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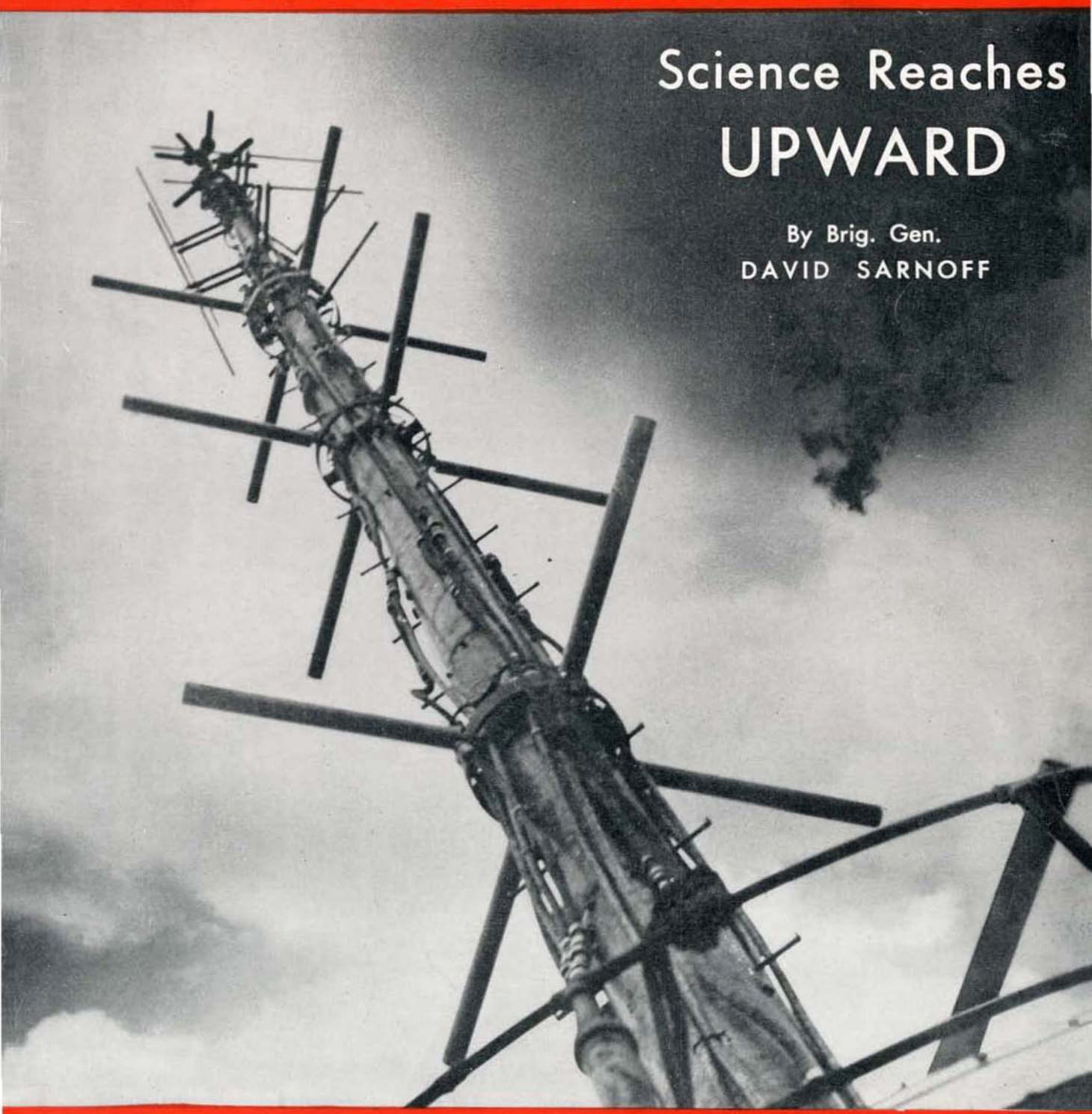
PROGRESS IN INDUSTRY



Science Reaches UPWARD

By Brig. Gen.
DAVID SARNOFF

ARE YOU STILL AN ACTIVE PARTNER...

in this "7½ billion-a-year" success?

NEVER was there a partnership like the nation-wide brotherhood of volunteers who have helped sell, advertise, and promote sales of U. S. Savings Bonds! Their program is the greatest sales operation at the lowest cost in history.

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For any help you need in conducting the Plan, call on your State Director of the Treasury Department's Savings Bonds Division.

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THE Treasury Department and the banks of America are making it possible for farmers, doctors, and other self-employed people to participate in "automatic" Bond buying by special arrangement with their banks. This extension of the Savings Bonds program is not a partial payment plan and is intended *only* for people who are not in a position to take advantage of the Payroll Savings Plan.

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Scientific American

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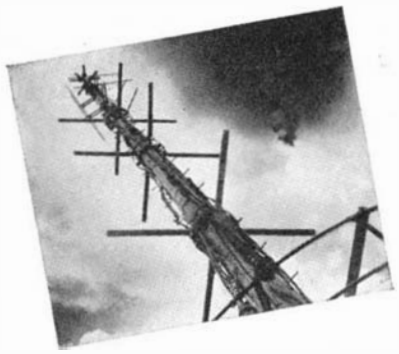

INDUSTRIAL DRAMA: Typifying the theme of Brig. Gen. Sarnoff's article starting on page 6 is our cover picture of the skyward-pointing N.B.C. television antenna which thrust upward toward the clouds from the lofty tower of the Empire State Building in New York City.

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In This Issue • July 1947

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By A. P. Peck

PROTECT YOUR BRAND

OF OUTSTANDING interest and importance to all producers of goods which are or may be protected by trade mark registration is the new Lanham Act. This latest Federal Trade Mark Act was signed by the President last year and becomes effective on July 5, 1947.

The Lanham Act will, in general, coördinate the presently scattered federal provisions relative to trade marks. In bringing our trade mark statutes up to date, it will gear protection of brand names and other marks to modern business needs and will reduce immeasurably the possibility of unfair competition. By providing that registrations may become incontestable after five years of continuous use, the Act will remove much of the uncertainty which exists under present conditions.

Because of the broad scope of the Lanham Act, it is impossible to do more than make this mention of some of its desirable features here. However, an analysis of the Act and of its effect on business has been prepared in booklet form by Sylvester J. Liddy, Esq., of the New York Bar. We are happy to be able to offer gratis copies of this pamphlet as a service to interested readers. Simply request a copy of Mr. Liddy's analysis of the Lanham Act on your business letterhead, and it will be sent by return mail.

MORE HUMAN ENGINEERING

JUST after our note, "Man's Humanity to Man," this page, May 1947, appeared, Eugene Holman, president of Standard Oil Company (N.J.) held forth on the same general subject. So pertinent is Mr. Holman's statement, and so indicative is it of a definite trend in industrial-worker relations, that we quote it to some extent:

"A considerable part of our future planning," said Mr. Holman, referring to his own organization, "will have to be centered in the field of human relations. Thrift plans, annuity benefits, and insurance are enjoyed by a very great majority of our workers. We regard these things as definite obligations to the employees, and we shall continue to meet them. But security alone is not enough. Beyond that we must work to increase the opportunities for the growth and advancement of the individual throughout the industry."

Here indeed is recognition on the part of one of the biggest of big businesses that mere material reward is not sufficient for even the lowliest of workers. Incentive payments, as we have dwelt upon before, are highly desirable in the industrial scheme of things. They produce results. But they do not produce—alone and by themselves—*all* the results that can be had from employer-employee co-operation. The boss must realize that the worker—every last one—is a human being. He must come to the realization that unless employees are happy and contented, their mutual profit will not be at the optimum. And it must be realized by all that this optimum cannot be attained when that "mutual profit" is thought of only in terms of dollars and cents.

When incentives in business comprehensively encompass higher wages in return for greater output, *plus* an opportunity for the human ego of each worker to expand and blossom, then—and then only—will man's humanity to man yield its greatest fruit in this complicated civilization of ours. "Do unto others . . ." and the rest of the Golden Rule looms larger on the industrial horizon than ever before. Those men in key industrial positions who realize the implications of it are those who will profit most—materially and otherwise.

CONSUMER TIME STUDIES

PRODUCERS of consumer goods may well take a page from the book of Proctor Electric Company, manufacturers of automatic electrical appliances and particularly of the so-called Never-Lift iron, billed as a boon to the housewife who does her own ironing. Through a series of time and motion studies, Proctor has evolved a system for home ironing which reduces fatigue to a minimum and at the same time speeds up what must be an onerous if necessary household chore. These studies show the housewife a "scientific" way to get through this job with the fewest motions and with the least possible consumption of time. If more manufacturers of household appliances and the like would take the trouble to inaugurate similar studies, and thus be able to show definitely how users could benefit by the advantages offered by their products, everyone's path would be made a bit smoother. And we don't mean the smoothness attained by removing the dust from cigarette tobacco!

UP IN THE AIR AGAIN

IF THERE ever was an industry with its ups and downs, it is the aviation industry as it is today. No matter how you look at it, the aircraft industry is still in the luxury class. The only possible purchasers of large transport planes—with a few and unimportant exceptions—are the airlines. The possible purchasers of private planes are the general public.

Let's look at these two markets separately. First, the airlines. According to the president of United Airlines, present plans for the airlines in the United States can account for the purchase of new planes to the number of only 1200 units during the next five

years. Two hundred and forty units a year are not going to keep our large-aircraft production possibilities in business unless the Government manages to coördinate its military requirements with those of the privately owned airlines . . . or vice-versa. If this can be done, so much the better for all concerned; if it cannot, look for trouble on the transport-plane production line.

The other aspect of the airplane situation concerns private planes—personal planes, if you will. For a number of years this market has been touted as the saviour of the aircraft industry. Now, at the time of writing, it appears that the bottom is dropping out of this section. Where second-hand light planes sold a few months ago for at least as much as the list price of a new plane, they are now a drug on the market. Already, of the bakers' dozen of light plane manufacturers, at least three have quit, with the probability that more of them will go out of business in the near future. The reason: too many people have been sold on the idea that private light planes are going to follow in the path of the automobile—at least one in every garage. But prices have remained high; maintenance is a problem; and airports are too far from home.

Private flying, of course, will always be with us. But to what extent it will replace the horse and buggy—and even the automobile!—is still one of the headaches of the private airplane industry.

WILL WE HAVE LIGHT CARS?

UNFORTUNATELY for the development of the light car in the United States, much of the public thinking has been concerned with "keeping up with the Joneses." On the other hand, in England, where motorists for many years have been more mileage-conscious, the light car has progressed rapidly. Just over a year ago, General Motors announced plans for a light Chevrolet; not long after, Ford followed suit. Now, both companies have apparently shelved their plans for trying these markets, feeling it "inopportune" to divert materials and man-power to the production of light cars which will produce high mileage per gallon of gasoline. Such moves leave Crosley alone in a market which can well be developed to a leading position in the low-priced car market if it is followed up by intelligent application of technological know-how to immediate production problems.

ON A PHOTOGRAPHIC NEGATIVE

OF INCREASING importance on the industrial horizon is the versatile tool that is offered in the shape of photography in all its phases. The photographic negative can "stop" motion, speed up motion, reveal the ultra-small, reduce the super-colossal, compact filing space to an irreducible minimum, record the vision of the probing eye of the X-ray, tame the spectrograph, replace the repetitive labors of the layout man, and do a thousand and one other jobs in industry, limited only by the ingenuity of man.

To capture the spirit of photography as it applies to industry, this issue presents the first of a series of articles on what Eastman pleases to call "funtional photography." But whatever the name—we call it "industrial photography"—the results are the same: a recording medium of high accuracy and infinite possibilities. If our articles stimulate thinking along industrial photographic lines, they will have served their purpose. Readers are invited to contribute new thoughts, new methods, new ideas.

More on this later: A high-speed X-ray motion picture technique has been developed to study the interior of the body in motion. Dwell for a moment on the translation of this process into a method of finding out what happens during lost-wax casting, flame-pressure welding, plastics and metal extrusion —during a thousand and one other industrial processes that today are followed empirically. Truly the X-ray, coupled with the motion-picture film, offers a means of recording research progress which cannot be surpassed; it has equal possibilities on the production line.

NYLONS FROM THE FARM

ELSEWHERE in this issue is announcement of the possibilities of production of nylon for hosiery from farm wastes, natural gas, and so on. One of the questions that is going to result from this report, without doubt, is: How many pairs of stockings can be made from a bushel of corncobs? The answer is: None. What the chemist actually does is to produce from corncobs just one of the chemicals which go into nylon. Other chemicals are equally important. So is plant investment. Thus, while it may be said that a bushel of corncobs can yield enough hexamethylene diamine to go into about 40 pairs of nylon stockings, it must be remembered that this bushel of corncobs represents millions of dollars of plant investment, the technical knowledge and skill of hundreds of highly trained research and development men, and the work of thousands of others in a great variety of jobs. Back of the announcement of nylon from corncobs lie 12 years of study and a million dollars or more spent on research, plant plans, and expansion of existing industrial facilities.

STRAWS IN THE WIND

WIDE use of plywood is booming prices, but if quality of this composite wood, as well as of other forest products, is not maintained, the wood industry is bound to suffer in the long run. . . Rubber from the Orient is coming back in huge quantities; synthetic rubber production is sky-high; we need our synthetic rubber plant for national protection; we must walk lightly and carry a big stick (that was another Roosevelt) to make sure that we don't come out on the wrong end of the deal. . . As predicted in this column, farm machinery manufacturers—International Harvester in particular—are invading the "small farm" machine field with equipment which is still running, production-wise, far behind demand: Among the devices being offered agriculturists are labor-saving post-hole diggers and beet and potato harvesters. . . Producers of equipment for floodlighting are riding a wave created by the sports-loving section of our citizenry; recreational facilities ranging from baseball to archery and from rifle shooting to swimming and tennis and horseshoe pitching are absorbing millions of dollars worth of floodlights.

50 Years Ago in . . .

SCIENTIFIC AMERICAN

(Condensed from Issues of July, 1897)

PNEUMATIC MAIL SERVICE— "Some thirty years ago the late Alfred E. Beach, of the Scientific American, exhibited in this city a working plan for the carriage of mail matter rapidly from branch stations to a central office by means of pneumatic tubes. He also experimented successfully on the idea of conveying loose letters in a smooth tube by a strong current of air, regarding it as an improvement over the old plan of having separate cars. The idea is in practical use today in the many mail chutes found in tall buildings, where gravity supplants air as a propelling force. Now, a generation after, a similar system is to be carried out in this city, permission having been granted by the Legislature to the United States postal authorities to lay pneumatic tubes in our streets."

LABORATORY WORK — "At the present day the systematic study and advancement of any physical or natural science, including the medical sciences, requires trained workers who can give their time to the work, suitably constructed workrooms, and equipment with all the instruments and appliances required for special work, a supply of the material to be studied and ready access to more important books and journals containing special literature of the sciences. All of these conditions are supplied by a well equipped and properly organized modern laboratory. Such laboratories are, with partial exception of the anatomical laboratory, entirely the creation of the present century and for the most part of the last fifty years. They have completely revolutionized during the past half century the material conditions under which scientific work was prosecuted."

PHOTOGRAPHING RAIL DEFLECTIONS — "An arrangement for enabling the deflections of rails, bridges, etc., under moving loads, to be photographically recorded consists of a camera, of which the plate holder is fitted to slide across the back by clockwork, so that a series of successive images may be taken upon one and the same plate at uniform intervals of time. The rail or beam to be observed has attached to it a brilliantly polished bead, which is photographed as a point of light, and the successive images of this point show the deflections. A second lens causes the images of a stationary point to be photographed upon the same plate in a line just below, thus furnishing a base line for comparison."

UNDERGROUND— "The latest addition to the system of underground railways in London will probably rank as the most important of all these lines before it has been very long in operation. . . The road will be about sixty-five feet below street level, and will be carried in two separate and parallel tunnels—a similar plan to that adopted in the Southwark underground railway in the same city. Each station will be served by two elevators and two stairways. The new undertaking will have especial interest for this country, from the fact that the electrical equipment of the road itself and of the extensive system of elevators by which it will be served will be furnished by American firms."

WINTON CAR — "After the recent unsuccessful motor carriage competition in England, it is satisfactory to note that several firms in the United States are now really in a position to make and deliver motor carriages. For a long time it was impossible to buy a motor carriage at any price, but, happily, this day has now passed. The horseless carriage which we illustrate is made by the Winton Motor Carriage Company, of Cleveland, Ohio. On September 1, 1896, Mr. Winton, the president and master mechanic of the company, completed his first motor carriage. It has been in constant use since that time in all kinds of weather and over all sorts

of roads. . . The motor and driving mechanism, bestowed in the body of the vehicle, are self-lubricating. The ten horsepower motor of the hydrocarbon type is almost noiseless, odorless, and free from vibration. The fuel is gasoline, seven gallons being carried on the carriage."

KITE BALLOON— "The usual form of balloon adopted by all the leading armies of today is the pear-shaped, captive balloon, connected to earth by means of a steel rope. . . A new form of gas reservoir has, however, been devised by the German Captain Parseval, which enables its occupants to use to a full extent and under all circumstances the excellent observation opportunities that an ordinary balloon offers only in a dead calm. The principle on which the new balloon is built is the well-known action of a kite. Its shape is that of a cylinder with hemispherical ends."

100 Years Ago in . . .

SCIENTIFIC AMERICAN

(Condensed from Issues of July, 1847)

LONG-DISTANCE TELEGRAPHY— "New Haven was put in telegraphic communication with Toronto, Upper Canada, recently, and messages were instantly exchanged between the two cities . . . the entire distance being nine hundred miles! The experiment was a most successful one, and the distance was overcome with as much apparent ease and promptness, as between New Haven and Hartford."

FEMALE LABOR —"Not far from $5,000,000 are yearly earned in Massachusetts, by females employed in the various factories and manufactories of straw hats, &c. About 40,000 females are thus annually employed."

PRE-FABRICATED CHURCHES — "A London Church-builder provides wood and iron churches for transmission to the colonies. He offers a church with stained glass windows, bell, &c., capable of seating 800 persons, for 500 guineas. But, if you cannot afford to buy a church, he will lend you one 'on hire.'"

RAILROAD SPEED— "The first locomotive built by Stephenson ran no more than five miles an hour, and it has been said that this celebrated engineer made the assertion, which he has since lived to condemn, that 10 miles an hour was a speed which was scarcely possible to obtain and which never could be surpassed. . . Last year Mr. Brunell ran his engine at 60 miles an hour, and on the Western Railroad from Boston, this same speed has been attained in several instances."

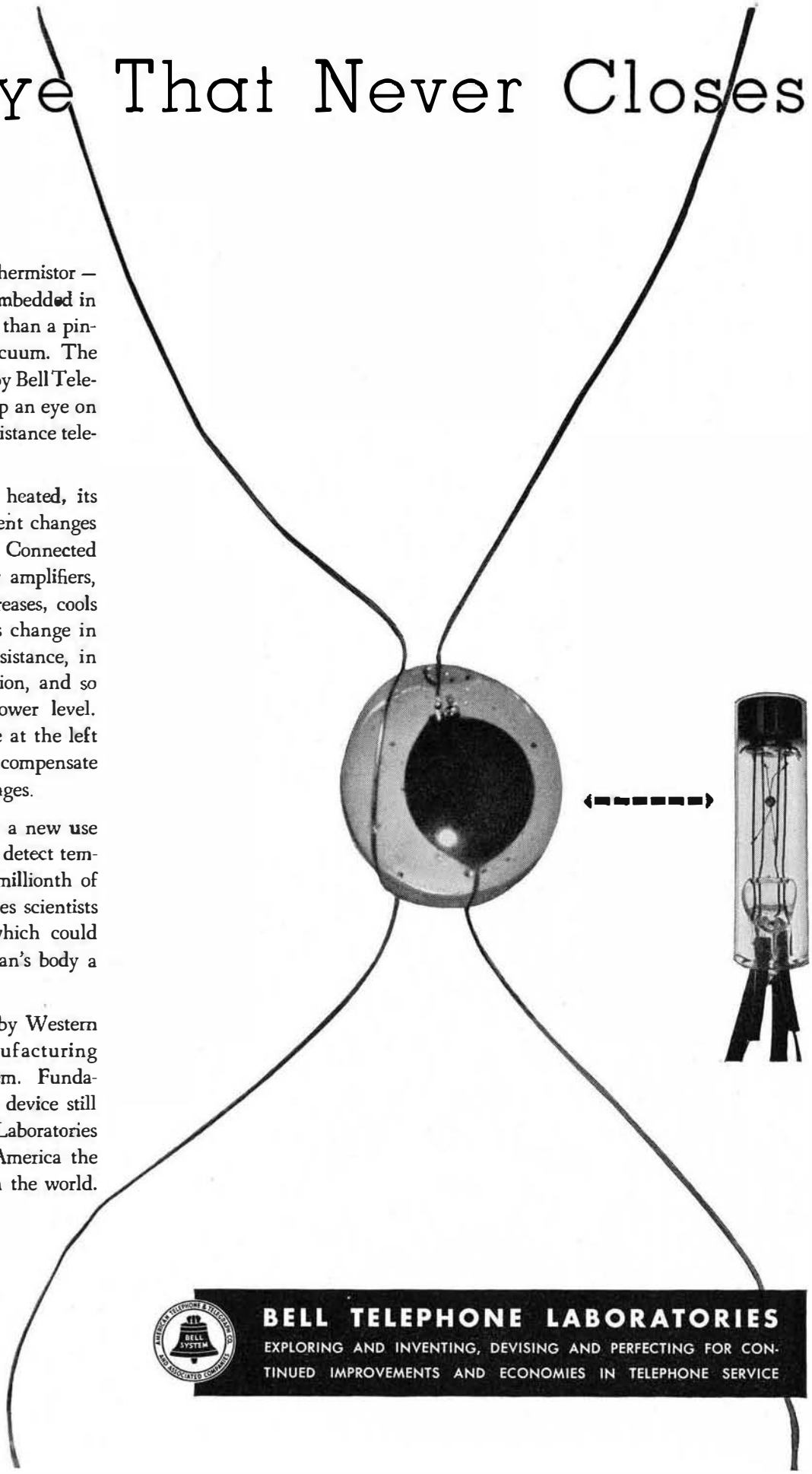
The Eye That Never Closes

You are looking at a thermistor — a speck of metallic oxide imbedded in a glass bead hardly larger than a pinhead and mounted in a vacuum. The thermistor was developed by Bell Telephone Laboratories to keep an eye on the amplification in long-distance telephone circuits.

When a thermistor is heated, its resistance to electric current changes rapidly. That is its secret. Connected in the output of repeater amplifiers, it heats up as power increases, cools as power decreases. This change in temperature alters the resistance, in turn alters the amplification, and so maintains the desired power level. Current through the wire at the left provides a little heat to compensate for local temperature changes.

Wartime need brought a new use for this device which can detect temperature changes of one-millionth of a degree. Bell Laboratories scientists produced a thermistor which could "see" the warmth of a man's body a quarter of a mile away.

Thermistors are made by Western Electric Company, manufacturing branch of the Bell System. Fundamental work on this tiny device still continues as part of the Laboratories program to keep giving America the finest telephone service in the world.



BELL TELEPHONE LABORATORIES

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

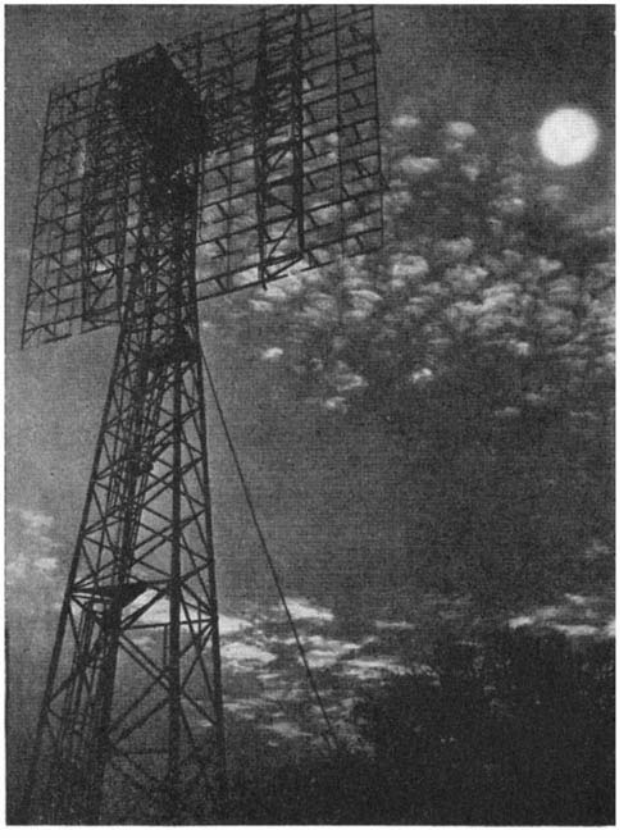
Scientific American
JULY • 1947

UPWARD REACHES SCIENCE

By
Brigadier General
David Sarnoff
President,
Radio Corporation of America

Recent Scientific Developments Have at Last Opened for Exploration The Vast Fields of Untapped Resources Which Lie Skyward. From the Air, From the Stratosphere, From Even the Moon and Planets, Man Will Gain Knowledge Hitherto Undreamed-Of. Proper Use of This Information Can Give Impetus to a New Era of Progress and Enlightenment

" . . . may even learn how to use the moon and the planets as radio sounding boards"



SCIENCE emerged from the war as a powerful force that created new instrumentalities and promised many others for use in peace-time, if man would only direct his thoughts to peace instead of war, and his scientific research to higher elevations.

During the war, science reached skyward and a miraculous invention called radar saved England in the blitz, guided bombers to their targets, doomed the U-boat, and aimed the big guns of battleships to fire with deadly accuracy, even in the dark. Aside from radar, post-war dictionaries have many new words that spring from radio and electronics, such as sonar, shoran, teleran, and the proximity fuse.

At the end of World War I, it was vividly apparent that scientific research was a vital factor in our industrial progress. As a result, it grew ten-fold between 1920 and 1940. Within the past two decades, in television alone, the radio industry spent more than $20,000,000 on research. That investment called for faith, for initiative, and for young men with new ideas.

Unified research on a national scale, costing $2,000,000,000, produced the atomic bomb. Scientists themselves were amazed at the speed of the development, having believed it would require 20 years or more to achieve such results. Their calculations, however, did not take into account the impact of war which produces speed, direct action, and concentrated effort.

Peace also can benefit from similar concentration on certain pressing problems. For example, what would result from even $100,000,000 wisely spent on cancer research? If research produced a cure for cancer, it would save more lives than were lost in the war.

Research into the unknown is a great adventure. It should be encouraged if American scientists are to blaze new trails in life, as the electron microscope has done in revealing the microscopic world which surrounds us. From a study of infinitesimal organisms and elements, from unseen rays and waves which permeate our bodies, we may find the answer to our future in the Atomic Age. The tiny, invisible things of life are only beginning to reveal their importance.

• LOOKING AHEAD •

Improved television systems for industry where direct human observation is impossible or impractical . . . Wide-area high-frequency broadcasting by the use of moon and planets as reflectors . . . Accurate weather forecasting and control as a valuable tool of industry and agriculture . . . Radio duplication developed to the point of a regular radio postal service.

The electron is the key to the world of the infinitesimal.

We have long associated power with great size, but we are now beginning to realize that tiny invisible things, such as the electron and the atom, are the axes on which our very existence whirls.

RESEARCH A BULWARK — Science today has the benefits of organized, industrial research affording inventors every facility, co-operation, and comfort for work and for study. Without it, World War II might have been lost. Industrial research conducted by private enterprise is a bulwark of the United States; it promotes victory in war and assures progress in peace. It is a safeguard of civilization.

We who are veterans in radio, as well as those in other fields of scientific endeavor, are continually encouraged by the knowledge that there are as many new frontiers of research today as there were 100 or 1000 years ago. The crossing of one frontier in science always leads to another. Each discovery, each invention, spearheads a new and undreamed-of advance. Through radio and electronics, for example, scientists now believe that some day they may be able to detour storms, to dissipate clouds and fog, to produce rain and snow, and thus measurably to control the weather.

The frontiers of science spread above the earth and throughout the universe, far into unfathomed space. Scientists, especially mathematicians, for centuries have been enchanted by the immensities of time and space, by gravitation, by the propagation of light, the theory of relativity, by electromagnetic radiation, and by radioactivity. But laymen have looked into the heavens and referred to "the emptiness of space." They have described the vacuum tube as a "glass bottle full of nothing." Now, thanks to science, we know that space is not empty, and that a vacuum tube is far from being filled with "nothing."

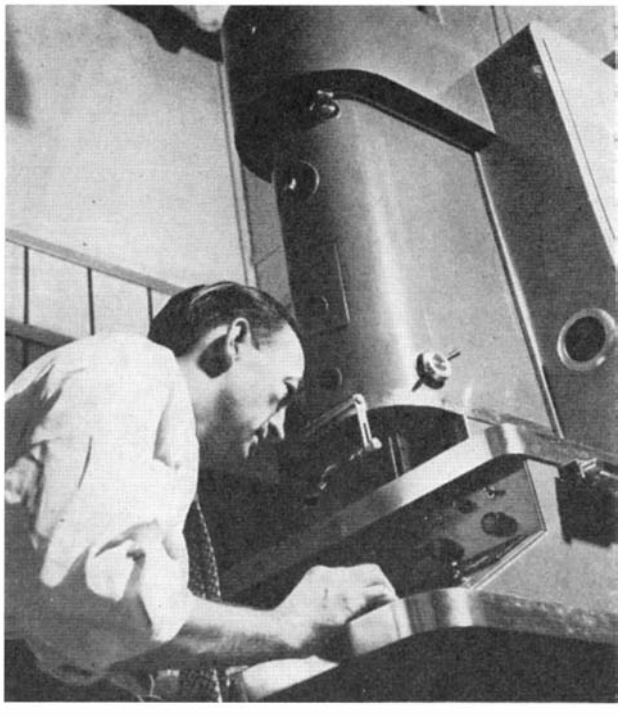
Radio and electronics have given space and the vacuum tube a new meaning. Scientists are learning how to snap the switch that will bring them the sounds and pictures of the universe. They are challenged by science to keep their eyes on the stars. Both astronomers and radio scientists now scan the blue dome of the world. The sun rises and sets with spectacular brilliance, yet it is a drama enacted as quietly as if performed with an electron tube, which also merely seems to glow! But within that tube there may be a voice from Melbourne, news from London, or music from Paris. Turn on a television cathode-ray tube, and its face lights up with a picture of the United Nations meeting in New York, or the 80th Congress opening in Washington, or the Army-Navy football game in Philadelphia. No longer is the electron tube full of nothing!

Air-borne television camera. "Man will be able to look around the world by television"

WIDENS MAN'S SENSES — New tools of science are opening man's eyes in the realm of the invisible. But we need not see to be convinced that science is a vivid reality beyond the range of human sight and hearing. Science works in no such narrow spectrum. We perceive evidence of this in new forces which extend the range of man's optic and auditory nerves. By radio, man now can hear even a whisper or the buzz of a bee across the seas; through the electron microscope, he peers into the realm of the molecule and the atom. By television, he sees beyond the horizon.

While these are inventions that open new vistas and widen man's earthly range beyond the microscope and telescope, we have ample proof that these forces are not confined to the surface of our planet. This world of ours actually spins in a boundless, inexhaustible laboratory. Radio beams flash through the ozone layer to probe through the dust of interstellar space. The plane that soars to 40,000 feet to learn the secrets of cosmic rays, or the rockets that carry automatic recording instruments more than 100 miles into space, are but feeble short-distance efforts of man to pierce the upper atmosphere.

Planes and rockets are mechanical devices which meet the resistance of Nature. But radio, radar, and television, travel on wings more closely allied with Nature. They will encounter little opposition as they mingle with meteors, nebulae, and galaxies. Radio, like sunlight, travels 186,000 miles a second. Indeed, radio is a relative of light, and the shorter the radio



Radiophoto equipment. " . . . faster than any aircraft or even mail-carrying rocket." Right: The electron microscope. " . . . we may find the answer to our future in the Atomic Age"

waves, the more apparent their kinship becomes.

The radar "peep" that echoed from the moon was more than a faint signal of hope to radio scientists and astronomers. To them it was as important as the first feeble transatlantic signal to Marconi's ears when he plucked the letter "S" from the air. That flashes of three dots in the Morse code told him that world-wide radio communication was possible. Similarly, the radar signal from the moon proved that man might some day reach out to touch the planets; it revived speculation on interplanetary communication and inspired great hope for interstellar scientific exploration. With electronic computers, sensitive photoelectric cells, and infra-red eyes that see in the dark, the mystery story of the upper altitudes will become available for man to read. The telescope with its giant mirrors is no longer the only exploring eye for discovery above and beyond the earth.

Radio and radar have proved that space is not empty and we know now that it is accessible to man. He may even learn how to use the moon and the planets as radio sounding boards and reflectors, to bounce or relay broadcasts and to mirror television pictures. The moon is only 240,000 miles, or radiowise less than two seconds away. It looks like a good radio concession! We may find future broadcasters staking claims for Saturn, for Jupiter, or for Mars and Venus as well.

YOUTH AS A RESOURCE — Let no youth today deplore the lack of opportunities. Look up at the Milky Way and behold a myriad of challenges. Science through radio and radar is providing new tools with which to explore electronics, chemistry, and physics. New resources are to be found in space which may be captured and brought to earth, to be harnessed or synthesized for the welfare of mankind.

Just as we have succeeded in releasing atomic energy from uranium, we must release the energy from the minds of our youth. In the fertile brains of American boys and girls are the master keys to the future. We must stimulate and encourage youth if this nation is to have health, prosperity, and security. With its natural interest in science, youth is one of America's greatest national resources.

Great industrial laboratories will be built, splendidly equipped, and on sites conductive to clear thinking; but they will be worthless, no matter how great the funds behind them, if trained men of research do not work within their walls. There is no substitute for brains. Men, not tools, are the lifeblood of research.

The chemistry of the atmosphere with its nitrogen, carbon, oxygen, hydrogen, the "noble gases," and perhaps other yet to be discovered elements or particles, represents intriguing continents for exploration. We now hear of a new component—the meson —believed to result from the interaction of the primary cosmic ray with atoms in the atmosphere. This so-called meson is estimated to have a mass 200 times that of the electron. Herein may exist a clue to devising a new source of energy to be harnessed and controlled by man.

BOUNDARIES IGNORED — Radio now spans the gaps of the hemispheres, leaps frontiers, ignores boundaries, and cannot be stopped by any man-made political "curtain." For radio goes everywhere —and through word and picture can bring information and understanding to all peoples of the world.

Already we are on the threshold of individual radio

communication. A motorist on the streets of New York may talk with a friend in Bombay, or with a relative on a ship somewhere on the Seven Seas. The day is coming when radio will speak man to man, and television will place them face to face in New York, London, or Shanghai. All this is the essence of "One World."

Man will be able to look around the world by television with the same facility that he now listens around the world by radio. Historic events will no longer encircle the earth only as sound. They will be seen and heard as sight and sound in tandem.

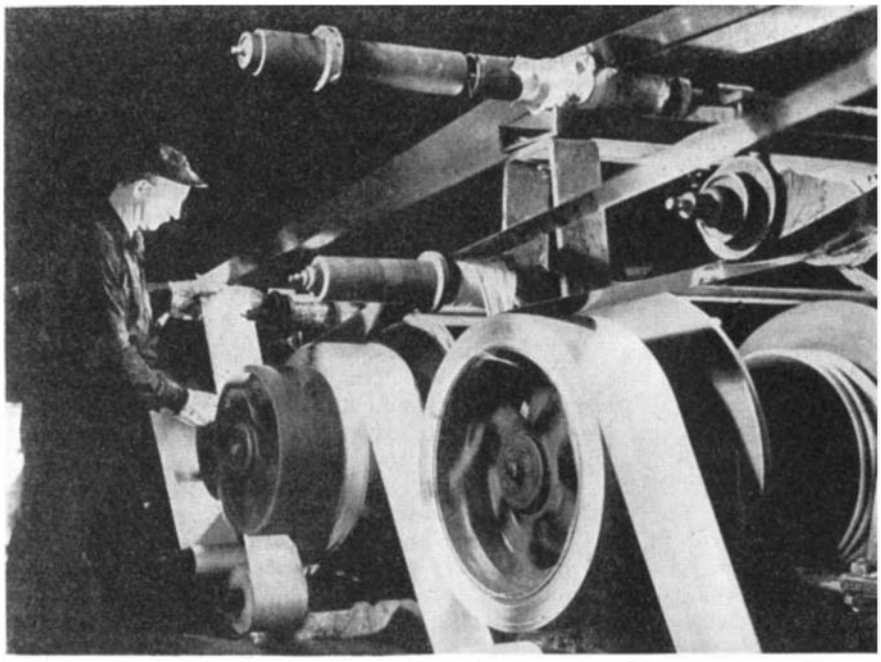
Nor should we think of television only as an optic nerve over which entertainment and information flow pictorially, for it has many other uses which may even dwarf its performance in the home and theater. Wherever transport needs vision, television will help to provide it. The airplane will see by television and radar; so will ships at sea. Similarly, wherever industry needs an eye, television will provide it. It will watch over industrial processes and machines; it will go into places the human eye cannot reach. Fireproof eyes will be put into furnaces to scan chemical reactions. Tunnels will have these radio eyes as will conduits and mines.

A radio signal traveling 186,000 miles a second, faster than any aircraft or even a mail-carrying rocket, circles the globe in one seventh of a second. Before a mail-laden plane could get off a runway in Australia, radio could be delivering mail from Melbourne—in Washington or London. In the future, a person will write a letter or a message that will be put on a belt moving in front of a television eye. In a split second that letter or message, exactly as written, will appear in England, South Africa, or China. There, it will be automatically reproduced by a photographic process for delivery in minutes—not hours as required by even the fastest airplane.

SEALED LETTERS BY RADIO — Eventually we may be able to take a sealed letter or document and flash it across the hemispheres without opening the envelope. That again is a television-possibility—and it's not too fantastic. If X-rays can look through the human body and through steel, why should it not be possible for the television eye to look through a paper envelope? This would make possible a radio mail system.

Science is at man's command. He can use radio and radar to guide rockets and bombs loaded with atomic warheads; he can equip these winged missiles and robot planes with television eyes focused on great cities as targets of destruction. Or he can use radio, radar, television, and atomic energy for peace-time pursuits in commerce, industry, and home-life that will contribute greatly to "One World" in which people everywhere may live together in understanding, happiness, and friendship.

Mobile television unit. "Historic events will no longer encircle the earth only as sound. They will be seen and heard as sight and sound in tandem"



Stainless steel strips are recoiled at an American Steel and Wire Company mill, and are interleaved with surface - protecting paper fed from spools near floor

Courtesy United States Steel Corporation

New Fields for Stainless

By Fred P. Peters
Editor-in-Chief, MATERIALS & METHODS

Expanded Production of Stainless Steels, Coupled With the Development of New Types Having Improved Properties, is Bringing this Group of Metals to a Position of Ever Increasing Industrial Importance

ANY MATERIAL which has expanded its output and increased its importance as rapidly as has stainless steel, must have much of interest to offer the manufacturer and designer. Indeed, new users are continually discovering special advantages in the various combinations of permanent beauty, rust resistance, special corrosion resistance, high-temperature properties, mechanical strength, fatigue life, high strength-weight ratio, and so on, available in different types of stainless. Many of the problems that limited stainless-steel applications in the past have been solved and most of the half-truths that were once accepted as gospel are now understood and kept properly within bounds.

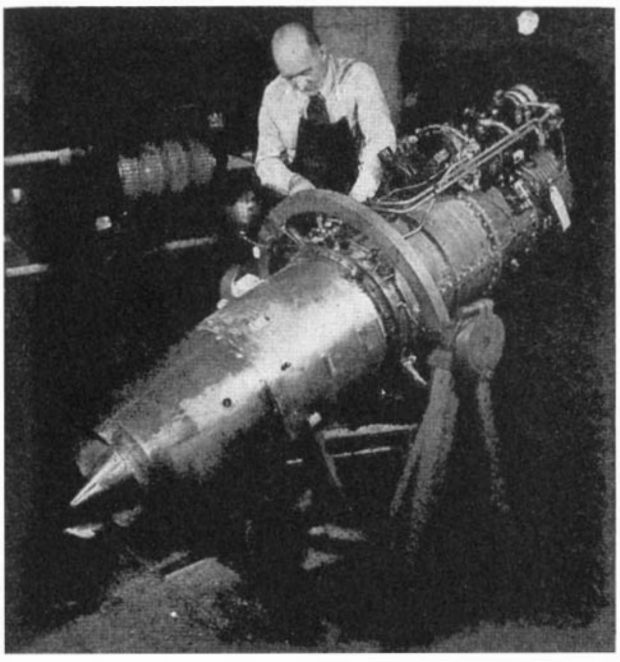
Last year the production of stainless-steel ingots in this country amounted to 542,000 tons, and 1947 production is currently at an even higher rate. This means that stainless steel has achieved a position as one of the eight most important engineering metals in our economy, being surpassed only by carbon steels, low alloy steels of all types, cast irons, aluminum, copper, zinc, and lead.

Just a few years ago the American production of stainless was in the neighborhood of 250,000 tons per year; many authorities expect it to exceed 1,000,000 tons within the next few years. At this rate of growth stainless could conceivably become more important industrially than every nonferrous metal except aluminum, and would justify the contentions of those who regard it as the steel industry's answer to the vigorous challenge of the light metals for available markets.

DIFFERENT TYPES — By "stainless steels" is meant those iron-base alloys with at least 4 percent chromium content and up to 50 percent total alloy content. The best known members of the group are:

Cutlery stainless or "13-chrome," heat-treatable steels containing 12 to 14 percent chromium, little or no nickel, and fairly high carbon; "18 and 8," non-heat-treatable (austenitic) steels containing 16 to 19 percent chromium, 7 to 10 percent nickel, and as little carbon as possible, (the most important grades from the standpoint of tonnage production); "17-chrome," non-heat-treatable steels containing 16 to 18 percent chromium, little or no nickel, and as little carbon as possible; and steels such as "25-12," which contains 22 to 24 percent chromium and 12 to 15 percent nickel, is non-hardenable, and provides exceptionally high corrosion resistance and mechanical strength, but at higher cost.

It is generally agreed that the corrosion resistance of stainless is conferred primarily by the chromium present, secondarily by the nickel, and that carbon



Many components of jet engines are of heat- and corrosion-resistant stainless steel. Typical example is this model developed by Westinghouse for the Navy

Courtesy Electro Metallurgical Company

Stainless steel is used in these mine pumps made by Alloy Steel Products Company because of its corrosion resistance

detracts from corrosion resistance. In steels of the "18 and 8" type the carbon causes a particularly annoying type of corrosion weakness, known as "intergranular corrosion" and its effect is counteracted through the addition of small amounts of columbium or titanium; steels so treated are known as "stabilized" steels, because they are resistant to the conditions that would otherwise produce intergranular corrosion.

The most familiar condition of this type, and the one that has the most industrial ramifications, is the slow-cooling of the steel that occurs in a weld just after it has been completed. Chromium-nickel stainless steels that are to be welded should be "stabilized;" otherwise they are strongly susceptible to subsequent serious corrosion in the areas adjacent to welds.

The stainless materials are available in all forms—castings, forgings, sheet, strip, bar, rod, tubing, and so on. Only a few manufacturers specialize in stainless-steel production (for example Allegheny Ludlum Steel Corporation, Carpenter Steel Company, Eastern Stainless Steel Company, Rustless Iron and Steel Division of Armco, Washington Steel Corporation, and others) although most of the large general steel producers (American Rolling Mill, Bethlehem, Carnegie-Illinois, Republic, and so on) and many smaller companies (Crucible, Firth-Sterling, Jessop, Sharon, Timken, and so forth) do a considerable (and increasing) business in stainless along with their other products. In addition, there are several steel and alloy foundries making stainless-steel castings for the chemical, marine, and other industries.

The early uses of stainless steel were in cutlery, where it served chiefly as a sort of non-rusting tool material, and in ornamental applications. Later came increasing use in the chemical and process industries and especially in the food and pharmaceutical fields, for equipment to process and handle corrosive materials or those which must remain free from container-contamination.

In the past few years stainless steel has found increasing favor by virtue of its mechanical properties. The cold-rolled stainless steels (or the newer precipitation-hardened grades) have among the highest strength-weight ratios obtainable from modern engineering materials, a circumstance which has led to their growing use in aircraft, railway cars, trucks, buses, and elsewhere. Machinery parts are increasingly being fashioned from stainless steel because of the material's exceptional fatigue resistance, as well as its general durability under a variety of severe service conditions.

WORKABILITY OF STAINLESS — But the major reasons for stainless' rapidly growing popularity with product manufacturers are the improvements in its workability which have been effected in recent years and the increasing familiarity with the material that manufacturers all over the country now enjoy as a result of war-time experience with it. For ex-

ample, stainless steel was once classed as very difficult to machine. Today, through the development of stainless steels containing small amounts of selenium or sulfur or bismuth, several "free-machining" stainless steels exist which compare favorably with other engineering materials in the speeds and finishes obtainable with them. When these are used with tool steels, set-ups, speeds, and feeds known to be best for stainless (instead of using the same procedures applied to ordinary steel), results have been known to astonish those who remembered only the troubles encountered in machining stainless steel 10 or 15 years ago.

Then, in the early days, there were many unfortunate "disappointments" with stainless steel, through lack of simple care in handling or maintaining it. Thus it has only recently become fully appreciated that the extent to which stainless steel products are kept clean by their users is important to their permanent brightness and their corrosion resistance. In one instance two store fronts trimmed with the same grade of stainless existed side by side. One was washed whenever the windows were cleaned, the other was cleaned only by the rain and the slop-over from window washing. At the end of ten years the regularly washed store front looked brand new; the untended trim was badly pitted and dull looking before five years had passed.

PRICE NO DRAWBACK — The higher price of stainless steel, in comparison with ordinary steels, is no longer as serious a drawback as formerly, for with the carefully worked out but simple-to-apply fabricating techniques developed especially for stainless steels, their fabrication costs may often be less than they would be with mild steel. This is because rust-prevention procedures and surface coating are eliminated, as are extra strengthening operations frequently applied to ordinary steel, such as heat treating or shot peening.

Then, too, the development of new stainless-steel materials has opened up vast new fields of application for these alloys—fields that are expected to be of even greater significance as time goes on than they are now. The free-machining alloys previously mentioned will loom increasingly large in the stainless picture and among engineering materials in general, for they overcome the greatest objection that has traditionally retarded stainless-steel's applications.

The "stabilized" stainless steels, formulated to resist intergranular corrosion, especially after welding, will be supplemented shortly by commercial stainless steels containing virtually no carbon at all. If the carbon content of the nickel-chromium types can be held below 0.03 percent, carbide precipitation and intergranular corrosion will not occur. "No carbon" stainless steels were developed and successfully used in England a number of years ago, and a few American producers have such steels of their own now in an advanced stage of development. This is the next important step to come in stainless-steel's progress and is being closely watched by all interested in the production and fabrication of these materials.

EXTRA HIGH STRENGTHS — The new age-hardening grades of stainless are also expected to find new applications for these steels. In the past the extra high strengths available in stainless-steel products have been built into the raw material by cold-rolling it. But cold-rolled stainless steel, although possessing about the highest strength-weight ratio obtainable today, is more difficult and expensive to fabricate than annealed or hot-rolled sheet. With the new age-hardening grades, a fabricator may buy the soft-annealed stainless steel, fabricate it easily and cheaply, and then heat treat the formed product to develop strengths comparable to those of the cold-rolled material. The new materials are unique in the three-way combination of high strength, maximum corrosion resistance, and workability they provide.

• LOOKING AHEAD •

More fabricators needed to specialize in use of stainless steels. . . Designers and manufacturers taking increasing advantage of unique characteristics of the metals. . . Better understanding of the utility of stainless and of its workability . . . Still other new stainless types for specific uses. . . . Gas turbines and jet engines will need even better super-alloys.

Again, stainless-clad carbon steels, made by bonding surface layers of stainless onto an ordinary mild steel base, are extremely promising materials. They provide the user with the combination of surface corrosion resistance and fatigue strength that are characteristic of stainless together with the low cost or good heat conductivity of ordinary steel. Cooking utensils, for example, are among the products that will increasingly be made of stainless-clad steel.

The super-alloys developed for high-temperature use in gas turbines, turbo-superchargers, and jet engines include several doped-up stainless steels. The Timken 16-25-6 alloy, for example, which is one of the best all-around super-alloys so far developed, is really a 16 percent chromium and 25 percent nickel stainless steel containing in addition 6 percent molybdenum. As reaction engines of these types come into increasing use, special stainless steels are certain to be widely used for many of their major structural components.

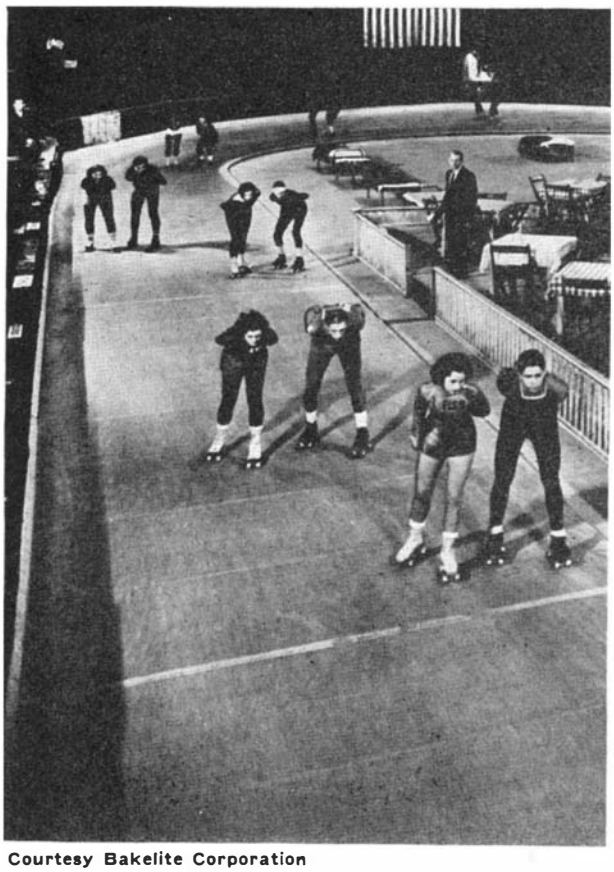
THIN STRIP — One of the very latest innovations is the use of the Sendzimir cluster mill for precision rolling of ultra-thin stainless steel sheet and strip. With the final bugs being worked out of the process at this writing, industry can look forward to a regular supply soon, of lower-cost, high-strength stainless sheet and strip in very thin gages.

One of the problems the stainless-steel producers face, which industry as a whole could well solve to its own advantage, is the need for more fabricators who will specialize in stainless steel. The demand for certain stainless products—especially hospital, restaurant, and household equipment—is far greater than existing fabricators can supply. There is reported to be a substantial and profitable volume of business awaiting new or old shops who will enter or expand the field of fabricating (for example) such products as hospital equipment and milk pails made of stainless steel sheet.

PLASTICS in PAINTS

Paints, Varnishes, and Similar Wood Surface Coatings With Synthetic Resin Bases Can Be Formulated To Meet Requirements of Specific Applications. The Resultant Coats Offer a High Degree of Protection, Beauty, and Durability

By Charles A. Breskin
Editor, MODERN PLASTICS



Courtesy Bakelite Corporation

Prime requisite for floor finish on indoor roller-skating rinks is high abrasion resistance

WITH THE recent emphasis in advertising on the plastics content of paints and other wood surface coatings, the average man is prone to think of the use of plastics in these products as a new development. Actually, plastics and synthetic resins have long been used in wood coatings. The *really new* development in the field, as a result of research, has been the increased knowledge of resin properties, and greater skill in the compounding of coatings to meet specific needs. Thus, it is not enough for the prospective purchaser to choose a "plastics paint." He must determine the specific resin contained in the coating and its proportion to other ingredients if he would obtain the one material best suited to his requirements.

There are several reasons for applying a coating to wood. The most obvious and universal motive is to achieve a decorative effect through pigmentation or a glossy finish. Resistance to abrasion is a less common reason, but one of importance in such special applications as bowling alleys and roller-skating rinks. In furniture designed for use in laboratories, a major consideration is resistance to acids and alkalies. One of the most important reasons, however, for coating wood is to protect it against the adverse effects of rapid changes in moisture content. Basically, that is why it is necessary to paint a house.

AGAINST MOISTURE — Coatings protect wood against the adverse effects of rapid changes in moisture content by retarding the passage of moisture through the surfaces. When moisture enters or leaves through the surfaces faster than it can diffuse within the wood, inequalities in moisture content and in degree of swelling set up internal stresses. These stresses cause grain raising and checking at the surface, then cupping, warping, and even splitting of the boards, unless they are fastened firmly enough to prevent this action. Weathering finally loosens fibers on the surface and permits the wood to waste away very slowly.

A coating, impervious to moisture and covering the wood on all surfaces, would keep the moisture content from changing, regardless of the degree of dampness of the surroundings but, unfortunately, no such coating has yet been developed. No coating, therefore, will alter the moisture content at which wood comes to equilibrium if it is given time enough. In most instances, however, the fluctuations in moisture content are relatively rapid, and a coating that retards the passage of moisture sufficiently limits the change in moisture content to a fraction of the change experienced in uncoated wood, thus keeping the wood closer to an average moisture content. Those are the conditions under which coatings furnish effective protection, and under which wood benefits most from their protection. It is much more difficult to protect wood adequately against cycles of exposure in which the damp and the dry phases are

each of long duration and the transition from one to the other is gradual. Flooring and furniture in houses that are heated in winter are exposed to such conditions.

TYPES OF COATS — Coatings may be divided into two major classifications according to the extent to which they penetrate the wood. Since wood is a cellular substance, at least part of the applied material nearly always sinks into the surface. Paints, varnishes, enamels, and lacquers, often called surface coatings, do not penetrate very far, and form a layer of substantial thickness on the surface of the wood, varying from 1 to 3 mils. In two-coat painting of new woodwork with house paints, the second coat will be 2½ to 3 mils thick. A complete finishing system may thus range from 1 to 5 mils. In contrast, there are "intra-surface coatings" such as wood stains, wood fillers, wood sealers, and water repellents which are expected to sink almost entirely into the surface, leaving little or nothing on top.

The greatest degree of protection for wood is obtained from surface coatings. Intra-surface coatings afford much less protection, though some of them furnish enough to be useful in the right places. In recent years, there has been a vogue for exterior coatings for houses that display the natural grain and color of the wood, instead of concealing them as paint does. Such intra-surface coatings as water repellents and wood sealers are generally used for the purpose, since the glossy finish of varnish is undesirable. Though low in resistance to moisture-penetration, intra-surface coatings are effective enough to prevent weathering, provided they are renewed at frequent intervals. Their main shortcoming is this lack of durability, for they generally need renewal at least once a year.

Intra-surface coatings, on the other hand, have some important advantages. They are cheap and easy to apply. The treated woods stands rough handling during shipment and erection at the site, since there is no surface coating to be scratched or chipped. This is also an advantage in the case of wood surfaces that slide over one another. Despite their limited effectiveness, the intra-surface coatings appear to have much usefulness for the protection of woodwork. It should be kept in mind, however, that they protect wood only against short-cycle fluctuations in moisture conditions.

RESINS COMMONLY USED — *Alkyd resins.* The most popular resins employed in compounding coatings are the alkyds. Various type of alkyd resins have been used successfully in coatings for wood. For example, the oxidizing type of phthalic alkyd is appropriate for use indoors where decorative qualities are of prime importance, rather than weathering or moisture-excluding characteristics. When this resin is made with soya oil, it shows excellent color and gloss retention, and is widely used for so-called architectural white enamels. These are the familiar high-quality synthetic white enamels produced for household use. There are special modifications of this type of oxidizing phthalic alkyd resins which produce coatings that dry faster and have increased water- and alkali-resistance and hardness. In general, however, such characteristics can be improved only at the expense of durability and color retention.

Alkyds based on maleic anhydride have a wide range of commercial applications. According to the end use, the resins are generally divided into two categories—the varnish type and the lacquer type. The varnishes are widely used as household utility varnishes, and as vehicles for architectural white enamels. They have good color retention, good hardness, and dry quickly, but they lack the durability which is characteristic of the phthalic alkyd resins made without rosin. The lacquer-type maleic resins are usually dissolved in solvents and used with cellulose nitrate in the production of lacquers. They improve the adhesion of the cellulose nitrate lacquers and, when included as an ingredient in wood furniture lacquers, impart qualities of depth to the film.

Alkyds based on sebacic and other high molecular weight aliphatic polybasic acids are also suitable for use in lacquers, and they offer good protection against rain and weathering.

Polyester resins, often of the alkyd type, cross linked with an unsaturated product such as styrene, when used in laminating plywood, form a protective surface which often serves to bring out the grain of the wood.

Phenolic finishes. Perhaps the next most commonly used synthetic resin in wood coatings is the phenolic group. These have proved very satisfactory for finishes on plywood in aircraft and on other wood constructions. Phenolic coatings have remarkable resistance to the passage of moisture, even when the finish is light-weight and thin. Probably the most unusual phenolic coatings are those based on the dispersion resins. They first gained attention because of their property of drying through the evaporation of the solvent alone, and having very slight penetration into porous surfaces. Further testing showed, however, that this coating was highly resistant to the passage of moisture and possessed remarkable exterior durability. Enamels based on these resins have shown excellent protection of wood after two years soaking in water.

Some of the current formulations in phenolic finishes for wood are cured by low-temperature baking. These result in coatings which are chemically resistant, and which will not scrape or chip off. Also, production costs are reduced because wood coated with this material can be hot-sanded.

Polyamides. Polyamide resins can be used in lacquers in conjunction with cellulose nitrate, or as a wood sealant with some alcohol-soluble resin which alone is too brittle as a coating. In the latter case, use of the polyamide results in a coating that is sufficiently elastic to be free from checking or cracking. This coating is excellent for sealing off knots of pine, Douglas fir, and other high-resin content woods. However, the price of these polyamides is still too high for them to be considered on a competitive basis with such established wood sealants as shellac.

Cellulosic Lacquers and Dopes. From the point of view of quick and easy application, both during processing at the factory and refinishing in the field, cellulosic lacquers and dopes are convenient. Various interior surfaces can be successfully treated with these materials and the resultant finishes are satisfactory in appearance. However, for applications such as aircraft plywood surfacing, the cellulosics do not exhibit sufficient flexibility and resistance to moisture.

WHEN Metal Atoms WANDER

Recognition of the Importance of Time as an Element in Metal Working Is Giving Rise to Theories Regarding the Action of Atoms When Subjected to Heat and Pressure. New Techniques Are Growing Out of These Theories

By Edwin Laird Cady

IN THE precision investment casting shop of the Haynes Stellite Company, a tool maker carefully positioned a hard steel model in the bottom of a thick-walled steel cylinder. He poured low-melting alloy into the top of the cylinder. Then he fitted a plunger piece inside the cylinder and on top of the molten metal. Five tons of hydraulic pressure were applied to that plunger piece as quickly as the hydraulic ram could be brought down.

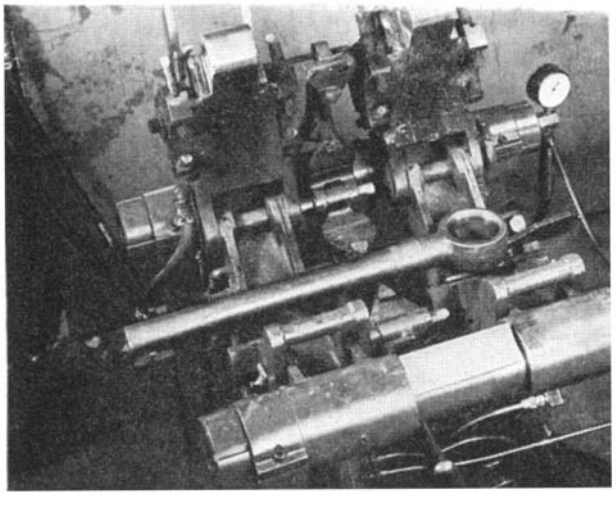
Ask the tool maker what he was doing and he would say he was making a soft-metal mold by the high-pressure casting technique. The steel model had intricate contours. Under the pressure, the low-melting alloy would be forced to conform to the slightest curve, to the smallest hollow in the steel surface. The model had a highly polished surface; the mating surfaces of the soft-metal mold would be highly polished also. If there were the slightest tool or grinding mark on the model, it would be reproduced on the soft metal surfaces.

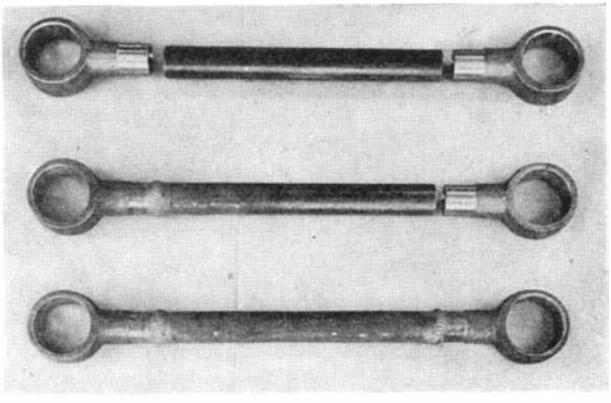
That the pressure produces fidelities of contours is easy enough to understand. Less easily explained is the fact that the pressure has to be maintained for at least 30 minutes.

Need to give the molten metal time to solidify would not account for the long time period over which the pressure has to be applied. On the contrary, the low-melting alloy is likely to solidify so quickly that the plunger piece has to be heated before use, lest it chill the alloy before the pressure is applied.

From such experiences with hot metals, science is evolving a theory which may change the whole picture of the welding industry, and of casting, and of the heat treatments of metals. The whole world of metals may be changed. Brand new products, new strengths, new methods, may emerge.

Courtesy Linde Air Products Company





Tubes and eye castings (above) were compression welded by machine at left

ATOMS MAY SHIFT — Briefly stated, the theory is: Given a supply of energy and half a chance, atoms may wander from one metallic crystal to another, forming new patterns. The accompanying sketch is a schematic diagram of a metal crystal. The large round dots represent the atoms which make up the structure.

It has long been inferred that under certain changes

of temperature or other energy, the atom at position 1 (in the center of the crystal) would move to the face, to a position such as position 2. But, asks the new theory, if atom 1 moves to position 2, why should not the other atoms be in motion also, and why should not atom 1 wander around to positions 3, 4, 5, or 6?

And if two crystals were pushed against each other under heavy pressure and at high enough temperatures, why should not they swap atoms and have their atoms rearrange themselves as if the two crystals were one? If this were to happen, then when the metals and their crystals were cooled to the point where the atoms no longer moved so easily, the crystals would be locked by each other's atoms into a true weld.

Welding had long been done by fusion methods. But at fusion temperature the metals are molten. As they cool to the solid state, they form crystals. But those crystals are formed together, and are automatically intermingled and interlocked.

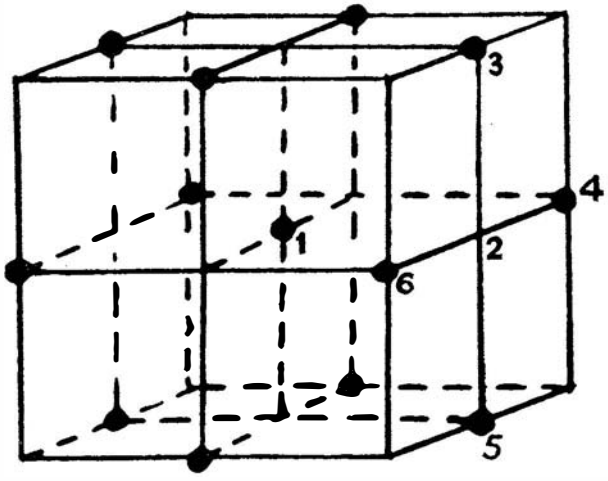
Cold welding, at temperature below the molten, had been done for thousands of years. But nobody understood why the metals joined each other. Therefore nobody knew how to improve the process.

Here, in the wandering atoms, is an explanation that could be used. And an employable hypothesis was all that was needed by the applied science called manufacturing.

One of the first starts was in the compression welding of steels. Heated to temperatures of 1860 degrees, Fahrenheit, and pushed together by pressures ranging from 1400 to 5000 pounds per square inch, depending upon the compressive strengths and therefore the resistances of the metals to upsetting under compression, the steels would become welded together.

Preparing for high-pressure casting of soft metals

Courtesy Haynes Stellite Company



The metal atoms, represented by the black dots, will shift if the energy conditions are right

The welds were not complete enough for a great many purposes. Etched and then examined under a microscope, clear weld lines could be seen. The atoms had not interchanged enough to merge the crystals fully.

Higher temperatures, up to the range of 2192 to 2282 degrees, Fahrenheit, were tried. The results were much better when the atoms had this much more energy to work with. The weld zones tended to disappear.

Engineering long had known that normalizing—holding the steel at a temperature above its critical range—tended to cause crystals to merge. What the atoms seemed to need was more time to wander back and forth within their own crystals and to emigrate from crystal to crystal. With the added time, they could form their new patterns among the crystals and at the juncture of the crystal faces, do a truer welding job.

ATOMS LOCK CRYSTALS — Normalizing was tried. The added time was given. And the atoms did what was expected of them. They locked the crystals together so completely at the weld zone that no difference could be seen between that area and any other in the steel. Tensile and other physical strength tests showed that the microscope was telling the truth. The weld zone had become exactly like the parent metal.

One of the first industrial applications was the flame-compression welding of eye castings to torque tubes for aircraft landing gear. This was done by the Linde Air Products Company's process on automatic equipment developed by the Menasco Manufacturing Company. The tube and one eye-casting were carefully cleaned, then were abutted. A ring of flame was applied to the juncture, and the pressure was applied. When at upsetting temperature, the two parts moved together.

Castings are difficult to weld to wrought steel or to anything else. But this process welded them so completely that there was no known way of testing the weld. The shops had to depend upon the examination of chips machined away when machining the upset area down to the diameter wanted in the assembly,

• LOOKING AHEAD •

Castings, ferrous and nonferrous, of greater strengths. . . Perfect welds . . . New knowledge about powder metallurgy. . . . Changes in the whole world of metals, wherever heat is applied.

and upon destructively testing some of the assemblies.

Another application was that of metals which are chemically different. The theoretical argument was that if the alloy of the two represented a lower total energy, then either welding should take place or else a special compound would be formed. In addition, if the homogeneous mixture were stronger than the mean of the two metals then the weld would be a strong one.

The theory was tried out. Stainless steel (18-8) was flame-pressure welded to engineering steel NE 9440. The bonding zone was proved to be a distinct alloy of much greater strength than either of the parent metals, and so thin that only an electron microscope could find it. When tested physically, the welded piece invariably failed in the stainless steel, which was the weaker of the two parent metals, and invariably at the full strength of the stainless.

WITH NONFERROUS METALS — The general idea of applying pressure plus heat plus time was tried with nonferrous metals. It worked with silver. It worked with copper, and with many of the copper alloys, especially if the copper could be held within a closed chamber which would prevent it from losing too much heat by conduction.

The atoms apparently would wander, then, if temperature or some other force gave them energy enough, if pressure brought the faces of the metals close enough together so that wandering was easy, and if enough time was provided. Further experiments are showing that, within limits, these three factors are adjustable. Nobody knows just how all of that will work out. But if the time is extended, then the pressure and temperature can be lower. And if the temperature is raised, then the time and pressure can be less.

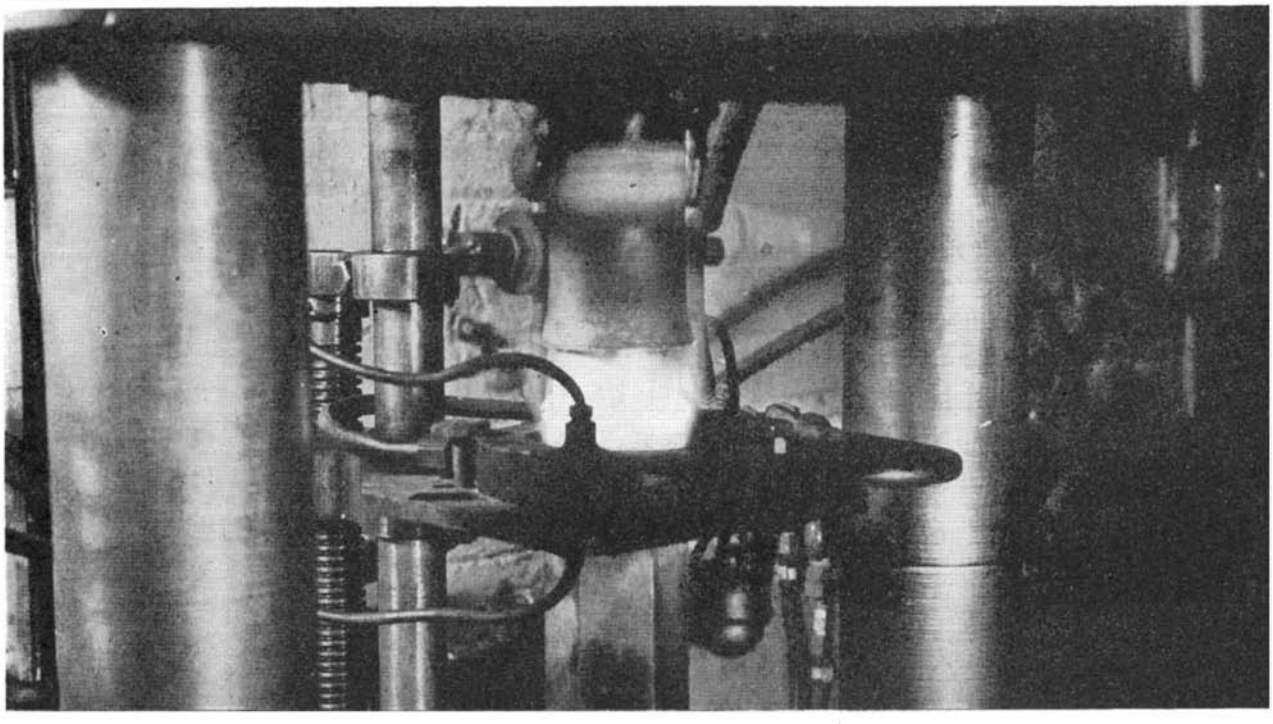
Powder metallurgy is making use of this theory. Copper and alloy powders join at thousands of faces when compressed within the molds. The pressure, time, and temperature are far more controllable within the molds than when the metals are exposed to the air, as they must be in either flame or electrical compression-butt welding. The powder particles are being joined with welds which show every evidence of being complete.

Pressure-welding of low-melting alloys to make injection molds is only one of the tasks which are being done in the casting industry. Here are all sorts of opportunities. The crystals of many metals tend to become large if castings are cooled slowly, as many castings must be. But cooled under heavy pressures, so that the crystals are under welding pressures through all of their welding ranges, the castings are tending to develop strengths and homogenieties never before obtained in cast alloys. And the pressures are easily applied—by hydraulic force, by centrifugal force, or even by pneumatic lines.

Developments of these techniques are mostly in the future. One application after another is being tried experimentally. The list of commercial successes is slowly growing. But nobody can predict what the effect will be upon industry when more of the atoms of metal crystals are encouraged to wander.

Welding a high-speed core bit to a low carbon shank by the flame-pressure method

Courtesy Linde Air Products Company



FUELS OF THE FUTURE:

For Reciprocating Automotive and Aircraft Engines

Editor's Note: **The accompanying article is the first of four, adapted by permission from papers presented at a recent Standard Oil Development Company seminar on Fuels of the Future. Each paper deals with different phases of fuels for engines of types now in use, under development, or projected. Together they summarize the general subject and furnish a glimpse of the fuels and engines which technology will be offering to transportation in the years to come.**

By Albert J. Blackwood
Assistant Director, Research Division,
Esso Laboratories

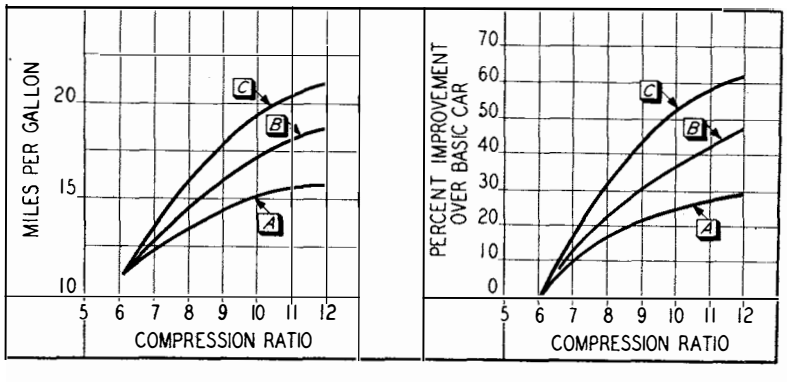
A LITTLE less than ten years ago, the turbo-jet reaction engine was first demonstrated as a practical means of propulsion, and the dominant position for motive power which the reciprocating engine had long enjoyed was seriously challenged.

In spite of the importance of the reaction engine and its many variations and applications, its birth did not signal the death of the reciprocating engine. Reaction engines were admirably suited to the high speeds and high altitudes that aircraft were striving to attain. But no one type of engine is best for all speed and altitude ranges. The reciprocating engine has been the work-horse of the automobile and aircraft so far. And although it may yield to the newer engines for the high-speed and high-altitude aircraft operations of tomorrow, it will long continue to serve as an important automotive as well as aircraft engine.

Much attention these days is being given to reaction engine fuels, but extensive research is also in progress on developing fuels for the improved reciprocating engine of the future.

AUTOMOTIVE FUELS — In the reciprocating automotive gasoline engine, under otherwise similar operating conditions, combustion efficiency is related to the compression ratio—the measure of how much the fuel-air charge in the cylinders is compressed before being fired. The more the charge is compressed, the higher the combustion efficiency—provided the engine does not knock because of inadequate fuel quality. Thus the knock rating, or octane number, requirement of the fuel is tied in with the compression ratio of the engine.

Discussions of the knock ratings of gasolines may at times be confusing because there are in common use today several different test methods for determining these ratings. The two methods most commonly employed for motor gasoline are referred to as the A.S.T.M. Motor Method and the Research Method. The numerical values of octane numbers obtained by the two test methods are rarely identical for a given sample of gasoline, because each method focuses on the behavior of the gasoline under specific operating conditions. The Motor Method appears to be better for determining tendency to knock under severe operating conditions, such as in an automobile at high speeds or in an airplane during



Left: Effect of compression ratio on economy at 40 miles an hour. Basic car has a 230 cubic-inch engine. In curve A, is effect obtained by increasing compression ratio; in B, displacement has been reduced in high-compression engine to give same car performance at 50 miles an hour; in C, axle ratio has been reduced, but displacement unchanged, to give same performance at 50 miles an hour. Opposite page: Graphic representation of the value of octane number

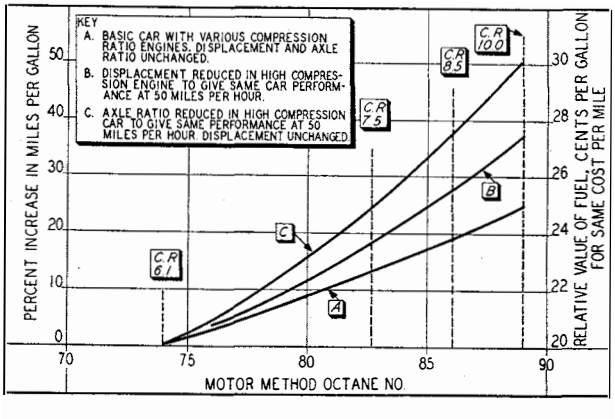
take-off and climb. The Research Method is a better indication of knocking tendency under mild conditions of use, such as an automobile in traffic. Neither method alone predicts accurately what will actually take place in the engine of an automobile on the highway under all conditions.

Automotive engine compression ratios have steadily increased over the years in order to take full advantage of increasing gasoline knock ratings. In 1930, compression ratios averaged around 4¾ and Motor Method gasoline knock ratings averaged slightly over 60 (the Research Method was not then in use). At the start of World War II the average compression ratio was about 6½ and the Motor Method knock rating of regular-grade gasoline was 73 while that of premium gasoline was about 80.

These increases in knock rating have been accomplished with a decrease in the service-station price of regular-grade gasoline, exclusive of taxes paid there, from about 16¼ cents per gallon to 12¾ cents per gallon. At the same time, labor costs were, of course, increasing. Raw materials—in this case crude oil—remained at about the same price level. The output of more efficient gasolines at lower prices was made possible largely through improved refining processes, in turn the result of research and development work by the petroleum industry. At the same time, progress in refining technology has made it possible to produce more gasoline today than before from the same amount of crude.

HIGHER COMPRESSION — Gasolines are now being developed and tested for automotive engines of as high as 12 to 1 compression ratio, which require a gasoline of nearly 100 Research octane number. Gasoline of this quality level could be made with already known refinery processes. Its cost per gallon would be a little higher than current motor gasoline, but the saving in mileage to the motorist would more than compensate for the increased cost. Such a gasoline is not yet on the market because engines are not yet generally available that would benefit from it. Without changing the performance characteristics built into an engine, an increase in its compression ratio from today's average value of about 6.5 to 1 to 12 to 1 can give as much as 50 percent increase in miles per gallon of gasoline. Possible future improvements in fuel economy can be expected from such increased compression ratios, together with changes in engine displacement as well as changes in axle ratios.

Since knock limits the efficiency that can be derived from a given engine-fuel combination, research on motor gasolines will continue to include studies on the subject of the detonation, generally considered to be a function of the chemical composition of the fuel, although the physical characteristics of the engine may be contributing causes. Some aspects of the physical condition of an automobile that can cause engine knock are carbon deposits in the firing chamber, hard-water scale and rust in the cooling system which cause overheating, spark plugs that run too hot, heavy loads carried by the engine, and incorrect air-fuel ratio resulting from an improperly adjusted carburetor. Any of these factors, plus too high a compression ratio for a given quality fuel, can cause detonation. But, in the final analysis, it is the reaction of these factors on the fuel that results in detonation.



OBSTACLES TO HIGH-OCTANE — High-octane aviation gasolines are not entirely suitable for automobile engines because of the different conditions under which they operate. However, the technology and new equipment which made possible the production of aviation gasoline are definitely applicable to the manufacture of high-octane motor gasoline. All indications have been that, with the return of peace, the trend in motor fuel octane ratings would continue upward as in the years before the war. Several factors, however, temporarily have slowed that progress. One of these is that for a number of reasons motor-car manufacturers have not introduced new engines of much higher compression ratios than before the war. As far as gasoline requirements are concerned, most of the 1946 and 1947 model cars are essentially the same as their 1942 predecessors. In addition, metallic lead restrictions were imposed by the Government for several months last year and this year, which prevented petroleum refiners from adding to gasoline the quantities of tetraethyl lead necessary for substantially raising octane numbers.

As motor-car production reaches its normal rate and the way becomes clearer for research into new types of engines, the trend will undoubtedly be toward engines of higher compression ratios—perhaps as high as the 12 to 1 ratio already mentioned—but of smaller piston displacement. The petroleum industry will be able to supply new and better fuels to satisfy the requirements of these new engines.

It is difficult to predict the exact way in which the improved performance of the new gasolines will be utilized in engines of the future. There are a number of directions in which progress can take place. Motorists may want greatly increased acceleration and speed; and if highways are built to accommodate higher average speeds, new higher-octane fuels can be employed to develop the necessary power while maintaining fuel economy at today's level. On the other hand, motorists may want greatly increased economy of operation, in which case they will have to be satisfied with comparatively small increases in the power of their cars. Dramatic progress can be made in the direction of more power or greater economy. Simultaneous progress in both directions is possible, but in that case it cannot, of course, be so great in either one alone.

A number of variables in future automobile design besides compression ratio may effect the fuel quality required. Among these are superchargers, hydraulic

Dynamometer and control board for testing performance of gasoline in automobile engines

transmissions, and torque converters. Supercharging permits more fuel to be burned for each stroke of the piston and places a premium on knock rating just as increasing compression ratio does. Hydraulic transmissions give the equivalent of more frequent gear shifting and, in engines so equipped, the revolutions per minute of the engine during full-throttle operation are generally higher. At high engine speeds there is less tendency to knock than at lower speeds, so that hydraulic transmissions may lower anti-knock requirements of the gasoline. The hydraulic torque converter is now in use in some buses, and many automobile builders are presently experimenting with the converter for use in passenger cars. It is not yet clear exactly what effect torque converters will have on the anti-knock requirements of the engine, but the development of torque converters is being followed closely by the petroleum industry, and fuels suitable for use in cars so equipped will be available.

AVIATION FUELS — During the war, high take-off power in aircraft engines was essential to lift maximum loads into the air, and to enable planes to take off on short and undeveloped airfields. Cruising fuel economy was also important in order to give airplanes the greatest possible flying range with heavy bomb loads. In other words, maximum power from the gasoline consumed was indispensable.

In the reciprocating aviation engine, the extra power needs are accomplished by high supercharging, which in turn calls for high octane rating in the gasoline. Aviation engines differ from automobile engines in that the fuel-air ratio is varied in the course of operation—a rich fuel-air mixture being used for take-off and a lean fuel-air mixture for cruising. Before the war, aviation gasoline was of 100-octane number, assuring good cruising fuel economy. However, this rating did not necessarily mean high enough rich-mixture performance for quick take-off and for bursts of power in flight. During the war, a new rich-mixture knock-rating method was developed and the rich-mixture rating of aviation gasoline was gradually increased considerably in excess of 100. Thus, by the war's end, 100-octane aviation gasoline was actually better than 100, and was officially known as Grade 100/130 gasoline, meaning that it had 100-octane rating for lean mixture and 130 rating for rich mixture. The figure used to express ratings of over 100 indicated approximately how much more power could be obtained from the gasoline than from 100-octane-number gasoline.

By the end of the war, gasoline even better than 100/130 was available. Now Army-Navy specifications are being set at 115/145, and some commercial airlines are expected soon to begin using 115/145 or possibly higher-octane aviation gasoline. Fuels of this quality level can be supplied in reasonable quantities.

Anti-knock quality is but one of many characteristics of aviation gasoline under continuous investigation. Volatility, for example, is also important, and its effect on gasoline performance under reduced barometric pressures encountered at high altitudes is significant. Stability and freedom from gum are necessary in an aviation gasoline to insure reliable engine operation. And considerations of engine design, such as cylinder-head fuel injection, already installed on some commercial airliners, may influence characteristics required of a fuel.

DIESEL FUELS — The high-speed Diesel engine uses a distillate fuel oil whose measure of burning quality is expressed in terms of cetane number, as octane number expresses knock characteristics of gasoline.

With increasing use of these engines, there has been a trend toward seeking super fuels of exceptionally high cetane numbers. Diesel engines must be of heavy construction to withstand the high pressures devloped with present fuels. If super fuels could be found which would not require the high pressures now needed to ignite the fuel, engine weight could be reduced and smoother operation would reduce maintenance and increase engine life. One method of achieving such a super fuel would be by the use of ignition promoters, substances that could be added to the fuel in small quantities, as tetraethyl lead is added to gasoline, to effect improved burning quality. Although moderately successful ignition promoters have been found, it is still hoped that some superior compound, perhaps a presently obscure chemical, may yet be discovered.

The growing commercial application of the Diesel engine may materially affect the nature of the future Diesel fuel. Whereas highest grade Diesel fuel has usually been straight-run distillate from paraffin-base crude oil, an excessive future demand for the fuel may make it economically desirable to manufacture it from other sources, incorporating required properties by the use of special additives.

[*Next month: Gas Turbine and Jet Propulsion Fuels.*]

Soaps In Reverse

Used in Ever-Increasing Volumes, Ammonium Quaternaries with Their Unusual Germ-Dissolving Properties Have Shown Themselves Superior in Many Ways to Conventional Materials in The Disinfecting and "Sanitizing" Fields

By Howard C. E. Johnson, Ph.D.
Chemical Editor, CHEMICAL INDUSTRIES

YOU CAN wash your hands, sterilize food-handling equipment, and improve textile finishes with quaternary ammonium compounds. Chemically the opposite of soaps, they can do many of the things that soaps can do—and do some of them much better. Unknown except in the laboratory until a few years ago, quaternary ammonium compounds have caught on to the extent that production of them jumped from 850,000 pounds in 1943 to almost 3,000,000 pounds in 1945. The 1945 figure is the latest one available, but production last year and this year is undoubtedly still greater.

When one considers that these compounds sell for over $1 a pound, far more than other disinfectants, their phenomenal acceptance is truly surprising. The explanation: because they are non-irritating, non-corrosive, and non-poisonous, the quaternary compounds can be used where chlorine or phenols cannot. Their high germ-killing power, moreover, enables them to be used in much higher dilution and makes their apparent high cost pretty much of a mirage.

These quaternary ammonium compounds are salts —not of a metal, as is sodium chloride or calcium sulfate—but of a nitrogen atom. In the usual ammonium compounds—like the ammonium nitrate that blew up Texas City last April—the nitrogen atom is surrounded by four hydrogen atoms. The "quaternary" in this case means that all four of the hydrogens have been replaced by organic, carbon-containing groups. The terms primary, secondary, and tertiary are likewise used to indicate substitution of one, two, and three hydrogen atoms, respectively, by such groups.

All salts consist of two portions which are held together by virtue of the fact that one portion, called the cation, bears a positive electrical charge, and the other portion, called the anion, is charged negatively. In ammonium nitrate, mentioned above, ammonium is the cation and nitrate the anion. In the quaternaries, one of the groups attached to the nitrogen atom in the ammonium cation is a paraffin-like water-insoluble group which confers soap-like properties upon the compounds. Because this group is found in the positively charged portion of the molecule, quaternary ammonium compounds are often called cation-active materials.

Soap and the better-known synthetic detergents like Dreft and Vel also contain a paraffin-like, water-insoluble group. But in this case it appears in the anion. Thus, while soap and the quaternaries have a lot in common, property-wise, they are actually opposite numbers, chemically speaking.

SINCE 1908 — References to quaternary ammonium compounds appeared sporadically in scientific literature from 1908 on. From the first, it was recognized that these materials were potent weapons against bacteria, and in 1916, two scientists at Rockefeller Institute described over 200 of these compounds in a series of eight publications.

Twenty years went by, and industry paid no attention. Then, in 1935, Gerhardt Domagk, the German scientist who had discovered sulfa drugs a few years

Humidity room where various quaternaries are tested as slime preventives

Courtesy Rohm and Haas Company

before, called attention to the high anti-bacterial activity of a simpler type of quaternary than had been studied previously.

A great deal of research, both in this country and abroad, followed Domagk's announcement, and even before the war, the value of these materials in antisepsis and disinfection was firmly established.

THEY ARE LIKE SOAP . . . — Some of the quaternaries will wash hands, shampoo the hair, launder woolens, and clean dirty eggs in much the same way as soap. One manufacturer, the Emulsol Corporation, reports that its product, called Emulsept, is being used in an impregnated paper for washing the hands of physicians and dentists. It is also being used in food processing plants for washing fruits and vegetables as they are received from the farm.

Quaternaries are being employed more and more in restaurants and soda fountains, fisheries and poultry farms, dairies and pasteurizing plants, bakeries and cold-storage warehouses, hospitals and doctors' offices.

. . . AND NOT LIKE SOAP — If cleansing were the only object, there would be no economic justification for using high-priced quaternaries instead of low-cost soaps or synthetic detergents. But these relatively costly and complex chemicals are being used increasingly in restaurants, hospitals, and other places where disease-carrying germs lurk. They are used here not because they are soap substitutes but because they are powerful germicides.

• LOOKING AHEAD •

Public health promoted by more effective sanitation of food-handling equipment . . . Expanded use of non-corrosive, non-irritating, non-poisonous disinfectants . . . Same chemicals applied in increasing quantities to fabrics, giving permanent waterproofness, softer finishes, and greater fastness to dyes.

Carbolic acid (phenol) is the long-established disinfectant against which other materials are rated. One of the new quaternaries, Emcol 888, is 600 times more effective than phenol against the organism which causes typhoid fever. The quaternaries, moreover, are effective in concentrations as low as one part in 50,000. Early applications of the quaternary germicides were in surgical procedures, where they were used not only to cleanse and sterilize the operative site for surgery, but also in scrubbing the surgeon's hands and arms to destroy organisms.

Many of the quaternary compounds are odorless, colorless, non-irritating, and non-toxic in germicidal

Courtesy Rohm and Haas Company

Left:
Odorless, non-toxic, fast-acting ammonium quaternaries provide highly effective germicides for dish water

Right:
Medical instruments can be sterilized without heating by means of the potent quaternary ammonium compounds

concentrations; and, of course, they contain no phenol, iodine, mercury, other heavy metals, or free chlorine. Solutions are stable in storage; they are not volatile, nor are they affected by boiling. Because of these unusual virtues, they can be safely used on food utensils, dairy equipment, operators' hands, and even on food itself. Phenols, cresols, pine-oils, mercurials, germicidal dyes, and other odoriferous and relatively toxic germicides are barred from such applications.

FAST ACTING — The quaternaries offer advantages, too, over chlorine or hypochlorites as disinfecting or "sanitizing" agents. Chlorine gas and water containing large amounts of free chlorine are irritating and corrosive. In eating and drinking establishments, alkaline hypochlorites and chloramines usually act too slowly to be effective when glasses and dishes are rinsed rapidly. Solutions must be renewed frequently, for the active hypochlorite deteriorates rapidly, and is inactivated by the organic matter rinsed off the dishes.

Extensive field tests reveal that the quaternaries are as effective as—or even slightly more active than —chlorine in reducing the bacterial counts on used glasses. The potency of the quaternaries does not fall off during use, moreover, and their activity is not affected by impurities in the water.

The quaternaries have also been used successfully in the disinfection of wounds and deep lacerations, in wet dressings and irrigations, and in the treatment of skin lesions caused by fungi. Properly used, they are highly active in "cold sterilization" of medical and dental instruments.

Public health authorities, too, accept quaternaries as suitable substitutes for chlorine disinfectants and employ them for control of mastitis, streptococcus, staphylococcus, colitis, diphtheria, and other bacterial infections in cattle.

"DISSOLVES" GERMS — By a mechanism not yet well understood, the quaternaries attack bacteria in a manner unlike any other germicide. They seem actually to dissolve the micro-organisms.

Bacteria, just like human beings, contain organic nitrogen and phosphorus compounds. These compounds are normally retained within the cells, but in the presence of germicidal concentrations of quaternaries, the nitrogen and phosphorus are released.

The quaternaries are apparently adsorbed on the surface of the bacteria, where they have an injurious effect on the cell wall. The membrane is irreparably ruptured, and the germ simply falls apart.

WITH FABRICS — Although it is as germicides that the quaternaries are most spectacular, it was in an entirely different capacity that they found their first commercial application. About 1930 it was discovered that quaternaries improve the fastness of dyed fabrics to water. They probably react with the dye molecules to form water-insoluble compounds without affecting the colors of the dyes.

Then a few years later it was found that the quaternaries were adsorbed onto cellulose from very dilute solutions, and that fabrics could thus be rendered very soft and smooth. Literally millions of miles of fabrics have been processed with the so-called "cationic finishing agents" or "cation-active softeners." The effect imparted by these materials persists even after repeated washings, which is rather surprising in view of the fact that the quaternaries are water-soluble.

A still newer process using quaternaries makes fabrics waterproof. Older waterproofing methods simply consisted of applying a paraffinic coating to the fabric. This was not permanent, however, for the coating would come off during wear or upon the application of dry-cleaning solvents. In the new process, of which Du Pont's Zelan is an example, the paraffin-like group is part of a quaternary ammonium compound. The quaternary is applied in water solution to the fabric, which is then dried and heated. At high temperatures the quaternary decomposes and the paraffin-like group reacts with the cellulose of the cotton or rayon, giving a permanent waterproof finish to the textile.

In spite of their relatively high cost, the quaternaries are here to stay. Public health authorities—be they local, state, or federal—are aware of the danger of disease transmission by unsanitary dairies, restaurants, and soda fountains. Charles McDonald, director of the Dairy and Food Division of the Akron, Ohio, Health Department, conducts a continuing educational campaign among food handling personnel; he reports that over 70 percent of Akron restaurants use synthetics for washing dishes.

The field of antisepsis is a huge market in itself. Add to this the various textile uses, and it becomes obvious that quaternaries are going places.

Metals Through the Microscope

Editor's Note: The accompanying article is the first of a series dealing with industrial applications of photography in all its phases. These articles will be designed to show our readers how the principles of photography can be utilized in a wide variety of industries and in locations ranging from the research laboratory, to the training school, and to the production line. Queries are invited from interested readers and suggestions for future articles in the series will be welcomed.

Photography of Prepared Specimens Provides Permanent Records of Metallic Structures For Future Reference. Technique Can be Applied to Quality Control as Well as to the Search for New Alloys and New Treatments. Equipment for Photomicrography of Metals Has Many Other Uses

By Peter R. Lewis

Photographic Service Technician, New York Sales Branch, Ansco Division, General Aniline and Film Corporation

MICROMETALLOGRAPHY is to the metallurgist what microscopy is to the doctor in the field of medicine. It deals with the anatomy of metals and shows exactly how changes in metal structure can influence the course of mechanical and thermal treatments to which they will later be subjected. In like manner, it can reveal the changes which take place within metals themselves after they have been worked, tempered, welded, or heat treated.

The microscope furnishes the means by which the metallurgist can determine good, poor, or indifferent physical properties of metallic structures; coupled with the camera it provides essential and permanent records for future study and comparison.

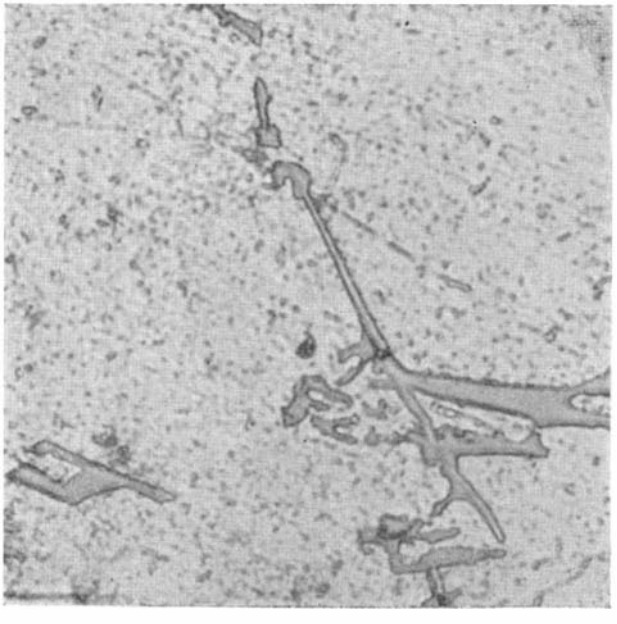
Some of the phases of metals that can be studied and photographed by means of micrometallographic equipment include: internal stresses due to fatigue, as revealed by intergranular structure; fractures and discontinuities from various causes; non-metallic inclusions; and identification of unknown metals by comparison of photomicrographs.

In addition, the same equipment used for photomicrography of metals has a number of other applications in industry. It can be used to study small-particled substances such as paints, fillers for plastics, and other non-transparent materials in the course of research or of production quality control. Likewise, soap, oils, fats, waxes, and the like yield many of their secrets to the probing eye of the microscope. In fact, there is hardly a single aspect of industrial research or production that cannot make profitable use of data revealed on the photographic negative as exposed through the lens of the microscope.

During the past few years there has been a marked increase in the use of photomicrographic systems to study and make permanent records of metallurgical specimens. With the increased use of innumerable metal alloys and the large-scale research being conducted by industry to find new substitutes for depleted metal stocks, there has been a need for maintaining records of new metals being manufactured—records which show the progress of research and then follow the metals through their final fusion and their rigorous uses during tests.

The metallurgist in his work must be able to produce metals which are required to meet exacting specifications set down by the industrial field. To keep records of a metal as it is developed to meet these specifications, the photomicrographic method provides an illustrated progress report to which the metallurgist can refer any time.

One example of the many possible industrial uses of photomicrography is this micrograph, taken at a magnification of 500X, which reveals the structure of the alloy obtained by the brazing of two pieces of copper



REFLECTED LIGHT USED — One of the basic principles involved in using a camera in a metallurgical photomicroscopic system is that the light utilized is reflected light rather than the transmitted light em-

ployed in a microscopic system used for examining biological or medical specimens. In these latter fields, samples are very thin in order that a maximum amount of light can be passed through the specimen and recorded on the sensitized material used in the camera. For metallurgical work, however, the sample under study is opaque; this is the factor which makes it necessary to utilize reflected light to record details on the photographic film.

In order to obtain proper exposure of the negative in the camera, it is necessary that the light source be intense, since a great deal of light is lost when reflected from the opaque surface. Metal, unlike most living cell specimens, can fortunately withstand a considerable amount of heat from the high illumination which must be used for this form of photomicrography.

To modify a simple microscopic system in such a way that it can be used for metallurgical study, several changes must be made. These changes involve removing the objective, the stage, and the condenser used in a standard biological microscope and replacing them with a new stage and a short-mount objective. A direct illuminator is used in place of the condenser.

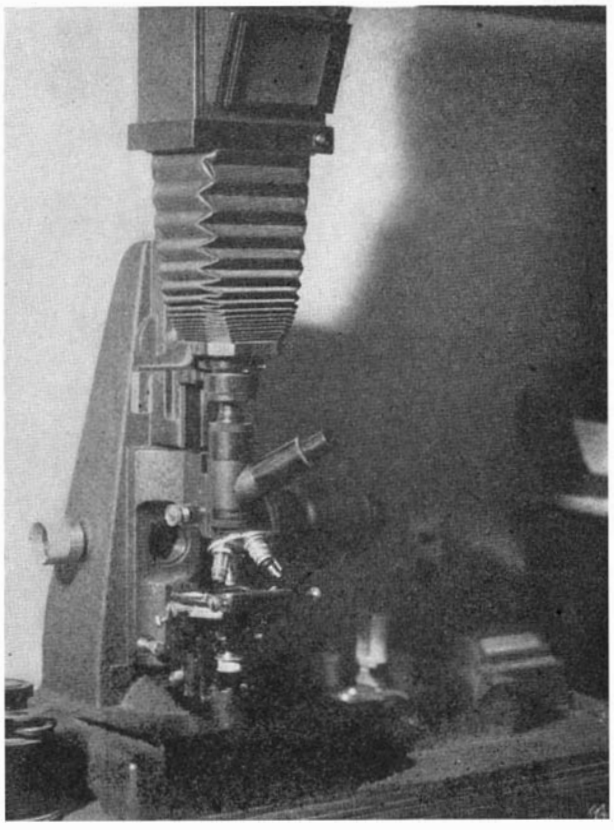
The new stage is solid; it does away with the center hole type used for biological work. The short-mount objective permits studies at high magnifications to be made of thick specimens and can be considered analagous to the use of the telephoto lens in ordinary photography.

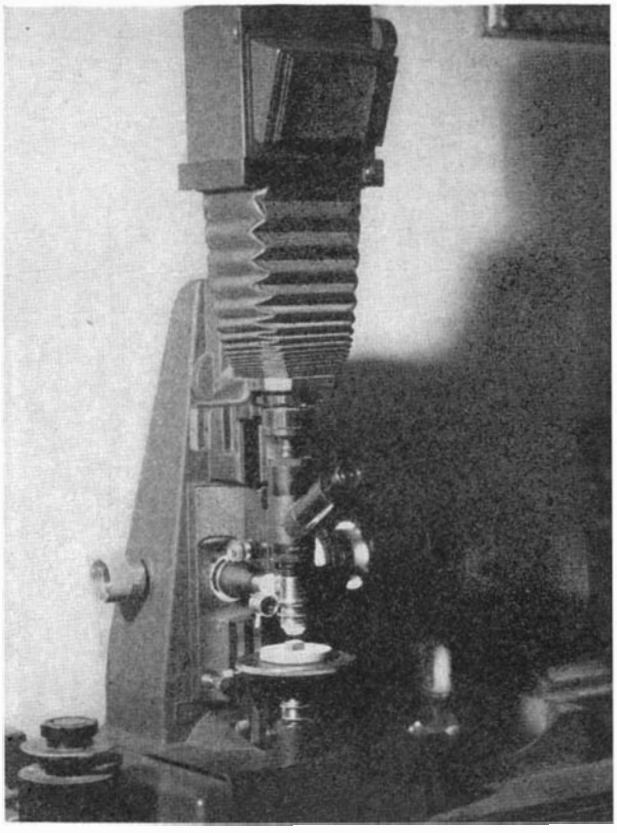
The metallographic setup shown in one of the photographs is one of the simpler types which are available. There has been a marked trend in recent years toward the inverted type of microscope for this work, because of its sturdiness. However, this type is very expensive and is employed primarily by industries which require continuous use of photomicrographic apparatus in metallurgy.

CRISP IMAGES — Because of the basic principle of the metallurgical microscope, the specimen can be studied not only in ordinary reflected light but it can also be viewed and photographed under polarized and ultra-violet light as well. Use of these light sources, selected according to the desired results, provides a high resolving power with which it is possible to obtain crisp, brilliant images of very small particles. In addition, the stage used in the metallurgical microscope system may have provisions for measuring very accurately the faces and angles of the crystals of a specimen placed on it. This feature is an important one in identification of metallurgical materials.

The greatest difficulty in using the microscope in the field of metallurgy is the preparation of the sample. The thickness of the sample does not matter, but the surface of it must be carefully ground and polished to mirror brilliancy. In fact, the same care must be exercised in polishing these metal samples as in polishing precious stones, and most of the tools used are actually lapidary instruments.

When the modification of the microscope and the preparation of the sample has been completed, normal methods of microscopic manipulation and photographic exposure can be used to supply the metallurgist with an accurate record of any particular metal he may wish to study.





Above: Photomicrographic apparatus using transmitted light. The stage has a center hole. Below: The same equipment adapted for metallurgical study with reflected light. Note prepared sample on solid stage

SCIENTIFIC AMERICAN'S Industrial Digest

REMODELED DRAFTING ROOM

Lowers Strain on Workers Through Better Lighting, Air Conditioning

MORE THAN 150 designing engineers in a recently enlarged drafting room have found that the room's new lighting and air-conditioning materially reduce the strain of their work.

Recessed, fluorescent units on 3-foot centers, extending the length of the room between welded rigid frame arches, have each been equipped with one daylight and one soft-white 40 watt tube. With mounting heights which range from 13 feet near the outside of the 70-foot span to 22 feet at the peak, a uniform, well-balanced lighting intensity of over 90 foot-candles is maintained on the drafting tables. The troffer units have been suspended from the purlins, and the metal acoustic ceiling is supported by these lighting fixtures.

Three lines of air-conditioning supply ducts are located on each side of the room toward the outside of the span. These extend the length of the building, and are supported on the rigid frame arches, being located between the purlins. A space between the four lines of purlins in the high center section serves as a return air duct.

Air - conditioning machinery, housed in a small two-story equipment building adjoining this drafting room of the Austin Company, includes a fan room designed to handle 35,000 cubic feet per minute. A new type of electrostatic filter, which applies an electrical charge of between 6000 and 9000 volts to filter paper, has been installed on the second floor. Reciprocating refrigerating compressors of 100-ton total capacity have been installed on the first floor, with evaporative condensers and other auxiliary equipment. Steam for heating is supplied by the existing boiler plant.

Recessed fluorescents maintain a light intensity of 90 foot-candles on the tables

POLYMERIZED PAINT BASE

Results in Longer Lasting, Better Looking Coats

HOUSE PAINT, superior to pre-war grades in appearance, dirt resistance, and durability, is the result of war-time technical development of meet the critical shortage of materials. The new paint, in which polymerized oils are used, has greater pigment content that the pre-war paint, and has more flow. This combination means higher gloss and a smoother finish, with fewer brush marks and streaks. It is also much faster drying, making for a shorter period of time during which wet paint can pick up dirt and moisture. When fully dried, the paint stays cleaner, since there are no sharp brush marks to catch dirt. And after the paint has been well exposed, it undergoes a self-cleaning chalking process which shows a marked improvement in appearance over the older types of paint.

The greater durability of the new finish results from the high pigment-content and a binder made up of polymerized and raw linseed oil. Developed by the Sherwin-Williams Company, the new binder, in which much of the oil has already been processed to a comparatively high state of polymerization, leaves a film that dries more thoroughly than the old, preventing runs, sags, and wrinkles, and providing a harder finish with considerable resistance to scratching and gouging.

The durability of the new paint is also increased by the fact that the few and shallow brush marks result in a thicker average film than the more deeply-marked pre-war paint.

CELLULOSE DERIVATIVE

Forms Many Useful Films, Improves Detergents

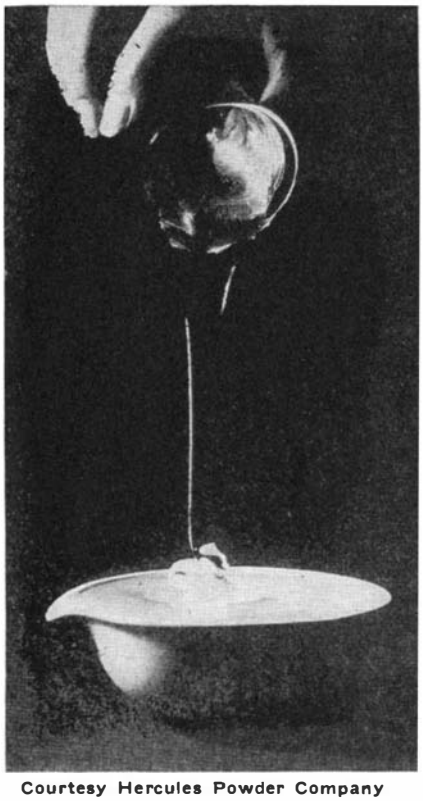
A WATER-soluble derivative of cellulose, carboxymethyl cellulose, which shows great promise as a thickening agent, a constituent in cosmetics, and in a score of other uses, is now being manufactured in this country.

CMC, as the material is called for short, is like soap in one respect—that it is the sodium salt of a weak, water-insoluble acid—and, as with soap, a precipitate is formed by the addition of acids or heavy metal salts to its solutions. Films of CMC are insoluble in all of the common organic solvents, such as acetone, benzene, ether, carbon tetrachloride, mineral oil, or peanut oil.

As a thickening agent, the material may be used in textile printing pastes, latex dispersions, embalming fluids, and other applications where viscosity regulation is important. CMC is useful as a stabilizer for emulsions and suspensions such as lotions, creams, and tooth pastes. In emulsion paints and lacquers, its film-forming properties come into

play as they also do in grease-proofing paperboard and sizing paper and textiles. This new product is also applicable as a binder and vehicle in crayons and leather pasting, and its colloid properties give it important stature in latex creaming, ceramic glazing, can-sealing compounds, and insecticide formulations. Of vast potential importance is its use in conjunction with synthetic detergents. Large amounts were used in Germany to improve the action of detergents in the laundry.

The material is now being produced by Hercules Powder Company, Dow Chemical Company, Standard Chemical Company, Ltd.,



Courtesy Hercules Powder Company
Carboxymethyl cellulose

and Sylvania Division of American Viscose Corporation.

CMC is now selling for 70 to 80 cents per pound. Considering the fact that ethyl cellulose, cellulose acetate, and cellulose nitrate, which originally sold for $1.50, $1.00, and $1.00, respectively, are now down to 50, 35, and 70 cents, it is to be expected that CMC will also come down in price over a period of years.—*H.C.E.J.*

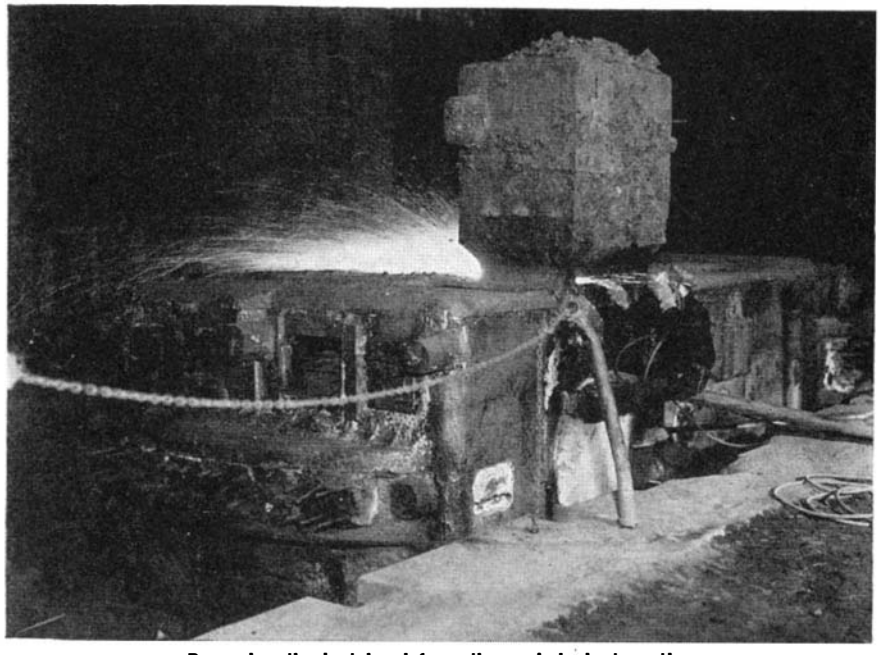
CARGO BIN LINING

Meets Plane Needs For Light-Weight Installation

AIRCRAFT companies are using increasing amounts of plastics materials, particularly on the interior finish and decoration of their planes. And they have been most progressive in adopting and adapting new plastics to their needs. A case in point is the use being made in United Air Line's cargo ship, the Cargoliner 230, of an ivory-colored plastics laminate, Plyon. The material, used as interior cargo space lining, is a polyester resin-impregnated, glass-fiber cloth.

Plyon was selected not only because of its light-weight, flexibility, and strength, but also because it comes in panelled sections that are easy to install. Further, since the plastics can be cleaned by sponging with water, food cargoes can be shipped in the Plyon-lined compartments.

Sheets of laminate 0.0625 inch thick are used for heights of 64 inches. Above that height and extending up over the roof the sheets are 0.030 inch thick. The material is held in place by aluminum cover strips.—*C.A.B.*



Removing the last head from the cooled giant casting

GIANT STEEL CASTING

For Forging Press Frame Took Two Months To Cool

RECENTLY completed by the United Engineering and Foundry Company is what is reputedly the world's largest steel machinery casting. It weighs 472,000 pounds and is to be used as a frame for a 6000-ton capacity, high-speed, mechanical forging press.

Four open-hearth furnaces poured molten steel simultaneously into four ladles, which in turn were carried to the pit by overhead cranes. The 600,000-pound main pouring was accomplished in four and one third minutes, after which 100,000 pounds of additional molten metal was poured at several intervals to make up for shrinkage. The casting was allowed to cool in sand for two months.—*F.P.P.*

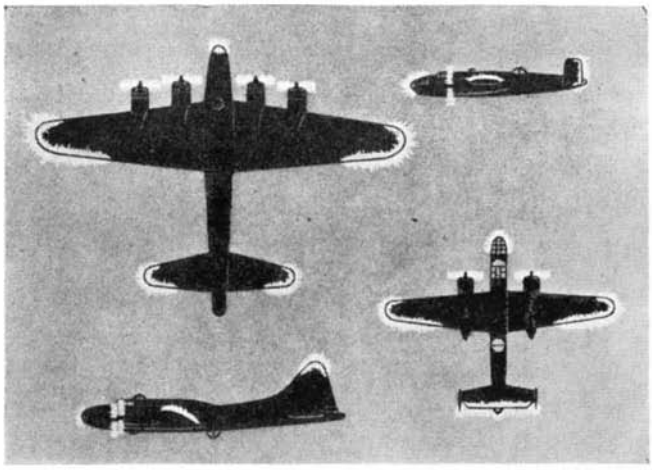
GRINDING'S IMPORTANCE

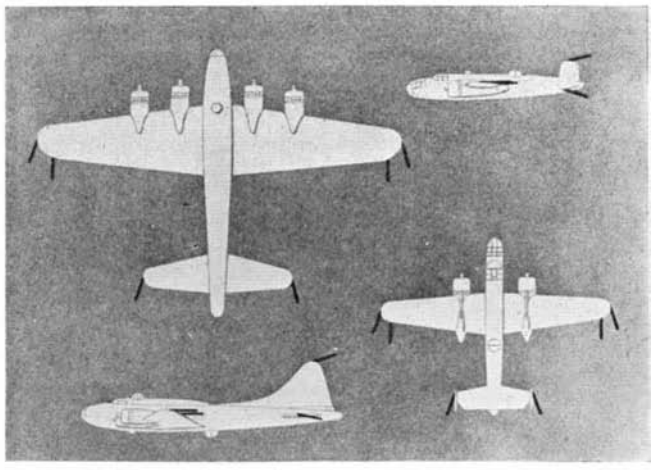
Increases as Knowledge of Techniques Broadens

PREDICTIONS that the first peacetime year would find a market glutted with precision grinding equipment are being belied as shop after shop spends tens of thousands of dollars to modernize its grinding rooms.

Back of all this is new knowledge that grinding, when carried on with too much cutting force or at too high temperature, can set up work strains in the ground surface and result in quick failures of parts; that much modern grinding has to be carried on with diamond wheels or others so high in cost that only the very latest machines can serve as their mountings; and that grinding must control the type of surface as well as the accuracy.

Only recently has industry realized that, given the same dimensional accuracy, one type of ground surface will shot peen better than another, or will be better for lubricating, for cyaniding, for corrosion resistance. Grinding once was done to dimensional accuracies; now it is done to standards of finishes also, and these





Air Materiel Command Photo

Static collects at indicated points, interferes with radio

Static dischargers eliminate much radio background noise

standards are as yet very little developed and defined. In these standards, however, are new horizons for grinding which make its former limitations seem tiny.—*E.L.C.*

AIRCRAFT RADIO STATIC

Effects Eliminated by War-Developed Devices

COMMERCIAL pilots are now able to get help in bad weather from the same simple static dischargers and suppressors which aided Army pilots during World War II. These devices are a series of insulators and strips of conducting cotton wicking so arranged as to provide a protective shield around the entire airplane and to carry off accumulating static, reducing the noise level in aircraft radio communication.

An aircraft in flight constantly comes in contact with particles of dust, sand, smoke, ice crystals, snow crystals, and rain which generate charges of static electricity when they strike against the surface of the plane. When the amount of electricity accumulated by the plane becomes greater than the amount of electricity in the surrounding air, precipitation static is set up in the aircraft radio receiving equipment.

To counteract the resulting sound of "frying eggs" which interferes with aircraft radio reception during the time when it is needed most, Air Materiel Command laboratories at Wright Field developed an antenna insulation system which protects aircraft radio from stray pulses which interfere with radio signals. The wick dischargers were developed with the co-operation of the Naval Research Laboratories.

This equipment, manufactured by Dayton Aircraft Products under government contract, shields all antenna terminals and splices, permitting good radio reception despite increasing accumulation of static charges on the skin of the plane. The wicks provide a means of quietly discharging the static electricity acquired by a plane in flight, and permit clear reception of radio signals.

Recent release from government restrictions make it possible for commercial airlines to install these same devices in non-military planes, and commercial pilots will now be able to receive radio signals clearly under nearly all weather conditions.

STEEL CONSERVATION

Takes Many Forms In Face Of Low Production

PURCHASING agents cast uneasy eyes at the comparisons between our 90,000,000 tons of steel mill capacity and the amount of steel which 55,000,000 employed people will consume. Seeing that we cannot make enough steel, ways are sought to get products made in spite of the shortage.

Better control of scale is one answer. Old fashioned steel mill methods of heating and descaling can waste 10 percent of the steel right in the mills, and another 10 to 20 percent in the heat treating and pickling rooms of the fabricating plants.

More strength with less weight in products by better design, more accurate machining, and better heat treating is another steel saver. This can mean a boom in the machine-tool market, especially for the most modern machine tools.

Alloy steels, even those with slight amounts of alloying elements, can make surprising increases of strength for weight and so get more consumer goods out of the same steel tonnage.

Every possible substitute for steel is being considered. In former times, the aluminums, magnesiums, plastics, and processed woods, had to fight against steel which was right at hand. Now to a large extent they have only to move into fields which steel has abandoned because of short supplies.

Foundry methods are under study as never before. More than one metallurgist is finding that with close control his foundry can run on scrap which he formerly sold back to the steel mills, and thus eke out his dwindling steel supply. The fact that this still further hampers the steel mills, and that more than one steel mill is refusing to ship steel unless it can first get scrap, does not completely prevent the practice of "self preservation" by the large plant that owns a foundry.

This situation is likely to go on for some time since the building of new steel plants capable of making up the shortage is unthinkable under present tax and labor laws.—*E.L.C.*

CONTINUOUS STILL

For Turpentine, Is Cheaper To Build and Operate

FOR THE distillation of turpentine from the oleoresin of pine trees, a continuous still has shown efficiency and economy of both labor and steam in pilot plant runs made in competition with conventional batch stills. Furthermore, the rosin produced by the new still is reported to be about half a grade better than that produced from the same gum by the traditional batch method. The new still operates on the flash principle, the clean filtered gum being pre-heated and sprayed into the flash chamber. Here about 80 percent of the turpentine is volatilized to go to the condenser. The gum

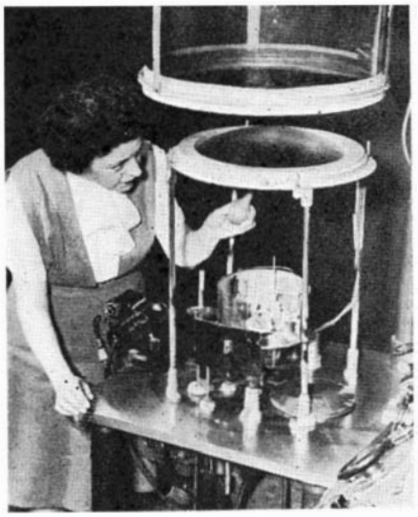
containing the remainder of the turpentine passes down a stripping column counter current to a flow of steam which strips out the remainder of the volatile solvent. The new stills are expected to be cheaper to build and install than the present batch stills, as well as cheaper and more efficient to operate.—*D.H.K.*

ELECTRONIC BOMBARDMENT

Cleans Optical Surfaces in Preparation For Coat

CLEANING optical glass surfaces by electronic bombardment prior to coating is a process designed primarily for aiding in the application of aluminum, the reflecting agent, to television and other first-surface precision mirrors.

The ground and polished optical glass is placed in a metal holder in a high vacuum bell, where a



Blowing the surface dust from a precision mirror prior to lowering the vacuum bell for electronic bombardment

tungsten filament, similar to the filament in an ordinary electric light bulb, is electrically heated to a temperature at which electrons are "boiled out." Since electrons are negative particles, they are attracted by the holder which is at high-plus voltage with respect to the filament. Thus attracted, the electrons bombard the glass at a speed of several thousand miles per second, leaving the surface entirely free of water and extraneous material.

After cleaning, the glass, still contained in the high vacuum chamber, is coated with aluminum by an evaporation process. The result: A mirror of extremely high precision.

When the glass is placed in the vacuum bell, an unnoticeable residue of moisture several molecules thick, which is always present on any surface, remains. This can be removed only by applying heat, but aluminum will not adhere to a heated surface; hence the electronic bombardment method was developed to overcome that difficulty.

Unlike other heating methods, the electronic bombardment technique, developed by the Bausch and Lomb Optical Company, heats only the surface of the mirror, which almost instantaneously cools to the temperature of the remainder of the glass. The aluminum coating, applied after this treatment, will adhere.

HOT-COLD PIPE

Separates Elements of Heat and Cold in Gases

A PIECE of pipe 15 inches in length, that blows hot air out one end and cold air out the other, requires only a stream of compressed air for its operation—no heating or cooling equipment whatever. And in so doing, it achives a long cherished dream of physicists: Separation of the elements of heat and cold that are present in every gas. While it is barred from the fields of commercial refrigeration and heating, because of its low efficiency, the "hot-cold pipe" may reveal hitherto unknown facts about the behavior of hot and cold gases. The instrument also holds good promise as a useful laboratory tool, since it is the simplest, most inexpensive way of producing low temperatures now known. The "hot-cold pipe," as constructed by the Westinghouse Electric Corporation, is 15 inches long and one inch in diameter, and is designed along the lines of a model 18½ inches long but only three-tenths of an inch in diameter, constructed by a German scientist and recently brought to America.

Operation of the pipe is amazingly simple. Compressed air is pumped into a nozzle at the right end of the pipe. Striking a steep spiral there, it is converted into a whirlpool of rapidly spinning gases. The air in the center of the whirlpool becomes cold almost instantly while that toward the outside grows correspondingly hotter. The inside or cold air then is drawn off through a quarter-inch opening at the right end of the pipe while the warm air goes out a similar opening at the opposite end. There are no moving parts and the pipe can be constructed using only a few dollars worth of material.

In the original tube, its German inventor, R. Hilsch, claims to have produced one air jet as hot as 154 degrees, Fahrenheit, and another as cold as 10 degrees, Fahrenheit. He also predicted that with proper design of the pipe and control of the air flow, temperatures, more than double the boiling point of water on the one hand, and 50 degrees below zero on the other, can be obtained.

The Westinghouse version of the pipe, constructed by Mr. Gaylord W. Penny, is more than twice as large in diameter as the German original,

Courtesy Westinghouse Electric Corporation

Warm air is drawn from the left end of the pipe, cold air from the right

so that the behavior of air in the "whirlpool" can be studied more easily. The larger diameter limits opposite-end temperature differences to only four degrees, but allows measuring instruments to be placed inside the pipe.

"What actually happens inside the whirlpool of air is not known definitely at this stage of the research," Mr. Penney says. "One theory is that the various 'layers' of whirling gas are traveling at different speeds. At the center they may be virtually at rest, while a fraction of an inch away they may have attained their highest velocity. This speed falls away gradually toward the outer edge of the whirlpool.

"Gases traveling at higher speeds are believed to exert a frictional effect on those of lower velocity—much as two surfaces rubbing against one another produce friction—thus transmitting energy from the inner portion of the 'whirlpool' to the gases at its outer edge. The net effect is that the outer layers are considerably warmed, while the inside layers are correspondingly cooled. No energy, however, actually is gained or lost. Whatever heat is extracted to produce the cold stream of air must be added to the warmer end of the flow."

PLATING BATH ECONOMY

Promoted by the Use of Plastics Tubes Floating on Surface

TUBES extruded of polystyrene, cut in three-inch lengths and closed at each end to resemble miniature pillows, when floated on chrome plating solutions in sufficient depth to blanket the bath, protect workmen from the acid fumes and prevent loss of chromic acid in spray form through the ventilating system. Heat and electric power in the plating room also are said to be saved by cutting down on the quantity of air withdrawn by the blower.

Known as Chrome-Lock tubes, these little plastics "pillows" move apart easily when a rack of objects to be plated is lowered into the solution, and move back into place around the rack spine, completely covering the acid bath, while the plating is accomplished.

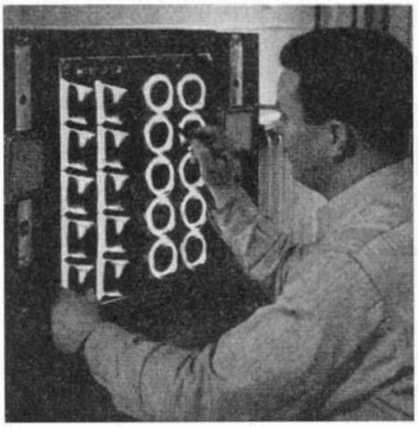
Made of the Dow Chemical Company's Styron, these tubes are resistant to acids, light in weight, and have a smooth texture. The tubes, produced by the Udylite Corporation, are not changed in appearance, size, weight, or chemical composition, even when immersed in the extremely strong acid solution for days. The plastics is shatter proof, preventing loss of the tubes by breakage, and very few are lost by drag-out when plated objects are taken from the bath.

X-RAY INSPECTION

Of Metal Parts Requires A Well-Trained Operator

INSPECTION of industrial products always has two purposes. The first is to prevent shipping imperfect goods. The second is to improve production techniques by slowly and steadily compiling statistics about what faults are being produced. Thus, inspection requires high orders of conscientious attention and imaginative interpretations.

Continuous X-ray inspection is a fairly new technique. It finds the flaws inside of metal parts without injuring the parts in any way. But



Hidden flaws revealed by X-ray

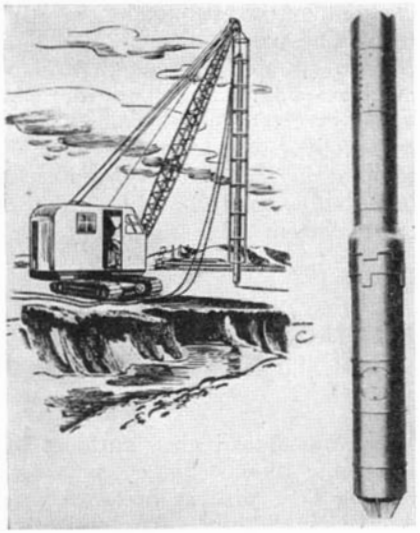
so much can be told and interpreted by skilled reading of X-ray films that, as a rule, the reading task is assigned to a highly trained engineer.—*E.L.C.*

SOIL COMPACTOR

Operates by Water Jet and High-Speed Vibration

COMPACTING sandy soil to increase its load-bearing capacity before starting construction work, a vertical cylindrical vibrator is powered by a motor especially designed by the General Electric Company to operate within the vibrator while it is submerged in wet sand.

The huge machine, which is handled by a crane, compacts the soil by the combined action of a jet of water and high-speed vibration induced by the motor. Called vibroflotation, this method diminishes the volume and permeability of soils,



Increases soil's load-bearing capacity

lessens the active soil pressure, and increases the passive soil resistance.

The entire process, including pumping the water, raising and lowering the machine, and driving the vibrator motor, is accomplished electrically. Vibroflotation was introduced in this country by Merritt, Chapman, and Scott, contractors, and Parsons, Brinkerhoff, Logan, and McDonald, consulting engineers.

RADIO YARDSTICK

Measures Distances With High Accuracy

USED BY surveyors in measuring distance and position, a new radio system is capable of detecting a one-inch movement of a small radio transmitter. It is also capable of measuring longer distances, and is not limited to line-of-sight measurements. In this system, known as Raydist, errors can result only from variations in frequency of a single transmitter and from radio propagation phenomena. By the use of a high-quality quartz-crystal-controlled transmitter, accuracy of the device, produced by Hastings Instrument Company, is limited only by the consistency of radio propagation.—*K.H.*

NYLON CONSTITUENT

Made From Farm Wastes Or Natural Gas

TETRAHYDROFURANE, a chemical solvent obtained by a series of reactions starting with oat hulls, corn cobs, and other agricultural by-products, is the basis of a new process for making hexamethylene dia-

mine, one of the two constituents of nylon. E. I. du Pont de Nemours and Company is constructing a $3,000,000 plant at Niagara Falls, New York, to make this intermediate. Celanese Corporation is also making tetrahydrofurane from natural gas at Bishop, Texas.

The interest in this compound is easily understood, for tetrahydrofurane is extremely versatile in its properties. It is reported to be an excellent solvent for natural and synthetic rubbers, the difficultly-soluble polyvinyl chlorides, and other vinyl polymers and copolymers. It will dissolve large amounts of resins, it is claimed, without becoming viscous.

Sheer hose from corn cobs or gas

It is also capable of polymerizing, giving soft resins or solid rubbers as desired. Its chemical reactivity as an intermediate, however, is its strong asset. Formation of the nylon intermediate is only one of such uses: its reactions with ammonia, amines, and sulfides are also being explored as commercial possibilities. —*H.C.E.J.*

PLASTICS-LINED PIPE

Decreases Corrosion Failures In Oil Well Drilling

TO PREVENT corrosion in the steel pipe used for drilling oil wells, the Spang-Chalfant Division of the National Supply Company has developed a thermosetting plastics coating for the inside of these pipes. [First announcement on page 112, March 1947 Scientific American.—*Editor.*]

The problem in developing this coating was to find a material that could withstand the operating conditions in oil well drilling, and that could be applied to 30 foot lengths of pipe. The coating had to be impervious to oil and water, be resistant to chemical attack, be able to withstand temperatures as high as 400 degrees, Fahrenheit, and to stand abrasion without flaking off.

To apply the coating, the 4¼ inch pipe is first shot-blasted on the inside. Then the thermosetting liquid is forced up inside the pipe until it reaches the top. It is next drained down slowly so that no air bells or streaks are formed. After a normal-temperature short drying time, the pipe is placed in an oven and the coating baked. This process is repeated for four coatings.—*C.A.B.*

CASTING INSPECTION

Greatly Simplified By Three Dimensional Projection

HAVING seen several years of successful application to thousands of intricate ferrous and nonferrous castings, a method for inspection and layout by three-dimensional projection of accurate layout drawings upon a rough casting has effected considerable savings in time and material. Moreover, an unskilled operator with but a few days training can employ the method, whereas the usual bench layout requires inspectors familiar with machining practice.

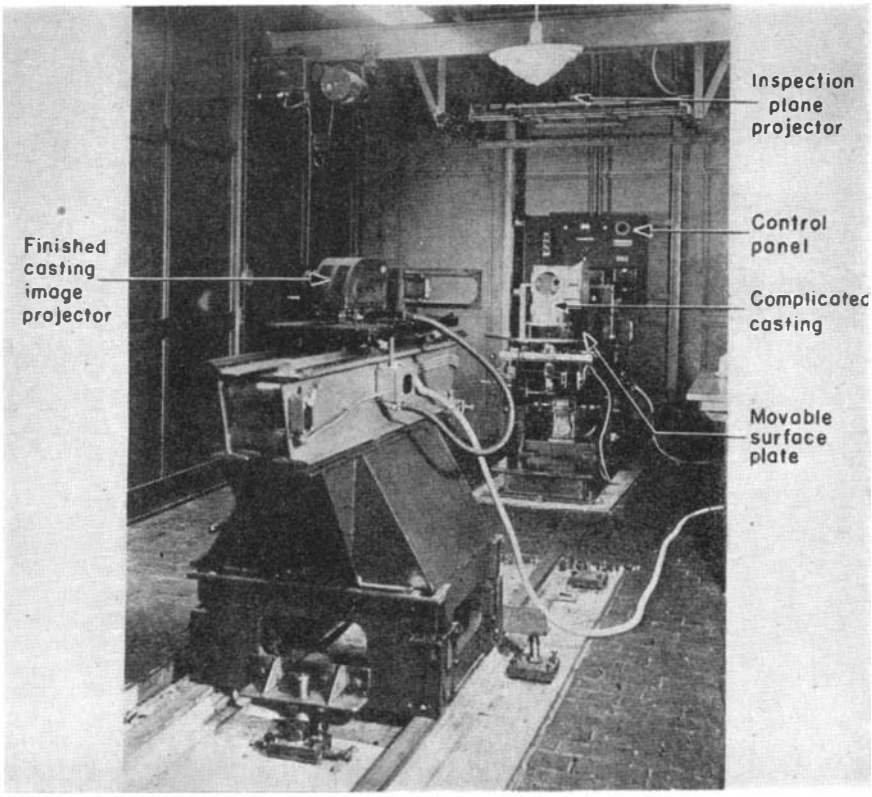
Originally designed to inspect and lay out parts for subsequent machining, this method has also been used for rapid inspection of finished parts. Projection may also be employed during an actual machining process, whether the part to be machined is stationary or revolving. The equipment assures layout accuracy within 0.015.

The installed apparatus, developed by the General Electric Company, consists of a layout image projector containing a photographic glass slide of the finished casting layout. The layout is projected by a lens directly upon the surface of the casting. To establish the plane of true projection and correct dimensions, an inspection plane projector is used to emit a sheet of light which falls vertically upon the casting.

When machining a piece which revolves and is symmetrical about the axis of rotation, the finished outline may be projected to serve as a template.

This template-projection system may be used in fabricating duplicate metal parts for tanks, boilers, and other burned-out and welded pieces. Variations of this system can be used for laying out intricate pieces, locating parts to be welded, shearing, and general layout operations.

To make this three-dimensional method practical, drawings of finished casting, which are suitable for photographing, are prepared. The size and focus of the drawing image on the ground glass of the camera are checked by microscope for accuracy.



Set-up for projecting layout drawings on casting in background

New Products

MINIATURE SWITCH

Features Snap Action and Precision Operation

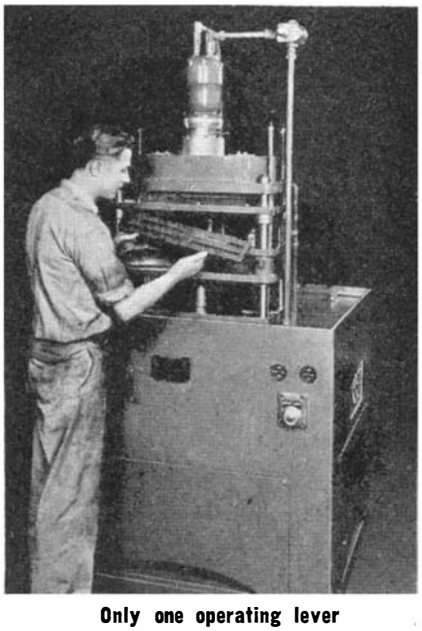
No larger than a dime, a new snap-action precision switch has as its outstanding characteristics compactness and rugged construction. Particularly adaptable in meeting specifications where space is at a premium, it serves ideally in the electrical circuits of dispensing machines, electric irons, linotypes, photographic timers, automatic washing machines, dictating equipment, and countless other consumer and industrial electric mechanisms.

Known as Q-Switch, it has high current-carrying capacity, and is designed to meet any circuit requirement— normally open, or normally closed; single- or double-throw, single pole. A product of the Mu-Switch Corporation, Inc., its electrical rating meets all Underwriters Laboratory requirements.

MULTIPLE DRILL UNIT

Shows Increase in Gas-Burner Output of 1600 Percent

Completing 385 holes simultaneously in a gas burner, a gearless, hydraulic drilling unit turns out an average of 30 burners per hour for an eight-hour day, where before its installation, 15 buners per eight-hour day was the best possible production. Standard threaded shank drills are used in this operation.



Only one operating lever

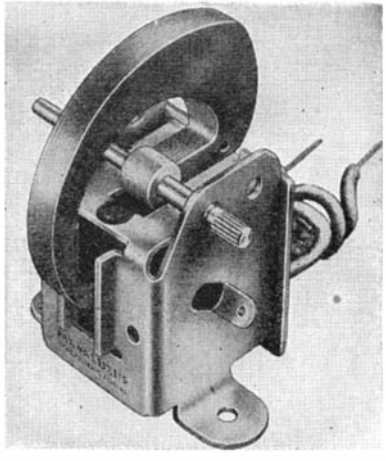
To remove or install a new set of drills, the operator needs only a pair of pliers, and the change can be made in matter of minutes.

The entire drilling cycle of the unit, product of Zagar Tool, Inc., is controlled by one operating lever. A hydraulic pumping system in the base of the unit operates the motor which runs the drill-head, as well as the ram that brings the casting up to the drill-head. This ram moves upward quickly, then automatically slows to a predetermined rate of feed as the spindles start to revolve. After the burner is drilled, the ram returns quickly to a normal position and the entire machine comes to a halt, completing one drilling cycle.

SOLENOID MOTOR

Produces Constant Torque Instead of Thrust

Operating as a solenoid except that it rotates through 180 degrees, a power device produces torque instead of



Torque througn 180 degrees

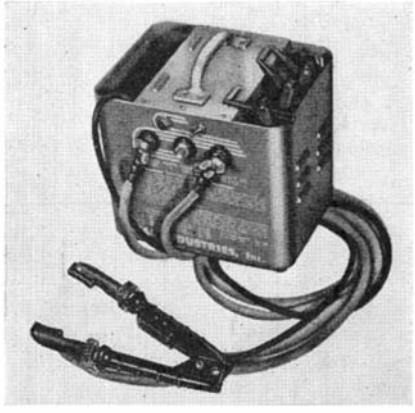
thrust and consequently eliminates the necessity of connecting linkages. The armature of this unit is so designed that it maintains a constant heavy-duty torque throughout its entire 180-degree travel. Originally designed for the operation of radio tuning units, especially in automobile receivers, the unit called Rotonoid, has widespread application in many fields ranging from electromagnetic valves to adding and calculating machinery. The entire unit is self contained, measuring approximately 2½ by 2⅝ by 3¼ inches high and weighing 10 ounces. Standard Rotonoid units now in production have a torque of 16 inch-ounces and can be operated continuously at 20 cycles per minute without exceeding a safe temperature. Where faster action is advisable, they can be used at 60 cycles per minute for periods up to 12 minutes on 115 volts, 60-cycle A.C.

When the Rotonoid is equipped with a current interrupter operating automatically at stroke completion, the temperature rise may be held to a minimum. This means may be employed to energize the coil for the necessary time only, and a relay attachment for this purpose is available.

SOLDERING TOOL

Is Compact and Portable, Will Not Over-Heat

Operating on the resistance heating principle, a redesigned soldering tool heats 20 percent faster, has thumb switch for close heat control, is light-

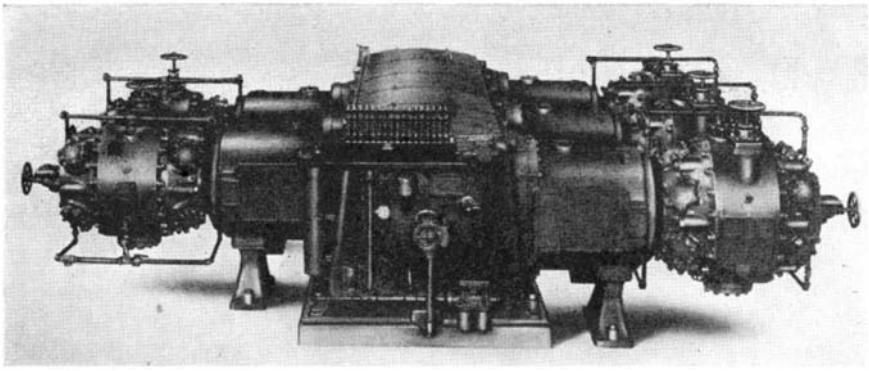


Rated at 1000 watts

weight, compact, and portable, and can be used for long periods of time without overheating.

Built to industrial standards, the complete unit includes a transformer or power unit and a soldering tool that operates like a pair of pliers. Holding the work with the plier tool completes the transformer secondary circuit and causes the work to heat instantly. No pre-heating is necessary. Heat is produced between the electrodes of the soldering tool only, thus concentrating it on the exact spot needed. There is no danger of melting nearby joints or burning other parts.

Handles of the soldering tools, produced by Ideal Industries, Inc., are made of light-weight plastics. Radiating fins isolate the Meehanite jaws from the handles to prevent excessive heat conduction. The plier can be locked in any position for special applications by tightening screw at hinge. Secondary leads, made of super flexible power cable and insulated with light-weight woven asbestos, are attached to the side of the jaw for easy handling and cooler operation. The plier is intended where work may be held in the jaws and heated—for example, in removing or applying solder lugs, sweating and



Can be powered by turbine, engine, or synchronous electric motor

unsweating copper pipe and fittings, soldering wire joints, and so on. Called Thermo-Grip soldering tool, it is rated at 1000 watts.

FIREPROOF FABRICS

Made From Flexible Glass-Asbestos Combination

DEVELOPED for use in theaters, nightclubs, restaurants, auditoriums, airplanes, trains, and similar places of public assembly, fireproof drapery fabrics of asbestos and glass are said to be exceptionally light in weight and to have excellent draping qualities. They will be produced in the form of gray goods suitable for dyeing and printing in a variety of colors and patterns.

The asbestos-glass fabric, developed by the United States Rubber Company, is the outgrowth of war-time research on fire-resistant materials for industrial use. Asbestos and glass complement each other when woven together, making a fabric with high flexibility and strength, low stretch with good resistance to abrasion, and stability under atmospheric changes.

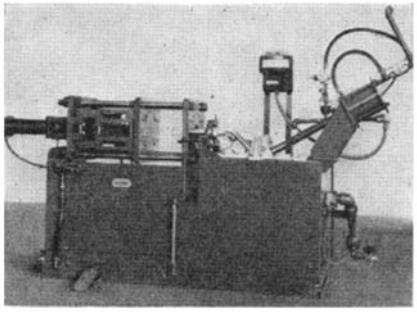
PACKAGED DIE CASTER

Simply Constructed, Is Easy To Operate

COMPLETELY self-contained, an air-operated die casting machine fills the need of many firms who require intermittent production die-casting work but without the facilities or need for establishing a regular die-casting division. This machine, needing only the simplest possible installation, measures 22 inches by 72 inches, and is 40 inches high. No special maintenance crew is required to adjust and maintain the die caster. Likewise, no specially trained die-casting technician need be hired to operate it. The average shop employee can handle production runs on this "goose-neck" type machine, the maximum casting capacity of which is one and a half pounds, with a possible maximum of 720 shots per hour.

In construction, the die-casting unit, manufactured by the Robert A. Cox Company, features single hook-ups for air, gas, and 110-volt current. It comes furnished complete with necessary blow torches for properly heating both goose-neck and nozzle. The holding pot has a capacity of 300 pounds of zinc alloy. It is cast of Meehanite iron and is designed in such a manner as to provide maximum heating area for the metal at all times. The furnace is lined with four and one half inches of fire brick insulation. A safety vent is also provided to take care of any metal which might get into the furnace by accident.

Simple operation throughout is an outstanding characteristic of the Cox machine. It is equipped with a loose-type nozzle, instantly removable. A removable bar facilitates die loading. All working parts are readily accessible for inspection, adjustment, or maintenance. Zerk fittings are conveniently located so that all bearing faces may be properly lubricated. By installing this



No trained casting operator needed

completely self-contained die-casting package, the average small and medium sized metal working shop, or any manufacturing plant making products requiring die casting, saves on job-shop costs, reduces inventory expense, and is provided positive overall production control.

AIR COMPRESSORS

Available in a Variety of Sizes and Capabilities

MANUFACTURED in six sizes and with a great variety of compressor cylinders, a motor-driven compressor of new design offers a wide range of volumes and pressures for handling air or gas. It is built with from one to six crank throws and ranges in horsepower from 500 to 2750. The compressor stroke is 14 inches and it operates at 300 revolutions per minute. Power for driving can be taken from a standard synchronous electric motor, an engine, or a turbine. The lubricating system, which includes a pressure pump and a built-in filter and cooler, furnishes oil under pressure to all moving parts.

Provision can be made for low vacuums or for high pressures, as well as for all intermediate pressures, enabling the selection of precisely the proper size and type of compressor cylinders for any desired volume and pressure within the horsepower limit of the unit. The low- and medium-pressure compressor bodies are of Meehanite metal, while high-pressure bodies are of cast or forged steel as required. The cylinder valves are of a standard ring-plate type and are self-cleaning. Valve seats are renewable, and interchangeable from suction to discharge.

Electrical or mechanical unloading by means of compressor suction valve lifters is also available, offering automatic control of flow or pressure. Automatic starting can be provided and compressor cylinders can be automatically unloaded for easy starting. Bearing temperature shut-down, low lubricating oil pressure shut-down and various other controls are available, depending upon the type of installation.

Dimensions of the compressor, designated by its manufacturer, the Cooper-Bessemer Corporation, as Type JM, range from 11 feet 7 inches to 24 feet 6 inches in length, and from 13 feet 9 inches to 24 feet 2½ inches in width. These lengths may vary slightly depending upon the size motor used, while the widths may vary according to the type of compressor cylinder used.

VERTICAL MOTORS

Have Positive Lubrication, Hollow Shafts

AVAILABLE in ratings from one to 500 horsepower, all speeds and frequencies, a hollow-shaft vertical motor designed specifically for pump drives is suitable for use on irrigation projects, deep-well turbine pumps, municipal and industrial water-supply projects, mine-

Protected from self-damage

dewatering pumps, and process- industry liquid pumps.

For motors rated at 10 horsepower, 1800 revolutions per minute, and larger, a system of controlled lubrication is featured, which allows just the right amount of oil to flow through the bearings, thus preventing oil-friction loss caused by foaming and churning. Bearings are protected from rust even during standby periods because the oil level is above the top of the balls.

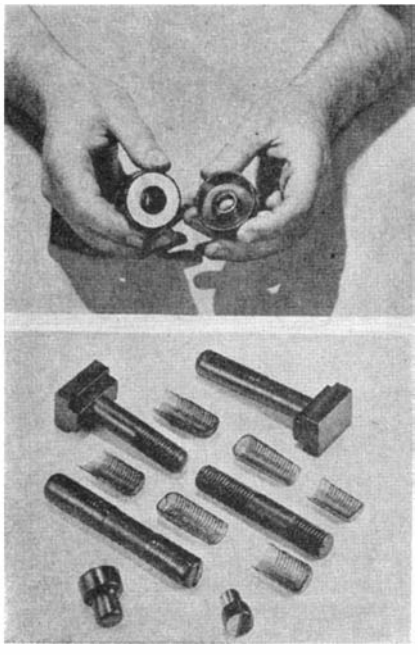
A large oil reservoir cast integral with the motor end-shields has sufficient capacity to allow the oil to cool and recover before being recirculated. A close-running fit between the end shield and couplings protects bearings and oil reservoir from the entry of dirt even when the top cap is removed for pump adjustment. Motors of 7½ horsepower, 1800 revolutions per minute, and smaller have grease-lubricated bearings.

Bearings, punchings, and windings of these new General Electric motors are cooled by a double-end ventilation system which draws in air at both ends of the motor and discharges it through openings in the stator frame. A protective "self-release" coupling prevents damage to the pump or motor caused by motor reversal. This consists of a top half-coupling keyed to the pump shaft and a lower half-coupling keyed to the motor shaft. It reduces installation time and provides a simple method of checking motor alinement.

PLASTICS GUARD

Protects Finished Parts While in Transit

To INSURE that the ultimate consumer receives metal parts in "factory fresh" condition, a novel protective system has been devised by the Jergens Tool Specialty Company. After the part to be shipped has been thoroughly oiled as a guard against oxidation, a tough plastics coat known as Seal-Peel, which is easily removed by the consumer, is placed over the portions most subject to damage. Thus the part is kept absolutely clean, and damage to ground surfaces, threads, and so forth, as a result of shipping or handling, is virtually eliminated.



Protects machined surfaces (above) or threads (below) from dirt, damage

COLD-STORAGE PAIL

Uses Fiberglas-Plastics Insulating Liner

EASILY portable, a container for iced storage of fish and game is provided for sportsmen by a Fiberglas-insulated, plastics-protected liner designed to be used inside the familiar 10-quart galvanized pail. Known as the Pailmaster, it has a removable top of Fiberglas insulation, encased in a sealed plastics cover and held in place by a braided draw-string passing through nickel-plated grommets. To insure rugged construction, all seams are electronically welded to form a homogeneous plastics protection for the inch-deep Fiberglas insulation.

As pail cover (left) and liner (right)

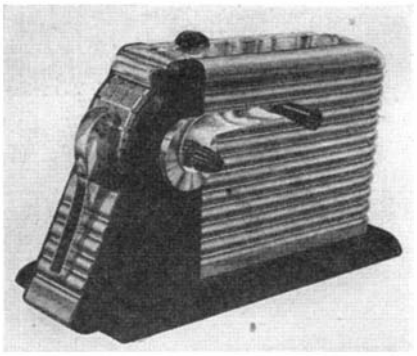
A typical test of the high efficiency of the Pailmaster was the placing of 150 ice cubes in the closed unit for 15 hours at a room temperature of 70 degrees, Fahrenheit. At the conclusion of the test, all the ice cubes were still large enough to use in the preparation of cold drinks.

The Pailmaster, manufactured by Plastic Sheet Fabrication, Inc., is also available in a design which provides insulation for the entire exterior of a standard galvanized pail. In this form it converts the pail into a container for frozen foods, ice cubes, milk, and other foods requiring refrigeration, and provides equally satisfactory storage for hot drinks and hot foods.

TAPE DISPENSER

Ejects Measured Strips of Adhesive Material

FOR use with transparent or colored pressure-sensitive tape in all widths up to one inch, a definite length dispenser takes either a one- or three-inch tape core. By simply setting the indicator on the side of the machine to the desired length and then pressing down the lever, the tape is ejected—cut off and ready for use in lengths from ⅜ to three inches. A variation for use in production lines can be made by adjusting the dispenser to cut long strips which are perforated at required lengths.



Cuts strips from ⅜ to three inches

The piece of tape rests on a "waffle" wheel at the front of the dispenser, and is easily lifted for whatever application is desired. The cutting of the tape into short lengths needed will bring about tremendous economy over the present wasteful, hit-or-miss hand method. The machine operates equally well with either cellulose or acetate fiber, and with all makes of pressure-sensitive tape.

This dispenser, called Tape-Saver, is a product of the A-L-B-E-Engineering Company and is expected to fill a need in factories, shipping rooms, mail rooms, offices, and on wrapping counters in retail stores.

HIGH-SPEED CORE DRILL

Has Coolant Supplied Through Stem to Abrasive Rim

DESIGNED to drill holes of any depth within the length of the drill and in all hard, brittle, non-metallic materials, a new core drill achieves exceptional drilling speeds due to the method of supplying coolant through the drill stem to the special metal-bonded diamond abrasive rim. Chips and sludge are flushed from the kerf as fast as developed, and since the coolant supply is constant, the drill functions without heat, regardless of the hole depth. The core drill may be used in drill presses, on portable electric drills, or directly coupled to motor shafts. It operates in any position with equal efficiency, and usually requires only a few seconds per inch of travel when drilling most materials.

Once seated, the drill, called the Di-Met Core Drill, travels in a straight line and, with care, unbroken cores of any length within the drill capacity are easily produced. On most operations coolant from the local water main is satisfactory. When drilling exceptionally hard materials, such as petrified wood, special coolants or additives, such as a soluble oil, may be preferable. The supply is connected to the coolant head through a flexible rubber hose and this head remains stationary during drilling operations. It is packed

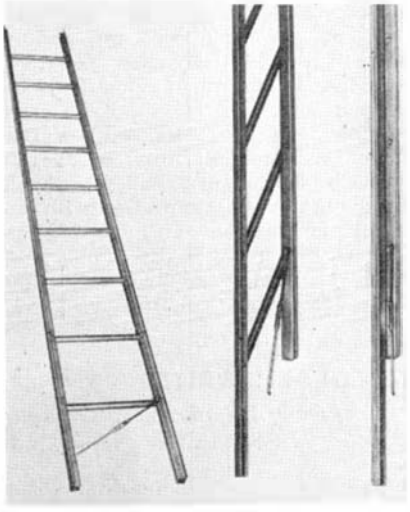
off both above and below the port of coolant entry.

The complete drill head assembly, a product of the Felker Manufacturing Company, consists of a collet drill shank, a coolant head, which slips over the shank, and individual collets to which the drills are attached. Drill collets readily detach from the collet drill shank, permitting free access to either end of the core drill. Tight cores are thus easily ejected.

COLLAPSIBLE LADDER

Folds Easily, Takes Little Space in Storage

LIGHT-WEIGHT and completely collapsible, a ladder whose rungs are made of aluminum tubing, and with side rails of extruded aluminum, weighs approximately 40 percent less than conventional wood ladders of the same length. When not in use, the two side rails fold together and the rungs fit compactly within the extruded sections, making the ladder easy to store and



Open . . . partially folded . . . folded

carry in close quarters. When folded, the ladder takes up less space than a two by four timber. A simple snap-action locks the ladder firmly and safely in either open or closed position. These ladders are made by the Gepfert Manufacturing Company in all standard lengths up to 28 feet, in either single or extension type.

REPLACEABLE HAMMER TIPS

In Three Hardnesses Extend Tool's Versatility

AVAILABLE in three grades of hardness, replaceable tips for a series of hammers are stamped "soft," "medium," and "hard" so that the operator can quickly select the tip needed for the particular job at hand. While in use, tips are locked firmly in place.

While these replaceable tips add to the versatility of the hammer, they are also an economy feature, since the hammer's life may be extended by inexpensive replacement of the tips.

Unlike rawhide and rubber hammers, these tips have virtually no rebound or sting, a feature that not only makes them less tiring to use, but also more accurate. The tips are made of "live" material called Nuplaflex that retains its shape under the most severe punishment. In tests they are reported to have regained their original form after being crushed flat by 20,000 pounds of pressure. The tips are chip-proof, non-explosive, and will not flash burn.

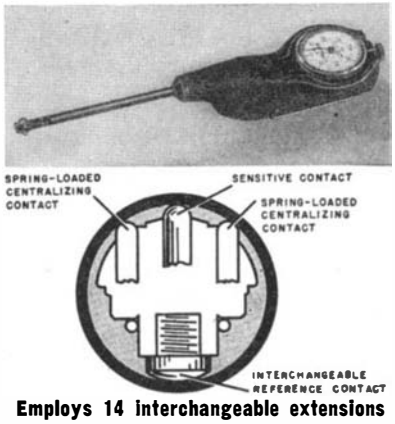
Called the Nupla Hammer by its manufacturer, The New Plastics Corporation, it is designed as an all-purpose tool for mechanics, machinists, auto body repairmen, assemblers—wherever a "soft" faced hammer is required. It is available in five sizes and ten weights.

HOLE GAGE

Features Self-Centralizing And Readability

REVEALING size variations in tenths of thousandths, a new small hole gage makes possible thorough inspection of inside dimensions between .250 and .500 inch. The spring-centralizing design plus precise measuring contacts and motion transfer units locate themselves in the hole and show the true diameter reading with a high degree of accuracy. The gage employs 14 interchangeable extensions to cover the full range from ¼ to ½ inch. It explores any hole within its capacity to a maximum depth of 2¼ inches, revealing diameter and also roundness, taper, bellmouth, and other hole inaccuracies.

Used as a single-purpose inspection tool or for checking a large variety of sizes, it shows precisely and sensitively how much a dimension varies, and not merely whether it's in or out of tolerance. Being a point-to-point contact gage, it reveals any small area imperfections in the hole. All contacts, both measuring and centralizing, are hard chrome plated and carefully radiused for long-lasting, accurate service. Called Model 1204 by its manufacturer, the Federal Products Corporation, it is extremely light and fits the hand comfortably.



Employs 14 interchangeable extensions

The gage comes complete with adjusting wrenches and the extension or extensions required. It is easily adjusted for a particular dimension with a master ring of the proper size.

The inspector can readily see dimensional variations as small as .0001 inch or as large as plus or minus .004 inch on the indicator dial.

PALLET LIFT TRUCK

Is Easily Elevated With Hydraulic Foot Pump

STRONG but light-weight, a pallet lift truck has a frame constructed of sheet

Relief valve prevents overload damage

steel formed into box sections, with wheels and other non-structural parts made of aluminum alloy. Elevation is accomplished by a hydraulic foot pump whose stroke length is dependent upon the stature of the operator. By pushing the foot pedal forward, the lift, a product of Lyon Raymond Corporation, is lowered. The pump is equipped with a relief valve to prevent overloading and possible damage.

CUTLERY HANDLES

Of Birch-Plastics Laminate Resist Heat and Acids

HARD enough to be used as a metal-forming die during the war, a compregnated wood and plastics material is now being used for household cutlery handles. The new material, called Pakkawood, has been in use since early last year, and has shown excellent qualities of durability, and heat- and acid-resistance. The new material retains its original luster even after continuous soaking in dish water. For many years the cutlery industry has been experimenting with materials for household cutlery handles that would retain their original color and lustre in use. Most handles were made of imported hard woods. Pakkawood, which during the war was also used to make propellers for training aircraft, is made of thin layers of birch wood that are immersed in baths of liquid plastics. The wood is then stacked

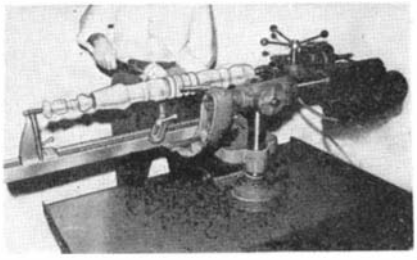
in layers and compregnated in presses that develop over 600 tons pressure to form solid blocks.

This material is also being used for cutlery cases containing the new self-sharpening carving knives currently being manufactured. The knives are completely encased in Pakkawood blocks which contain carborundum sharpening hones and automatically sharpen the knives as they are removed or replaced.

DRILL AS LATHE

Combination Made Possible by Simple Attachment

CONVERTING any bench or floor model drill press with a column either 2½ or 2¾ inches in diameter into a wood turning lathe, a unit known as Dril-Lathe is easily and quickly installed as a permanent part of the drill press.



As lathe, takes work up to 36 inches

Conversion from one position to the other is accomplished in a matter of seconds by simply loosening one bolt and indexing the drill press head and lathe bed in the positions desired. By combining the two tools in a single unit, a considerable amount of floor or bench space is saved, as is the cost of a second electric motor.

Installation of the Dril-Lathe, a product of the Nobur Manufacturing Company, on the conventional drill press requires only the removal of the standard drill press column for replacement by the two-piece pivotally connected tubular column furnished as part of the unit's assembly. No further changes are required, and the utility of the drill press is in no way altered. When moved to the lathe position, the converted tool can handle all types of wood turning, and will take work up to 36 inches in length.

OSCILLATING COMPRESSOR

Has High Output, Can be Adapted to Many Uses

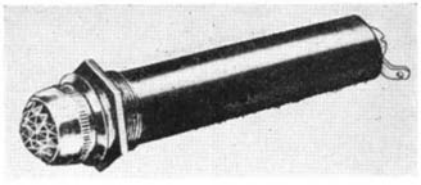
HAVING only four major driving parts, a new oscillating compressor produces an unusually large volume of air with a comparatively low horsepower motor running at a low speed. The two cylinders of this compressor are each divided into four compartments by two stationary vanes and one oscillating rotor which is fixed to the rotor shaft. Thus an equivalent of eight-cylinder performance is achieved. A test model weighing 350 pounds, with a bore ten inches in diameter and nine inches deep, was run at 235 revolutions per minute. It produced over 500 cubic feet per minute of free air at room temperature, an output reported to be 10 times that of conventional compressors of comparable size. And after having run for eight hours with no cooling device, the temperature of the compressor was found to be only 100 degrees, Fahrenheit. Vibration is so low that a coin balanced on the compressor's housing remained poised during the entire test. A 20 horsepower, three phase, 220 volt motor was used for the test.

This compressor, developed by Associated Engineers, Inc., is expected to find wide application where conventional models are impractical because of weight and size. It can be adapted to refrigeration, hydraulic, ventilation, and stage booster pumps.

WARNING LAMP

Easily Installed, Features Automatic Blinking

CONTAINING all the necessary elements including the flashing mechanism, an attention-arresting panel warning lamp blinks automatically when activated. The lamp is easily mounted in a single hole; with a grounded panel, only one terminal wire is required. Standard



Can be mounted in a single hole

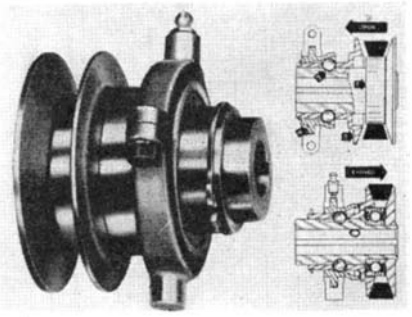
lamp bulbs are used, and are readily accessible from the front of the panel. Manufactured by Jersey Technical Enterprises, the device is known as Blink-O-Light, and is available in a variety of sizes and voltages.

V-BELT CLUTCH

Provides Shockless, Easily Controlled Load Pick-Up

DESIGNED to grip or release directly on the V-belt, a clutch unit, complete in itself, may be used either as a driving or a driven pulley. In operation, the positive, smooth clutching action is the grip of the sidewalls of the pulley against the belt. When the clutch is opened, the belt slackens and idles on a free-running, grease-sealed, ball-bearing, with no attendant belt drag or creep. One fixed flange of the V-belt sheave is an integrally attached part of the hub and the inner race of the sealed ball bearing belt idler, as shown at point Number 1.

Four free-rolling steel balls (Number 2) rides in grooves in the hub and carry all turning and locking forces. The balls are carried forward by the sliding clutch sleeve or movable flange (Number 3), and drop into pockets at the ends of their grooves. The cam sleeve (Number 4) then moves over the clutch sleeve, and locks the clutch against the balls in driving or driven position. All parts turn with the shaft.



Driving or driven pulley

The engaging action which grips the belt and at the same time forces it away from the idler bearing and into working position is smooth and shockless in load pick-up.

A stop ring prevents over-travel of the cam sleeve in disengaging action. The cam sleeve carries a projected flange on which a shift collar is mounted, in its turn actuated by a shifting fork.

Known as the Ball-lok V-Belt Clutch, it is manufactured by the V-Belt Clutch Company and is suitable for application in connection with internal combustion engines, motors, tractors, and many types of machines where compactness, light weight, and controllability are requirements.

TELEGRAPH WRITER

Permits Inexperienced Operator To Send Clear, Rapid Code

FULLY automatic, a telegraph code writer will send perfect telegraphy in any code from two to 60 words per minute. Since the code writer is similar in appearance and operation to an electric typewriter, even inexperienced operators can send flawless and easily-understood code. Unaffected by centrifugal force, it may be operated on

Can also be used for code instruction

ships, in airplanes, on trains or automobiles. Nervous strain and the "swing" of operators are entirely eliminated.

A repeat key on the code writer, produced by the Selectograph Manufacturing Company, makes possible self instruction at any speed desired. An electronic oscillator and loudspeaker monitor (which may be replaced by a sounder) with jacks for head phones or a remote loudspeaker affords easy instruction and invaluable aid to classroom instructors. The speed of transmission is controlled by a speed selector and a calibrated speed indicator mounted on the instrument.

The Selectograph Code Writer is motor driven and may be equipped for any A.C. or D.C. voltage specified. Machines are available for International Morse Code, American Morse Code, or any other type of code. Ciphers may be easily adapted to the instrument for secret transmissions, using standard codes, by changing cams, or by use of private code ciphers. Code is sent by the instrument through a series of cams operated by friction drive. An interlocking key mechanism prevents striking a key while a cam is in motion.

Standard equipment includes volume control and switch, three position tone control, and indicator lights. Later models will include tape recorders for recording code transmissions or for preparing tapes for transmission.

PARTICLE COUNTER

Detects Dust and Bacteria In Air By Noting Scattered Light

AUTOMATICALLY counting individual smoke particles or bacteria as small as 25 millionths of an inch in diameter and weighing only four millionths of a billionth of an ounce, a new photoelectronic instrument is expected to be useful to the research bacteriologist in testing contamination, and in many industrial plants producing pharmaceuticals, such as penicillin or streptomycin, or chemicals, such as alcohol or acetone, by fermentation. The counter also may serve in detecting dust which must be excluded in the manufacture of photographic film and fine optical instruments.

When sunlight streams through a window into a darkened room, the sparkling motes of dust are clearly visible, because of the light which they reflect and scatter. All suspensions of finely divided materials in air, called "aerosols," show this property of scattering light. This is true whether the material be transparent or opaque, solid or liquid.

The new instrument utilizes the light scattered by the microscopic particles. A brilliant light is concentrated in the center of a black-walled cell by means of a condensing lens. A stream of air containing the suspended particles—of smoke, for example, or bacteria—is passed through this bright spot, and each particle signals its presence by a flash of light. An electric eye, arranged to view these flashes, translates each into a tiny electric pulse, which is amplified 200,000 times by an electronic circuit.

The amplified pulse then is fed to a trigger tube which gives a large enough surge of current to actuate an electromagnetic counter. Thus each pulse advances the hand of the counter one division on a circular dial, which is graduated from zero to 100.

The apparatus, originally designed to check the filters of American service gas masks by detecting the passage of even a few microscopic particles, can serve as a supersensitive filter tester. If one particle out of every 10,000,000 in a concentrated test smoke passes through a filter, its presence can be detected.

Experiments carried out with airborne spores of bacillus globigii showed that these could be counted satisfactorily. The device, built at Northwestern University, is being tested to determine its usefulness in counting other airborne bacteria. For those bacteria which are not too small, the counter may supply the bacteriologist with a method of determining the concentration of bacteria in the chamber in which his test animals are placed under carefully controlled conditions.

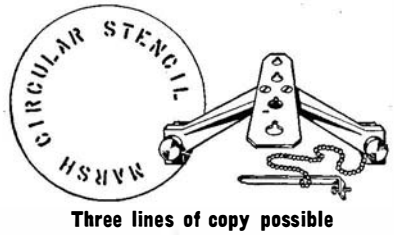
Unfiltered laboratory air passed through the apparatus gives more than 1000 pulses per minute, more than can be counted by the instrument in its present stage of development. Hence, the counter is extremely useful now in detecting small leaks of room air into systems in which the air is supposed to be filtered carefully. In testing con-

tamination of a system in which sterile conditions are required, the presence of a trace of room air will show up instantly on the counter, while in the usual bacteriological count, involving collection, culturing on an agar plate, and counting of resulting bacterial colonies, it will not appear until hours later.

CIRCULAR FEED ATTACHMENT

Facilities Change From Straight To Round Stencil Cutting

SHIPPERS of barrels, drums, pails, or similar articles, will find a circular feed attachment for stencil-cutting



Three lines of copy possible

machines a convenience. Quickly and easily installed, the attachment enables instant change-over from cutting straight to circular stencils, and vice-versa. Developed by the Marsh Stencil Company, it is adjustable to permit cutting three line addresses or copy in inside diameters of 11, 14, 17, or 20 inches. Letters are spaced automatically and accurately, and word spacing is the same as when cutting a straight stencil.

STAINPROOFED TEXTILES

Quickly Cleaned by Wiping With Damp Cloth

FABRICS which can be quickly wiped spotless and clean of spilled foods and beverages are made possible by the applications of a new stain-repellent chemical which can be applied to wool, cotton, rayon, aralac, nylon, acetate, and to mixtures of these fibers. Primarily developed as a water repellent, the new product differs from ordinary repellents in that it enables the fabric to retain all of its original strength and beauty after it has been treated, and ordinary liquids and foods can be wiped off with a damp cloth with no effects apparent in the fabric.

Application of repellent wool fabrics in new planes of American Airlines enables the line to serve meals aloft without risk of staining the planes' interior fabrics; the fabrics will apparently retain their wool gabardine appearance indefinitely.

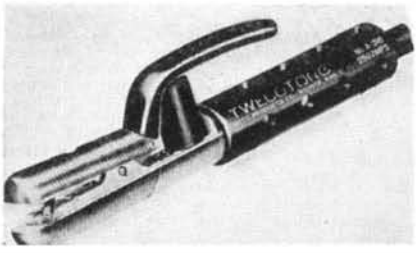
The chemical, developed by the Monsanto Chemical Company, is applied within individual fibers of a fabric which thus retains its original look together with its ability to "breathe"

through inter-fiber spaces. This quality is of increasing importance in future clothing applications, including use in men's suits. The treated fabrics may be laundered or dry-cleaned with no reduction in their water-repellent and stain-resistant characteristics.

COMPACT ELECTRODE HOLDER

Built To Withstand Heat and Shock

DESIGNED primarily for the small job shop or the maintenance welder, an electrode holder with a capacity of 250



Capacity is 250 amperes

amperes will take rods ranging in size from 1/16 to 3/16 inch. Simple both in construction and operation, the tool, made by Tweco Products Company and called Twecotong, weighs only 18 ounces and is nine inches long. Tip and body insulation is of glass cloth impregnated with Bakelite, which offers high heat and shock resistance. The cable connection is a simple clamp.

IMPROVED CONVEYOR BELT

Carries Heavier Load a Greater Distance

MOVING coal, iron ore, and other bulky materials over long distances, a new conveyor belt, 250 to 400 percent stronger than previous rubber-fabric belts, has as the key to its increased strength a new textile construction of nylon and Ustex yarn that increases the permissible working tension of each ply two and one-half times and permits the use of more plies. The new product is especially designed for use in mines, quarries, and large dam construction projects. Carrying heavier loads than other rubber-fabric belts, it will extend the range of conveyors and eliminate many costly transfer points and extra driving mechanisms.

In addition to greater strength, the new belt has the advantages of low stretch lengthwise and increased flexibility crosswise. These two features make it possible to build a longer and heavier belt with a minimum of stretch and excellent troughing qualities. The belt can be spliced easily and quickly, and repairs can be made promptly by conventional repair techniques.

Ustex yarn is a development of United States Rubber Company textile scientists, and was used during the war to make Army parachute harness.

The Editors Recommend

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

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Conducted by K. M. CANAVAN

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TEN GREAT INVENTIONS. This 32-page booklet tells the story of invention of the following basic machines whose modern counterparts are used today: power loom, sewing machine, cotton 'gin, lathe, steamboat, locomotive, coal cutter, typewriter, linotype, and the continuous sheet steel mill. *National Machine Tool Builders' Association, 10525 Carnegie Avenue, Cleveland 6, Ohio.—Gratis.*

THE DEVELOPMENT OF THE BRITISH GAS TURBINE JET UNIT, a series of lectures originally published in War Emergency Issue No. 12 of The Institution of Mechanical Engineers, is now available in book form. It provides first-hand accounts of researches conducted in Great Britain to find general solutions to the basic problems of the gas turbine engine which will be applicable to most forms of power plant. *The American Society of Mechanical Engineers, 29 West 39th Street, New York 18, New York.—$3.00.*

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By John Clayton Tracy

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By Gordon B. Thayer, B.S.E. (M.E.)

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Edited by W. Heisenberg
Translated from the German by T. H. Johnson

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By Myron L. Begeman

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mary of progress. The collection is above all interesting, sometimes fascinating, in its presentation of a great diversity of scientific subjects, in spite of the fact that more than half of the selected articles deal with health, hygiene, and disease. Here, as in many other cases of what has come to be known as popular science, the field of science is interpreted to give special emphasis to ingenuity and mechanical adaptations rather than to the deeper intellectual searchings that characterize the scientists' view of their calling. In spite of its inherent interest, this book can hardly be considered as a true evaluation of a decade of scientific progress. (310 pages, 6 by 9 inches.)—$3.10 postpaid.—*D.H.K.*

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The Editor

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By Edward Sagarin

WHILE this book gives the reader a cross-section of the industry of perfumery, its primary function seems to be to introduce the reader to all the various parts of a subject which the writer has found fascinating in the extreme. Having found his subject absorbing, the writer is moved to share his enthusiasm, and this he does with good effect. The treatment is that of a survey intended to give a broad view of the subject matter rather than to teach techniques or to supply the details of processes. The historical and the phychological aspects of perfumery are stressed, as well as gathering the raw materials of the perfumer's art. The value of the book, in addition to its natural interest, lies in the background it provides against which to view the details of the industry of odors and flavors. (268 pages, 5 by 8 inches, illustrated.)—$3.10 postpaid.—*D.H.K.*

ESSAYS IN SCIENCE AND PHILOSOPHY

By Alfred North Whitehead

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Edited by John Warren Knedler, Jr.

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Telescoptics

A Monthly Department for the Amateur Telescope Maker

Conducted by ALBERT G. INGALLS

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

NOW THAT 16" telescopes are being tackled by more and more amateurs, advice about ways to work large mirrors is being sought. A 16" may be worked by hand atop a full-size tool. Porter did this years ago and Wm. Buchele, Toledo, in 1939, worked a 100-pound 21" mirror that way but was very muscular. Plate glass tools are satisfactory against Pyrex. To forefend against sticking, no joke if on a 16", the tool should be channeled and the lap sub-faceted as described by Ferson in "A.T.M.A.," (printings since 1944, June), pages 101 and 99. Better than the full-size-tool, face-down method may be the sub-diameter hand tool, face-down method described in "A.T.M.A.," page 49. Not all have had happy results with this method; it is hard to confine strokes to desired zones and to apply even pressures. More experience letters that would help others are needed concerning it.

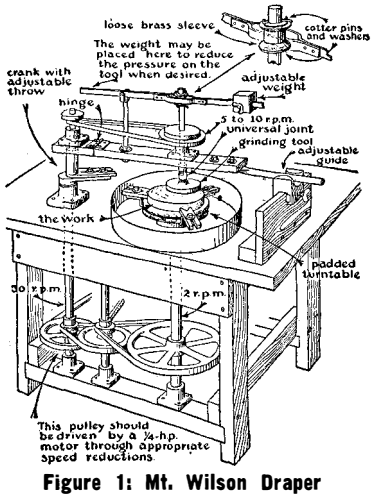

Figure 1: Mt. Wilson Draper

Probably a 16" mirror calls for a machine. The Hindle machine is analogous with full-size-tool, mirror-on-top hand work. Neither method scientifically provides what Dévé in "Optical Workshop Principles" calls the "condition of uniform wear," hinted at by Driscoll in this space 1945, November. Referring to the common mode of working, he wrote: "On a concave surface a polisher having the same diameter as the work will have a tendency continually to shorten the radius of curvature, polishing the center more than the edge. Therefore a hyperbola develops. In trying to lengthen the radius and get out of this hyperbola the worker resorts to very short strokes and thus, by polishing the edge more than the center, he lengthens its radius and winds up with two foci."

Suppose, now, we substitute a machine (or analogous hand methods) using sub-diameter tools with such correctly chosen (1) size (2) stroke length (3) endwise decentering (4) sidewise offset, that the curve will sink as a whole—no change of radius, no zones of differing radii, just uniformly thin slices off the mirror, curved of course. This is the condition of uniform wear and you can learn the needed combination of the four factors named by experimenting a long time with an old mirror and connecting causes and effects; or by digesting Ritchey's classic "On the Modern Reflecting Telescope, and the Making and Testing of Optical Surfaces" (out of print, rare); or by reading this department next month. Meantime, let's look at two modified Draper machines.

There is no officially correct, ordained form for the Draper but the one shown in Figure 1, reproduced by permission from Strong, "Procedures in Experimental Physics" (Prentice-Hall, New York) is well regarded by many, though its trappy top hammer and slippy vertical crankshaft belt are regarded by others as details not to imitate. The machine from which this drawing was made is still in use at the Mt. Wilson Observatory Optical Shop and a tracing of Figure 1 was sent to Ralph Dietz, a former amateur then working there, to elicit comment. He replied: "The machine in Strong's book is the best type as far as I am concerned; I have used many but like this one best."

On specific details of this drawing he commented: "The belt over the arm is used only in roughing out or fast grinding." Some find Drapers, like Hindles, are not fast excavators and suggest an auxiliary for hogging out, perhaps a hand lever spindle like "A.T.M.," page 163, Figure 3, *C*, with 5/6 diameter channeled glass tool or half-diameter ring tool (circle of glass blocks pitched to metal backing). Broadhead temporarily belts the motor directly to the turntable pulley, substitutes for the turntable a convex sub-diameter iron tool, face up, and holds the mirror by hand. Or the Draper may be used normally but with as fast strokes as it will stand and the tool forcibly rotated. (Note: Universal joint in Figure 1 is used only for hogging out.)

Dietz again commented: "Arrange machine so that driving pin can be shifted along arm—very important and useful." This calls for a slot adjustment in the arm; see "A.T.M.," page 165, original Draper. This in turn nullifies belt atop arm. A cone pulley there would, it is true, afford four positions but entire freedom would be still better. For ordinary grinding and polish-

ing, also figuring, Broadhead favors an entirely free tool, as does Ferson for all purposes. Ritchey insisted strongly on forced tool rotation. Numerous advanced amateurs today can match Ritchey in skill. Take your pick; it's a free country. An effect similar to decentering along slot may be had by off-centering mirror on turntable. Ferson often uses this on his Draper machine.

Dietz further wrote: "If afraid of wrist-breaking crank at table level in the Strong drawing, substitute the crank I sketch." This is re-drawn in Figure 3, at *A*. Central bolt might enter from beneath and have big wing nut. Better than set-screw, weld round eccentric on vertical crankshaft.

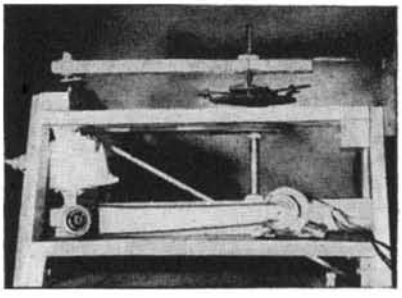

Figure 2: Broadhead's Draper

Sketches in Figure 3 are your scribe's and your groans are excusable. Would that Porter were handy. A draftsman who himself is a telescope maker and therefore knows what he is drawing, and also is an artist, is a combination devoutly to be desired. Many have written and spoken glowingly of Porter's pencil-skilled help to our hobby.

Dietz comments, finally: "I never used fancy counterweight lever on top but piled lead weights on collar on driving pin." This reminds one of Harold Lower's comment about his simple hogger-outer in "A.T.M.A.," page 410: "Our machine was so damn' simple that fellows who copied it added fancy complications, and then it was out of order half the time." Perhaps Lower overlooked "Yankee ingenuity;" that is, never leave simple what can be possibly be complicated.

The "adjustable guide" in Figure 1, which permits changing offset of stroke *without stopping* is important. If you must stop you will not fully exploit such a feature, which Ritchey regarded as highly valuable. This, too, might be complicated but the piece of gas pipe shown, running in a plain open metal or wooden notch, is as good.

In the Draper the stroke is slightly elliptical which, as Broadhead points out, brings the lap to two zones at ends of strokes instead of to same zone at either end. This would not be the case if decentering were gained by off-centering mirror on turntable.

As it is difficult to avoid high extension of crank pin above bearing at tabletop this shaft should be rugged and a little more than generous. Majority of machines made by amateurs have had too light shafts—whippy, some scandalously so. The bearing may be made from a common cast-iron, plumb-

er's floor flange bored out in a lathe. No babbit is needed since cast-iron is porous and absorbs oil.

No scaled blueprints for Figure 1 are to be had. Original drawing in Strong's book is twice present scale, also includes detail of turntable shaft, its head and plate. But most advanced amateurs own this book or should.

One of the best machines your scribe has seen is a modified Draper (Figure 2) built by Dave Broadhead, Wellsville, N. Y. Frame is a double A-frame, a big saw horse of two-by-fours. Length 44", leg spread 36". Height to table top 38" (make it to suit your own legs or high stool). Lower part of legs does not show in illustration. Table top is two two-by-sixes.

Same illustration shows motor with step pulley, lower right, and long transverse belt (sag helps adhesion if pull is on lower member). At left is a worm gear speed reducer, vertical type, 36:1 (belts are less satisfactory for high torque at low speeds). Directly coupled above reducer is a Ford transmission. Belt for side drive to turntable has pulley hidden within housing. Crank is at top left. Arm is a two-by-four ending with ⅜" gas pipe in metal notch.

Turntable shaft (full 1¼") has 7/8-14 SAE right hand thread at top and is shouldered. Most commercial machines have ¾" 10-pitch National Coarse threads, at least for work up to 10", and spindles which rotate counter clockwise.

Arm slides freely up or down around drive pin (Figure 3, *D*), its weight not on tool. Additional weights, if used (but see Broadhead's "Moist" technique, this department, 1947, April), are added to top of single weight shown.

Figure 3, *E*, shows two simple vertical thrust bearings for shafts. Omitted in the sketch is some kind of lateral retainer; otherwise the shaft might some time hop off the ball.

End of gear shift handle does not show in Figure 2—bent up for easy reach. Transmission gives three speeds and plenty of torque. Broadhead says his 1/10 h.p. motor at 1750 r.p.m. gives 600-pound thrust, in low gear. He uses slow speed for more exacting work—getting smooth spheres, figuring. Nine speeds permit choices that work out in similar lineal speeds regardless of diameter of mirror.

Motor belt cone pulley	Turntable	Arm
1	low 1.2	6
	2nd 2.0	10
	high 4.5	22
2	low 2.0	12
	2nd 4.0	20
	high 7.5	38
3	low 6.0	32
	2nd 8.0	40
	high 13.5	68

A 1/3 h.p. motor easily handled 31" tools for 36" mirrors on job described here last month. Here a separate turntable was used, driven from same crank.

A car light-dimmer floor switch in the power line has been useful as a quick stopper for emergenecies.

Action of the polishing lap, free to

rotate automatically, is interesting to watch. If the initial contact is poor the lap rotates retrograde from the arm but after a minute or two as contact improves it slows, stops a moment, then reverses; thereafter rotating in the same direction as the arm.

Nearly all manufactured machines for use in the optical industry—that is, commercial machines—have free tools but Ritchey insisted strongly on driven

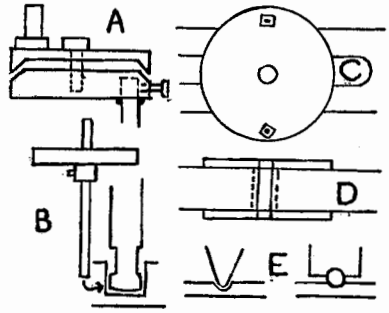

Figure 3: Draper details

tools, writing "the slow rotation of the grinding and polishing tools is rigorously controlled by pulleys and belts." Which, then, is the correct way? Proponents of each argue heatedly but the cynic punching the type mill on which these comments are written suspects that the correct way is largely the one you happen to adopt and get used to using. If this is the case, may it not be best to fall back on the principle, when in doubt plump for the lesser complication and resist temptations to exploitation of Yankee ingenuity.

Arc stroke machines like "A.T.M.," page 163, *B*, are basically Drapers. Their "adjustable guide" feature shifts automatically each stroke, spreading the work over two zones. The otherwise elliptical stroke is deformed into a kind of bent hot dog shape.

Triangular (German) machines like *A*, same figure, are still more versatile. Not shown in sketch is adjustable speed drive for secondary arm, also sliding attachment of that arm along main arm. Note that secondary arm may be lengthened, shortened. Gadget above letter *A* is a bevel gear screw for altering spindle level. On this German, Zeiss, or triangular machine the "adjustable guide" shifts automatically but not so often as in the arc-stroke. Back geared. Ritchey chose to shift this (his "transverse slide") by hand and often, but he usually worked on such big mirrors that this may have seemed to be a better way to distribute the work widely over the zones. Anyone who knew Ritchey might be likely to say that, with his meticulous nature, it would have been difficult for him to sit and watch the machine do it all. He would have to have a frequent hand in it. The transverse slides of his machines were equipped with a screw to perform this function which he did by means of a hand wheel (lathe type). This may have resulted in smoother progression across the zones but, avast!, mention of this may lead some reader into the temptation to substitute a screw and wheel for the simple adjustable slide.

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