This number of blanks soon were ordered and supplied to the users. A large part went to professionals who took advantage of the opportunity, and their co-operation is welcome. Some of these professionals formerly were amateurs.

This department now receives belated word that nine more 16" blanks are wanted, two of these from a worker who put off sending his shekels to Corning Glass Works till too late to get into the earlier club. Also, several who advised this department that they "had joined" apparently thought a mere expression of intention would serve, but Corning's mare won't go without the actual spinach. We now propose a 1947 "Sixteen-Inch Club" started off by the nine mentioned above. Present price is

$37.50 per blank, f.o.b. Corning, N. Y., and a batch molding will take place at Corning when the other orders come in. If you don't feel equal to a 16" job now, perhaps you will later. Do not send any money to this magazine since business dealings are entirely with Corning, but if you wish, please let this magazine know you have joined its 1947 club, in the manner just named.

How thick, how rigid, must the glass tool be on which a mirror is ground and polished? On this there have been two schools of thought. One school says as rigid as the mirror, or almost. The other says rigidity makes little or no theoretical difference in a tool.

This question came up when this department was asked whether Corning's 5/8" or ½" Pyrex "Panel Stock," cheaper than mirror blanks though of the same glass, could safely be used as the tool for a fairly large mirror, say a 12½". This stock is given standard commercial annealing but not the special annealing that mirror blanks rate. The question was passed to a few advanced amateurs. One replied: "I've been using tools much thinner than that but haven't noticed any astigmatism." Another: "Used a ¼" tool on a 4¼" mirror. No astigmatism." A third: "I tend to side with the thin tool boys, provided the worker keeps rotating the mirror and circumnavigating the barrel." The last clause is the basis on which the thin tool school argument is based, but few appear to have risked loss of labor by making a planned experiment that would bring the answer out unequivocally, such as trying a 10" or 12½" mirror on a ¼" tool. Goat wanted.

You no doubt have made your formal will but, even then, what would your puzzled heirs know about disposing of your optical things? Pause and try to think out just exactly how mother, wife, or children would proceed with this job. You are an angel hovering overhead but you can't make your presence known and you are thinking, "There go my best eyepieces for a dime apiece and that fine little flat for two cents while they are trying to get $100 for that worthless unfinished, unfigured objective lens." You'd be thinking things no angel is supposed to think.

Would it not be a kind, thoughtful thing to jot down in pencil some informal notes on what to do with each item? Where to offer it. Value.

The total volume of optical stuff today thrown out or gathering dust because heirs don't know what to do with it probably would load a freight train. For a trifling favor one amateur's widow recently tried to give your scribe a microscope worth several hundred dollars, while another amateur who had promised his copy of Ritchey's rare classic "On the Modern Reflecting Telescope" omitted to implement his promise with a memorandum for his heir before he died (earlier than he expected) and the book was burned up and so is your scribe. Two examples of the crazy things that happen because heirs are left puzzled.

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

PICTURE QUIZ: Which of these five people gives the right reason for buying U.S. Bonds?

(ANSWER BELOW)

1. Easy to save! "I'm putting my money into U. S. Bonds because it's the *easiest way* for me to save. Under the Payroll Savings Plan, I put aside a regular amount each week for Bonds. So far, I've saved $500 without missing the money!"

2. Good investment! "Getting back $4 for every $3 I invest—the way I will in ten years' time with U. S. Bonds—is my idea of a *good investment*. I know it's safe and sound, too, because it's backed by Uncle Sam. Buy Bonds, I say."

3. Plans for the future! "Ten years from now, the money I'll get for my U.S. Bonds will help to send my kids to college, or buy our family a new home. I think that buying U. S. Bonds is the wisest thing a family man can do."

4. Fights inflation! "I want America to stay economically sound. That's why I'm putting all our extra dollars into U. S. Bonds. It's like buying a share in our country's future prosperity!"

5. Rainy day! "Maybe a rainy day's coming for me. Maybe it isn't. But I am taking no chances. That's why I'm buying all the U. S. Bonds I can through my Payroll Savings Plan."

THE ANSWER

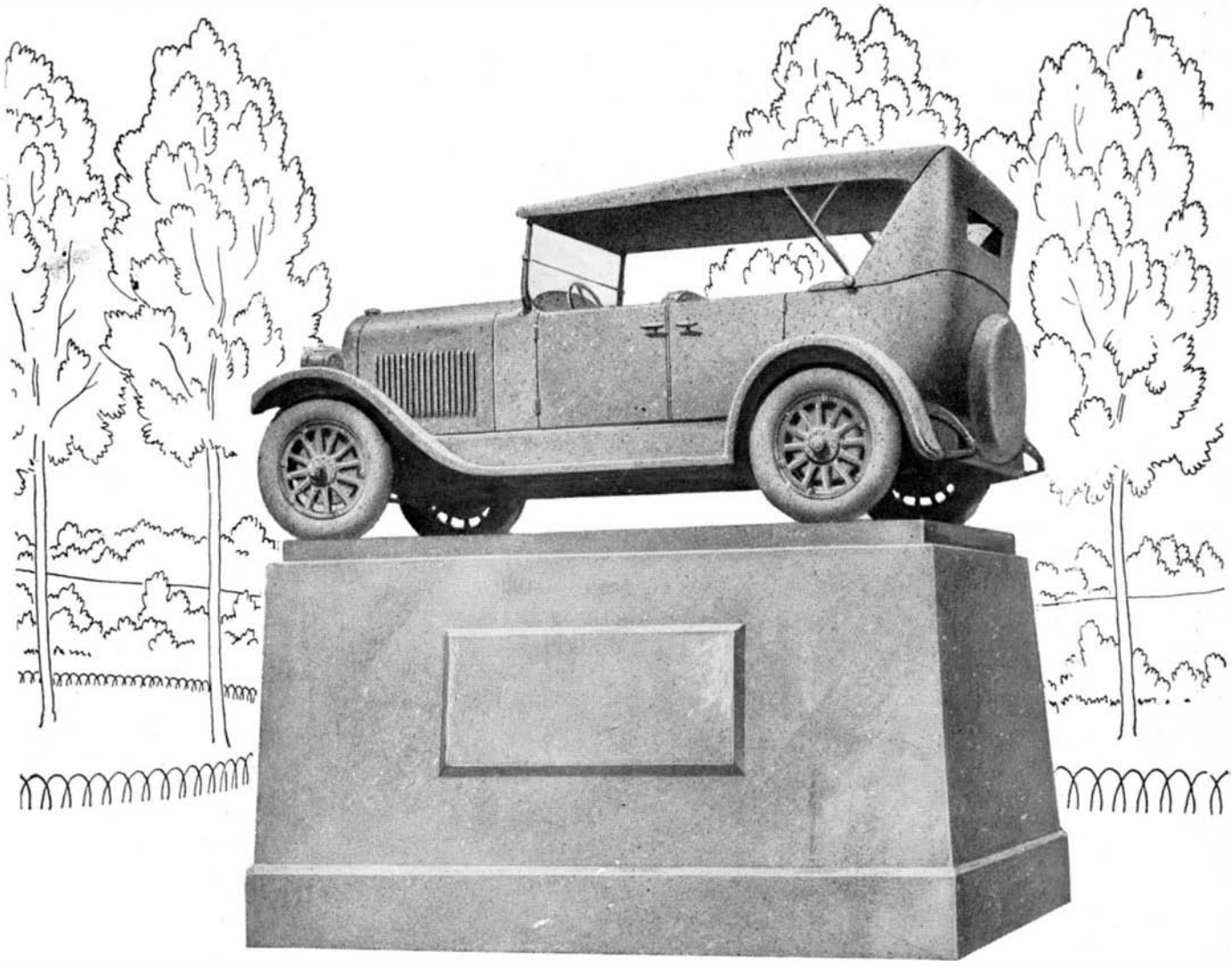
Every one of these people gives the "right" reason—because there's more than one right reason for buying U. S. Bonds.

Whichever way you buy them—through Payroll Savings, or your local bank or post office—U.S. Bonds are the best investment you can make!

Save the easy way..buy your bonds through payroll savings

Contributed by this magazine
in co-operation with the Magazine Publishers of America as a public service.

A PUBLIC SERVICE PROJECT
The Advertising Council



The Great Emancipator

NO MAN in the pages of history better deserves the title of "The Great Emancipator" than Abraham Lincoln. He once and for all established the principle of individual freedom that will endure as long as this nation endures.

But America has seen another great emancipator—this one not a man, but a machine, the automobile. The automobile freed country folk from the wearing isolation of farm life. It enabled city dwellers to escape the oppression of stone and steel at a moment's notice. It gave the average man a completely new kind of freedom—the freedom to go where he pleased, when he pleased.

Today, Americans accept and enjoy this new freedom of movement. It has become a part of their very lives. That's why they show such keen interest in improvements designed to increase automobile utility, responsiveness, economy and pleasure.

Since an automobile can be only as good as the gasoline that propels it, automotive development depends upon improvements in fuels as well as in engines. Therefore, restrictions on the quality of gasoline, such as have been in effect for the past several years, would tend to act as a brake upon automotive progress.

But now, as the day of restrictions comes to a close, petroleum refiners are once more looking forward to making better and better gasoline . . . and automobile engine designers are already at work on engines designed to utilize this improved gasoline.

Advancement in refining processes and the continued use of "Ethyl" antiknock compound will help both the automotive and petroleum industries achieve their common goal—better motor transportation for everybody. For as refiners raise gasoline quality, they also bring new opportunities to the motor manufacturer to further improve the automobile itself. Ethyl Corporation, New York 17, N. Y.

ETHYL