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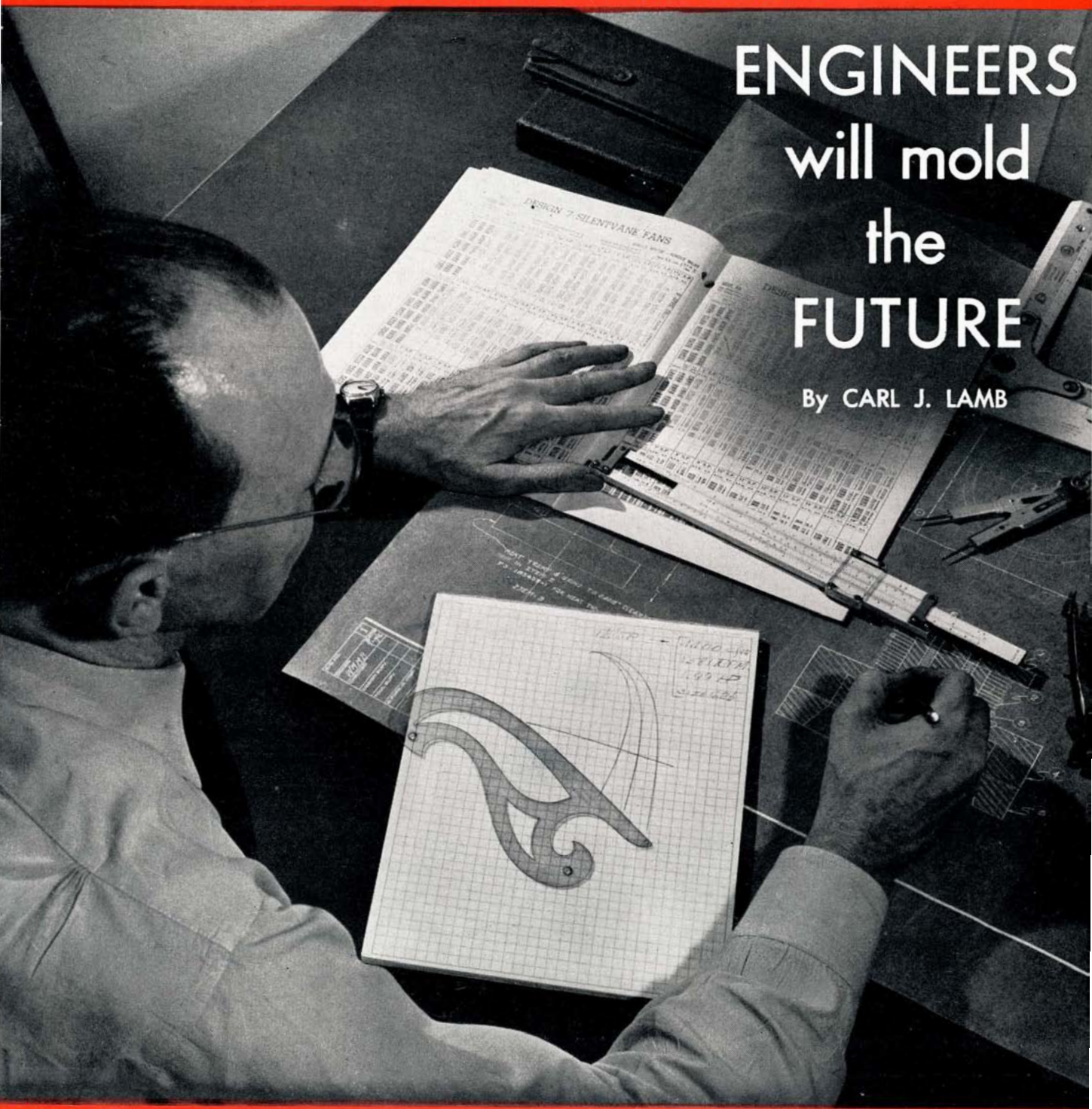

ENGINEERS will mold the FUTURE

By CARL J. LAMB

esy Westinghouse

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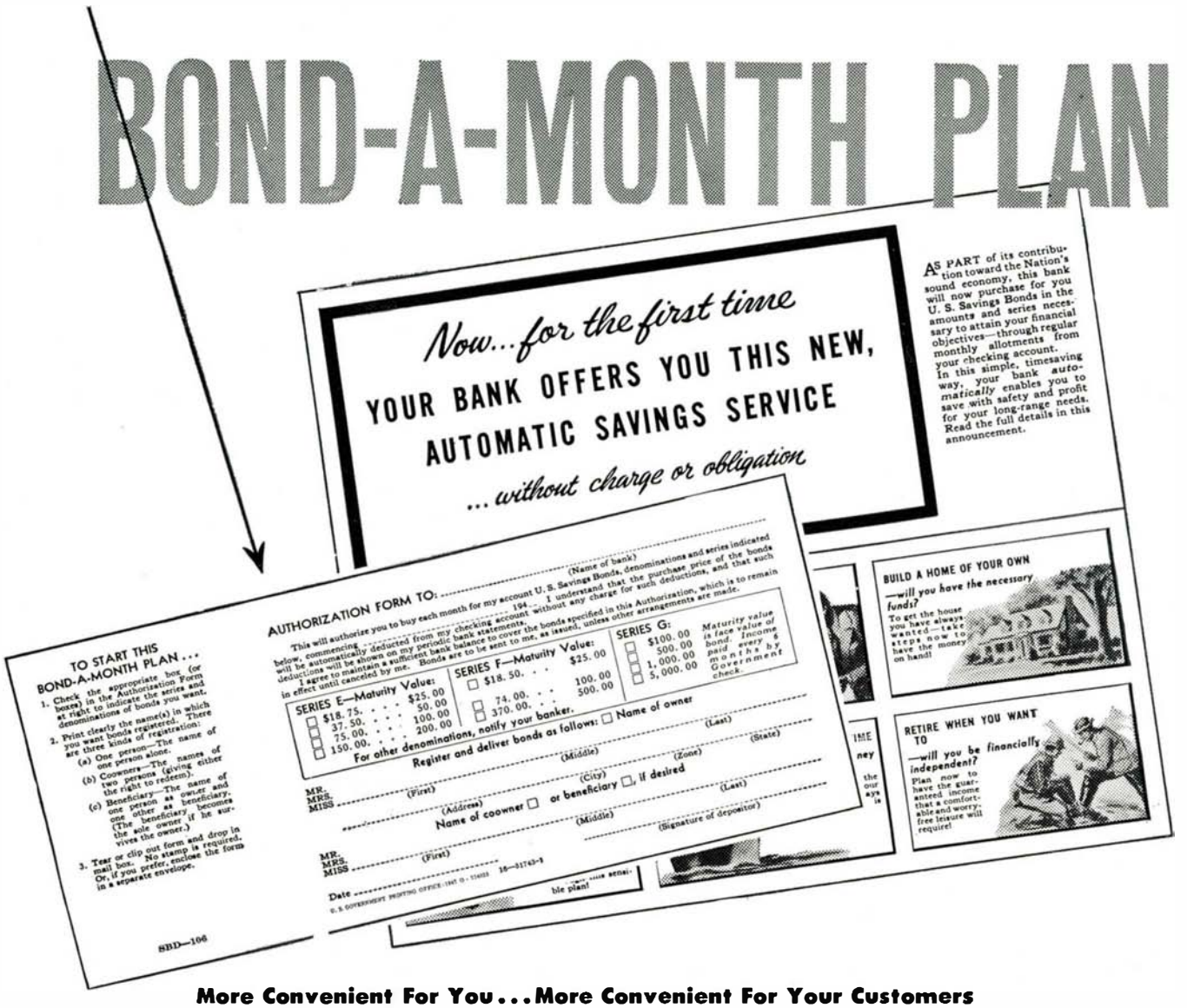

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Scientific American

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Industrial Drama: Armed with the tools of his trade, the engineer portrayed on our cover symbolizes the impact which his profession can have on this nation's industrial future. On page 197 Carl J. Lamb, himself an engineer, drives home pertinent points.

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In This Issue • November 1947

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50 Years Ago . . .

SCIENTIFIC AMERICAN

(Condensed from Issues of November, 1897)

ROAD TRAVEL — "The subject of traction on common roads early received the attention of engineers, and many experiments have been tried to solve this interesting and important problem. The steam traction engine has been used to a limited degree, but it does not appear to have been so successful as it might be. Light automobile carriages have been used to some extent, and it is probable that in the future they will attain a considerable usefulness. The electric carriage offers advantages for use on common roads, but it is doubtful if they will prove very successful, owing to the great weight of the storage batteries, except on the most perfect roads that have small grades."

WATER POWER— "The statistics of the present state of water-power utilization show that it is advancing with rapid strides. America leads the world with a total installation of over 70,000 horse power. Switzerland comes next with 32,000 horse power. France has 18,000 horse power and the great power plant at Rheinfelden, Germany, will give Germany the fourth place with about 17,000 horse power. Italy has nearly as much, and Norway and Sweden are each credited with 15,000 horse power. In Great Britain there is a total installation of about 4,000 horse power."

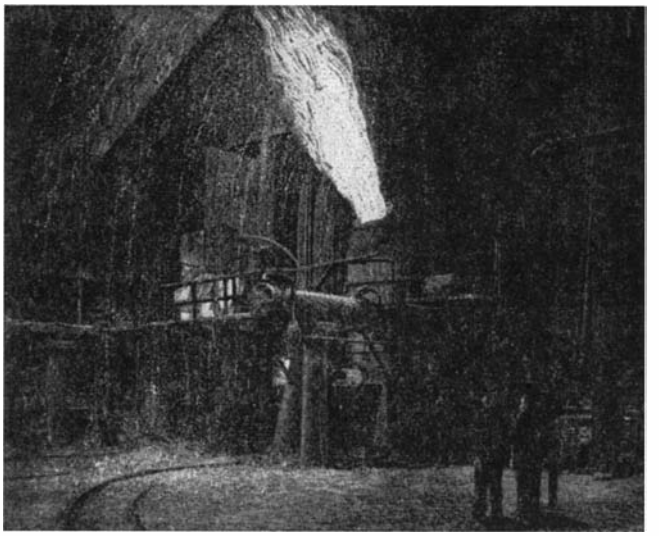
BRIDGE RENEWAL — "A remarkable record for rapid bridge renewal was made by the engineers of the Pennsylvania Railroad Company on Sunday, October 10, when a large iron structure on the busiest part of that road was taken away and a new span put in its place in the remarkable time of nine minutes. This feat was performed on the bridge which crosses the Schuylkill River, carrying the tracks of the New York branch over that beautiful stream just above Girard Avenue, Philadelphia."

BALLOON RAILWAY — "A mountain railway built on quite a novel plan is to be shortly opened for regular service. The principal feature of the new system is that the force of traction is directed vertically upward, and is derived from a balloon. A single rail is used for the only purpose of directing the course of the train and keeping the balloon with its load captive. To this end the rail is made T-shaped, and the car runs on it, gripping it from the sides and from below."

ELECTRICITY ON WARSHIP — "On November 5 a trial was made of the electrical equipment for the turning of the large turrets of the United States cruiser Brooklyn, at the Brooklyn navy yard, which was very successful. The trial lasted two hours. The great turrets were moved in all directions, rapidly and at slow speed, and so accurately that the guns could be quickly trained on the target."

CALIFORNIA OIL — "The discovery of oil in and about Los Angeles bids fair to revolutionize certain lines of business, and promises to produce the long wished for power for manufactories. The Terminal Railroad has adopted the oil as fuel, and the Southern Pacific is said to be experimenting in the same direction."

BESSEMER STEEL — "In the whole range of the various industries there is probably no one process so famous, or that has exerted such a vast influence upon the progress of civilization, as the Bessemer process. . . When a Bessemer converter is to be charged it is swung back into a position a little below the horizontal, and a stream of the molten pig iron is run into it through the open neck. . . The air blast is then turned on and the converter is swung back to the vertical position. While this is taking place a shower of sparks and burning graphite begins to pour out. . . This continues for the first three or four minutes of the blow, during which the graphitic carbon in the cast iron is changed into combined carbon, and the silicon combines with the oxygen of the blast in the form of silica, which in turn forms slag by combination with the iron and manganese. These chemical changes are accompanied by a rapid increase in the temperature of the molten mass and in the volume and brightness of the flame, until what is known as the 'boil,' shown in the engraving, is reached. This lasts for about eight minutes."



DYNAMITE DETONATION — "At the Verbelia, Colorado, tunnel the dynamo used is located in the gulch twenty-five feet from the mouth of the tunnel; wires are run into the tunnel connecting with electric caps, which, when the current is turned on, explodes the dynamite."

100 Years Ago . . .

SCIENTIFIC AMERICAN

(Condensed from Issues of November, 1847)

GLUED FABRICS—"A patent has been taken out for dispensing with sewing in the manufacture of shirts, collars, and linen articles. The pieces are fastened together with indissoluble glue."

LIFE RAFT —"Recently we saw a mattress enveloped in an india rubber cover, and it floated about in the Mississippi, with a man upon it, with all safety. Their introduction on board our steamboats would relieve passengers of much of the anxiety arising from accidents to the vessels, as they would be the certain means of safety whenever it became necessary to leave the boat."

ICE—"From a table in the Boston Shipping List, we learn that for the month ending October 31, 3206 tons of ice have been exported from this port, of which 1363 tons went to Calcutta, and the remainder to the south and to the West Indies."

PHOTO RECORD—"M. Brunel, a contractor on the Italian and Austrian Railroad from Florence to Bistaja, has a daguerreotype picture sent him every evening, which represents the state of the works at the point where it was taken. Thus he has at the end of every day exact information of the progress of the style in which the building has been conducted."

YOUR TELEPHONE TRANSMITTER AND RECEIVER, *voice gateways to the telephone plant, are so essential to satisfactory service that they have been under study in Bell laboratories for seven decades.*

A TELEPHONE RECEIVER is a complex system of electrical and mechanical elements. Its coils, magnets, diaphragm and cap react on each other as they convert the electrical waves of your voice to sound waves. What is the best size for the holes in the ear cap? Will 1/1000th inch greater thickness help a receiver diaphragm to carry your telephone voice more clearly? One way to find out is to build numerous experimental receivers and test them.

But Bell Laboratories have found a shorter way. They built an all-electrical replica, an "equivalent circuit" in which electrical resistance stands for air friction in the cap holes; capacitance corresponds inversely to the stiffness of the diaphragm. Over-all performance of this circuit can be quickly measured and design changes economically explored. Later, a model can be built for final check.

The "equivalent circuit" was pioneered by Bell Telephone Laboratories 25 years ago. It is a useful tool in many Laboratories developments—saving time, saving the cost of machine-tooled models, encouraging experimentation. It is one more example of the way Bell scientists get down to fundamentals as telephone progress continues—and service keeps on improving for all subscribers.

BELL TELEPHONE LABORATORIES

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

By A. P. Peck

SMALL BUSINESSES THRIVE MIGHTILY

MANY a pessimistic view of the future of industry in these United States, despite anti-trust and similar laws, foresees a rapid decline in "small business" and an equally rapid gobbling up of the lion's share of industrial profits by huge and heartless corporations.

Reference was made to the fallacy of this view on this page, December 1946 issue; now let's look at a few new figures which show the extent to which government buying is being tossed to small business groups. In fiscal 1947, small businesses received more than 55 percent of federal contracts of the sort they could handle; in the middle '30s they averaged about 25 percent of the same type of orders. In dollars, the fiscal 1947 business given to small manufacturers and suppliers by federal buyers amounted to $777,000,000.

Another angle of the same situation, but differing in a matter of degree, shows that the independent makers of automobiles—Hudson, Nash, Crosley, Studebaker, Willys-Overland, Packard, and Kaiser-Frazer—have grabbed a large share of the present automobile market, the largest, in fact, that they have been able to serve since 1931.

Looking at the industrial horizon through such facts as these, it becomes apparent that our industrial economy is not yet going to the infernal bow-wows via the dread octopi of ruthless big business.

WEED CONTROL

SUCCESS during last summer of the use of a form of 2,4-D as a large-scale weed killer on 18,000 acres of corn in Kentucky adds one more laurel to the crown of applied science. In this case, $2,000,000 worth of corn was saved from total loss through the expenditure of less than $10,000 for applying weed-killer. The chemical destroyed the weeds yet saved the corn when a series of excessive rains prevented normal cultivation and permitted weeds to grow so rapidly that they almost completely covered the corn itself.

OIL IS WHERE YOU FIND IT

IN ANY consideration of the future of the petroleum industry, figures are freely bandied about which can be made to show that our earthly oil resources will dwindle to zero within the next generation—or that they are virtually inexhaustible! It all depends on the point of view, even when coal and shale are barred from the discussion as sources of liquid fuels.

Exploration for new oil fields goes on apace, all over the globe. And right close to home things are happening that may seem to becloud, but actually can brighten, the petroleum horizon. Thus, the Leduc field in Alberta, Canada, is already producing fair quantities of oil; surveys are daily extending the potentialities. South of the border there are the unexploited and largely unexplored Mexican oil fields, largely shackled as yet by political and economic considerations. Within the continental limits of the United States, oil geologists are emulating a combination beaver-gopher in their industrious probing for new sources to exploit.

It is still anybody's guess as to the actual extent of this planet's oil reserves, whether in the form of crude or otherwise. In any event, assurance can be had that the aggressiveness of the petroleum industry as a whole will squeeze the last drop of crude from the earth before it cries quits.

INDUSTRIAL CONSULTANTS

TYPICAL of the results that may be expected when a manufacturer employs a specialist consultant to perfect a product is the announcement of a new water-dispersed paint received too late for inclusion elsewhere in this issue. This paint, which dries in less than half an hour without odor, yet reportedly possesses the durability and finish of high-grade oil paints, has as its vehicle a dispersion of totally synthetic resins in water, plus a pigment and a synthetic wetting agent.

What makes this development a bright spot on the industrial horizon is the fact that the manufacturer, Shawinigan Products Corporation, conceived the original idea, carried it through the early experimental stages, and then turned the whole thing over to a group of independent chemical consultants, Foster D. Snell, Inc., to perfect the experimental product.

Moral of this little industrial success story is that it usually pays in the long run to make use of specialized services, even though a manufacturer may think that his staff should be adequate to carry a project through to completion. An outside viewpoint, unhampered by company tradition or other handicaps, can often produce better results more economically.

STRAWS IN THE WIND

VACUUM hoses are being used more and more widely for handling various types of materials in industry; latest application is in unloading fish from boats, where a million fish can be handled in one sixth the time required by hand methods. . . Present air cargo rate-cutting war is a good way of hindering progress, raising accidents per ton mile. . . Comparative time-and-motion studies in small home construction shows promise of cutting costs, increasing efficiency of an inefficient operation. . . Lightning rod manufacturers expect 1947 to be a banner year; more and more industries are becoming conscious of lightning hazards and of means of protecting against them. . . Glues, whether animal or synthetic, can be given pleasant odors by suitable treatment.

ENGINEERS will mold the FUTURE

If Available Resources of Engineering Brains are Properly Used, They Can Go Far Toward Replacing Certain Dwindling Natural Resources. With Engineers Showing the Way, and Management and Labor Co-Operating, American Industry Can Reach Even Greater Heights of Efficiency and Productivity Than Ever Before

*By Carl J. Lamb**

IN A REMARKABLY short space of time this country, founded by refugees and starting from scratch, has become the most powerful in history. A nation has developed which leads the world in the fields of power generation, mass production and continuous processes, and the mechanization of industry, among many others. And it possesses not only great material wealth but an even greater wealth of engineering knowledge, ingenuity, and daring.

Because nature blessed this nation with great natural resources, lip service has been given to conservation, but it has not really been practiced. Now, after two World Wars in a third of a century, appears a real dilemma, not yet widely appreciated. The United States is no longer a "have" nation with respect to mineral resources; many minerals whose ample supply has always been taken for granted are now depleted and substitutes must be found for them in the future.

Everyone today is conscious of high prices. Real estate, labor, and material costs are at such levels that industry is faced with vastly higher investment costs for buildings, machinery, and equipment, together with materially increased operating costs. Based upon present conditions and the past record of technology, it is evident that there is great need to utilize the country's engineering resources to the utmost. If present income levels and high standards of living are to be maintained, it will be necessary to replace obsolescent plants and equipment, to reduce both investment and operating costs drastically, to develop the use of more abundant materials, and to engineer new processes and techniques or to materially modify old ones. Anyone who is doubtful that this can be done—if the problem is properly approached—has only to review the history of the development of this great industrial and mechanical nation to realize that its engineers can continue to perform miracles in the future as they have done in the past.

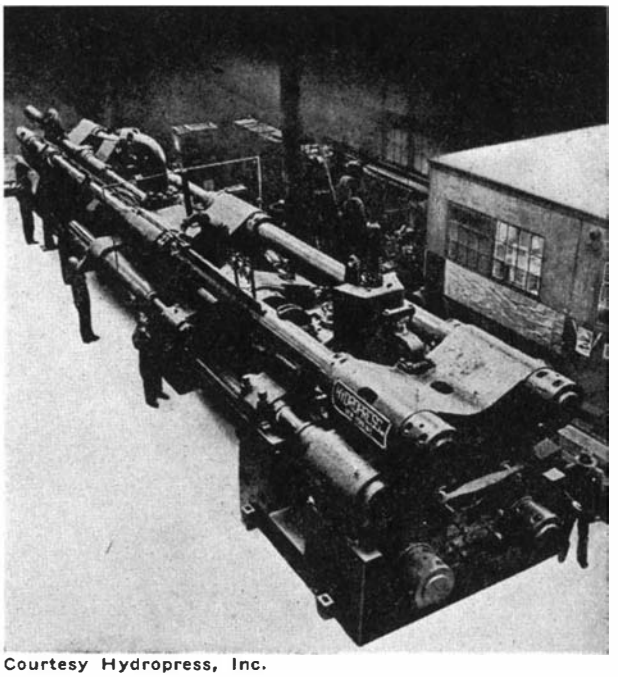
Up to the present time, full consideration has not been given by industry to means of reducing building and power costs, primarily because such costs until recently have not been of sufficient comparative magnitude to emphasize the necessity for so doing, or have not been considered fully on the basis of engineering economics. The greatest war effort ever known has just been concluded; for seven years engineers gave first consideration to maximum production rate, ability to operate under a wide range of atmospheric conditions, resistance to corrosion and shock, to minimum weight and space requirements, and so on. The question of cost was only of minor importance. Many able and experienced young engi-

*Staff engineer, Douglas M. McBean, Inc. Consulting Engineers.

neers, purchasing agents, and salesmen have neither an actual first-hand knowledge of cost-reduction nor a full realization of its importance.

ECONOMY ESSENTIAL — Conversion from a war- to a peace-time economy is still under way. Those considerations which should always guide product and design engineers must be re-established—lowest possible first cost, reliability, performance, long life, and appearance. This is mandatory not only so far as manufactured products are concerned, but also with respect to the plant in which they are produced and the machinery or process employed. Engineers should now be better prepared than ever before to undertake their assigned tasks because to their great store of peace-time knowledge and experience has been added a vast fund of war-time accomplishment which can be invaluable as a guide to the improvement of old practices and the development of new ones.

An obvious departure from pre-war conventional plant design practice, and one method worthy of serious consideration is quite simple. It consists of so engineering buildings, equipment, machinery, and processes as to save both the utmost space and weight, consistent with efficient operation and adequate accessibility. Too many plants have been (and still are being) engineered without serious consideration of the cost benefits to be obtained by such reductions in weight and space. Most machinery weights and dimensions are reduced appreciably as speeds are increased. Then, too, certain pumps, heat exchangers, and other machinery may frequently be mounted advantageously in vertical rather than in horizontal positions. Continuous processes require materially less space than do batch ones and are lower in first cost. High steam pressures and temperatures result not only in lower fuel costs, but also in reduced weight and space requirements in steam plants. Many types of machinery, particularly power generating equipment, have become so reliable that it is no longer necessary to provide spare or stand-by units. Proper consideration and use of such facts as these, by responsible engineers, may produce appreciable savings in size of buildings; thus, greatly reduced first costs may frequently be attained without sacrifice of efficiency—and often with a gain. It is obvious that a saving of 10 percent, for example, in floor space required for equipment to perform a certain operation means a corresponding reduction in cost of real estate, foundations, and building.

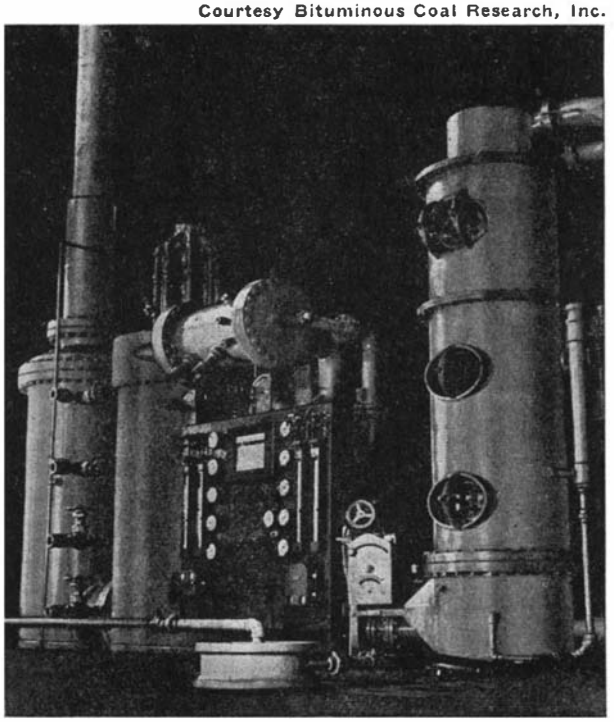


Courtesy Hydropress, Inc.

A 4000 ton extrusion press which promises new uses for tubes of nickel and steel alloys

Pilot plant for research on coal-burning gas turbines. Left: Fly ash separator. Center: Combustor and instrument panel. Right: Coal feeder system

Courtesy Bituminous Coal Research, Inc.



During the war the Army needed emergency floating power houses. Gielow, Inc., naval architects, designed power barges, each of 37,500 kilovolt-ampere rating, which could be towed to desired locations, and which performed invaluable service. There is available a large surplus fleet of Liberty ships, some of which might be converted to permanent generating stations, or, as was the case with the S. S. *Jacona*, previously converted by Gielow, to portable ones. Such plants built in surplus ships should be completed more quickly and at lower certain cost than could new land stations.

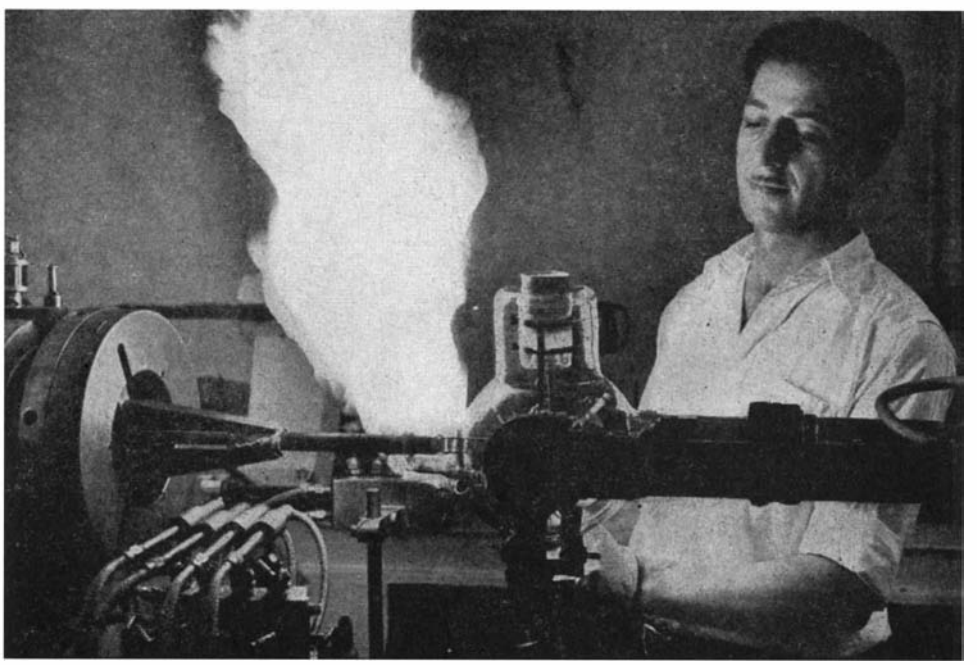
Entirely aside from the power house or boiler plant, there is a great opportunity to reduce costs in the production line or process plant, not only when designing new establishments, but particularly when examining existing ones with critical eyes. During the recent war, for example, a Westinghouse electronic tube plant was faced with the problem of multiplying production of large tubes in the existing space available, without any possible expansion of

area. Because the operation of sealing glass to metal had been done by machinists, it was natural that such work should be done in horizontal lathes. The responsible production engineer rose to the occasion and developed vertical lathes for the purpose, with astonishing results. They occupied only a fraction of the space taken up by horizontal ones, and the actual production achieved in the same working space was eight times that previously attained.

NEW MATERIALS FOR ENGINEERS — Because of acute shortages of various metals, great advances have been made in the use of the light metal alloys. The wider use of magnesium alloys as engineering materials by the Army and Navy will broaden the fields of their industrial use and should reduce their costs. In a recent paper presented before the A.S.M.E., H. A. Lorant, Chief Engineer of Hydropress, Inc., announced results obtained by the International Nickel Company with a 4000 ton extrusion press producing tubes of nickel and steel alloys. This engineering development makes possible for the first time the economical production of tubes and profiles in special alloys of steel and nickel, which previously could not be formed. Due to war-time shortages, Linde Air Products developed synthetic sapphire, ruby, and spinel gems for engineering use. These synthetic stones have been used for micrometer and precision gages, extrusion dies, thread guides, cutting tools, and fuel and injector nozzles. In addition to other possible uses, sapphire balls for high speed ball bearings are now being produced, thus making possible the use of ball bearings in corrosive atmospheres, at high temperatures, or in vacua, again opening new vistas for the engineer in the design of new and improved machines.

While it has been said for years that the world is rapidly using up its supplies of petroleum, the time has arrived, apparently, when a shortage actually exists. Pittsburgh Consolidation Coal Company is erecting a laboratory and pilot plant to produce liquid fuel oil and gasoline from coal. Then, too, the Locomotive Development Committee of Bituminous Coal Research, Inc., has for the past two years been carrying on an intensive research program which is now culminating in the building of two large coal-burning gas turbine locomotives. They have successfully demonstrated in a one-third scale pilot plant a system of pulverizing coal, burning it, and separating the fly ash to such an extent that abrasion of the turbine blades is no longer a serious problem. The relations of railroad fuel costs and locomotive efficiencies are such that a rail horsepower-hour costs

Courtesy Westinghouse



Above: Sealing the ends of a high-power radio transmitting vacuum tube in a vertical glass lathe of a type that was developed to take up less floor space than horizontal lathes such as shown in the photograph at the right. Through this engineering application, tube production was multiplied eight times in the same working space. The vertical lathes also reduce "set-up" time for each tube

about 0.57 cent for fuel in a conventional steam locomotive, and 0.53 cent for fuel and lubricating oil in a Diesel locomotive; whereas the coal-fired gas turbine locomotive should produce a rail horsepower-hour for only 0.20 cent.

A major asset of the gas turbine in directly utilizing coal as its fuel is the very large amount of excess air which is necessarily employed. This tremendous amount of air makes possible the "freezing" of the ash in the form of tiny particles, rather than as liquid slag, and a heat release rate of 1,000,000 Btu per hour per cubic foot of combustor space can easily be attained, as compared with a maximum of 50,000 Btu in industrial coal-burning boilers. It is believed that the coal-burning gas turbine will find application in land and marine power plants as well as on the railroads, because of its unique ability to produce power at good efficiency from low-cost fuel without the necessity of using water.

ENGINEERING CASE HISTORIES— Recently a textile manufacturer asked our firm to undertake a survey of the glove and mitten departments, and submit recommendations for the additions necessary to increase production materially, with the objective that such expanded production would not increase costs excessively. As a result of this survey and a revised production layout, it was possible to increase production by 68,000 dozen pairs of gloves and mittens per year, without any addition or increase to building, floor space, or personnel.

In another case, we were called upon by the Richardson Corporation, large producer of soda fountain syrups, and with the co-operation of the Richardson organization were able to plan an approximate production increase of 100 percent, at the same time releasing 1/3 of the existing floor space for future expansion. This was done in what was formerly considered to be an overcrowded plant. The resultant large increases of production, with consequent cost-reduction and without increase of floor space, in both of these cases were accomplished by rearrangement of production lines, speeding up some operations, improving certain details, and changing others. In each case a small amount of obsolescent equipment was, naturally, replaced.

Due to the energy and ambition of business men in general, many existing large manufacturing plants were neither designed nor planned, but like Topsy "just grew," their success resulting from the personal ability of the individual management. Probably 25 percent of the industrial plants in the United States could profit to the same degree as the two above, if they made good use of engineering brains, experience, and progressiveness; and at least another 25 percent suffer from obsolescence.

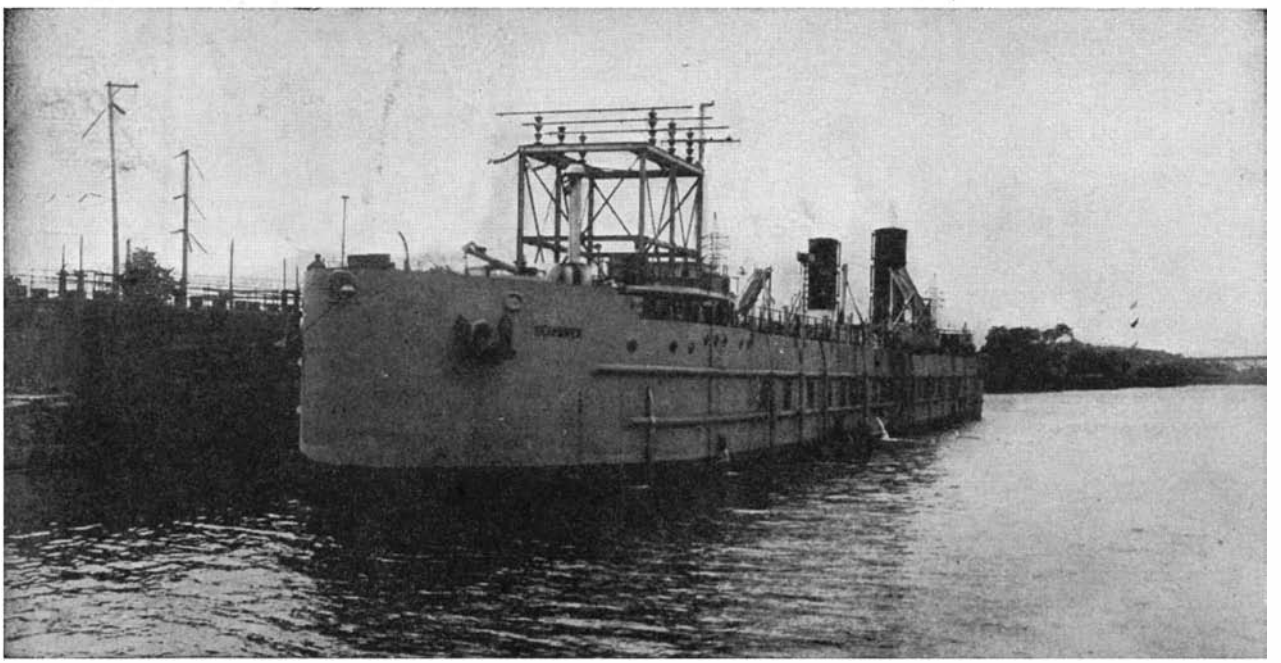
In life as it is today, industry cannot stand still. It must either go forward or backward. The surface of applied engineering or knowledge has only been scratched. The responsibilities of engineers in American life have become greater, and must continue to increase if national progress is to continue.

High wages and short working hours, with the present high standards of living can be maintained —or raised even higher. In order to do so it is necessary that engineers continue with such developments as have been briefly sketched here, that labor buckle down to produce a fair return for its wage, and that management improve its present performance and plan constructively for the future.

The force—the power—the greatness—of this nation do not depend upon a few great leaders, upon winning wars, nor upon the adoption of new economic theories. The importance of the United States to its people and to the world is, and will continue to be, the result of the average of accomplishment by engineers, laborers, management men—all its citizens—each in his own field and each working vigorously to obtain the maximum results in that field.

Floating power plants can be built in surplus ships more quickly and at lower cost than new land stations

Courtesy Gielow, Inc.



Wool + Heat + Pressure = Felt

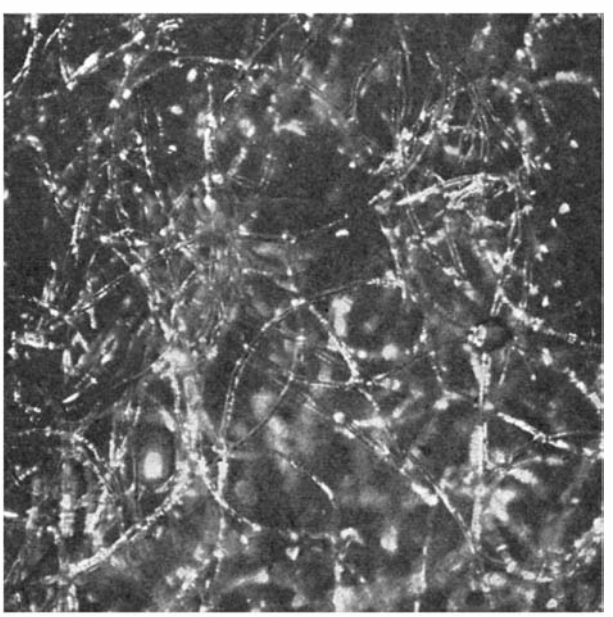
Felt, Most Ancient of Textiles, Has Become an Important Material of Modern Engineering. Covering a Wide Range of Characteristics, Felts Are Now Available for Fabricating a Great Variety of End Products

By Edwin Laird Cady

FELT was the first textile worthy of the name. Indeed, the first spun yarn probably resulted from experimentally felting a small wad of wool by rubbing it between the palms of the hands.

When a desert-dwelling Mongol wants a new piece of material for his tent, he lays an old piece flat on the ground, covers it with a thick layer of loose wool, and rolls it up around a wooden pole long enough so that both ends will protrude from the roll. Then he ties a rope around the roll to hold it together, hitches the traces of his horse to the ends of the pole, and utters the Mongolian equivalent of "giddap." The horse moves forward, the roll is rolled along the ground. After a few miles the horse is stopped, the rope removed, the roll unrolled. What had been loose wool now is brand new felt—warm, wind- and rain-resistant, and hard or soft in accordance with whether the roll was rolled a long distance or a short one.

Photomicrograph of felt shows the interlocking fibers. Oval spots at several points are particles of oil entrapped by the material



The Mongol has no microscope to tell him that each wool fiber is covered with small scales which interlock and hold tightly as his rolling action forces the fibers to penetrate the mass and entangle each other. But those interlocks are the reasons why new felts and new uses for felts are constantly being presented to industry.

Thus while our Mongol is rolling his bundle across hot sands, checking occasionally as he rides to see how much heat and pressure and work his felt is getting, American felt mills are using those same three factors plus chemistry and cleanliness. The modern felt mill is equipped from end to end with automatic controls, instruments, inspection devices, highly skilled men. It can turn out felts ranging from those as soft as dress fabrics to those as dense as hard wood. It can meet specifications laid down by the Society of Automotive Engineers and prove them by tests established by the American Society for Testing Materials. And with all of this it can make so many different special felts of controlled qualities that no catalog ever has attempted to list them all.

FIBER MIXTURES POSSIBLE — The interlocking abilities of the wool fibers can hold more than the wool itself. Wool felt can be admixed with as much as 80 percent of some other fibers, both natural and synthetic, although fibers such as nylon have such low coefficients of friction that only a 35 percent admixture seems to be practical at the present stage of development.

Among the synthetic fibers so admixed are viscose rayon, plasticized acetate rayon, vinyon, aralac, high tenacity rayon, and nylon. Cotton can be used as the sole admixture, or can be used in addition to silk or any of the synthetics. The mixture is worked out to have the wear resistance, permeability, absorption capacity, chemical resistance, strength, or other physical properties needed by the product into which

the felt is to be made or in the processing of which it is to be used.

By making batts of the synthetic fibers and then applying heat and pressure to them, a felt-like material which contains no wool can also be made. The "all plastics" felt is not here yet but its first cousin is. And this material has all the highly desirable properties of the plastics. It could, for example, be made resistant to chemicals which disintegrate or else hopelessly weaken natural fibers like wool and cotton. By the use of nylon and high-tenacity rayon formulations it might be resistant to temperatures of over 400 degrees, Fahrenheit.

When fiber mixtures, hardnesses and thicknesses of felts, and other properties have been worked out, the felt may further be impregnated, laminated, proofed, sized, or coated for extensions of its utilities.

Asphalt impregnation is a weather sealer when the felt is to be used for cowl seals on airplanes or for anti-squeak chassis strips on automobiles. Bakelite improves the dielectric strengths of felts in electric motor washers, spacers, other electrical devices. Graphite adds lubricity to felt anti-friction lubricating pads and to seals for bearings. Chromate, natural rubber, synthetic rubber, petroleum products, natural and synthetic waxes, are other impregnations. Resin emulsions add stiffness.

FELT LAMINATES — Felt can be laminated with almost anything that can be held by cements. Aluminum foil laminations with felt, for example, are used for insulation in light-reflectant, and acoustical and thermal insulating blankets. Lead foil laminations are used as vapor seals in cold line pipe insulations. Buna-S and Hycar are laminated with felt, as are various natural and treated woods and all of the common metals. A hard or stiff felt can be laminated with a softer one. An ever-increasing number of products are felt lined or clad.

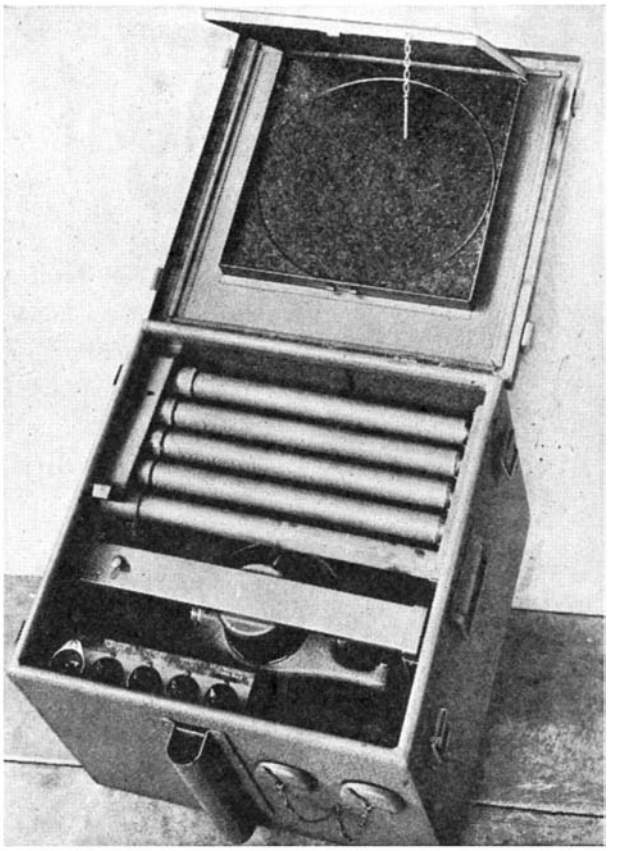
Chemical proofings can make felts resistant to flame for aircraft use; to flame and fungi for acoustical and thermal insulation; to fungi for use in the tropics. Mildew, mold, moths, carpet beetles, vermin, flame, moisture, or water all can be resisted by felts which have been proofed against them.

Sizings applied to felts can create any physical property from slight to high stiffness. Latex sizing imparts a spring-like property, makes the felt stiff but flexible.

Surface coatings are largely for adhesive backing. The coated felt handles like a dry surface material for all ordinary purposes. But when subjected to slight wettings with solvents or to the controlled application of heat, the surface becomes adhesive so that the felt will hold to surfaces pressed against it. Automotive channels thus made will hold to the metal or other parts with which they are assembled. Coated felt letters, heated and pressed into place, can be expected to hold their positions. Rubber-coated felt weather stripping even is made pressure sensitive, needing neither solvents nor heat.

MANY FABRICATING METHODS — Once the felt has been made, it becomes a raw material for fabricating into end products. And there probably is no other single type of material which runs the gamut of so many fabricating methods.

Soft felts are handled much like any fabric. Almost



Two felt sheets offer excellent shock-protection to the spare lens housed in the lid of this emergency field-surgery floodlight unit

all felts may be machine cut to precise shapes or stripped to close dimensional tolerances. But whereas the soft felts are die stamped with simple knives such as might be used on paper, the hard ones shear more like metals and must be handled accordingly. And the harder felts may be set up in lathes or other machine tools and machined like hard woods.

The felts which are heavily admixed with plastics fibers and, even more, the all-plastics felt-like materials, may be heat sealed—"electronicly stitched"—or formed to shape by the use of heated dies such as are ordinarily employed for the forming of thermoplastic sheets. No single authority seems to know how many of the methods common to metals forming and to thermoplastic sheet and rod fabrication are being applied to these felts right this minute. The use of synthetic fibers in felts dates back more than ten years, but in most of its phases it is so new that many of the product makers are keeping close guard over secret procedures learned by trial and error. But more than one practitioner is rolling his felt products to finished shapes, even spinning them as sheet metals and plastics are spun on lathes.

One of the primary properties of felt is multi-directional strength. It is possible when making rolls of felts 30 to 40 yards long by 72 inches wide to obtain either balanced strength or some superiority of longitudinal strength over transverse strength. And in sheet felt which usually is made in one square yard dimensions there are almost no differences in directional strengths. Since most roll felts are also

• LOOKING AHEAD •

All-plastics felt-like materials. . . Felt and felt-like materials formulated with qualities "made to order". . . Further studies bringing new uses and markets. . . Major improvements in the fine arts of grinding and polishing.

made with balanced strengths, very little attention need be paid to the directions in which stresses will be applied to felts. And in this felt differs from nearly all of the woven textiles, the woods, and the wrought metals.

STRESSES ARE LOCAL — Another property of felt is that a compressive force applied to felt tends to result in strains which are concentrated in the direction of the stress. A heavy load placed on a small area of a felt sheet tends to compress the felt immediately beneath the pressure and not to spread the felt sideways. This is useful in that felt parts of machines do not tend to spread and bind against adjacent moving members, and in that the uncompressed and little strained areas of the felt retain their full capacities for noise and vibration dampening.

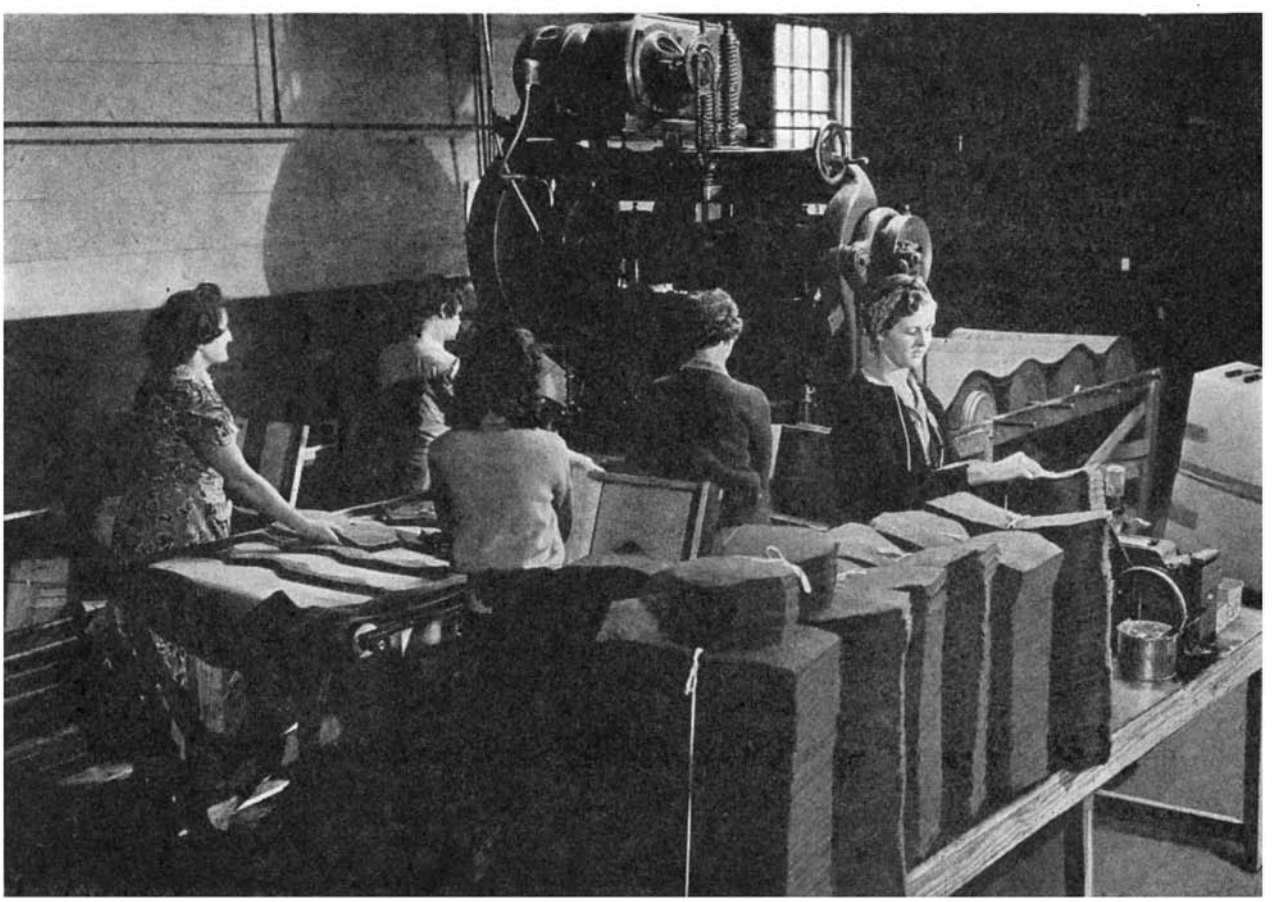
By varying the admixed fibers and the treatments, the wetting-out and hence the capillary action of felts can be varied widely and with close control. Capillary action is important where felts are used to feed lubricants as in wick feed lubricators, or to apply or remove water and other fluids as in paper machine blankets.

Because of the ability of hard felt to absorb and store polishing compounds while acting as a frictional surface, a felt surfaced lap or wheel can take scratches out of sheet glass by causing the glass to flow rather than by grinding it away. Similar abilities to make the surfaces of thermoplastics flow under frictional heat can be useful as an industrial art. Wool felts—and felts admixed with nylon and some of the other abrasion-resistant plastics—are highly embeddable to abrasive dusts and polishing compounds and can make major improvements in the fine arts of grinding and polishing.

Felt, one of the simplest materials to make in its cruder forms, is one of the most complex to diversify. The felt industry really is producing an entire family of materials; it is just as uninformative to say "felt" without adding a specification as to say "steel" without stating whether the steel is low carbon, high alloy, stainless, wrought, or cast.

Felt types already are immensely diversified, closely standardized. The study of them continues, and from it comes a continuous development of new and useful products. Directly ahead are highly important markets. And toward them felt is feeling its way.

Almost all felts may be cut to accurate dimensions on precision machines



Elasticity Explained

Investigations With the Ultramicroscope Have Proved Visually that Elasticity is No Monopoly of Just a Few Substances. Molecular Weight Distribution is Important and Realization of This Has Already Resulted in Improvement in the Elasticity of Synthetic Rubber

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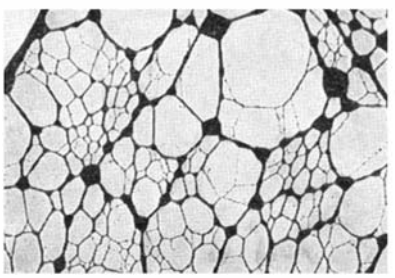
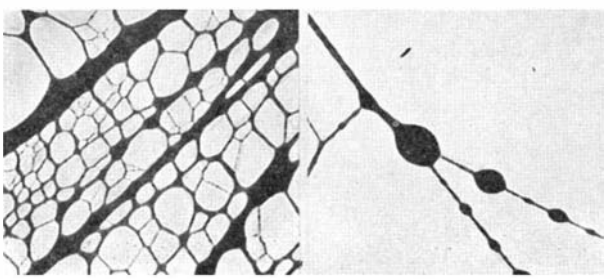
THREE years ago the scientific world was startled by revelations made with the electron microscope in regard to the moleecular configurations of rubber. To obtain such visual evidence, conditions had to be chosen so that the density differences of regions resolvable with the electron microscope (above 6 Angstroms—1 Angstrom equals 0.00000001 mm) are large enough to be observed. Suitable specimens were made by spreading a thin film of rubber which had been dissolved in an organic solvent on water, and then allowing the solvent to evaporate. When the film is picked up over a 200 mesh wire screen it breaks into fibers and nodules which range in width from several microns down to 100 Angstroms. The first specimens examined with this method in the electron microscope were prepared from benzene solutions of smoked sheet hevea rubber.

In these preparations two distinct types of structures were found. Figure 1 represents an electron photomicrograph of hevea rubber. One can easily differentiate between slender fibers and numerous ellipsoidal nodules along their length. The shape of the nodules is strongly suggestive of fluid regions, whereas the fine network structure indicates considerable rigidity. To test this assumption, preparations of guayule rubber were made. This natural rubber, although chemically identical in composition with hevea, differs from the latter in that it is composed of a much greater percentage of a low molecular weight fraction. Figure 2 shows this visually. To substantiate these findings even further, hevea rubber was subjected to fractionation into the so-called "sol" and "gel" fraction by virtue of its differential solubility in appropriate solvents. Figure 3 was obtained from the low molecular weight, or sol, and Figure 4 from the high molecular weight, or gel, fraction.



Left: Figure 1. Hevea rubber through the electron microscope



Below: Figure 2. Guayule rubber. Total (left), sol fraction (right)

SOME QUESTIONS NOT ANSWERED — As interesting and admittedly exciting as these findings were, they placed before the colloid rubber chemist several questions which begged for answers. How are these nodules formed? Is this an instantaneous reaction? Has this apparent two-phase structure any bearing on the property of elasticity? Why do the strings or nodules not coalesce when they tear, as shown for example in certain parts of Figure 4 (see arrows)? To answer these questions satisfactorily, some other technique had to be worked out. The electron microscope does not permit the study of the same preparation over a prolonged period: electron microscopy calls for high vacuum and the preparation is exposed to electron bombardment and a resulting increase in temperature.

Although the resolving power of the electron microscope is many times greater that that of the ordinary microscope, its limit lying close to 6 Angstroms, this extremely high power is not the predominant factor in an investigation such as that of the fundamentals of elasticity, as long as the shape or morphology of the preparation can be observed.

Ultramicroscopy with incident light seemed to be a technique which might fulfill all requirements since the resolving power of the ultramicroscope using the most modern methods of illumination permits observation of discontinuities down to 20 Angstroms. The preparations used in this study were made in exactly the same way as those for the electron microscope.

The only instrument suitable for such work is the "Ultropak," developed by E. Leitz in Wetzlar, Germany. It differs from other microscopes using incident light for illumination such as the metallurgical microscope (see Scientific American, page 25, July 1947) in the path taken by the rays of light used for the

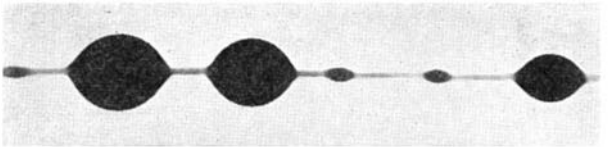


Figure 3. Hevea rubber, sol fraction

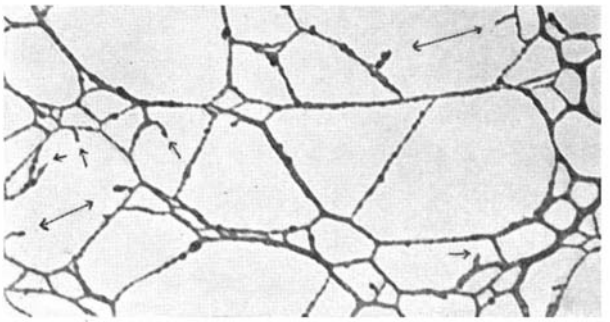


Figure 4. Hevea rubber, gel fraction

illumination of the specimen. As shown in Figure 5, the light is focused on the preparation through a lens ring surrounding the objective. This results in an ultramicroscopic type of illumination. Only light reflected from any discontinuity in the preparation is reflected through the objective of the microscope into the eyepiece or the photomicrographic apparatus.

FORMATION NOT INSTANTANEOUS — The first results clearly demonstrated the feasibility of this new technique. Enlarged and reversed prints (Figure 6, for example) give an effect directly comparable with the pictures made in the electron microscope. Very soon it was discovered that the formation of the globular nodules was not instantaneous, but rather a time-consuming reaction, and that their size was dependent on the ratio of low to high molecular weight fraction of the polymer under investigation (Figures 7 and 8).

The next step was to find an explanation for this phenomenon and to offer as much evidence for it as possible. Careful studies of the filaments with polarized light and facts known from X-ray investigations of rubber indicated that the high molecular weight fractions are composed of long chain-like molecules which aline if put under tension. When this happens, the low molecular weight fraction, composed of short chains, is squeezed out and forms the globular nodules. This phenomenon is known to the colloid chemist as synaeresis. Since this reaction is based on the movement of the molecules it should be possible to speed it up by raising the temperature.

A heatable substage was therefore constructed for the ultramicroscope and the same preparations studied at slightly elevated temperatures. The formation of the nodules which took 24 hours at 20 degrees, Centigrade, only took 15 minutes at 40 degrees, Centigrade (Figure 9).

Gutta-percha is chemically identical in its composition to natural rubber. X-ray studies have shown that the only difference between them is the location of the methyl group in the hydrocarbon molecule. If a preparation of gutta-percha is subjected to ultramicroscopic studies, one finds only very coarse filaments with ragged edges (Figure 10). If, however, this sample is heated to 65 degrees, Centigrade, the formation of fine threads and globular nodules immediately becomes apparent (Figure 11). At this temperature gutta-percha is elastic.

These are the facts, and now it is up to us to see if they are the long-missing pieces of the jig-saw puzzle entitled "elasticity." Before trying to put the picture together, we would like to quote from two old publications and offer more experimental facts.

IN OLD PAPERS — In a paper published in 1896 in the *Journal of the Franklin Institute,* Reginald Aubrey Fessenden says: "The elasticity of such substances as India rubber and gelatine was investigated. It was shown that such substances consist of two or more compounds interpenetrating but not combining with one another."

In a paper by Paul Bary and Ernst A. Hauser (*Kautschuk,* May 1928) on the structure of rubber, one finds the following statement: "Bary's theory that rubber consists of two components which under normal conditions are intersoluble, is in accord with results obtained from X-ray investigations. The observation that elongation of rubber causes a separation of the dissolved part and the solvent (theory of Hauser and Mark) leads to the assumption that rubber is composed of a network which will give rise to X-ray interference spots if, by putting it under tension, the lower molecular weight fraction is squeezed out, thereby increasing the coherence and alinement of the long molecular chains."

The colloid rubber chemist knows also that the

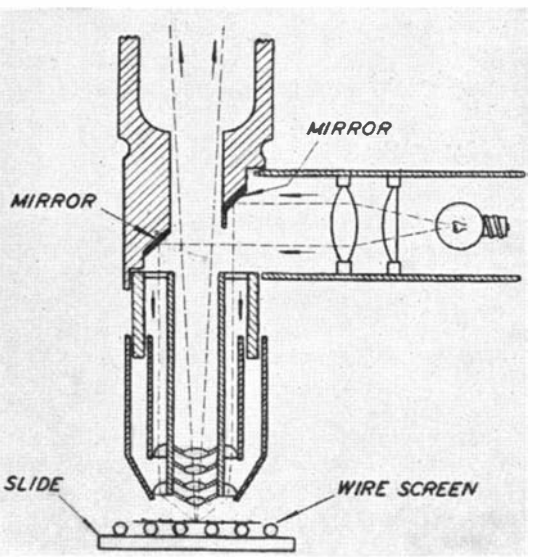


Figure 5. Diagramatic sketch of "Ultrapak" ultramicroscope

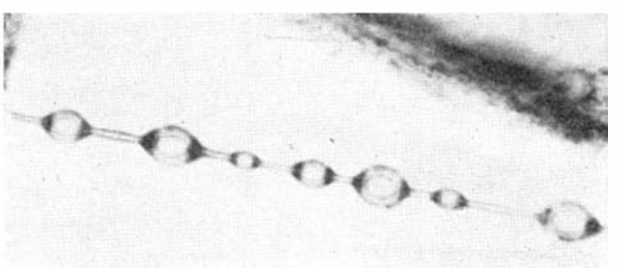


Figure 6. Hevea rubber (reversed print)

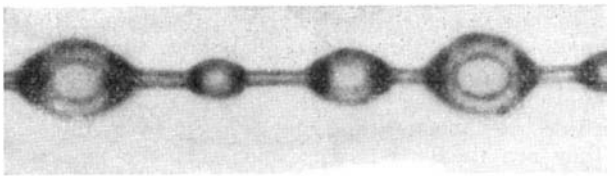


Figure 7. Guayule rubber

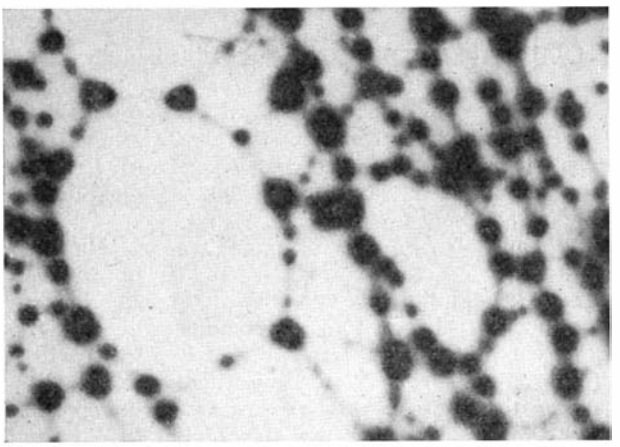


Figure 8. Cryptostegia rubber

low molecular weight fractions of natural rubber are a sticky substance; the highest molecular weight fractions are a hard substance; both fractions are lacking in elasticity. And it is known too that this property of elasticity is a function of the molecular weight distribution present in natural rubber.

If we now place all these pieces of information together, the picture is complete. Contrary to some admittedly ingenious theories which have been postulated, elasticity is not the monopoly of matter composed only of snarled-up long molecules comparable in their structure to a wire spring, but is the result of a specific molecular weight distribution of the same chemical compound, or the dispersion of a lyocratic colloid in a solvent.

Fessenden's and Bary and Hauser's multiphase theories have now found the visual proof they were still lacking. This is admittedly a very straightforward statement and since the conclusions which can be drawn therefrom may have far reaching consequences of scientific and industrial importance, it seems only fair to at least attempt to offer further proof for its validity.

ADDITIONAL EVIDENCE — Polyisobutylene is a fully saturated hydrocarbon and therefore much less reactive than rubber. The lowest polymers are clear, free flowing liquids, the polymers of medium molecular weight are sticky masses, and the high molecular weight polymers are hard and brittle. Films deposited on a screen from the former collapse completely upon evaporation of the solvent. The high molecular weight fractions only yield bands. Mixtures of the two, however, result in filaments studded with nodules. Such a polyphase system also exhibits pronounced elasticity.

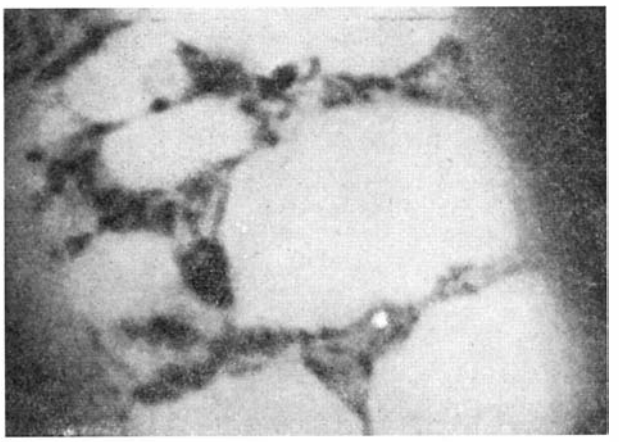


Figure 10. Gutta-percha

The elastic property of the copolymer of isobutylene and butadiene or isoprene, known as butyl rubber, as well as of the butadiene-styrene copolymer known as Buna S or GR-S, has also been considerably improved since the importance of molecular weight distribution has been taken more into account.

The new ultramicroscopic technique has not only offered the first visual proof that elasticity is primarily the property of multiphase systems, but has thereby discredited the idea that elasticity is a property monopolized by only a few substances. The field is wide open and new developments in the synthesis of elastic matter can therefore be expected from now on at an increasing rate.

Figure 11. Gutta-percha at 65 degrees, Centigrade

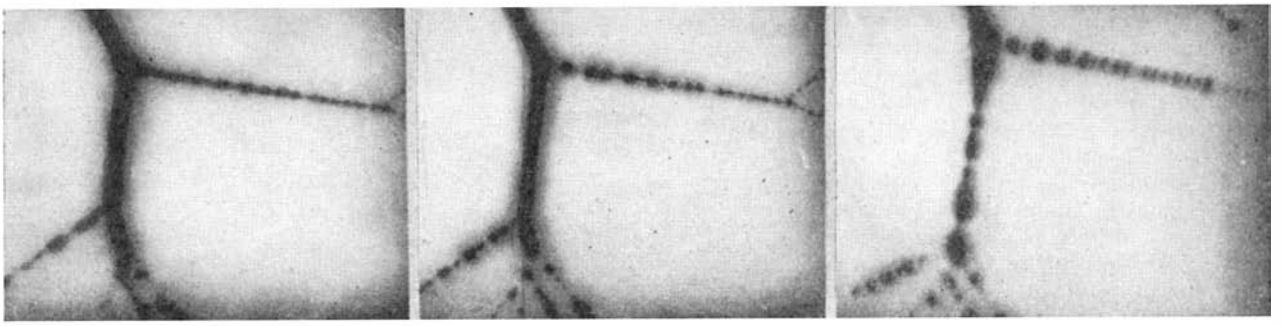


Figure 9. Cryptostegia rubber at 40 degrees, Centigrade. Left, at 0 minutes; Center, 7 minutes; Right, 15 minutes

Putting PLASTICS In Its Place

By
The Technical Service and Design Staff of Ross-Frederick Corporation

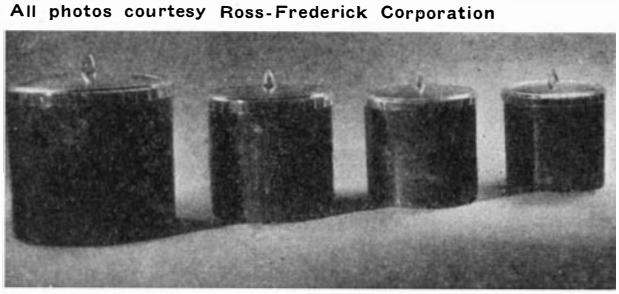
Misapplication of Plastics During Recent Years Has Led to a Long Procession of Wholly Unsatisfactory Products, With a Noticeable Loss of Faith in Plastics by Consumers as a Result. This Can Be Corrected Only by Applying Sound Engineering Practices to Plastics Fabrication — By Assuring Right Plastics for the Right Job

THE MISUSE and abuse of plastics in consumer products have long been a serious headache to sales managers and customers. Many new items designed for consumer use have been unable to withstand normal usage; either they were poorly designed or the plastics chosen was incapable of performing its assigned function. Even when the proper plastics was chosen, the amount of material employed was often too skimpy to transform the basic concept into a useful and durable object.

War-time shortages of metal and wood increased the demand for plastics items, but too often the consumer learned, to his or her expensive sorrow, that the rush to exploit this market produced little but shoddy merchandise. The public naturally resents purchasing plastics products which became valueless after one or two applications, and the industry as a whole is injured when consumers lose faith in plastics.

To give plastics their proper places as fabricating materials, a program has been laid out for applying sound engineering and research principles and practices to consumer-goods design and fabrication. Main objective of this program is to use the right plastics for the right job and to use other material

All photos courtesy Ross-Frederick Corporation



Polystyrene canisters are easily cleaned, light-weight, and rugged

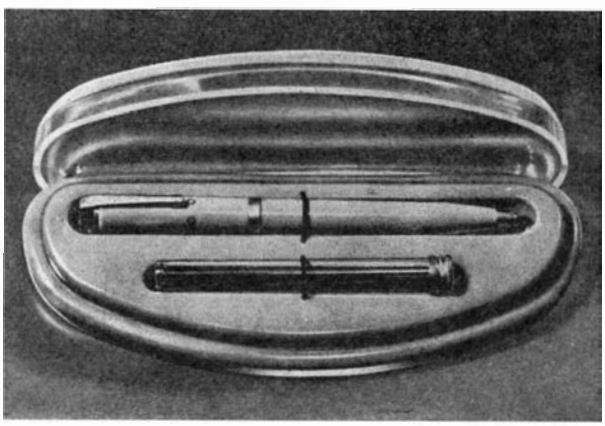
if a plastics cannot be found which will fulfill all requirements. Work along these lines is resulting in an entirely new concept of the ways in which plastics can be applied.

ENGINEERED TABLE LAMPS — A brief review of some of the consumer goods that have been produced by adhering to these principles will point up the success of the program thus far. For example, in a series of modern table lamps designed to take full advantage of the decorative and structural properties of various plastics, it is at once apparent that one of the design fundamentals has been the use of sufficient material where it will give the desired strength and beauty; there has been no stinting of material, no use of scrap or surplus stocks. Rather, the idea was to design toward a desired effect and to procure plastics material for that given effect.

Thus acrylic may be used with molded phenolic, with wood laminates, with rods made from phenolic-impregnated linen—each material adding its own special quality. Color and brilliance, for example, are contributed by the acrylics. It is the light-transmitting quality of this plastics that gives the effect so desired in lamps intended for the living room and bedroom. And by making bases of wood laminates and molded phenolics, they can withstand the knocks and scratches which will almost inevitably befall them.

Varying the materials not only insures beauty and durability, but makes possible the keying of a lamp to a particular color scheme. Then, too, the apparent weight or mass of a lamp can be affected by the wise selection of plastics materials. Thus, a library lamp might well use a preponderance of laminated tubing in the darker wood colorings, or deep-toned sections of acrylic stock. This would contrast with

Methyl methacrylate was chosen for this pencil barrel for its durability and weather resistance



slender spires or diamond-cut disks of clear acrylic fashioned into boudoir lights. The effects that have been achieved in these lamps were made possible through the imaginative and generous use of plastics materials. In one lamp, for example, use is made of the light-carrying properties of methyl methacrylate in the light and dark toned amber rods that make up the body of the lamp. The sweeping curve of the rod assembly serves the double purpose of insuring a balanced appearance regardless of the angle from which the lamp is viewed, and of increasing the sparkle of the lamp body by presenting more and varied surfaces to the rays of light.

The same basic design has been employed in a number of other lamps. In one case, the rods are made of phenolic-impregnated rolled linen tipped at both ends with clear acrylic. As with the other lamps of this same construction, the base is of laminated wood, a material which has been found to withstand the wear usually meted out to lamp bases, at the same time blending with the overall color scheme.

A modification of this stacked or tiered design is employed in another lamp. Rods have been replaced with flat sections of methyl methacrylate tapered at the edges so that the lamp standard brings to mind the curved roof of a Chinese pagoda. No attempt has been made to camouflage the center tube through which the wiring is strung. Rather, it has been thought to enhance the design by interrupting the pattern which has been set by the clear plastic sheets.

Entirely different is another design. Here, vertical rods are the motif—in this case, alternating rods of clear acrylic and laminated tubing made from phenolic-impregnated rolled linen. By substituting clear acrylic for the laminated tubes, an entirely different effect is created. Or smaller clear plastic rods may be set around a large center rod of acrylic or an opaque material.

Holding these rods in position at top and bottom are solid sections of molded phenolic. A wood laminate, however, serves as well, and disks of acrylic have been used in some models.

WITHOUT ADHESIVES — An unusual feature of these lamps is their lack of internal binding. No glue or other adhesive is used to hold the lamps together. Instead, each piece is fabricated (cut and machined from sheet stock) to tolerances as close as 0.0005 inch. These close fitting pieces are then mounted, one above the other, on the metal tube holding the wiring. Pressure is applied from the top finial to complete the assembly and to form a sturdy, decorative lamp. This pressure is sufficient to bind the lamps tightly together and prevent slippage of the individual pieces.

Another item to which sound plastics engineering practices have been applied, is a four-piece canister set for storage of flour, sugar, coffee, and tea.

In developing this kitchen aid, the primary consideration was to protect, yet not contaminate, the contents. A maximum of safety had to be achieved to protect users. In addition, the set had to be attractive, sturdy, light-weight, reasonably priced, and easy to clean with soap and water. Although plastics have been used in other household ware, this was one of the first applications where plastics would be in continuous contact with foods over long periods.

From the 22,000 plastics formulas available to plastics manufacturers, one had to be chosen which would meet the consumer needs and at the same time would be adaptable to certain manufacturing essentials. The material had to be available in various colors, available in sufficient quantities for mass production, and easy to handle in the manufacturing process.

Polystyrene was the plastics selected. It had all the consumer requirements and, since it was basically colorless, could be colored to suit any need. Low water absorption would prevent moisture from the canisters and ruining the food. Also, there was no objectionable odor which could be passed on to the contents. It had good die finish, eliminating tedious hand finishing after initial manufacture. Its inherent luster lasts for years without waxing or polishing. Developed before the war, polystyrene had undergone severe war-time usage, and was known as a rugged material.

The characteristics of polystyrene indicated that injection molding would be the best method of manufacture. The round shape of the canisters was adopted because women prefer this conventional form. It is easier to clean with soap and water, and there are no sharp corners to tear clothing. Also, granular foods flow easier from this shape. The bottom was niched to provide additional strength—arch construction being one of the strongest of the basic design concepts—and so the container would sit flat without bulging.

The clear polystyrene tops provide an instant view of the interior. To insure a close-fitting, dust-pro-

Sound engineering and good taste combined to produce this table lamp. Vertical rods of clear acrylic are alternated with rods of phenolic-impregnated linen

• LOOKING AHEAD •

Full realization by the public of the capabilities and limitations of plastics . . . Plastics products which live up to consumer expectations . . . Plastics invading many new territories from which public prejudice has long barred it . . . Plastics losing the stigma of "substitute material."

tecting cover, the tops are ridged around the edges. These ridges grip the canister tightly—so tightly, in fact, that a vacuum pull is felt when the top is lifted. A finger grip, molded as part of the top, completes the cover.

SIX-COLOR MECHANICAL PENCIL — The production of a six-color mechanical pencil presented new problems. A sturdy case, but little larger than an ordinary pencil, had to be designed to hold the mechanism and colored leads. Although six different leads are contained within the barrel, it was felt that the size should be as close to an ordinary mechanical pencil as possible. The case had to withstand weathering, as many of the users would be construction engineers and others engaged in outdoor projects. A durable finish, to increase the sales appeal, was necessary. The weight of the case was important, too, since a heavy, bulky barrel would decrease its effectiveness as a handy tool. Finally, the material had to have good dimensional stability, to withstand extreme changes in temperature, and not be brittle.

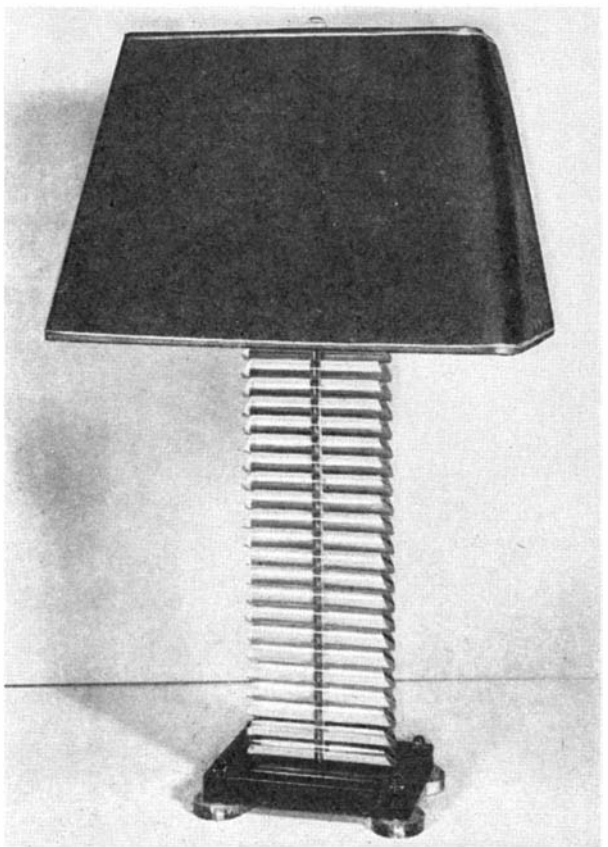
Methyl methacrylate was the material chosen. Noted for its clear transparency, it was also available in many colors, both transparent and opaque. Light grey was the final selection as it is a neutral color, and will not readily show wear and tear.

Again, injection molding was used because of the material's characteristics. After molding, each barrel is finished by hand and the final assembly, including mechanism and leads, is performed by hand.

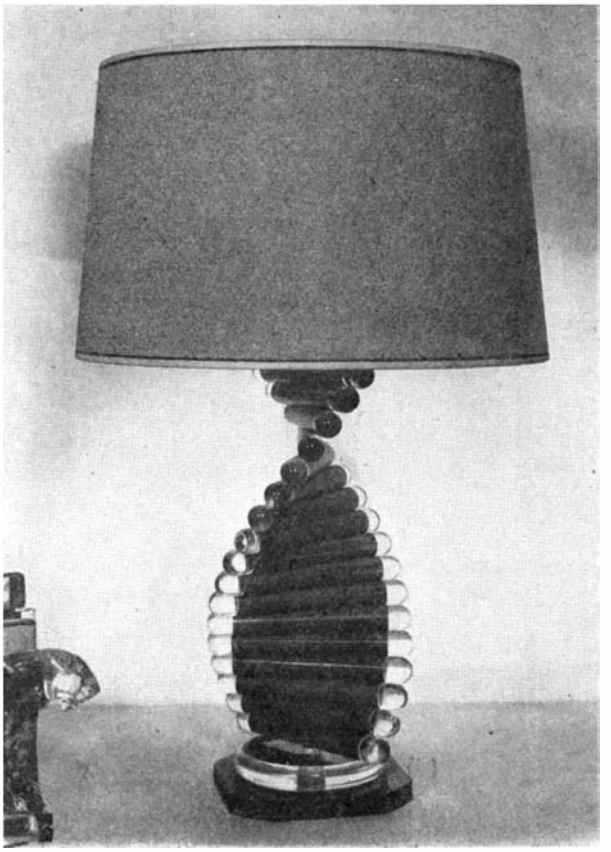
The finished pencil is a combination of methyl methacrylate and chrome plated brass. The mechanism is all brass, since it was felt that no plastics could perform the function properly. Brass bands reinforce the point, center, and head of the barrel while the clip, which is also the color selector, is formed from the same metal. Thus the best qualities of two different materials are combined to create a useful writing tool.

The fields for plastics merchandise are only now beginning to be appreciated. In the future, careful engineering of the thousands of available plastics materials will provide a host of products to benefit both industrial users and home consumers, and to bring about the recognition of plastics for their own special properties and not as temporary substitutes.

Suggestive of a Chinese pagoda, the tapered sections are of clear methyl methacrylate



Phenolic-impregnated linen rods tipped with clear acrylic make a sturdy, unusual lamp stand



CO-OPERATION HITS Corrosion

Competitors Working Hand in Hand Are Carrying on Extensive Studies Aimed at Breaking Through the Barrier of Question Marks Which Surrounds the Corrosion Characteristics of Metals. Information Thus Gained is Aiding the Co-Operating Manufacturers to Turn Out Better Products More Economically

By T. C. Du Mond
Managing Editor, MATERIALS & METHODS

CORROSION, in effect, is the cancer which destroys metals. Starting as a tiny, perhaps invisible spot, corrosion steadily eats its way through the very heart of the metal on which it is working until, for all practical purposes, the metal dies. Indeed, when corrosion has worked long enough on certain metals those metals actually fall apart. And just as cancer attracts the attention of medical scientists throughout the world, a small army of metallurgists, engineers, and researchers is devoting its efforts to learning how corrosion works and what can be done to prevent it, or to slow its destructive action.

Although the problem of corrosion has been faced for many years, it has not been until recently that much progress has been made in understanding the whys and wherefors of rust. We know that mere protective coatings are not sufficient to prevent corrosion for anything more than a relatively short period. When and where coatings are retained intact, corrosion in inhibited, but once these surfaces are broken by so much as a microscopic hole, the action starts and rust begins to form.

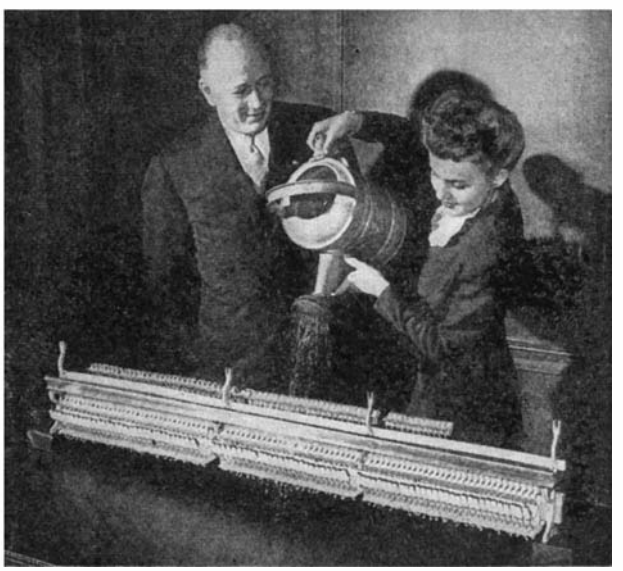
Except for the so-called noble metals—gold, silver, platinum, and the like—all metals are affected to some extent by corrosion. However, on some metals such as aluminum the corrosion product is a tightly adhering oxide film that serves to protect the metal under it. Other metals are not so fortunate.

The greatest problem in learning about corrosion lies in the fact that corrosion's causes and effects vary with most metals. Since iron and steel are the most common and least expensive of engineering metals, most of the study now being conducted centers about them.

Some metals tend to oxidize in any atmosphere, but most others are relatively stable unless the atmosphere is moist or contains salt, sulfur, or acid fumes and other harmful impurities. Thus, while a material might last for long periods in some dry mid-western area, that same material might disintegrate in a very short period in such a locality as Kearny, New Jersey, where the atmosphere is not only salt-laden from the ocean but also carries all types of corrosive industrial fumes. Since it is seldom known where a product will eventually be used, manufacturers must select materials that will survive in all but the worst extremes of climate.

CO-OPERATIVE TESTS RUN — Typical of the extensiveness of corrosion studies being carried out by industry are those run at the test station at Kure Beach, North Carolina. This station is maintained jointly by the International Nickel Company and the Magnesium Division of Dow Chemical Company. Other active co-operators in the project are Carnegie-Illinois Steel Corporation, American Rolling Mill Company, and Union Carbide and Carbon Company. Producers of many materials other than metals send their products here to be tested to learn how marine atmospheres affect them. At this particular test station more than 15,000 specimens of various metals and alloys are exposed to marine atmospheres, while another 2000 pieces are immersed in sea water.

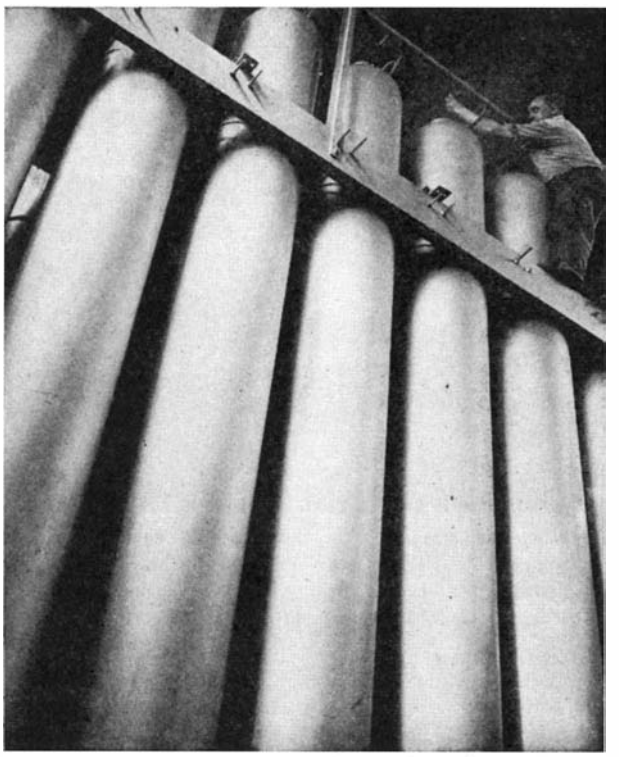
The Permat piano action, made of magnesium, plastics, and other water-resistant materials, is said to withstand destructive humidity



Most compositions to be tested are represented by 16 samples. Two specimens of each are removed after exposure for six months, two more after 18 months, and four more after 42 months. After 7½ years four more specimens will be taken in for study, and the remaining pieces will continue to be exposed for a full fifteen year period.

When specimens are taken off the test racks, they are studied to see the visible effects of exposure. After their appearance has been noted, the samples are cleaned and then weighed and measured to determine the weight-loss through rust, and to learn the rate of corrosion penetration. Finally, the specimens are given physical tests to determine changes in tensile strength.

Although most of the knowledge gained through corrosion studies is primarily of interest to corrosion engineers, considerable information of immediate interest to the consuming public has been unearthed. For instance, it is now possible to estimate, after six month's exposure, how long a steel or iron can survive in the atmosphere to which it is exposed. The studies show that corrosion-resistant metals and alloys corrode rapidly for the first few weeks of exposure and after that period rusting takes place very slowly. Major changes in color and weight occur in the early months and many samples appear to be much the same after exposure for six years as they did after only six months.



Strong, clean, non-corrosive stainless steel is ideal for use in these nitrogen and argon gas tanks at Westinghouse's lamp manufacturing plant

VARIATIONS IN STAINLESS — As might be expected, the stainless steels show corrosion resistance superior to other steels, but there is considerable variance within the stainless group. Those stainless steels having more than 14 percent chromium stain rather than rust. Several grades show remarkably little staining and pitting even after exposure to salt air for considerable periods. Types 310 (25 percent nickel, 20 percent chromium) and 316 (16 percent chromium, 12 percent nickel, and 2 percent molybdenum) are the most resistant. Nitriding of stainless steels seems to reduce their resistance to corrosion.

Copper appears to be the most powerful element for improving the corrosion resistance of steels, especially when used in small quantities. Ordinary steels are helped immensely by the addition of about 0.05 percent copper. Little further improvement comes from increasing the copper content unless the copper is combined with some other element such as nickel. Among the other principal alloying elements the following effects are noted: Manganese, slightly beneficial; silicon, strongly favorable in conjunction with other elements; nickel, uniformly beneficial effect roughly proportional to the nickel content; chromium, similar to nickel, with those steels having 13 percent or more of chromium showing practically no weight loss through corrosion.

Results of the tests show that the position in which the iron or steel is used has considerable bearing on how fast it corrodes. While most of the damp atmospheres would be expected to condense on the top surfaces of exposed metals, most of the rusting on the test pieces at Kure Beach took place on the under surfaces at roughly a 60/40 ratio. The action of rain and sun in washing and drying the top surfaces apparently slows corrosive action on such surfaces.

In addition to bare metal samples, exposed specimens include those protected with a variety of coatings, both metallic and non-metallic. For steel, aluminum varnishes and zinc-dust paints seem to be most satisfactory. Vinyl coatings are standing up better than phenolics. A new type of metal combination—aluminum dip-coated steel—produced by hot-dipping steel strip and sheet gives promise of highly satisfactory service life. However, the tests seem to indicate that the most economical and long-lived method of coating steel is still galvanizing. The only really satisfactory metal-spray coatings appear to be aluminum, zinc, and lead.

Tests at Kure Beach have done much to prove the contention of magnesium producers that magnesium alloys, properly used, present no corrosion problem. Test specimens exposed for many years on racks only 80 feet from the Atlantic Ocean are still in satisfactory condition. Magnesium samples include rolled, extruded, and die-cast alloys. Bare samples as well as those with various coatings are on the test racks. Most of the magnesium alloys have resisted heavy salt atmosphere attacks with only minor surface pitting and etching.

BOLTED, RIVETED JOINTS — Since most of the corrosion problems in connection with the use of magnesium alloys are due to galvanic action, tests are carried on with various joints and bolted and riveted assemblies. Because the working characteristics of magnesium alloys are such that they cannot be used for rivets, various aluminum alloys have been tried. Both service tests and tests such as these at Kure Beach prove that 56S aluminum rivets are most suited to use with magnesium and thus are universally recommended, replacing the 17S aluminum

With non-corroding aluminum used in such engines, railroads are able to achieve light-weight construction, reduced maintenance, and a lasting bright appearance

alloy rivets formerly used. When bolted assemblies are required and are to be used in damp, corrosive atmospheres, cadmium-plated steel bolts are satisfactory if 52S aluminum alloy washers are used as insulation. Stress-corrosion cracking in welded magnesium-alloy structures can be avoided by stress-relieving treatments; consequently such treatments are now advised for all magnesium welds.

Several copper alloys are being tested both in salt atmospheres and in sea water. Outstanding observations thus far indicate that the tin in Navy "G" bronze can be replaced by nickel without significant loss of either corrosion resistance or mechanical properties, and that pure copper resists action of still sea water better than it does fast moving sea water. (The opposite result was noted with Types 310 and 316 stainless steel.)

Knowledge gained by such studies as those at Kure Beach has led to development of a cupro-nickel which contains only 10 percent of nickel, instead of the usual 20 percent, plus 0.8 percent iron. This material is as low in cost as naval brass and has the added advantage of not being subject to dezincification. For condenser tube service this newly developed material is fully as satisfactory as the traditional 80/20 cupro-nickel.

Such research as has been described is already resulting in metal products that will survive everyday usage much longer than was formerly possible.

Here are some of the things resulting from such research: automotive bright-work, such as bumpers and decorative strip, can now be plated with the correct type and thickness of plating to prevent it from being marred by rust spots after only one or two years of service. Those who are driving pre-war automobiles can appreciate what this will mean. Those searching for extremely long-lasting metal window screening material can have it now through an alloy of stainless steel and molybdenum; outdoor lighting reflectors, searchlights, and metal mirrors can now be made to retain their brightness and reflectivity for many years with little or no care; home plumbing that can withstand a lifetime of service is now possible. Although these materials are now actualities, their cost is such that they may not be widely used for some time, but investigation is continuing to either produce the materials more economically or extend their uses so that volume production will bring the cost down.

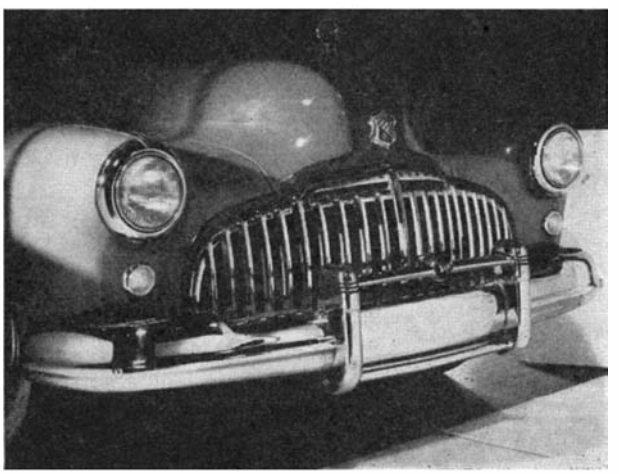
• LOOKING AHEAD •

Chromium plate resisting rust-spotting even after prolonged exposure to moisture. . . Plumbing which lasts a life-time . . . Understanding of corrosion enabling the selection of the most suitable metals for the job. . . More effective corrosion preventives. . . Corrosion ceasing to be a major problem.

Industry can save untold thousands of dollars every year by selecting those materials which provide highest corrosion resistance per dollar of material cost. Although stainless steel and special alloys are best in the matter of corrosion resistance, they might be too expensive to apply generally. Thus, through test data, the so-called high-strength, low-alloy steels might be shown to be quite adequate. The railroads have found this latter group of steels highly satisfactory for such uses as hopper cars, since they combine their anti-rusting qualities with high strength characteristics to provide greater pay-load capacities.

The Kure Beach project serves to demonstrate how producers of competitive materials can co-operate for their common good. Here competitors work hand in hand to learn more about corrosion so that all of their materials will be applied in the best possible way.

To provide sure protection against corrosion, grilles of some makes of automobiles are capped with stainless steel, which is then further protected by chromium plating



ELECTRONS GUIDE THE CUTTING TORCH

A Photoelectric Tracer, "Reading" Directly From an Inexpensive Drawing, Controls the Oxyacetylene Torch to Cut From Any Pattern

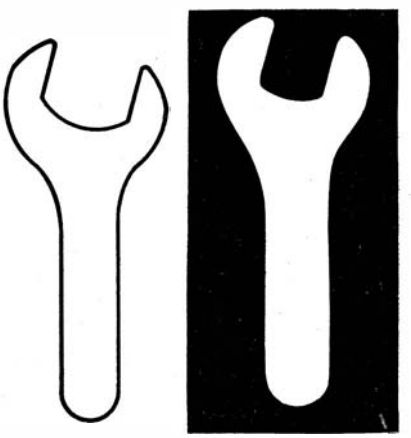
By T. H. Ayling
Technical Sales Division
Air Reduction Sales Company

ELECTRONICS, whose application to countless industrial processes has spelled higher production, greater accuracy, and greater safety, has now entered the field of oxygen torch cutting, making possible human-eye versatility combined with mechanical precision. A photoelectric tracer which "reads" from a template drawing, controls the cutting torch through a pantograph, faithfully reproducing the original pattern.

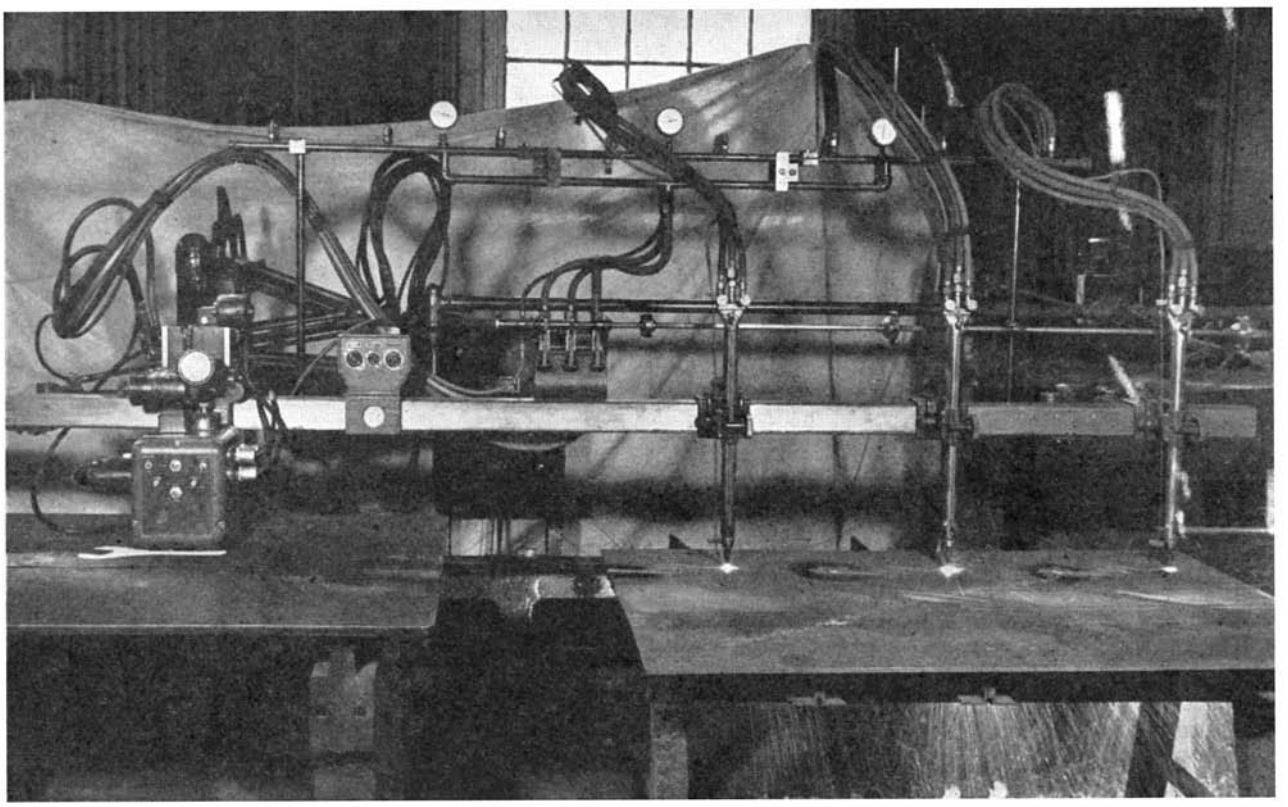
The oxyacetylene cutting torch was originally guided by hand, but over a period of years the torch itself has been so improved and refined that it has become far more reliable and accurate than the hand which controls it.

To take full advantage of the accuracy of which the cutting torch is now capable, machines have been developed in which the torch is guided by a precision-made track to cut straight lines. Or a radius rod can serve as a guide if precise arcs or circles are to be cut.

For simple irregular shapes, torches are mounted on pantographs. By means of the pantograph, the torch is made to follow a path identical to that of a



Torches, mounted on a pantograph, are guided by an electronic tracer (below) that "reads" from a template drawing. The template may be either a line drawing or a silhouette (right)



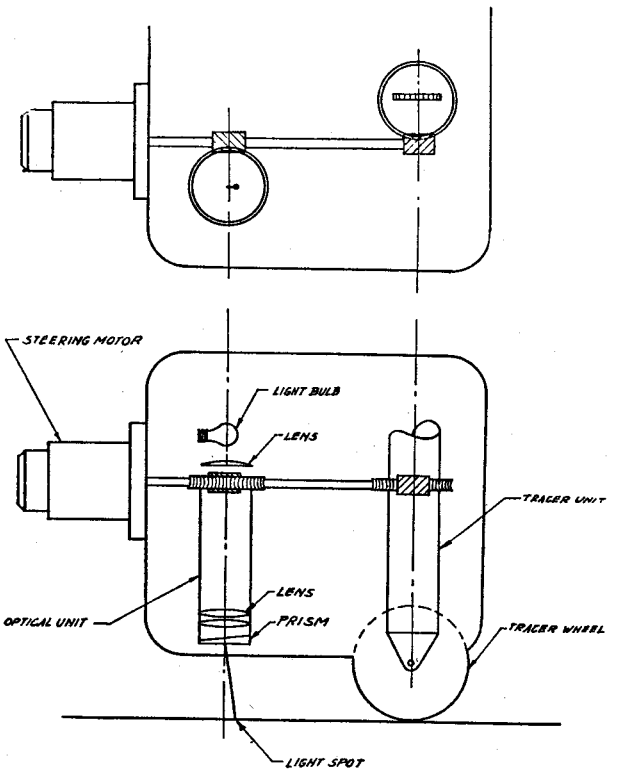
tracing mechanism as it moves along the line of a drawing, or follows the contours of a solid template. When drawings are used as guiding templates, tracing can be accomplished by a wheel which rides on the drawing and is directed over the lines by hand. When greater cutting accuracy is required than can be obtained by the human hand, solid templates can be made and the tracing device designed to follow the template contours through appropriate followers. One common type of template tracer uses a steel template followed by a magnetic spindle. The magnetized spindle clings to the template surface and is rotated to drive it along the template face.

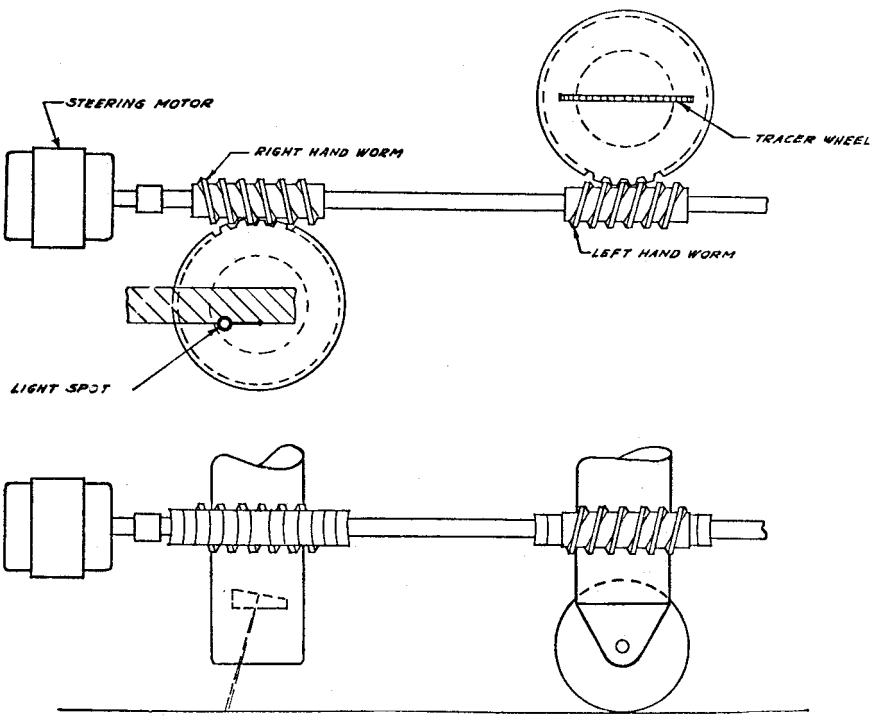
For the reproduction of complicated shapes, however, template design often presents considerable difficulty. Close-tolerance cutting demands that the guiding surfaces be accurately machined. Designing and producing steel templates for oxyacetylene cutting is often expensive and time-consuming work. When only one or just a few shapes are to be cut, the savings in cost which are made possible by the cutting method itself can be more than eaten up by the cost of the template. Even when template cost is negligible because of the quantity of reproductions to be made, a shop can spend a great deal of money for them over a period of time. And what is perhaps more important there are contours for which it is impractical to make steel templates.

The electronic tracer has greatly widened the practical field of machine gas cutting, not only by greatly simplifying the template problem, but by extending the limits to include work for which it is impractical or impossible to manufacture proper steel templates.

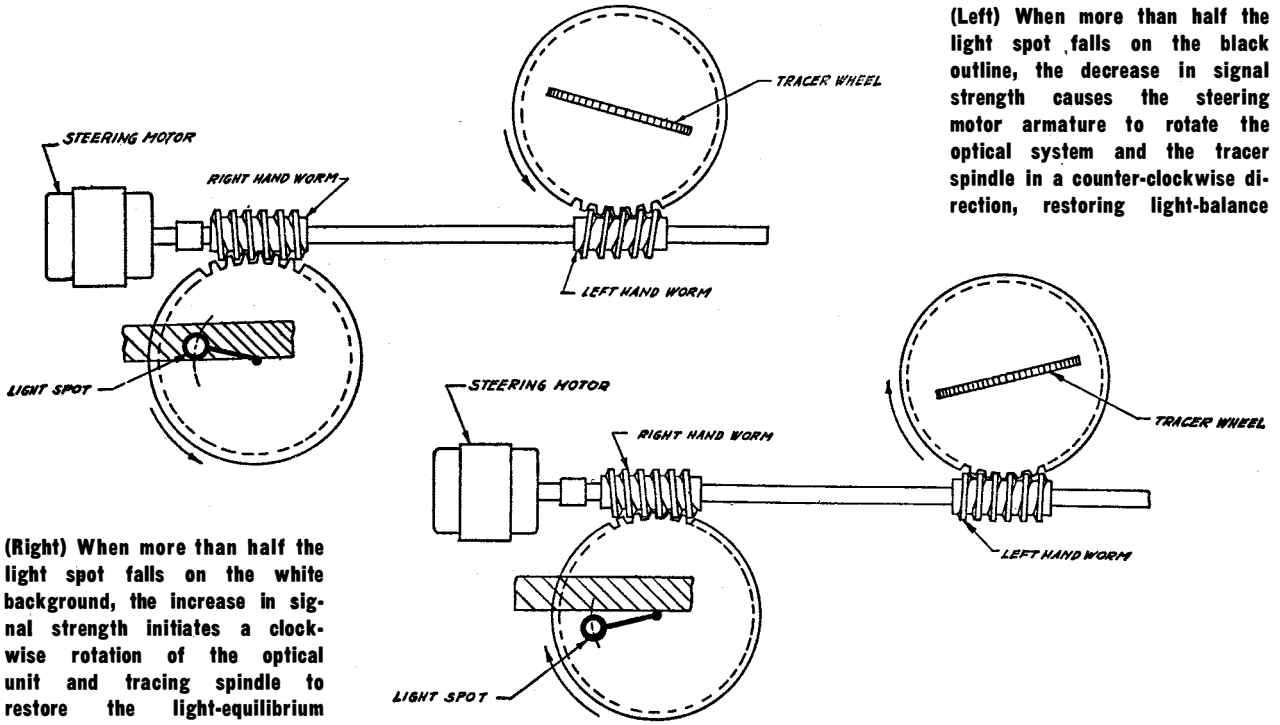
PHOTOTUBE GUIDES PANTOGRAPH — A tracer for oxyacetylene cutting performs two functions: It controls the speed of the cutting torch, and it directs torch movement. With the electronic tracer, the speed is controlled in the same way as it is controlled with the hand-guided tracer; namely, by adjustment of the speed of a motor which operates a driving wheel. The direction of the motion is controlled by photoelectric tubes which "read" a drawing or a silhouette to guide the pantograph.

To "read" the drawing, the photoelectric system picks up reflected light from a light spot which is directed onto the drawing. Using this reflected light, the electronic system directs the light spot to follow the outlines of the drawing, and thus directs the tracer around the contour of the template.





Schematic drawing (above) shows arrangement of optical system, tracer spindle, steering motor, and worm gear drive in tracing head. Note that light is deflected approximately 3/32 inch from center of optical unit. Sketch (left) shows operation of tracing head when following straight line. With the light spot centered half on white and half on dark background, no rotation of the steering motor armature takes place



(Left) When more than half the light spot falls on the black outline, the decrease in signal strength causes the steering motor armature to rotate the optical system and the tracer spindle in a counter-clockwise direction, restoring light-balance

(Right) When more than half the light spot falls on the white background, the increase in signal strength initiates a clockwise rotation of the optical unit and tracing spindle to restore the light-equilibrium

• LOOKING AHEAD •

Expensive, time-consuming machined templates eliminated . . . Range of shapes economically possible by oxyacetylene cutting greatly broadened.

The actual steering is done by a steering motor which operates to change the direction of the driving wheel's progress. The action of this motor is governed by the photoelectric system whose operation is directed by the intensity of light which it receives. When the light-intensity received becomes less, the system acts to operate the motor to steer the driving wheel and move the tracer in one direction—say, to the right. When the intensity becomes greater, the system will operate the motor to steer the tracer in the opposite direction—say, to the left. When the intensity of the light received by the photoelectric system reaches the point at which the system is in balance, the mechanism is inactive, the motor is inoperative, and the tracer will continue moving in one direction until the light-intensity is again changed.

If the surface from which the light is reflected is dark-colored, comparatively little light will be reflected. Much more light will be returned by a light-colored surface. Thus, if the spot of light from the tracer falls partly on a dark surface and partly on a light surface, the intensity of the reflected light can be varied by shifting the spot to fall more on the dark or more on the light surface. The operation of the electronic tracer is the continuous positioning of its projected light spot on the intersection of dark and light areas so that the intensity of the reflected light will be such as to balance the photoelectric system.

When the light spot is directed onto the line of a drawing or onto the edge of a silhouette whose color is in contrast to the background, the electronic system will act continuously to position the light spot partly on the outline and partly on the background, seeking to adjust the intensity of received light to balance the photoelectric system. This continuous searching of the electric eye for the contours or lines of the pattern beneath it enables the tracer to follow easily prepared drawings or silhouette templates.

INEXPENSIVE TEMPLATE PATTERNS — The template drawing may be a blueprint or a tracing or an original drawing or it may be a simple solid outline on a background of contrasting color. In any case, the pattern can be quickly and cheaply prepared and may be easily filed in a small space for future reference.

The light which actuates the electronic system originates in a lamp in the tracer itself. It is directed onto the template-drawing on a tracing table under the tracer, and is reflected to the photoelectric system.

The lamp sends its light through an optical system which is mounted so that it is free to rotate about a vertical axis, and it is so designed that the light is directed from it at an angle. The spot of light which is projected on to the tracing table is thus free to "search" in a circle. The optical system is geared directly to the steering motor on the same shaft which steers the driving wheel.

The electronic tracer can work to very close tolerances and, through its use, shapes can be reproduced by oxyacetylene cutting for which steel templates might be very costly or practically impossible to make.

BAKING UNDER THE MICROSCOPE

Taken Through the Microscope, a Full Color Motion Picture of a Paper-Thin Cake Being Baked in a Miniature Oven Reveals Secrets Which Spell the Difference Between Baking Success or Failure

By Sara H. Carleton

FEW INDEED are the industries which have been left untouched by the camera and the microscope. These instruments, combined in photomicroscopy, have made possible better products and fuller understanding of their true natures in nearly every branch of industry. And the field of baking is no exception.

Through cinema photomicroscopy and an ingenius process dubbed "micro-baking," knowledge of the manner in which the various ingredients of a batter combine during baking is being gathered, which should ultimately make possible higher quality baked products, and remove the elements of chance and guesswork from both commercial and domestic baking.

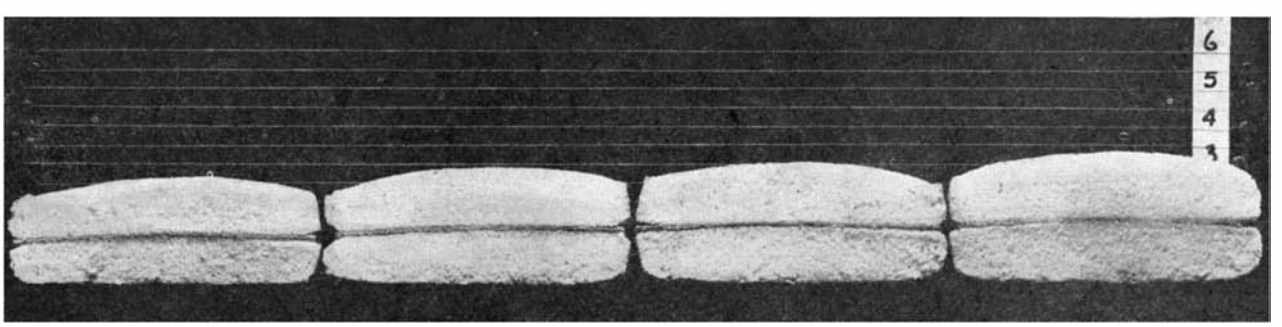
A full-color motion picture, taken through a microscope, of a paper-thin cake being baked in an oven of Lilliputian dimensions, has recorded heretofore unknown facts which explain what factors determine the desirable and undesirable qualities of a cake. The film offers the key to consistently successful baking.

Micro-baking represents the first attempt to study scientifically the functions of the basic materials used in baking a cake. So far, the work has no more than got off to a good start. How long it will be before these investigations will pay off in faultless baked products of increased nutritive value is a matter of speculation. It will depend largely upon the rapidity with which manufacturers fall into line, and carry on further investigation of a similar nature. Photographing the actual baking process is only one aspect of the possibilities for future scientific study. A separate analysis of each ingredient that goes into a bakery product and what happens to it under varying conditions is required in order to learn how to improve each product accordingly.

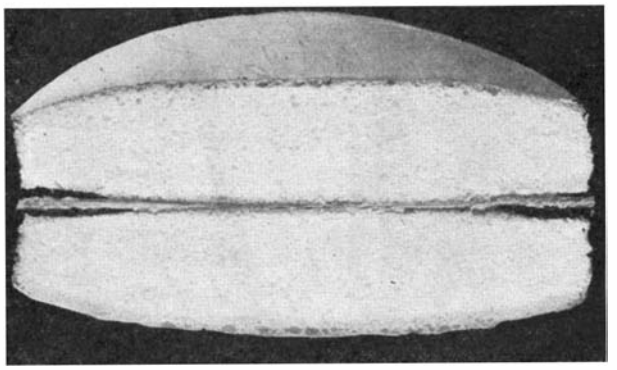
The cake-baking movie film has already been shown at bakers conventions, to women's clubs and homemakers groups, and has been used extensively in the home economics departments of a number of colleges. Hunter College in New York has run it a half dozen times.

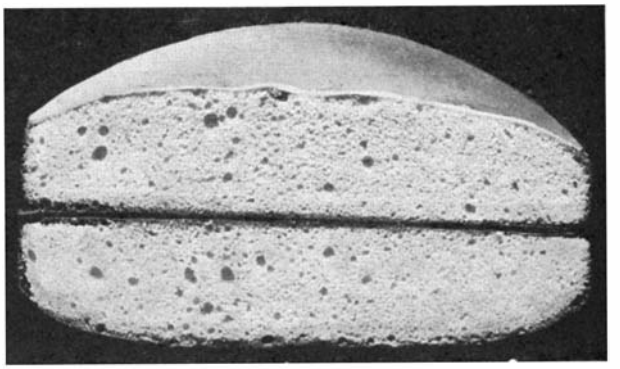
INCENTIVE FOR FURTHER STUDY — While the results of the first experimental film are not yet conclusive, and while they are important only in so far as they serve as an incentive for large baking concerns and manufacturers of the products used in every-day cooking to delve into the matter more deeply, micro-baking under the watchful eye of the camera is significant because it sets an advanced standard for research.

Although Americans have won a reputation for being lovers of good food, progress in the science of cooking has been slow. It may not seem so with the millions of dollars that have been spent on the scientific studies of various food products in the laboratories since the discovery of vitamins, or with the electrical gadgets and modern devices that facilitate the preparation of meals, or with the new methods of processing foods to preserve their vitamin and mineral content. Yet, in spite of these innova-



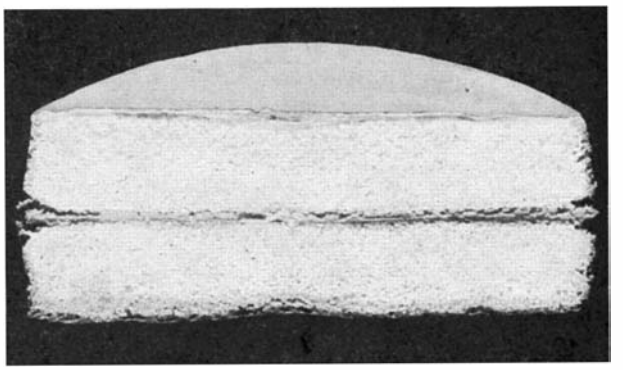
Four cakes baked with same amount of ingredients. Cake at right was made with a shortening that coated each air cell evenly





All pictures courtesy Swift and Company

Cake (above) made with normal batter. Tough cake with large holes and tunnels (top right) lacked shortening. Made with too much sugar (lower right), cake was too weak to support self



• LOOKING AHEAD •

Photomicroscopy applied to many other phases of food study. . . New knowledge of reactions formerly used empirically. . . Techniques evolved for employing photography in research aimed at improving accepted but still inefficient processes.

tions, our knowledge of the culinary art has been derived not so much through scientific fact as from the experience passed on from one generation to the next.

Some improvements in the baked goods on the market have taken place within the last ten years, due to the constant efforts of the baking industry, notwithstanding sugar shortages and other war-time handicaps. These advances, however, have been brought about, for the most part, through the efforts of one baker attempting to match another in putting out a superior product.

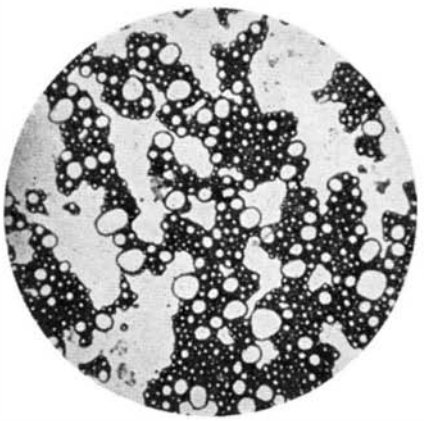
With micro-baking and its attendant movie film, these improvements will be extended still further, and guesswork that has gone into baking will, if the hopes of scientists are fully realized, be largely eliminated. Bakers will gain an understanding of the difficulties they encounter every day. And consumers will look forward to receiving increased dollar value, while each piece of baked goods will be uniformly as near perfect as any other. Improvements of the various ingredients utilized will also work as a means toward product control.

PRODUCTION BROUGHT PROBLEMS — Producing a full-color motion picture whose basic purpose was to reveal with microscopic detail the inside story of the baking of a cake presented problems of no mean proportions. First, in order to photograph the inside structure of a cake, it was necessary to use a batter that was sufficiently thin to transmit light readily. After considerable experimentation, a batter was formulated which formed a layer on the "pan" no thicker than a sheet of ordinary tissue paper. The baking "pan" also presented considerable difficulty. A piece of glass, not quite as thick as regular window glass, was finally selected. Another serious headache was the oven. It had to develop enough heat to bake the batter, and yet be small enough to fit on the stage of the 250-power microscope. A thin piece of insulating material, through whose length a hole was drilled, was found to serve the purpose. A length of resistance wire placed in hole served as a heating element. The entire oven when complete was no more than a half inch in height.

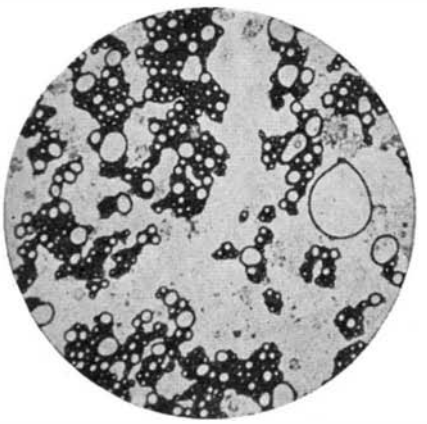
In order to expose the color film properly, a light of very high intensity was required. This was supplied by a powerful carbon arc lamp. Then the motion picture camera was attached to the microscope to record the reactions during the baking. In all, it was a year before all the difficulties involved in such a set up were ironed out.

As the experiment progressed, new problems were met. It was difficult to identify the ingredients in the cake. To overcome this, the shortening was colored red with an oil-soluble dye which would not affect the color of the water component. Flour was dyed purple by adding a small amount of iodine. It was unnecessary to color the sugar and baking powder as these ingredients quickly dissolved into the liquid. When their solution was complete they were no longer distinguishable through the microscope.

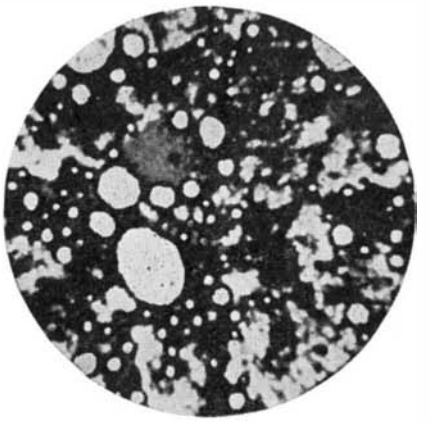
PARTICLES MOVE — As the baking on the little glass slide of the oven commenced, each little particle, each air cell, each unit of flour, each shortening pool —everything that was visible through the microscope—began to move. There was an increased rush



Normal batter under microscope



Lack of fat—too few air cells



Too much sugar—framework weak

of activity as the heat inside the cake increased. Air bubbles collided, and some broke open as the baking progressed.

One of the important factors brought out through the microscopic study was that the air cells were found only in the shortening, and in no other portion of the batter. It was further revealed that the gas which was given off by the baking powder was not visible through the microscope. It was apparently dissolved by the water of the batter and then discharged into the air cells which had been creamed into the batter with the shortening. These cells puffed up like tiny balloons during the baking.

When the baking was almost finished, every tiny particle was rushing around violently but, as the cake began to set, the movement subsided. While the particles were in motion, each one appeared to follow an upward sweep, just as air tends to rise from a hot radiator across the ceiling of a room. As the cake assumed a rigid structure, hundreds of air cells within the batter began to explode. This took place when the movement of the various particles ceased, and was what formed the texture of the cake.

An interesting method was employed in testing the cake to tell when it was done. Here the housewives' favorite "broom-straw" test naturally could not be applied. The cake-baking scientists were aware that each grain of wheat-flour starch appears to be marked by a cross if it is observed under polarized light. So they reasoned that by watching the cake under polarized light they could tell exactly when it was done, for at this point the cross marking the wheat starch would disappear completely.

At the final stage of the cake baking, wholly unexpected color effects could be observed, as though a motion picture producer of the microscopic world had arranged a grand finale. When polarized light was brought into the experiment, sugar crystals took on all the shades of the rainbow. As they rotated in the light, they sparkled as brilliantly as diamonds.

BAKERS GAIN INSIGHT — Through micro-baking the baking industry has gained an insight into its science that was not possible before the film was produced. Bakers have learned that little things make a big difference in striving for better products. As an example, they have learned that only slight differences in the shortening will make a big difference in the quality, volume, and texture of the cake when it is done. The volume of the finished product is dependent on the ability of the shortening to take up air. If too little fat is used the air cells are unevenly dispersed throughout the batter.

In the second place, the film has taught bakers a considerable amount about formula balance. They have found out why a tough cake has large holes and tunnels running through it, and why a tender cake falls in the oven—not, as many suppose, because the oven door was slammed; when too much sugar is used, the air cells move faster than they should, weakening the framework of the cake. Micro-baking has also revealed what determines good flour, and why some cakes are heavy.

WHY CAKE WAS CHOSEN — In carrying on the the original experiments and photographing the results through a microscope, a cake was chosen as the subject of the investigation because in the baking of cakes a greater chemical reaction occurs than in other types of food. Technicians have, however, already commenced studies of bread dough, and it is expected that more of these will be made, as well as examinations of the ingredients of pies and cookies.

In addition to aiding the commercial baker, micro-baking will prove an asset to those who take pride in baking in their own kitchens, for with superior grades of flour, sugar, shortening, and other materials, superior cakes and pies of their own making will grace their tables.

Unfortunately, the equipment necessary for carrying on research in micro-baking is expensive. While it is expected that larger bakeries will shortly acquire their own photomicrographic equipment, it is likely to be some time before the majority will be able to do so and gain first hand knowledge on the subject.

So, while progress along this line may be slow, the first steps have been taken, a sound groundwork laid, standards and operating procedures established. Baked products will be better for the knowledge already gained, and steady improvements will be noted as further investigations are pressed forward.

With what has been accomplished through cinema photomicroscopy in the field of baking as an incentive, other branches of foods preparation, handling, and production can be expected to adopt techniques comparable to micro-baking to yield uniformly better tasting, more nutritious foods of all types.

SCIENTIFIC AMERICAN'S Industrial Digest

MOCK-UPS OF BUILDINGS

Aid Laymen in Visualizing Projected Construction

"SEEING is believing," and modern architects and contractors are now making this adage serve their clients by the use of what are known in the industry as "mock-ups"—full scale models of sections or features of the planned building.

In its work on the $6,000,000 Harvey S. Firestone Memorial Library, now under construction at Princeton University, the Turner Construction Company built several mock-ups at the suggestion and under the supervision of the architects, Robert B. O'Connor and Walter H. Kilham, Jr. The success of these models in interpreting construction features to the laymen who are concerned with the building proved that one mock-up is worth many words and blue prints.

Basic areas in the planning of the Firestone Library, which will be the largest open stack library ever built, are the 18 by 24 foot bays, adaptable to stack, study, or seminar use. In order to determine the most satisfactory ceiling height, lighting arrangement, and equipment, the construction company, under the direction of the architects, built four model bays in the Princeton riding hall. Ceilings of two of the bays were attached to pulley arrangements so that the effect of various heights might be tried out.

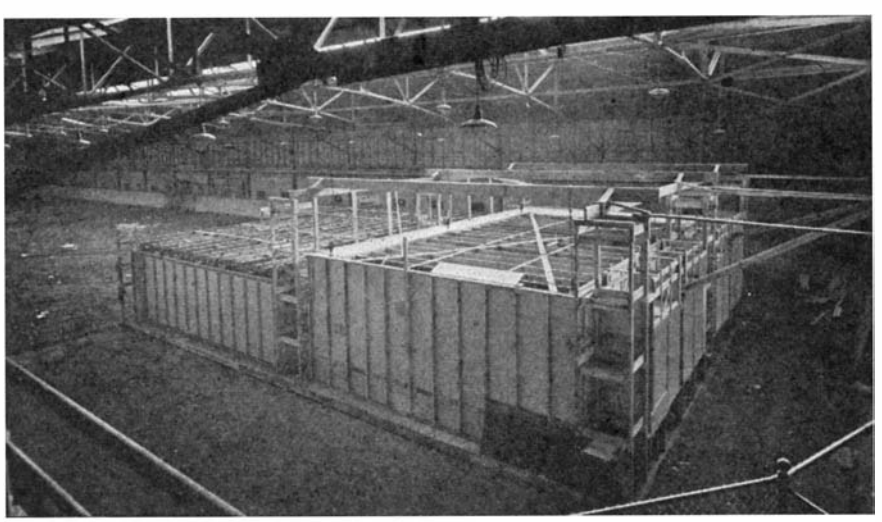
Incandescent lighting was installed in one bay and fluorescent in another. Members of the University's Coöperative Committee on Library Building Plans tested the two systems and a decision was reached on the basis of their recommendations.

The library is to contain more than 650 individual study cubicles or carrels for student use. Five such carrels were installed in the mock-ups and various types of lighting were demonstrated in actual use. Other equipment such as book stacks were also tried out in the full size model bays.

Working models not only succeeded in making architectural plans three dimensional and easily understood by the laymen directly concerned with planning and use of the library, but resulted in general agreement between professionals and laymen on details of construction. In deciding, for instance, on the height of the ceiling, lay consultants agreed on a height of eight feet four inches which closely paralleled the recommendations of technical experts.

The mock-up principle was also applied to the exterior of the Princeton library building. Several patterns of stone work were under consideration for the outside walls of the building. It is difficult to look at samples of rock and visualize their appearance in a wall, so the Turner Construction Company built three wall sections about six feet high, side by side, and of different types. It was then possible to compare the styles of masonry and type of materials and reach a satisfactory decision.

"Mock-ups are proving to be of great value on large scale production projects," say officials of the Turner Construction Company. "The small additional cost is easily offset by preventing a client's possible dissatisfaction resulting from the difficulty of visualizing, from blue prints and descriptions, the installations as they will actually appear."



Movable ceilings in two right-hand models permit testing various ceiling-heights

IMPROVED CATALYSTS

Developed By Electro-Magnetic Process

THE CHEMICAL industries spend fantastic sums in making, replacing, and improving catalysts which make possible the economical manufacture of gasoline, fertilizers, plastics, drugs, and many other products. A new magnetic technique for designing still more efficient catalysts promises wide-spread savings in time and money.

Developed at Northwestern University, the new process has already yielded better catalysts for several applications, and it is possible that it will divulge at least a partial answer to the old problem of "how does a catalyst work." This same technique is also being applied to the study of high polymers, such as plastics and rubber, and to cellulose. It enables chemists to tell to what extent certain groups of molecules are arranged in an orderly fashion.

In using the magentic technique, a sample of the catalyst to be tested is chilled in liquid nitrogen and then suspended by a thin quartz fiber between the poles of a powerful electro-magnet. Under the influence of the magnet, the catalyst turns slightly. Changing the angle

at which the catalyst is suspended, the chemist performs the experiment several times, each time observing the amount of twist due to magnetic attraction.—*H.C.E.J.*

JET THRUST AUGMENTED

By Burning Fuel in Engine's Exhaust Stream

INSTALLED downstream from the turbine of a conventional jet engine, a device called an "after burner" can add more than one third to the power plant's normal propulsive thrust, giving added power for take-off, during combat conditions, and on all occasions where extra speed are required. This is accomplished by spraying fuel into the tail-pipe where its combustion adds mass and velocity to the gases of the jet stream.

This after burner, developed by the Ryan Aeronautical Company, is in effect a ram-jet engine attached to a turbo-jet. The after burner application is simpler than the ram-jet, however, because the inlet velocities, pressures, and temperatures are higher. Since the ram-jet depends solely on its speed to compress the air rushing in its nose, it has to be launched by rockets to attain the initial 500 mile-an-hour speed required for it to operate effectively. But with the after burner, the speed of the air stream in the tail-pipe is well above that needed to make the ram-jet operate, so that the use of the basic ram-jet configuration as a thrust-augmentation device is logical and easily accomplished.

Fuel consumption of the after burner at low speeds is high compared to the jet engine, but at very high speeds it is more economical of fuel than the turbo-jet.

One of the unique advantages of the use of an after burner with a turbo-jet engine is the fact that this method of augmenting thrust does not affect the operation of the turbo-jet by imposing additional stresses upon it. Since turbo-jet power plants are operating near the critical stress limits of the turbine components, the after burner is an especially desirable method for increasing thrust. This is not the case with water injection and most other methods which are employed to attain thrust augmentation.

With gasoline used as a fuel in an internal combustion engine, a fuel-air-mixture ratio of 1 to 16 is necessary to obtain complete combustion of the oxygen in the air which is sucked into the cylinders. In contrast, the turbo-jet engine operates at a fuel-air ratio of 1 to 50, and as a consequence there is a great deal of unburned oxygen in the jet stream. The quantity of this unburned oxygen, then, is the limiting factor in the amount of thrust augmentation which it is possible to attain.

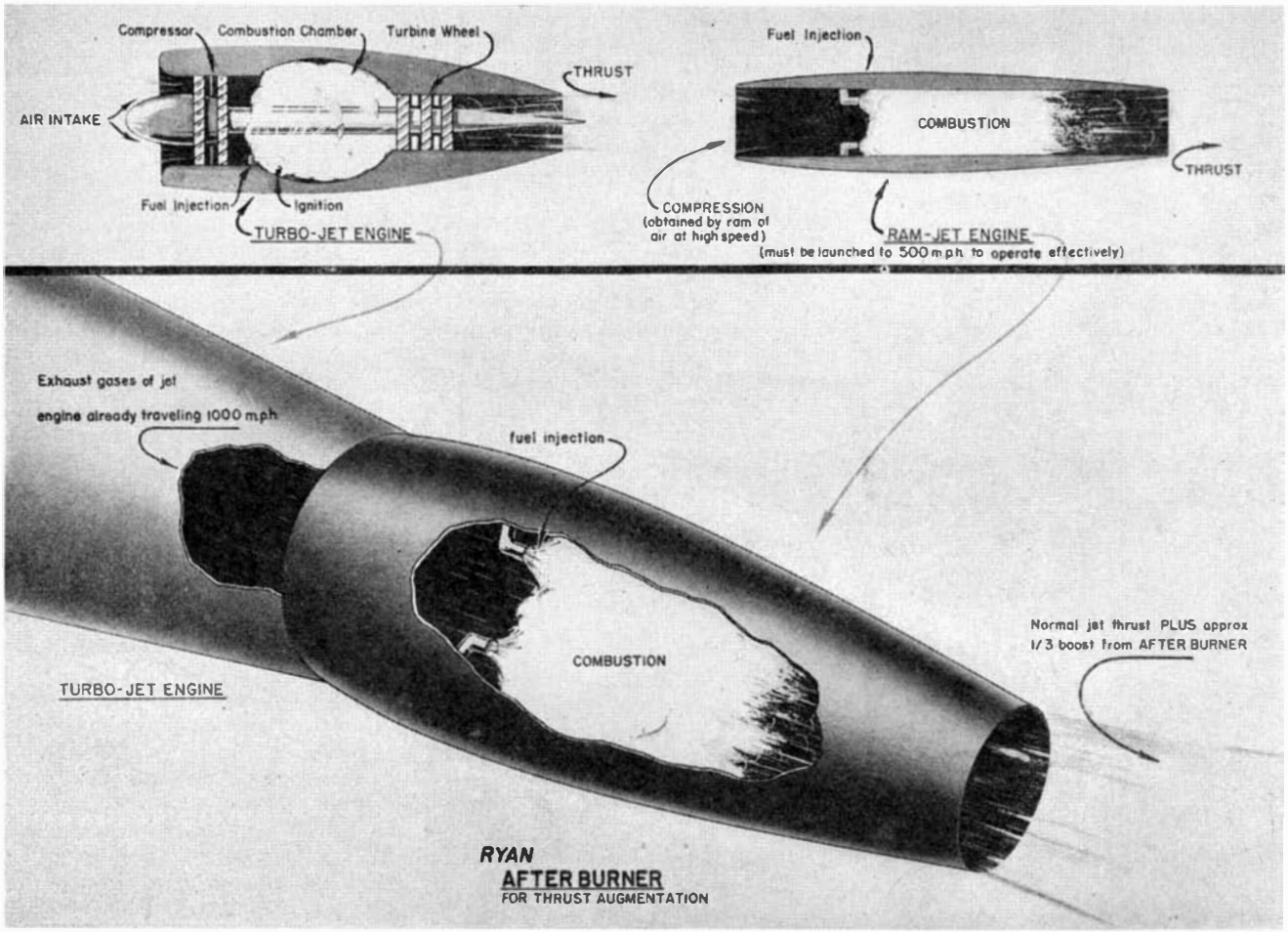
Unlike the turbo-jet, which is limited by the stresses imposed in the rotating turbine blades and temperature considerations, the after burner is a completely static mechanism and can be cooled below critical temperatures.

Essentially, the use of the after burner permits raising the fuel-air ratio of the combustible mixture to the limit of the chemistry of combustion, whereas the turbo-jet alone is limited by the physical requirements of the turbine blading.

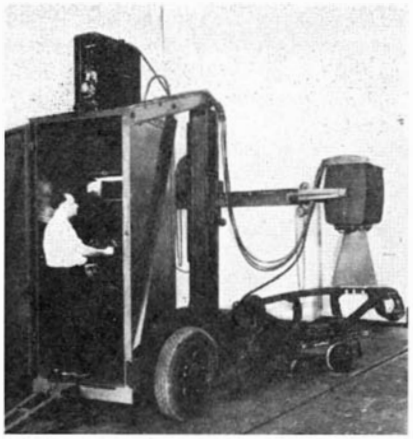
RAILROAD X-RAY

Checks Metal in Cars, Locomotives, Rails, for Internal Flaws

EMBODYING the most modern techniques for examining steel, aluminum, brass, and other metals used



Turbo-jet and ram-jet (above) are combined (below) for increased thrust



250,000-volt mobile X-ray unit checks a side frame for a freight car truck

in rails, locomotives, cars, and other equipment, a new X-ray laboratory assures increased safety of railroad operation. Thus technical progress in the field of radiographic testing of metals for internal flaws has been utilized by the Pennsylvania Railroad.

In the X-ray plant just opened, as an addition to the Pennsylvania Railroad Test Department, photographs are taken through metals to provide assurance against such internal defects as concealed cracks, imperfectly welded joints, cavities due to shrinkage of metal during cooling, and the like.

To use this new technique, a 250,000-volt mobile X-ray machine is mounted on automobile wheels so that it may be used either in the specially constructed laboratory building, or, when some very large object such as a locomotive boiler is to be examined, in the adjacent construction and repair shops. It can examine the internal structure of metals as much as three inches thick.

The laboratory building, equipped with 18-inch concrete walls to permit the use of X-ray equipment as powerful as 2,000,000 volts, includes a dark room for immediate development of X-ray photographs and equipment for projecting them for close examination by engineers skilled in detecting the slightest flaw depicted by the photographs.

MICROWAVE SPEED METER

Finds Vehicles' Speed by Measuring Shift of Wavelength

A SPEED meter, having numerous applications in traffic engineering studies, operates on the principle that a radio wave reflected from a moving target will shift its wavelength in proportion to the speed of movement of the target. Microwave energy is radiated from the antenna unit, a portion of the energy striking the surface of the vehicle and being reflected back to the unit. The direct and the reflected signals are received and mixed, and the output signal contains the difference of frequency, which is in direct proportion to the vehicle speed in miles per hour. This speed is read on the linear scale of the meter, calibrated in miles per hour.

The speed range of this instrument, developed by the Automatic Signal Division of Eastern Industries, Inc., is 0 to 100 miles per hour, accuracy being within 2 miles per hour throughout the range. A spring-wound graphic recorder furnishes a record of the speed of the moving vehicle.—*K.H.*

HOSES HANDLE MATERIALS

And May Replace Conveyor Belts in Many Uses

DURING the pre-war years, materials handling systems were hampered by the fact that metal pipes were comparatively rigid, rubber hoses were destroyed by oils or solvents, flexible metal hoses were limited in their wall strengths.

Synthetic rubbers with new and war tested fabrics and other wall strengthening materials have greatly increased the abilities of rubber hoses to meet those problems. Among the results are more uses of liquids as carriers so materials can be pumped through hoses, and more use of pneumatic carrier systems having readily positionable intake nozzles and outlets.

The changes which are being made in the handling of normally dusty and otherwise difficult materials point to the elimination of the conveyor belt and the adoption of the hose. But this does not mean any changes in the houses selling the devices. The same companies make both.—*E.L.C.*

HEAT-TUBE MATERIAL

Of Aluminum Alloys Resists Action of Corrosion

ALUMINUM and many of its alloys have several chemical characteristics that fit them for use in condenser and heat-exchanger tubes. A new alloy combination, Alclad 3S, which is resistant to localized attack, is now being successfully used for such purposes.

The new material, developed by the Aluminum Company of America, has a central core of 3S aluminum, with a coating of another aluminum alloy, 72S, on one or both sides of the 3S core, the coated surface being intimately and integrally bonded to the core over its entire surface. The coating is anodic to the core, so that if an area of Alclad 3S sheet is exposed to corrosive water that starts a pit in the sheet surface, once the pit has penetrated the coating, it will not extend deeper into the core, but will broaden out along and parallel to the surface.

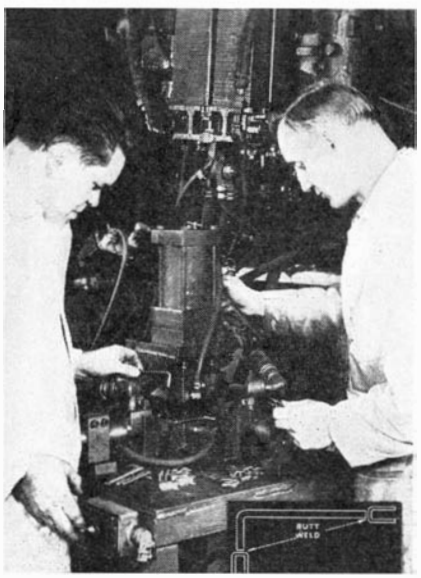
Over 250,000 Alclad 3S teakettles have been made and only five of these were reported as perforating over a four-year period. American Airlines found that fuel tanks made of Alclad 3S were still in good condition after 15,000 flying hours.

The cost of the Alclad 3S tubing per linear foot is about the same as that of seamless steel for tubes of smaller diameters, but is slightly higher for larger or heavier tubes. Aluminum alloy tubes have been used successfully in contact with cast iron or steel tube sheets, headers, or shells.—*F.P.P.*

CONVERTED PORTABLE WELDER

Uses Special Air Clamping Stationary Fixture

THE FLEXIBILITY with which resistance welding equipment can be adapted to specialized assembly problems in mass production is illustrated by a simple welding "machine" for assembling "universal" automotive radiator petcock wrenches. The machine was made up by converting standard portable spot-welding gun equipment to a stationary butt welding "machine" by use



Welds 150 wrenches per hour

of a special air clamping stationary fixture. With this, a production of 150 completed double-end petcock wrenches per hour was obtained.

The wrench consists of two U-shaped mild steel stampings of different sizes, welded one to each end of a bent steel rod. Simple air-clamping dies hold the shank of the wrench. The two jaws are dropped over specially formed electrodes of two standard hydraulic push guns mounted in place. The guns move the petcock wrench jaws up to the shank under welding pressure to form the series butt weld.

Clamping pressure is applied by means of an air cylinder controlled by an air valve mounted on the cylinder support where it is convenient to the operator. Balance of the equipment consists of standard 50 kilo-volt amperes portable gun welding transformer, a standard air-hydraulic booster to apply welding pressure, and a simple weld timer, mounted on a nearby wall to control the welding cycle. Electrodes, dies, cables, and transformers are all water-cooled.

The arrangement, devised by the Progressive Welder Company, lends itself to maximum operator-comfort with high productivity, an operator standing or being seated (it's just as easy either way) in front of each of the two guns. The operator at the right loads the wrench shank and one jaw, and works the air-clamp control. The operator at the left loads the other wrench jaw, initiates the welding cycle by pressing the palm switch, and unloads the completed wrench.

"COLDEST COLD" BATH

Employed in Research on Super-Cooled Metals

PRODUCTION of the coldest cold ever attained—less than one degree above absolute zero or about 458 degrees below zero on the ordinary Fahrenheit thermometer—will enable scientists to uncover new facts about the behavior of super-cooled metals and to find ways to make use of such frigid temperatures. Extremely low temperatures cause certain metals to behave in a strange manner, says Dr. Aaron Wexler, who is conducting these experiments at the Research Laboratories of Westinghouse Electric Corporation.

"If an electric current is set up in a ring of a certain type metal while it is immersed in a super-cooled liquid," says Dr. Wexler, "the current will continue to flow without loss even after the source of current is removed. This is because such a super-cooled ring will offer no resistance to the flow of current. The same ring at room temperature will resist the electrical flow and cause losses in the form of heat."

It would be theoretically possible to super-cool an electric transmission line so that there would be no loss of power from generator to user, Dr. Wexler says, but the cost of providing a constant source of refrigeration for the power lines makes this impractical.

Dr. Wexler produces his super-cold temperatures by changing gaseous helium to the liquid form, causing a drop of some 520 degrees, Fahrenheit. The helium gas, in ultra-pure form, is raised to a high pressure by passing it through a four-stage compressor system. This gas under high pressure then is put to work driving two piston engines, and in so doing gives up a large amount of its energy in the form of heat—thus cooling the gas.

The cold expanded gas is used to cool incoming high-pressure gas in a continuous process. Finally, a point is reached where the cold being produced inside the apparatus just balances the heat leaking into the system.

To get to the temperature of liquid helium—four degrees above absolute zero—a small portion of the high pressure gas, pre-cooled by gas from the engines, is expanded through a tiny opening. Temperatures a fraction above absolute zero can be obtained by pumping a vacuum above this liquid helium.

Dr. Aaron Wexler—super-cold specialist

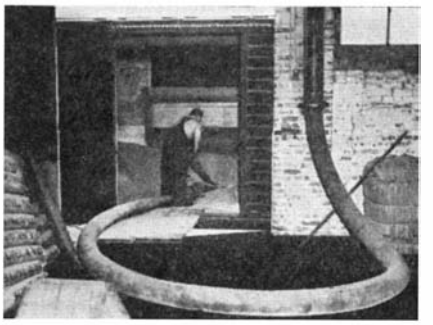
The liquid "cold" is bottled up in a five foot deep cylinder in the center of the apparatus. Metals to be studied can be lowered into the cylinder, which is carefully insulated to prevent heat from leaking in.

Liquid helium temperatures are too low to be measured by the ordinary thermometer. To find out how cold it is in the helium "bath," the Westinghouse scientist measures the pressure of the vapor above the helium. From this pressure reading the temperature can be calculated.

WHEAT-MOVING HOSE

Of Rubber, Last Longer Stays Cooler Than Metal Tube

RUBBER has long been known as a transportation medium in divergent fields one of the newest of which is



Unloading wheat through rubber hose

a rubber hose used to unload wheat by suction. The hose, made by The B. F. Goodrich Company, replaces a flexible metal tubing which broke frequently due to failure caused by the friction of the wheat. The metal tube was too hot to touch when the system was in operation, and was heavy and cumbersome.

A 35-foot length of six-inch diameter hose permits the grain to be transported at high velocity, the smooth lining producing less friction than the metal.

DRYING LUMBER

Accomplished by Extracting Moisture With Solvent

RECENTLY developed, a process for drying lumber saves time and gives a product which is lighter in color, less prone to warping, and, in the case of knotty wood, is easier to paint because the pitch is removed. Reported to be four times as fast as ordinary kiln-drying, the new method is based on the ability of a water-miscible solvent, such as acetone, to extract water from wood.

The lumber is stacked and bound in packages which are stood endwise in an extracting tank. There it is sprayed with solvent at the rate of 100 gallons per minute. The spent

solvent, together with water and organic extractives, goes to a reboiler, which sends part of the solvent back to the extractor and part to a still. In the still, the solvent is separated from the water and pitch, which are recovered as a partial emulsion. The organic materials, predominantly fatty acids (from sapwood) and resins (from heart wood) rise to the top and are decanted. Other by-products are turpentine and neutral fats.

Finally, the lumber is treated with superheated steam, bringing the acetone content down to about 0.2 percent of the weight of the wood. Drying to 3 percent water is possible but, commercially, 8 to 13 percent is practical.

Now in the pilot-plant stage at the Shevelin-Hixon Company mill, the new procedure was developed by Albert Hermann and A. B. Anderson of the Western Pine Association Laboratories.—*H.C.E.J.*

MOTORIZED HOISTS

Made Easier to Manage, Save Time, Promote Safety

FAMILIAR to the incidental handling of materials, positioning of heavy chucks, and moving of machines is the task of moving and mounting hoists. It usually takes two men and a block and falls to position a one-ton capacity motorized hoist for operation.

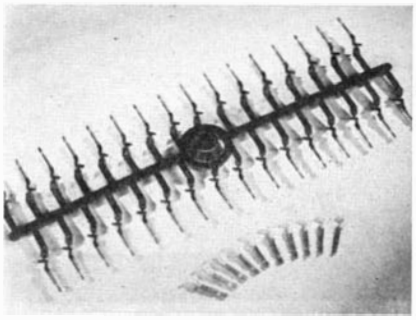
Following the modern trend toward lighter weight for the same strength, new motorized hoists are so light that one man can handle them. Saving of man-power hours and adding to the safety of handling the hoists are among the gains. But the principal gain reported by the users is that of encouraging the men to use hoists where they formerly used slower and more dangerous equipment.—*E.L.C.*

NYLON KNEE

For Phonograph Needle Is Said to Have Less Scratch, Longer Life

AN INTERESTING new use for nylon is in the "knee" of a phonograph needle put on the market by Webster-Chicago Corporation and Decca Records, Inc.

A number of nylon's outstanding characteristics are put to good account in this application. For example, the needle takes advantage of the pronounced internal resistance or self-damping characteristic of nylon to minimize mechanical



Groups of 32 knees are injection molded

resonance distortion such as needle scratch and surface noises, and to obtain improved tracking at high and low frequencies at reduced needle pressure. The nylon knee, molded by National Organ Supply Company, does this by absorbing vertical shocks caused by the pinch effect of record grooves and also levels out horizontal shocks of needle bounce.

The net result is improved reproduction quality, prolonged record life, and extended useful function of the hand-polished sapphire jewel tip, which is said to be good for as many as 15,000 playings.

The properties sought in the knee for this needle are listed below, all of which were met by nylon:

1. Very light weight, minimizing inertia of moving parts.
2. Resistance to fatigue and crystallization under service conditions.
3. Good mechanical strength and toughness.
4. Excellent elastic memory and recovery.
5. Good negative cold-flow characteristics.
6. Ability to be injection molded, in the interest of high production, as well as uniformity and stability.
7. Very high melting temperature.
8. Chemical stability and resistance to moisture.
9. Non-magnetic and non-electrostatic properties.

RADAR LIGHTHOUSE

Appears as Bright Point on Ship's Radar Screen

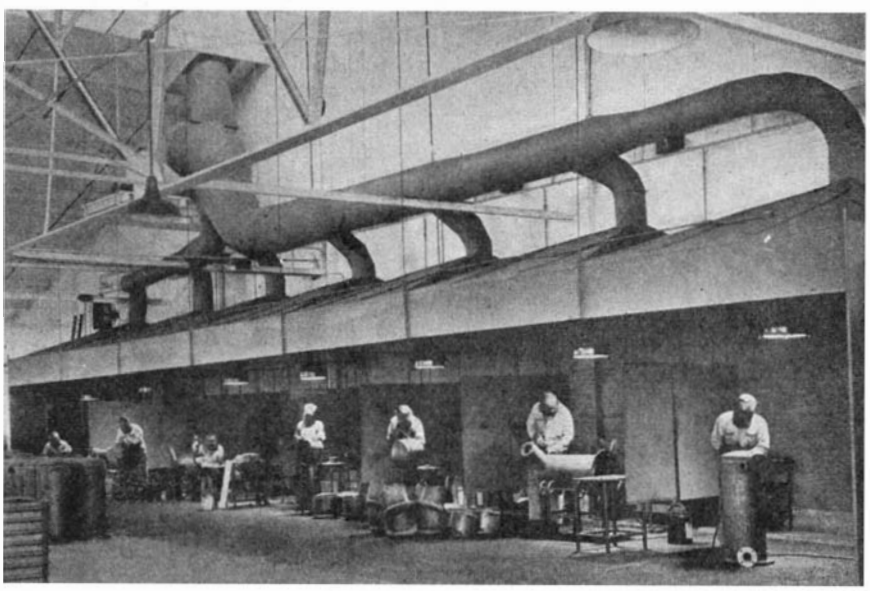
EMITTING signals which can be detected by radar-equipped ships, a small radar beacon for lighthouses has been built by the General Electric Company for the United States Coast Guard. The unit should prove useful during periods of fog, rain, snow, and sleet, when normal sight and sound warnings are limited.

The signal from the electronic beacon appears as a bright spot on the radar's cathode-ray tube, showing the exact direction of the beacon, in much the same way as the conventional lighthouse is located optically by the beam of light it emits. —*K.H.*

WELDING BOOTHS

With Individual Exhaust Outlets, High-Intensity Lighting

CONSIDERED to be one of the most modern welding-booth systems in the country is the one at Erie Meter Systems, Inc. Each booth has an individual exhaust outlet, arranged for each operator, which is so regulated that it may be turned off as desired, and there is a large light in each booth, strong enough to permit the operator to see the outlines of the piece on which he is working even though his shield is down.



Each booth has an individually controlled exhaust system and a high-intensity lamp

New Products

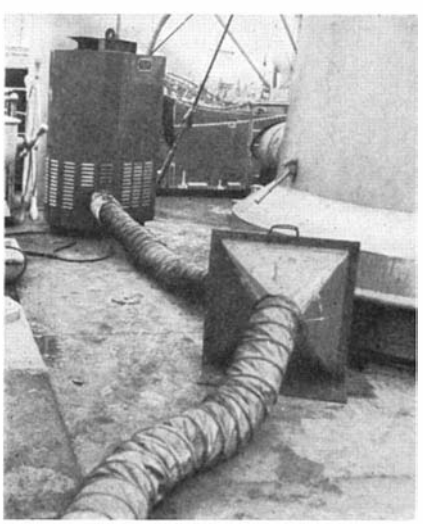
HOT AIR GENERATOR

Speeds Many Industrial Heating And Drying Operations

PRODUCING homogeneous hot air of controllable velocity, temperature, quantity, and pressure, a heated air generator found its first application in speeding the common shipyard operation of drying ship's motors and engine-room machinery which has either been flooded or covered with moisture through condensation.

However, additional applications for the new generator will be found wherever the problem of cleaning and drying machinery exists—on ships, in aircraft maintenance shops, in hotels, large buildings, laundries, and so on. Other uses for the hot air generator, developed by Todd Shipyards Corporation, will include various manufacturing processes such as pre-heating, melting, annealing, dehydrating, aerating, sterilizing, hardening, enameling, cooling (by shutting off the heat and using it as a blower), tempering, curing, refining, and plating.

A further use around motors of the device, called THAG (Todd Heated Air Generator), is in connection with cleaning and painting. Through usage, main propulsion machinery and auxiliary motors acquire a coating of grease mixed with carbon dust. After a time this coating becomes quite thick and is difficult to remove. By applying hot air at about 200 degrees, Fahrenheit, to the part, the grease melts readily and the area can be rapidly washed with carbon tetrachloride which evaporates quickly. After a cleaning it is customary to paint the exteriors of electrical equipment with a special varnish which must be baked to give it a hard and longer-lasting protective finish. This operation, formerly done with infrared lamps, is now accomplished much faster and cheaper with the controlled hot air generator.



Hot air generator on freighter's deck drives moisture from the engine room

SPRAYED HARD-FACING

Is Smooth, Thin, Uniform Coat Inexpensively Applied

A NEW METHOD for hard-facing by using a metallizing gun and a "wire" composed of a powdered hard-facing alloy extruded with a plastic binder, attains the previously difficult objective of applying smooth, uniform, relatively thin hard coatings in a highly practical and inexpensive manner.

During the Sprayweld operation, the plastic binder is completely volatilized, and the deposit consists entirely of the metallic constituent. Subsequent fusing, with any fusing torch or with an attachment on a metallizing gun results in a coating alloyed to the base which is, according to the Metallizing Engineering Company, the developer, physically and chemically identical to hard-facings of the same alloy applied by other methods.

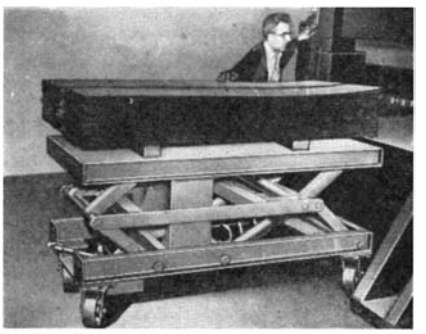
The alloy used in the "wire," which is called Metco-Weld H, is unusual in many respects. It possesses excellent resistance to abrasion—will outwear hardened steel 3 to 10 times for this type of service—and it resists corrosion better than stainless steel under most of the conditions for which stainless is generally used. It combines a low melting point with a long range of plasticity (1850 degrees to 2050 degrees, Fahrenheit). It is reported to have high strength at red heat and exceptional resistance to oxidation.

SHEET FEED TABLE

Elevates Hydraulically, Will Support 10,000 Pounds

FOR HANDLING and feeding to presses and shears loads of sheet steel up to 10,000 pounds, a new hydraulic toggle-lever-type table is portable for transporting loads. The hydraulic elevation allows leveling of load with press bed for efficient horizontal feeding. Stock may be loaded on the table by fork truck or by overhead means, either in the stock room or at the press. The advantage of the toggle-lever design is the full support given to the entire length of the table top—particularly desirable in the case of long, heavy loads. Lifting action is obtained by a hydraulic pump through hydraulic cylinders which operate laterally against the toggle-lever mechanism. The table guides are inverted so that no uprights extend above table top.

The table top is 30 inches wide by 96 inches long. The lowered height is 22 inches, elevated height 34 inches, giving a total lift of 12 inches. The table, manufactured by the Lyon-Raymond Corporation, is equipped with one set of 12 inch diameter wheels, one set of eight inch diameter swivel casters, a floor lock, and a two-speed hydraulic foot pump. The pump may be mounted on the unit or furnished with a flexible hose attachment for placing wherever it is most convenient for the operator. A motor-driven pump with push button controls is an optional feature.



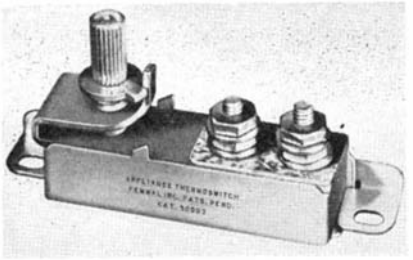
Elevates to maximum height of 34 inches

Extensions for the table top may be furnished for the support of loads wider than 30 inches and longer than 96 inches. Also available are superstructures of any thickness to increase height of table top, retaining the 12 inch lift. These features insure the adaptation of the table to different press heights and material sizes.

HEAT REGULATOR

For Flat-Surface Appliances Is Accurate Despite Shock

DESIGNED for electrical appliances, a new type of thermostat provides safe, constant, accurate, fast-acting heat control under the most severe operating conditions. The thermostat, called the Fenwal Appliance Thermoswitch Control, is said to maintain its efficiency even though the appliance in which it is installed may be continuously exposed to shock, vibration, tampering, and other outside influences. The control, manufactured by Fenwal Incorporated, is available in two models: the high temperature model which provides control over the wide range of 175 degrees, Fahrenheit, to 600 degrees, Fahrenheit, and the low temperature model providing critical control throughout its range of 50 degrees,



High- or low-heat models available

Fahrenheit, to 250 degrees, Fahrenheit.

The welded, one-piece case and cover assures a rugged, tamper-proof unit and stable temperature settings. Torque applied to the terminal binding posts, it is claimed, will not shift contact support members, and the temperature adjusting screw will not drift under normal vibration. The mounting bracket provides for side or bottom mounting, or a cross-mounting bracket is available for special applications.

The control is designed to operate at 110 volt A.C., 60 cycles, and to control temperatures in flat-surface applications, including: flat irons, automatic ironers, waffle irons, sterilizers, pasteurizers, dairy water heaters, hot plates, and so on.

RESPIRATOR FILTER

Of Chemically Treated Felt Is Small with High Efficiency

PROTECTING industrial workers exposed to poisonous and disease-producing dusts smaller in diameter than 24 millionths of an inch, a new dust filter, first of its kind, consists of a felt which has been chemically treated so that its ability to prevent the passage of dust is 40 times greater than untreated filters. In addition, a new respirator has been designed to utilize the high efficiency of the new filter which is so versatile it can protect the respiratory system against a combination of all types of contaminating dusts in air.

The filter protects workers against poisonous arsenic, lead, cadmium, and chromium dusts; silica dust responsible for silicosis, a frequently fatal lung disease; and nuisance dusts produced by coal, limestone, iron ore, and aluminum operations.

Filter (in man's hand) is black with the dust that would have been inhaled

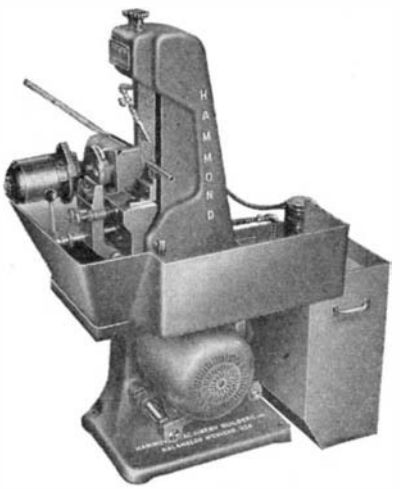
The chemically treated filter, one eighth inch thick and slightly over five square inches in area, is the equivalent in dust filtering efficiency of previous untreated filters of the same thickness and 42 square inches or more in area. This increased efficiency is reported to make it possible to produce a respirator filter of the smallest area so far developed without making it more difficult for the wearer to breathe through it, thus increasing his field of vision and reducing the respirator's weight.

Filtering action of previous respirator filters was primarily dependent on the smallness of the openings in the filter's interior fiber structure through which air passes. Functioning of the new filter is not contingent on the size of the openings but on a chemical treatment which radically changes the physical features of the fibers in such a way that dust filtering efficiency is greatly increased.

CENTERLESS GRINDER

Operates Wet or Dry, Takes Rods, Bars, or Tubes

USING coated abrasive belts for grinding and polishing rods, bars, or tubes from one-eighth to one and one-quarter inches in diameter, a new centerless grinder will remove up to 0.005 inch per pass on ferrous metals, and up to 0.10 inch on non-ferrous. Accuracy on production items is 0.001 inch, with closer limits on some work. The work supports will handle half-inch bars up to 18 inches in length, and one inch bars up to eight inches long.



Grinds to tolerance of 0.001 inch

This machine, made by Hammond Machinery Builders, Inc., uses an endless abrasive belt which is four inches wide and 60 inches long. It may be operated wet or dry, although for better finishes, higher production, and longer belt-life, wet operation is recommended.

Two methods of feeding are employed with the grinder, designated Model OD-1: through-feed and in-feed. The through-feed method is generally used, and is accomplished by swinging the regulating wheel on its horizontal axis from zero to 12 degrees. The rate of feed can be varied from zero to 18 feet per minute.

TEMPERATURE CONTROL

For Electric Furnace Regulates Current Flow Electronically

MAINTAINING the temperature of electrically heated ovens within less than 1/10 degree, Fahrenheit, at temperatures up to 1200 degrees, Fahrenheit, a proportioning electronic temperature controller adjusts the input power to the oven. The power flows continuously rather than in "on-off" cycles. Rapid achievement of temperature is accomplished because the instrument does not throttle power until the furnace reaches a point within 15 degrees, Fahrenheit, of the preset temperature. Quick and accurate selection of temperature is made by means of a vernier type dial. The controller, manufactured by W. S. Macdonald and Company, operates on 110 volts A.C., but can be used with furnaces requiring 110 volts or 220 volts A.C. The unit measures 19 inches wide by 10½ by 10½ inches, and can readily be adapted to particular installations.

Continuous control, not on-off cycles

DUAL-METAL WIRE

Electroplated, Then Drawn, Will Not Chip or Flake

CAPABLE of being bent, swaged, hammered, woven, or twisted without flaking, a new type of electroplated and drawn wire has a wide range of manufacturing applications in radio tubes, incandescent and fluorescent lamps, electrical devices and appliances, jewelry, and wire goods. "Fernicklon," trade name of this new product of the Kenmore Metals Corporation, is the result of an entirely new process. Metal rods of ¼ inch diameter are first electroplated continuously with high accuracy, then cold-drawn down to diameters as fine as 0.0038 inch. One inch of ¼ inch plated rod may produce as much as 100,000 feet of plated wire, permitting it to be ordered in continuous sections of almost any length.

Initial production includes steel wire

with nickel, copper wire with nickel or silver for radio tubes and lamps, tinsel wire, and many other wire products where finish and durability are required. Die polish or satin finishes are available. Because of its surface perfection and the absolute bond between its constituent metals, Fernicklon can be subjected to the severest climatic conditions when an anti-corrosive coating metal is used. It can also be welded to form a product without destroying the coating at the point of the weld.

GASKET CEMENT

Is Flexible, Resists Heat, Shock, and Vibration

MANUFACTURED for automotive, airmotive, and wide industrial uses, a synthetic, flexible, deoxidized rubber cement, forms a permanent seal in pipe joints, gaskets, and places where flexibility is required to permit expansion and contraction of metals. Since it is heat resisting, it makes an excellent head and exhaust gasket seal for regular automotive and airmotive repair, maintenance, and rebuilding applications. It is claimed that it will not blow out under high pressure, and that its flexibility resists vibration and shock.

Good adhesion as well as fast drying time are characteristics of this cement for sealing cork, rubber, fiber, paper and metal gaskets. Industrial users have found the new material, called Gascacinch, to be satisfactory also as an industrial belt dressing.

The cement, product of the Porter Manufacturing and Supply Company, holds gaskets in place tenaciously while assembling parts, and prevents troublesome sliding or slipping. When set it is also resistant to aliphatic fuels and water.

EMERGENCY FLOODLAMP

Switches on Automatically When Circuit Failure Occurs

FOR EMERGENCY USE when a regular lighting circuit fails, a new battery-operated lamp answers the requirements of many communities whose local building laws demand emergency auxiliary lighting. A switching relay in the lamp is connected to the regular lighting circuit through an extension cord. When the circuit fails, the relay automatically turns on the powerful floodlamp. The extension cord can be removed from the lighting circuit and placed in a space provided in the relay housing, thus transforming the unit into a portable hand lamp which can be switched on or off at will.

Called the Big Beam Auxiliary Lamp, it is available in two models: Model 801 with a single lamp head, and Model 802 with dual lamp heads. The lamps, products of U-C Lite Manufacturing Company, are rustproof and weatherproof. Lamp heads of both models can be turned a full 360 degrees in any direction, and both models are powered by four standard dry cells.

"SPONGE" RUBBER PAD

Has Nitrogen-Filled Cells Which "Give" but Will Not Flatten

TELEVISION tubes and other delicate equipment can now be protected against damage during shipment by spongelike cellular rubber pads.

The pads, developed by United States Rubber Company, are readily fabricated from sheet material and will protect equipment weighing from five pounds to several hundred pounds. They are said to be particularly useful for packing expensive television equipment and electronic devices.

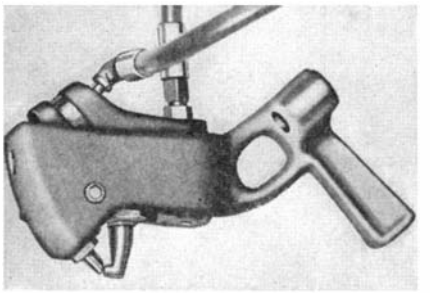
The rubber derives its cushioning ability from millions of microscopic cells filled with nitrogen. The cells "give" slightly under pressure but do not flatten out as do the cells of regular sponge rubber.

HYDRAULIC WELDING GUN

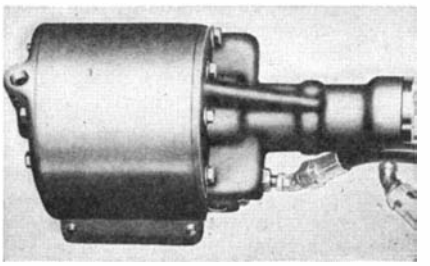
Assures Uniform Pressure, Reduces Flash, Pitting, and Burning

USING no springs, and insuring uniform point pressure regardless of the wear on the points, a new double-acting welding gun and booster is hydraulically operated. Destructive burning and pitting at the weld are reduced to a minimum, and there is so little flash that operators using the gun are said to have discarded their heavy helmets during welding operations with no danger of eye injury. Also, by the reduction of burning and of the sticking of points to metal, the service life of the points is considerably extended. The minimum life of points used on automobile body production, operating at 3000 shots per hour, is reported to be 108,800 shots.

The mechanical speed of the gun, made by Dalhart Engineering and Manufacturing Company, is limited only by the maximum speed at which the solenoid air valve can be operated. Welding pressures may be varied by controlling air pressure on the booster inlet. Thus a variety of metal thicknesses may be welded with a single gun. Small cylinders and high pressures combine to make this light-weight, compact tool adapted to a wide variety of applications.



Minimizes pitting, burning, and flash



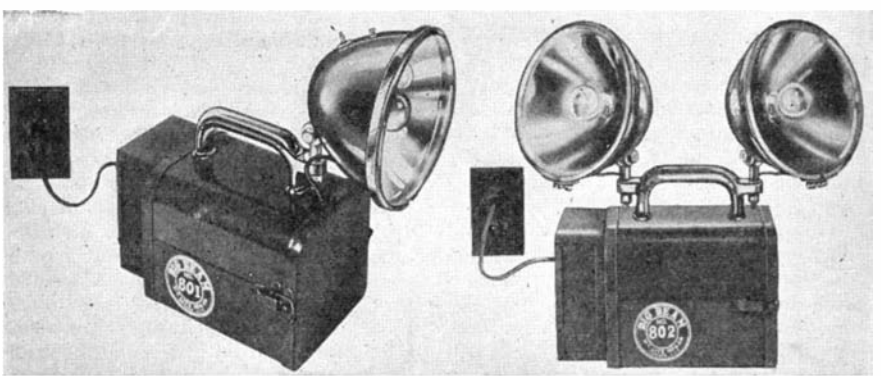
Booster unit for welding gun

PAINT ADDITIVE

Aids Hardness, Color, and Water Resistance of Coatings

IMPORTANT qualities in paint—wear and mar resistance, gloss and color retention, and quick-drying—are reported to be improved and another quality, better water and alkali resistance, added by a chemical which is incorporated with the other ingredients of paints, enamels, varnishes, and similar products at the time of manufacture.

Chemically, this material, called Pentek, is a commercial version of pentaerythritol, an alcohol derived from formaldehyde. When decreasing imports of tung oil resulted from the Sino-Japanese war, paint manufacturers were required to substitute domestic oils for the imported raw materials. They found that in some ways the resulting finishes were not up to previous standards. However, when Pentek was incorporated, surface coatings were produced which, according to the Heyden Chemical Corporation, who pioneered in the development of



Available with single or double lamp heads, the emergency units serve also as hand lamps

the chemical, exceeded many of these standards. The water and alkali resistance factor, for instance, is reported to make Pentek paint superior for use on fences, shutters, window trim, and similar exterior woodwork and metal. In the interior of a house, the increased mar resistance and high gloss of a Pentek varnish results in longer lasting, better looking floor finishes.

The water resistance factor applies again in painting bathrooms and for doors and light-colored woodwork which may become finger-marked. Dirt can be washed off repeatedly without injuring the finish or causing fading.

The color retention imparted by the chemical is particularly valuable in kitchens where light or white paint tends to yellow and smudge because of smoke and fumes from the stove.

DUST COLLECTOR

Is Light, Portable, and Easily Cleaned

ESPECIALLY suited for laboratories where space is extremely limited and where quiet operation yet proportionately high dust storage is required, a new, low-cost, portable, bench-type dust collector is entirely self-contained and requires no installation other than simply placing it in position on the bench and plugging in to a regular power line outlet. A ¼ horsepower, continuous duty motor turning at 1745 revolutions per minute and operating on 110 volt, single-phase power, drives a paddle-wheel fan which is capable of clearing chips and dust from grinding, lint and strings from polishing and buffing, as well as sludge from pumice and other wet-finishing operations. The hood which is fastened on this dust collector, designated Model 330 Dustkop by its manufacturer, Aget-Detroit Company, has a baffle, a light fixture for illumination of the work, and two removable trays for easy emptying of debris which drops from the work. The two trays also eliminate mixing accumulated dusts from wet or dry work.

Dust and dirt are removed by means of a drawer from the left side of the unit. A hand crank on the side of the unit immediately above the dust drawer facilitates a quick and easy "shake-down" of the spun-glass filter material. This spun-glass filter material is cheaply and easily renewed after repeated shakings.

Gold and other precious metals can be reclaimed from the unit by removal of the dust from the collecting pan and also by melting it out of the spun-glass filter material.

GERMICIDAL DEODORANT

Eliminates Strong Odors, Is Non-Poisonous

ACTUALLY destroying odors, instead of concealing or masking them, a new kind of deodorant was originally intended as an all-purpose bactericide. Then the material was discovered to possess deodorizing properties which are now finding widespread use in eliminating odors at the source in large manufacturing plants and around garbage dumps and polluted streams. Since the material eliminates the odor, its effect is longer-lasting than that of other deodorants.

The material is a quaternary ammonium compound, and is known as Hyamine 1622. It can be used effectively against such odoriferous materials as garlic, onions, spoiled potatoes, or decayed fish. Since it is used to kill germs and bacteria, it is effective in eliminating any kind of bacteria-induced putrefaction. It is odorless, and at use-dilutions is harmless to humans and animals. For surface odors, sponging or mopping with 0.1 to 0.5 percent solutions are recommended, and for space spraying 0.05 percent is satisfactory. The material is available to manufacturers in commercial quantities either as the 25 percent aqueous solution or as finely powdered crystals.

Commercial deodorizing has long depended upon materials which either cover obnoxious smells with pleasant ones, or deaden the sensitivity of the olfactory nerves. In commercial tests in one pharmaceutical plant which manufactured a hormone during the war, the raw material used in this process developed an odor so powerful and persistent that it was impossible to conceal the smell for longer than a few days. Yet with the development of Hyamine 1622, one scrubbing at a concentration of one part in a thousand eliminated

the odor entirely and there has been no recurrence.

Manufacturers of disinfectants and other antiseptic preparations incorporate this deodorant, produced by the Rohm and Haas Company, in their consumer products. These preparations include not only products for deodorizing, but also for sanitizing dishes and glassware in soda fountains, where it has proved 200 times more powerful against germs than carbolic acid. Products containing Hyamine 1622 are used also in restaurants and bars; in disinfecting rinses for hopsital and veterinary service; and the sanitizing of dairy and food-processing equipment.

FIRE EXTINGUISHER

Using Dry Chemical Is Simple to Operate, Easily Refilled

DESIGNED for effective use by inexperienced operators, a new four pound dry chemical fire extinguisher is only 19⅛ inches long and three and one-half inches in diameter. This extinguisher, product of the Ansul Chemical Company, is suitable for extinguishing fires in flammable liquids, gases, solids, and electrical equipment, and also for controlling fires in ordinary combustibles. The extinguishing agent used, Ansul Plus-Fifty Dry Chemical, is claimed to be non-toxic, non-corrosive, non-abrasive, and a non-conductor of electricity. Maintenance is said to be greatly simplified and the extinguisher can be quickly recharged on the spot after use. It is supplied with a quick-opening bracket for vertical or horizontal mounting in locations where space is limited.

SAFETY GOGGLES

With Plastics Frames Are Sturdy, Light, and Easily Cleaned

NON-HAZARDOUS in the presence of fire and unaffected by oil and perspiration, cup-type safety goggles with Tenite frames have smooth surfaces which are easily cleaned; the safety-glass lenses can be removed for a thorough cleaning job inside and out.

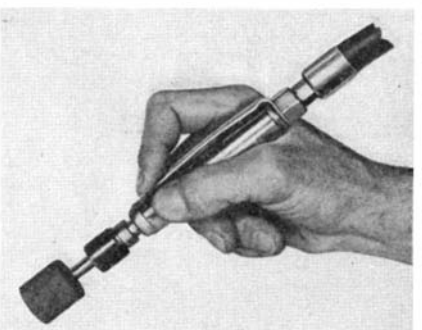
The extremely light weight of the Tennessee Eastman Corporation's Tenite is a considerable factor in making these Willson goggles comfortable to wear. And this tough material withstands rough treatment without breakage. It is pleasant to the skin in all temperatures. Perforated metal pieces are inserted in the sides of the goggle frames for ventilation.

Goggles are light-weight, comfortable

HIGH-SPEED AIR DRILL

For Wood, Nonferrous Metals, Can Also Clean Dies, Molds

ESPECIALLY designed for use on small drilling applications, a new high-speed air-drill has a speed of 26,000 revolutions per minute, and is equipped with a 0 to ¼ inch chuck and a lever throttle. This new model is recommended for drilling wood and nonferrous metals such as brass, aluminum, and magnesium. Also, it is well suited to cleaning stamping dies and molds. Its high speed will clean, but is not powerful enough to remove metal, leaving die dimensions unaffected. The tool, designated Model 7022, can be applied to the same type of work in glass and plastics molding plants. The drill, produced by the Aro Equipment Corporation, is particularly adaptable for multiple mounting in jigs or fixtures where more than one hole must be drilled simultaneously. Because of its small size, drills can be mounted close together.

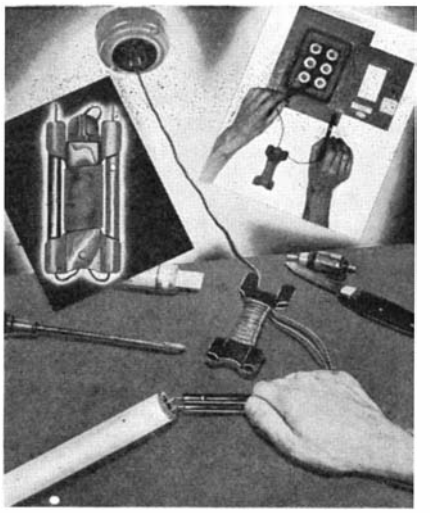


Air drill with cleaning attachment

HANDY NEON TESTER

Checks Continuity, Indicates Power Line Voltages

CONSISTING of an insulated sprocket around which is wound six feet of test wire with the test cord terminating at one end in a standard base plug, at the other end in two test prods, a new pocket continuity tester operates directly from any 110 volt base receptacle. It is also adaptable to conventional line testing, indicating voltages from 75 to 600 volts. The test lamp is located in one of the test prods, and is protected by a filtered circuit to eliminate all false indications caused by adjacent live wires, inductance, or body capacitance. A high resistance is enclosed in the other test prod to avoid accidental grounds. The filtered neon test circuit, by eliminating false glows, gives the equivalent test results of a large carbon lamp.



Filtered tester gives no false glows

Inserting the attached plug into a base receptacle enables the user to check continuity with the test prods. Bench testing of motor armatures, coils, fluorescent lamp units, radios, and other appliances is readily accomplished in this fashion. The continuity testing features are adaptable to the quick checking of electrical circuits in automobiles and airplanes, and to tracing signal circuits such as in elevators.

Power circuits of from 75 to 600 volts are tested by inserting a rubber plug into the self-contained socket on the frame of the device. The test prods are then used in the conventional manner for location of blown fuses or detection of grounded appliances.

Called the SureTest Universal Tester, it is a product of the Star Fuse Company, Inc., and weighs four ounces. When not in use, the test prods are fastened to the frame around which the test wire is wound, and it can be carried conveniently in the vest pocket.

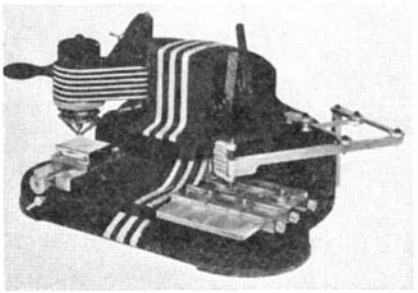
ENGRAVER-PROFILER

Has Pantograph For Precise Work By Untrained Hands

FEATURING simple operation, a new profiling and engraving machine is equipped with a pantograph which permits accurate engraving in desired reductions even by inexperienced hands. Operation requires only placing of lettering, templates, or drawings on one side of the machine and tracing with the arm of the pantograph which, while moving over the inscription, engraves the work-piece in full view of the operator. The machine is driven by a universal electric motor, 110 volts, A.C.-D.C. A standard ratio of three-to-one is achieved with the pantograph, but other ratios can be had on request.

The operator can engrave his own templates in one-to-one ratio from drawings and thereafter reduce them for reproduction as required.

The adjustable vise of the unit will hold work up to five by eight inches and the machine will engrave areas up to four by four inches. The work table, with adjustable rulers and instantaneous cam-locks, permits the operator to assemble templates in a few seconds. Copying of the text of the inscription and its distribution in symmetrical lines are absolutely accurate. The vise is easily adjusted and can be locked in any position. It can also be quickly removed for substitution by a work table, or by a special fixture for mass-production engraving work. Both the vise—with the work to be engraved—and the table with the assembled templates, are located in front of the operator so that he may observe the progress of work at all times. A micrometer depth adjustment device allows engraving from hairline to deep cut. Convex or concave surfaces can be covered from a flat master, with uniform thickness of the engraved line.



Engraves work up to four by four inches

The overall dimensions of this Automatic Engraving and Profiling Machine, as it is called by its manufacturer, Airdraulics, Inc., are 21 by 21 inches; overall height, 14 inches; and the total net weight, 42 pounds.

SPOT WELDING TIMER

Set to Metal's Thickness, Assures Correct Welding Time

ELIMINATING guess-work and assuring uniform production in spot welding, an electronic welding timer gives precision control to the welding current flow. Once set for a particular thickness of metal, timing becomes automatic throughout an entire production run.

The Timatron Timer, as it is called, is designed to make installation simple and inexpensive on all types of spot-welding machines, and it can usually be installed in less than an hour. The control has the capacity to time any machine up to 10 kilo-volt amperes, and is adjustable from .1 second to 5 seconds by a hand control covering any timing range which may be desired. The dial, which adjusts the timing period, is calibrated so that adjustment can be speedily made when switching from one thickness of metal to another.

The timer, produced by Ripley Company, Inc., makes it possible for a workman to produce a solid weld and eliminate defects common when the timing is left to the discretion of the operator, such as welds that will not hold due to short timing, or burning and pitting of the metal due to over timing.

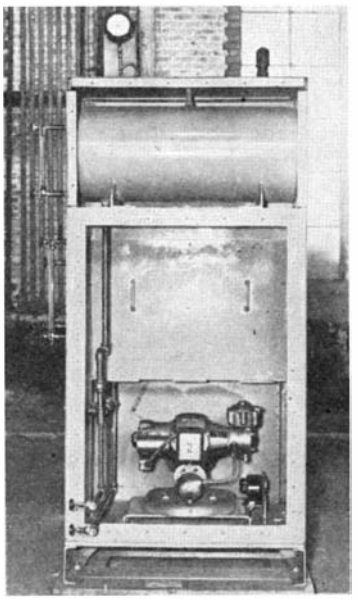
WASTE HEAT BOILER

Operates on Exhaust of Diesel Or on Household Oil Burner

SELF-CONTAINED and compact, an exhaust waste heat boiler of new design is enclosed in an insulated steel cabinet only six feet, six inches long; seven feet, six inches high; and three feet, two inches wide. The unit functions automatically on exhaust gases from a turbocharged Diesel engine, or it can be operated by a household type oil burner.

The waste heat boiler generates 500 pounds of steam per hour on the Diesel exhaust and considerably in excess of that figure when operating on the oil burner.

Exhaust gases at 600 to 800 degrees, Fahrenheit, coming from the Diesel engine run the unit as long as the engine functions. When the engine is shut down, the oil burner is cut in by a few simple steps, so that there is almost no interruption in the boiler's operation, and no break at all in the heating service. When no heat is required, the boiler can be run dry, acting as a muffler to the Diesel engine.



Oil burner in bottom of housing is used when Diesel is not operating

The new waste heat boiler, developed by the American Locomotive Company, features strict safety precautions. When the engine is operating, the oil burner in the boiler cannot be turned on accidentally. The oil burner combustion chamber is lined with refractory at the plant.

The compact unit is shipped ready to

operate. All that is necessary is to connect it to the gas exhaust, hook up water and oil lines, and plug in the current.

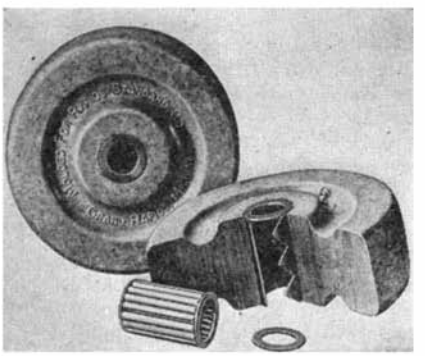
A wide range of application for the new waste heat boiler is seen, not only for product pipelines and central power stations but in all industries using Diesel engines where the unit can be applied profitably for heating on limited amounts of process steam.

PLASTICS-CANVAS WHEELS

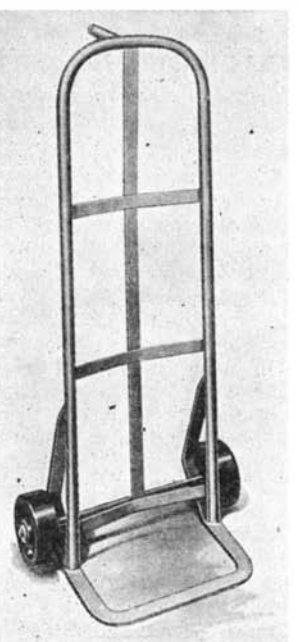
Reduces Floor Wear, Can-Not Create Sparks

Composed of phenol formaldehyde resin and macerated duck canvas, plastics truck wheels possess excellent floor protective and shock-resilient qualities. They roll easily under heavy loads and their resistance to oil, mild acids, and temperatures varying from zero to 100 degrees, Fahrenheit, (inherent properties of the Durez resin used) make them well suited to numerous industrial uses under widely varying conditions.

Floor maintenance costs are kept down when industrial trucks, whose wheels formerly pounded and chipped



Section of plastics-canvas wheel



Wheels will not chip or pound floors

expensive floor surfaces, are equipped with these wheels made by American Brakeblok Company for Rapids-Standard Company, Inc.

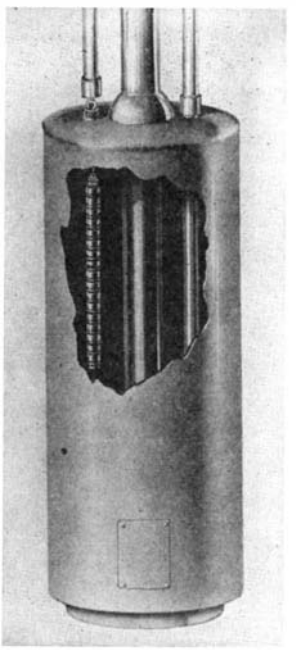
Floor truck wheels and casters must withstand shock and fatigue from continually striking obstacles, floor plates, and obstructions. The macerated duck-Durez wheels, called Durastan Resinoid wheels, have great impact strength.

The non-metallic qualities of the wheels make it impossible for them to create sparks by striking a concrete or steel surface. Consequently, in manufacturing plants where flammable or explosive conditions prevail, these wheels may be used with complete safety.

WATER TREATER

Removes Scale and Rust By Electrolysis

CONTROLLING electrolysis, removing scale, and preventing its formation in hot water heaters of all kinds, a new electrolytic device consists of a number of zinc and copper plates mounted in series. When submerged in the water, this combination sets up an electromotive force in the hot water heater which, it is claimed, renders the salts and minerals inert, at the same time removing scale and preventing corrosion. Easy to install, this treater is inserted at the hot water outlet and suspended in the water. Known as the McRay Treater, this device is said to require a minimum of attention after installation, and in every case where it was used, it not only removed scale from the hot water tank, but also from the pipes fed by the tank. Regular size for household use has a capacity of 300 gallons of water per day, and larger types are also available.



Cutaway view shows treater (at left) suspended at the hot water outlet

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Conducted by K. M. CANAVAN

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Edited by Alan T. Waterman

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in omitted parts of drawings, as well as completed blueprints with accompanying work sheets and grids for the reader's own sketches. There are no "classroom problems," as such, and no trick exercises; every drawing in the book has been taken from an actual commercial blueprint. Hence, the emphasis is on practical work rather than mere theoretical exercises. Nevertheless, the material is so arranged that the reader absorbs fundamentals as well as the more advanced applications of blueprint production and use. (255 pages, 9½ by 11½ inches.)—$5.10 postpaid.—*A.P.P.*

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The Editor

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By James B. Conant

HARVARD'S chemist-president wrote this short book to explain, by actual cases from science's past, to lawyers, writers, teachers, public servants, business men, and other people of influence, just what the only half-suspected and largely submerged mysterious thing called the "method of science" actually is. For all except one of these categories it would accomplish that purpose though it is rather scholarly. But what science needs for its future salvation and the world's, now that politicians threaten to push it around to its everlasting injury, is a book that Senator McKellar and some others would read, absorb, finish, and heed—and this is not it. (145 pages, 5 by 8 inches, 10 illustrations.)—$2.10 postpaid.—*A.G.I.*

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By L. S. Pratt

THIS volume is an outgrowth of the two chapters written by the author on the same subject for Volume II of Mattiello's "Protective and Decorative Coatings." It is a comprehensive and authoritative treatment of the basic data on organic pigments, particularly the lakes and toners made from synthetic dyes. While the preparation and reactions employed in the production of organic pigments are described, the book is not a recipe book. Testing, identification, and evaluation of organic pigments receive major attention. (359 pages, 6 by 9 inches, illustrated.)—$6.10 postpaid.—*D.H.K.*

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with in this organized textbook useful for understanding the visible features of the earth in their widest variety. Author is a New Zealand geologist and nearly all illustrations are from New Zealand, rich in landform variety, but same underlying principles apply everywhere. (505 pages, 5½ by 8½ inches, 473 illustrations.)—$6.10 postpaid.—*A.G.I.*

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By Frank Henius

THE SECOND edition of this authoritative dictionary has been enlarged and revised to include the many important changes in the terms and practices of foreign trade since the war's end. Six thousand terms common in international trade are given clear, detailed definitions, and the book deals with every phase of this large field. A collection of some 300 documents used in foreign trade are shown, these embodying the latest changes. And a clear, concise explanation of how and when to use each is supplied. Also included are tables for conversion of weights and measures from the metric system to our own, and a complete listing of abbreviations used in international trade terminology in four languages—German, French, Spanish, and English. (959 pages, 6½ by 9½ inches, unillustrated.)—$12.65 postpaid.—*N.H.U.*

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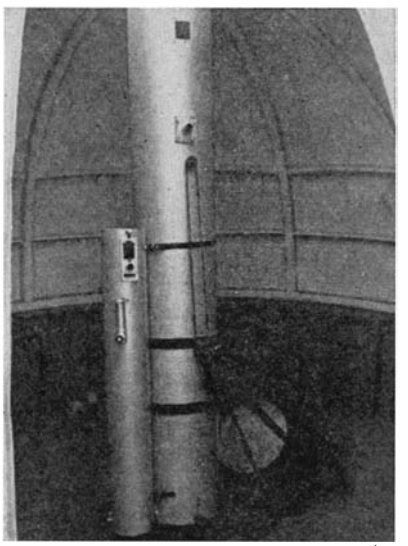
RICHEST-FIELD TELESCOPE

For Awe-Inspiring Views of the Milky Way

THE AMATEUR star observer using a short stubby telescope in the upper illustration is a General Electric Company employee who has also made two larger telescopes and the private observatory dome shown in the lower illustration. Why, after making two more powerful telescopes, one magnifying 100 diameters the other 200, does he bother to build the smaller one he holds since it magnifies only 25 diameters?

This is a special kind of telescope, relatively easy and inexpensive ($15) to build because it needs no mounting—the simple tube is held in the arms. This, however, is not why it has become so famous. The spectacular purpose

Richest-field telescope with eyepiece and auxiliary diagonal finding mirror



Telescopes mounted parallel (piggyback)

of this "richest-field" telescope is to make visible in single, striking views the largest number of stars. A million stars in the Milky Way, wholly invisible to the unaided eye, come to visibility, and few people are so lacking in impressibility that they fail to be silenced in wonder.

There is such a vast expanse to the Milky Way—our whole universe with its billions of suns—that this special purpose telescope actually has wide general application and has been made and liked by hundreds of amateurs.

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"

RUSSELL PORTER, at last getting some earned rest at 75, has become a TN again and sends the fraternity the following, via this department.

"The accompanying drawings (Figure 1) show an attempt to erect the image of an objective by means of mirrors instead of the two Porro prisms almost universally used today in binoculars. The four mirrors *a*, *b*, *c*, and *d*, are flat and aluminized. The axial paths of the objectives, *o*, are shown dash-dotted in all four views, and the marginal lines of the cone from objective to its focus are full lines.

"Mirror *a* receives the incoming light and reflects it upward at 45° (the normal to its surface being at 22½° to the axial ray). Mirrors *b* and *c* are really parts of surfaces at right angles to each other, their intersections being parallel to the incoming and outgoing axial rays. I have shown *b* and *c* as elliptical in outline only to show more clearly the areas cut by the narrowing cone of light. Finally, the cone goes from *c* to *d* and thence to the focus. The normal to *d* is also at 22½° to the axial ray.

"By referring to the plan view one may see that the light path from *b* to *c* is not at right angles to the main axial rays, but makes an angle of 45° to them.

"I have made two or three of these telescopes—one a binocular—and find that they perform very well. The light loss through reflection is comparable to the reflecting and absorption losses in Porro prisms. Unquestionably, their manufacture and adjustments are more complicated than when Porros are used. But the light paths, being entirely through air (they cross each other several times on their way to the focus) render the telescope extremely short. For example, in the one shown in the diagrams, where the focal length of the objective is about 8", the length of the housing comes out only 3", hence it is very compact.

"I do not know whether this method has been tried out before. I worked this out myself some ten years ago."

SOME who try to build their final telescope first put much hard work on instruments they often wish were different but the telescope shown in Figures 2 and 3, made by Fred Larsen, 638 West 110 St., Los Angeles, Calif., when closely studied, looks more than most like a third-job design on a first-job instrument. Good judgment with regard to various details appears to have been used. It is partly a machine-tool job but is not over-elaborated. Let's look it over.

Pedestal: Much more than mechanically adequate but esthetically just right. However, if looks don't mean a thing, as some claim, then perch a big telescope atop a mechanically adequate 2" or 3" post where it will look as if "all top." Posts are pretty cheap. Why skimp?

Drive: If there is to be one at all and unless photography is to be done, why must a drive be highly precise? Larsen's will keep an object in the field of view as long as most observers care to look. It is a simple sewing machine motor with an electric governor of the type used in movie projectors. If the telescope moves too fast one of the switch knobs at the end of the wire in Figure 3 will start it moving slowly

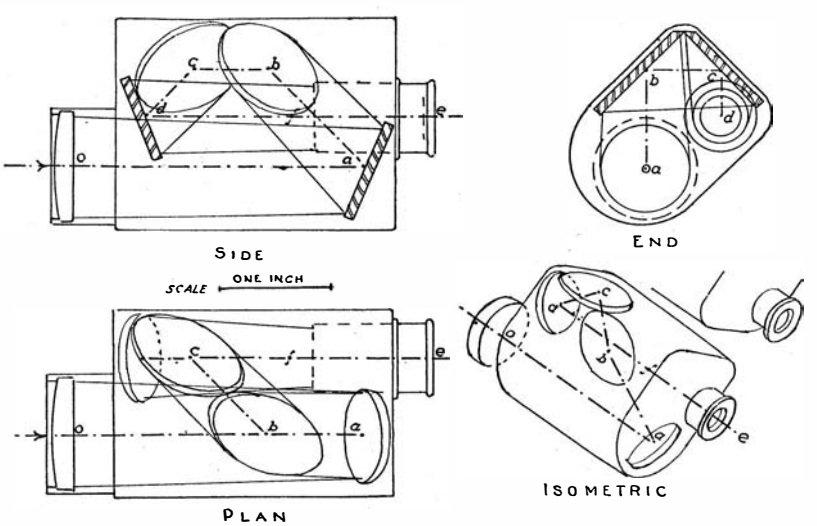


Figure 1: Porter's experiment with mirror erecting systems

backward; or vice versa with the other. These switches are within easy reach. So is the second integral pair of knobs a little higher up. This is a slow motion in declination and is simply a cross-screw on the end of a bar which has a friction fit bearing on the outside of the declination bearing, as on a surveyor's transit.

Drive gear: An 185-tooth worm gear cut with a 1" tap ("A.T.M.A.," p. 365). It came out very well, Larsen says.

Bearings: Tapered and therefore without play and solid.

Setting circles: Laid out on a lathe, using some of the thread-cutting gears held with an improvised ratchet to divide them.

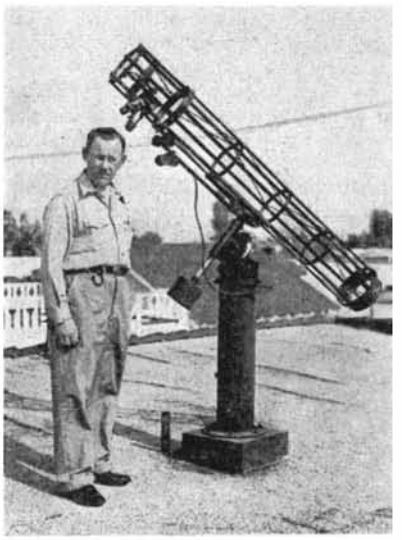


Figure 2: Larsen and telescope

Tube: Metal, skeleton. Tube has a rotating head; the heavier ring near the top is actually two rings, the upper rotating on the lower. "This," Larsen writes, "is *very* useful but must be accurately and rigidly made, else it will not stay collimated well." Such rings wring no necks, a big comfort.

Eyepiece holder: Triple turret type. No truant eyepieces.

Finder: Simple peep type. A 1/8" hole at the eye end and a 1" ring at the outer end. No cross hairs. Center by judgment.

Polarizing diagonal: Three flat mirrors the size of the telescope diagonal, set at 57° critical angle. Rotate to vary sunlight. Removable.

Site: Flat-top residence roof. Pier shown rests on crossing of wooden partitions below. It has proved solid and walking below does not shake it.

"To have spent many hours of spare time building this telescope has been one of the most gratifying experiences I have ever had," Larsen writes. "It has given me a little of the feeling that must come to an artist after he has finished a painting; one feels satisfied when anyone shows interest in his workmanship, and the ego shows signs of inflation.

"Thirty years ago in the land of the great Tycko Brahe and Ole Roemer," he continues, "I came upon a description of a homemade telescope, a 3"

made in the usual manner except that it did not mention the all-important Foucault test, described in 'A.T.M.' Carbo and rouge did not grow on any of the plants my father raised, but years later I became again infected by the

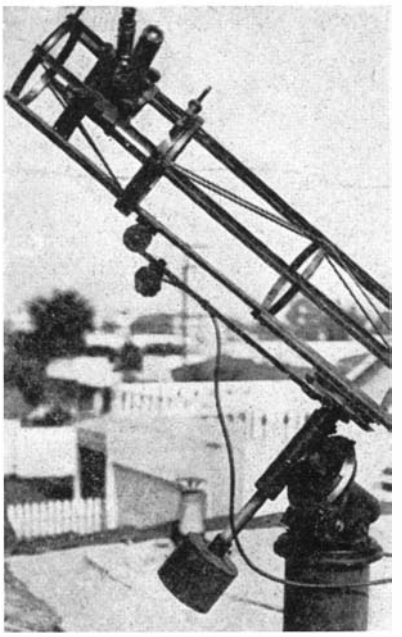


Figure 3: "Teeko Bry" would envy

Bacillus telescopia and have had the fever ever since."

In describing Larsen's telescope pedestal this department characterized it as esthetically just right. Subsequently, two photographs of even fatter pedestals were found among old files, and these, the first by W. W. McClure, Grosse Pointe, Mich., the second by Ralph Munn, Pittsfield, Mass., seem even more pleasing though individual tastes in legs differ. Not wishing to single out any example of the opposite

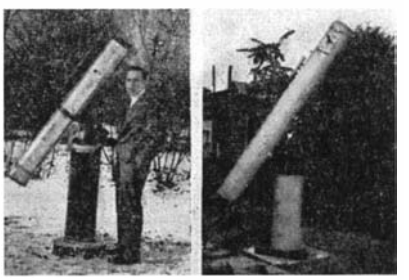


Figure 4: A study in pedestals

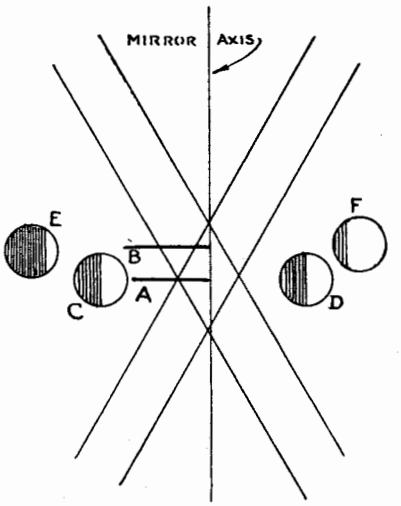
kind—spindly—we forbear from illustrating this extreme, but examples are numerous.

How Dr. Anderson tests the 200" mirror is explained by Porter: "Over the mirror he places a diaphram with a series of 5" holes 6" apart across a horizontal diameter. The knife-edge and light source are at the c. of c. of the mirror about 110' away. Starting from zero in the center, each pair of holes is numbered—1, 2, 3, and so on, to right, same to left.

With the knife-edge at *A* (Figure 5)

the two holes (windows) will appear as at *C* and *D*, half darkened. The knife-edge is moved along the mirror axis until this condition is found. If the knife-edge is not where it should be, at *A*, but is at *B*, you will get the shadows shown at *E* and *F* and the knife-edge is accordingly moved back to *A*.

The radius of curvature for each pair of holes has been computed and



Drawing by R. W. Porter
Figure 5: The Anderson test

thus any departures of *A* can be determined.

It takes only a few minutes to run through all the pairs.

In addition to this, the mirror is rotated to detect any astigmatism.

RECENTLY several amateurs were asked how they would vote to use 16" blanks. Walter Houston, Cincinnati, voted for an *f*/7 Newtonian; H. E. Bussey, Atlanta voted for an *f*/8 or *f*/9 Newtonian; G. P. Arnold, Chicago, favored an *f*/8 Newtonian. Your vote?

PERHAPS Vicksburg's express agent will never be a TN. Mrs. Nona Ledbetter of that community, who is, says a local TN wanted to ship a mirror to be aluminized but, fearing breakage, spent half an hour explaining the whole art, to impress the gentleman. He listened politely, looked puzzled, hesitated, wrote on the waybill: "1 pc. glass, value $50."

NEW LIFE for planetary and lunar observation among amateurs in America is promised by the inception of a monthly periodical, "The Strolling Astronomer," edited by the generally recognized leader of this activity, Walter H. Haas of the Institute of Meteoritics at the University of New Mexico, Albuquerque, N. M. It starts off with 50 subscribers and in mimeographed form. Amateurs interested in lunar and planetary observation now will gather around Haas and through this organ work out ways to end the existing situation in which each separated individual goes it alone, which is less fun than going it together.

The years melt away

(as the years always do)

As your years dwindle down—as everybody's must—you'll need more than affection and companionship.

You'll need a place to live and food to eat. Which means you—not the family next door, but *you*—will need money.

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if gasoline were sold in crates...

you would expect to see labels giving specifications, information about quality, and ingredients pasted right on the crates. However, since you take gasoline home in your own gas tank, there's no way to actually label each gallon you buy. That's why oil companies put "Ethyl" trade-marks on their pumps. The familiar yellow-and-black emblem means that they have improved their best gasoline with "Ethyl" antiknock compound —the famous ingredient made by the Ethyl Corporation to step up power and performance. *Ethyl Corporation, New York.*

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