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Scientific American

★ 100th Anniversary Year ★

REPORTING THE PROGRESS OF SCIENCE AND INDUSTRY

SCIENTIFIC AMERICAN.

THE ADVOCATE OF INDUSTRY AND ENTERPRISE, AND JOURNAL OF MECHANICAL AND OTHER IMPROVEMENTS.

VOLUME I. NEW-YORK, THURSDAY, AUGUST 28, 1845. NUMBER 1.

THE SCIENTIFIC AMERICAN.

By RUFUS PORTER.

IMPROVED RAIL-ROAD CARS.

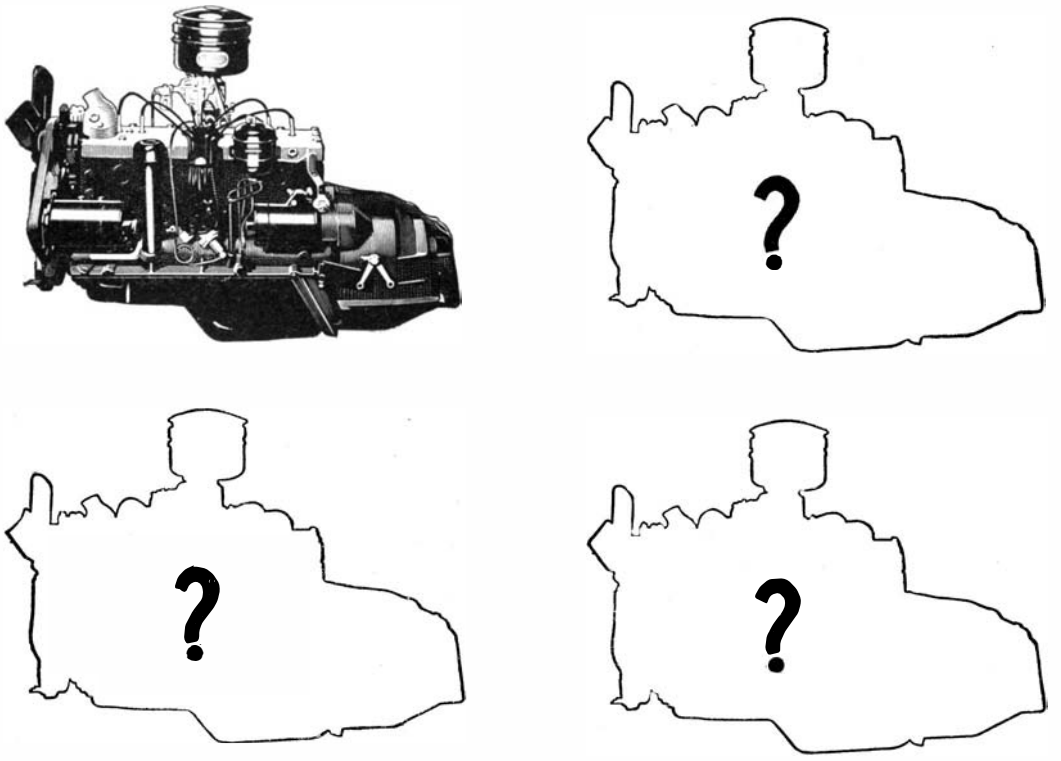
There is, perhaps, no mechanical subject, in which improvement has advanced so rapidly, within the last ten years, as that of railroad passenger cars. Let any person contrast the awkward and uncouth cars of '35 with the superbly splendid long cars now running on several of the eastern roads, and he will find it difficult to convey to a third party, a correct idea of the vast extent of improvement. Some of the most elegant cars of this class, and which are of a capacity to accommodate from sixty to eighty passengers, and run with a steadiness hardly equalled by a steamboat in still water, are manufactured by Davenport & Bridges, at their establishment in Cambridgeport, Mass. The manufacturers have recently introduced a variety of excellent improvements in the construction of trucks, springs, and connections, which are calculated to avoid atmospheric resistance, secure safety and convenience, and contribute ease and comfort to passengers, while flying at the rate of 30 or 40 miles per hour. We purpose to give a particular description of these improvements, accompanied with suitable engravings, in our next number, that our readers may be enabled to appreciate more fully the progress of improvements in this important branch of mechanism.

Wife, Children and Friends.

Attraction.

CATALOGUE OF AMERICAN PATENTS ISSUED IN 1844.

Anniversary
Issue
No. 12



HOW MANY ENGINES ARE THERE IN YOUR LIFE?

LET'S SEE—there's the engine in your car. That's one. But don't answer the question too quickly; you may be overlooking dozens of other important engines.

For example, when you came down to breakfast this morning you found a bottle of milk that had just been delivered in a milk "wagon" hauled by an engine instead of a horse. Your rolls, eggs and coffee, too, came at least part way by truck. And the breakfast food you ate was probably grown with the aid of a gasoline-engined tractor.

There's a good chance you came to work on a bus. That's another big engine to remember. The airmail letter waiting for you on your desk got there with the help of two—maybe four—powerful aviation engines. And sometime during the day a motor truck will roll up to your door with materials for you, while perhaps another one is delivering your products to your customers.

We could go on and on—but by now you've realized there is scarcely a thing you eat, drink, read, wash yourself with, make, buy or sell that isn't manufactured or transported with the help of gasoline engines. In fact, your life is full of engines. Doesn't it follow that when these engines are made more efficient, more powerful, more economical, more durable, you will benefit?

Our product, Ethyl antiknock fluid, helps petroleum refiners make higher octane gasoline, which in turn permits engine builders to build more efficient engines. Helping to improve engines, fuels and lubricants—the three must be considered together—has been the function of the Ethyl Corporation for the past two decades and remains our goal for the future.

More power from every gallon of gasoline through

RESEARCH • SERVICE • PRODUCTS

ETHYL CORPORATION, *Chrysler Building, New York 17, N. Y.*

Scientific American

Founded 1845

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Our Cover: Page 1 of Volume 1, Number 1, Scientific American, greatly reduced in size, forms a fitting subject for this month's cover illustration. A running history of the development of Scientific American—from 1845 on—will be found in the article starting on page 327.

SCIENTIFIC AMERICAN, December, 1945. Vol. 173, No. 6. Owned and published by Munn & Co., Inc., Orson D. Munn, President; I. Sheldon Tilney, Vice-President; John P. Davis, Secretary-Treasurer; A. P. Peck, Assistant Secretary; all at 24 West 40th Street, New York 18, N. Y. Entered at the New York, New York, Post Office as second-class matter June 28, 1879, under act of March 3, 1879. Additional entry at Orange, Connecticut. Published monthly by Munn & Co., Inc., 24 West 40th Street, New York 18, N. Y. Manuscripts are submitted at the author's risk and cannot be returned unless accompanied by postage. Files in all large libraries; articles are indexed in all leading indices. Subscription $4.00 per year. Canada and foreign $5.00.

Previews of the Industrial Horizon

By A. P. Peck

ATOMIC POWER

NOW THAT the first burst of enthusiasm—misguided and otherwise—regarding atomic power has simmered down somewhat, it seems appropriate to scan briefly some well-founded opinions on the subject.

At a recent meeting of the American Society of Mechanical Engineers, members of the Gas Turbine Coördinating Committee rendered a preliminary report on atomic power. Looking upon atomic energy as an addition to the world's supply of fuel, the committee goes on record as saying: "It is felt that atomic power certainly will not replace present fuels but will supplement them, as oil supplements coal." They look forward to the possibility of power-plant units "above 200,000 kilowatts, wherein both the gas and steam turbine are utilized in the same plant, using both present fuel and atomic power to achive the greatest efficiency."

Because the heat evolved in atomic fission offers an intriguing lure to the power engineer, the Gas Turbine Committee warns: "Possibility exists also that radio-active by-products of the atom-splitting process might make the air unusable in a gas turbine. It appears from this consideration that a semi-closed cycle might be preferred, using the heat created but eliminating the radio-active by-products from the gas turbine."

All informed sources stress two important aspects of atomic power: Cost of material and time of development. Cost will undoubtedly be extremely high for years to come, and the necessary development work will pursue a long and arduous path. Thus, to central power stations, railroads, and other businesses in which the generation or use of power is of extreme importance, General Electric engineers put it this way: "Were we responsible for conducting the affairs of such organizations, we would go right ahead with our plans for the years to come on the basis of present-day commercially available sources of energy: namely, coal, oil, and water power. Only as research and development proceed shall we learn the limitations and possible practical commercial applications of nuclear power."

PATENTS AND SMALL BUSINESSES

STATING that "the Patent System functions as the indispensable stimulant to that competitive enterprise upon which the continued progress and security of America depends," the National Patent Council has been organized to represent smaller manufacturers in the defense of the United States Patent System. The Council, controlled by the smaller manufacturers, will appeal directly to fair-minded Americans to prevent misled "reformers" of the patent system from promoting monopoly by making changes in our patent laws which would threaten the life of every smaller company relying for its existence upon patent protection.

FURNITURE FINISH

AN ENTIRELY new finishing system for wood looms on the horizon and promises a better, faster, more economical method of operation for all wood furniture plants.

In the past, the accepted method of finishing fine furniture involved the use of a number of coats of comparatively slow-drying varnish. Each coat was carefully sanded by hand and given its final polish by the same method. Then came the fast-drying lacquers that cut finishing time from weeks to a matter of days, but still required polishing to bring out the grain of the wood. But—and here was the catch—a finish that could successfully be sanded could not be hard, tough, and elastic; and hardness, toughness, and elasticity are greatly to be desired in furniture finishes.

Now comes the new Durez process, in which neither varnish nor lacquer is used. Rather, the protective film is a pure resin of the type found in phenolic molding compounds. However, it does not have to be applied in sheet form but can be sprayed like an ordinary lacquer and cured in a matter of minutes, using infra-red. The resulting film is tough and hard, and resistant to water, mild acids, alkalies, and abrasive compounds. Best of all, from an industrial standpoint, it makes possible the development of a beautiful finish on a piece of wooden furniture within three or four hours after the parts have been assembled.

FUNNY FUZES AND RADIOS

RADIO engineers see great commercial possibilities in the extended use of the equipment that made possible the radio proximity fuze. This device, dubbed the "funny fuze," causes rockets, bombs, and other projectiles to burst when within a predetermined radius of the target. Heart of the funny fuze is a set-up of five vacuum tubes housed in a space smaller than that encompassed by a tea-cup. The fuze operates on radar principles but its greatest implication at the moment is for the development of pocket-size radio sets and extremely compact electronic equipment for many industrial control and indicating purposes.

TELEVISION COST

PRICES of television receivers are subject to serious discussion these days. And here's what to expect in the near and medium-near future: For $100 there will be sets giving a picture of about post-card size, suitable for two or three persons to view; for $250 to $300 it will be possible to buy a receiver that will give a picture which eight or ten persons, sitting an average of ten feet from the screen, can enjoy; if projection on a screen is wanted, so that a whole roomful of people can be entertained, expect prices upward of $1000 or more. Its all a case of getting what you pay for. The television field surely will have its Fords and its Cadillacs; and now as always, more people ride in Fords than in Cadillacs.

WOOD WASTE MAKES WOOD

A HARD wallboard made from sawdust, by a process so simple that it can be applied even by small saw-mill operators, holds promise of solving many of the problems of our diminishing wood supply. Production of the new grainless board has been likened to the housewife's use of prepared cake flour—add water, stir, and bake.

Secret of the process is the use of chemical catalysts, themselves made from wood. Reports so far indicate that the entire procedure, from sawdust through mixing and pressing, takes less than 15 minutes to the finished board.

FOR FUTURE REFERENCE

AUTOMOBILES, says an aluminum authority, should weigh 1000 pounds and up, instead of the present 3000 pounds and up. . . Those concerned with the development of aviation—both commercial and private—should give serious consideration to the development of more sightly airports. . . Color, bright and durable color, has great industrial significance; buyers of everything from tooth-brushes to tractors are more color conscious than ever before. . . Ceramics, resistant to intense heat, will in part replace metals in tomorrow's gas turbines.

So you'll see better

Nature designed your eyes for seeing by daylight. *But the average person spends most of his waking hours under artificial light.*

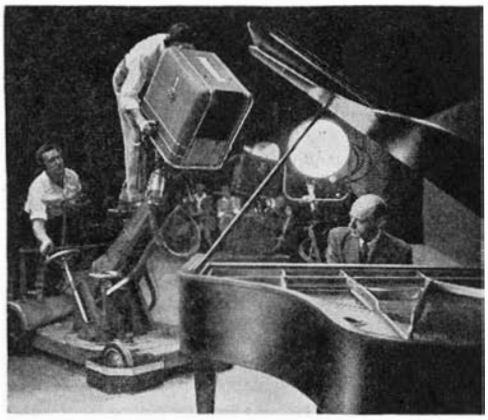
To develop *better* artificial light —for all living and working conditions—has been a continuous project of G-E engineers and research scientists. They have even developed a whole new Science of Seeing.

The pictures on this page illustrate a few ways in which G. E. is helping you see the day-by-day and night-to-night things more easily. *General Electric Company, Schenectady, N. Y.*

The tiny 7-watt G-E bulb in this night light makes darkened halls safely navigable for sleepy people. It's especially useful in homes with small children. And the cost of electric current has been brought so low that, at average residential rates, this little lamp will burn for four 8-hour nights for only a penny or so!

Powdered Light. This luminous powder that you see is a *phosphor*. Coating the inside of every G-E fluorescent lamp, it transforms invisible rays into soft, cool light. Recently General Electric developed a remarkable *new* phosphor which will be used in a new fluorescent sun lamp to provide healthful summer sunshine all year round, economically and efficiently. And speaking of economy, G-E lamp research has reduced the cost of a 60-watt G-E bulb by 75% since 1923. Another way in which General Electric helps to bring More Goods to More People at Less Cost.

What's the best light for reading? Above is one of many testing devices in the G-E Lighting Research Laboratory. The amount of light on the page and the amount of general illumination inside the sphere are varied to determine best seeing conditions.



You'll soon see important events as they happen —by improved television with a bigger screen and clearer reception. Back in 1928 a G-E engineer, Dr. E. F. W. Alexanderson, gave the first public television demonstration. And for more than five years now, G. E. has been telecasting regular programs from its own station, WRGB.

The best investment in the world is in your country's future

KEEP ALL THE BONDS YOU BUY

GENERAL ELECTRIC

50 Years Ago in . . .

SCIENTIFIC AMERICAN

(Condensed from Issues of December, 1895)

TELEPHONES — "Chicago police now have a telephone and signal system, consisting of 887 public and 370 private boxes, operating on 81 circuits, connected with the 37 precinct stations of this department, in which they are located. The system includes public sentry boxes placed at street intersections, equipped with a signal box to transmit the number of the station; a telephone for patrolmen to report and receive orders over; a chemical register at the station which records the calls, and the necessary switches for operating the telephone and testing for electrical disturbances."

ELECTRIC MOTORS — "On January 1, 1895, the Edison Electric Illuminating Company had connected 7,615 horse power of electric motors, but at the end of October it had no less than 11,263 horse power, an increase of 3,648 horse power in the short period of ten months. . . The company has 251,487 incandescent lamps connected and 3,280 arcs. This would figure out in the neighborhood of 25,000 horse power, so that one-third of the company's total connected capacity is now represented by motors. . . It is evident that the stationary motor industry must be increasing at a rapid rate, for these figures, large as they are, take no account of other stations than the Edison and do not include isolated plants."

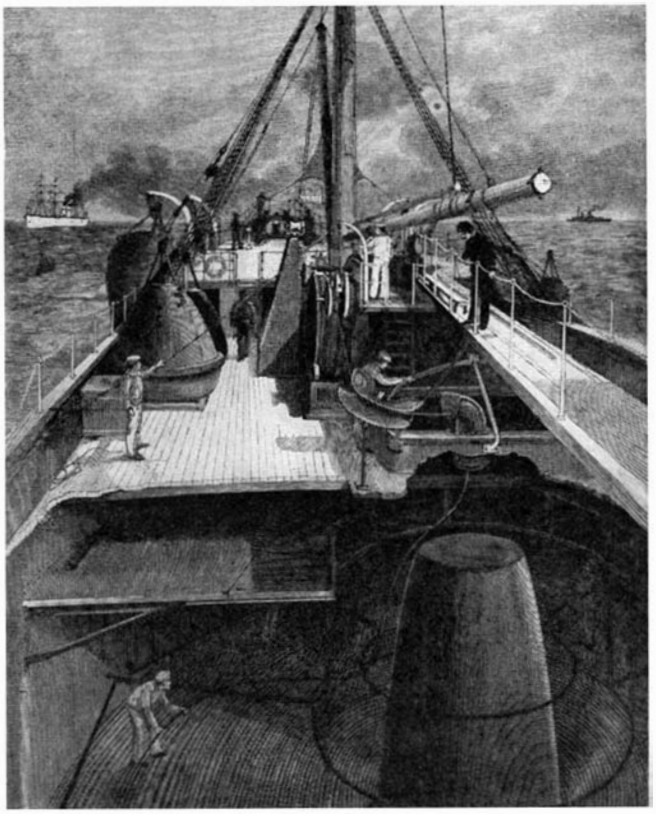
WINDMILLS — "In this country the windmill has of late years been greatly improved and brought extensively into use. It is estimated there are over half a million windmills now running, and the annual increase in sales is estimated to be upward of 50,000. They are mainly used for pumping the domestic water supply; in many of the Western States a farm is scarcely considered to be complete unless it can boast of its windmill pump."

FIREFIGHTING — "At a recent fire the Chicago firemen demonstrated at the Masonic Temple their ability to cope with fires in the upper stories of the tallest buildings. Engine No. 1 of the city fire department pumped a stream of water through 500 feet of hose and standpipes to the roof of the building, where there was sufficient force to drench the roofs of neighboring buildings. The water pressure at the engine was 240 pounds. On the roof at the same time the pressure was 54 pounds to the inch."

PROPELLER SHAFTS — "It is getting to be pretty well understood that the frequent breaking of propeller shafts is not due to the defective material of the shafts themselves so much as to the excessive strains to which they are subjected, owing to the working and straining of the hull of the ship in a seaway."

JORDAN DEVELOPMENT — "According to consular reports, it is the intention of the Turkish authorities, at Jerusalem, to establish a steamship line on the Dead Sea. The existence of asphalt in that region has been ascertained, and it is supposed that petroleum will be found also. A rational development of the Jordan Valley from Lake Tiberias down, and especially the opening up of the rich mineral resources of the Dead Sea basin, is considered a very profitable undertaking."

CABLE STEAMER — "One of the great companies, the Commercial Cable Company, owns and operates three complete submarine lines between Europe and the United States. To keep these cables in order this enterprising company has a fine steamer, the Mackay-Bennett. She is 260 feet long, 40 feet beam, and 22 feet deep, and propelled by twin screws driven by independent compound engines. The Mackay-Bennett is provided with three cable-holding tanks with a total capacity of 385 nautical miles. . . The steamer is fitted up with all the modern machinery for grappling, picking up and paying out cable. . . On the deck are placed two powerful engines for heaving in and paying out the cable."



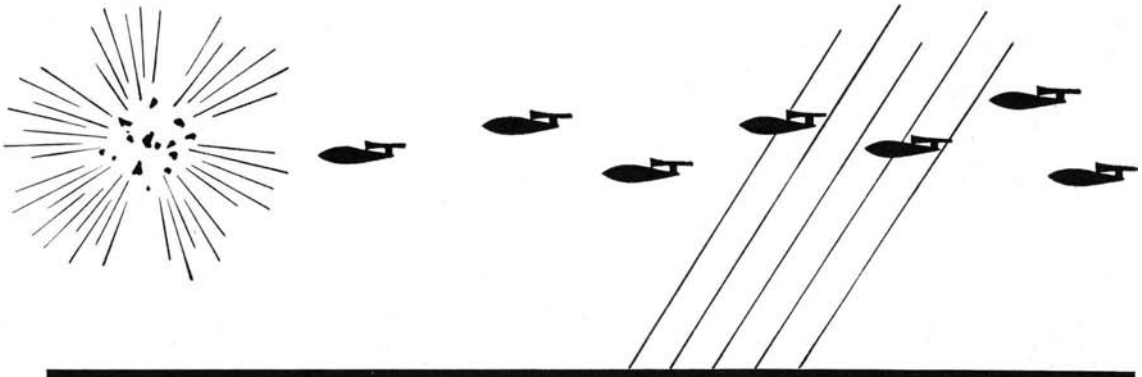
GAS VS STEAM — "The gas motor occupies less space than the steam engine with its boiler and chimney, and it has the advantage as regards attendance, for one man can look after several gas engines, while a steam engine plant of any importance requires an engineman and stoker, and often an additional hand to keep up the coal supply. Another advantage of the gas motor is the fact that it can at any time be put to work immediately."

HEELS — "One of the latest features of wood pulp industry is the manufacture of shoe heels from that material, white pine and other kinds being used for the purpose."

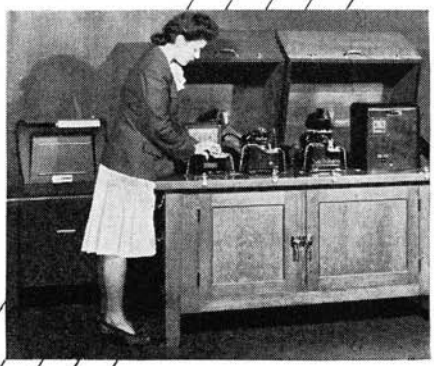
WOODWORKING — "No branch of mechanics has received greater development in the United States than that which relates to woodworking. America has been pre-eminently a wood-producing country, and has brought shaping, planing and sawing machinery into the greatest perfection."

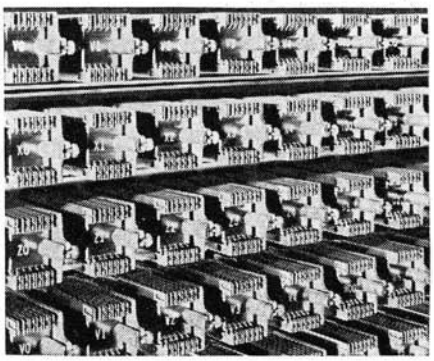
SULPHUR — "The Standard Oil Company has finally solved the great problem, on which hundreds of thousands of dollars have been spent in vain, of getting at the immense mass of sulphur which lies some hundreds of feet below the surface in Calcasieu Parish, Louisiana. . . Superheated water is forced through ten inch pipe on the sulphur, melting it, and the liquid sulphur water is then pumped up. A little exposure to the air, so as to evaporate the water, leaves almost pure sulphur. The experiment has been a success beyond expectations."

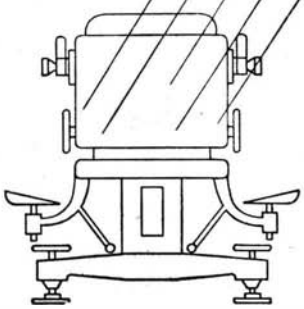
CALCIUM CARBIDE — "The production on the large scale of calcium carbide to be used for the manufacture of acetylene gas is now being carried out at the works of the Wilson Aluminum Company. By heating in an electric furnace a mixture of lime and carbon a combination of the two substances ensues, and a stone like material, the calcium carbide, is produced. When water comes in contact with it, part of the hydrogen of the water combines with the carbon, forming acetylene; the rest of the hydrogen, with the oxygen of the water, combines with the calcium, forming calcium hydrate."



Target practice with Relays and Keys







(Left to right) The operator punches the problem data on tape, which is fed into the computer. The solution emerges in the teletype receiver. Relays which figure out the problem look like your dial telephone system.

In designing the gun-control systems which shot down enemy planes, Army ballistic experts were faced by long hours of mathematical calculations.

So Bell Laboratories developed an electrical relay computer. It solved complicated problems more accurately and swiftly than 40 calculators working in shifts around the clock.

Resembling your dial telephone system, which seeks out and calls a telephone number, this brain-like machine selects and energizes electric circuits to correspond with the numbers fed in. Then it juggles the circuits through scores of combinations corresponding to the successive stages of long calculations. It will even solve triangles and consult mathematical tables. The operator hands it a series of problems with the tips of her fingers — next morning the correct answers are neatly typed. Ballistic experts used this calculator to compute the performance of experimental gun directors and thus to evaluate new designs.

In battle action, Electrical Gun Directors are, of course, instantaneous. Such a director helped to make the port of Antwerp available to our advancing troops by directing the guns which shot down more than 90% of the thousands of buzz bombs.

Every day, your Bell System telephone calls are speeded by calculators which use electric currents to do sums. Even now, lessons learned from the relay computer are being applied to the extension of dialing over toll lines.

BELL TELEPHONE LABORATORIES

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

As Reflected In Dichroic Coating Of Optics By Swain Nelson

When the new techniques of coating are correctly executed, precision optics cease merely to be highly polished pieces of glass, but take on new properties and offer possibilities once undreamed of.

The high type of artistry and technical perfection put into the Dichroic coating of lenses by Swain Nelson experts offers amazing selectivity as to light reflections and color transmission. Close to 100% efficiency is the standard result you may expect from Swain Nelson Dichroic coating.

Throughout the war period and since, Swain Nelson techniques in coatings of all types—including low reflecting coatings, and aluminizing, on a production basis, have attracted inquiries and business from some of America's largest manufacturers.

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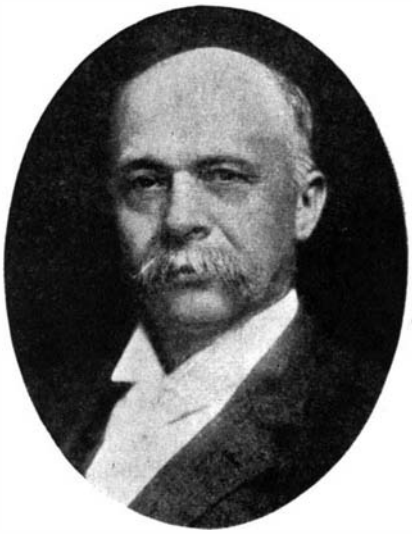
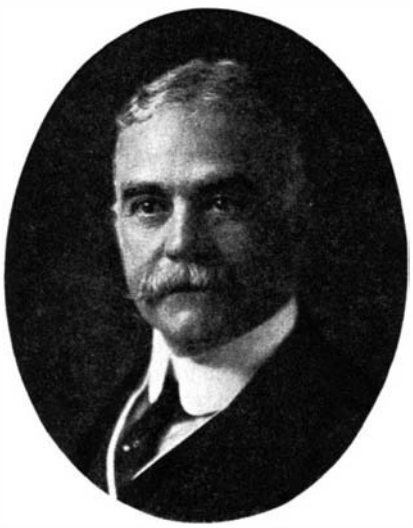
2320 GLENVIEW ROAD GLENVIEW, ILL.

Creators and Manufacturers of

OPTICAL, ELECTRONIC AND RELATED PRODUCTS

Scientific American
DECEMBER • 1945





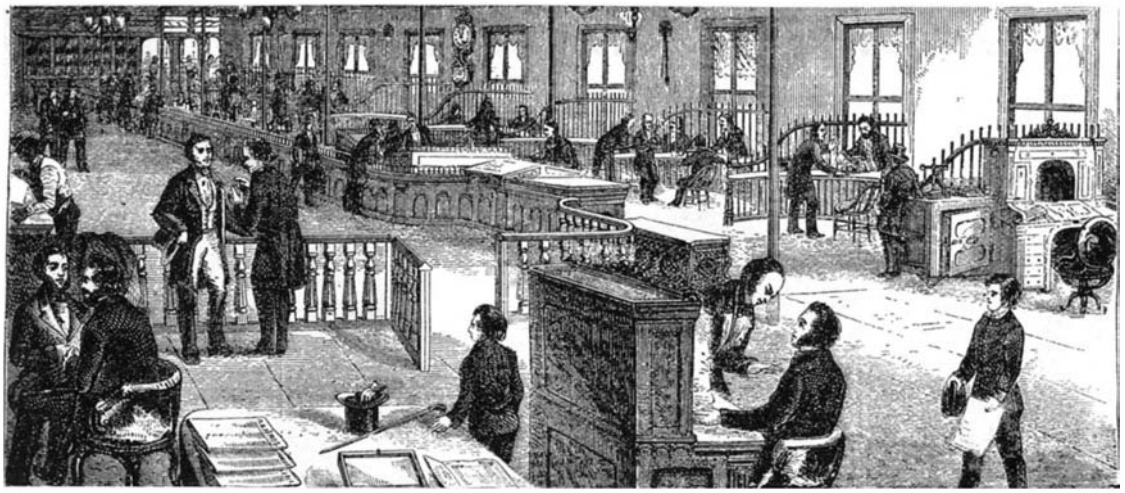
Upper left: ORSON D. MUNN, co-owner of Scientific American from 1846 on with ALFRED E. BEACH, (above). Upper right: FREDERICK C. BEACH, who was secretary of Munn & Co., for many years following the death of his father Alfred. Left: CHARLES A. MUNN, who acquired the Scientific American business from his father Orson and from the Beaches. Right: Present editor and publisher, ORSON D. MUNN, nephew of Charles and grandson of Orson

A Century of Scientific American

By ALBERT G. INGALLS

Founded as a Serious Newspaper for All Americans Whose Interests Were Scientific, Mechanical, and Inventive, Scientific American Grew Up with America's Great Age of Invention and Took Prominent Part in that Age. Its Main Aim Has Always Been to Report Technological Progress, Especially as it May Affect Industry

BEFORE the writer lies prized, century-old Volume 1 of Scientific American, dated 1845, its pages only slightly browned with age, otherwise in a perfect state of preservation. Physically it is almost as large as a modern newspaper, its pages measuring 15 by 20 inches. Its publishers in 1845 thought of it as a newspaper and called it such—not a magazine. Scientific American a century ago was a new species of periodical, a specialized newspaper for those Americans whose interests were scientific. It aimed "to furnish the intelligent and liberal workingmen, and those who delight



A view of the interior of the Scientific American offices of the period of 1859 to 1882. Reproduced from an issue dedicated to the 50th Anniversary of the founding of the publication

in the development of those beauties of Nature, which consist in the laws of Mechanics, Chemistry, and other branches of Natural Philosophy, with a paper that will instruct while it diverts or amuses them, and will retain its excellence and value, when political and ordinary newspapers are thrown aside and forgotten."

To find enough material of a scientific nature, in the limited circumstances of the American community of 1845, to fill a newspaper with things scientific must have taxed the resourcefulness of Rufus Porter, the publisher, during the opening year of the periodical. Yet within only a very few years Scientific American (published from 1846 on by Munn & Co.) became so widely known that matter of that kind gravitated toward it from all over the nation and world.

At first, however, everything scientific, near-scientific, and only slightly scientific had to be grist to Rufus Porter's mill, and his struggles to keep the new venture alive and make it grow show plainly through the picturesque pages of 1845. "If our paper appears dull this week," he confides to his subscribers in the number for January 22, 1846, "our readers must attribute the fault in part to the dullness of our exchanges, for we can assure them that we have selected the brightest ideas from nearly 200 newspapers, besides adding the best of our own." "The best of our own" consisted of original feature articles and, in each number, "two to five original engravings, many of them elegant, and illustrative of New Inventions, Scientific Principles, and Curious Works." In addition there were "general notices of the progress of Mechanical and other *Scientific Improvements;* American and Foreign Improvements and Inventions; Catalogues of American Patents; Scientific Essays, illustrative of the sciences of Mechanics, Chemistry and Architecture; useful information and instruction in various Arts and Trades; Curious Philosophical Experiments; Miscellaneous Intelligence, Music and Poetry." For some years each early number of Scientific American contained a column of poetry—at least it was verse—and not a few homilies on temperance. Except for these components the aim of Scientific American today centers around the same scope—things of a practical and industrial kind.

The subscription price to Scientific American was two dollars a year and the paper was published weekly. The publisher announced each week that "any person procuring two or more subscribers will be entitled to a commission of 25 cents each. Postmasters who will send us four subscribers shall be entitled to one copy gratis." Subscriptions were payable in advance and "persons desiring to subscribe, have only to enclose the amount in a letter."

Bound volumes of Scientific American occupy in its present publication offices 19½ feet length of shelf-room, or 33½ feet if the Scientific American Supplements are included. Often have the editors of the present, and no doubt all those of the past, looked at this long vista and resolved someday to read all of those fascinating back numbers. Futile hope! Merely to turn the pages and examine the illustrations would require more time than a modern editor can find. But no normal human being could even turn over those same pages without an urge to stop and read. The editor who each month selects the items for "50 Years Ago in Scientific American," complains that he suffers perennially from "repressed complexes" because the pace of modern work does not permit him to read every word of the fascinating volume he surveys.

ELEGANT STREET CAR — The very first number of Scientific American affords as succulent browsing, as far as sheer reader interest is concerned, as any in the earlier years. The "superbly long, elegant car," states the caption beneath the opening illustration (see front cover), "runs with a steadiness hardly equalled by a steamboat in still water, while flying at the rate of 30 to 40 miles per hour. Let any person contrast with it the awkward and uncouth cars of '35." Perhaps as we read this we smile, yet if we of today smile at the best that 1845 could offer, we shall in turn deserve to be smiled at by someone writing the story of Scientific American's first *two* centuries in 2045.

Page 2 of Scientific American's first issue tells its readers that "Morse's Telegraph, this wonder of the age, which has for several months past been in operation between Washington and Baltimore, appears likely to come into general use through the length and breadth of our land. Arrangements are already made for extending the lines to Philadelphia, New York, Albany, Buffalo, Springfield, Boston, and various other cities and sections. It is contemplated by the merchants of our Western states, to communicate their orders for goods, &c, by means of the telegraph, instead of abiding the slow and tedious process of rail-road cars."

HEADLINES OF 1845 — The same maiden number of Scientific American announced that the Frenchman, Martiner, has invented a panoramic daguerreotype camera with a curved metallic plate.

The skeleton of a carnivorous mastodon 23 feet in length is being exhibited in New York. (In 1845 there was nobody of scientific knowledge to which publisher Porter could turn to check an impossible claim for a "carnivorous" mastodon.)

Pittsburgh is building 26 iron furnaces of 100 tons daily total capacity.

There is much talk of introducing electro-magnetic light as a substitute for oil or gas. Just exactly what this prophetic terminology connoted, publisher Porter does not state in the ancient files of Scientific American nor in any private record preserved today. (Readers in 1945 sometimes ask for "further data from your records" on things published in Scientific American as long ago as half a century, but even editors grow old and die, and so do records.)

On the third page of his first number the publisher editorialized scornfully concerning Signor Muzio Muzzi's travelling balloon. "We doubt," he asserted, "whether any event has transpired within the present century, which has served to develop the ignorance and gullibility of the citizens of New York to so great an extent. We have been distressed with mingled sensations of regret and vexation to witness the applause of several of the most popular city papers, and men of reputed scientific attainments, appended to a certificate of commendation of a contrivance, the futility of which is so palpable at first sight, that a schoolboy of nine years would be censurable for dullness if he could not readily detect it."

The futile contrivance consisted of a spherical balloon to be steered by a rudder. Suspended beneath the balloon was to be a sloping or diagonal plane. When the balloon ascended, the sloping plane would drive it ahead. When it had risen to its summit its gas was to be valved off and the plane was to be reversed, so that the descending balloon would proceed an equal distance farther; or, in all, two miles! "Such, gentle reader," ridiculed the infant ancestor of the magazine you are reading, "is the invention which has been lauded by our first men and biggest editors."

AIR-MINDED — Not, however, that Scientific American wasn't air-minded even in 1845, for it offered, three weeks later, on its own account, "an aerial apparatus, on perfectly rational and established principles, that will navigate the atmosphere at a speed of 100 miles per hour, with safety, and perfectly at command; being in the form of an elliptic spindle, with a buoyancy of several tons, and driven forward by the power of steam, applied to revolving spiral fan-wheels."

The original woodcut of this proposed pre-Zeppelin dirigible deserves detailed and serious examination. The 350-foot balloon was to be hydrogen-filled. It was to be stiffened by 16 lengthwise rods—would weigh 7000 pounds and, with a 12,000-pound lift, would carry a net useful load of 5000 pounds. A two-horsepower engine which, the publisher stated, "we have already constructed and put into operation, if built on a scale of ten horse-powers, or if necessary, 30, will drive two spiral fan-wheels 16 feet in diameter and give a speed of 100 miles an hour."

The rudder was to consist of "two broad fans, intersecting each other at right angles in the centre and controlled by four lines, by means of which the direction of the balloon is completely governed, both horizontally and vertically."

"This balloon being once inflated, is intended to be kept constantly afloat, being moored at about 100 feet distance from the earth. With regard to the safety of this mode of travelling, we think there will be less danger in travelling over land in aerial vessels, than there now ordinarily exists in travelling by either sailing vessels or steamboats. The balloon will be furnished with an improved parachute for each passenger."

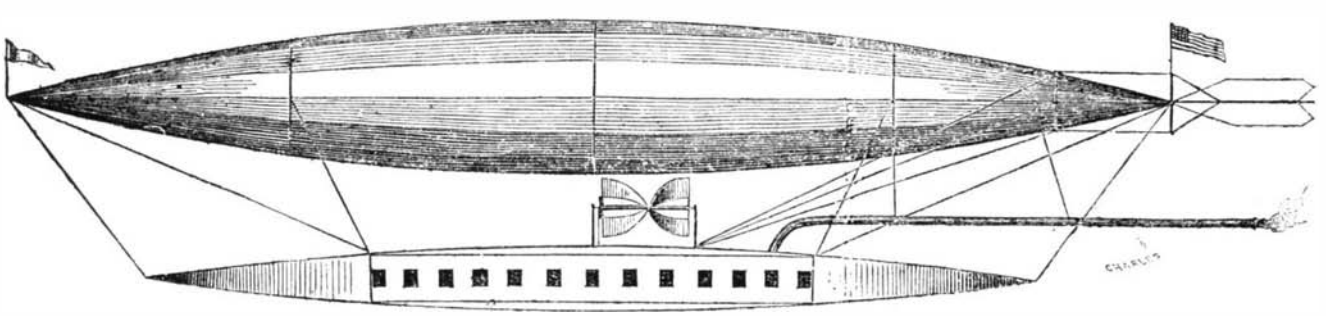
Not so accurately prophetic was a note in June, 1846: "A project is in motion for extending a submarine [telegraph] line between England and France; but it is known to many in this country that the plan is utterly impracticable."

UNINHIBITED — In Volume 1, No. 5, the outspoken, uninhibited publisher Porter hotly resented a slur. "It is reported," he wrote, "that our paper is generally well received, and that the only objection is that 'it is too small for the price.' We can assure the stupid, senseless boobies who make this assertion, that we could afford the paper at one-half its present price, if we were to fill two pages with advertisements. We should be glad," he continued, "to instill a little common sense into the heads of such people, but as that cannot be done, we must be content to furnish our paper to those who have more consideration than to suppose that the value of a paper is in proportion to its dimensions."

After eight weekly numbers of Scientific American had appeared the periodical's publication offices in Spruce Street, downtown, then mid-town, Manhattan, were completely burned with a loss of $700, and there was no insurance. The account in Scientific American a month later when publication was resumed tells us that the flames were at the door, and that Rufus Porter siezed his most valued possession, the subscription list, and rushed through these flames to gain the street. A young man who was present in the offices had asked for a pail of water and then impulsively followed the publisher to the street "without attempting an application of it." Thus from the flames were rescued two things, the infant Scientific American's precious subscription list and a bucket of water.

In June 1846 Rufus Porter, so Scientific American's columns state, made a business trip to Washington, D. C., and conveniently skipped a number, apologizing in the next number. This precedent will be an attractive one to all editors of the present day!

ENTER MUNN AND BEACH —When Scientific American was almost a year old, publisher Porter sold his interest to two young men, Orson Desaix Munn, grandfather of the present editor and publisher of the same name, and his school-mate chum, Alfred Ely Beach. The sale price was $800, roughly equivalent to $1500 today,



Reproduction of "The Travelling Balloon," from the September 18, 1845 issue of Scientific American. Said the editor: "The practicability of travelling rapidly and safely through the air, has been already established, so far as theory can establish a point without actual experiment; and the principles . . . have been already thus established."

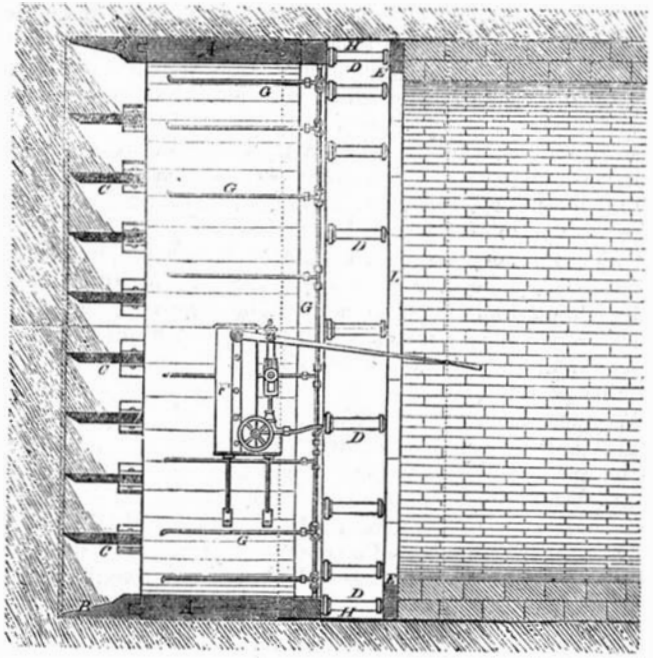
and each man put up half of this amount. Munn was then twenty-two and had recently come to New York City from Monson, Massachusetts, where his father had a general store. Educated at Monson Academy, at 19 he had become a clerk in a bookstore in Springfield, Massachusetts. This experience eventually proved to be the turning point in his career, for he then became conscious of the future possibilities in the publishing field. He later became a clerk in his father's store and post office in the village of Monson and, being gifted with a keen business sense, he built up a reserve of capital which was later to start him in business in New York.

Mr. Munn lived to the age of 82, dying in 1907, and devoted much of his time during the intervening 60 years to Scientific American as Editor. His active span therefore covered fully 60 percent of the whole life span of Scientific American even today.

Alfred Ely Beach was only 20 years of age when Munn and Beach bought Scientific American, but he had spent some years in the office of the New York Sun, then owned by his father. This experience was of great value in building up the small and still struggling little journal which they had purchased. And because Beach was a minor, his friend, Orson Munn, held his half interest in trust until he became of age, at which time a partnership was formed known as Munn & Co. This name appeared on the mast head of Scientific American from then on.

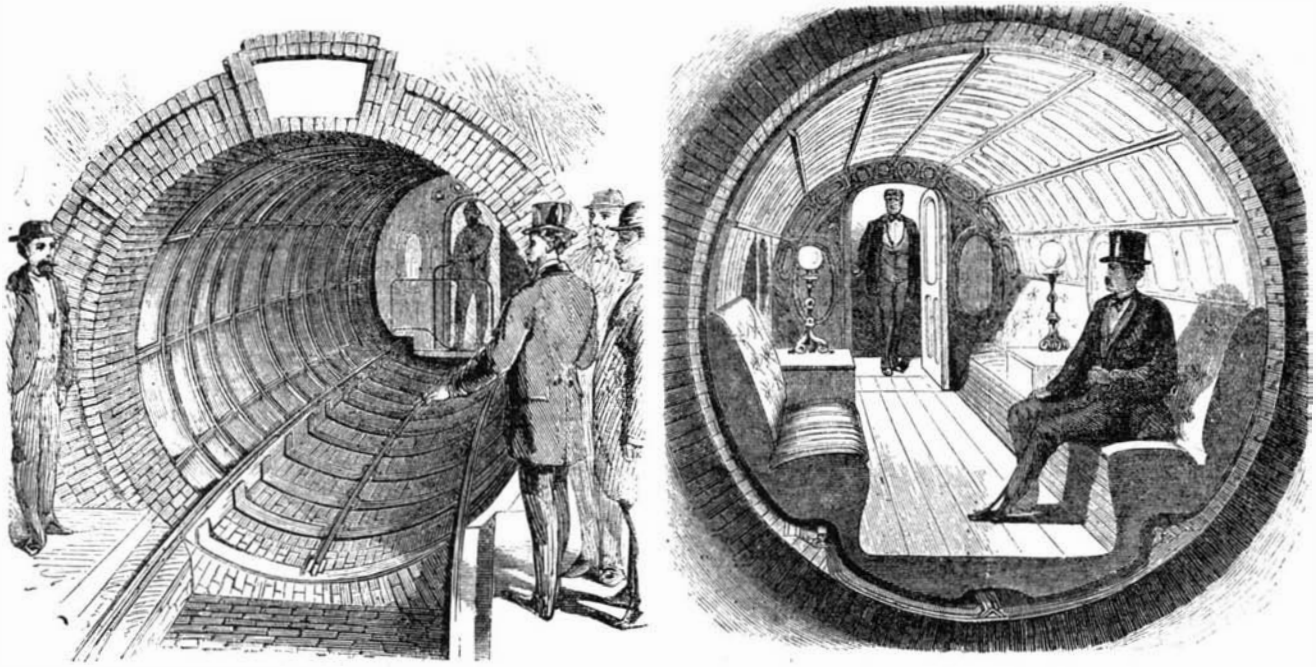
Mr. Beach, a man of versatile mechanical bent and great perspicacity, was intimately associated with the preparation and prosecution of patent applications which were later undertaken by the original partnership and gave personal supervision to practically all the patent work done by the staff of Munn & Co. Beach, in fact, was a mechanical genius and an inventor of note, among his inventions being one of the first successful typewriters and the tunneling shield which made possible the construction of his experimental subway under Broadway, the forerunner of New York's present vast subway system.

Under the management of Munn and Beach, the periodical lost in quaintness, picturesqueness, and excentricity but gained in authority and standing. No further editorial referring to "stupid, senseless boobies" and the like are to be found in the files, indicating, no doubt, that Rufus Porter, while remaining for a time as Editor, was under constraint of greater decorousness and dignity imposed by the new owners. After another year he dropped out of the picture entirely, and thereafter Scientific American was urbane and—from the point of view of an antiquarian searching a century later for entertaining evidences of rugged individuality—considerably less provocative of chuckles.



A cross-section of the tunneling machine or shield, invented by Alfred E. Beach, of Scientific American, and which not only made possible the construction of the first subway but served to establish the principles upon which tunnels are still constructed. The cutting edge of the shield is at B and the hydraulic jacks at D

INVENTION AND INDUSTRY — The page size was reduced to 11 by 15 inches and the number of pages was increased from the previous four to eight. Paper and printing were improved, more illustrations were pre-



The doors of the Beach Pneumatic Transit Company were opened to the public on February 26, 1870. At left is a view of the tunnel and at right a section of one of the cars that were driven by air from "a gigantic blowing engine"

sented, and from this time on emphasis was placed by publishers Munn and Beach on the interests of the American inventor and American industry.

A resident correspondent was placed at Washington, "in a measure connected with the Patent Office," so that "our subscribers will receive the first notices of any NEW INVENTIONS. The latest foreign inventions will also be published." This was the beginning of the Patent Department of Scientific American and for 50 years the two went hand in hand—the periodical proper, largely devoted to mechanical progress and its Patent Department for encouraging and assisting inventors.

Steadily the new journal, unique in kind, grew in size and circulation. In 1849 the circulation was 12,000, in 1852, 16,000. Little attention was paid to advertising. In fact, advertisers were made to jump through the hoop as soon as circumstances permitted. The advertising section each week, beginning in 1853, carried a rate card. An advertisement of four lines cost for each insertion 75 cents; 16 lines, $3.00. Accompanying this is a statement which may give modern advertisers cause to grin or faint: "Advertisements exceeding 16 lines," it stated flat-footedly, "cannot be admitted; neither can engravings be inserted in the advertising columns at any price." With such a frank, forthright statement there could be no possible argument.

NEEDED BY MANUFACTURERS — An editorial in the same number called attention to the new typography and paper, and the fact that the weekly paper had been increased to 16 pages. "All the patent claims, as issued by the Patent Office, will be published every week," the publisher stated. "On this account no man interested in patents should be without the 'Scientific American,' and if he is wise for himself he will not. There is not a manufacturer in our land but should be a subscriber, because he does not know but some invention may come up any week to revolutionize his whole business. It affords us no small degree of pleasure to know that many of our countrymen have been greatly benefitted in circumstances because they have been readers of the 'Scientific American.'"

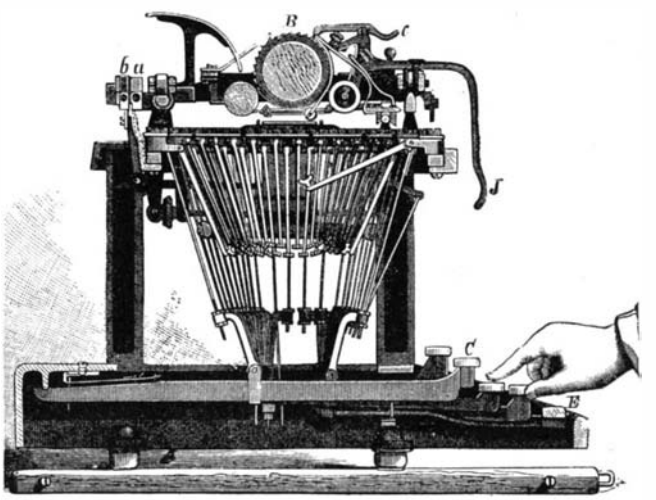
Thus this periodical has had a large share in the industrial growth of the nation. It arrived on the national scene at a period in our history when invention was on the upsurge, yet when a virtual vacuum existed in regard to media of publication through which mechanics—today we would refer to them as mechanical engineers and machine designers—could meet, as it were, in the printed page. It became the focus of their common interests and thoughts and, since the enterprise was conducted in an intelligent manner, it thrived lustily. "There are at least 6,000,000 of our population interested in inventions, science, chemistry, and the arts," continued the editorial of 1853. The great wave of invention which was to place this land in the industrial lead was advancing and Orson D. Munn and his partner Alfred E. Beach, the country youths, were on the spot at the correct time waiting for it.

A century ago patent attorneys were practically unknown. Isolated inventors scarcely knew how to proceed to obtain patents and market their inventions. Scientific American, with a corps of experts on patents, became the genial sun that thawed out this frozen situation. A former commissioner of patents, Judge Charles Mason, was retained to head the periodical's patent department and a branch office, an essential link, was opened at Washington. The business grew rapidly. At the time of Munn's death 60 years after he and Alfred Beach purchased Scientific American for $800, more than 100,000 patents had been secured for clients.

Naturally, Scientific American's offices soon became a resort of inventors in the flesh, and to them came men now famous in the history of invention to consult with the editors—Capt. Ericsson, Commodore Stevens, Capt. Eads, Samuel Morse, Elias Howe, Dr. Gatling, Peter Cooper Hewitt, Thomas Edison, and others of fame. In 1877 Edison dropped in one day with a package under his arm, which he silently proceeded to open and whose content announced itself, when he turned a crank, by speaking the words: "Good morning. How do you do? How do you like the talking box?"

The editors of Scientific American were among the first to see the Edison incandescent lamp, the Edison dynamo, and the Edison moving picture machine, the "kinetoscope," and it is not Edison's fault that we do not today go to the "kinetos" instead of the movies.

For half a century the Patent Department of Scientific American flourished and Munn & Co. served the dual purpose of publishing an industrial journal and advancing the interests of inventors. Then, in the early 1890's, a law was passed prohibiting corporations from practicing before the Patent Office. At that time a separate partnership was formed to represent inventors. From then on the publishing and patent businesses went their separate ways, operating as separate entities. The present patent partnership is practicing under the name of Munn, Liddy, and Glaccum, with Orson D. Munn, editor of Scientific American, as senior member of the firm.



A typewriter of 1888. Fundamental to its development were radial swinging arms, invented by A. E. Beach

THE "SUPPLEMENT" — In 1876 Munn & Co. announced the publication of the new Scientific American Supplement, uniform in size with Scientific American and designed "to meet the wants of that large class of readers who desire an increased supply of scientific information, particularly of the more technical and detailed character. It will embrace a wide range of contents, covering the most recent and valuable papers by eminent writers in all the principle departments of science and useful knowledge, to wit: chemistry and metallurgy; mechanics and engineering; electricity, light, heat, sound; architecture; technology; agriculture, botany, and horticulture; rural and household economy; materia medica, therapeutics, hygiene; natural history and zoology; meteorology, terrestrial physics, geography; geology and mineralogy; astronomy." The Supplement was a separate and independent publication.

No longer by then was a "scientific newspaper" unique. Other more technical scientific journals were being published and from these journals Scientific American Supplement reprinted the best selections,

with credit to the sources. Thus, by subscribing to the Supplement the reader could, in a sense, subscribe to a hundred other periodicals. The Supplement was published until 1921 when it, the child, was swallowed by its parent publication which at the same time became a monthly. Explaining this major change of policy the editor candidly stated:

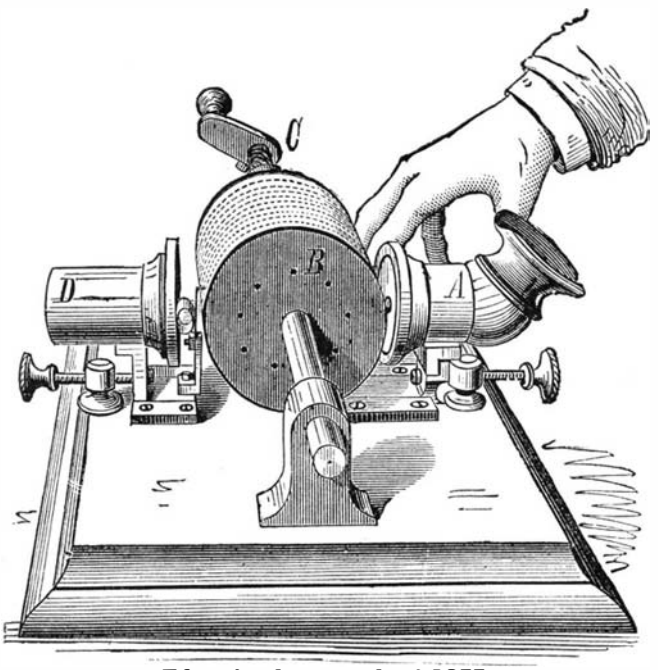
"The position which the scientific weekly held 75 years ago, when Scientific American was founded, is no longer a sound one. In 1845 the daily press gave the scantest space to scientific matters. There was a real demand for a periodical devoted to the world's advance, which should not necessarily give such complete or such technical statements as the quarterlies and the annuals of the physicist, the chemist, the electrician and the engineer, but which should enable the intelligent reader to get a sufficient idea of what has been done, and to get this without waiting for the appearance of quarterly or annual.

"Today," it continued, "this is no longer the case. The daily papers give excellent summaries of every scientific advance, of every invention of importance. As regards the mere function of a scientific newspaper, it is obvious that the weekly can compete with the daily no more than the quarterly could compete with the weekly."

In short, times had changed and the serious newspaper for scientific Americans of 1845 no longer enjoyed near uniqueness. A formidable book of 814 large pages, entitled "A World List of Scientific Periodicals," published in 1934 (Oxford University Press) and available for inspection in most large libraries, contains the names of over 36,000 (thirty-six *thousand*) such journals.

TODAY — Scientific American has traced the trends of the times for 100 years, often presenting its reports in advance of the obvious trends. And its development into the industrial publication of today is just as logical as was its change from a weekly to a monthly in 1921. Before Scientific American was started in 1845, there was no "newspaper" that served the mechanically inclined; in 1943 (when the last major change was made in the editorial policy of Scientific American) there was no general magazine that reported technological progress for industry as a whole. It was simply a case of expanding industrial coverage, with a background of almost a century of experience in industrial reporting. Into that niche, which sorely needed filling, stepped Scientific American with its September 1943 issue. Today, with a group of contributing editors who are individual specialists in their own industrial fields, its pages not only report technological progress but interpret and prophesy as well.

Thus Scientific American is the dean—the senior—of American periodicals of popularized science. Even among professional scientific journals only two in this nation, *The American Journal of Science,* largely devoted to paleontology, and *The Journal of the Franklin Institute,* are older. A century of Scientific American's history is essentially a century of American advance in scientific and industrial progress and invention.



Edison's phonograph of 1877

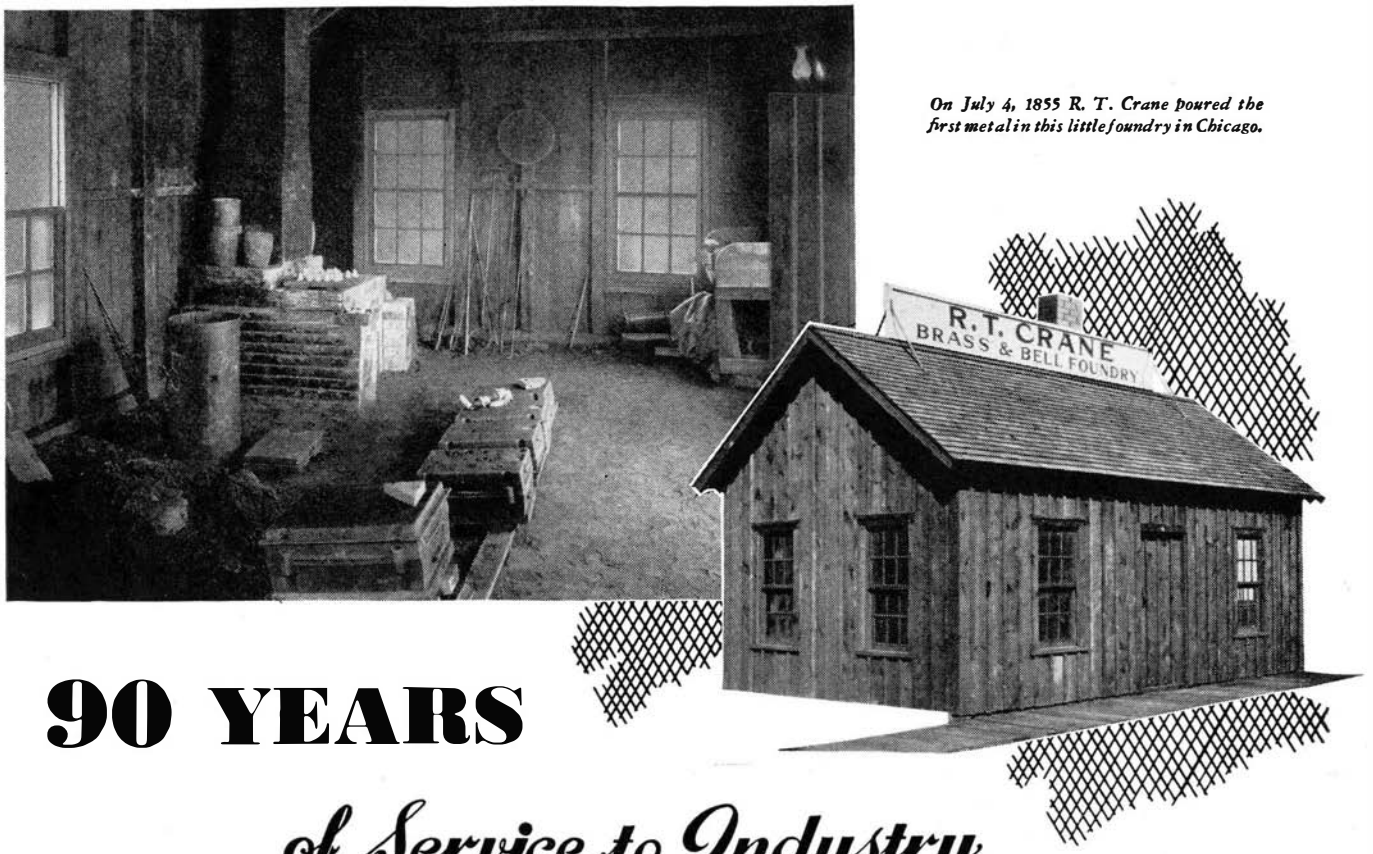
OTHER ACTIVITIES — It is only natural that a successful magazine publishing concern should at times turn its attention to book publishing. But realizing that its first interests should concern the magazine, Munn & Co., Inc., has entered the book field only in a specialized way. For over 40 years "The Scientific American Cyclopedia of Formulas" has been the standard of its kind and has run through many editions and hundreds of thousands of copies. "The Finger Print Instructor" is another volume that has made an enviable name for itself. It is the "Bible" of police departments throughout the country and is widely used by the F.B.I., in private detective work, and in industrial plant personnel operations.

In the middle 1920's the writer of this article published a series of articles in Scientific American on the subject of amateur telescope making. As a result, further information was requested by readers in such great numbers that a small book entitled "Amateur Telescope Making" was published. Its reception was warm indeed, and now, in its fourth edition, it is a full-grown volume of some 500 pages. The appeal of telescope making as a hobby requiring more than usual application and diligence was so great that the elementary book was followed by a companion volume named "Amateur Telescope Making—Advanced." Altogether, these two books have been sold in numbers approximating 40,000, with an estimated readership of several times that number.

At the height of enthusiasm for amateur photography in the decade prior to World War II, Scientific American published a book for those camera users who wanted fundamental instruction in how to get the best results from their cameras. This volume, "So You Want to Take Better Pictures," is now out of print.

In addition to its specialized activities in the book publishing business, Scientific American conducts a book department for the benefit of its readers. In connection with this service, its pages each month carry a number of reviews of the latest books of other publishers. These books are made available through the department, whose slogan is: "We can supply any book in print."

PRESENT EDITOR — Since 1923, Orson Desaix Munn, grandson of the Orson Desaix Munn, the enterprising clerk in a Massachusetts village general store who almost a century ago purchased a half interest in a struggling new venture and built an institution that is closely linked with the history of American invention, is the publisher and editor of Scientific American. First associated with the publication in 1906, he succeeded to the editorship upon the death of his uncle, Charles A. Munn, to whom the publication was bequeathed by its builder. Mr. Munn is a Princeton graduate Litt.B., and holds the degrees of LL.B. from New York Law School and Sc.D. from Oglethorpe University.



On July 4, 1855 R. T. Crane poured the first metal in this little foundry in Chicago.

90 YEARS

of Service to Industry

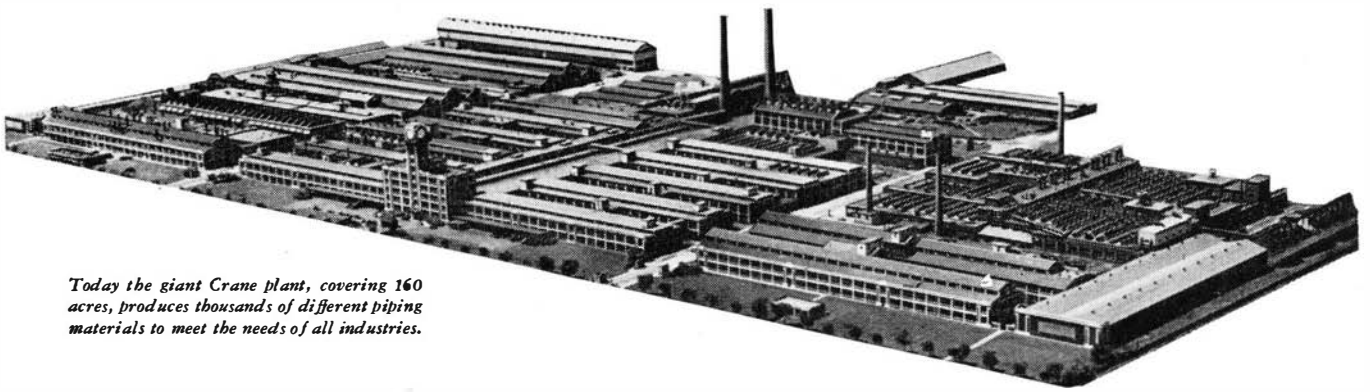
When R. T. Crane poured a ladle of molten metal into a flask 90 years ago, a new industry was born.

The growth of Crane Co. from 1855 to 1945 is symbolic of the growth of America's dominance in production, for Crane Co.'s business is supplying the valves, fittings and pipe so essential to all industry.

It is difficult to conceive of any production that does not depend to a greater or lesser extent on piping. For wherever steam, air, water, oil or any other liquids flow, it takes valves, fittings and pipe to control them.

Today Crane Co. is the world's largest producer of flow control equipment and the Crane line includes: "everything for every piping system." Users of piping are familiar with Crane's nation-wide distribution that serves every section of the country through Crane Branches and Wholesalers.

Crane Co., 836 S. Michigan Ave., Chicago 5, Ill.



Today the giant Crane plant, covering 160 acres, produces thousands of different piping materials to meet the needs of all industries.

CRANE

90 YEARS OF PROGRESS 1855 1945

VALVES • FITTINGS • PIPE

PLUMBING • HEATING • PUMPS

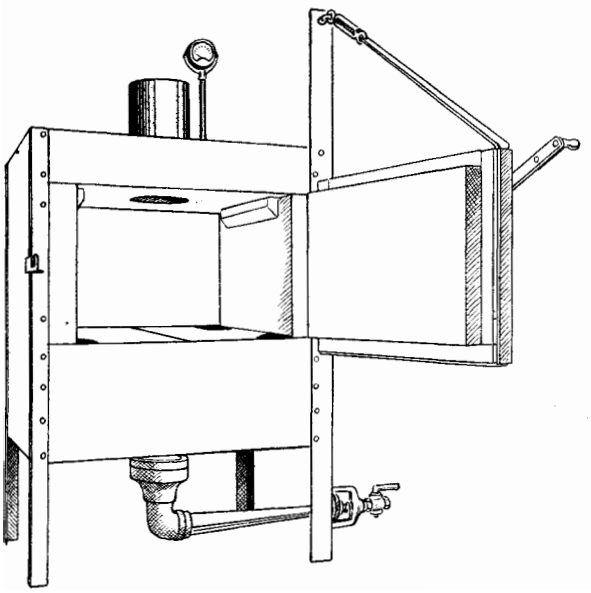
BRANCHES AND WHOLESALERS SERVING ALL INDUSTRIAL AREAS

Lost Wax At Work

Precision Castings Can be Produced Commercially by the Lost-Wax Process, but Not by "Off-in-the-Corner" Methods. Materials, Processing, and Equipment Must be Fitted to the Job in Hand; then Lost Wax Can Show Outstanding Advantages in Accuracy and Scrap Reduction

A PRECISION cam which is the nerve center of a business machine needed 59 machining operations to complete it. Many of its dimensions had to be held to plus or minus .001 inch on irregular contours; its cam-curve outside diameter was held to plus or minus .0025 inch.

Naturally, the precision machining spoilage was high. Allowing an average of less than 1 percent spoilage on each operation, the manufacturer would have to start with 150 blanks to obtain 100 finished cams. The overall costs added up to more than $7 a cam.



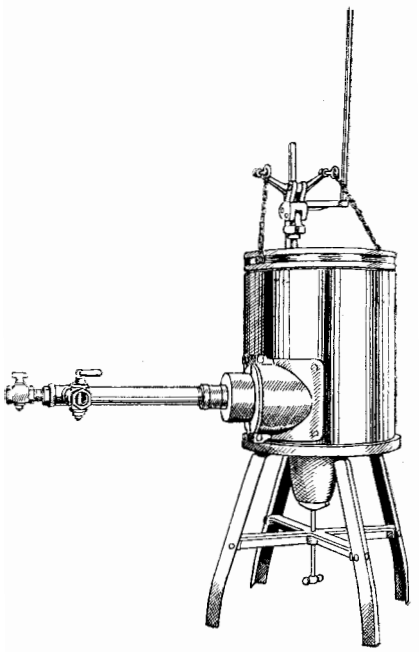
Right: Gas fired melting furnace for metals

Left: Gas fired furnace for eliminating wax

Lost-wax* precision-investment casting allowed this cam to be made for $1.25, a saving which when multiplied by the usual factors applying to manufacturing mark ups would provide $15 a machine for reducing the retail price, or for sales and advertising costs, or for cash reserves and profits. But before such a result could be had the company management's attitude toward lost-wax casting had to change.

This company, like so many others, had regarded lost-wax casting as an "off-in-the-corner" process which almost anybody could operate. After all, the process is simple. A full sized model of the part to be produced is made of metal, wood, or any other hard material, a mold with suitable parting faces and sprue passages is made around that model, wax is poured into the mold to form a wax replica of the model with its sprue, several wax replicas are ganged by connecting their sprues, an investment is poured around the gang, the investment is hardened or "set," the wax is evacuated by putting the investment into a furnace and "losing" the wax up the chimney as gases, and molten metal is poured into the investment where the wax used to be. Cut or dissolve the investment away from the cooled metal, cut away the sprues, and there are the finished parts with accuracies as close as .001 inch.

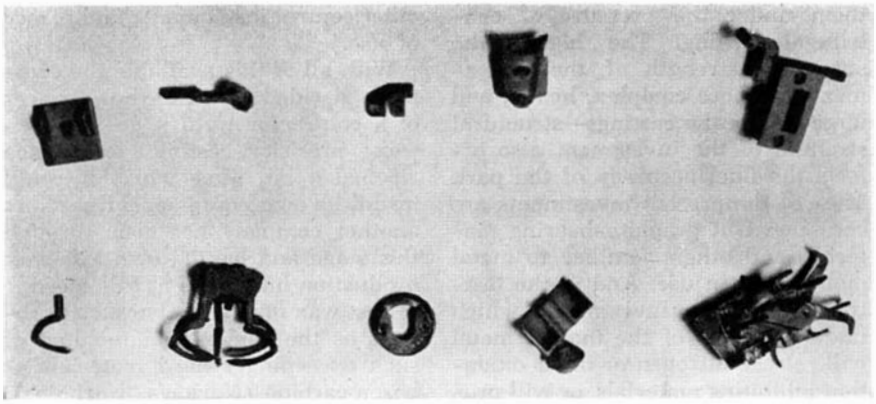
The trouble is, molten metal will shrink, swell, warp, turn porous, become harder in some areas than in others, and play other tricks as it cools. The company tried the simplest form of lost-wax precision casting and found the part coming neither to true dimensions nor to acceptable metallurgical quality.



DOWN TO CASES—Then a consultant, Baker Castings, was called in and real work began. First of all, the model had to be changed. This company had believed the all too common statement that a finished piece of correct dimensions is all that is needed for a model, and had proceeded accordingly in its original experiments. And, of course, where the finished dimensions do not need to be too close, as in ornamental parts making, the original piece does make a good model. But if cast metal is going to shrink or warp as it cools then the dimensions of the model must be changed to compensate for all that.

The final model was by no means

*For further details on the lost-wax casting process itself, see page 259, December 1943 issue of Scientific American. — Editor.



Courtesy Ecco High Frequency Company

Small parts like these, made from brass, gold, platinum, high carbon, and stainless steel are quickly and accurately produced by the lost wax method

an oversized version of the original piece. Lost-wax casting has methods which can improve products as well as its own processes, and some of these were used.

A pin, for example, ground to .0001-inch accuracy, was used in the molding of the wax replica. Withdrawn from the wax, this would leave a hole which would be within the tolerances usually achieved by grinding-in the finished piece. The hole would be only three sixteenths of an inch in diameter and eccentric to the axis of the piece; a size and position in which internal grinding would have been so difficult to perform that the company had abandoned the idea of obtaining the desired accuracy.

Soft rubber plugs attached to parts of the mold could be pulled straight out from the wax replica, causing them to stretch thin and come out without distorting the wax. One of these was used to form an oil hole which followed a curved path from the side of the piece to an oil chamber at the axis of the piece. Another formed the oil chamber itself, with the chamber recessed in the middle of the piece and the sides coming down to the diameter needed for the bearing bushing. Without this lubricating arrangement a costly drilled shaft would have had to be used to get oil to the bearing.

Arrangements like these brought the company's product designer into the picture. Lost-wax casting was ceasing to be considered an odd process for the production of one part of the machine, and was working its way into the family of processes which make up the production line.

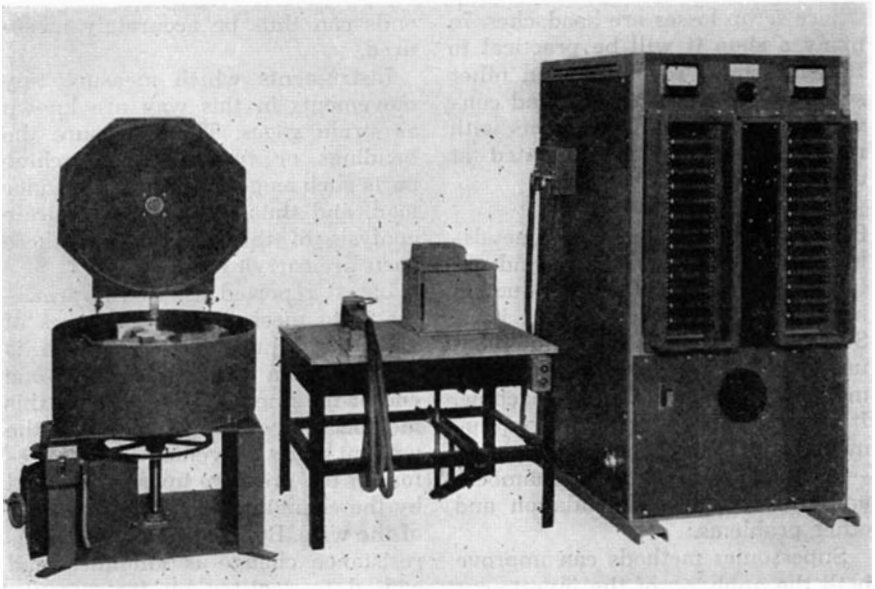
NEW MATERIALS—With the new process a stainless steel could be used for the part. In fact, lost-wax precision casting works better on alloy steels than on plain carbon ones. This brought the metallurgist into the picture.

Finally came the question of the cost of lost-wax casting. It was found that, although this process can hold very fine tolerances on nearly any dimensions, the cost can be less if some tolerances are allowed to go to plus or minus .005-inch. Furthermore, although lost wax does produce smooth surfaces and true ones, it does not yield the brightness and smoothness of ground ones.

The decision was made to cast some dimensions slightly oversize and grind to size. And thus lost-wax precision casting worked itself fully into the production scheme as a production line process which feeds other processes. Part of this decision involved selecting the control surfaces by which the parts were to be chucked for grinding. These had to be made of ample widths for the collets to grasp, and of high concentric as well as parallel and dimensional accuracy. Further modification of the part was involved, with consequent remaking of the model.

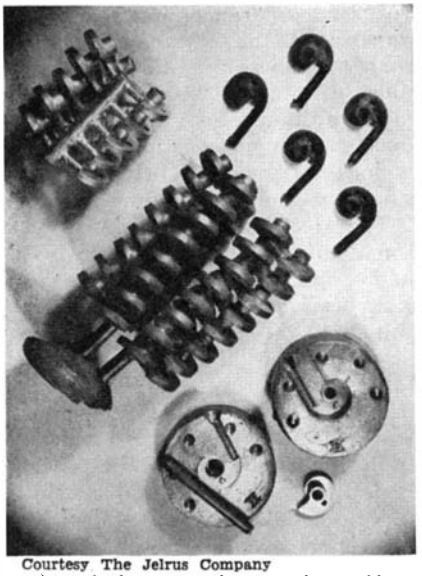
Installation of a lost-wax precision castings department was considered. But the company found that the lost-wax process shares one condition with forgings, screw machine products, stampings, die castings, plastics, powder metallurgy, and other resources available to machinery makers. There are wide varieties of equipment available, and each variety has special but limited abilities. Contractors which devote themselves mostly or wholly to this process either have widely varied and highly adaptable equipment to take on almost any job, or else have highly specialized production lines to do extra good work at low prices on narrow ranges of products.

Equipment for lost-wax casting has been developed very rapidly. Old-line makers such as the Jelrus Company, Ecco High Frequency,



Courtesy Ecco High Frequency Company

Above: Electric equipment for lost wax casting—casting machine, furnace, high-frequency converter. Above, at the right: Unit for making four castings at once



Courtesy The Jelrus Company

A typical set-up showing the mold, investment, and the molded product

Detroit Dental Casting, Kerr Dental Manufacturing Company—to mention a few—and specialized supply houses like Alexander Saunders and Company, are bringing out new and improved equipment and supplies at a rapid pace. Companies like General Electric have some new products and ideas too. Furnace makers such as Baker are well up in the equipment parade.

The fact is, lost-wax precision casting equipment and supplies form a tempting target for every phase of industry.

BETTER WAXES—The waxes—primary key to the whole process—must be capable of assuming high dimensional accuracies when forced under pressure into molds, of flowing into all sorts of recesses, of assuming true shapes when molded to such contours as threads and sharp re-entrant angles, and of holding their accuracies and contours while handled by human hands or by machines at room temperatures. Many improvements in the qualities and abilities of waxes have been made, others are on their way. Waxes which, for example, will have higher structural stabilities in thin walled sections, soon will be obtainable. Some of the "waxes" are plastics which contain little or no wax. Complete evacuation ability is needed too.

Investment materials, the secondary key to the process, are another chemist's opportunity in this business. The investment must be capable of penetrating to the tiniest openings in the contours of the cast wax, and of holding true contours while being set, while the wax is being gasified and evacuated, and while heavy and somewhat abrasive molten metal is being forced into them under the pressure of centrifugal casting. The higher the structural strength of the investment the more complex, heavy, and large can be the castings—structural strength of the investment also affects the final accuracy of the part. Most of the present investments are ceramics. But graphite-bearing materials and others familiar to metal melters are in use. And in the test-tube stages are investments which under the heat of the molten metal will release nitrogen or other oxidation inhibiting materials, or will provide other special surface conditions on the finished parts.

Molds for casting the waxes are receiving a great deal of study. They can be made of plastic rubber which later is vulcanized—this is the simplest process. Some of the bismuth alloys are especially adapted to the making of these molds. Molds can be made of hydrolized wood (Masonite die stock) or of plastics. They can be sunk by die makers. In short, molds for wax are a brand new invitation to imaginative tool and die makers.

The metallurgical end of the production line offers chances for metals makers and users to remove some of their limitations. The fact that the process works at its best on some of the metals which are too high in melting points for die casting, too tough for machining, and too hard or brittle for extruding, already is putting plenty of lost-wax casting equipment to work. The advantage that this process wastes only the very least of the raw material to machining chips and to scrap of any kind, is one of the main reasons why it appealed to jewelers and other users of precious metals before it did to industry as a whole. Lost wax will solve many a problem where scrap losses are headaches. In many a shop it will be practical to transfer chips, rod ends, and other scrap to the lost-wax line and convert them into useful products with raw materials costs calculated at only scrap values.

EQUIPMENT—Any kind of metals-heating equipment from oil and gas furnaces to dielectric and induction heaters can find employment here. Some of the most modern equipment uses electrical means to melt the metal right in the casting machine. It is practical to run such equipment—and other casting equipment—in controlled atmosphere chambers and thus get rid of oxidation and other problems.

Supersonics methods can improve both the applying of the investment and the casting of the metal. Electronic equipment, pyrometers, and other control instruments find plenty of use.

With all of this available the company decided to use the services of a contractor until it got its lost-wax precision-casting experience ripened a bit, after which it could install its own equipment. But many another company has gone through this stage and has its own lost-wax production line going at full speed.

Lost wax may yet solve such problems as the commercial molding of such exceedingly hard materials as boron carbide (Norton's "Norbide"). But aside from these experimental opportunities, the process has a firm grip on production lines; it has come of age.

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SENSITIVE CONTROLS

Use Principle of Changing Electrical Resistance

USE HAS long been made of the fact that a wire of a given alloy changes its electrical resistance with changes in diameter. One very old use, for example, is to find the diameter of an extremely fine piece of wire of a known alloy by measuring its resistance and from this computing its diameter.

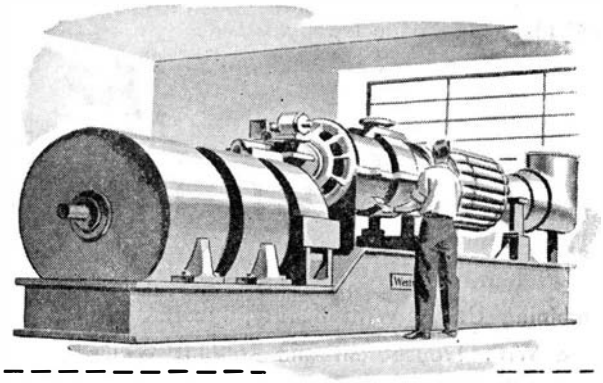
With the diameter and alloy already known, use has been made of this same principle by measuring the amount which the wire stretches under extremely minute movements of devices which are attached to its ends. When the wire stretches, its diameter is reduced and its electrical resistance goes up. Movements of as little as one millionth of an inch of the devices fastened to the wire ends can thus be accurately measured.

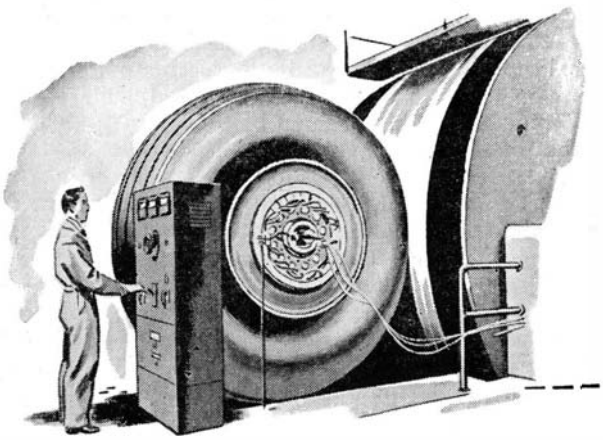
Instruments which measure tiny movements in this way are known as strain gages. They measure the bendings or twistings of machine parts such as gears and shafts under load, and thus permit the accurate analysis of the loads which these parts are carrying.

Latest reported use of the principle is to measure the pressures of gases or liquids. The pressure is imposed on a member to which one end of the fine wire is attached; this member moves accordingly, and the amount of its movement and therefore of the pressure upon it is found by the changing electrical resistance of the wire. By electronic means this resistance change is amplified and caused to register on instruments, to make records, or to operate pressure regulating automatic controls.

In a laboratory a SCIENTIST experiments with a new gas turbine . . . using heat-resisting alloy blades that are far stronger, at 1100°F., than *ordinary* steel at room temperature.

. . . the name on the GAS TURBINE is Westinghouse.





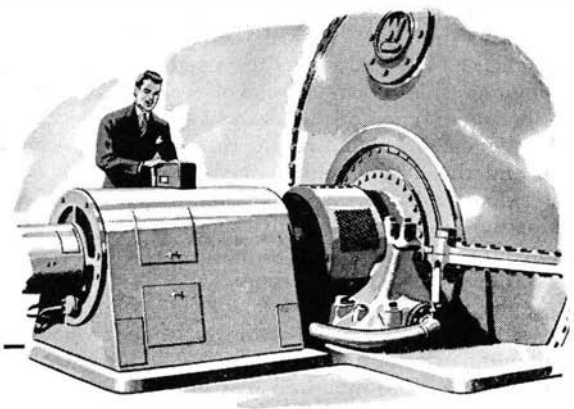
On a special machine a TESTER employs a Rototrol* for smoothly accelerating a large flywheel, used in determining the wear-resisting qualities of tires and brakes—for huge air transports of the future.

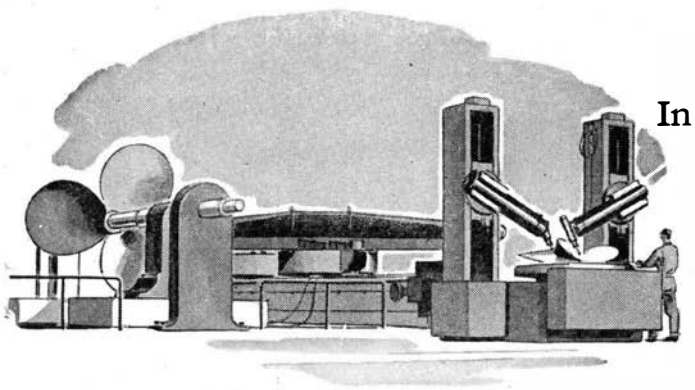
. . the name on the ROTOTROL is Westinghouse.

*Registered Trademark

In a power plant an ENGINEER uses a Vibrograph to "take the pulse" of a turbo-generator . . . recording the smallest vibrations as a trace on a film.

. . . the name on the VIBROGRAPH is Westinghouse.





In a manufacturing plant an OPERATOR uses an electronic control to regulate the movement of milling cutters—for accurately machining irregular contours on giant ship propellers.

. . . the name on the ELECTRONIC CONTROL is Westinghouse.

Westinghouse
PLANTS IN 25 CITIES OFFICES EVERYWHERE

NOW THAT Westinghouse technical skill and "know-how" have turned from war to peace, expect great things . . . from Westinghouse research, engineering, and precision manufacture.

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Your Home In Plastics

Combining Utility With Beauty, Plastics Provide the Modern Small Home With Transparent and Radiant Walls, Giving the Illusion of Greater Size to Small Rooms. Plastics are Used for Curtain Rods, Colorful Door Knobs, Drawers, Trays, Tables, Chairs, and Bath Fixtures

MATERIALS of all types have come in for their share of over-publicity in the last few years, and plastics are no exception. To counteract this condition and to help crystallize the thoughts of architects, homebuilders, and buyers alike, Rohm and Haas Company has designed and constructed a full-size, compact bedroom, dressing room, and bath assembly wherein plastics are used only where good engineering and good design dictate. This exhibit was constructed with one idea in mind—to show how plastics in home furnishings and fittings can be at once functional and attractive. Plexiglas is the only plastics used throughout this mock-up except for the bedroom curtains, spread, and pillow covers which are of Koroseal, and the Tego-bonded plywood closet doors and dresser fronts.

Most home-owners have frequently longed for an air conditioning unit, particularly for the bedroom. Yet too many have refrained from positive action in the belief that such equipment would be overly costly, both to install and maintain, An unusual solution to the problem is this exhibition bedroom which is held to a size that permits the efficient operation of a small air-conditioning unit at a cost approximating that of a home refrigerator.

LIMITLESS ROOM—To offset the closed-in feeling that might come with solid walls enclosing such a small space and to give the impression of almost limitless room, curved transparent sheets of acrylic are used as the front and half of the side partition. This space-giving wall sweeps around to the doorway, also of acrylic sheet, which opens without noise or effort by sliding back into the other wall.

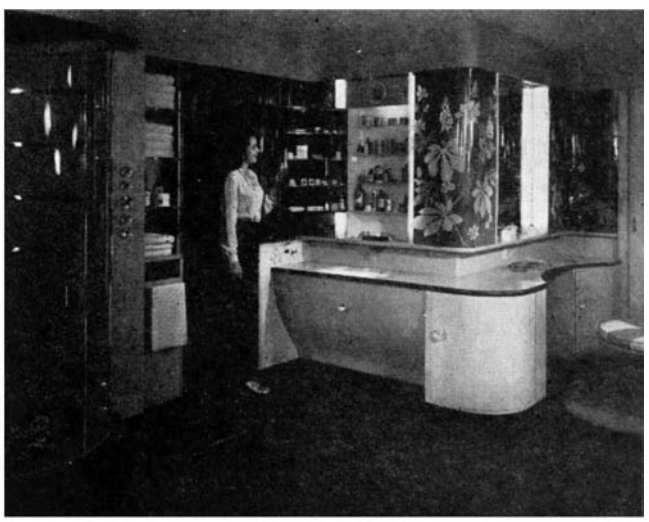
An equally unusual feature of this sleeping room is the mural that arches over the head of the bed. In the exhibition room the scene is one of lighted skyscrapers reaching up into the darkened night, but the design could as easily have depicted a green forest, a surrealist's nightmare, or a child's dream

The three-dimensional effect and the startling lighting achieved in this mural are produced by engraving or painting individual elements of a design on separate pieces of acrylic, each the size of the finished mural. The top layer was painted with buildings for the foreground, the next sheet with those a bit further away, while the last or bottom piece was entirely covered with a solid background of color. Small air spaces separate the various layers.

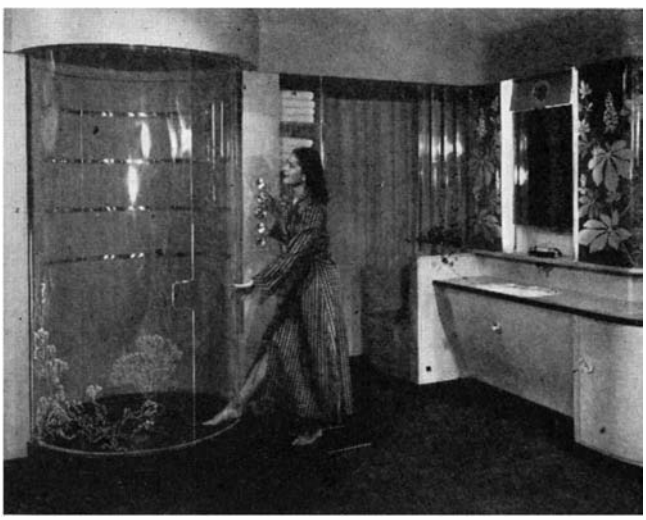
Before insertion into position in the wall, the mural is provided with edge-lighting from a concealed light source. This light causes the etched or painted portions of the acrylic sheets to glow and sparkle, producing a mural that is truly "painted in light."

Small by comparison with the mural but equally well designed for the role it must play is the clear flat strip of acrylic which acts as a curtain rod for the multi-striped polyvinyl chloride curtains in the bedroom. More important than the ease of installation is that these pieces can be wiped clean with a damp cloth. And, unlike the usual metal rod, this flat strip of transparent plastics sheet blends into the walls and drapes, and does not need to be painted.

The knob of the bedroom door is a good example of the ingenious manner in which color is combined with transparent acrylic materials. To get a colorful, workable unit,



Medicine cabinet has shelves in the door



The design is etched into the curved shower wall

a hole was bored in a clear acrylic knob, then color poured into the space in the center. Another piece of this same plastics, pierced by a bolt, was next cemented to the knob, acting as a means to attach the knob to the door.

SPACE-SAVING—As in the entire assembly, not an inch of space is wasted in the attractive dressing room. Even a projecting corner just outside the bedroom door has been put to use as a hat and shoe closet. Double doors swing wide to reveal

Air conditioned spaciousness in the bedroom is achieved by use of transparent walls and edge-lighted mural

a hat rack at the top and three tiers of transparent acrylic shoe shelves at the bottom. About 15 small hats can be accommodated on the revolving rack, which is formed entirely of acrylic bars.

Near the dressing table is a double closet which provides space for full-length evening gowns, street-length dresses and suits, and men's coats, trousers, and so on. Drawers, built in above the clothes rack and on the floor, add considerably to the storage space in this unit assembly.

Acrylic handles on the drawers in this closet serve a second purpose —that of label holders. Slips of paper printed with the contents of particular drawers can be slipped under the transparent handles which are in the form of a scroll. The acrylic acts as a magnifying glass so that the labels can easily be read from a considerable distance—or by a somewhat nearsighted person.

RADIANT WALLS—Both the decoration and the illumination of the dressing room come from its walls. To accomplish this double purpose, they are covered with a sheet of Plexiglas which has been engraved and painted with a design—in the case of this exhibition room, a color-

Curved plastics trays—easy to clean

ful and bold chestnut leaf pattern. Hidden fluorescent lamps edge-light the wall, causing it to glow radiantly wherever the paint or engraving has interrupted the smooth polish of the normal acrylic surface. The theory behind this effect is like that of the bedroom mural, only in this instance one sheet of acrylic is used instead of several. This wall follows the curves of both the dressing room and bath, and provides general illumination for both rooms.

This somewhat new concept in room lighting is comparable to the "warm wall" idea of room heating—the light spreading out evenly from the entire wall instead of intensely from a fixture. In both the radiant wall and the mural painted in light, a different design is seen by reflected light than is evident when the acrylic sheets are edge lighted.

Special provision has been made for bottles, jars, small articles of clothing, and the odds and ends which usually hide themselves away as soon as they are needed. Within easy reach is the perfume niche whose circular shelves will hold a myriad of bottles. Illumination is provided by the radiant wall which also forms the background of this tier of shelves.

One side of the dressing table swings open to reveal a set of removable transparent acrylic trays for cosmetics, hose, and other small articles. These trays are formed with deep sides and rounded corners which combine to make them easy to clean.

On the other side are three deep drawers which are designed to hold lingerie or other articles of apparel. These drawers are equipped with blown acrylic liners which can be quickly and easily removed for cleaning. After these liners were formed, they were sprayed on the back with a pale pink paint to make them opaque.

The huge dressing-table chair is a transparent drum formed from sheets of acrylic resin, topped with a tufted cushion covered with polyvinyl chloride fabric. With room enough for two, it does away with odd chairs that are always getting in the way in most bedrooms and dressing rooms. It also adds a strange lightness and sparkle which complements the airiness of the rest of the compact three-room unit.

What might otherwise be waste

Dressing-table chair is a plastics drum; perfume niche in right background has circular plastics shelves

space in the bath is again put to good use; a protruding corner is turned into a drying rack. Three bent acrylic rods are affixed to the door of this cabinet which is designed to be heated with a special unit so that drying time can be cut to a minimum.

Just beyond the drier is the oversize wash basin where baby can be given a bath or where small articles of clothing can be washed with ease. Like the drawer liners, this basin was deep drawn from clear acrylic sheet, then sprayed on the back with white paint.

The faucet handles are fabricated from heavy pieces of this same transparent plastic to a shape which is easy and comfortable to grip. They are cut in such a way that the clear plastics catches and reflects the light almost like a gem.

There is double space in the medicine cabinet because acrylic shelves are attached to the back of the mir-

rored door, supplementing those usually found in such cabinets. To prevent bottles from falling into the basin whenever the door is opened, each of these four shelves has an inch-high lip at the front.

POISON—The fear of mistakenly seizing a bottle of poison instead of some innocent medication seems to be universal. Recognizing this fact, the designers of this three-room suite have set aside one entire shelf in the medicine cabinet for poisons. To make doubly sure that no mistake can be made, this shelf is covered with a downward swinging sheet of red acrylic resin upon which the word "POISON" is painted in white letters.

And to top off the wash basin and medicine chest is the commuter's clock whose acrylic dial is lighted by fluorescent tubes set on either side of the mirror that covers the cabinet door. As with the fluorescent tubes around the dressing table mirror, these lamps also light the radiant walls.

The toilet, the smooth functional lines of which mean easy cleaning, is shielded from the remainder of the bath by a row of acrylic resin bars cut in the shape of prisms. Because of the reflections thrown from the surfaces of these bars, the acrylic appears to be opaque—providing complete privacy.

Just beyond, half-way between the wash basin and the shower stall, are towel shelves and racks, and a concealed hamper. Again, transparent acrylic resin sheets and bars are used to good account.

Immediately adjacent is the shower which is equipped with automatic temperature controls both outside and in. Anyone who has tried to regulate the flow of water in a shower without either freezing or scalding himself will appreciate the convenience of this dual system of water regulation.

The space-giving effect that can be achieved through the use of large sheets of acrylic resin is again put to test in the shower wall. One half of the wall of this shower consists of two pieces of curved Plexiglas, one of which slides back of the other to permit entrance to and exit from the stall. In this exhibition unit the transparent wall of this circular shower is etched with only the faintest design. However, should greater privacy be desired, the pattern could be so heavy as to make the sheets almost opaque. Just as with the rest of the illumination in this exhibit, the lighting for the shower comes from fluorescent tubes set into the wall on either side of the transparent enclosure.

A GOOD START—Many novel uses have been suggested for plastics in this life-sized bedroom, dressing room, and bath assembly—but as many more will probably occur to the reader. The way has been shown, however, in which beauty can be combined with practicality—with no sacrifice of either of these essential qualities.

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BOTTLE BREAKAGE

Higher in Glass Than in Plastics

SOME light is shed on the question of the comparative resistance of blown thermoplastics and glass bottles to shipping hazards by a series of tests recently carried out through the co-operation of a manufacturer of blown plastics bottles, two container manufacturers, and an independent testing laboratory.

A seven foot hexagonal drum, studded on the inside with various obstacles designed to subject the test packages to a great many different types of falls, was used for the test. For purposes of accurate comparison all bottles were of similar shape and size, or as nearly so as possible. Bottles made of three types of plastics formulation were tested: acetate; Butyrate; and polystyrene, as well as bottles made from flint glass. All the bottles were filled with a similar liquid and fitted with standard type closures. The cartons or boxes used to pack the bottles were of identical size and construction.

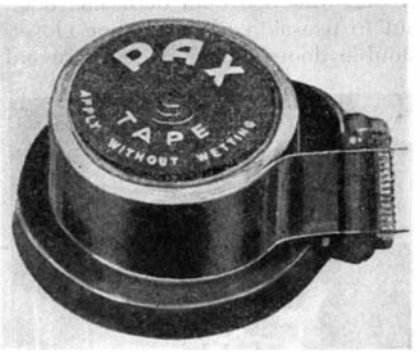
According to reports of the tests carried out, acetate bottles showed the greatest endurance, surviving five drum tests, each of which involved 150 falls of the drum, without visible damage. Butyrate bottles stood up almost as well as acetate, withstanding 150 falls in all but one of the tests. In the case of the polystyrene bottles, performance varied, breakage occurring after 36 to 104 falls of the drum. The glass containers performed according to long established standards—breakage occurring in each case after 46 to 69 falls.

SEALING UNIT

Has Plastics Housing and Uses Plastics Tape

A TRULY all-plastics application is a sealing unit put out by Cofax Corporation. Not only is the housing of the unit injection molded of Lumarith, but the tape is produced on a cellophane backing or Lumarith film.

The sealing tape holder is made up of two parts—a base and a snap-on cover. Both parts presented a number of molding problems to the Sterling Plastics Company. In the case of the base the difficulty was with the proper forming of the teeth which are used to cut the tape to the desired length. As for the cover, it was necessary that this piece snap in and out without too much pressure being exerted, yet hold firm when the sealer was used.



All plastics

The Pax dry seal tape is available in transparent form and in a range of colors.

UPHOLSTERY MATERIAL

Resists Constant Scuffing And is Easy to Clean

SINCE real leathers and fine woods are almost prohibitively expensive, manufacturers of dining-room equipment are always on the lookout for materials which will give the same effect of elegance yet will not require too large an initial investment. Furthermore, they are attracted by materials which will remain flexible, will not crack and spot, and will not lose color under constant exposure to light.

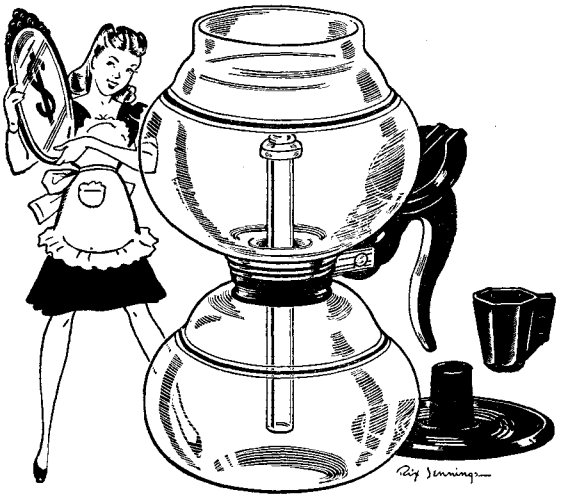
The Monsanto Chemical Company has come to the aid of these restaurant materials manufacturers with a vinyl butyral coated upholstery covering which is designed to meet all these adverse conditions. Used for the first time in the dining room of the Sheraton at Springfield, Massachusetts, the new covering has proved specially suitable as the outer lining of the pantry service door. Not only does it resist the constant scuffing it receives from the feet of waiters but it can be wiped clean with a damp cloth. And as a covering for the seats and benches that line the walls of this dining hall it has proved itself to be stain proof and remarkably resistant to sunlight.

DUREZ

PHENOLIC RESINS

- MOLDING COMPOUNDS
- INDUSTRIAL RESINS
- OIL SOLUBLE RESINS

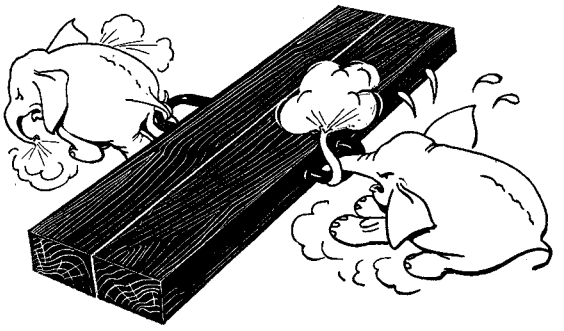
MOLDING COMPOUNDS



BREWING REAL PROFITS

Like most products which are being successfully merchandised in the highly competitive consumer markets of today, the Cory Coffee Brewer makes skillful use of plastics. The hinged decanter cover, safety upper glass stand, easy-grip handle, and measuring cup are all molded from a Durez phenolic compound. Such inherent characteristics as heat resistance, dielectric strength, brilliant finish, excellent moldability, highest dimensional stability at temperature extremes, and moisture resistance, make the more than 300 versatile Durez molding compounds of tremendous value to the imaginative design engineer... make them the natural starting point when you're looking for the plastic that fits your job.

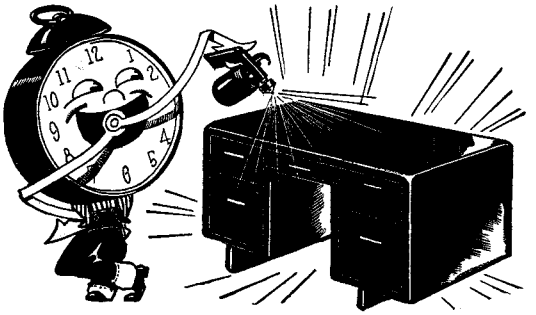
INDUSTRIAL RESINS



THEY SAID IT COULDN'T BE DONE ... AND IT COULDN'T!

Durez laboratory technicians said that the strength of a Durez 12688 bond was such that even elephants couldn't pull it apart...the wood would give way first. Subsequent tests (without the elephants) proved this to be absolutely true. In fact, a Durez 12688 bond is virtually indestructible. This remarkable room-temperature resin adhesive produces bonds which are just as durable and waterproof as those in hot-pressed plywood ... opens up many new markets of which laminated lumber, keels, and prefabricated housing are but a few.

OIL SOLUBLE RESINS



HOW TO DO A DESK JOB ... 24 TIMES FASTER!

Furniture which used to take three or four days for finishing can now be ready for packing and shipping in four hours if Durez 50824 Liquid Resin is incorporated in your paint manufacturer's formulation. This amazing new resin typifies the continuing leadership of Durez oil soluble resins in the protective coatings field.

The phenolics are the most versatile of all plastics and, therefore, are the most widely used throughout industry. As specialists in the production of phenolic plastics and resins for the past quarter century, Durez technicians have gained the vast experience so necessary for giving competent guidance to the newcomer. This rich background is further enhanced by the fact that these men have actively participated in the successful development of literally thousands of products. Their services are available at all times to you and your custom molder. A new booklet entitled "Plastics Primer" was recently completed by the Durez staff. Its purpose is to inform today's over burdened executive of the basic facts about phenolic plastics. You'll find it a brief, simple, crystal-clear digest filled with the kind of authoritative information you've been waiting for. Write for your free copy today. Absolutely no obligation, of course. Durez Plastics & Chemicals, Inc., 5212 Walck Road, North Tonawanda, N. Y. *Export Agents: Omni Products Corporation, 40 East 34th Street, New York 16, N. Y.*

PLASTICS THAT FIT THE JOB

Two-in-One Materials

Plating, Hot Dipping, Powder Metallurgy, Inserting, and Cladding, Offer Virtually New Materials With Desirable Properties for Many Specific Purposes. Plastics Plus Metals and a New Aluminum-Cast-to-Steel Process Open Many Fields of Application Hitherto Undeveloped

PROGRESS—technical and otherwise—often comes from unexpected directions. The war demanded many materials with special properties or combinations of characteristics not previously available, and the natural approach was to develop new alloys or improve the old to solve such problems. While several new materials were born out of this stimulus, the answer in many cases was found in composite materials—combinations of two different metals, for example, in which the best properties of each are utilized in a way not possible through alloying.

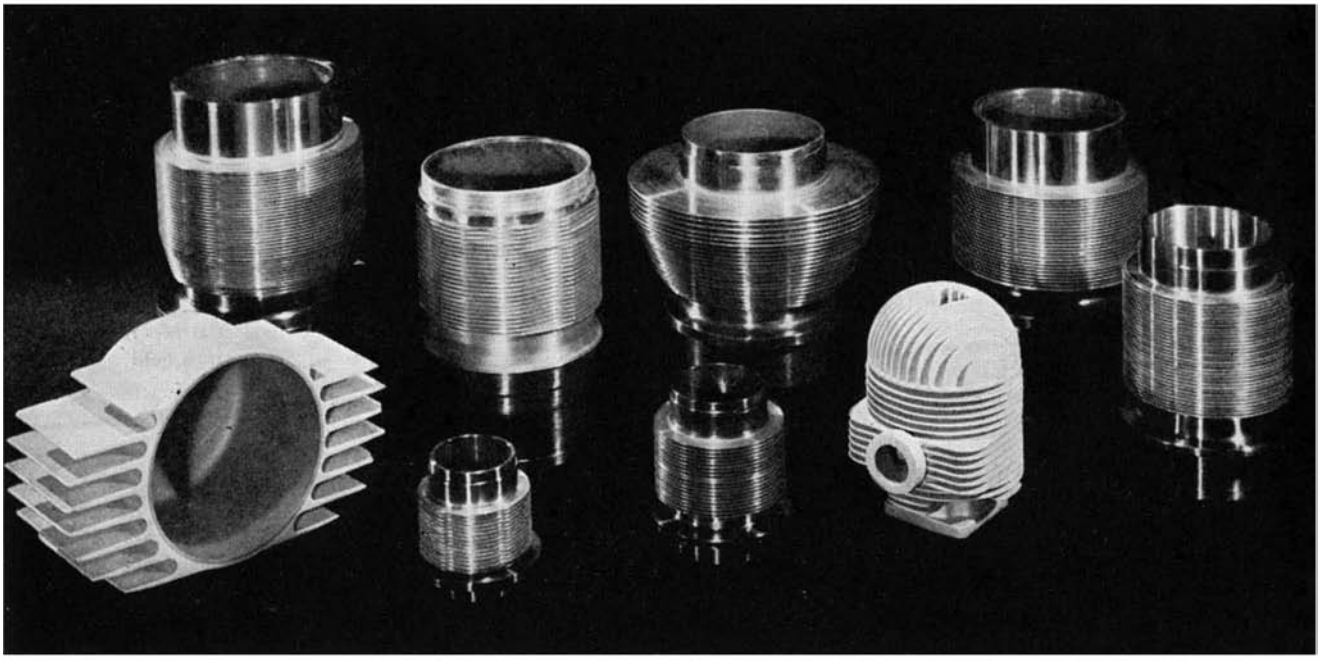
The composite materials have opened up a vast new field for materials engineers and metallurgists and, indeed, the technique has joined the more familiar alloying as a second method of achieving needed material characteristics for special applications. They are already being widely incorporated in the new peace-time products now being blueprinted or manufactured.

For such industrial products the two-in-one materials of greatest interest are metals plated or coated with other metals, duplex powder-metallurgy products, inserts of one material in another, composite metallic-nonmetallic materials, a wide range of clad-metal combinations, and bonded-assemblies of different metals, such as the Al-Fin cylinder barrels.

Although not popularly considered as composites, electro-plated or otherwise-coated metals are actually the oldest and most familiar of the duplex materials. A "tin" can, for example, is made of sheet steel coated with tin; the steel provides the mass-productibility, formability, and low cost required of can materials and the tin confers the necessary corrosion-resistance, non-contaminating quality, and solderability.

The double advantages of thin layers of one metal applied on another are widely appreciated, so that the application possibilities for some of the newer developments of this type are broad indeed. For example, the recently developed aluminum-coated steel sheet (produced by hot dipping) combines the corrosion- and heat-resistance, the reflectivity, and the appearance of aluminum with the cheapness and workability of steel, and may find uses in such diverse products as mufflers for internal combustion engines, oven and furnace linings, and firewalls in airplanes.

The reverse of this—the plating of other metals on aluminum—yields a product that features the light weight of aluminum with better surface wear or electrical-contact properties than those of the light metal. Thus gold and silver outer coatings are used where low contact resistance or high surface conductivity are required. Nickel and chromium may be employed to improve the wear resistance and tin or cadmium to facilitate soldering.



Composite aluminum and steel products made by the Al-Fin process

Courtesy Reynolds Metals Company

Hot rolling a slab of clad aluminum alloy material

Electronic equipment, electrical appliances, and aircraft instrument components are among the applications expected to develop for this type of plated metal.

Similarly the development of high-speed continuous zinc electroplating on steel promises a new, inexpensive duplex material for many purposes, such as automotive and radio-set stampings and general hardware—all of which will require the workability and built-in coating-adhesion of such pre-plated steel.

BUILT-IN DUPLICITY — Certain types of powder metallurgy parts are shining examples of built-in duplicity. Electrical contacts, in which copper and tungsten particles are unalloyed partners within the metal's structure, possess the conductivity of the copper and the hardness and arc-resistance of the tungsten.

The same principle applied to discrete aggregates of other dissimilar materials is being used to make bearings, friction plates, and armature brushes with one wear-resisting and one lubricating constituent; it will doubtless be expanded to give us light-weight aluminum aircraft bearings; thermal insulating refractory parts with the built-in extra strength of dispersed metal powders; and molded plastics products containing enough admixed metal powder to provide a metallic sheen or semi-luster for ornamental uses or to increase the strength of insulating parts for dielectric applications.

The possibility of using inserts of one material cast or molded into another has not received the attention it deserves. Steel pins in nonferrous castings and brass threaded studs in plastics moldings are familiar, but the opportunities for new combinations of built-in properties can go much farther than these.

For example, die castings in zinc, aluminum, and magnesium can be produced with cast-in or anchored steel springs, with brass bushings for bolts or bearing uses, with bronze strengtheners for extra-load-bearing, or with insulating plastics for localized insulation in an electrical part. Such applications, if more widely used, would bring the fast-production and close-tolerance advantages of die casting to industries like machinery building, automotive engine manufacturing, and railway equipment production whose highest mechanical strength requirements have often led them to avoid the use of die castings for structural parts.

The combinations of metals and nonmetallic materials that are now available provide one of the most fertile fields for modern designers, especially in architectural and building products, in furniture and consumer durable goods, in boats, and, of course, in aircraft. The automotive industry has long made successful use of plastics-metal composites, as in many modern dashboards.

Several engineers are sure that laminated products—a light nonmetallic material in thick section combined with a strong alloy in thin section—may provide the combination of light weight, strength, and general rigidity needed in many fields. An interesting recent development of this type is a combined wood-and-aluminum sheet which possesses strength, lightness, rigidity and eye-appeal as well as resistance to fire, termites, and seasonal temperature changes. These qualities will make the material especially attractive for post-war buildings, railway cars, buses, and private airplanes. [Other metal-nonmetallic composites have been described in recent articles on plastics in April, and on glass in September, Scientific American.]

METAL ON METAL—The clad metals represent today the largest two-in-one material tonnage produced and offer the greatest opportunity for exploitation by designers. The Alclad aluminum alloys and stainless-clad steels, for example, are already well-established products with great potentialities.

The pure-aluminum-clad alloys were developed to provide a sheet material for airplane construction that would have the strength of the underlying age-hardening aluminum alloy with the corrosion resistance of the pure aluminum surface. The recent improvements in both underlying strength and surface (fatigue) strength inherent in such new and stronger combinations as Alcoa's Alclad 75 S and Reynold's R 301 and R 303 have now broadened the market for the clad aluminum alloys to include all types of transportation equipment and home appliances as well.

Stainless-clad steel is today the fair-haired boy of the duplex materials field, with the possibility ahead that it may reach production tonnages near those of straight stainless a few years ago. The stainless clad steels are made by a vaviety of processes but in their final form they are all sheet or strip material consisting of a thin layer of stainless steel permanently bonded to a heavier base of ordinary steel.

This combination in effect offers the corrosion resistance of stainless steel in a much cheaper material. In addition, the clad material has better fatigue strength than ordinary steel. It can be fabricated by the

welding, cutting, and forming processes suitable for stainless steel. Originally developed for applications in the chemical process industries, the stainless-clad steels are reaching out for structural uses as well and are sure to find employment ultimately in building construction, automotive components, and railway equipment as well as widely increased use in the chemicals, oil refining, rubber, paper-processing, and related fields.

Similar to stainless-clad but more specific in their serviceability are nickel-clad, Inconel-clad, copper-clad and even admiralty-metal-clad steels. These are mostly designed for and will be ultimately used in chemical processing. One manufacturer has brought out a line of duplex tubes that are simultaneously good for two corrosive environments —one on the inside of the tube and the other on the outside.

CAST COMPOSITE — One of the most significant of recent developments in the composite materials field is the Al-Fin process in which aluminum or an aluminum alloy is integrally joined to steel, iron, or other base metals by casting the light metal in the usual manner against a specially prepared steel or other surface. This particular combination combines the heat-dissipating ability, light weight, conductivity, and corrosion resistance of the aluminum alloy with the strength and hardness of the ferrous metal.

Developed originally for airplane cylinder barrels (the aluminum muff and fin structure removes the heat from the steel barrel around which it is cast) the Al-Fin process and product can rely on other advantages (for example, the excellent high-temperature oxidation resistance of aluminum and its good bearing properties) to make them suitable for such diversified uses as radio transmission power tubes, airplane exhaust stack heat exchangers, bearings, and composite gears.

Indeed it has been characteristic of the two-in-one materials that the purposes for which they were originally devised in each case have been "only the beginning," and they have gone on to many new applications in fields undreamed of by their original developer.

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WELDING DISTORTION

Can Be Cured by Finding Causes

WELDING will play an important role in America's industrial future as a means of fast production and in making possible the streamline designs that engineers are projecting for many consumer and industrial goods of tomorrow, says Charles H. Jennings, welding authority with the Westinghouse Research Laboratories. This engineer terms distortion as one of the major problems of welding. He explains that the heating and cooling of the metal within the area being welded, and the contraction of the filler metal during the cooling period cause the fabricated structure to shrink or warp.

"However," Mr. Jennings continues, "by properly studying the fundamental factors producing distortion and applying corrective measures—such as clamping the parts in fixtures during welding, pre-distorting the parts to compensate for expected distortion, or developing special welding techniques—distortion can often be held to a very low point or entirely eliminated.

COPPER TUBING

Is Finding Increased Use in Factories

THE FAMILIAR advantages of copper or brass tubing that have led to its use for house water lines are beginning to be recognized by plant men and engineers and should lead to its increasing use for water, air, oil, and hydraulic lines for factories.

For industrial water lines, copper tubing with solder-joint fittings not only outlasts rustable piping several times but also is lighter in overall weight and more convenient to install.

WELDING HAZARDS

Proved to Be Largely Mythical

ARC WELDING is the victim of more unjust or exaggerated charges of danger to health or safety than any other metal-working operation, and a recent investigation has scientifically laid many of them to rest.

Thus it is definitely untrue that most arc-welding equipment gives off "mystery" radiations that may cause sterility or other strange ailments. At General Electric's Schenectady plant, welding operators have carried pieces of photographic film around in their clothing for weeks at a time without any evidence of X-ray-like radiation appearing.

Again, a survey of four manufacturers using arc welding showed that they employed a total of 14,475 industrial workers and suffered a total of 13 fatalities in one year, or an average of one death per 1100 workers. Included in these totals were 1125 arc welders, among whom there was one fatality.

Obviously, the electrical shock hazard in arc welding is no greater than the normal hazard in industrial work in general.

MAGNESIUM ALLOYS

Are Not Potential Fire Hazards

THE GREATEST factor curtailing the wider application of magensium alloys has been the common misapprehension that these alloys are inflammable.

This ghost has been scientifically laid to rest by Louis A. Carapella and Wm. E. Shaw, of Mellon Institute, who conducted tests on a number of magnesium alloys to ascertain their behavior on direct exposure to fire. It was demonstrated beyond question that *solid magnesium alloys do not burn.*

Melting must occur before burning can take place, which means that ignition cannot possibly occur until the metal reaches temperatures from 840 to 1500 degrees, Fahrenheit. Massive magnesium does not reach such temperatures easily, either, because of the relatively high heat conductivity of the alloys. Furthermore, burning need not occur even when handling the molten metal, for with simple precautions alloy-making, metal-refining, pouring, casting, and welding are widely performed without trouble.

POROUS CHROME

Is Successful in Prolonging Life of Engine Cylinders

AN EXAMPLE of how successful porous chromium plating can be in lengthening the operating life of engine cylinders to which it is applied has recently been reported.

A merchant ship whose main Diesel-engine cylinders were porous chromium plated ran for five years and traveled 300,000 miles before the chromium had worn enough to require reprocessing. At one time the engine was submerged in seawater 14 days before the ship could be salvaged.

Porous chromium plate differs from the usual chromium plate in that its surface is covered with tiny pits or small channels which effectively retain lubricating oil. While its use is steadily increasing on ship Diesel piston rings and cylinders, this type of plating has operating advantages that are also of special interest to makers and users of auto, truck, and railway engine cylinders as well as for cylinder surfaces in hydraulic equipment, pumps, and so on.

What new "armor" for steel can save America millions each year?

YEAR AFTER YEAR—in war or peace—America pays a colossal toll in dollars to a foe as unrelenting as any ever known.

It is the enemy *rust*, that attacks and destroys things made of steel. But now a remarkable new discovery can bring you steel products that will *defy* rust up to 4 times longer . . . Hardware, screens, fencing, automobiles, tractors, dozens of important items that will outlast any you've ever owned by as much as 4 to 1!

This remarkable discovery is CORRONIZING, the patented alloy "armor" that gives steel a new lease on life. Yes, CORRONIZING is new . . . but also thoroughly tested and proved. For CORRONIZING has demonstrated its overwhelming superiority in the war, under the worst possible conditions on land, at sea and in the air.

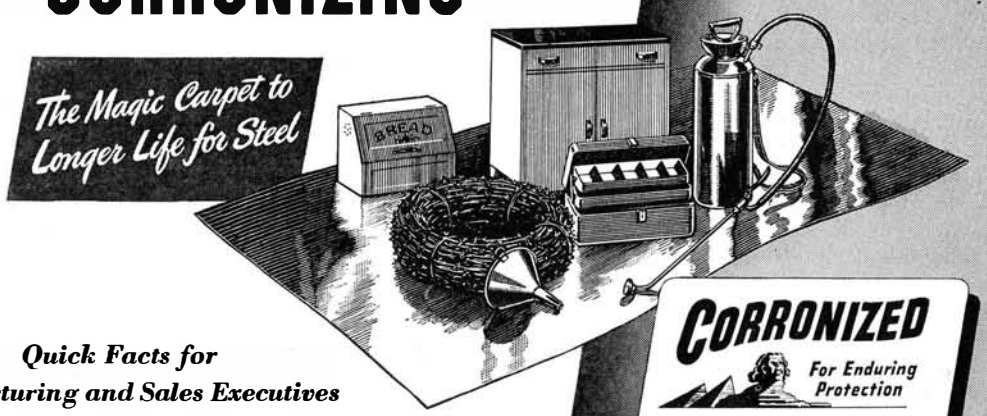
By test and performance, CORRONIZING FAR OUTLASTS OTHER PROTECTIVE COATINGS FOR STEEL. Now, the more progressive factories and retailers will be able to bring you products made of "Corronized" steel. Motor car makers—always leaders—will be among the first to offer you this sensational advantage.

Remember that name—CORRONIZING. It can save you and millions of other Americans a huge tax bill now needlessly paid to the enemy rust.

Standard Steel Spring Co.

ORIGINATORS OF

CORRONIZING



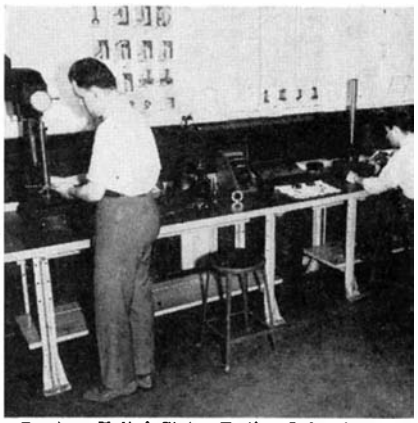
Quick Facts for Manufacturing and Sales Executives

Do not confuse CORRONIZING with other metal coatings. This patented process provides a permanent alloy "armor" with 5 layers of defense against corrosion! It becomes part of the steel base . . . can be worked in any manner. Permits using lighter materials by prolonging steel's period of greatest strength. Write for samples and complete information.

STANDARD STEEL SPRING COMPANY
CORAOPOLIS, PENNSYLVANIA

Research For Small Business

A Little Research into Effective Means of Utilizing Research Reveals that Small Businesses Can Put Themselves on a Par With Big Business By Making Use of Available Facilities. Government Research Must Benefit All and Hence Must Fail in at Least One of its Avowed Purposes



Courtesy United States Testing Laboratory
Materials testing

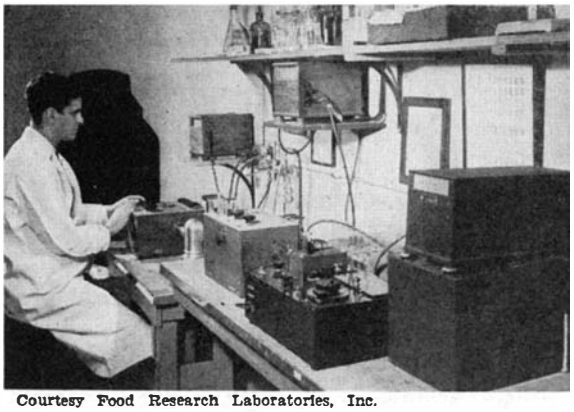
As THE story of industrial progress during the war years is gradually uncovered, tremendous forward strides are revealed. Basically, this progress has depended on the development to commercial usefulness of scientific research for a long period preceding the war. This again emphasizes research as the stuff of all progress; that industry must build on science. As has been truly said, man has come to live in a fourth kingdom, a synthetic kingdom, cognate with the animal, vegetable, and mineral kingdoms of his childhood. This synthetic kingdom is clearly a creature of research, of science put to work, of the abstruse concepts of science materialized into the work-a-day things of modern living.

No longer is it possible for any business or industry to ignore science. Research has of necessity become an integral part of all civilization. There can no longer be any argument about its value. The only question that can now properly arise concerns the types of research appropriate to a particular enterprise and when and how these may be obtained.

Research—in the chemical field or elsewhere—is the method of discovery and invention. It stands out as a dominant force in war. It is equally vital, though less spectacular, in peace. Its immense value has been stressed and explained to greater and greater numbers of people through extraordinary research achievements of the past five years. Quite naturally it has attracted political attention and pressure has been applied to put our paternalistic government into the business of supplying research facilities to those who presumably cannot afford it for themselves. The idea is to help the small business man by providing research for him, at taxpayers' expense, thus giving him an advantage comparable with that enjoyed by big business. That is a perfectly good idea and a laudable objective, but it can only be made to work by observing and considering the peculiarities of research itself.

Considering the significance of the place research occupies in the world, it is amazing how little is actually known about it by otherwise well informed business executives. Where to go to get research for one's business needs, what types of research one should engage in, and even what research is; these and like questions apparently vex many intelligent business executives and impede their progress toward that Utopia which research is expected to open to business and industry.

It will be worth while to look into the whole subject because of the danger, already apparent, that research may become a political issue. Not that a thinking person can be of two minds as to its fundamental value, but rather that handling of the mechanics of research in the customary political manner is sure to entangle the main proposal with useless and complicating appendages having little or no relation to the main theme. It even seems likely that the anticipated benefits may become lost in the tangles of red tape. Therefore it behooves thinking persons to become familiar with the subject in order to be able intelligently to decide the issues likely to require decision soon.



Courtesy Food Research Laboratories, Inc.

The chemist in the research laboratory of today seldom stands at a window peering through a test tube. More often he is found at a table such as this one, making use of photoelectric and other precision equipment

RESEARCH DEFINED—Research resembles food which must undergo subtle changes within our bodies before it can be absorbed and become an actual part of us. The pangs and perils of overloaded digestions are common experiences. And it is scarcely necessary to emphasize that all foods are not equally suited to all digestions. Picture a rabbit wolfing a beefsteak, for instance, or a lion nibbling a lettuce leaf! Research, which, is a mental process and deals with ideas, is like that. Too much research, particularly too much successful research at one

time, can bankrupt a company quite as surely as too little. It is also true of research that to be useful it must be directed toward ends compatible with the abilities and aims of its expected beneficiaries.

We must recognize as types of research both the search for new knowledge for its own sake alone that characterizes the purest of research and the extremely valuable application of acquired knowledge to new situations and combinations. These are distinguished by the newness of the knowledge acquired and by the novelty of its applications from the repetitious and more or less mechanical operations of testing and analyzing products. The scientific speculations, experiments, and observations which led up to the idea that vast amounts of energy could be released from atoms by bombardment with neutrons clearly belongs to the first phase of research. The second phase is equally well illustrated by the development of methods, mechanisms, and materials to apply this basic principle to a military weapon. During the course of both phases of this incomparably important research almost countless numbers of more or less routine analyses and tests had to be made in collecting information necessary, but subsidiary, to the main objectives. This last belongs in a category that may at one time be definitely research and at another quite as definitely outside of that class. The distinction is based on the purpose for which the tests are conducted.

For present purposes, then, research is the search for new knowledge, facts, and combinations in whatever field and for whatever purpose. Physical entities alone are the concern and hence researches are conducted by the experimental method of the physical sciences. That greatly narrows the definition but it still covers an immensely wide territory, excluding only certain activities sometimes falsely called research which are simple searches for information known already to exist.

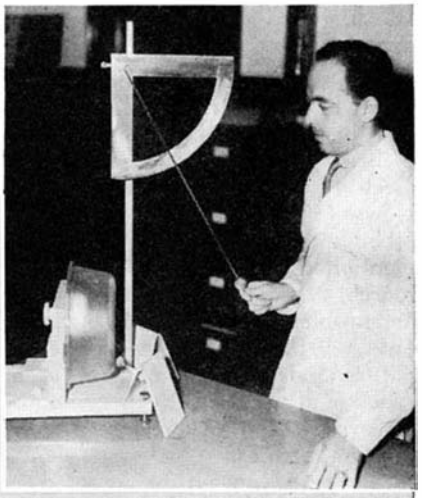
"FOCUSING" RESEARCH—While it is obviously true that no research is worthy of the name whose result can be known in advance, yet it is always necessary to direct and control the progress of an investigation so as to bring its probable result within a limited area. In other words, it is possible, as well as necessary, to "focus" research. This is an essential of fruitful research. Whereas it is entirely proper for an academic group in a university alone to pursue a search for knowledge for its own sake alone, without serious thought as to its possible economic value, this is quite out of the question for most commercial enterprises. Such abstract research may also be conducted by government agencies.

Endowment of such pure research is sometimes provided by the earnings of industry and certainly industry can sometimes profit by such investigations, but only in rare circumstances can industry itself afford to carry on such excursions into knowledge for its own sake. Notable exceptions were the researches of Irving Langmuir and others in the laboratories of the General Electric Company into atomic structures, high vacuums, surface chemistry, and related matters which ultimately materialized in tremendous economies in electric lighting, among other benefits.

Very few corporate groups are able to engage directly in such pure researches because of lack of focus on specific problems. Hence, most businesses confine their efforts more particularly to what may be called the next circle of research. Leaving such purely theoretical investigations to the universities and other purely academic groups—defined as unconcerned with economics—the usual business research accepts the findings of the academic groups and applies them to specific problems either existing or likely to arise through expansion. The research group may be part of the organization, the common situation with big business, or it may be a specialized group employed for this sole purpose but maintaining a quite independent existence.

GOVERNMENT RESEARCH? — Those who would provide research for small business at taxpayers' expense overlook several essential aspects of the general problem. While the objective is to put little business on a competitive par with big business, merely providing the results of government research cannot affect the competitive situation. Proponents of the plan overlook the fact that no governmental activity can, by its very nature, confer a competitive advantage on any group but must, on the contrary, be equally available to all—big and little alike. This basic fact requires that any governmental research be conducted primarily on the plane of pure theory—designated as academic research since it must ignore economic considerations. In other words, the research that can be conducted by governmental agencies requires that

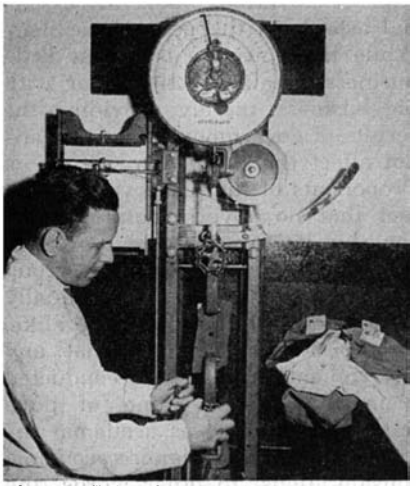
Below: Precision equipment in a modern laboratory. Right: Using an impact testing device on a glass bowl



Courtesy United States Testing Company, Inc.

the beneficiary be able to adapt its findings to his own problems.

This is an important requirement and one that cannot be ignored. The mere application of economic considerations to the findings of academic research makes a vast difference in both its value and its cost. Redman, past president of the American Chemical Society, investigated the relative costs of researches and their applications some time ago and found that the cost



Courtesy United States Testing Laboratory, Inc.
Checking strength of cloth

of *applying* the research was roughly ten times the original cost of the research. In other words, government research will on the average cost the beneficiary some ten times its own cost after he has applied it to his operations before he begins to draw profits from it.

All this applies to the broadest view of research and neglects another vital aspect of the problem, mentioned above—the focus of research. A small business necessarily has problems, as does a big business, but they are usually of a different nature and certainly of a different order of magnitude. Even given the research organization and activity of a big business, a little man would surely find himself bankrupted in attempting to utilize it. On the other hand, the small business can profit substantially from researches planned for him and directed at his particular problems.

To illustrate: The researches on atomic fission, mentioned above as leading to the atomic bomb, can have no more than a most casual interest for any but the largest business groups. On the other hand, as parts of this stupendous project, numbers of subsidiary researches could properly interest even small businesses. A number of chemical elements and their compounds, not otherwise common, are required in certain kinds, purities, and quantities in some of the operations connected with the production of the bomb. Researches on these subjects ultimately led to methods that could be applied on reasonable scales by companies in the smaller ranges of big business. Numerous other subsidiary projects suitable for small business have resulted from the prosecution of other major campaigns on larger objectives. The growth of a small company making the instruments developed and needed by a large research organization is quite typical of this kind of thing.

CONVERTING IDEAS — The essential point is that the small business must be in a position, within its available means, to convert the ideas developed by its research into profitable activity. This aspect of research seems neglected by the busy planners who would use taxpapers' money to create research facilities to put small business on a par with big business already organized to conduct its own research. Clearly, the competitive advantage which each small business (or large one) seeks through research can only be gained by the exercise of private enterprise which will center its attention on an attainable objective and which will further hold the results obtained in a satisfactorily confidential status.

Small business needs a certain guidance in this matter which has been lately supplied by Major W. P. Putnam, President of the American Council of Commercial Laboratories. Major Putnam, himself head of an important laboratory, points out that it is quite possible, and highly advantageous, for a small business to entrust its problems that can be solved by research methods to highly skilled scientists in well equipped independent commercial laboratories. Furthermore, the extent of any research can be established in the beginning so that the business man can limit his expenditure to any amount that may seem to him desirable, whether it be a hundred dollars or a thousand or many times that amount.

Frequently, too, the need of the small business may not involve research as it has been defined, but rather may be the simple and direct application of known principles of science or engineering to solve a given problem. The wide experience available in America's independent consulting laboratories also provides this kind of service at the lowest reasonable cost to the client.

In these independent laboratories, themselves small businesses, already exist research organizations for other small businesses far more effective for their purpose in a competitive world than government research could be. Obviously, small business has an important asset here that must be recognized.

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DISTILLER'S GRAINS

Waste Contains Many Nutriments

ALCOHOL distillers use only the starch of the grain; the waste contains the original protein, fat, and vitamins of the grain, plus any additions, particularly vitamins, made by the growing yeast. This aspect of the alcohol industry has lately been emphasized by distillers in an effort to obtain more leniency in the war-imposed restrictions on their operations and raw materials. One pound of corn distillers' dried grains will replace 3.7 pounds of corn in balancing the ration of beef animals. The high protein content of the recovered grain is important.

CABLE SPEED

Increased by Use of Polythene Plastics

HIGHER speed transmission is reported for submarine cables in which the customary gutta-percha insulation is replaced by the new polythene plastics developed during the war. British cable operating companies are said to be actively prosecuting the development of the new insulation for this purpose. Plants for producing polythene plastics are being expanded in the United States.

CANNED ARMS

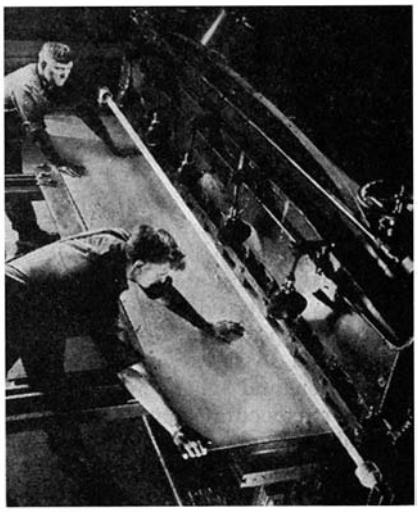
Are Involved in Huge Protection Project

WHAT IS probably the largest canning project ever undertaken is being carried out by the Ordnance Department of the United States Army. The purpose is to preserve the guns, instruments, and other intricate units made for the late war against any possible future need. Many types of drums, specially constructed containers, and plastics layers are under investigation or in use. The objective is to prevent access of air, moisture, light, and other possibly destructive agencies that might damage expensive products.

Economics of Electronics

Much of the Enthusiastic but Misguided Publicity Given to Electronics May Prove a Boomerang to Acceptance of Really Worthwhile Developments. Uses of Electronics, Especially in Manufacturing Techniques, are Almost Unlimited, but Require Careful and Responsible Development

By JOHN MARKUS
Associate Editor, *Electronics*

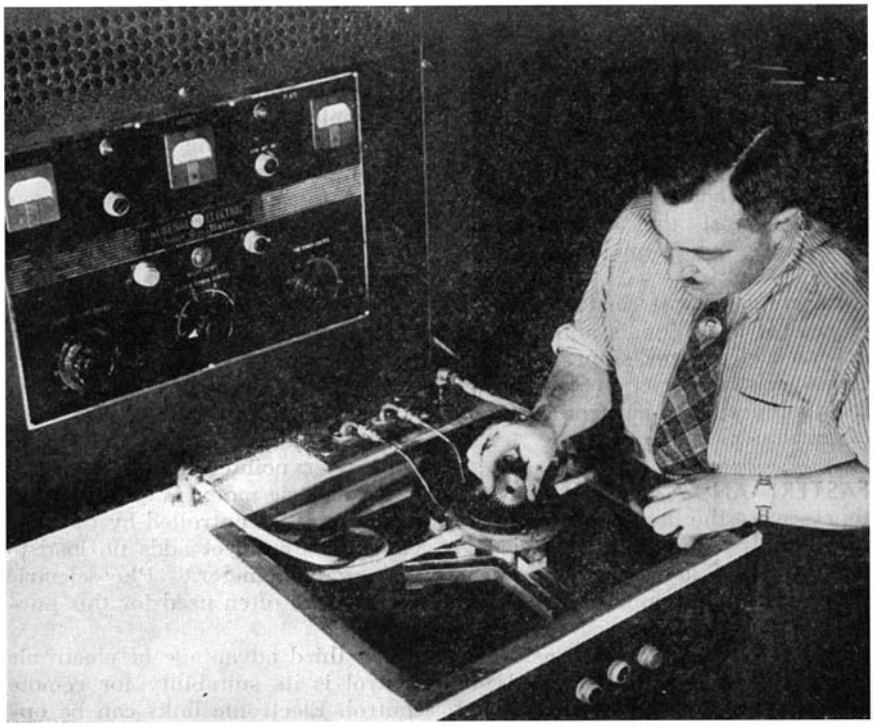


An excellent example of an economically sound electronic application is this Westinghouse photoelectric safety system that prevents the metal-cutting shears from descending when workmen's fingers are in blade's path

AMONG recent additions to the long parade of electronic inventions is an electronic rat trap that operates when a rat passing through an open tunnel cuts an invisible ray beamed on a phototube. Electro-magnetic latches, energized by a photoelectric amplifier, drop trap doors at both ends of the tunnel. The bewildered rat, seeing light only above him, goes up a ramp to a small chamber where he steps on a switch plate. This turns on a current that electrocutes him.

The rat trap just described would undoubtedly catch rats, and might also be technically satisfactory, but it is certainly not a good idea from an economic standpoint because such a device would cost way over ten dollars, even in mass production, and good rat traps can be bought today for a dime apiece. Electron tubes can and do accomplish wonderful things, but the electronic industry cannot exist on the glamour or publicity value of the job it is intended to do.

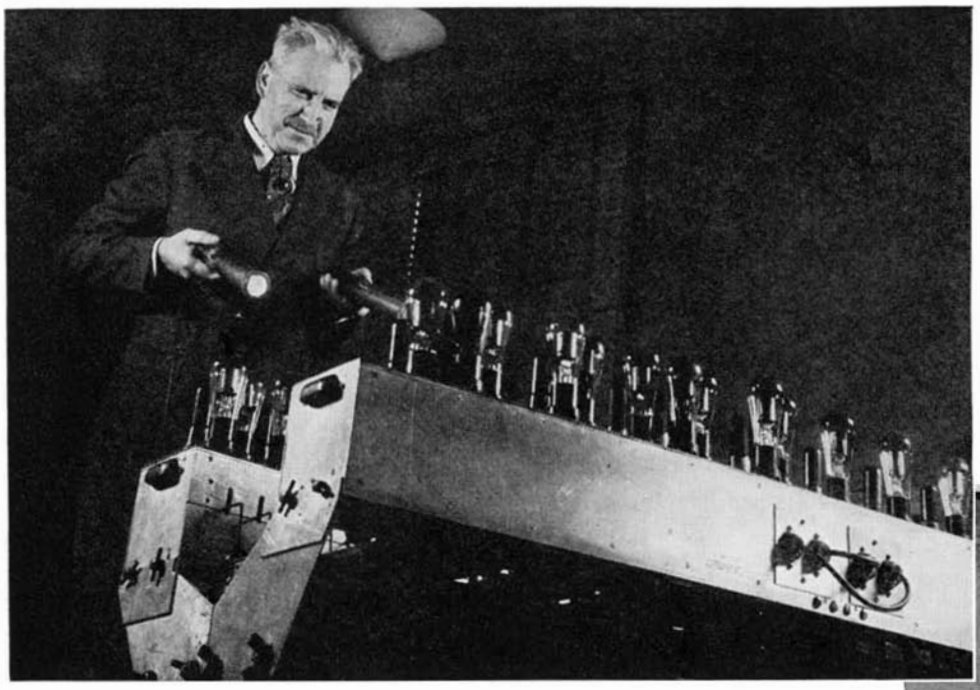
During war-time the manufacturers of munitions and ordnance devices knew that their tremendous volume of business was due solely to war demands. The same was true of the aircraft manufacturers. Far too many electronic manufacturers are hoping, however, that somehow or other the huge war-time demand for electronic equipment will be converted into nearly the same volume of peace-time electronic business, possibly on the much-publicized premise that we have entered the new era of electronics.



Electronic timing and control are combined in this General Electric heat-treatment equipment for surface-hardening gears. All the operator has to do is handle gears and press buttons

What the layman sometimes forgets is that military electronic requirements were necessarily inflated far beyond that of corresponding peace-time requirements. The useful life of electronic equipment in war-time is necessarily much shorter than its obsolescence life in normal use, due to vibration and concussion in combat and rough handling during transit and storage in all corners of the globe. Commercial electrical equipment is capitalized on a basis of 10 to 20 years, whereas the life expectation of radio equipment in war-time is probably more like 10 to 20 months, if not weeks.

A second factor in the war-time electronics picture is the large number of spare parts that were manu-



The electronic marimba (left) is interesting but not a good bet economically. On the other hand, electronic motor controls (below) speed up operations and exemplify good engineering practice

factured for each piece of military electronic equipment. Tanks, planes, and ships had to be used and serviced in huge numbers in hundreds of widely scattered localities. Therefore, spare parts were produced and distributed so they would be available when and where needed, in a ratio far exceeding that required for normal or peace-time electronic devices.

SALES APPEAL—The glamour attached to electronics unquestionably adds to the sales appeal of a product. This is due to the blaze of publicity that electronics has received and because of its winning role in the war. Unfortunately, however, electronics has been overpublicized. The marketing of electronic devices that are either involuntary or deliberate fakes, doing a job no better than cheaper mechanical or electrical equivalent products, will harm and discredit the electronic industry. For the industry to prosper, its products must possess definite advantages in greater efficiency of operation or must do things that have never been done before.

Electronic heating, as an example, meets both requirements. It heats and dries materials faster and more uniformly than older steam, gas, or electric methods and it has a high score of never-done-before achievements. Here the future is legitimately bright, and every alert businessman should investigate the possibility of applying this war-time-mushroomed electronic technique to improving his own products. The extent of industrial electronic heating today is clearly shown by a report of a recent survey which lists over 125 different models of induction and dielectric heating equipment made as standard packaged units by 15 different manufacturers, and still more firms offering custom-built units for special applications.

Applications for high-frequency heating are divided into two distinct groups: (1) induction heating units for melting, hardening, brazing, soldering, and heat treatment of metallic and conducting materials, and (2) dielectric heating units for heating, dehydrating, sterilization, or cooking of non-conducting materials such as tobacco, wood products, food, cereals, and other agricultural products.

Electronic heating is expensive, though—even more than electric heating—because the tubes that convert the ordinary 60-cycle power into high-frequency power are expensive and are not 100-percent efficient. Here, as in every other electronic application, the initial cost, power cost, and maintenance cost must be compared to similar costs of other methods and the result balanced against the advantages of electronics before making a decision.

Reacting almost instantly to a change of condition is another role in which electronics shines, and this characteristic of vacuum tubes lends itself admirably to electronic control of machinery and processes.

FASTER AND BETTER—Welding timers were the first large-scale and exceedingly successful industrial application of fast-responding electronic control circuits. The task of the welding timer consists of delivering to the welder transformer powers running into hundreds of kilowatts but only for a short period of time. Electronic timing is indicated because it is extremely difficult to devise mechanical or electromechanical timers to handle the large current with sufficient accuracy and without rapid deterioration of contacts.

Another important advantage of electronic control is high sensitivity combined with the ability to do useful work such as operating relays. A fine galvanometer can move a pointer or deflect a light beam up the scale, but nothing more. If the power for a furnace is to be started or stopped as directed by the galvanometer deflection, the position of the galvanometer pointer must be translated into the desired action.

The modern link between a galvanometer pointer and a contactor or an electric motor is an electronic device that is controlled by the galvanometer and yet adds no load to the galvanometer. Photoelectric systems are often used for this purpose.

The third advantage of electronic control is its suitability for remote control. Electronic links can be op-

erated over almost any desired distance with conventional wiring, and now even radio links can be used. Thus, the readings of the altimeter and other instruments in a pilotless plane can be transmitted to duplicate instruments on the ground by radio and read there.

One other major point of superiority is the flexibility of control design. The variety of tubes and other circuit elements available is almost as great as the number of combinations in a chess game, so the electronic control can be given almost any characteristics. It can be fast, or time delays may be readily incorporated. It can be rugged and sensitive at the same time.

Electronic control of D.C. motors is a major industrial application of electronics. In response to electronic, electrical, or mechanical monitoring devices, tubes can regulate or change the speed of the motor in the required manner.

DELICATE SENSING — Electronic links have been extremely useful in stopping or starting some or all operations on high-speed machines where mechanical methods become awkward or impossible. If, for example, a delicate sensing device is needed to start, stop, or control heavy equipment, an electronic link will probably do the job better than anything else. An electronic device may, for instance, be designed to follow up the movement of an instrument pointer and perform almost any control function, either near the instrument or miles away from it. One interesting application is to the automatic cutting torch, which reproduces the pattern of a template without touching it.

Electronic devices for the inspection of metals for uniformity, soundness, and size are in use in many places. Devices of this type may reveal cracks, slag inclusions, voids, changes in chemical composition, results of faulty heat treatment, and under- or over-size. The devices are nondestructive and very fast. Old style tests sometimes destroy or mar the test pieces and are much slower, so here electronic techniques are advantageous.

Many electronic devices sold to industry have ended in the factory morgue or curio cabinet after a six-weeks trial. Such devices were too difficult to use, or required too much supervision and maintenance.

Reliability is essential for industrial use. A 10 percent variation in the output of a radio receiver over a period of time will be barely noticeable, infrequent clicks being ascribed to static, but such variations in industrial devices might cause spoiled products or even loss of life.

This does not mean that electronic devices are less reliable than their mechanical and electrical brethren. It means only that electronic devices require more ingenuity and meticulous care in design before they are manufactured and released for use.

Truly, industrial electronics is as replete with opportunities as it is beset with traps for the unwary. Anyone who looks into a crystal ball and sees electronics doing most of the work in the homes and factories of the future should have another crystal ball handy, into which he could peer and determine the date when these marvelous developments will become available to customers.

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MILLISECOND TIMER

Can Be Used for Test and Experimental Applications

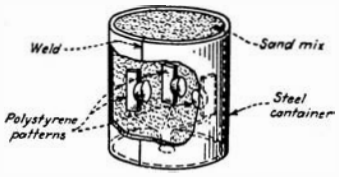
OPERATING on momentary impulses of extremely short duration, a new millisecond timer is designed for use in factory test departments and experimental laboratories. Among its industrial applications are the measurement of pull-in and drop-out timing of high-speed circuit breakers and relays, and timing of other high-speed operations.

The complete timer assembly comprises a millisecond timer movement and an electronic control chassis. The timer movement is driven by a 115-volt, 60-cycle synchronous motor of the high-speed shaded-pole synchronous type. The movement drives two hands over a dial that is calibrated in units of 0.0002 second and totalizes to six seconds before repeating. The faster hand is driven at a speed of 600 rpm. The timer movement is capable of resetting the hands to zero from any position by the manual operation of a reset lever or knob. The unit is made by Standard Electric Time Company.

STYRENE PATTERNS

Removed From Molds by Melting

CENTRIFUGAL casting of intricate steel parts produces accurate castings requiring no machining. One of the major problems, however, is that of getting the patterns out of the sand mold without dislodging sand and thereby destroying the fine details of the casting. In the recently developed electronic solution to this perplexing problem, a heavy sheet-metal cylinder serves to enclose the molding sand, and a polystyrene pattern is used instead of wood. The styrene is melted out by induction electronic heating applied to the metal cylinder, after which



Induction electronic heating speeds up melting of polystyrene patterns

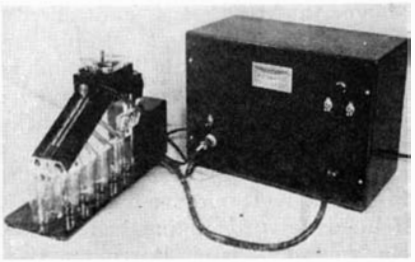
the molten metal is injected into the cavity by centrifugal force.

A slow rate of heat of the styrene pattern is required at the start to prevent excessive moisture and alcohol in the sand mix from exploding the mold. On one set of samples, submitted to Commonwealth Edison Company engineers, the ideal seemed to be four one-minute cycles separated by one-minute intervals. The method formerly used required from 1¼ to 1½ hours to melt out the styrene.

BALL SORTER

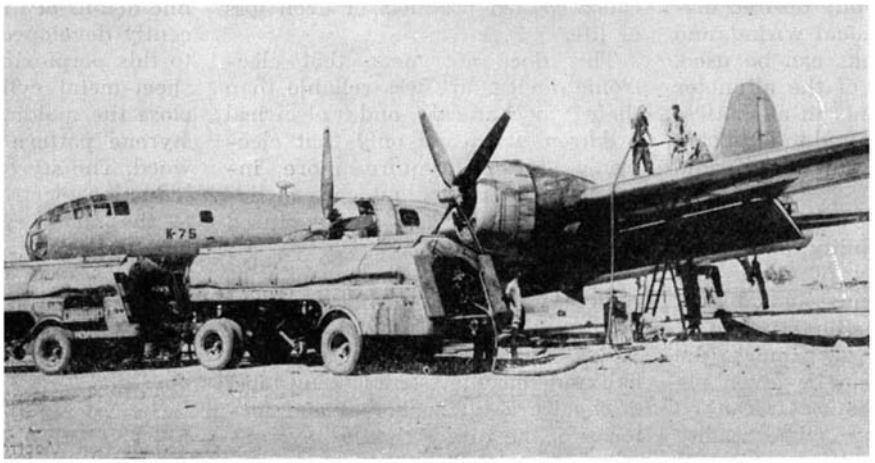
Employs Electronics for Extreme Accuracy

HIGHLY polished steel balls, all within 1/20,000 of an inch of the same size, are sorted into groups of as many as ten size selections automatically by an electronic gage de-



Steel balls from the hopper roll down the incline; metal fingers in vacuum tube circuits sort them automatically

veloped by Jack and Heintz, Inc. The balls in any one group then differ in diameter by only ten millionths of an inch, a precision more than adequate for the finest ball bearings. One operator can handle four machines easily, and these will sort more balls than 32 skilled operators could do with conventional measuring equipment. The operator merely fills the Plexiglas hopper, and removes the sorted balls from their individual containers a few seconds later. Vacuum tubes connected to contact fingers sort the balls.



A Heil mobile refueling unit saves time and trouble

AVIATION Conducted by ALEXANDER KLEMIN

Flying Aids

Aviation Gas Stations—Complete With Fuel, Oil, and Information Service—Offer Increased Safety and Convenience to the Pilot. A Number of Combination Automobile and Aircraft Stations Have Their Own Flight Strips. Fire-Fighting Equipment Adds to Overall Safety

MANY an old-time pilot recalls with mingled feelings the day when to take up a plane for even a short cross-country hop was very much of an adventure. Once safely off the rough flying field, often just missing the boundary fence by inches, he climbed slowly above the tree tops and silently prayed that his engine would not start missing on half its cylinders. Always he kept his eyes open for possible emergency landing spots—an open field, a golf course, or a rambling estate, where he was sure to find a welcome from the owner if he developed engine trouble and was forced to land. Barring a sudden rainstorm, or unexpected ground mist, he arrived at his destination safely and climbed out of his plane with a feeling of genuine relief. The local garage would supply him with gasoline of sorts, filtering it through a chamois cloth which the pilot wisely carried in the plane with him. And if he needed any minor repairs to his plane, which frequently was the case, the garage mechanic would set to with what tools he had available. Happily—those days are gone forever.

Today a pilot takes off knowing that his engine will not stop just as he rises from the smooth airport. And as he gains height he can see, within easy gliding distance, not one, but perhaps several well kept airports. And he can be informed beforehand that the weather at the airport where he plans to land is clear, with no rain or fog hiding it from view.

Flying today, thanks to the intelligent co-operation of every one connected with flying, from the oil companies to accessory manufacturers, is rapidly becoming not only a pleasant pastime but, to the busy executive, an invaluable time saver.

Profiting by its many years of experience in assisting motorists who purchased gas at its roadside filling stations, Standard Oil Company (New Jersey) has prepared a small plastics Flight Data card which it gives to every pilot who gasses up at an Esso station. In addition, the company provides him with whatever flying information he may require such as the latest reports concerning weather ahead as well as other flying aids to insure his safety.

BETTER FUELS—There are many other ways in which the oil companies are helping flying in general and private flying in particular. They are making available to the private flyer 80-octane gasoline which is really as high a fuel rating as the current makes of engines in private flying require. In fact, they are making an effort to create universal acceptance of 80-octane gasoline for private flying. Some privately owned aircraft of the executive class having engines exceeding 450 horsepower may require 91-octane and will get it. The best fuels will now be available to flying generally and not to military and naval flying only.

The roadside gas service station has in many respects become the equivalent of the old coaching inn. The service station is the place where the motorist stops off and seeks refreshment for man and "beast," only his beast is a mechanical one. In the aviation gas stations are also clean rest rooms, attractive merchandise displays, and a lounge where flyers may rest. Motorists have long used credit cards valid all over the United States. Esso is planning international credit cards for aircraft owners that will be good all over the world. In addition to the pilot's flight data card described previously, he will be given quick

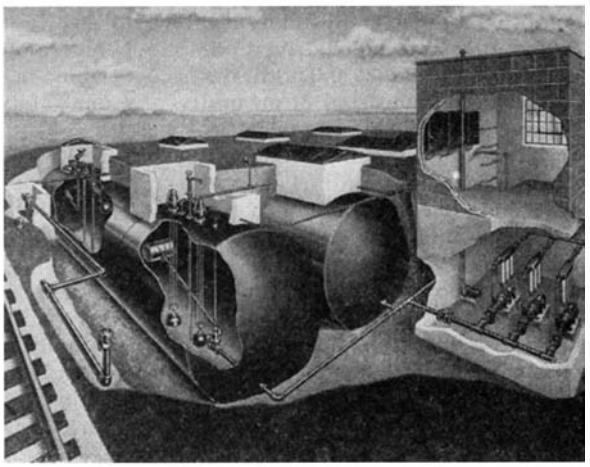
calculators for estimating distances, fuel consumption, and so on.

The oil companies have also undertaken to educate the flying public in matters of lubrication, quite as thoroughly as they have done in regard to the lubrication of the automobile. One oil firm has prepared a fine "check-chart" for airplane lubrication. No part of the airplane is left unnoticed. An arrow leads to such parts as Elevator Tab Drive Drum Bearings; Tail Wheel Shock Strut; Aileron Hinge Bearings, and so on. For each moving part the proper lubricant is indicated, together with the appropriate lubricating interval in flying hours. The same chart carries practical instructions for filling shock struts and fuel tanks. Such a chart is an indication of the fact that private flying is becoming as frequent and almost as common place as automobiling. Will the oil companies issue flying maps, like the maps which many motorists treasure in the pockets of their cars? Not as yet. They do not wish to enter into competition with the complicated aerial navigation charts which the United States Coast and Geodetic Survey issues twice a year.

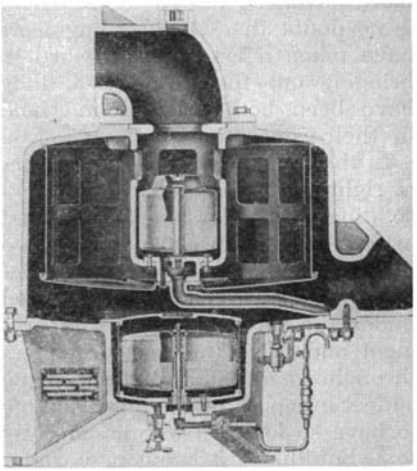
Considerable thought is being given to the development of combination roadside automobile and aircraft service stations, with flight strips laid out behind the service station. Several of these have already been established. As private flying increases in volume, the flight-strip gasoline stations will also increase in number.

MOBILE FUELING — Manufacturers of accessories are co-operating in many ways in the common task of aiding civilian flying. An example is in the provision of mobile units for rapid fueling and servicing of airplanes. These units are very popular and the greater percentage of aircraft fuel today is pumped from tank trucks or trailers into aircraft fuel tanks. The Heil Company has done much pioneering in such

Right: Partially cutaway view of a flooded suction system for gasoline storage and delivery at an airport. In this Bowser Company set-up, the pumps are located below the level of the tanks



Below: Cross-section of a water and gasoline segregator developed by Wright Field



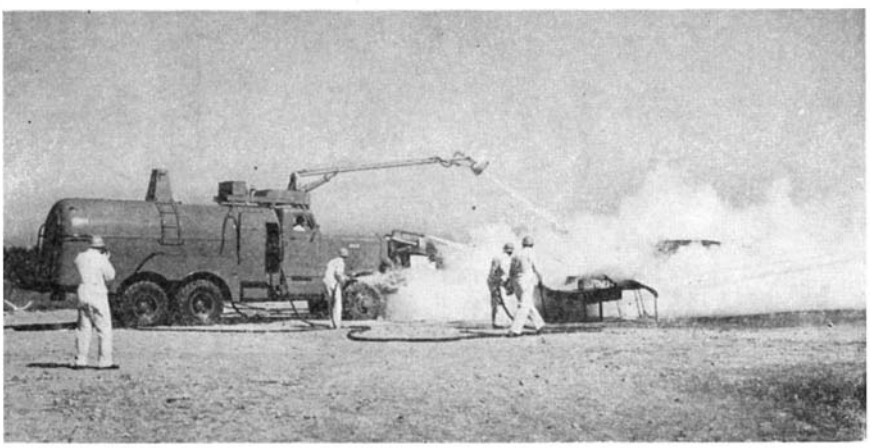
units. Instead of taxying the heavy, expensive planes up to the fixed fueling station, losing time and effort in the process because the aircraft has to be carefully positioned right at the fuel pumps, the mobile refueler is drawn into position directly opposite the front of the plane. Two wing tanks may be filled simultaneously from two rear hose. Or, by using the two rear hose and one side compartment hose, the wing tanks and the belly tanks of planes may be filled at one time. Capacities of the mobile refuelers are enormous, running to 4000 or even 5000 gallons.

There is a great deal of engineering design that goes into such refueling apparatus. Welded tank construction, concealed hose reel, emergency valves, streamline design, and "trailerized" construction are only a few of the things which engineers have built into these trucks. The refueler can travel over the roads as a trailer or semi-trailer at 40 miles an hour. It can pump fuel from a tank car into its own tank under its own power; or pump from a tank car into a storage tank; or pump fuel *out* of as well as into a plane. Fuel meters and fire extinguishers are also part of the equipment.

A highly important part of the refueler's equipment is its segregator which automatically compensates for variations in gasoline and removes any water which may be present. It is based on the simple principle that water and gasoline have different specific gravities. The segregator, developed by Wright Field engineers, has a float valve which is balanced to float in water and sink in the lighter gasoline. When the water accumulating in the segregator bowl rises to a point where it lifts the float valve, the water is automatically discharged to the outside.

Experimental work is in progress in the use of pressure filters for the removal of not only water but of all solids down to specified measurements. These filters are made up of paper or fabric packs, and the degree of purity is governed by the number of packs and the degree of pressure used. The solids accumulate directly in the packs which have to be periodically changed or cleaned. Water is passed off either automatically or manually at the bottom of the filters. Air is eliminated by means of an air release, the air rising to the top of the filters where it is accumulated and automatically passed off.

But if the mobile airplane refueling unit is considered a remarkable piece of engineering, the fueling system at some airports is a revelation to the uninitiated. Growing airplane traffic and gasoline con-



Fire-fighting at an airport with a Cardox crash truck

sumption necessitated underground fuel storage and motor driven pumps as early as the 1920's. The first system installed consisted of an underground storage tank, an electrically driven rotary pump, centrifugal strainers, and a pipe line to an underground pit containing a meter and hose mounted on a hand-operated reel. Since those days, many new developments have come, and the Bowser Company has developed many fueling refinements. Rotary pumps have largely, for many reasons, been superseded by flooded centrifugal pumps. These centrifugal pumps are located below the level of the tanks and the fuel flows to them by gravity to maintain the flooded suction condition. There are many valves, strainers, and other accessories, such as air and vapor eliminators in the system. Pumps are installed in an underground pump house. The system will deliver aviation gasoline at any desired point on the hangar apron.

FIRE PROTECTION — Until nonflammable safety-fuel comes into general use, the extinguishing of gasoline fires resulting from crash landings is a vital matter. The Cardox Corporation has given the AAF much valuable service in the development of fire extinguishing trucks, which are now coming into civil use. Fires due to a crash landing are the toughest of all to extinguish, fed as they are by hundreds or even thousands of gallons of aviation gasoline. The problem of extinguishing them is a surprisingly technical one. But the principle is simple, involving the discharge of tons of carbon dioxide, released at low pressure, (but with great rapidity and power) in combination with "foam" discharged at high pressure. The Cardox airport fire trucks have saved hundreds of planes and many lives. The mass discharge of carbon dioxide, supplemented by the blanket of foam, cuts a path to the heart of the fire so that the rescue of entrapped personnel may frequently be started within five to ten seconds after the truck reaches the scene of the fire!

FUTURE — Safe and comfortable private flying is already here. It is daily increasing in volume. With the cost of planes now within the reach of many, department stores in the larger cities are displaying and selling them. Thousands of young military-trained flyers are returning to civil life 100 percent air-minded. The future of civilian flying and related industries is assured. It remains only for more and far-reaching flying facilities to be developed to see airplanes rival the earthbound motor car in popularity and —what is more important—maximum safety.

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THE DC-8

Has Enclosed Liquid-Cooled Engines

THE AIRLINER most commonly seen for many years is the famous and sturdy Douglas DC-3. But the best of things must come to an end, and even the DC-3, splendid as its service has been, must give way to more advanced design ideas. There is no doubt that Douglas engineers have taken a long step forward in bringing out the new DC-8; they have been both original and bold in their conceptions.

In the DC-8, there are no engines in sight and the huge twin counter-rotating propellers are mounted astern of the fuselage. The two liquid-cooled Allison engines of 1200 horsepower each are mounted under the forward cargo compartment and drive the rear propellers through gears and shafting some 60 feet in length. It is a disadvantage to have so long a transmission system, but this disadvantage is more than balanced by the many advantages which the new power plant system has introduced.

Thus, the DC-8 has twin engine safety without the offset thrust which is such a nuisance on more conventional twin-engined aircraft. The "center-line thrust" is going to be very helpful in single-engine emergency flying. Because the engines are hidden inside the fuselage, the surface of the wing is beautifully clean, with greater aerodynamic efficiency and a better lift distribution along the span. Because the propellers are aft, the wing can be placed quite close to the ground, and this makes for easy entry of passengers and cargo into the fuselage. Again, the shorter landing gear saves weight. Because the propellers can be made large in diameter, take-off and climb are improved.

It has been said that Douglas will have many difficulties to surmount because of the long transmission system, but these difficulties should be well worth facing. And the specifications are very attractive. The new transport will have a payload of 12,000 pounds at 300 miles range, and will carry 48 passengers and 2400 pounds of baggage at 223 miles per hour. The direct operating cost per ton mile will be only 3.5 cents. Maximum gross weight will be 39,500 pounds and wing span will be 110 feet.

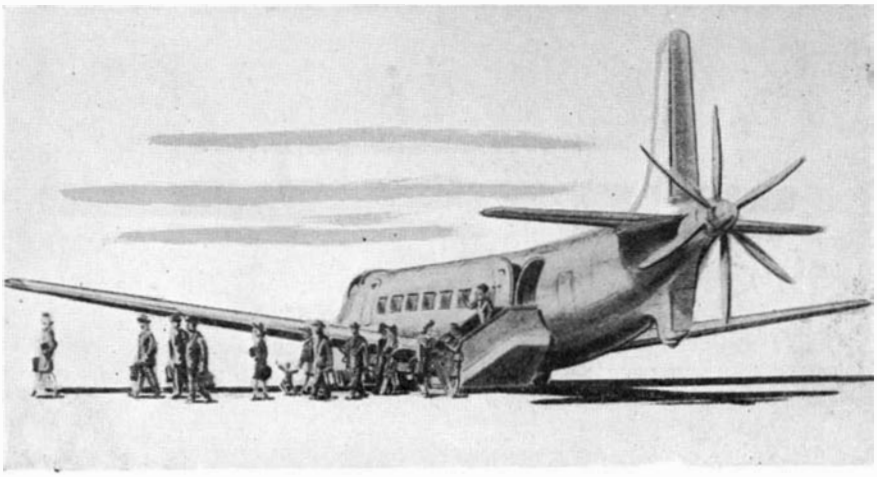
TWO-CYCLE ENGINE

Appears to Have Many Advantages

ENGINEERS have frequently said that a two-cycle aircraft engine would have decided possibilities.

Now General Motors Corporation announces a new 200-horsepower liquid cooled engine, radial in type, which seems to have solved the two-cycle difficulties. At any rate, it has very attractive specifications. The engine has four cylinders, and is provided with a supercharging blower which provides not only scavenging but also increases performance and gives reserve power for take-off and high altitude flight. Although the piston displacement is but 250 cubic inches, or about the displacement of a conventional automobile engine, the engine is rated at 200 horsepower and the weight, dry, is only 275 pounds.

This engine is perhaps the only small liquid-cooled motor ever built for aircraft use, and the diameter is only 35 inches. Fuel consumption is comparable to other engines of similar power, running about 13 gallons an hour on 91 octane gas.



A number of advantages are inherent in the DC-8

Power Brakes

Motor Vehicle Brakes, on the Average, Must Absorb Ten Times as Much Energy as the Engines Develop. Despite the High Energy Absorption of Airplane Brakes, They Are Not Yet Adaptable to Automotive Use. Current Limits of Braking Systems Must be Overcome in the Future

ALTHOUGH it appears that there is no satisfactory substitute for periodic inspection of motor-vehicle brakes, scores of research and development projects are under way to improve this phase of automotive design. Since a tremendous amount of work is afoot to improve vehicle powerplants, and extended research has been and is being concentrated upon new fuels and matching them to the engines of the future, power brake development is a natural corollary. Several engineers are exploring the possible use of the gas turbine for vehicles, and they admit that with prospective faster acceleration and higher speeds, brakes will be forced to handle unprecedented loads in dissipating the huge kinetic energies contemplated.

During recent years the establishment and exploitation of fundamental principles of braking have offset, in importance, many of the ingenious power-brake developments, in the opinion of Stephen Johnson, Jr., of Bendix-Westinghouse Automotive Air Brake Company. At a recent symposium on brakes held by the Metropolitan Section of the Society of Automotive Engineers, he declared that current loads imposed upon braking systems demand proper balancing of the brake effort, plus periodic inspection and adequate maintenance.

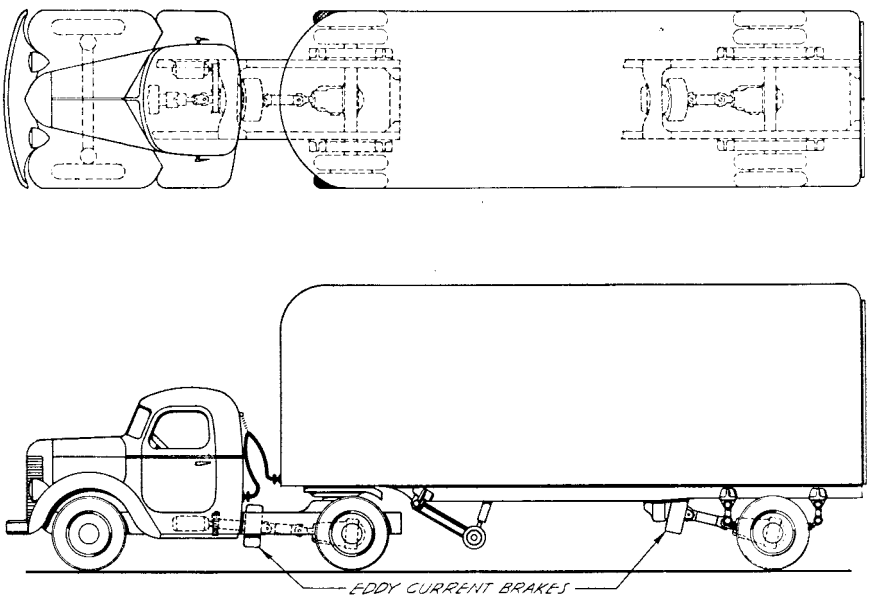
COMPLEX SYSTEM — Only comparatively recently has the brake evolved from a fairly simple mechanism to a complex system of highly specialized and effective units, without the aid of which motor transportation of passengers and freight as it is known today would be impossible. In the power brake, the composite action of all the units, from the intake of the compressor on the engine to the point of contact of the tire on the road and the last fitting or coupling on the truck and trailer train, is effective and efficient only in proportion to the fitness of each for the part it must contribute, if the final result is to be all that is desired or possible.

The analogy between the prime mover and the power brake is close. Both derive their capacity to perform useful work from the engine. The power of the engine is transmitted through the clutch, transmission, and axle—and the wheels turn. If the frictional resistance of the road to the slipping of the wheels is not exceeded, the rolling of the tires on the road moves the vehicle.

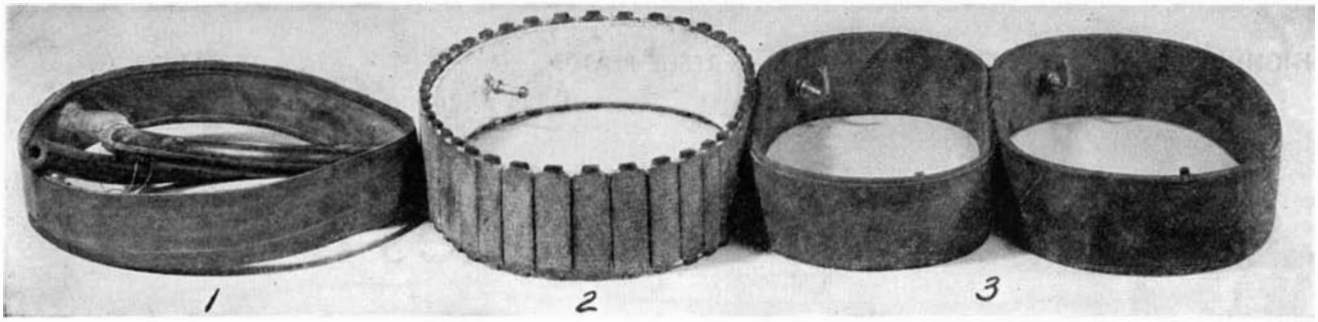
When this motion is to be reduced or stopped, the same source of energy—the engine—and the same fulcrum—the adhesion of the tires to the road—are utilized, but the impressed forces are so disposed as to resist, instead of sustain, the rotation of the wheels.

Some of the horsepower of the engine is utilized to drive the compressor or pump which supplies a convenient and manageable pressure to suitable reservoirs. This pressure is transmitted through pneumatic or hydraulic mechanisms to the brake chambers on each wheel, and the resultant force is carried to the brake drum through the cam and brake shoes, thus setting up the required resistance to the rotation of the wheels.

As greater speeds become commonplace, the loading imposed on brake systems has increased apace. Engineers used to think that practically all the effectiveness of the power brake was in the performance of the air or hydraulic devices, and that only a little of the effectiveness or efficiency came from the foundation brake gear. However, it was discovered that this ratio might well be reversed; without an efficient and properly designed foundation brake gear, the most highly developed and most efficient power brake mechanism is of little value. The brake which can transform the pressure of compressed air or brake fluid into a very great mechanical force needs a foundation brake rigging sufficiently rugged for the application of this force. If this is not provided,



How the eddy-current supplementary brake is installed on a tractor-trailer unit



Automotive engineers were recently given information on advances in aircraft brake developments. Left above is the original Linderman expander brake tube. The British Palmer tube is shown at (2) and the B. F. Goodrich tubes at (3)

every undesirable condition in braking that can be conceived may occur.

Some of the important operating developments of recent years which have aggravated the brake problem are:

1. Higher operating speeds made possible by finer highways require increased stopping ability with safety.

2. Adoption of larger section, smaller rim diameter tires increase the cooling problem and limit the diameter of brake drums.

3. State legislation which limits the overall width of the vehicle makes it difficult to find space for adequate brake drum and lining on many vehicles.

BRAKE HORSEPOWER — Naturally, the power plant or motive power equipment used to produce motion in a motor vehicle is very important, and a great deal is heard about the horsepower of the engine and the top speed of the vehicle. A great many claims are also made regarding the rapid acceleration which the increasingly powerful engine makes possible. It is just as important to slow down or stop a vehicle once it has been set in motion, but it is seldom that anyone boasts about the horsepower of the brakes.

A modern truck or bus, in starting from a dead stop, requires at least one minute—for the most powerful—up to one and one-quarter minutes for the average, to accelerate to a speed of 60 miles per hour.

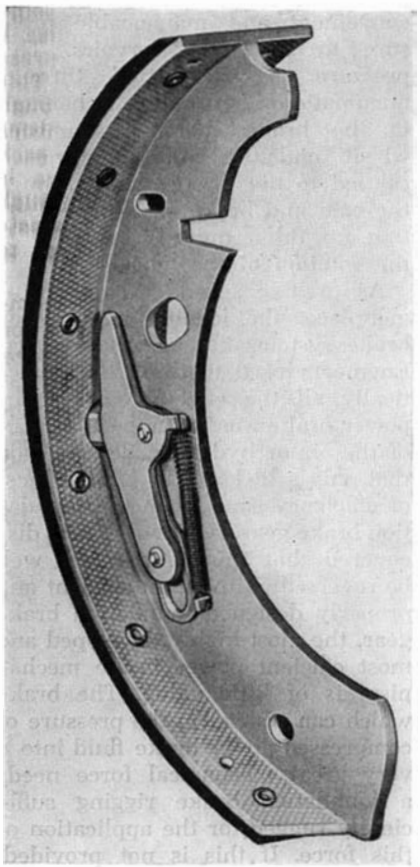
This same modern truck or bus, having brakes in good condition, can stop from a speed of 60 miles per hour in six seconds. The engine of the modern vehicle is able to develop anywhere from 100 horsepower and up; therefore, since the brakes can stop the vehicle from 60 miles per hour in one tenth the time that the motor requires to accelerate the vehicle to this speed, the brakes must be ten times as powerful as the engine. If the powerplant develops 100 horsepower in accelerating to 60 miles per hour, then the brakes must develop 1000 horsepower to stop the same vehicle with the same load in one-tenth the time.

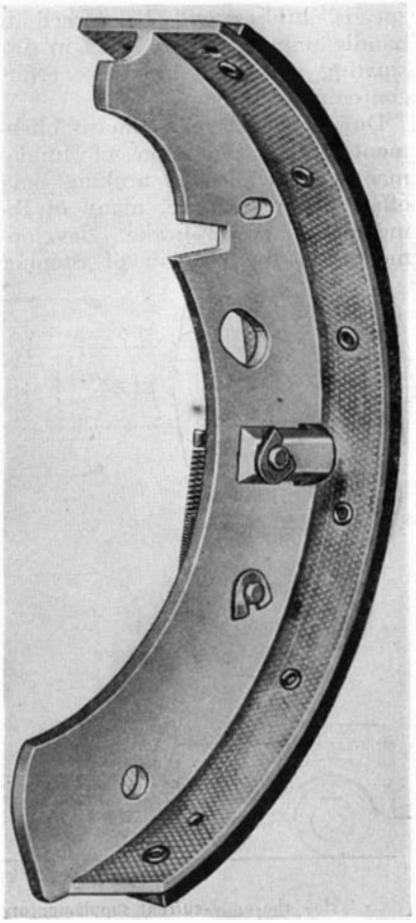
The engine has an elaborate cooling system to protect its working parts from the effects of wear. Water is carried in the cylinder block and head and circulated by pumps through a radiator mounted in the best position to take advantage of the cooling breeze. There is also a fan which helps to keep the operating temperature of the motor low. On the other hand, the brakes which do the same amount of work many times faster than the motor, are mounted on the wheels underneath the fenders. The present-day streamlining has brought the fenders down on the sides and ends, making it very difficult for cooling air to reach the brake drums and carry away excessive heat.

Brakes are mounted in positions which expose them to all the dirt and muddy water splashed from the road by the tires. This tends to lower their efficiency.

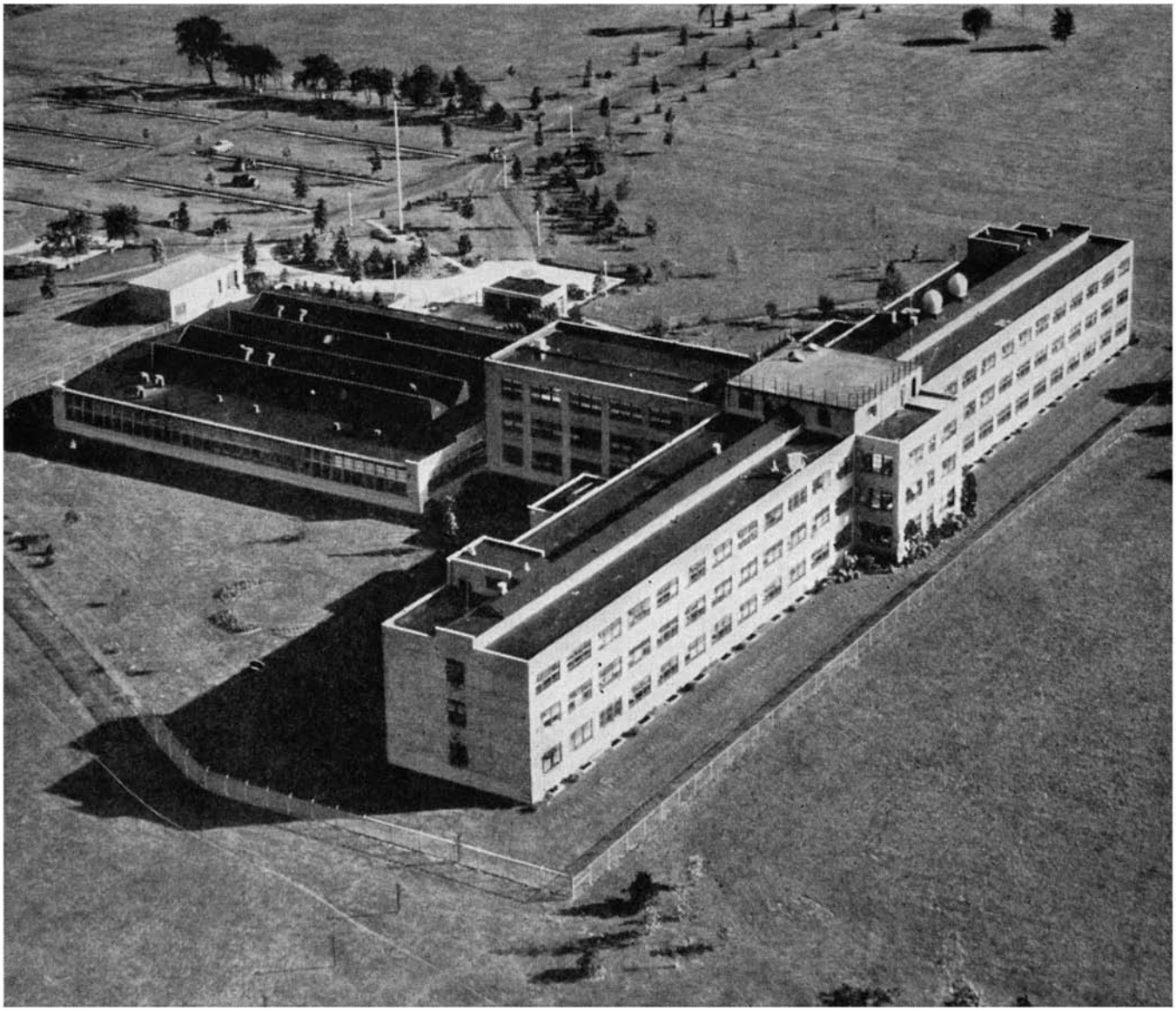
LUBRICATION PROBLEMS — The engine has a highly efficient lubrication system which insures that parts intended to slide over one another can do so with a minimum of resistance. Braking systems sometimes have the correct amount of oil and grease in the correct places, but most of them have insufficient lubrication on sliding contacts and too much oil or grease in places where they do not belong, such as on the lining surface.

These considerations are among those which have lead to an earnest





Right and left: Back and front views of Wagner's automatic brake adjuster



RCA Laboratories—Center of Radio and Electronic Research

RCA Laboratories at Princeton, N. J., are far more than one of the most modern and best-equipped laboratories ever built. It is a community of scientists, research men and technicians—each a top man in his field—each working with the other—contributing wherever and whenever his specialized knowledge will help.

It is a "university of ideas"—where visions are graduated as practical realities . . . where human wants are fulfilled through the creation of new products and processes, new services and markets.

It is a birthplace of scientific, industrial and social progress for the entire nation.

It is the reason why anything bearing the letters "RCA"—from a radio tube to your television receiver of tomorrow—is one of the finest instruments of its kind that science has yet achieved.

For just as the RCA electron tube, television receiver, radio, or the Victrola, is stamped by the RCA trademark, so does the product itself bear a stamp of experience and research that gives RCA pre-eminence in the field of radio and electronics.

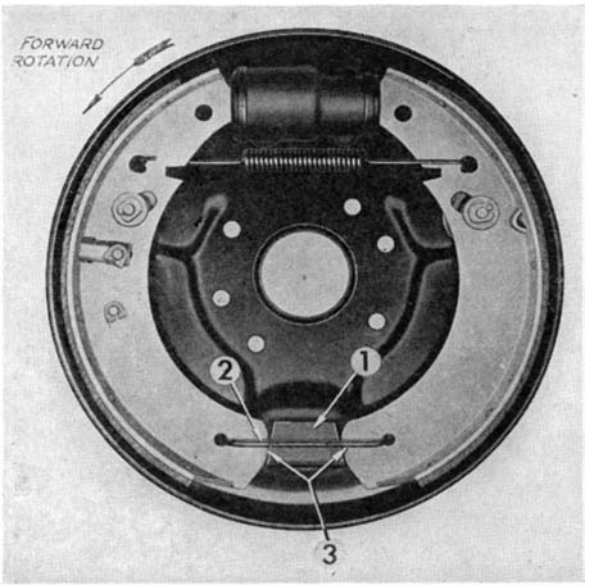
Radio Corporation of America, RCA Building, Radio City, New York 20. *Listen to The RCA Show, Sundays, 4:30 P. M., Eastern Time, over the NBC network.*

PIONEERING

Scientists and research men who work in RCA Laboratories made many vital contributions in helping to win the war through application of radio, electronic, radar and television techniques. Their skills now are devoted to peacetime applications of these sciences.

At RCA Laboratories the electron microscope, radar, all-electronic television (featuring the projection system for the home) and many other new instruments of radio, including hundreds of new electron tubes, were developed to improve and to extend the services of radio around the world.

RCA **RADIO CORPORATION of AMERICA**



A self-centering brake developed by Wagner Electric. The assembly photo shows (1) the fixed anchor and (2) the spring that holds the rounded ends of the shoe segments (3) snugly to the anchor

search for new and improved braking systems for motor vehicles. Manufacturers have scanned the field of aircraft brake engineering, in the hope that some of the tremendous effort put into this work, by large outlays of taxpayers' money, might give them a clue. In general, the expander tube and disk types of airplane brakes cannot take the long periods of braking that are imposed on motor vehicles as compared with aircraft. The concensus among brake engineers seem to be that they would cost at least three times as much as the present shoe-type automotive vehicle brake. But the translation of these aeronautical achievements is going ahead, because of the increase in braking requirements for the years to come, as compared with the current "limits" of vehicle brake systems.

A recent study made by J. George Oetzel, of Warner Electric Brake Manufacturing Company, shows that the passenger car, commercial vehicle, and city bus force their respective brakes to absorb, and to dissipate, on an average, a kinetic energy of 2455 foot pounds per square inch of active drum surfaces, whereas, in airplanes, brakes must have an energy absorption of about 12,000 foot pounds per square inch of active drum surface. He believes that brake drum and lining performance must be raised in order to chart the course of future development. In the meantime, he has been working on the development of an electrical brake system which embodies the eddy-current principle to supplement the friction type brake —particularly in operating over hilly and mountainous roads.

DIESELS AND FUELS

Both Will Change Engineers' Concepts

NEW CONCEPTS of Diesel engines and their fuels have obsoleted the pre-war yardsticks of the cetane number scale, and the Navy has asked the engine and petroleum industries, through the Society of Automotive Engineers, to look into this question in view of supercharged Diesel power-plants and additive fuels. The cetane number indicates merely the minimum quality of fuel for starting engines and to prevent excess smoking.

Several years ago the Navy undertook to standardize Diesel engines on all of its ships—large and small—and the war caught the Navy Bureau of Ships short on supply of power-plants. One of the most pressing of war production jobs was getting enough Diesel engines built for our Navy and for the needs of our Allies. In the meantime, little development work on either fuels or Diesel engines has been done since the engineering staffs of all the engine builders have been busy on manufacturing problems of their own plants and those of their subcontractors and parts suppliers.

That a new measuring device is needed is shown by the fact that by the addition of a small amount of amyl nitrate to Diesel fuel of 44 cetane number, a Diesel engine can be made to produce the same power output per gallon as on 50 cetane fuel containing no additive.

Conversely, the newer concepts of fuel and increased supercharging of engines will require fundamental changes in the thinking of engine designers of tomorrow to obtain the best combination of engine-to-fuel relationships. While the potentialities of tomorrow's power-plants remain barely scratched, the recent emergency directed many an eye toward the future.

HANDICAPPED DRIVERS

To Be Aided by Research Now Underway

DEVELOPMENT of driving aids designed to enable disabled war veterans safely to operate cars and trucks has been undertaken by the War Engineering Board of the Society of Automotive Engineers in co-operation with Army officers, motor vehicle administrators, medical societies, and rehabilitation hospitals.

The technical committee is now testing some of the devices installed on the committee's experimental automobile. When the work is finished, the information will be made available to car, vehicle, and accessory manufacturers, garages, and others who may be interested.

LIGHT ENGINE

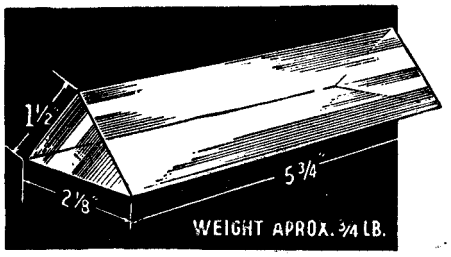
Made Largely of Aluminum, Has Auto Possibilities

COURTING the attention of automotive engineers is the Skinner gasoline engine, built largely of aluminum die-casting weldments, and soon to be manufactured in quantity by Jack and Heintz, Inc. Developed by Ralph L. Skinner over a period of 20 years, the engine is believed valuable as an auxiliary in bomber aircraft by AAF officials because of its relatively large power output due to an eight-to-one compression ratio and high speed. Weight as light as 1.75 to 2 horsepower per pound is claimed for it.

It is a double opposed or "pancake" type, and is designed so it can readily be converted from the 28 horsepower two-cylinder unit to multiples thereof. Therefore, its sponsors believe, it will fit readily into the automobile's future if it can be produced at a reasonable cost per horsepower.

Detroit reports indicate that Henry J. Kaiser and Joseph W. Frazer are interested in the Skinner-Jack and Heintz proposition. An immediate consideration, in respect to price and availability, is the large surplus of aluminum alloys resulting from war order cutbacks on the one hand, and the continued shortage of gray iron castings—despite these cutbacks—on the other. Old-line automobile companies are currently having trouble in getting sufficient gray iron castings for their projected manufacturing schedules.

SENSATIONAL WAR BARGAINS in LENSES & PRISMS

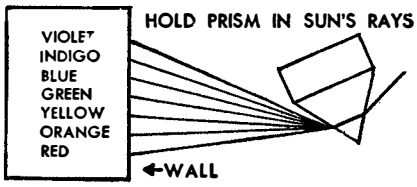


TANK PRISMS

In order that the tank driver shall not get shot in the face, 2 of these Silvered Prisms are used to make a Periscope. We have secured a number of these that are very slightly chipped, making possible their sale at a very low price. They are 90-45-45 degree Prisms of huge size—5¾" long, 2⅛" wide, finely ground and polished. Used to build a Periscope . . . excellent also for experiments, classroom demonstrations. Some of our ingenious customers have used these prisms to make camera stereo attachment, range finder, etc. Prism easily converted into desk name plate by affixing gold letters. 100 gold letters supplied at only 10c. (Order Stock #3008-S.) Normally these Prisms would retail from $24 to $30 each.

SILVERED TANK PRISM
Stock #3004-S.....$2.00 Each Postpaid

PLAIN TANK PRISM
Stock #3005-S.....$2.00 Each Postpaid
FOUR TANK PRISMS—Special.....$7.00 Postpaid
. . . The most sensational bargain we have ever been able to offer.



TO SEE THE COLORS OF THE SPECTRUM, hold a plain tank prism in sun's rays as shown in drawing. White incident light which passes through prism is thus broken up into a band of primary colors known as the spectrum—a beautiful sight! By looking through a tank prism at a certain angle, you can see a world of colors everywhere. Truly amazing!

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

YOU CAN EASILY MAKE

Telescopes, Magnifiers, Photographic Gadgets and Hundreds of Experiments with these Low Cost Lenses. Excellent also for XMAS gifts.

To translate millimeter measurements: 25.4 mm. quals one inch.

MONOCULAR SET OF LENSES AND PRISMS

From Navy's 7 x 50 Binocular. All the optics you need to make a 7 Power Monocular. Complete Directions included.
Stock #5101-S.....$5.00 Postpaid

MICROSCOPE SETS

Consisting of 4 Cemented Achromatic Lenses for making a 40 Power Pocket Microscope or 140 Power regular size Microscope. These color corrected Lenses will give you excellent definition and may be used for Micro-photography.
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Consisting of Prism, Mirror and Condensing Lens. These used together with Stock #1037-S will make an excellent micro-projector enabling you to get screen magnification of 400 to 1,000 Power according to screen distance.
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SPECIALS IN LENS SETS

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Set #15-S—"The Experimenter's Dream"—62 Lenses, Prisms and Optical Items, and New 50-Page Book, "Fun With Chipped Edge Lenses." $15.00 Postpaid. The variety of Lenses and Prisms in this set will enable you to conduct countless experiments, build a great variety of Optical Equipment. **A sensational buy.**

NEW 50-PAGE IDEA BOOK "FUN WITH CHIPPED EDGE LENSES"
Contains wide variety of projects and fully covers the fascinating uses of all Lenses in sets listed above . . . only **$1.00 Postpaid.**

OPTICS FROM 4-POWER PANORAMIC TELESCOPE—Excellent condition. Consists of Objective Prism, Dove Prism, Achromatic Objective Lens, Amici Roof Prism, Eye Lens Set (. . . a $60.00 value)
Stock #5016-S.....$6.00 Postpaid

14-POWER COLOR CORRECTED MAGNIFIER SET—Consists of 2 perfect 18 mm. diam. Achromatic Lenses and section of metal tubing for mount.
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RAW OPTICAL GLASS . . . An exceptional opportunity to secure a large variety of Optical Pieces both Crown and Flint glass (seconds) in varying stages of processing. Many prism blanks.
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SPECTROSCOPE SETS . . . These sets contain all Lenses and Prisms you need to make a Spectroscope plus **FREE** 15-page Instruction Booklet.
Stock #1500-S—Hand Type Spectroscope ..... $3.45 Postpaid
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CLEANING BRUSH SET . . . For Lenses, Optical instruments, etc. Perfect quality—12 inch Flexible Plastic handle, hollow circular const. Range from stiff to very soft. 4 Brushes to set.
Stock #504-S—(Reg. $6.00 value).....Price $1.00 Postpaid

MISCELLANEOUS ITEMS

Stock No.	Item	Price
2024-S	10 Pieces Circular A-1 Plate Glass (Diam. 31 mm.—for making Filter)	.25
3021-S	Amici Roof Prism (3rd Grade). Each	.25
4009-S	Heat Absorbing Glass 4" x 5". Each	.35
4010-S	Heat Absorbing Glass 2" x 2". Each	.10
523-S	Six Threaded Metal Reticle Cells	.25
26-S	First Surface Aluminized Mirror, Diam. 1¼". Each	.25
624-S	Neutral Ray Filter size 4¾" x 2½"	.25
3022-S	Round Wedge 65 mm. Diam. Each	5.00
22-S	Inclinometer—Aircraft type. Each	.25
704-S	Lens Cleaning Tissue, one ream (480 sheets), size 7½" x 11"	1.50
1030-S	2" Diam. Reducing Lens. Each	.25
1031-S	Perfect 6 Power Magnifier—Diam. 28 mm. Each	.25
2043-S	Standard Crossline Reticle—Diam. 29 mm. Each	.50
1034-S	Burning Glass Lens. Each	.25

(Minimum Order on Above—1.00)

COLOR FILTERS

1 Red and 1 Yellow Filter in following Diam.

20 mm. (seconds)	40c	31 mm. (seconds)	70c
32.5 mm (seconds)	70c	45.5 mm. (seconds)	90c
37 mm. (seconds)	70c		

(Minimum Order on Above—$1.00)

PRISMS

Stock No.	Type	Base Width	Base Length	Price
3040-S	Right Angle	33 mms.	23 mms.	$1.00
3049-S	Right Angle	69 mms.	167 mms.	10.00
3047-S	Right Angle	53 mms.	103 mms.	4.00
3038-S	Roof Prism	18 mms.	34 mms.	2.50
3042-S	Right Angle	41 mms.	40 mms.	1.00
3045-S	Right Angle	70 mms.	168 mms.	8.00
3001-S	Lens Surface	20 mms.	14 mms.	2.00
3009-S	Porro	52 mms.	25 mms.	1.00
3016-S	Pentagon	45 mms.	22 mms.	.75
3029-S	Dove	16 mms.	65 mms.	1.25
3036-S	80 Degree Roof	60 mms.	36 mms.	4.00
6136-S	Rhomboid	20 mms.	17 mms.	.50

ALL THE LENSES YOU NEED TO MAKE YOUR OWN TELESCOPE! ALL ARE ACHROMATIC LENSES

GALILEAN TYPE—Simplest to make but has narrow Field of View.
Stock #5003-S—
Power of either 5, 6 or 10.....$1.60 Postpaid
Stock #5004-S—
Small 2 Power Pocket Scope.....$1.00 Postpaid

TERRESTRIAL TYPE—Have much wider Field of View than Galilean Type.
Stock #5007-S—11 Power Telescope..$3.20 Postpaid
Stock #5008-S—20 Power Telescope.. 3.45 Postpaid
Stock #5009-S—40 Power Telescope.. 7.45 Postpaid

PRISM TELESCOPES—Uses Prism instead of Lenses to Erect Image and are much shorter than Terrestrial Type. Have wide field of view.
Stock #5010-S— 6 Power Telescope..$3.00 Postpaid
Stock #5011-S—11 Power Telescope.. 3.25 Postpaid
Stock #5012-S—20 Power Telescope.. 7.25 Postpaid

LENS FOR KODACHROME EYE-VIEWER—Color corrected cemented Lens 38 mm. diam., 2 inch F.L.
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TANK PERISCOPE

Complete Set Mounted Components

Rugged, strong, originally constructed for U. S. Tank Corps. Consists of 2 fine Periscope Mirrors mounted in metal and plastic. Perfect condition. Only plywood body frame is required to finish this exceptional Periscope. First surface mirror is well protected by glass windows. Set weighs 2¾ lbs. Overall length of mount 6⅛", width 2⅛". Would normally retail at $40 to $50.
Stock #700-S....$3.00 Complete Set Postpaid
TWO SETS (4 UNITS).....SPECIAL $5.50 Postpaid

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

More Oil From Wells

A Method of Horizontal Drilling, Using a Turbine-Operated Bit, Holds Promise of Opening New Oil Horizons. Applied to Old and Seemingly Exhausted Wells, this New Procedure May Make Available Millions of Barrels of Oil that Otherwise Would Remain in the Earth

WHILE guesses are constantly being made as to the probable extent of the petroleum resources of the world and the length of time it will take to exhaust them, petroleum engineers have steadily improved production from older oil fields by drilling deeper wells and utilizing improved means of extracting the crude oil known to lie under the surface.

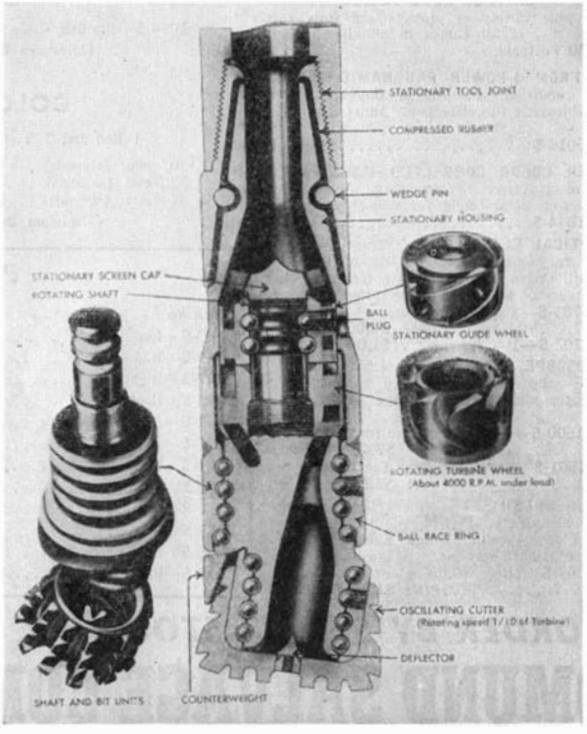
One of the latest methods of more efficiently tapping the known underground sources of crude oil is that invented and put to use by John A. Zublin, a Los Angeles manufacturer of drilling equipment. His method is to drill several holes in a horizontal direction, stemming many feet from the original vertical bore of an oil well. Thus a greater area of oil producing formation is tapped by the original bore. Up until now the only successful method of mechanically increasing drainage into a well has been by "gun-perforating"—shooting of bullets through the sides of the bore into the formation. But bullet holes are small and can penetrate only a few inches into the oil sands.

Left: Three units required in drilling a horizontal hole. A mandrel; a curved, flexible drill pipe; and a pressure operated turbine bit

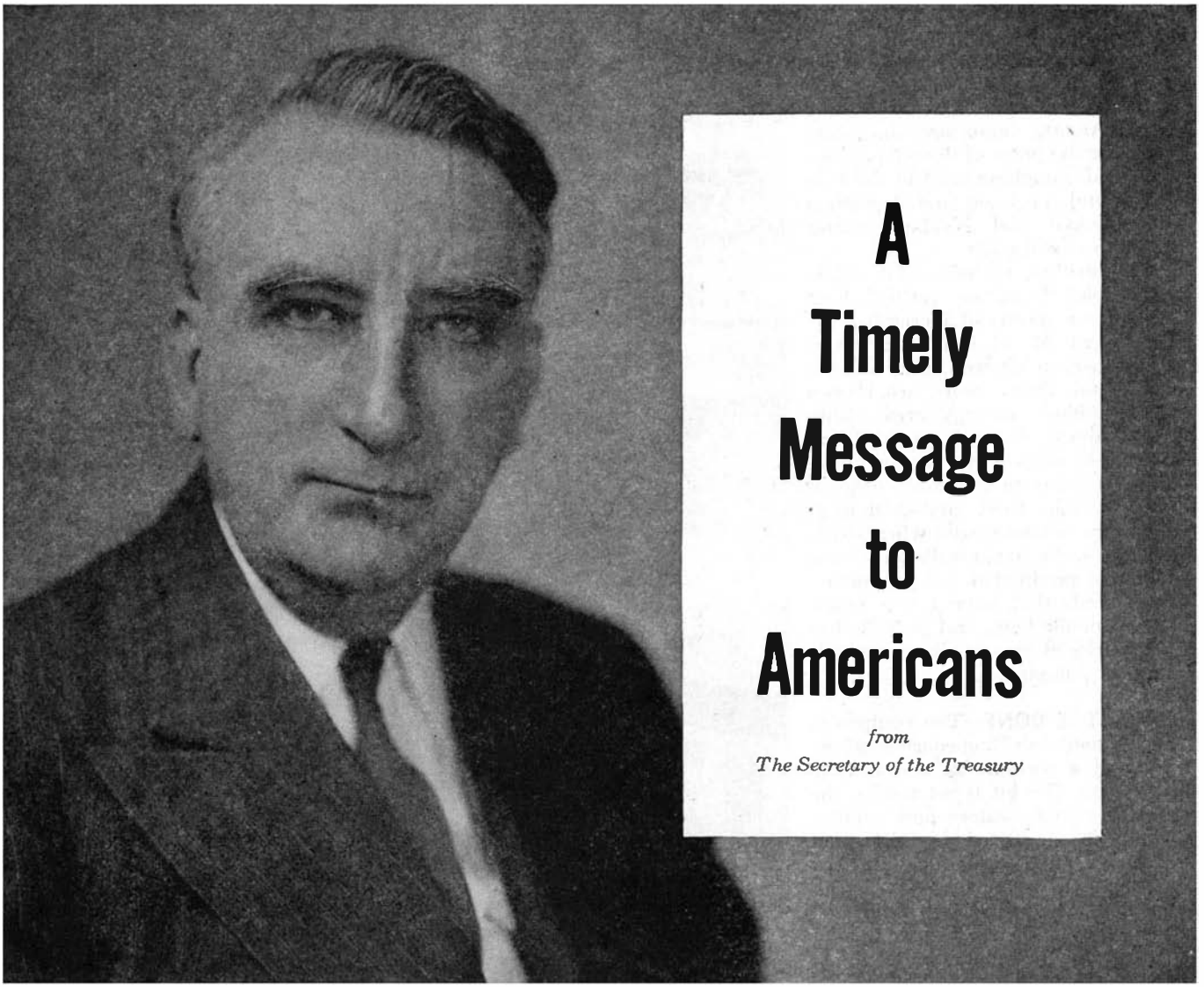
Assuming that an oil well extends down into a producing oil sand for a distance of say 60 feet, it would normally drain only 60 feet vertically. By drilling a series of eight horizontal holes, each 100 feet in length, an additional 800 feet of drainage can be added, or in the ratio of 13 to 1.

Of course, the actual area drained by any well drilled through or into a producing sand is problematical. This applies whether the hole is vertical or penetrates the sand at an angle, as when the well is drilled by directional control to reach a predetermined point some distance from the surface location or when the bore "wanders" from the vertical. The flow of oil to the bore is governed by many natural factors such as permeability and porosity of the sand and the cementation of the grains, and by adverse factors tending to retard the flow of fluid into the bore, such as infiltration of water from drilling mud, plastered faces due to use of improper mud, and sloughed sand.

As a well produces, the flow of oil to the bore increases and movement of fluid from the outer circumference of the assumed drainage area becomes less. Actually, the true drainage area probably shrinks as the well produces and much more



Right: Detailed drawing showing the construction of the Zublin turbine bit used in drilling horizontal holes from a vertical bore



A Timely Message to Americans

from
The Secretary of the Treasury

America has much to be thankful for.

Abroad we have overcome enemies whose strength not long ago sent a shudder of fear throughout the world.

At home we have checked an enemy that would have impaired our economy and our American way of life. That enemy was inflation—runaway prices.

The credit for this achievement, like the credit for military victory, belongs to the people.

You—the individual American citizen—have kept our economy strong in the face of the greatest inflationary threat this nation ever faced.

You did it by simple, everyday acts of good citizenship.

You put, on the average, nearly one-fourth of your income into War Bonds and other savings. The 85,000,000 owners of War Bonds not only helped pay the costs of war, but also contributed greatly to a stable, prosperous postwar nation.

You, the individual American citizen, also helped by cooperation with rationing, price and wage controls, by exercising restraint in your buying and by accepting high wartime taxes.

All those things relieved the pressure on prices.

THE TASK AHEAD

We now set our faces toward this future: a prosperous, stable postwar America—an America with jobs and an opportunity for all.

To achieve this we must steer a firm course between an inflationary price rise such as followed World War I and a deflation that might mean prolonged unemployment. Prices rose more sharply after the last war than they did during the conflict and paved the way for the depression that followed—a depression which meant unemployment, business failures and farm foreclosures for many.

Today *you* can help steer our course toward a prosperous America:

—by buying all the Victory Bonds you can afford *and by holding on to the War Bonds you now have*

—by cooperating with such price, rationing and other controls as may be necessary for a while longer

—by continuing to exercise patience and good sense with high faith in our future.

The challenge to America of switching from war to peace with a minimum of clashing gears is a big one.

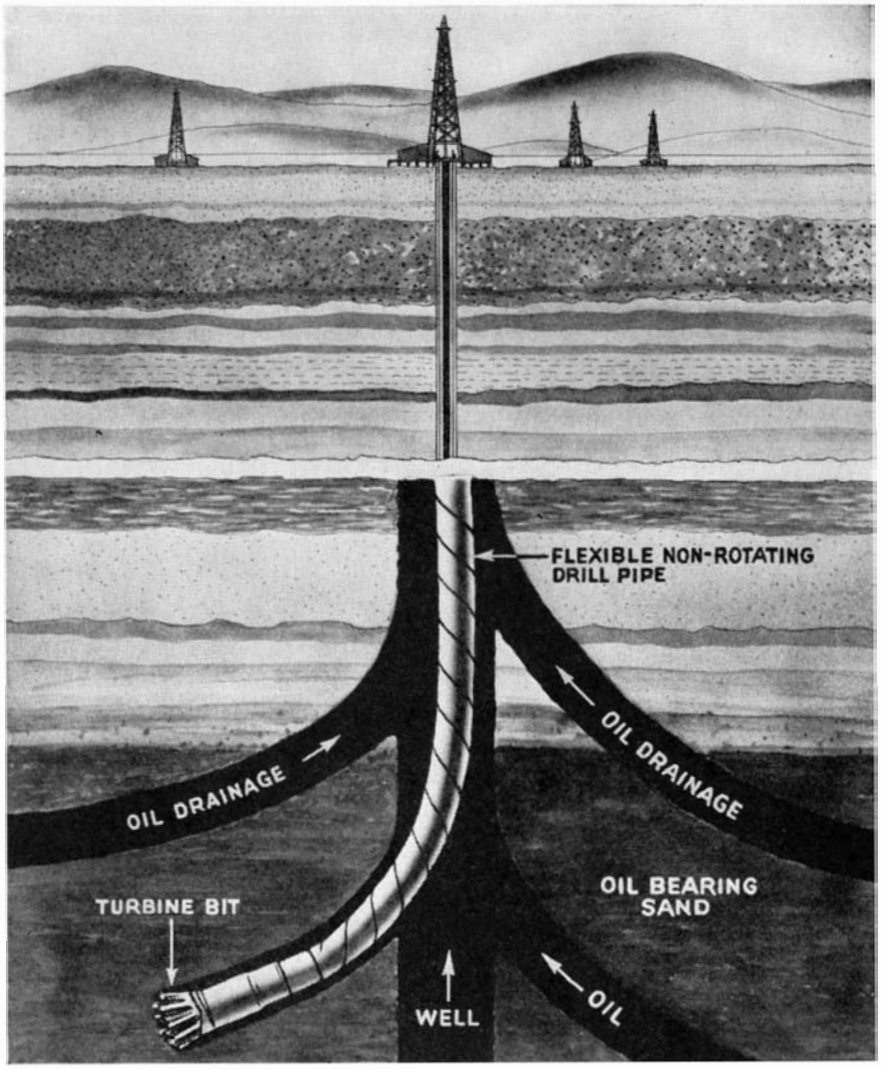
But it is a small one compared to the tasks this nation has accomplished since Sunday, December 7, 1941.

Fred M. Vinson
Secretary of the Treasury

A Government message prepared by the War Advertising Council and contributed by this magazine in cooperation with the Magazine Publishers of America.

oil at a distance from the well is left in the sand than is left in the area immediately surrounding the bore. Moreover, additional retarding factors enter the picture, both in the sand itself and at the face of the hole. Among these are fine sand clogging the pores of the oil-producing sand, sloughing sand in the hole or around the liner, and deposition of colloidal and residual matter from the oil itself.

The drilling of horizontal tributary holes from the vertical bore provides a means of increasing the movement of oil from the entire drainage area of a well. Each of these horizontal drain holes establishes an individual drainage area within the assumed range of the well and provides a passage for the flow of oil from its drainage area to the original vertical hole. Horizontal drilling is therefore advantageous when drilling new wells, in old wells for stimulation of production, for production from wells that have fallen below the economic limit, and in wells being produced by secondary methods such as pumping.



How horizontal holes are drilled from vertical bore

HOW IT IS DONE—The equipment for horizontal drilling consists essentially of a turbine bit and flexible drill pipe. The bit is rotated by the drilling fluid—water and mud—which is circulated by the mud pumps, the fluid being maintained at a suitable viscosity for operation of the bit. The drill string is not rotated during the normal course of drilling the horizontal hole.

One or more horizontal holes may be drilled from the vertical bore, the number being determined by the well conditions and the experience of the operator. The holes take off from the well in a vertical arc and may be located at desired vertical distances above each other. The holes can be started at any point in an open hole or through windows cut in the liner or casing. The direction of the horizontal holes may be predetermined and the holes started off in any desired direction by properly orienting the drill string in the well.

The lower part of the drill string used for drilling a horizontal hole consists of the number of joints of flexible drill pipe necessary to carry the hole for the distance from the vertical bore to the point in the sand to which the horizontal hole is to extend. The bottom flexible joint to which the bit is attached is made from a curved section of drill pipes. This causes the hole to start off in an arc as the bit begins cutting. The other flexible joints are straight and follow the curved joint along the arc which it establishes. The upper portion of the drill string is made up of conventional drill pipe.

The flexible joints at the lower end of the drill string are made from 4½ inch flush-joint drill pipe. A spiral slot is cut through the wall of each joint of pipe throughout its entire length and the joint is lined with a high pressure rubber hose, made fluid tight at each end to prevent leakage of the power-circulating fluid. The spiral slot provides adequate flexibility for the pipe to change from a vertical to a horizontal direction as it passes from the vertical well bore into a horizontal hole.

The curved flexible joint used at the end of the string, and to which the turbine bit is attached, is made by cutting a spiral slot in a joint of drill pipe that has been bent to a definite radius and heat treated to maintain its curved form. A 25-foot radius joint will allow the hole to continue in approximately a horizontal direction after the vertical arc from the bore has been drilled since gravity causes the curved joint to straighten out as the bit continues to bore the hole. Should a slightly upward inclination be desired for production reasons, a curved joint of smaller radius can be used.

Before the curved section of pipe is run into a well, a mandrel is inserted as a core. Thus the curved joint is held in a straight position until it has reached the point of operation. Then the mandrel is withdrawn and the curved pipe is allowed to assume its curved form within the limits of the hole in which it is confined.

THE TURBINE BIT—The rotary turbine bit attains a high rotational speed by means of power derived from the energy of the fluid pumped down the drill string. The cutting action of the bit depends in part upon the tendency of the cutter teeth to lift and drop the bit. A highly efficient bearing mechanism is therefore provided to carry the axial loads imposed by the tendency of the bit to rise and fall.

The entire bit—including housing, turbine, and cutting member—is made as short as possible to provide for starting the curved hole with

which the horizontal hole takes off from the vertical. The overall length is only 20 inches. The driving fluid is discharged as close to the cutting teeth as possible in order to remove cuttings from the bottom and to keep the bit and well bore clean.

DRILLING PROCEDURE—In operation, the turbine bit is attached to the bottom of the curved joint of flexible pipe which is flexed to a straight position and kept straight by the mandrel. Above this are the required number of straight flexible joints to reach from the vertical bore to the point in the sand where the horizontal hole is to end. These make up the lower portion of the drill string which consists otherwise of conventional drill pipe. When the bit reaches the depth at which the horizontal hole is to take off from the vertical, the mandrel is removed and the lower joint allowed to return to its curved form to the extent the hole will permit. The drill string is then hooked up to the pumps which deliver the mud-water fluid at a pressure of from 225 to 600 pounds per square inch, or sufficient to operate the turbine drill bit at 4000 revolutions per minute.

When the pumps are started, the bit, being forced by the curvature of the flexible pipe against the side of the vertical hole, will begin to dig into the wall of the bore and start a new hole at the point where it is positioned.

WEED KILLING

Petroleum Spray Leaves no Residual Taste in Vegtables

OVERCOMING the chief disadvantages of weed-killing fluids with which farmers have experimented for many years, a new petroleum-derived weed-killing spray has been developed which is reported to impart no taste to the vegetables whereas sprays of kerosine and other petroleum fractions have often ruined entire crops because of their residual taste.

Known as Sovasol 5, the new weed killer has completed a full season of field tests, according to Socony-Vacuum Oil Company, Inc., who developed it. Recommended *only* for use in carrot, parsnip and parsley fields, it has been successful in destroying weeds at a cost of less than $12 an acre as compared to $60 an acre in hand-pulling methods.

The weed-killer is a thin, water-white liquid that evaporates, leaving no apparent residue. Within a few hours after its use, the weeds begin to wilt and in a few days appear as if they had been killed by a sudden frost.

About 80 gallons of the liquid are required for each acre, and almost any kind of spraying apparatus may be used, elaborate equipment being unnecessary. Experiments have shown that it is important to treat areas when the carrots have reached the two or four leaf stage. A second treatment may be applied the following week, if desired, but it is rarely necessary. Slightly better results have been noted when spraying is conducted on damp days but this is said to be relatively unimportant.

Destruction of weeds is important in carrot, parsnip, and parsley production since these vegetables are so slow to germinate that weeds may gain headway before they can be pulled out without injuring the tender plants. In the great carrot growing areas of the West such as the Salina, San Joaquin, and Imperial valleys of California and the Yuma and Salt River valleys of Arizona, where cost of irrigation is also an important agricultural item, destruction of weeds is most imperative because of their competition with the crop for water.

'Mightiest Nothing'

Helium, Best Known for its Use in Airships, is Being Developed for Many Other Purposes; Today it Finds Important Applications in Deep-Sea Diving, Medicine, and Welding as Well. What of the Future?

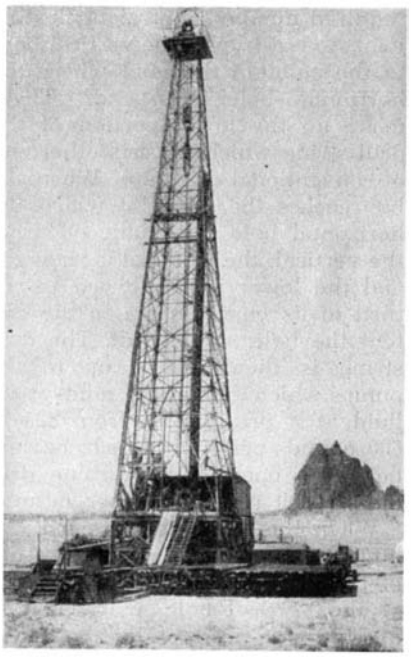
By LEWIS NORDYKE

MENTION of helium brings to most a vague notion of something with which to inflate balloons and blimps. But this rare, inert, gaseous element, which is an exclusive product of the United States because it has been found in important quantity only in the natural gas of some of our mid-continent fields, has proved to be a precious possession with increasing numbers of vital war, industrial, and medical uses—from welding parts for B-29 bombers to starting breath in newborn babies.

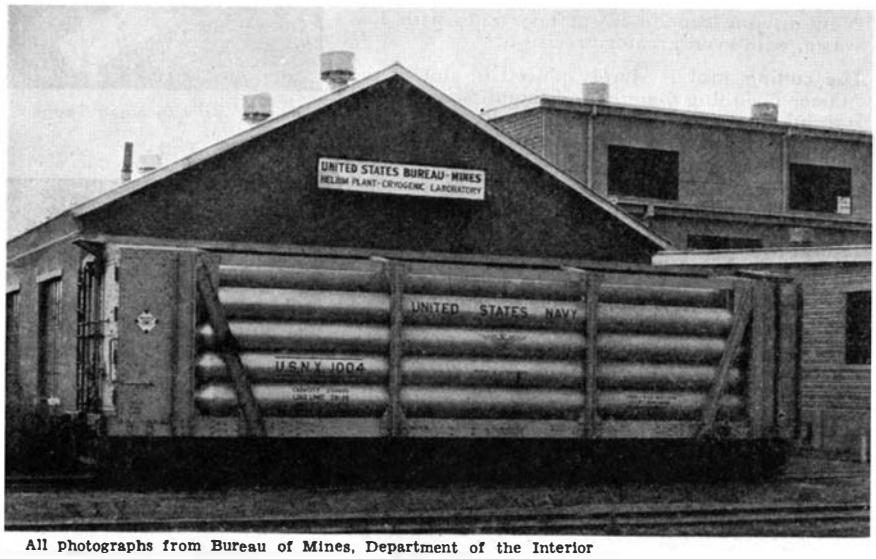
Scientists refer to the gas as our "mightiest nothing." This is because helium is tasteless, odorless, colorless, non-flammable, non-explosive, and non-poisonous; it has only one seventh the weight of air and steals into places where few other things can go, but it is so aloof it won't combine with other elements. Helium, often found with natural gas, cannot be made from anything else. It is an individualistic element.

Its "non-everything" properties are what make it great; it is indestructible and can be used under any conditions because it leaves no after-effect in the human body or in the snorting hot nozzle of a welding torch.

The United States has had this prize possession to itself since 1918, when the government started separating helium from natural gas for use in inflating airships and balloons. It was considered so important for this purpose that the Bureau of Mines of the Department of the Interior took over control of production, and helium became a government monopoly. Not until 1937, when Congress passed a law permitting the sale of surplus helium to anyone needing it, was the gas available to private interests and the general public, even for adequate research. War-time needs were so great that production was stepped up almost unbelievably; now, for the first time, there is plenty of helium for present and potential uses, at reasonable cost. The importance of the fact that the United States had helium and knew how to use it as a war material can't be exaggerated.



A gas well in the Rattlesnake field



All photographs from Bureau of Mines, Department of the Interior

Multiple-cylinder tank car for transporting helium

GERMANY WANTED IT — Helium is the one thing German scientists didn't have. Germany begged for it in 1937 after the *Hindenburg* exploded and burned over Lakehurst, New Jersey. The plea was on the grounds that the non-explosive gas was needed for the furtherance of commercial lighter-than-air craft. Secretary of Interior Harold L. Ickes decided that Germany might want the gas for military experimentation or use; so he refused to approve exporting the helium.

Not long after the German submarine packs started blasting our coast-wise and sea-going shipping, the Navy was able to send out fleets of helium-filled, snub-nosed blimps to search out and destroy the subs. Admiral Charles E. Rosendahl reported that not a ship was lost from a convoy protected by the sausage-shaped gas bags, which were also used for rescue and observation at sea. Helium lifts observation balloons for the United States Weather

Bureau and has proved to be of tremendous value to military weather men. With the vast expansion of aviation, weather stations had to be moved to the air fields. Sounding balloons carry instruments high in the sky for recording data from which essential long-range forecasts are made. Use of explosive gas is dangerous around airports; helium is as safe as a child's breath.

METAL WORKING — The use of helium in war industry has been of extreme importance, as it now is in peace-time. It makes possible the welding of light metals so essential to airplanes. Magnesium, which is only two thirds as heavy as aluminum, and of amazing strength, is ideal for aircraft, but it can't be welded satisfactorily in the ordinary manner. Fire from the torch might ignite it and it would disintegrate like a Fourth of July sparkler. With a helium-carrying tube in its nose, the welding torch snorts out a thin shield of the gas that won't burn. This constant shield protects the magnesium from the air and makes possible an effective, smooth weld.

Helium has proved as valuable in the welding of stainless steel, and it promises revolutionary improvement in the welding of many metals. Many precision tools and metal parts are shaped while the steel is soft and then given the right temper, or hardness, through heat treatment. Even the most carefully worked metal may develop objectionable properties through absorption of oxygen (known as oxidation) if, after heat treatment, it cools in the natural atmosphere. When cooled in an inert atmosphere of helium, oxidation is impossible.

UNDER WATER—A synthetic atmosphere of helium and oxygen has revolutionized deep-sea diving. Until helium-oxygen mixtures were used, the maximum depth for a diver was about 300 feet, and he could stay there only a few minutes; now—as a result of co-operative research by the Bureau of Mines and the Navy Department—he can stay at that depth for six hours and can work at a depth of almost 600 feet for shorter periods. When breathing ordinary air while under high pressure at great depths, the diver may suffer temporary lapse of mental faculties, but in air containing a percentage of helium his mind remains clear. The gas also reduces one of the biggest dangers to the diver on his return to normal atmospheric pressure: caisson disease, or the bends. This is caused by bubbles of dissolved nitrogen popping out of the body fluids, as pressure is reduced, and collecting in joints and blood vessels. In the new mixture, helium replaces nitrogen and is less apt to cause bubbles because it is one half as soluble as nitrogen and diffuses out of the blood twice as fast.

Another new use for the gas is for inflation of airplane tires. In a big liner such as the Lockheed Constellation, for example, use of the much lighter helium instead of air in the tires reduces the weight of the plane by 100 pounds.

IN MEDICINE—One of helium's big future roles, that may well affect everyone, lies in medicine. Nearly all first-class hospitals are already equipped with tanks of the gas.

Dr. Alvan L. Barach of Columbia University reports that helium has saved the lives of people with very severe asthma. A victim of asthma can take a few whiffs of an oxygen-helium mixture and get almost immediate relief. The helium is so light it is easier to breathe; it penetrates clogged, swollen passages and carries with it the needed oxygen.

The gas is likewise used for treating other respiratory ailments, including tuberculosis and pneumonia and in aiding infants whose lungs fail to expand normally at birth.

People have died on operating

tables because of the explosion of an anesthetic in their lungs. A mixture, which can't explode, made by adding helium to the anesthetics, eliminates the danger. Moreover, the light helium mixture goes into every nook and crevice in the lungs and when it is exhaled it brings out a portion of the anesthetic that otherwise might linger in pockets and cause serious after-effects

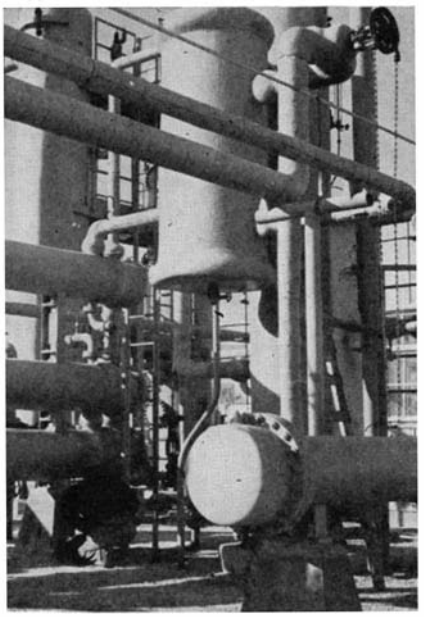
The gas also has promise in the treatment of sinus infection. Because of its penetrating properties, it can go into passages which are stopped so tightly that air can't enter.

PRODUCTION — The Bureau of Mines owns a lease on rich helium gas acreage in the Rattlesnake fields near Shiprock, New Mexico; two reserves totaling 16,000 acres in Utah: and the 50,000-acre Cliffside field near Amarillo in Texas. Before the war, the separation plant at Amarillo was the only one in the world. When the nation started arming, C. W. Seibel, supervising engineer at the plant, was assigned the job of increasing production. Refineries were built at Otis, Kansas; at Exell, near Amarillo; and at Shiprock. The gas from the Rattlesnake field is richer than any other from which the Bureau of Mines has produced helium. It has a 7 percent helium content, while the average of other fields is less than 2 percent.

SALVAGE—By October 1945, production was so great that it became possible to close down all the plants except the one at Exell. This plant uses gas from commercial natural gas fields; consequently, no helium whatsoever is being taken today from the government's rich reserve. Instead, helium for future use is being pumped from the Exell plant and stored in the government owned Cliffside field.

For years, natural gas with 1 percent helium content had been going to commercial market, and the helium went along and was wasted. The Exell plant was built to snare that wasted helium. The natural gas now goes through the separation plant and the helium is removed; then the natural gas, slightly improved as fuel because of removal of the non-burning element, goes back into the pipe lines for use in homes and factories. This was also the case at Otis. Some 17 billion cubic feet of gas had been removed from the Cliffside field, so there is plenty of room for the storage. The important thing about this arrangement is the fact that helium that was formerly going to waste is now meeting the present demand for the gas and at the same time increasing every day the supply in the government's reserve.

Refining of helium is a fairly simple process, if the almost automatic separating equipment and refrigeration system is taken for granted. The natural gas containing



Heat exchangers, reboilers, and columns of the carbon-dioxide removal equipment at the Amarillo helium plant

the helium is piped from the wells into the plant under pressure of 600 pounds to the square inch. It is first washed in a chemical solution to remove carbon dioxide. Then the gas goes into the pipes of a refrigeration system and is cooled to 300 degrees below zero, Fahrenheit. This liquefies everything except the helium, which is removed in gaseous form from the liquid and goes out of the plant into steel bottles or specially-built tank cars, ready for shipment. The remaining natural gas is sold to a gas company.

DISCOVERY—Seibel has done more than any other person to develop helium from a laboratory play-thing to a plentiful product of vital uses. When he started toying with it as a student in the University of Kansas 30 years ago, helium was a chemical curiosity. It was first discovered in 1868 by J. Norman Lockyer, a British scientist, while he was studying light from the sun with a spectroscope. He found a spectrum line never before recorded, indicating the presence of a hitherto unknown element in the flaming vapors of the sun. He named the new found element "helium," from the Greek "Helios," meaning sun.

A small amount of the gas was found on earth in a radioactive mineral in 1895 by Sir William Ramsay of England; in 1905, Dr. H. P. Cady, chemistry professor at the University of Kansas, analyzed gas from a near-by oil well and found that it contained 1.87 percent helium. Seibel, a student of Dr. Cady, wrote the thesis for his master's degree on a study of helium, and in April, 1917, the month the United States entered World War I, read it at a meeting of the American Chemical Society in Kansas City. At the time, there was about one cubic foot of helium in the United States. It had been purified in a laboratory and was sold at the rate of $2500 a cubic foot. Britain was pleading with the United States to try to develop a non-explosive filler for airships.

Dr. R. B. Moore, a Bureau of Mines chemist, and others obtained funds from the War and Navy Departments for helium research. A nation-wide hunt for helium-bearing natural gas started; samples of gas from every known field were sent to Seibel for analysis. The most promising was one near Fort Worth, Texas. Machinery used in liquefying air was modified so that it separated helium from natural gas. When the war ended, there were 147,000 cubic feet of helium on the New Orleans docks ready for shipment to England. It had cost less than 50 cents per cubic foot. Since then the production cost has been cut to one cent per cubic foot, or less.

EXPANSION AHEAD—Seibel thinks that great expansion in the uses of helium lies in the days ahead. Since the end of World War II, he has been actively concentrating on the development of new uses for helium. He has offered industrialists the cooperation of the Bureau of Mines in experimentation and in providing the gas in adequate quantities. His ultimate objective is to produce so much helium at such low cost that industry and medicine will find more and more jobs for it to do.

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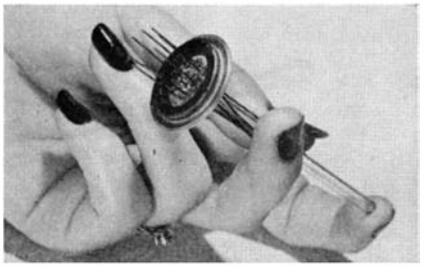
STEEL-TO-GLASS

Seal Makes Electron Tubes Airtight

FUSING steel and glass in a permanent airtight seal for metal electron tubes is now being done by a new method developed by Radio Corporation of America. The method provides a more foolproof process, in addition to permitting the use of a staple metal for the glass-to-glass seal in place of special alloys which are more costly and sometimes scarce.

The new procedure depends upon the control of processing so as to secure good "wetting" of steel by glass. At the same time, it incorporates a mechanical design which provides compression strains at the glass-metal boundary, and thus compensates for differences in expansion of the two materials.

The surfaces sealed by the new method are the outer edge of a flat, round, glass button and the inside of a metal band known as the header insert. The glass button serves to insulate the wire leads which connect internal elements of the tube with the pins on the base. The header insert is used to join the button to the header, a ring of steel which, with the button, forms



Steel header insert is sealed to the glass button through which wire leads are introduced into a vacuum tube

the "floor" of the tube, and is welded to the open end of the metal envelope to support the internal structure and complete the enclosure.

The principle which now permits the use of steel for the header insert involves the fact that glass is a solvent for oxides. By applying intense heat from fine jets of gas flame to the outside of the oxidized steel band, after the glass has been softened and pressed into a button inside the band, it is possible to cause any excess oxides to dissolve into the glass. Before this principle was applied, too much oxidation was as serious an obstacle as too little, the latter preventing adhesion, while the former left a porous interface between the metal and the glass.

CONCRETE CURING

Tests Show Comparative Ultimate Strengths

COMPARATIVE strength and wear tests of Portland cement concrete are reported in an article prepared by H. C. Volmer for publication in the *Proceedings of the Highway Research Board.* The concrete specimens were stored at 70 degrees, Fahrenheit, and 50- to 60-percent relative humidity. Six methods of curing—burlap, integral, and surface calcium chloride, and three samples of sprayed surface membranes—were used. Damp burlap for 18 hours with calcium chloride used either integrally or spread on the surface upon removal of the burlap, gave 28-day strengths of the same order as the three-day wet-burlap method. The strengths obtained with the three sprayed membranes were lower. Compared to the specimens cured with burlap for three days, the specimens cured with surface or integral calcium chloride had higher wear resistance, and specimens cured with the three membranes had lower wear resistance.

FABRIC FIRES

Depend Largely Upon Construction

FLAMMABILITY of textile fabrics is not necessarily due to the kind of fiber from which the fabric is made, but depends more upon the construction of the fabric and particularly on whether the fibers used are brushed out or are in the form of a long pile, according to Dr. Frederic Bonnet of the American Viscose Corporation in a discussion of current proposed legislation designed to curb the sale of flammable fabrics.

When fibers such as cotton, rayon, linen, or ramie are twisted together into a thread and then woven into a compact cloth with few or no fine fibers protruding from the surface, they are not readily flammable, or subject to rapid combustion, Dr. Bonnet pointed out. When, however, such fibers are in a finely divided state and thus permit the ready access of air, they are rendered quite flammable.

Flammability may also be caused by the use of a flammable finish applied to glaze the surface and so make a fabric more easily cleanable, Dr. Bonnet said.

New Products and Processes

AIR-OPERATED FIXTURES

Make Fast Precision Tapping Possible

USE OF simple air-operated combination clamping and positioning fixtures on medium duty lead-screw tapping machines has made possible continuous high production precision tapping of even blind holes. The loading speed and tapping accuracy resulting from the design of the simple two-position shuttle type fixtures permits the tapping machines to operate on automatic-repeat cycles, relieving the operators of the necessity of starting, stopping, and reversing the machines.

Pneumatic positioning and clamping fixture in place on tapping machine

The equipment—designed and built by Detroit Tap and Tool Company—comprises hand controlled air-cylinder and piston operated shuttling fixtures, with two-piece work holders bearing on convergent vertical ways of clamping and horizontal locating, and vertical positioning pins for accurate control of tapping depth. The taps for blind hole tapping are standard four fluted "Detroit" taps ground with a short chamfer, driven at approximately 70 feet per minute and guided by lead screws that are not subjected to the cutting torque.

ELASTIC SILICONE

Unaffected by Intense Heat

BUILT upon a tough, heat-stable skeleton of silicon and oxygen atoms, Silastic, a family of elastic silicone products, is the latest group of high polymeric organo-silicon oxide polymers to develop from laboratory research into commercial production. These new rubbery silicones provide another class of silicone products which fill the need for rubbery materials combining heat resistance with elasticity or compressibility.

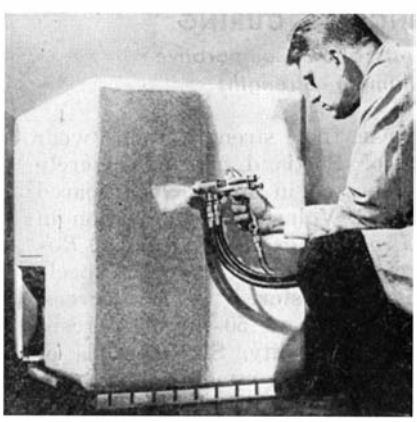
Silastic, developed by the Dow Corning Corporation, now provides a group of engineering materials which remain elastic and compressible at temperatures of 300 degrees, Fahrenheit, for long periods and can be used at temperatures up to 480 degrees, Fahrenheit, for certain applications. Silastic covers a series of heat-stable, oxidation-resistant elastic silicone products characterized by their good dielectric properties and chemical resistance. Silastic is furnished compounded ready for molding, extruding, or coating in several stocks covering a range of physical properties and hardnesses. This new product opens new lines of engineering thought wherever the problem can be solved by a material which retains its compressibility at elevated temperatures. It also retains flexibility at temperatures far below zero, together with good electrical properties, arc-resistance, chemical inertness, and water-proof qualities.

TWO-COLOR FINISHES

Applied in One Coat By New Spray Gun

TWO-COAT spatter finishes and simulated hammered finishes which give the effect of iridescent metal are now possible in one spraying operation with a newly-developed spray gun which sprays two colors simultaneously through one nozzle.

Ideally suited for decorating automobile dashboards, radio cabinets, sewing machines, lighting fixtures, vacuum cleaners, and other metal products where a finish combining beauty and durability is desired, it provides a one-operation finish that is more durable, faster, and cheaper to apply than conventional hammer and spatter finishes requiring two or three operations. The



It looks like an ordinary spray gun, but it applies a new two-color finish

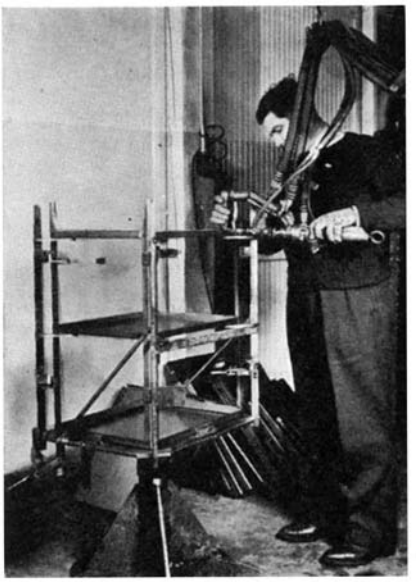
smooth finish, moreover, has no dust-collecting cracks, wrinkles, or fissures typical of crackle and wrinkle finishes.

Known as the Dimenso gun, a development of the Sherwin-Williams Company, it differs but slightly from ordinary spray guns in appearance or operation. It has the normal spray fan control valve and fluid control valve, trigger assembly, head, fluid tip, and needle. However, it has an additional fluid inlet near the head of the gun to accommodate the second color paint.

PRODUCTION WELDING

Speeds Market Tryout For New Product

SPOT welding with automatic or semi-automatic equipment can be employed to get certain types of products on the market economically and with much greater speed than has heretofore been possible. With the aid of assembly spot welding, a cabinet company was able



Assembly spot-welding of tables carried out with minimum of investment

to produce a trial lot of all-steel utility tables without major investment in production equipment on the part of the manufacturer. Portable gun spot welding—carried out in the job welding department of Progressive Welder Company—was the fabricating method used.

A standard C-type Progressive portable resistance welding gun was used to make the spot welds. Only a single clamping type rotary work-holding fixture was necessary to complete the assembly of the tables. A production speed of 16 tables per hour with one operator was attained, thus permitting the entire lot of 5000 units to be placed in the hands of the retailer some five weeks after the inception of the project.

This number of all-steel tables of one size is generally considered a high production run and normally involves considerable financial investment in dies, jigs, fixtures, and other equipment with which to fabricate the units. Use of spot welding made possible the production of the 5000 tables at a minimum overall cost and so permitted large-scale local sampling of the market

for this particular item in a space of time generally held to be insufficient to make even a cursory market analysis.

DIE GRINDER

Is Air Cooled for Continuous Operation

AN INCREASED-POWER pneumatic die grinder for continuous high speed operation has a one-piece housing of aluminum alloy with head, muffler, and throttle lever blending with the general housing contour.

Special construction features include the built-in oil reservoir which holds oil for eight hours' operation and which may be filled by simply removing one screw. Oil is metered to the grinder through an automatic feeder device incorporated in the tool.

Cool exhaust air circulates around the finned surface of the cylinder, permitting continued operation at high speed without over-heating.

Compact air-operated grinder

Bearings are rigidly mounted in end plates for perfect alinement and accuracy and packed with grease for 1000 hours' operation. A special shield keeps grease in and grit and dirt out.

THERMOPLASTIC TAPE

Provides Insulation and Protects Against Abrasion

TRANSPARENT and flexible, a new thermoplastic tape, which greatly facilitates inspection and servicing of equipment on which it is applied, is useful not only as electrical insulation but also to protect wiring, cables, and equipment against abrasion. The tape is heat sealing, flame resistant, flexible at low temperatures, and resists attack by acids, alkalies, moisture, oil, grease, and corrosive fumes. With proper adhesives, it may be bonded to fabrics, metal, ceramics, wood, and other materials.

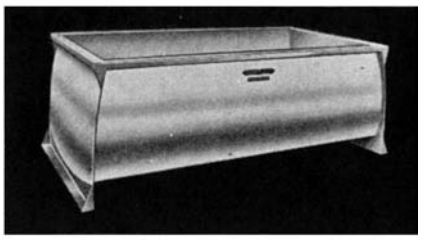
Fibron tapes, made by the Irvington Varnish and Insulating Company, have been applied successfully as gasketing material; in the construction of automotive and aircraft lighting and ignition harnesses; and in splicing plastics insulated wire and cable.

CURVED TANKS

Have High Strength For Many Uses

PRE-FORMING of the sides of stainless steel tanks to a curve determined by hydrodynamic principles has increased tremendously the tank's strength per weight, according to the Rodney Hunt Machine Company, which has been using such tanks in its textile wet finishing machines.

The success of this "built-in" natural curve opens up many possibilities for adaptations to other fields than textiles and the Rodney Hunt firm has already made tanks of this design for several applications in the chemical and food processing industries.



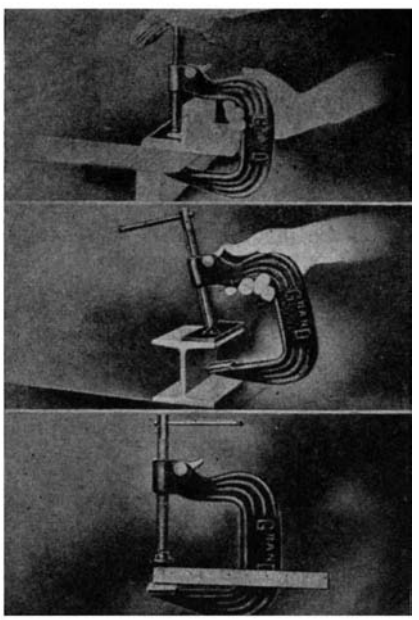
Sides are curved for high strength

The tank illustrated shows how the curved sides do not have to be reinforced with supports which would be needed to resist pressures built up by liquids inside a typical straight-sided tank. This principle can be applied to a wide range of sizes and styles.

SPEED CLAMP

Tightened Quickly, Released Instantly

IN ADDITION to an extra deep throat, for which there have been many requests, a new type of "C" clamp incorporates "quick-action" features. It is claimed that the clamp can be positioned instantly by simply pushing down on the ratchet screw (eliminating waste time and motion required to run down the conventional type of clamp screw) and tightening with a turn of the lose-proof handle. The clamp is said to release instantly by merely loosening the handle and pushing with thumb or finger on the trigger release pawl which frees the ratchet screw so



A push and a turn lock this new clamp; it is quickly released by the trigger

that the clamp is ready immediately for application to work of any other size or thickness.

This new Grand clamp is claimed to hold work with a firm tension grip on any surface, even slanting or irregular, and is equipped with replaceable ball and socket swivel to prevent shifting or creeping. The trigger release pawl is described as having hardened teeth which hold a meshed grip under spring tension on the ratchet screw while the clamp is set.

TOWING HANDLE

Telescopes Under Hydraulic Table

A TELESCOPIC towing handle has been added to the hydraulic elevating table made by the Lyon-Raymond Corporation. Extended, the handle provides means for easily moving the table from

For easy moving of tables

place to place. Collapsed, the handle is below and under the table top where it will not interfere with operations involving transfer of materials across the table or support of overhanging pieces.

EYE PROTECTION

Afforded by Gradient-Density Sun Glasses

SUN GLASSES that permit flyers to look directly at the sun by turning their eyes upward yet give them normal horizontal vision have recently been developed. Called gradient-density sun glasses, they shield the flier's eyes from the sky or bright sun above and the glare from water, sand, or other reflection below.

Through the center, they are comparable with ordinary sun glasses, transmitting about 20 percent of the light, sufficient for normal, daytime vision in sunlight. They are coated with a stainless steel film of microscopic thickness, the density of which is gradually increased toward the top and bottom of the sun glass lenses so that light transmission at these points is about 1/100th of one percent, sufficient for comfortable vision while looking directly at the sun.

The gradient-density sun glasses are made either with the gradation on both

top and bottom, or on the top only. The latter type is preferred by many fliers. The wearer finds that the landscape looks the same as through ordinary sunglasses while the bright sky is converted into a cool overcast.

The Bausch and Lomb Optical Company, who developed them, claim that the new sun glasses will have wide application in motoring, skiing, and golfing.

ELECTRIC SORTER

Quickly Identifies Unknown Metals

PORTABLE and easily operated is a new machine which quickly identifies and sorts pure metals, steels, and nonferrous alloys. Made by the Farmers Engineering and Manufacturing Company, and known as the Metalsorter, this machine requires no special electrical power supply to make non-destructive tests on finished products.

Employing the tribo-electric effect, a metallic specimen of standard, known, or acceptable character is rubbed against the surface of an unknown or doubtful piece. If a chemical or metal-

Tribo-electric effect put to work

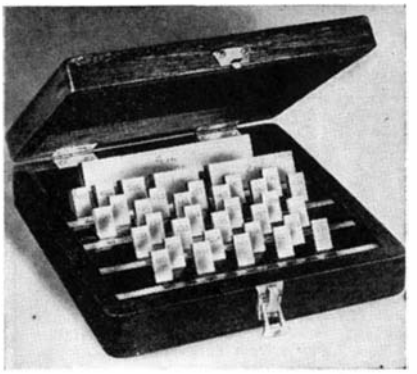
lurgical dissimilarity exists between the two pieces, a minute electrical current is generated and is registered by an indicator on a calibrated scale. When there is no dissimilarity, no electrical current is indicated. Various fixtures, tools, and connector leads are standard accessory equipment to enable the device to use almost any shape of metallic part for a reference standard.

CARBIDE GAGE BLOCKS

Reported Superior to Steel Or Chrome-Plated

FOR THE first time a complete set of gage blocks meeting Bureau of Standards requirements has been manufactured from tungsten-carbide and offered for general use. These gage blocks are manufactured in sets of 35 pieces ranging in size from .001 to 4.00 inches, and are said to have a wear resistance at least 100 times greater than that of steel gage blocks, or 98 times greater than chrome-plated blocks. Made by the Fonda Gage Company, its engineers predict that the users of Fonda carbide sets will have no occasion whatever to replace a carbide gage block.

The wringing qualities of these car-



Reported to wear "forever"

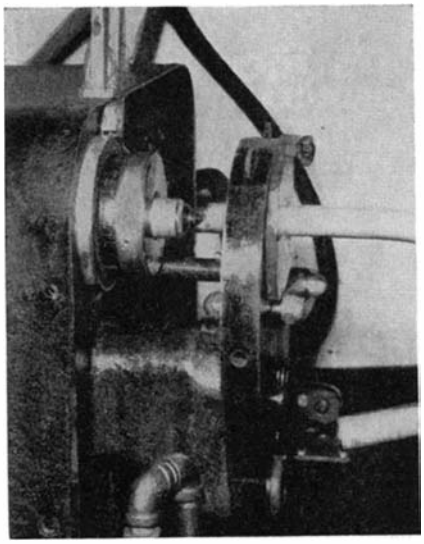
bide gage blocks are said to be far superior to those of either steel or chrome, and carbide blocks are corrosion-proof against moisture or fingermarks.

CARBOLOY INSERTS

Increase Tube Flaring Production 35 Percent

USE OF Carboloy lathe center inserts as tube flaring tools is reported to have multiplied tool life ten to one as compared with that obtained when conventional flaring tools, made from steel, are used. Cemented carbide tipped tools are used to flare the ends of many sizes and kinds of tubes, the machine employed for this purpose being a Leonard Precision Flaring Machine. The flaring tool used in the machine is made by brazing a stock Carboloy C-6 lathe center tip of solid cemented carbide to a tapered steel shank having a special taper to fit the machine. The lathe center insert is large enough so that all the work done during the flaring operation is taken by the carbide and none by the less-wear-resistant steel shank.

The high-speed steel flaring tools originally used produced only about 100 tubes before wearing out. The Carboloy flaring tools turn out at least 1000 pieces each before wear becomes pronounced and the tip of the tool has to be replaced or reground. In addition to the saving in tool cost and the



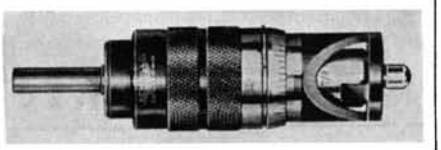
Tube-flaring tool uses a cemented-carbide lathe center insert on shank

more continuous machine operation, the longer runs obtained mean greater consistency of work turned out, while pieces produced per hour have been raised some 35 percent due to the elimination of down time for tool changes.

COUNTERSINK

Available With Threaded Or Tapered Shank

A HEAVY-DUTY unit capable of withstanding hard usage, the new 6300 Model Micrometer Adjustable Stop Countersink has a cutter capacity of 7/8-inch diameter. Cutters are driven off a threaded shank or a standard



Adjustable in .001ths

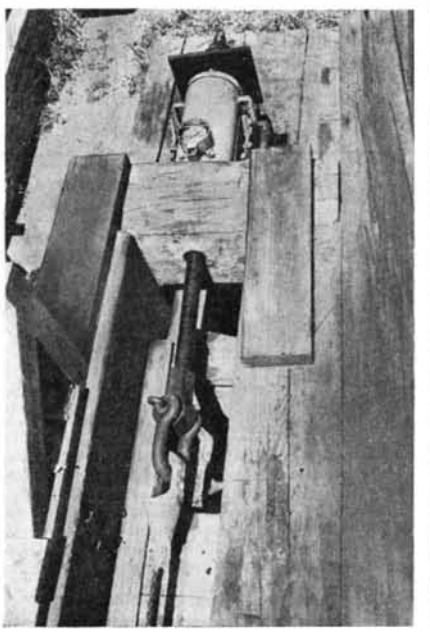
taper. Adequate lubrication is assured by a full length, self-lubricating bearing. Adjustments are made in increments of .001 inch and a positive lock prevents loss of this accurate adjustment. The taper shank cutter style has a self-contained knockout pin which facilitates cutter removal.

HYDRAULIC TESTER

Can be Set Up For Field Use

WIDELY used for heavy duty pulling, pushing, and lifting jobs, the Simplex Jenny Center Hole Hydraulic Puller has recently made its bow in tensile testing in the field.

The picture shows one of these Jennies of 100-ton capacity, testing a 1½ inch cable sling to 90,000 pounds. A clevis through the dead eye is secured to a long bolt which has been inserted through the Jenny and fastened above the cylindrical ram. The



Testing a cable sling

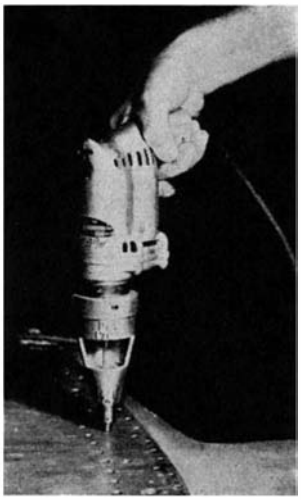
dial furnished with the unit accurately and constantly shows the pulling power applied, and consequently the tensile strength displayed by the member under test.

This hydraulic unit is also adapted for making tensile tests of cable, rods, hooks, and other members which are subjected to tensional stresses. One man is usually all that is necessary for such tests.

PRESSURE FOOT

Designed for Use in Production Line Drilling

PROVIDING a means of utilizing steel metal template stock in place of heavy drill plates and bushings in production line assembly drilling by indexing to standard size holes in the template, the construction of a new drill guide pressure foot also allows the use of standard size tips, which can be quickly interchanged to provide various drill



Drill guide pressure foot in use

sizes. Templates can be duplicated quickly from master templates by employing clips and fasteners, and can be used as assembly jigs as well as drill templates.

FLEXIBLE CORD

Has Plastics Insulation In Several Weights

FLEXIBLE electrical wire insulation which is reported to be the only flexible cord with a plastics jacket so far approved for use on household appliances by Underwriters Laboratories was recently announced by its manufacturers, the Whitney Blake Company. Called "Plastite," the new cord uses "Vinylite" plastics as the insulator and is said to possess dielectric strength far beyond similar type cords insulated with conventional materials. In addition, the plastics is resistant to oil, flame, alcohol, water, alkali, and most common solvents. Also it can be produced in a variety of colors.

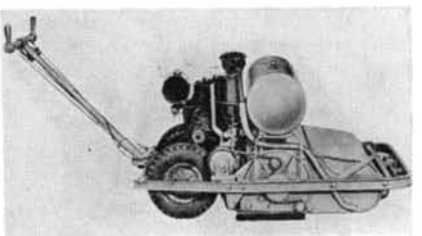
The household applications for which its manufacturers recommend it include lamps, clocks, radios, and light appliances, and vacuum cleaners, fans, and food mixers. There is also a medium duty type cord for washing ma-

chines and refrigerators, as well as a heavy-duty cord for use on portable tools, conveyors, bus heaters, floor sanders, and so on. It is available also in a parallel type with an extremely flexible tinsel conductor for use on electric razors, vibrators, and the like.

DIRT IN CORNERS

Removed Readily By New Power Sweeper

GETTING in close to the wall has always been a sweeper's problem, even when the cleaning is done by hand, but now, on a new model Moto-Sweeper, a blower, with an attached flexible metal tubing attached, cleans out the corners,



Blower tube, lower right, forces dirt into the path of the revolving brush

blowing the refuse and dirt right into the path of the revolving brush. Other refinements include an improved method of laying the dust, Where before air was pumped into water tanks to produce a fine spray, now it is applied at the nozzle, providing a more positive control that eliminates the necessity of building up undesirably high air pressures in the water tank.

Moto-Sweeper is easy to operate; it turns right or left under its own power, by means of a separate clutch on each wheel of the tractor, controlled at the handlebar.

BENCH LATHE

Designed for Precision Production Work

LATEST addition to the South Bend Lathe Works' line is a V-belt drive nine-inch precision bench lathe, made especially for those who prefer the several advantages of the V-belt drive. This bench lathe features 4-step, V-belt cone pulleys which, with the back gears, provide either 8 or 16 spindle speeds ranging from 46 to 1176 revolutions per minute. It is made with either quick-change gear or plain change gear equipment for a wide range of thread cutting and power longitudinal feeds. Two of the models incorporate power cross-feeds.

All models have a 9¼-inch swing over the bed and saddle wings, and ¾-inch headstock spindle hole with maximum collet capacity of ½ inch. Choice of bed lengths gives maximum distances between centers up to 34 inches.

This lathe is designed for precision toolroom or production work, and for general use in machine, laboratory, and **repair shops for** machining metals, plastics, compositions, and other machinable materials.

Current Bulletin Briefs

Conducted by K. M. CANAVAN

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

CATECHISM OF ELECTRICAL MACHINERY. This 48-page booklet presents in a simple way the most important features of common types of direct-current and alternating-current motors, generators, and control equipment. The text was prepared for those not familiar with electrical phenomena and terminology. Request Bulletin E100D. *Fairbanks, Morse and Company, 600 South Michigan Avenue, Chicago 5, Illinois.—Gratis.*

THE OBSERVER'S HANDBOOK FOR 1945 contains data on the planets and other astronomical phenomena, month by month; also lists of double and multiple stars, variables, four star maps, an ephemeris of the Sun, and miscellaneous astronomical data. Most amateur astronomers obtain this booklet each year. *Royal Astronomical Society of Canada, 198 College Street, Toronto, Ontario, Canada.—25 cents.*

A STUDY OF RADIANT BASEBOARD HEATING IN THE *I-B-R* RESEARCH HOME, by Alonzo P. Kratz and Warren S. Harris, presents the results of an investigation carried out to determine the effect of introducing heat into a room by means of long, low panels, heated by hot water, these panels being placed near the floor and extending along the exposed walls of the room. *Engineering Experiment Station, University of Illinois, Urbana, Illinois.—Gratis.*

DOW CORNING SILICONES, NEW ENGINEERING MATERIALS, is a 12-page illustrated pamphlet describing a family of synthetic materials of wide potential applications which are produced in many forms. These forms include fluids, greases, resins and varnishes, and silicone rubber. Silicones' outstanding property is the great extension of operating temperature ranges. *Dow Corning Corporation. P. O. Box 592, Midland, Michigan.—Gratis.*

PROPERTIES OF AMERIPOL D is an eight-page catalog section outlining the properties of an oil- and heat-resistant synthetic rubber. Illustrated with pictures of various Ameripol D products, this section serves as a guide to determine where the use of this synthetic is practical. *The B. F. Goodrich Company, Public Relations Department, Akron, Ohio.—Gratis.*

LIGHT FROM FLOORS is a 24-page illustrated booklet describing the peacetime possibilities of light-reflecting concrete floors. Results of a survey, involving over 300 lighting tests, are presented. Sections are devoted to recommendations for floor construc-

tion, surface treatment, and maintenance. *Universal Atlas Cement Company, 135 East 42nd Street, New York 17, New York—Gratis.*

UNDERWATER ARC-OXY CUTTING AND WELDING EQUIPMENT is a four-page folder describing specialized torches and related accessories. *Chicago Tool and Engineering Company, 8383 South Chicago Avenue, Chicago 17, Illinois.—Gratis.*

SANDING AND FINISHING is an 84-page booklet based on a newly announced system for identifying coated abrasives. Recommendations are given for the use of coated abrasives in metalworking, woodworking, plastics, printing, and other industries. *The Carborundum Company, Niagara Falls, New York.—Gratis. Request this booklet on your business letterhead.*

THE VISMETER, MODEL A, a technical bulletin, describes equipment for determining the viscosity of oils in a relatively simple yet accurate manner. The Model A provides for continuous sampling of a fluid and continuous indication of viscosity. *Carl D. Miller, Ph.D., 327 Salem Street, North Andover, Massachusetts.—Gratis.*

PLASTIC MAGNESIUM OXYCHLORIDE FLOORING presents in a folded circular a description of the various types of flooring employing magnesium oxychloride cement. The text describes the composition, the desirable qualities of such floors, and the general method of installation. *Oxychloride Cement Association, 1010 Vermont Avenue, N. W., Washington 5, D. C.—Gratis.*

CATALOG OF SURVEYS is a folded circular describing a special survey service organized to furnish technical and non-technical data on every product mined or manufactured. *J. J. Berliner and Staff, 212 Fifth Avenue, New York 10, New York.—Gratis.*

USE WOODCUTTING BAND SAWS SAFELY is a folded set of six charts which present "Dos" and "Don'ts." Graphic illustrations and pithy text drive home the points. Request Industrial Service Chart —Series E, United States Department of Labor. *Superintendent of Documents, Government Printing Office, Washington 25, D. C.—Five cents.*

CAST IRON IN THE CHEMICAL AND PROCESS INDUSTRIES is a 28-page booklet presenting extensive data on the corrosion rates of cast iron exposed to the action of substances commonly handled by chemical structures. *Gray Iron Founders' Society, Cleveland 13, Ohio. —$1.00.*

WELDERS GUIDE TO SUCCESSFUL HARD FACING, a 32-page booklet, sets forth in simple and understandable text and drawings the proper technique for handling successful hard-facing jobs. Hard facing itself is first described and then details are given on the acetylene and electric processes. *Mir-O-Col Alloy Company, 2416-30 East 53rd Street, Los Angeles 11, California.—Gratis.*

Our Book Corner

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

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ATOMIC ENERGY IN THE COMING ERA

By David Dietz

LONG was the road to the discovery of the secrets of atomic power. And the author of this book, has, himself, watched much of the journey from the viewpoint of a trained science reporter. In this volume he has traced the path. He has told as much as can be told about the research that led up to and culminated in the atomic bomb. From this background he ventures some predictions for the future. Essentially this volume should be considered as a running story of one phase of science, devoid of mathematics, and written to give the general reader an overall picture. (183 pages, 5½ by 7½ inches, several drawings and photographs.)—$2.10 postpaid.—*A.P.P.*

ATOM SMASHERS

By Raymond F. Yates

ELEMENTARY in the extreme is this volume that explains, in simple and non-technical language, the background of atom smashing and its link with atomic power. The author goes as far back as the ancient Greek philosophers in an attempt to present a view of all recorded thinking about the atom, its structure, and the energy locked within it. (182 pages, 5½ by 8½ inches, a number of photographs and a few drawings.)—$2.10 postpaid.

MINERALS OF MIGHT

By William O. Hotchkiss

WRITTEN in the form of a discussion among business executives traveling on a Great Lakes ore carrier, this book gives the reader information not only on iron, aluminum, copper, salt, and petroleum, which are so closely interwoven in our civilization today, but traces the first known uses of minerals far back into history. The author intelligently touches upon the future supply and conservation of our great mineral resources. He points out that all great cultures have developed and thrived during periods of exploitation of mineral resources; that the great civilizations of the past fell into oblivion when control of the sources of mineral wealth was lost to other races or nations. (206 pages, 5½ by 7½ inches, maps, tables, and charts.)—$2.60 postpaid.—*W.D.A.*

CUMULATIVE INDEX FOR VOLUMES I, II, III, IV, V AND VI OF THE CHEMICAL FORMULARY

By H. Bennett

OWNERS of one or more of the volumes of "The Chemical Formulary" mentioned above will find this cumulative index invaluable for reference purposes. It lists all of the formulas included in the six volumes, arranged in strict alphabetical order with numerous cross references. (164 pages, 5½ by 9 inches.)—$4.10 postpaid.—*A.P.P.*

THE PACIFIC ISLANDS HANDBOOK

By R. W. Robson

ANNUAL standard reference book giving for the many islands from Hawaii clear around to Sumatra the principal data on populations, anthropology, history, economics, native labor conditions, industries, and administration. Emphasis of this book is on trade and commerce. (371 pages, 6 by 9¼ inches, numerous maps.)—$4.10 postpaid.—*A.G.I.*

HIGH JOURNEY

By Carleton Putnam

WRITTEN by a man who combines literary qualities with the vitality and energy of a man of action. Early chapters deal with fascinating flying adventures, particularly in the Southwest. Later the book portrays devotion in the cause of early airlines; the brief,

but eventful life of Pacific Seaboard; and the success of Chicago and Southern, the airline of which Mr. Putnam is president. This is one of the few books which have captured the true, romantic, and courageous flavor of a unique chapter in the history of American aviation. (308 pages, including index, 5½ by 8 inches.)—$2.85 postpaid. —*A.K.*

SIMPLIFIED DESIGN OF STRUCTURAL STEEL

By Harry Parker, M. S.

ONE of a series of elementary books dealing with structural members used in buildings, this volume will serve as a handbook covering the most common structural steel members. Basic principles of mechanics are dealt with and it is shown how these principles simplify problems and lead directly to solutions. The problems discussed range from simple to rather complex. Tabulations necessary to the work are included. (226 pages, 5 by 8 inches, 95 drawings, 29 tables.)—$2.85 postpaid.

THUNDER GODS GOLD

By Barry Storm

ACCOUNTS of lost or buried treasure are always intriguing reading. This, a fairly well written book liberally interspersed with autobiographical data and photographs of the author, is a compilation of many stories well known throughout Arizona and the Southwest of the lost gold mines originally worked almost a hundred years ago by the Peraltas of Old Mexico, and of the author's experiences in searching for them. (166 pages, 6 by 9 inches, maps and illustrations.)—$2.85 postpaid.—*W.D.A.*

EXPERIMENTAL STRESS ANALYSIS

THIS IS a "top of the desk" book for any engineer who must design products which have the greatest strengths in the least spaces or with the least weights. It should be in the libraries of purchasing agents and of many a sales manager. The book consists of the proceedings of a meeting of the Society For Experimental Stress Analysis. There are 16 separate topics such as Shot Peening To Improve Shock Resistance, with original papers, discussions, and at least 200 bibliographical references. A list of members of the society is given. There are dozens of such illustrations as photographs, drawings and charts, and of tables and mathematical formulas. (170 pages, 9 by 11½ inches.)—$5.10 postpaid.—*E.L.C.*

INDUSTRIAL ELECTRIC LAMPS AND LIGHTING

By Edwin S. Lincoln

ARCHITECTS, engineers, and others responsible for lighting installations in all types of industrial plants where proper illumination is important to insure efficient and high production will find this book invaluable. Every phase of industrial lighting, from battery-operated flashlights to the floodlighting of an air-port, is thoroughly covered. All types of lamps are discussed in detail—fluorescent, mercury, sunlight, bactericidal, and so on—together with the proper types of fixtures to be used under various circumstances. Correct location and methods of installing lights in factories, offices, mines, garages, machine shops, hangars, and even in fire-hazardous locations such as flour mills and grain elevators are elaborately explained with the aid of diagrams and charts. (342 pages, 5½ by 8½ inches, over 200 illustrations, index.)—$3.10 postpaid.—*W.D.A.*

THE STORY OF LINEN

By William F. Leggett

THE STUDY of textile fibers is not only of interest to the cloth merchant but to the student of political economy also. Although fibers have been cultivated and woven into cloth for thousands of years, no definite date can be established as to when man first invented the process of cloth making. The author here gives a thorough, although brief, account of the known history of linen, from its manufacture and use by the ancient Egyptians, down through the times of the Romans and the Middle Ages to its introduction into Colonial America. (103 pages, 5 by 7½ inches, index, unillustrated.)—$2.85 postpaid.—*W.D.A.*

DISCOVERY OF THE ELEMENTS

By Mary E. Weeks

IN RESPONSE to a steady demand, a fifth edition of this solidly informative book is now available, revised and enlarged to contain much new material. A veritable treasury of fascinating information for those interested in the growth of human knowledge, this account of the discovery of the elements brings together as a connected narrative a vast amount of knowledge concerning the development of the science of chemistry, especially in its historic beginnings. (578 pages, 6 by 9½ inches, illustrations, index.)—$4.10 postpaid—*J.C.*

METEOROLOGY FOR PILOTS

By Robert W. Mudge

ONLY flyers know how really important a knowledge of weather conditions can be to insure safe flying. To the many air-minded owners and prospective owners of private planes this book summarizes all that a pilot should know of meteorology. Written in non-technical language, it nevertheless conveys the full meaning of the theories of meteorology and their practical application to every-day flying practice. Its convenient size enables it to be easily stowed in the plane's map compartment or in the pocket of a flying jacket. Useful also to the young man or woman who wishes to keep abreast of all phases of aviation. (259 pages, 6 by 9 inches, easily understood diagrams and photographs.)—$3.10 postpaid.—*W.D.A.*

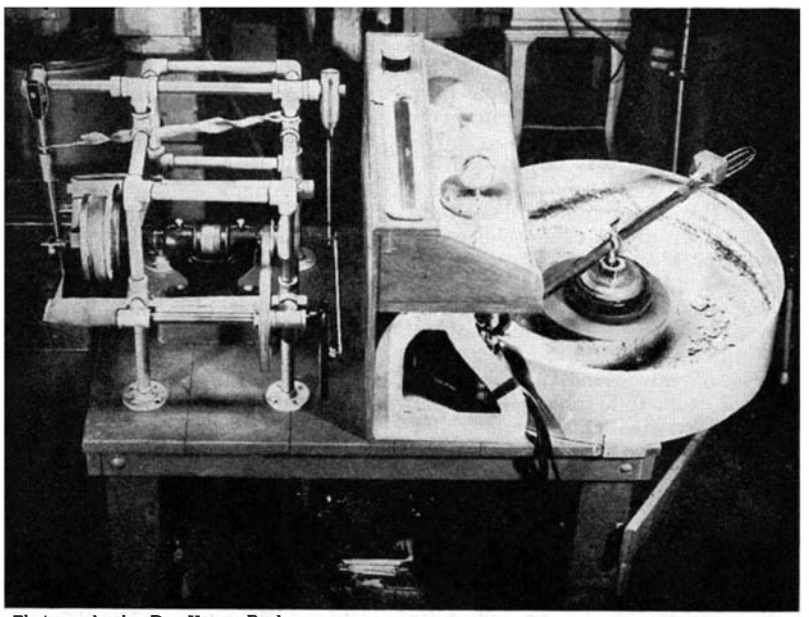
Telescoptics

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"

IN THIS department in the October and November numbers Patrick A. Driscoll described the design and use of a telescope mirror grinding and polishing machine of the vertical-spindle, hand-lever type. Now in this and next month's numbers Dr. Henry Paul, 119 North Broad St., Norwich, N. Y., will describe his own machine (Figure 1) of the same general type, combined with a polishing machine. The grinding part is seen on the right in the photograph, the polishing part on the left, but the grinding part alone will be described this month. Paul's description is as follows:



Photographs by Dr. Henry Paul

Figure 1: Henry Paul's combined grinding and polishing machine

It is often the desire of the amateur to have one machine which alone is capable of handling the greatest possible variety of optical work. This combination grinding and polishing machine has very satisfactorily served for the past five years in making highly varied optics ranging from ordinary *f*/8 paraboloidal mirrors and optical flats to roof prisms and correcting plates for Schmidt cameras. The same motor is used to drive both grinder and polisher. A separating wall in the center of the machine serves to keep abrasives from straying over to the polishing side. The grinding spindle will handle disks up to 12″ diameter.

The sturdy table, 2′ wide, 3′ long, and 3′ high, was constructed of ⅞″ hard wood. Drawbolts were used to fasten the 3½″ square legs in place. Lag screws were also used at key points. Thus, joints may be tightened and the table kept solid.

A ½ h.p. capacitor type reversible motor is recommended if such a machine has plain bearings, although a 1/3 h.p. motor might be used. For less power than this, ball bearings should be placed at the greatest friction points. The motor was swung on a hinge at one side of its base, which facilitates the use of four interchangeable motor pulleys, 1″, 1½″, 2″, and 2½″ in size. While the weight of the motor may hang on the belt alone, a rubber-cushioned wedge supporting a part of the weight of the free side adds to smooth operation.

Starting from the motor, a V-belt drives a 10″ pulley (Figure 2) on the ¾″ jack shaft. The latter is supported in plain-bearing, self-alining hangers.

On the right-hand end of the same jack shaft, by means of a flange, is fastened a 10″ by ⅜″ steel disk, its face machined perfectly true and perpendicular to the shaft. Here, freedom from wobble affords beautifully smooth operation and is worth seeking. The disk might well be permanently welded to the shaft and then machined true.

The vertical grinding spindle proper was made from a saw mandrel having standard bronze bearings. Its top end has a standard 1″ 8-thread (specified right-hand). The shaft of these sturdy mandrels is usually about 1 3/16″ in diameter.

For the end-thrust bearing of the spindle a thick brass plate, or disk, was fastened over the bottom end of the lower bearing, and a ½″ hole was drilled or turned just deep enough into the lower end of the shaft so that it would drop over about three fourths of a ½″ ball bearing. After some operation such a ball will wear a small, efficient bearing point in the brass plate. Lubricate well with a large amount of thin cup grease or heavy oil. As a simple alternative the end of the shaft could itself, if turned to a dull-pointed cone, serve as a bearing.

The 10″ faced disk drives a 2″ by 10″ pneumatic tire fastened with rim cement to a heavy wooden disk turned to receive it. Two cast-iron flanges—one on either side of the disk is best—were bored to a *close* sliding fit on the vertical shaft. A small flat area was filed from top to bottom of this shaft and a ⅜″ setscrew from the upper flange against this keeps the rubber-tired, variable-drive wheel at the selected position on the vertical shaft. Without the flat area, setscrew marks will soon result in a wheel that is hard to slide up or down the shaft. A knee lever (flat board hinged on one side) permits the spindle to be stopped almost instantly by hard knee

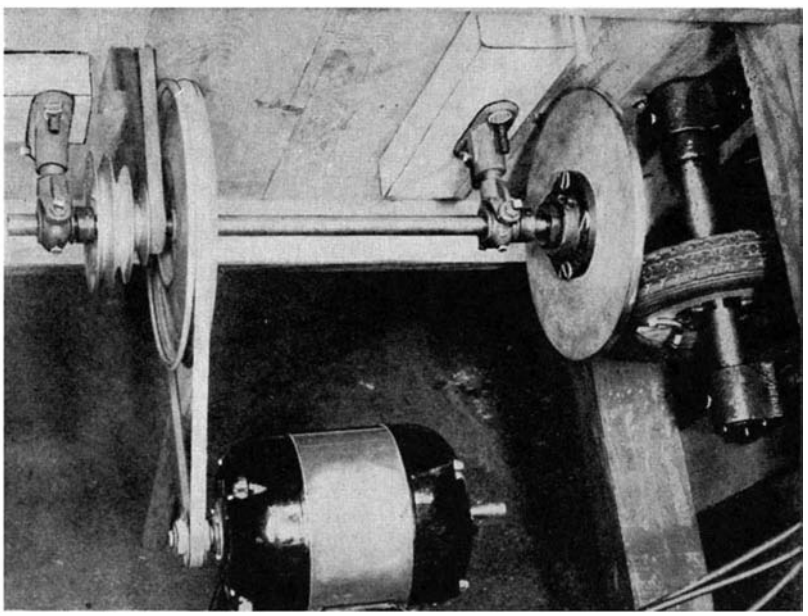


Figure 2: Same machine from below, with jack shaft and spindle

pressure; a *really quick* stop may "save all." Until the switch is off, the tire skids on its driving disk. At the point where the shaft passes through the bottom of the 24" by 6" heavy-gage pan is soldered a sleeve 1" high and about ¼" larger in diameter than the shaft. Under the 1" 8-thread hex nut, which serves as a shoulder on the same shaft, or spindle, is placed a circular washer of soft aluminum turned down at the edges. This effectively keeps water and abrasive out of the bearing. Warning: Put a high-water mark on the pan. A drain plug also would be handy.

The hand lever, or pin bar, should be at least 9/16" or ⅝" in diameter. A ½" shaft hanger permits universal motion at the attached end. Three cables, the third permitting a reversing switch (very handy to run laps off their thread) run along this bar (a tubular pin bar with the cables inside would be neater and easier to clean) to the on, off, and reverse switch fastened within reach of the thumb at the hand grip. A bicycle handlebar grip is good here. The best clamp I have found for holding the central pin on the bar was made from a Castaloy laboratory clamp (the former No. 20195, now No. 5-766, Eimer and Amend, 633 Greenwich St., New York, N. Y.). Ordinary cast-iron clamps break easily (goodbye mirror), while a solid support cannot be easily removed for cleaning.

The head plates for attachment of the mirror lenses were made by brazing 1" 8-thread hex nuts to ¼" or ⅜" thick disks.

Speeds of this grinding head may be varied from 0 to about 400 r.p.m. The operation is smooth and quiet. Ordinary dry soap applied to the tire stops any tendency to squeak.

End of Henry Paul's description of his grinding spindle. Next month he will describe the successful and nearly unique polishing part of his combination machine, with the mirror rotating constantly in an edgewise position in a bath of rouge water, and working while you sleep.

ATTENTIVE readers will recall that in the November number Driscoll urged not exceeding a spindle speed of 200 r.p.m., warning, "Faster, disaster." They may therefore ask how Henry Paul gets away with double that speed (quadrupled centrifugal force). For one thing, his is an especially well balanced machine. For another, its user is especially well protected by a thick splash pan turned over a heavy ring. And the 400 r.p.m. is, anyway, only its outside speed, seldom attempted. Just exactly what happens by way of disaster? Unpredictable. Asked whether he had ever lost control of a mirror Paul replied, "Yes, one flew off and put a dent in the pan but luckily did not chip the mirror, or me." An 8" mirror at 400 r.p.m. represents a peripheral speed of about 10 miles an hour and might only knock the wind out of the recipient. Yet who, except the indestructible Popeye, would choose to be hit by such a slug? "Reasonably safe speeds," Paul comments in a letter, "go up to about 400 *edge* feet per minute, corresponding to 150 r.p.m. for a 10" mirror, 200 r.p.m. for an 8", 250 r.p.m. for a 6"."

Leo J. Scanlon of Pittsburgh, who also has used the hand-lever type of machine, reports that "while grinding does proceed at a rate proportional to the pressure applied, speed of rotation, and amount of overhang, and there is a strong temptation to speed up the machine, high speeds throw off the abrasive wastefully. Also, seizure, if it occurs, takes place so quickly as to end in disaster if the grinding surface becomes dry or warm. It is also," he continues, "a delicate venture to entrust the mirror, in the last stage of fine grinding, to a rotating tool, though I have done it frequently. Usually in this last stage and one or two preceding it I do not use the pivot pin but hold the mirror in my hands, with my foot on the motor switch. (Paul too states that he grinds the last ten minutes by hand with mirror at 5 r.p.m.—Ed.) I also try always to avoid passing the mirror over the center of the tool, since that favors seizing, especially if the mirror is not yet spherical. Incidentally, we always try to finish a mirror in fine grinding with a slightly raised center. It then is easy to get a sphere by polishing."

Scanlon mentioned, above, the effect of centrifugal force in throwing off the abrasive. Here Paul comments, "Increasing the viscosity of the water used will retard centrifuging off the abrasive before it is broken down, and therefore will decrease grinding time. To accomplish this, household gelatin may be used, or 'Metamucil-2,' a drug-store powder which may be stirred into the water until the desired viscosity is reached. But this thickening of the grinding water is recommended only for the hogging out part of producing deep curves such as *f*/0.6 to *f*/2, where working times of 50 to 100 hours have been reported. Here the worker will soon speed up his machine to hurry the job along. Thickening of grinding water offers no advantage at slow speeds and should not be done with fine abrasives at any speed. On shallow curves it is not worth the bother, as these work out in a very short time on the vertical spindle. In general, the hand-lever machine requires more skill to obtain much faster results than other types of machines."

Apropos, not of machines but of Paul, is a distinct contribution of his to the art of rough figuring by fine grinding of aspherical surfaces such as Schmidt corrector plates. "My luckiest find," he says, "is the use of the round, thin, microcope cover glass held down and moved about by the finger and used on the rotating disk just as the thumb is sometimes used in zonal figuring polishing. Such cover glasses are from ½" to ¾" in diameter and only 0.002" to 0.005" thick and are therefore flexible under the finger." This method might prove applicable when rough figuring mirrors of such depth of curve that the greater part of the parabolizing is preferably done in grinding.

INDEX TO VOLUME 173, JULY—DECEMBER, 1945

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

Here's the *Inside Story* on Coming New

Radio-Phonographs

1.

Goodbye scratch and rattle. A revolutionary Zenith Radionic development will bring out hidden beauty never heard in records before—miraculously free from surface noise and scratch. It will give records 10 times their former playing life, too! And only Zenith will have it!

2.

No painful pauses between records, so disturbing to listeners. New Zenith record-changers will be lightning fast, amazingly simple, utterly safe for records. Quiet, too—no annoying mechanical noises and clicks. You'll say there's a touch of genius in Zenith engineering.

3.

No more groping around in a dark well to load record-changers. Zenith will have no trays or drawers to slide out, yet Zenith player units will glide silently into full view, completely accessible—then glide back into the cabinet out of sight! It's another Zenith exclusive!

4.

Be your own music master with Zenith's new, improved Radiorgan. Over 64 tonal combinations at your fingertips. Like a master-musician you'll blend radio, or record or F-M music to your own taste . . . bring out gorgeous passages and shadings the way you want them.

5.

Plenty of storage space for records in coming new Zeniths. No more stacking favorite records and albums in dust-catching piles. They'll be safe, easy to reach in beautiful cabinets, with flat tops you never need to lift. Zenith designers have worked wonders.

Naturally Zenith Will Be a Step Ahead Because Zenith Concentrates on

RADIONICS EXCLUSIVELY

For 30 years, Zenith has been a world leader in radio "know-how" by concentrating on Radionics—*the science of radio waves*. This has made Zenith radios outstanding—so dependable that their owners have enjoyed unparalleled freedom from service expense. It has also made Zenith one of the "big 3" in radio sales.

Today, Zenith is still concentrating on Radionic marvels for war. Soon, you may enjoy many of them in the coming Zeniths—the finest radios we've ever built and the top values in the field. When you see and hear them, you'll know for sure that there's a touch of genius in everything Zenith does!

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For the Best in Radio Keep Your Eye on Zenith

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LONG DISTANCE RADIO

RADIO • FM • RADAR • TELEVISION • RADIO-PHONOGRAPHS • HEARING AIDS

Scenes like this were common **IN THE 50's**
when our founders established this business

The renowned
Flame-Grain Kaywoodie,
inlaid with Turkish Meerschaum
$12.50
Shape No. 07. "Billiard."

PHOTO BY MATHEW BRADY

A rare old photograph, with authentic colors added, of Lower ***BROADWAY, NEW YORK CITY****, as it looked to our founders when they were making pipes nearby. They began this business in 1851 at No. 59 The Bowery, and in 1860 moved to No. 121 William St. A reproduction of the Broadway illustration in colors, together with booklet illustrating Kaywoodie Pipes, will be sent on receipt of 10¢ to cover costs.*

Only IMPORTED briar is use
in making Kaywoodie Pipe
Not all imported briar
suitable, but only t
choicest. Before it becom
"Kaywoodie Briar," it unde
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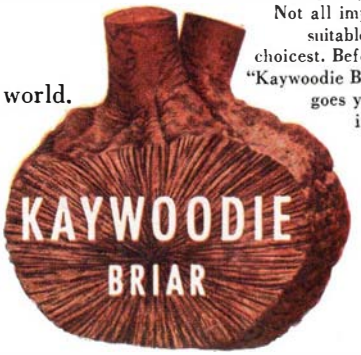

Kaywoodie Pipes are well known to pipe smokers in all parts of the world. Each Kaywoodie is the product of 94 years of pipe manufacturing experience. The qualities that make pipe smoking more enjoyable will always be found in Kaywoodie. Kaywoodies may be had at your dealer's for $3.50 to $25. Kaywoodie Company, New York and London. In New York, 630 Fifth Avenue, New York 20, N. Y.