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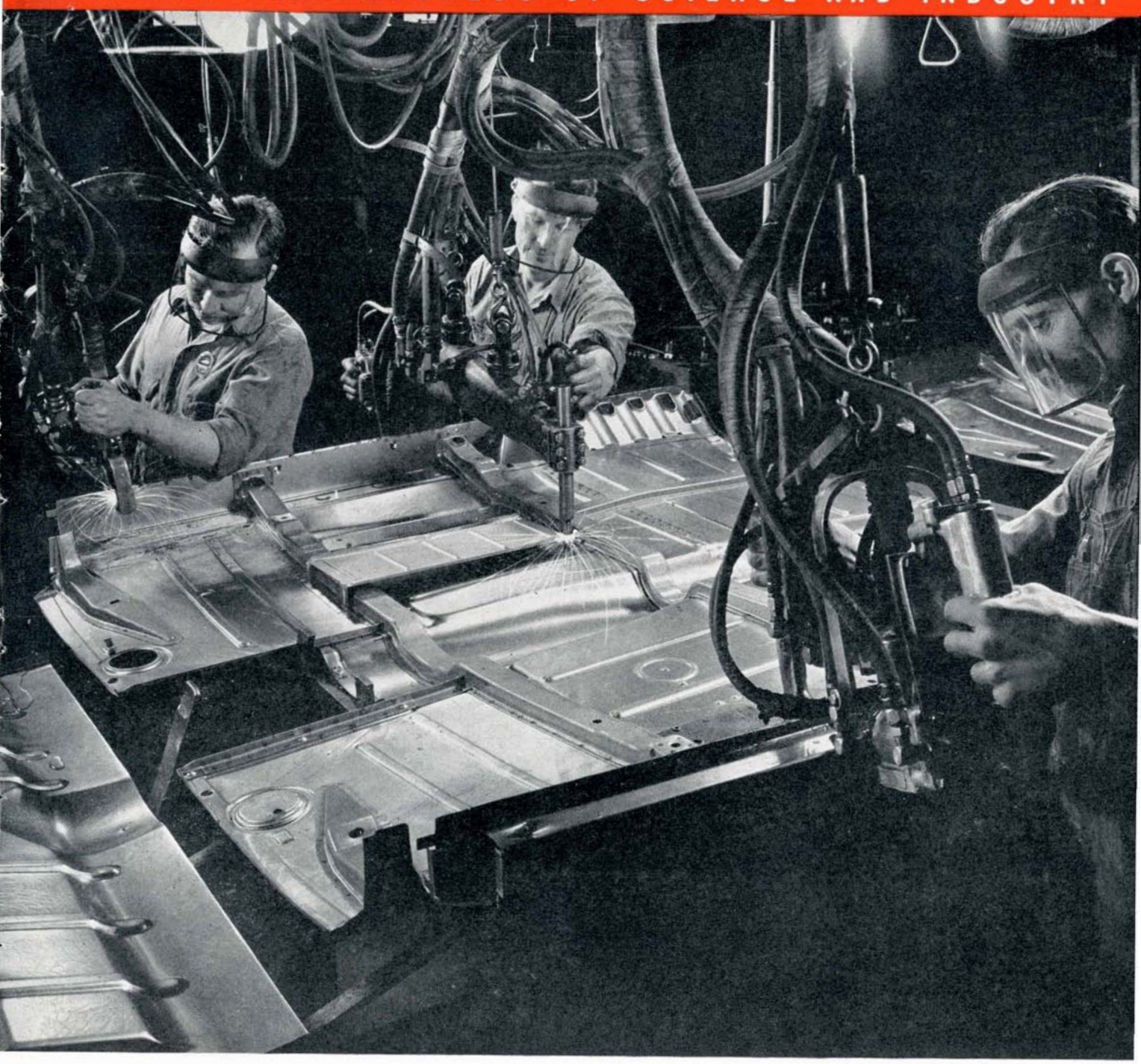


Teamwork Welding . . . See page 145

A CLEAN SWEEP FOR DUREZ PLASTICS

The parallel development of Hoover Vacuum Cleaners and Durez phenolics points up an era in which household appliances and plastics have progressed together...and lightened further the labor of housekeeping.

For many years, the Hoover Vacuum Cleaner Company has recognized the unusual value of Durez phenolic plastics as a material for vacuum cleaner housings, functional parts and accessories. In fact, H. Earl Hoover once stated: "The special Durez plastics used for certain (Hoover Vacuum Cleaner) parts not only help reduce weight, they also add smart, modern contours, a lustrous scratch-proof finish. And because they're self-insulating, they simplify our design and assembly."

Durez Versatile

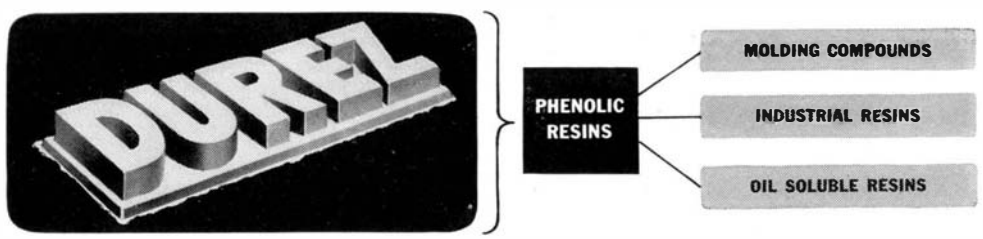
Non-resonance, impact strength, heat resistance, and dielectric strength . . . these are among the other characteristics of Durez phenolic molding compounds which gave development engineers the necessary freedom, in designing the vacuum cleaner to its present state of efficiency. Of utmost significance, however, has been our success in perfecting more than 300 modifications of a plastics material whose versatility has been recognized for years. A finer appliance than ever before, the Hoover of today uses more molded Durez than ever before.

About Your Problem

Perhaps you have a plastics material problem. If so, we urge you to consult your custom molder. New methods of preheating, molding and finishing greatly extend the advantages of his service.

Remember, too, the competent counsel of experienced Durez technicians plus a wealth of proved product development data is available for the asking.

Write to: Durez Plastics & Chemicals, Inc., 110 Walck Road., N. Tonawanda, N. Y. *Export Agents: Omni Products Corporation, 40 E. 34th St., New York 16, N. Y.*



PLASTICS THAT FIT THE JOB

INDUSTRIAL DRAMA: A welding crew, working in harmony to speed automobile production, apply their welding guns to a body floor pan in one of the plants of the Fisher Body Division of General Motors Corporation.

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50 Years Ago in . . .

SCIENTIFIC AMERICAN

(Condensed from Issues of October, 1896)

THE AMERICAN WAY — "Better the most cast iron conservatism than a liberalism which is lawlessness; that pulls down where it should build up; that sets man against man, class against class, and ultimately loosens those bonds, light as air yet strong as steel, which bind our great country into a union where we have proved that it is possible to have unity without uniformity."

VANADIUM — "A new source of vanadium compounds has been found on the South American Andes. On one of the high plateaus a mine of anthracite has been located, which, when burned, leaves an ash containing vanadium and silver. The vanadium is now being extracted for use in making aniline black and coloring porcelain."

HEATING AND COOLING — "A German inventor has built a house of tubes, whose advantages are, he says, a constant temperature and, incidentally, strength, comfort, and beauty. He first put up a frame of water tubing, allowing continuous circulation to a stream of water. Around this frame he put up his house in the ordinary way. . . In the summer, fresh, cool water circulates under pressure through the network of tubes and cools off the walls. . . During the long and severe winter the water entering through the basement is first heated to nearly 100 degrees and then forced through the tubes."

PEARLS — "According to C. E. Benham, although a little of the color of the pearl is caused by striations or fine grooves on the surface of the nacre, the greater part of the color is produced by interference of the rays of light by reflection from the outer and inner surfaces of the thin layers of nacre forming the substance of the pearl. The colors of a pearl have, therefore, a similar origin to those of a soap bubble or the iridescence of ancient glass which has been scaled by time."

DIRIGIBLE — "At the Berlin Industrial Exhibition there is to be seen a wonderful dirigible balloon. On August 28 and 29 this balloon rose to the height of about sixty-five feet, and was propelled in all directions, even against wind. . . The motive power of this elliptically built balloon is an eight horse power engine driving a double bladed ship's propeller, having a diameter of about three yards."

FORGES FORGE FORWARD — "The large brick forge and leather bellows, so often poetized and made the theme for the artist's pencil, is rapidly becoming a thing of the past. . . The portable forge and hand or power blower furnish a neater and more perfect forge than the old brick one in its palmiest days, and no modern smith would think of fitting up a new shop with any other."

DIAL PHONE — "The Houts Automatic Telephone System provides improved means for allowing any subscriber in a system to instantly connect himself with any other subscriber without the aid of an operator at the central office. . . In making a call the subscriber presses the handle on the face of the call box, moving the dial forward until the number with which he desires to communicate is opposite the button at the left. The button is pressed, which fixes the position of the dial, allowing the handle to turn on until it again reaches the home point or falls into the notch from which the subscriber has started it."

LIFE SPAN — "To what extent human life in the aggregate has been prolonged by better food and more of it, improvement in sanitation and the advances made in the scientific treatment of disease, can never be statistically determined. But it is certain now that diseases are due to the operation of causes which are pretty well understood. Cities understand that they can no longer afford to have bad sanitation, and these improvements alone mean the prolongation of the working periods of men's lives."

MOVIES — "Ever since the kinetoscope was brought to public attention and proved to be so popular, inventors have been striving to perfect apparatus for successfully projecting these miniature images upon a screen. . . Two factors in solving the problem have been the use of the electric arc lamp as an illuminant and of continuous transparent cellu-

loid flexible films. . . The pictures are made at the rate of twenty-five to a second, about three-quarters of an inch in diameter and one-quarter of an inch apart, on a continuous sensitized celluloid strip about one and a half inches wide, having perforations in its edges in which the sprocket wheels of the projecting device engage."

100 Years Ago in . . .

SCIENTIFIC AMERICAN

(Condensed from Issues of October, 1846)

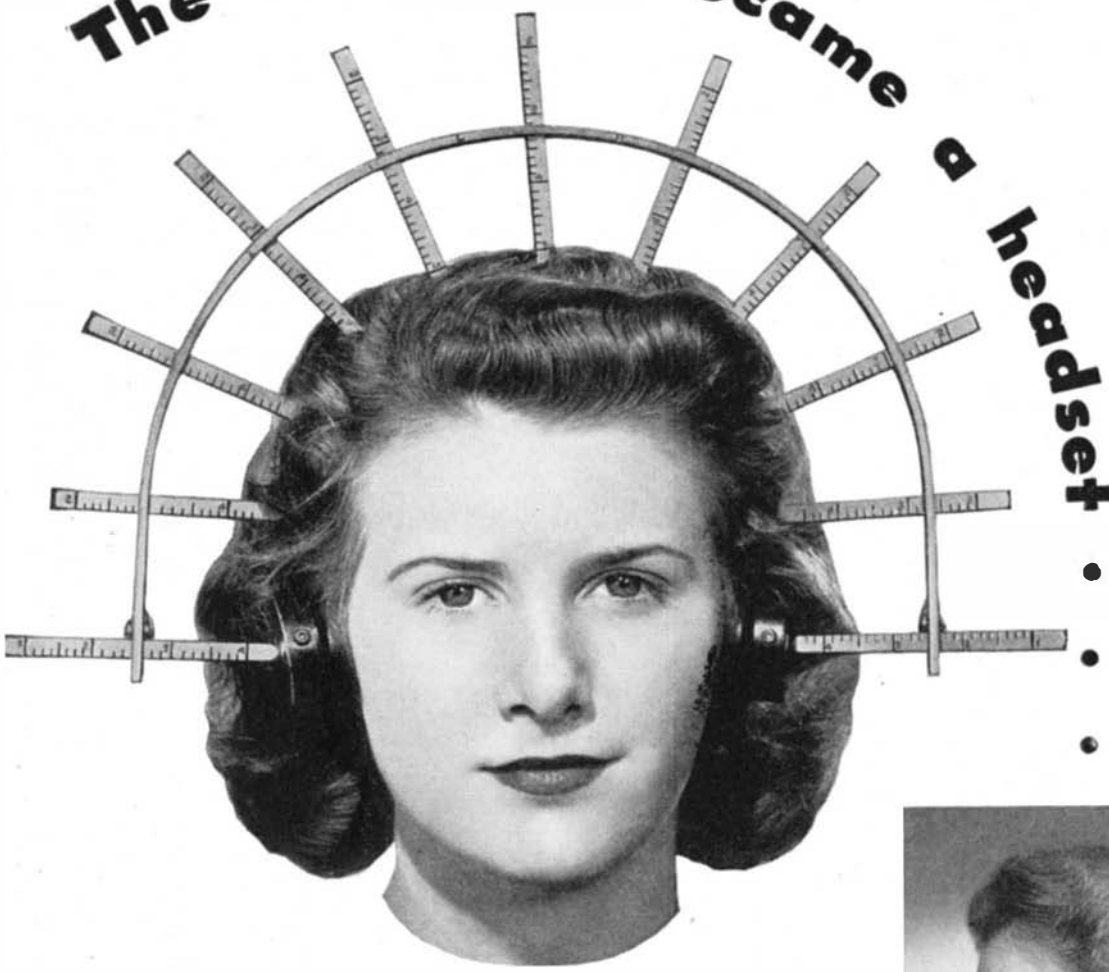
TELEGRAPH — "The Southern Magnetic Telegraph line, it is said, will be extended to New Orleans, via the Mississippi and Ohio rivers. It commences at Philadelphia, thence to Harrisburg, Pittsburgh, Wheeling, Cincinnati, Louisville, Saint Louis, Nashville, Memphis, Vicksburg, Natchez, to New Orleans."

FREIGHT — "Experiments prove that railroads can be profitably used in carrying heavy freights at low rates, and that they will come into successful competition with navigable rivers. The experience of the past year shows that they can be successfully used in transporting southern cotton to the north, and in carrying the produce of the valley of the Mississippi to the Atlantic ports."

IRON BOATS — "Messrs. Knapp & Foster, of Pittsburg, have completed four iron boats, intended for the use of the U. S. Army. These boats are each 45 feet in length, 10 feet in breadth, and 4½ feet deep."

PAPER — "From statistical documents presented before Congress, it appears that the capital employed in the manufacture of paper in the United States is $18,000,000. The number of mills, 700: the annual product $17,000,000, and the number of operatives employed, 100,000."

The hat that became a headset . . .



Telephone operators in New York, Atlanta and Montreal wore the strange head-dress you see pictured above. It's a specially devised gauging instrument — Bell Laboratories' scientists used it to measure head contours in designing the new operator's headset.

With the new set, the telephone user can hear the operator more clearly, and she in turn hears better too—through the improved receiver and transmitter. Her voice enters the transmitter at an even level because, as she turns, the mouthpiece moves with her. Neckstrap and horn are eliminated. The whole thing weighs less than six ounces.

The new Bell System headset brings together the latest techniques in voice transmission and the ideas of the operators themselves — offering comfort, convenience, and electrical efficiency.

Out of new knowledge has come this novel head telephone fitted to the operator and designed to improve your telephone service.

BELL TELEPHONE LABORATORIES

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

Previews of the Industrial Horizon

By A. P. Peck

NEW RESEARCH TRENDS

EVER SINCE research became recognized as an important tool of industry, much of the emphasis of the laboratory—perhaps too much of it—has been on the adaptation of materials to end uses. All too often the result of this type of thinking was to force a certain material into products that might better have been made from some other material which, unfortunately, had not been favored with the laboratory attention it deserved.

Now it appears that much of this thinking is being reversed. More and more the emphasis is being placed on finding the best material for a given use. And, to the benefit of all research, this sort of work is being forwarded by a far larger number of industrial organizations than ever devoted attention to promotion of specific materials.

Of a piece with this trend in industrial research which places product improvement ahead of materials used is the newer mode of testing which emphasizes performance of a finished unit rather than the basic characteristics of the materials which make up that unit. But for details on this phase of production research and testing, see the article by Contributing Editor Peters on page 199 of this issue.

To summarize this trend: More industries, large and small alike, can benefit from advancing technology if they will devote even a modicum of attention to the relationship between product and material. Perhaps, as examples, one of the light metals—aluminum or magnesium—can do a better job than the sheet steel now used; maybe plastics can advantageously replace the light metals; possibly old-fashioned cast iron has desirable properties which have been overlooked in the rush to use the newer materials. A searching—and continuing—investigation of the suitability of materials for the job in hand will usually pay out.

WHO WILL INVESTIGATE?

PART AND PARCEL of this newest phase of research, only now being appreciated, is the creation of departments for the purpose of forwarding special interests of industrial concerns, but unhampered by conventional rules and regulations of production or even research units. Such "unnamed departments," dealt with by Contributing Editor Cady in the article starting on page 157, can unearth information of unusual value, especially if they are left to operate in the unconventional manner indicated by their namelessness.

All in all, a break from tradition is underway in research and semi-research departments. It will be the smart, and successful, company that recognizes the need for such a break and that gets the jump on competition by taking advantage of this new approach to an old need.

HOW IT WILL BE DONE

DESCRIBING their new pilot plant that will serve as a practical link between the laboratory test tube and the production line, an official of Corning Glass Works has this to say about the way in which they are attacking immediate phases of "new thought" research: "This plant will be equipped initially with one continuous furnace and the most modern machinery available, thus enabling us to conduct experimental work without interfering with the production schedules of any of our manufacturing plants. As our laboratories develop new products, manufacturing techniques for producing them at low cost will be worked out in the pilot plant, and the knowledge so acquired will be translated into commercial production units."

Another indication of the trend in research today is the new physical laboratory built by Universal Oil Products Company, to be devoted to aiding its own and other oil refineries. Says the company:

"Up to 10 years ago, most petroleum research was in chemistry. But with the advent of catalytic cracking in the middle '30s, physical research has been playing an increasingly important role."

In the new laboratory will be X-ray, ultra-violet, and infra-red equipment, together with an electron microscope, which will make it possible to conduct studies of the catalytic cracking process in all its aspects.

From such pilot plants and laboratories can stem new industrial knowledge that will be not only of immediate benefit to the specific industries concerned but to all allied industries as well. On such bases must the industrial future of America be built. The sooner this research philosophy permeates all industry, from the automotive and electrical giants to the two-man producers of cast concrete objects and plastics products, the sooner production can be expedited and progress turned to the benefit of all.

THE RIGHT TO FAIL

INSEPARABLY linked with the new research philosophy thus far discussed is "the right to fail." When research departments of any kind are given the freedom to venture into new and hitherto untried paths, they must also be given the privilege to fail. If they are not, they will be so hindered in their operations that results will be practically nil. This is not to say that consistent failure can be considered as a sign of success; but it is to indicate that occasional failure should not be taken as a reason for discontinuing efforts in a particular direction. Research risks must be intelligent risks, must be carefully appraised in advance and thoroughly thought out before they are taken. On such a basis any research program which takes recognition of the problems involved and which takes intelligent risks will be the one to succeed, as compared with the one which, through ultra-conservatism, refuses to acknowledge the right to fail and, hence, finds itself so hide-bound by tradition that it follows those beaten paths which lead only to mediocrity.

FOR FUTURE REFERENCE

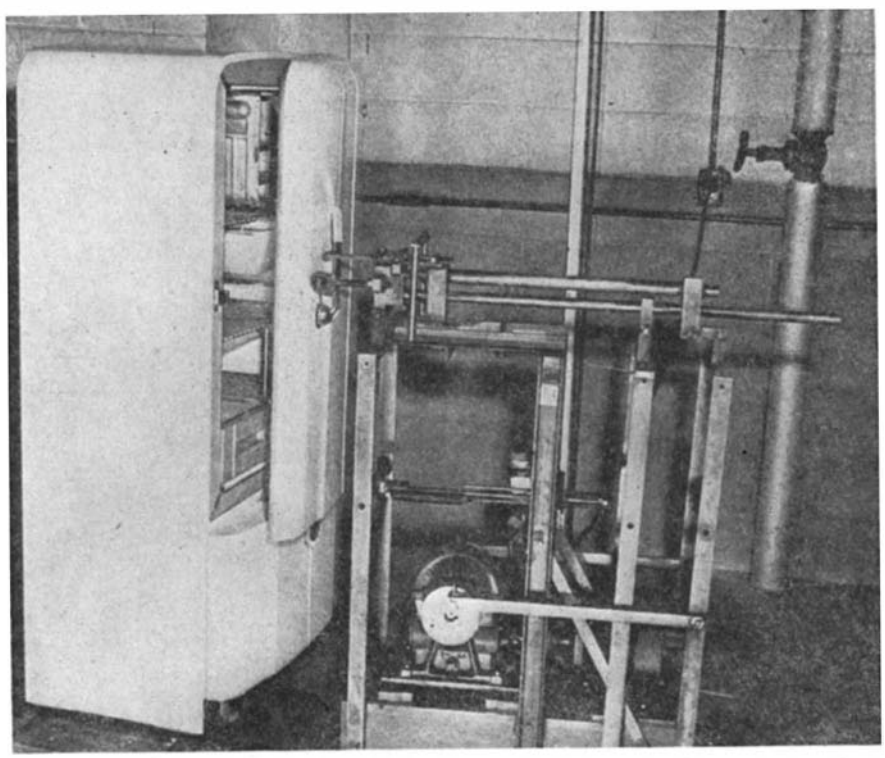
AIRCRAFT heating units—small, light in weight, economical of fuel—have been engineered and tested for application to home-heating purposes and should be available by the time these lines appear in print; first indication of this trend was mentioned on this page in March 1944. . . Newspapers by radio facsimile, on the horizon for years and specifically called for on this page in September 1945, will be given a service trial in a number of United States cities early in 1947. . . Where extreme heat, coupled with problems of corrosion, has to be dealt with, look to the porcelain enamel industry for solutions, based on war-time experimentation with engine exhaust pipes and mufflers. . . Aluminum's progress—current output is triple that of pre-war—is taking it out of the pot-and-pan field and putting it squarely into a number of construction jobs of considerable magnitude; aluminum is clearly one industry that is not caught with its plants down; it can and will produce as markets require. . . Lumber, our one replaceable natural resource, must be seasoned before it can be satisfactorily used; now comes a chemical solvent method of drying which reportedly beats the kiln process by four to one in time factor. . . When thoughts wander toward large corporations as patent monopolies, remember these figures as the latest available: Patents to individuals represent 43 percent of all issued; to small corporations, 34½ percent; to large corporations, 17 percent; to foreign corporations, 5½ percent.

METALS IN INDUSTRY

Tests Or 'Traditions'?

Conventional Materials Tests and Methods Have a Place—But Only If the Information Gained is Truly Significant in the Light of Actual Product Usage. Simulated-Service Tests are Often Much More Truthful, and May Indicate the Application of Previously Unconsidered Materials

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



Courtesy Westinghouse

Simulated-service test on refrigerator door packs years of hard use into days

AN OLD engineering maxim holds that "one test is worth a thousand opinions." Broader understanding of this principle has been a leading factor in the development of American manufacturing over the the past three decades. Out of standardized-test methods have come not only better quality engineering metals and alloys, but also the uniformity of properties so essential to the reproducibility of parts and finished products. This latter, of course, is the keystone of minimum-cost mass production.

Now, however, another idea is fast taking hold and is expected by leading engineers to be the handmaiden of product and process development in the years ahead. A simple axiom for the idea would be, "One good test is worth a hundred bad ones!" Today, this concept is finding increasing application in the careful scrutiny of time-worn test methods, procedures, and equipment to see how much of their hide is bound to 1935 ideas; in the exclusion of "irrelevant" physical properties as major factors in materials-selection or design, even though the use of such properties and tests may have been standard practice for the past 20 years; and in the growing use of "simulated-service" tests, especially on finished parts or product assemblies, as against standardized tensile or fatigue tests on bars of the raw materials before processing.

SIMULATED SERVICE — This last phase is creating the largest ripples of all in today's testing circles, and as the simulated-service test wins new converts it is in turn inspiring new highs in inventive ingenuity. Sometimes the simulation is a virtual duplication of service conditions; in other cases it is a highly simplified reproduction in the test of the one or two basic service factors that usually cause failure of the material or part when in use.

The case of bearing metals offers an example of such a problem. It is known that a multiplicity of factors —compressive strength, flowability, wettability, embeddability, resistance to galling or seizing, coefficient of friction, corrosion resistance, resistance to "fatigue" failure, and so on—are all involved in bearing service. At one extreme, bearing metals have often been appraised by individual tests or a series of separate tests of tensile strength, ductility, salt-spray corrosion resistance, fatigue strength of polished bars, study of microstructure, and the like. At the other extreme—also used quite frequently—is the method of putting bearings made of the materials in question into an automobile and driving the car until the bearings fail.

The best practice, and the one used more and more by the better engine and bearings producers, is to devise a bearing-testing machine in which assembled bearings can be quickly and easily inserted, run at controlled and recorded speeds against whatever shaft materials are

desired, at selected bearing pressures and clearances, and under lubricating conditions that can be varied and controlled at will. Such tests are carried out on an accelerated basis that has previously been proved to rate the different bearings accurately with respect to the particular service conditions applied in the test. This preparatory and correlative work isn't always easy or inexpensive to do, but once done it pays dividends in common-sense results, in assurance of intelligent selection of materials, and in improved life of the product.

TESTS THAT AREN'T TESTS — Some of the well-known "properties of materials"—and their required tests—that have been standard bases for materials-selection for years are now regarded unfavorably by capable materials engineers and metallurgists. "Ductility," for example, is usually measured by the standard elongation test, in which a test bar is pulled in a tensile machine until it breaks. The amount the bar stretches before breaking is expressed as a percentage—called the percent elongation—and is generally accepted as a reliable index of the ductility of the material.

Moreover, good ductility is usually considered a basic criterion of the engineering quality of a material—except by some of the more analytically minded technical men. To the latter, if ductility is actually required in the specific service to which the material is to be put, then ductility should be specified and tested for; but if the service involves no plastic deformation the ductility requirement is completely irrelevant and materials with test figures near "zero" elongation may, for entirely different reasons, be better for the particular service involved than those with 20 or 30 percent elongation.

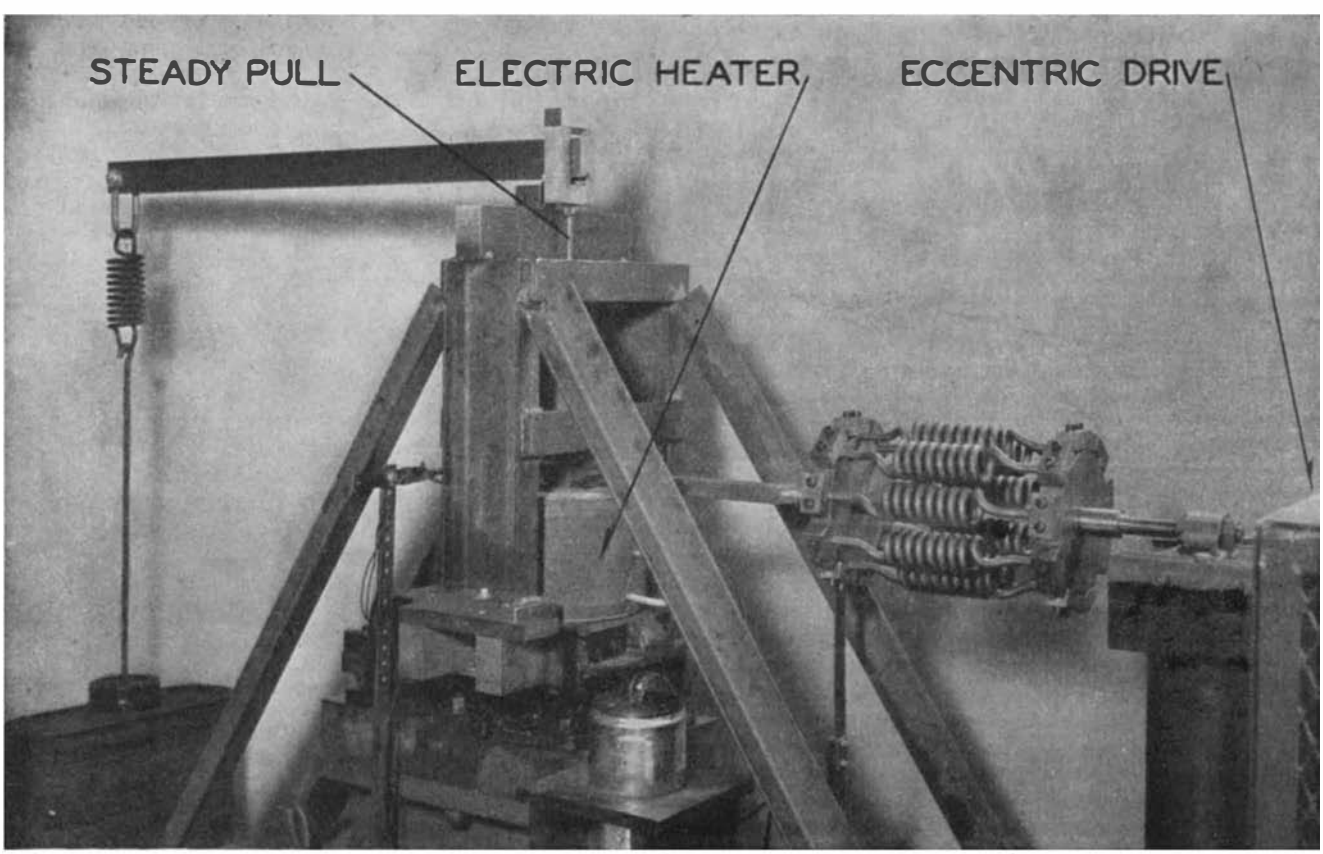
• LOOKING AHEAD •

Fewer failures in use of materials thought to be thoroughly tested. . . Reduction of manufacturers' losses on defective parts. . . Lower-cost materials effectively applied on basis of accurate test knowledge. . . Longer trouble-free service life of functional parts. . . Establishment of new standards for modern composite materials.

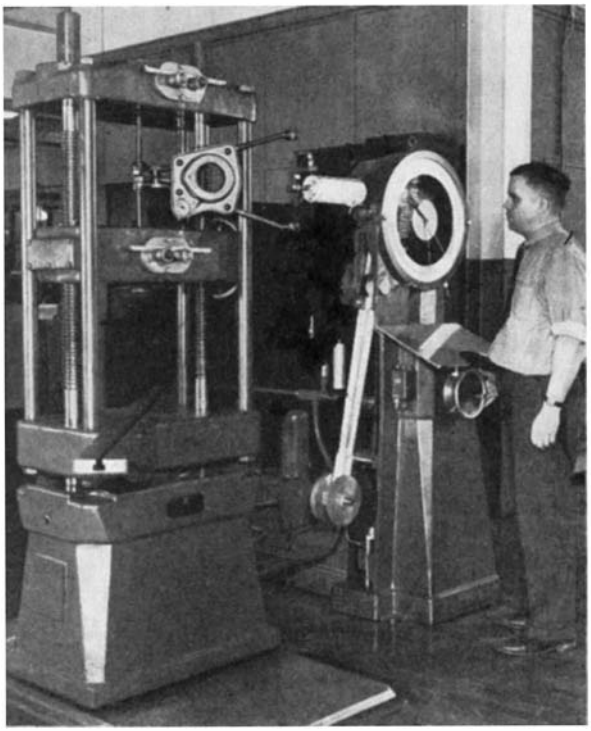
With this common-sense engineering philosophy some of the oldest prejudices about materials are rapidly vanishing. Cast iron, actually a "brittle" or non-ductile metal, emerges as a first-class engineering material. Engineers recall that cast iron has long been used successfully for hundreds of structural purposes including machine-tool bases, certain types of bearings, motor frames, and so on, and proceed to apply modern, stronger, cast irons—still with relatively poor ductility—in crankshafts, forming dies, marine propellers, pumps, and elsewhere to marked advantage.

This policy of fitting the property-requirement and the test to the actual needs of the service involved is similarly applied to the impact test, a standard procedure in which mechanical shock resistance is measured by determining the amount of energy required to break a piece of metal, usually notched, by striking it with a hammer. Many engineers have sworn by the notch-impact test as the best single indication of "inherent" quality in a material. But it becomes a foolish method of rating or selecting materials for an application that does not involve sudden blows upon the metal or if the design of the part can be made to avoid notches, sharp changes in section, or other potential points of weakness.

Corrosion tests have notoriously been abused through their complacent application in situations where their results were actually misleading. Thus, the so-called "salt-spray" test, in which pieces of metal are sprayed with a salt-water mist fed through a circulating system, has been employed in many specifications and by many organizations as an infallible measure of corrosion resistance no matter what the actual service environment is to



A variety of forces act upon turbine blades. Test above reproduces the more important ones for study under controlled conditions



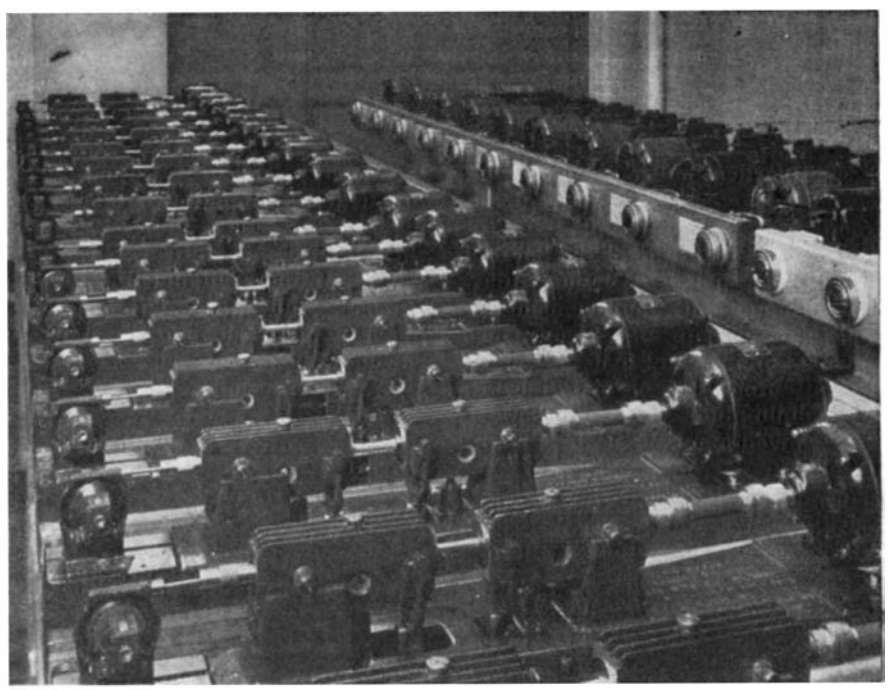
Left: Testing of finished parts—a Buick knee-action member—and (below) of basic raw materials—battery of testing units at Aluminum Company of America—exemplify dual aspect of industrial testing problem

be. For many sea-going applications the salt-spray test is a truly reliable index of merit, but for other corrosive services it is only coincidentally so, and for many uses the salt-spray test gives absolutely false ratings of alloy suitability.

NEW MATERIALS: NEW TESTS—The American Society for Testing Materials, pioneer in the standardization of engineering materials-specifications and test methods, has been quick to spot the evident weaknesses in the use of many of its own standard tests, and is now carrying out a program of establishing the actual limits to which standard individual tests on single materials can be employed for service-life evaluation. Searching studies are being made of the significance of ductility and of the services for which fatigue, impact, salt-spray, stress-corrosion, and other "pet" tests are really meaningful, and those for which they are irrelevant or downright misleading.

Even more important, the Society has established an administrative committee on simulated-service testing, with the stated purpose of studying, developing, and standardizing methods of tests of simple materials, composite materials, and fabricated parts in actual or simulated service conditions and environment, insofar as performance has a bearing on the properties of the materials.

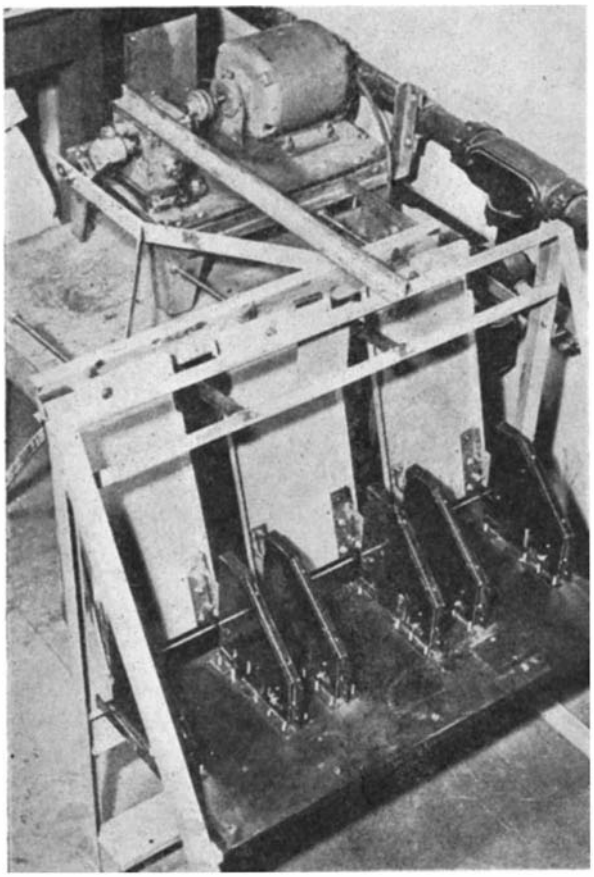
The prime movers behind this whole broad trend have been the increasing number of "composite" materials—reinforced or laminated plastics, plated metals, metal-plywood sandwiches, and so on—and the lengthening list of fabricated forms—die castings, powder-metallurgy parts, precision castings, impact extrusions, brazed assemblies, and deep-drawn shapes—in which materials are now placed in service. Each of the fabricating processes has its own effect on the quality and serviceability of the material; beyond that the material in the assembled product often behaves differently than it would before assembly or before processing.



YEARS BECOME DAYS—Because of this last effect, one of the most fascinating of all testing fields—the evaluation of materials by simulated-service testing of the entire unit in which they are used—is coming into increasing prominence. At a recent A.S.T.M. meeting a Westinghouse engineer described some of the unusual set-ups used by that company to give an accelerated but accurate measure of the way materials would perform in service. A refrigerator door, for example, may have a fine appearance and work well for a few times, but this is no assurance that it will function satisfactorily over a period of years. The spring in the latch could break, through fatigue; the latch and hinges could wear excessively; the sealing could become inadequate, and so on.

Therefore, in place of fatigue and wear-testing the materials or parts by conventional test methods, and in place of waiting for a housewife to open and close the refrigerator door to death, a machine was made which performs that operation continually—verging on the slamming side for good measure—24 hours a day to failure. The machine operates at 15 cycles per minute, and an equivalent door life of 15 years is compressed to about 12 days by the robot door-slammer.

In another case, a test apparatus simulates the repeated sliding of a refrigerator tray or drip pan, as a check on the durability of finishes, materials, and the design of supports. And in still another check-up, a simulated-service fatigue test for turbine blades, the blade is heated electrically to simulate the temperatures reached in service, variable stress is applied through an adjustable eccentric, centrifugal force is simulated by a flexibly con-



Oven-door hinge and lock stop operate hour after hour in this service-type tester. Materials, as such, may have apparently desirable properties yet give a disappointing job performance. In other cases, standard materials tests do not indicate actual capabilities of material as it is used; hence, simulated-service tests

Editorial purpose of Scientific American is to provide its readers with thought-provoking feature articles and shorter items on all phases of industrial technology. In every case the material is drawn directly from industry itself. The Editor will be glad to refer interested readers to original sources and, when available, to additional literature giving further details of a more specialized nature.

nected vertical pull mechanism, and so on—a far cry from conventional room-temperature fatigue tests on machined bars of the blade material. And these modern methods have led to important improvements in materials, design, and performance.

This is not to say that the fundamental properties of materials are of declining interest to engineers, or that conventional standard tests will ultimately be abandoned. On the contrary, designers are increasingly and intensively interested in learning more about the fundamental fatigue properties of stainless steel, the notch sensitivity of zinc alloys, the flexural strength of individual plastics, and like subjects. With such information entirely new materials can more intelligently be developed, while such data can also be used for broad and preliminary weeding out of materials being considered for specific applications.

But there is a sharp trend toward using the conventional standard test *only where it has significance*, and developing simulated-service tests for evaluating application-performance where several complicated service factors are involved.

● ● ●

ALUMINUM vs COPPER

Battle Heightens as Prices Approach Same Level

HOTTER and hotter competition is expected between copper and aluminum for electrical-conductor applications in the future. Already aluminum—steel-reinforced—is preferred over copper for power-transmission lines, despite the still lower price of the latter on a weight basis.

But the trend is for aluminum prices to go down and for copper, if any change develops, to go up. Britain recently lowered its aluminum price below that of copper. American copper producers have sought a 15 cents per pound price for copper, which would make 14- to 15-cent aluminum slightly more attractive on a price-per-unit-weight basis, and considerably more so on a price-per-equivalent-volume or a price-per-conductivity-unit basis.

SILVER "SOLDER" BASE

Applied by Brush or Spray, Requires No Firing

A NEW coating composition containing finely divided silver particles to be spread upon almost any material to form a "solderable" base for attaching metals has been developed. Several silver solutions have come out in recent years for firing onto a glass or ceramic base, but they must be heated to around 1000 degrees, Fahrenheit. In this newer compound, the silver particles are combined in a solution of butyl methacrylate polymer dissolved in naphtha, butanol, or xylene. The coating can be applied by brush, spray, and so on to virtually any permanent base.

VIBRATION DAMPENED

By Use of Magnesium Castings

MAGNESIUM is now finding new uses because of its vibration-dampening properties. Thus, one automobile maker has decided on magnesium-alloy wheels, both because of lightness and freedom from the vibration of steel wheels—the latter vibration is said to cause wear on the rubber tires. This maker is now experimenting with processes of manufacture, including sand casting. A maker of fishing tackle accessories has devised a magnesium reel. The light metal's dampening qualities are reported to make the reel silent and smooth in operation.

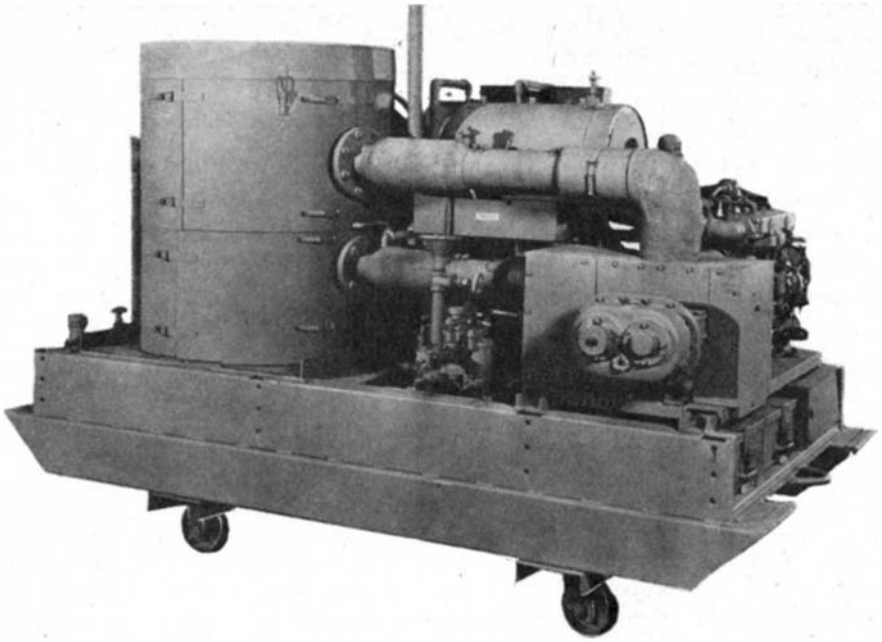
PRESSURE VESSELS

Built Up of Multiple Layers of Pre-Formed Plates

A NEW method in pressure-vessel construction has been applied by A. O. Smith Corporation in the fabrication of large accumulator bottles for stored-energy systems and chemical processing equipment. This is the use of several layers of steel plate, each one rolled to a specified radius and then welded.

This type of construction permits the use in service of much higher working stresses than otherwise. Shatter failures through the built-up wall of the vessel never occur. The use of steel plate and welded fabrication also permits closer control over the quality of the pressure-vessel materials, since uncertainty regarding deep-seated flaws is eliminated.

In the chemical-process field, welded multi-layer construction also provides all the advantages of "cladding," since the innermost layers may be of a corrosion-resistant steel and the outer layers of ordinary mild steel.



Production model of Kleinschmidt compression still can be mounted on a trailer or skids. Capacity is 1800 gallons per day; water obtained is exceptionally pure

CHEMISTRY IN INDUSTRY

Making Heat Work Overtime

Basically Simple and Extremely Practical, Compression Distillation is One of Those Processes that Prompts the Unanswerable Question of "Why Hasn't It Been Done Before?" By Complete Heat Utilization, the Method Produces Pure Water Quickly and Economically, Yet Involves No Cooling, Uses Little Space, and Demands a Minimum of Attention

By D. H. KILLEFFER
Chemical Engineer

IT ALL started because the Navy needed distilled water for the storage batteries of its submarines —distilled water at low cost, lower than any yet known, particularly in terms of space inside the crowded confines of the submarine's narrow hull, and in terms of fuel that might mean precious extra miles, or hours, or speed for the vessel, and of man-hours of operating attention. All this was realized by compression distillation, but that was only a beginning. A whole war has intervened, with sea battles on the far reaches of the Pacific and invasions of waterless islands won, in part at least, because our men could supply themselves with sterile, fresh water when the enemy could not. And even yet only beginnings can be reported.

Now that the basic problem of this new distillation system has been solved, the whole thing appears absurdly simple. Absurdly simple, that is, if it is simple to think of a refrigerating machine as a still, and to put it to work freshening seawater. In that respect, the Kleinschmidt compression - distillation unit has all the characteristics of a great invention—anyone could invent it now that he knows how. Which of course is no slight at all to Commodore R. V. Kleinschmidt, of U.S.N.R. and Arthur D. Little, Inc., whose invention it is. Quite the contrary.

The basic fact of distillation is that the operation ends with the water just as it was in the beginning. The heat put in to vaporize the raw water is just equal to that taken from the steam to condense it. It is quite possible, theoretically, to distill water so that the heat given up by the condensing steam will boil an equal quantity of water. The whole process might thus be made self sustaining, but practice can never quite equal theory. What occurs in the Kleinschmidt compression still is the closest approach yet to that theory.

INPUT VS. OUTPUT—An analogy of gravity to heat or temperature makes the whole thing clearer. Distillation in those terms is equivalent to lifting a load to the top of a hill and then dropping it down the other side; like an inclined railway up a mountain whose car is pulled up by the engine and then allowed to coast down. In an ordinary single-stage distillation, this is just what occurs; energy is put into the water to vaporize it—carry it to the top of the heat hill—and then it is

• LOOKING AHEAD •

Application of pressure stills to food processing, chemical manufacture, biologicals. . . Increased use of distilled water in industries where cost is a large factor. . . Portable water supplies for construction crews, explorers, survey parties. . . More cargo space on ships large and small.

dropped down the other side—cooled. The heat initially put in is simply wasted.

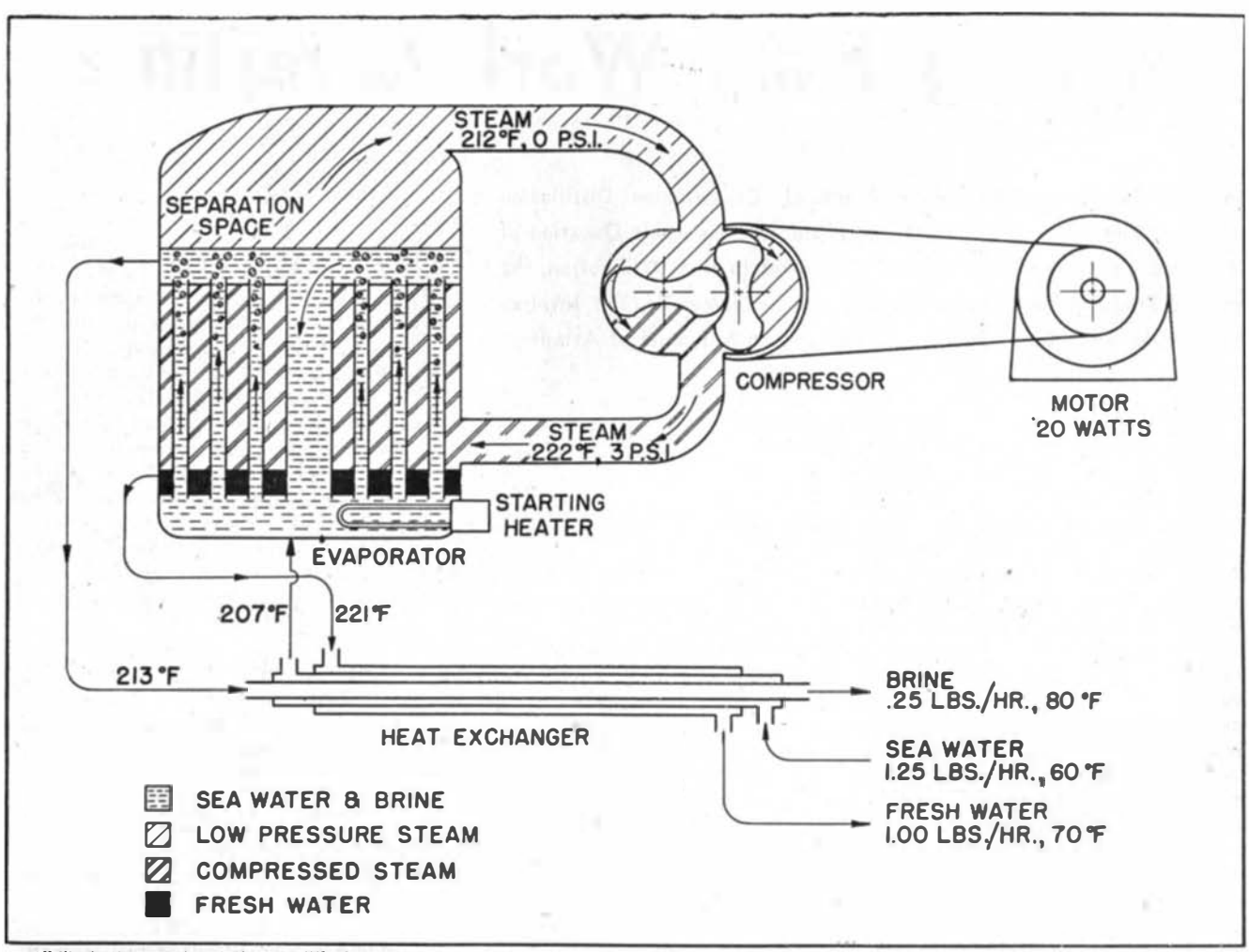
This waste is not too bad if heat energy is plentiful and if water is abundant to cool the condenser and waste its heat. But these conditions seldom happen, and hence the thing to do is to recover as much as possible of the lost heat.

The case of the cable railway is quite different if a car going down is connected to one coming up by a cable running around a pulley at the mountain top so that the two cars counterbalance each other. Then the energy needed is merely the small amount required to balance the two cars plus another small amount consumed by friction. The engine need work no harder than would be necessary to move the two cars on a level. The difference is obvious—it is also tremendous.

Multiple-effect evaporation provides a number of stops on the downward slope of the heat-hill at which the heat initially introduced into the system is made to work again. In principle, a multiple-effect system should theoretically produce an almost infinite amount of distillate for any given amount of heat put into the system. The vapor from the first stage is condensed to heat the second stage, which is maintained at a slight vacuum to allow its contents to boil at a lower temperature than that of the condensing vapor from the first stage. As vapor from the second stage condenses, it heats a third stage maintained at a still lower pressure—higher vacuum. And so on.

Theoretically, any number of effects should be possible and the quantity of water distilled by the combination should be as many times that vaporized by the heat initially supplied to the system as there are effects. In other words, a double-effect system should yield twice as much distilled water as the same amount of heat input would vaporize in a simple evaporator. A triple-effect unit should yield three times as much, and so on. In practice, the sizes of heating surfaces required, the temperature drop necessary in each step, the vacuum required, and other similar considerations limit multiple effects to three, or possibly four, stages for maximum economy. Only under most unusual circumstances is it practicable to go beyond that, and then only in units of immense size.

HEAT STAYS IN—The principle of the Kleinschmidt mechanical-compression distillation unit is quite different and is analogous to the cable railroad mentioned before. The heat to vaporize water is supplied by condensing the vapor boiled off from the same boiler. The heat of condensation is returned to the system through a heat pump operating on exactly the same principle as a mechanical refrigerating machine. Because only one transfer of the major quantity of heat is



All illustrations courtesy Arthur D. Little, Inc.

Figure 1: Schematic drawing of Kleinschmidt still reveals temperatures, pressures, and flow channels in conversion of sea water into fresh water and brine. No cooling water is used, process is continuous, and adjustments are both simple and infrequent

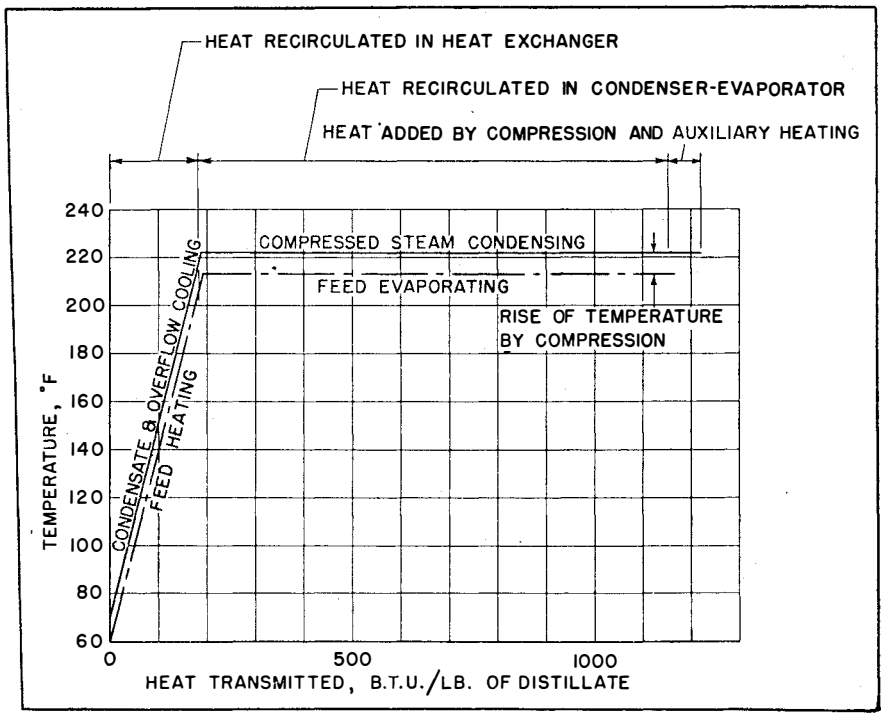


Figure 2: Temperature differentials maintained within compression still are fundamental to the ingenious heat transfer that gives system its efficiency

necessary, only a single resistance need be overcome by energy put into the system. Hence compression distillation units are many times more efficient than practicable multiple-effect system in terms of distilled water produced per unit of energy or fuel. Furthermore, the entire unit is self contained; requires no cooling water; is stable in operation; needs a minimum of attention from the operator; and yields sterile distilled water of highest chemical purity directly from seawater. The whole unit is so compact that losses of heat to the outside are extremely low, far less proportionately than would be reasonable for an ordinary multiple-effect installation.

Compression distillation depends upon mechanically compressing the steam leaving the evaporation compartment of the still to raise its temperature a few degrees. At the higher pressure, the steam condenses above the boiling point of the evaporating raw water, so that heat can flow from the condensing steam to the raw water and boil it. The complete unit includes insulation to reduce heat loss to the atmosphere and exchangers to recover heat from both the hot distillate and the hot, concentrated brine carrying off waste. No separate condenser and no cooling water are needed.

The process as applied to the production of fresh water from sea water is diagrammed in Figure 1. Initial pre-heating brings the apparatus and its contents to operating temperature. As soon as the evaporator is filled with steam, the still is ready for continuous operation. The seawater feed enters through a triple passage, liquid-to-liquid heat exchanger to extract heat from the outgoing distillate and brine, and to heat the feed. The feed thus heated to about 207 degrees, Fahrenheit, enters the evaporator and mixes with a relatively large volume of brine circulating naturally through vertical tubes. Steam at, or slightly above, atmospheric pressure is led from the evaporation space through an entrainment separator to the compressor which raises its pressure to about three pounds gage. This raises its condensing—saturation—temperature to about 222 degrees. Since brine boils at about 213 degrees, a temperature differential of about nine degrees between the compressed steam and the boiling brine permits transfer of heat from one to the other. Substantially all of the latent heat of the compressed steam is thus transferred to the evaporation space and no separate condenser or cooling water is needed.

SIMPLE TO OPERATE—A unit of 1000-gallons-per-day capacity will yield one pound per hour of pure distillate using about 20 watts of electrical energy. A single-effect evaporator would require approximately 300 watts for the same yield. The Kleinschmidt compression-distillation process thus has an economy equivalent to some 15 or more effects in a multiple-effect system operating on seawater, and the compression-distillation unit is far simpler to operate than a multiple-effect unit. Its connections, heat-transfer apparatus, and controls are no more complex than those on a single-effect evaporator. Control is ordinarily effected by adjustment of feed only and shop test units set up for manual control have run day and night for as long as a week without adjustments of any kind.

The basic principles of the process are best understood from the relationship between the heat quantities and temperatures throughout the process as shown in Figure 2. Cold feed entering at 60 degrees, Fahrenheit, is heated (inclined dot-dash line) to 207 degrees by heat exchange with the outgoing condensate and overflow (inclined solid line). Final heating in the evaporator raises the brine from 207 degrees to 213 degrees. The hot feed is vaporized (horizontal dot-dash line) by heat exchange with the condensing compressed steam (horizontal solid line). Clearly, suitable temperature differentials permit exchanges of heat where needed. The temperature differentials are 10 degrees in the heat exchanger and nine degrees in the condenser-evaporator. An excess of heat on the high-temperature side (right-hand end of horizontal solid line) offsets heat loss through the insulation and leaves an operating margin.

The operation is stabilized by allowing excess heat to escape with a small amount of steam discarded to the atmosphere through a breather vent. The total excess heat required for insulation and stabilization losses is about 55 Btu. per pound of distillate. Introducing 68 Btu. into the process at the compressor not only supplies this excess, but also creates the necessary temperature differential. In this manner 960 Btu. are recirculated in the condenser-evaporator and 190 Btu. in the heat exchanger. Thus the 68 Btu. introduced by the compressor circulates a total of 1160 Btu. per pound of distillate, and also supplies surplus heat for operational leeway.

With all-electric drive, the efficiency of the steam compressor need not be high. The amount of energy theoretically required for this compression would be only about 15 Btu. compared with the 68 Btu. practical in moderate-sized units. Actually, 35 Btu. is introduced at the compressor, and 33 Btu. by electric heaters in the evaporation zone.

Economy is somewhat governed by the pressure of the compressed vapor. This relationship, presented in Figure 3, suggests the limitations of the compression principle. These calculations are based on steam, but

could be calculated for other vapors. Compression-distillation units developed thus far have capacities of less than 250 gallons per hour. Insulation losses and allowance for operability are the governing factors in determining the heat input needed. Larger units operating under typical industrial conditions should be more efficient.

USES LESS FUEL—From seawater the Kleinschmidt compression method produces 175 or more pounds of distilled water for each pound of fuel consumed, a ratio three to four times greater than with efficient conventional systems using fuel to generate heat. This low fuel consumption proved of great value to the armed forces during the war. In the Navy, these stills released space normally given to fresh-water storage and, for many types of vessels, extended the cruising range to an extent that was strategically important. Kleinschmidt stills were used by Army and Marine landing parties, particularly in desolate Pacific Islands. On Iwo Jima, for instance, the Marines continuously had fresh water from beach-head compression stills, while the Japanese suffered desperately for water. By the end of the war, enough Kleinschmidt compression-distillation units were in service to produce pure distilled water for the daily needs of over a million men.

The Kleinschmidt distillation system is particularly valuable where waste steam is not available from other process operations. On Diesel and gasoline propelled fishing craft and small cargo vessels, the compression still replaces stored water and releases valuable space for cargo or fuel, thus increasing cruising range substantially. The Kleinschmidt still gives a definite saving, sometimes of critical importance, by requiring no cooling water. The new process not only gives a product from sea water containing less than one part per million of impurities by a single distillation, but the cost of producing this pure water may be less than 10 cents per hundred gallons.

Although the original objective of the system was to save precious fuel in distant places and on shipboard, this process, like most fundamentally sound processes, has other characteristics which may be of even greater interest than its economy of power. Thus the units are simple to operate, requiring control of only two valves—one for starting and one for control of the rate of feed of raw water. Any Navy engine-room rating can learn the operation in ten minutes. Another rather unexpected advantage is the extreme purity of the product, which, when made directly from sea water, contains less than one-tenth of the impurities allowable under Navy standards for double-distilled battery water. It is also sterile, since all the vapor is heated by compression to over 220 degrees, Fahrenheit.

The industrial possibilities of extremely pure water at low cost are enormous. In the photographic field alone there is a great opportunity for better and cheaper products. Pharmaceutical and other chemical industries, high-pressure steam plants, railroads, sugar refineries, and even textile factories, paper mills, and laundries in hard-water regions, may soon find compression-distilled water within their reach.

The obvious necessities and urgencies of war have directed development of this important new system toward freshening of seawater. Other possibilities have had to wait. Thus water looms large in all of the industrial uses of compression distillation now planned. Not just the production of pure water but also the removal of water from solutions as in the production of evaporated milk, maple syrup, and similar concentrates. Since the pressures and temperatures involved can be set at any convenient points above or below atmospheric, concentration of biological products and other heat-sensitive materials seems feasible.

Extension of the process to non-aqueous liquids, alcohol, solvents, petroleum, and so on, may be expected to follow commercial development of present fields. Certainly the economy and adaptability of the process suggest it.

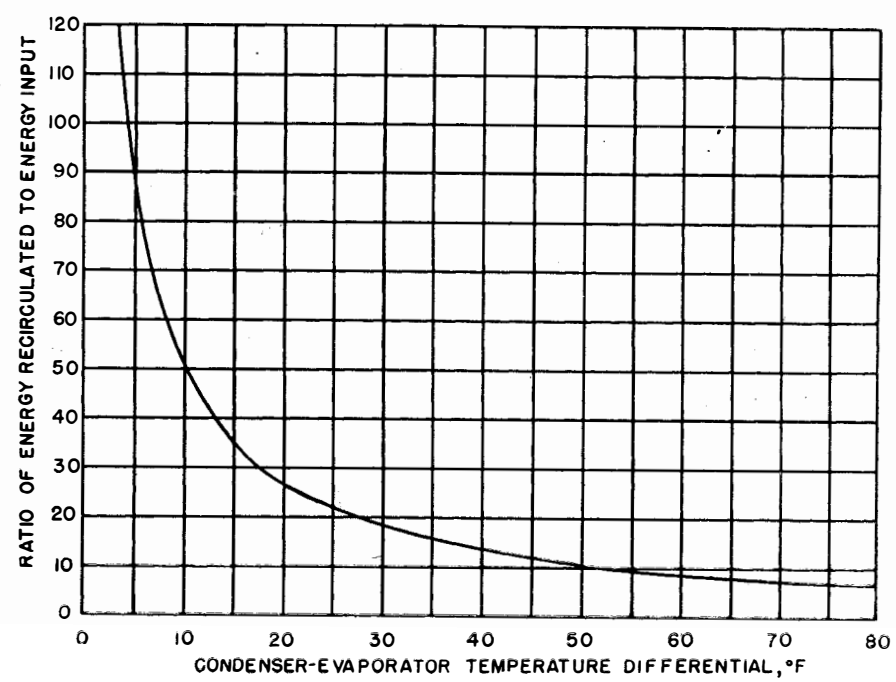


Figure 3: Economy of Kleinschmidt still is governed by compressed-vapor pressure

PAPER-MILL SLIME

Controlled by Use of Convenient, Packaged Chemical

HIGHLY soluble and effective as a germicide and fungicide, pyridyl mercuric acetate has been used with success for the control of slime in paper mills. Pyridose, developed by the Mallinckrodt Chemical Company, is packaged in one ounce quantities in paper envelopes.

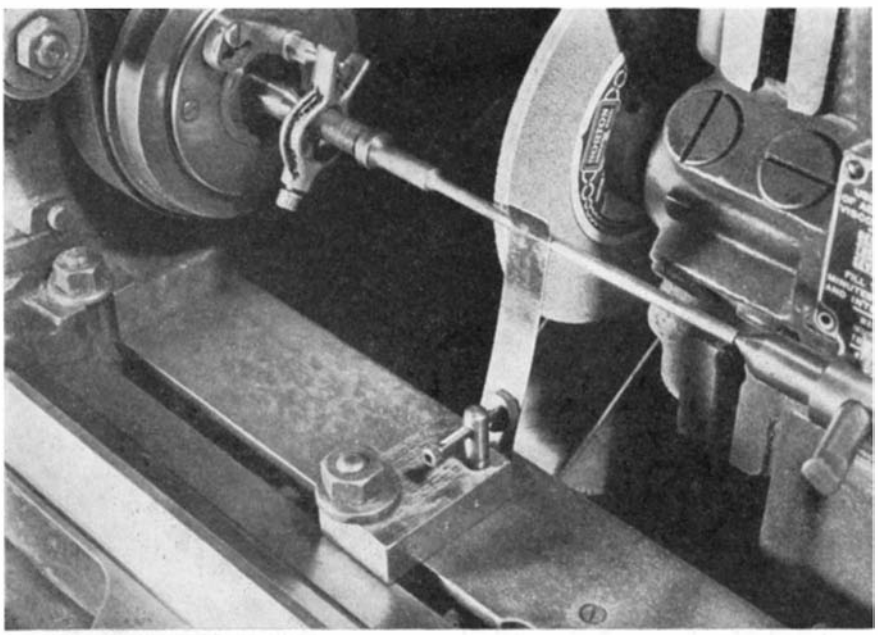
One package is the usual requirement for the treatment of 5 to 15 tons, dry weight, of paper pulp. One or more envelopes as needed are simply thrown into the beater or other convenient place in the stock preparation equipment. The envelope immediately disintegrates, distributing the treatment material evenly throughout the pulp.

The compounds formed from the substance with the ions common in water are significantly more soluble than the corresponding salts of other organic mercurials. Effective control of fungi and bacteria can increase the efficiency of the operation of paper-making machines, lengthen the life of the paper machine felts, and prevent unsightly blotches on the finished paper caused by contamination. Pyridose can be used to remove slime from an infected system without the necessity of shutting down the mill for cleaning.

Departments Without Names

Most Executives in Most Departments of Industrial Organizations are Too Specialized and Too Busy to Obtain a Bird's-Eye View of Their Firm's Integration in the Economic Matrix. Cognizant of These Facts, Many Companies are Establishing Departments—Sometimes of One Man—to Keep an Ear to the Ground and a Keen Eye on the Horizon

By EDWIN LAIRD CADY



Courtesy General Electric Company

Devices too small for any particular department's attention often make large differences in production or costs. Spring-travel grinding rest is an example

ONE of the world's largest makers of plywood has just hired a mechanical engineer, put him in full charge of a department that probably will never have a name.

Plywood is one of the oldest of engineering materials. The Pharoahs had their artisans make furniture and coffins of it before 1500 B.C. And yet its most ordinary forms were reduced to standards only a few years ago, and some of its most modern glues, wood treatments, and production techniques were new in 1945. The industry as a whole can produce at least three billion square feet a year of the well known spruce or softwood and the standard gum or other hardwood kinds. Hundreds of different combinations of woods, plastics, and glues are made into plywoods suitable for everything from extremely low-priced packing cases to such completely engineered and higher-cost items as textile-loom shuttles and airplane propellers.

In a situation that has as many possible ramifications as this one it is very easy for a big company to miss some of its best bets or to devote sales and production time to items which do not promise the best return.

CRYSTAL GAZER—It will be the job of the new engineer to watch all of this. He might be called the head of the Who-Ought-To-Do-What - And - When - And - How-Should-He-Do-It Department.

He will report to the president. But before reporting, he will ask a great many questions.

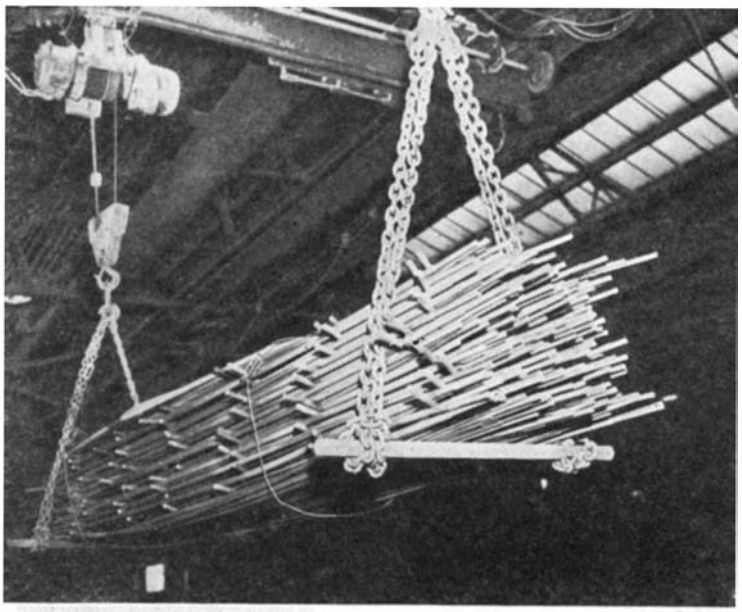
Who has planned the best prefabricated house and what kinds of plywood would reduce its costs or increase its saleability? Should lumber yards stock standardized houses made largely of plywood, or standardized parts of houses the rest of which can be made of almost anything? Will a brand new plastics glue for plywood veneers permit a greater use of demountable and returnable shipping cases for butchers scales, thus leading to the use of less plywood by some users of shipping cases but to larger ultimate sales by reducing costs and attracting new customers?

He will be going everywhere, talking to everyone. A machinery maker has a brand new veneer cutter which will cut the wood more accurately and smoothly. The more accurate the cutting the more strongly the modern glues will hold. Can the company make more money with veneers cut on these machines? Should smaller, specializing competitors be encouraged to take on the machines, improve their own products, get the bother of some of the smaller but highly specialized markets off the big company's hands?

This engineer gave no permission to quote his name or that of his company lest he be deluged with suggestions and inquiries which ought to go to sales or purchasing or other departments. But in an interview, he said "I must read every trade and business paper I can, be familiar with every kind of industry, meet every research man. There seems to be nothing in industry which my men will not find to be touching the plywood picture somewhere."

LONG-RANGE PLANS — A large foods company took two of its ace public relations men, put them in charge of just such a department several years ago. And the department has paid dividends.

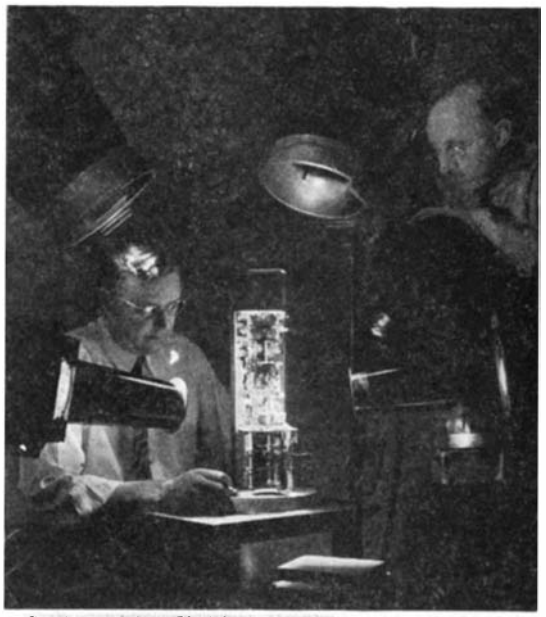
Working closely with these men is every mechanical engineer and chemist in the company. They all have to take long looks into the future. The foods manufacturing busi-



Courtesy Du Pont Company

Modern methods of de-scaling steel were once only dreams in departments without names

Below: Movies at 2500 frames per second yield data for unnamed departments. Product performance, new fabrication techniques, knowledge of users' problems and competitors' activities, are often bits of industrial intelligence that form a basis for the reports from these departments



Courtesy Western Electric Company

• LOOKING AHEAD •

Technically, economically, politically —fewer business "bumbles". . . Less confusion within companies on "policy" and planning. . . Keener executive appreciation of the interdependence of producers, users, even educators. . . Advitising that says more, means more.

ness is changing all the time and almost always for the better.

There is, for example, the matter of vitamins. Vitamins can be synthesized and added to foods in the processing plants. But some of the best forms of them are best added by growing them right into the raw foods on the farms. And this often means that the farmers must use vitamin-bearing fertilizers, chemical combinations that all too seldom are put into the soil.

Does an adequate college text book exist on the subject of "getting more vitamins into the crops?" If not, this department must talk with professors in the better agricultural colleges, make contacts with technical-book publishing houses, get such a book written and published.

Many a food-value question is going unanswered because there are no specially trained scientists who have the time to find the answers. This department goes to the colleges, sets up scholarship and other funds, gets brilliant young science students to study specific problems. There will be a job waiting for every one of these students when he finishes his studies. Perhaps that job will be with this company, perhaps with a competitor, perhaps in a university, or with a government department. These nameless departments of business have to take it for granted that hundreds of other business and professional institutions will benefit by their work just as thousands of smaller makers of similar products get free rides on the advertising of the larger companies.

This department keeps in constant touch with developing laws in the national and state capitols, has long and serious talks with legislators. Bigger public health budgets mean higher sales of the better and costlier foods products. A law which suggests or requires changes in food processing methods may mean big changes in foods factories right now, even bigger ones to take place gradually over a period of years.

The mechanical engineers must be ready with the plans for new machinery and equipment to take advantage of or to comply with a new law long before that law is formally entered on the statute books. The engineers have to know, too, what the new research is likely to bring out, what production plans they must make. Otherwise, the fulfilment of an opportunity to make and sell more and better foods would be a slow process.

"BRINGING UP" A PROCESS—One of the largest strip-steel and wire-products makers has an engineer in charge of a department so nameless that he does not even know to whom he is supposed to report his activities. He just reports to anybody in the company, brass hat or assistant foreman, who might be interested in something the department is doing.

The research department brought out a new welding technique which would permit stronger than usual joining of thin, stainless-steel materials. After making sure that the process would work on a commercial scale, this engineer and his assistants began to ask questions of prospective users.

Who needed stronger welds in thin, stainless-steel products, and at what costs, and with what production speeds? They asked the product designers of automobile and airplane companies. They went to the makers of building materials, to the National Bureau of Standards, to the National Housing Authority. They sent researchers to local hardware stores to see what complaints the consumers were making about present products. They studied mail-order catalogs and advertising pages of magazines, talked with makers of thin-materials forming machinery to see if the new product might make differences in production speeds or bring about new machine designs, did everything to get more and more ideas.

Their story would have been very nice if it had turned out that the process was perfect and that an enormous market awaited its products. But there were problems. The process was a little too slow. Worse still, it was not flexible enough, it would not work equally well with all of the variations of carbon con-

tent and metals ratios which steel makers are permitted by existing standards to put into a single grade of stainless steel. It needed highly expensive, rarely obtainable special steel grades to do its best work.

Any company which did not have one of these nameless departments would almost certainly have had to abandon the project, write off its development costs, give up hopes for its profits. But this engineer and his department were just starting.

First of all they walled off a special department in one of the company's buildings, got the process set up, started making products on it. These products often were sold at a loss. But from every one of them something new was learned.

This went on for three years. In the meantime the engineer went to a local engineering school, signed a large check in behalf of the company to set up a fellowship, got a professor to work on the equipment and its problems, persuaded several engineering students to work on it as part of their studies.

One by one the kinks were ironed out, the process was applied to new and more profitable uses, the markets developed. As fast as the engineering students who worked on it in school were graduated they found good jobs waiting for them, either as operators of the process or as application engineers to get it into operation in the plants of customers of the company.

BENEFITS WIDESPREAD—A maker of abrasives has a department within the nameless department to study all new processes and developments which might affect the making or the using of the company's products.

These men may recommend that the company buy up a new material or mechanism, or buy some of the rights to it, or buy out the company that developed it so as to get the engineering man-power as well as the sales and physical assets behind the product.

More often, they go to work for the product developer without charging him a cent for their efforts and even, in some cases, without telling him what they are doing. They go to the research laboratories of universities and to consulting laboratories, spend company money to have the applications and possible improvements of the products studied. If the new product can increase or otherwise affect the sales of their own products they issue bulletins on it to their sales engineers, suggest its purchase to customers, arrange for mill supply houses to stock it.

What they learn from the universities and the consulting laboratories cannot always be taken direct to the product maker lest he suspect that a big company, perhaps big competitor, is interfering in his business. But a quiet hint to a user of the product to ask for certain improvements, or any of a dozen other roundabout methods usually will get the desired results.

As a result of this work the company almost always is ready with new products before the changes in its markets occur, and always is a leader in new technical developments for its own production line.

MEN ALSO STUDIED—The treasurer of one of the largest makers of alloys is the head of an unnamed department. He studies men rather than products and techniques.

Every time the company hires an exceptional student from a college, and whenever someone already on the payroll shows signs of imagination, this treasurer runs a personal file on that man. He learns what the man is thinking about, what he likes to do, has personal interviews with him, studies his work and his progress in the company.

Sooner or later the treasurer finds a new development which the man is capable of handling. The man is put in full charge, told to work with the company engineers and other authorities, but to build that new development if he can. He is given a budget plan which may cover five or more years ahead. The men so developed have made the company such a leader in its field that government authorities want to break it up, yet never once has this selecting and building of men been made a formal policy under a department with a name.

These nameless departments are everywhere in industry. No two of them are exactly alike, excepting that all seem to be preservative and constructive to industry as a whole as well as profitable to the companies that have them.

"BUTTER-LAYERS"

Once Weakeners of Parts, Yield to "Super-Finishing"

ANY STEEL is a mechanical mixture of extremely fine particles or grains variously bound together. Some of the grains are hard and brittle, some are hard and not brittle, some are soft and brittle, some soft and malleable.

The malleable grains can cause trouble. Cutting tools, whether they be the steel tools used in cutting or the abrasive grits of grinding, will break off the brittle particles and push aside the grains which are hard but not brittle. But the malleable grains have a tendency to stretch under the tool pressures and be spread like butter across the finished surfaces.

In extreme cases, such as permitting lathe tools to "ride the work," this "butter-layer" can appear like a burnishing job with the work becoming as much as .003 inch oversize. In fine grinding, this buttering effect can produce a surface which measures accurately under the micrometer but shows a roughness as great as 20 micro-inches under the Brush Surface Analyzer.

Also, the butter-layer is a false finish prone to sluff off in bearing metals and shorten the lives of bearings, to abrade mating surfaces, to be an easy point of corrosion attack, and to provide areas at which stresses may concentrate to cause abrupt failures of parts.

Modern super-finishing methods, done with specially contoured abrasive stones, eliminate this false layer and greatly increase the dependabilities of machine parts.

AIRCRAFT TECHNIQUES

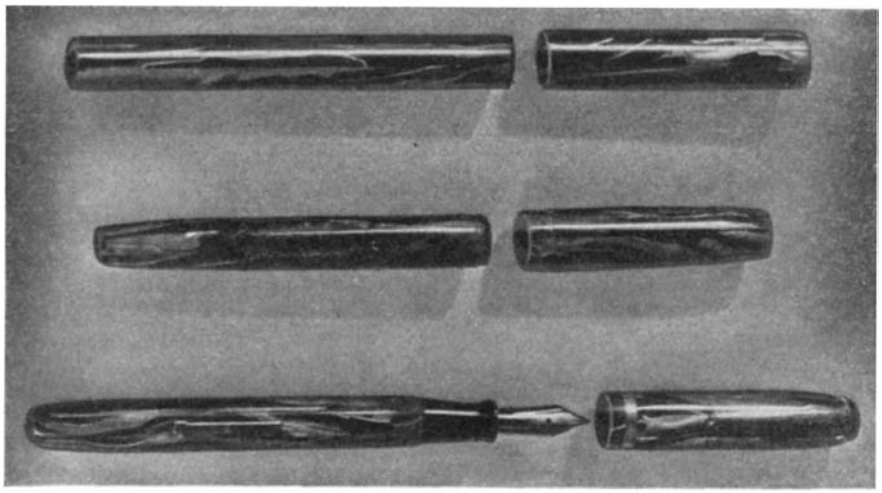
Adapted and Modified for Many Other Industries

INDUSTRY-in-general always seems to have some one division which works out the materials specifications and the production techniques for everybody. Up to about 1914, the railroad shops were the fountain heads of all wisdom, then the automobile industry took over, and now the aviation industry is beginning to show the way.

The main difference between automotive and aviation production is that aviation has to work with structures of lighter weight, with larger dimensions, and has to make changes in designs far more frequently.

Truck bodies are now made of high-tensile, corrosion-resistant steel tubing and structural shapes which are so cross-braced and steel sheathed that every ounce and inch of metal bears its full share of the stresses and no metal "rides for free." Such bodies are light in weight, can carry more payload, are long lived, and easily maintained. The technique for making and designing them was borrowed almost entirely from airplane experience.

Similar gains are being made in railroad cars, boats, pre-fabricated houses, and industrial materials-handling equipment.



Plastics tubing to fountain pen in three steps: Cap and barrel cut to length; ends formed and threaded; working parts installed. Technique is vital factor

PLASTICS

Layer-Cake Plastics

Not Always Made as Simply as Their Appearance and Applications Might Suggest, Plastics Products—Fountain Pens, for Example—Frequently Undergo a Number of Carefully Planned Fabrication Stages

By CHARLES A. BRESKIN
Editor, *Modern Plastics*

• LOOKING AHEAD •

Striking patterns of "laid-up" plastics adapted to a growing variety of articles. . . Endless possibilities of designs and combinations with other materials. . . Machinability of patterned plastics will attract attention of manufacturers seeking appearance coupled with fabricating flexibility.

IN A MATERIALS field where both color and eye-appeal are the rule, "laid-up" plastics rank near the top on both scores. Pearl-like panel effects, simulated wood grains, grained ivories, and other attractive patterns are only a few of the possibilities of the roll-lamination or hand-lay-up methods. Applications range from protective covers for golf-club shafts to decorative and useful domestic equipment and fountain pens. As an example of the process used to attain these beautiful and varigated plastics articles, the familiar fountain pen serves admirably.

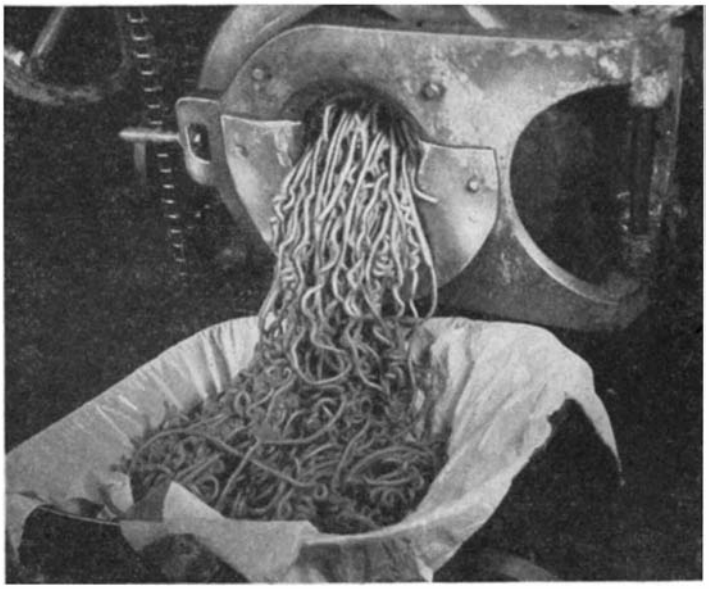
The cellulose nitrate unit represents an estimated 90 percent of the fountain-pen market. Its production is a painstaking operation requiring skill, technical knowledge, and a flair for color and design. The patterns used are varied, and the processes used to produce them are, of course, also varied to some extent. The type using a series of pearled cellulose nitrate panels ⅛ inch wide and separated by plain colored or transparent strips of the same material may, however, be considered as fairly typical.*

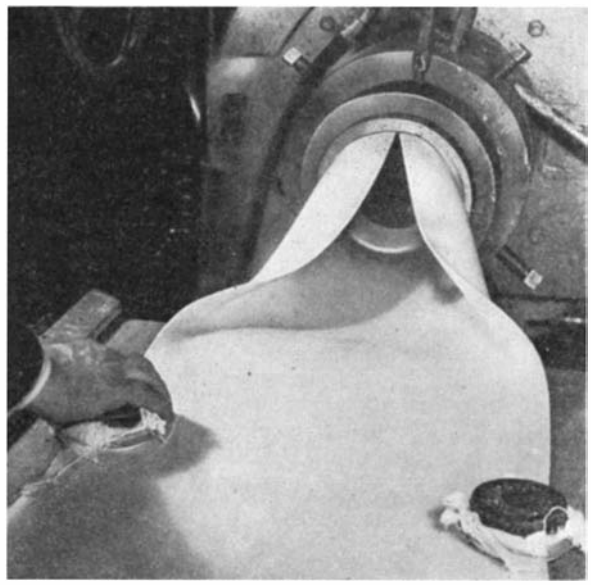
PEARL ESSENCE—The first step in the manufacture of pens of this type, and all other types, is the mixing of the material. Pearl essence, a substance obtained from herring scales, comes in tiny flat crystals, the largest being less than 0.003 inch long. Suspended in a suitable carrier, such as cellulose-nitrate lacquer, the pearl essence is mixed with camphor as a plasticizer, tinting dyes, cellulose-nitrate flake, and alcohol as a solvent. As a general rule each batch of material weighs approximately 250 pounds as it goes into the large mixer whose action insures complete intermingling of all the components.

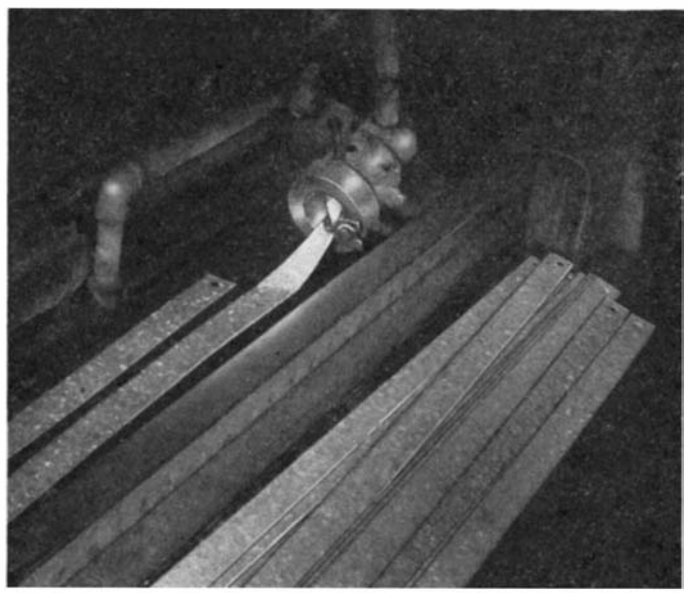
Since the slightest foreign matter of any type can ruin a quantity of pen bodies and caps, the pearl-essence compound is carefully filtered before further work is done on it. The equipment used in this operation is similar to a large hydraulic extruding machine. In it, a filter disk of muslin is backed up on one side by several screens, each of a different mesh. These screens, in turn, are backed by a plate perforated by ¼ inch holes spaced about ½ apart.

When the material is placed in the cylinder of the filter, a hydraulic plunger forces it slowly through the filtering muslin and screens and then through the perforated back plate so that the plastics emerges in the form of spaghetti. To convert the material to a form in which it can be managed by the extruder, this so-called spaghetti is divided into 60- to 70-pound lots and pressed into a tubular container. Weighed down on top over a long period of time, the material loses its string-like appearance and becomes a homogeneous mass. This is possible because of the solvent re-

*Nixon C/N is the cellulose nitrate used in the plant described and pictured in this article.







Colorful pen-plastics stem from multiple-step process: pearl-essence compound is filtered (upper left) through "spaghetti" extruder; extruded again (upper right) and split into sheets for "layer caking" (lower left); pearl essence thus oriented, pen tubing is drawn (lower right)

maining in the material which keeps it in a soft state.

The plastics as it is removed from this tubular form and taken to the extruder is known as a "jelly roll." The roll is of the exact size and shape to fit into the chamber of the extruder—the latter being quite similar to the filter used in the previous operation.

The cellulose-nitrate tube extruded by this machine is generally about six inches in diameter and has a relatively thin wall section. Just as it emerges from the die which has formed it into the tubular shape, the material is slit along the upper side so that it flattens into a sheet.

This extrusion operation is the beginning of an involved process that spells the success or failure of the production of high-luster pearl effect. As the plastics mixture is forced through the narrow annulus of the extruder, the minute pearl-essence particles are forced to aline themselves in the direction of the extrusion. Thus they present the maximum amount of luster at the surface of the sheet. If the pearl essence were not oriented in this manner the extruded sheet would be relatively lusterless.

LAYER TECHNIQUE—But this is only the beginning of the desired pearl-essence effect. Depending on whether a ribbon or mottled effect is desired, the flattened cellulose-nitrate sheet is cut into strips or into large chips. These strips or chips are then placed flat in a cake-press form measuring 23 by 56 inches and built up to a depth of five inches. Under heat, and pressure exceeding one ton per square inch, the pieces of plastics become a solid homogeneous mass, called a cake.

Sheets of material ⅛ inch thick are sheared from the top of this cake and cut into five-inch wide strips. Then the material is once again laid-up in the cake press, but this time the strips are placed on edge rather than flat. As a result of the laying-up of the strips in this manner the cake, when it is again formed under heat and pressure, has the luster of the pearl essence oriented toward the side rather than toward the top.

Again the cake is sheared into sheets which, at this phase of manufacture, have very little surface lus-

ter because of the deliberate side orientation of the pearl essence in the last operation. When the sheets are again cut into strips and placed on edge in the cake press form, however, the luster is brought to the top where it appears in the final cake.

It is in this final lay-up that the the pattern of the pen body and cap is determined. Instead of being made up entirely of strips of pearlized cellulose nitrate, the pattern may call for the insertion of various colored plastics strips between the pearl strips, or of transparent cellulose-nitrate strips if the design is for a pen utilizing the visible ink supply principle. Whatever the design, this last lay-up operation is followed by another caking cycle and the slicing of the cake into sheets approximately 0.050 inch thick.

TUBE FORMING — Before these sheets can be made into tubes they must be seasoned so they will not warp when finally made into pens. This operation, in which all the remaining solvent is removed, is accomplished by placing the sheets on racks in rooms held at a temperature of about 110 degrees, Fahrenheit. Since the plastics tends to curl slightly during this treatment, the sheets are placed between high-luster plates and subjected to a relatively high pressure in a hydraulic press.

Cut into strips 1½ inches wide and 50 inches long, the material is ready for tube forming, which can be done either by butt-welding or by spiral-welding. In both cases, the strips are first placed in hot water to soften them, then pulled through a forming die which causes them to take the shape of a tube.

For the butt-welded type of pen case, a steel mandrel is placed within a die having a diameter equal to the desired outside diameter of the finished tube. Once the cellulose nitrate is softened it is hooked at one end to the front of the mandrel which is, in turn, attached to a moving chain. As the chain pulls the mandrel through the die, the plastics strip is drawn into the funnel-shaped mouth of the die which starts the forming of the strip so that it will wrap around the mandrel. When the material reaches the final forming section of the die, which is chilled, it sets in the form of a tube with the edges of the joint pressed tightly together. The joint is not yet welded, however.

The only difference between the production of the butt-welded and the spiral-type tube lies in the fact that with this last type the mandrel revolves as it pulls the material through the die.

The one prerequisite of a good seal is the careful separation of the edges of the joint to permit the solvent, in which the tube is placed, to come in contact with them. A hooked knife run down the entire length of the joint in a butt-welded tube effectively separates the edges, while a slight twist of a spiral-type tube in the direction opposite from that of the spiral opens the joint enough to allow the entrance of the solvent. Once the hooked knife is withdrawn or the spiral tube relieved of pressure the joint will seal without the addition of pressure. After an aging period of approximately three weeks to allow for the evaporation of all solvent absorbed during the welding operation, the pearl-paneled, cellulose-nitrate tubing is ready for the finishing operations that insure the proper functioning of the fountain pen.

TUBES INTO PENS—No matter how carefully the cellulose-nitrate tube is formed, it still lacks the necessary accuracy on its inside diameter. To bring the tubes to size they are placed in hot water where they become soft and pliable; then over a steel mandrel ground to a size corresponding to that specified for the inside of the fountain-pen body. Next the tube and mandrel are placed in a chilling bath of cold water and the mandrel removed as soon as the plastics hardens. Finally, a centerless grinder is put to work on the tubing to give the desired outside diameter. And with that the work of the cellulose-nitrate fabricator comes to an end.

There still remain a number of operations which the pen manufacturer must complete before the fountain pen is complete. First, the tubes are cut to length, threaded, and otherwise machined, using standard machining methods. To close the bottom of the pen barrel and the top of the cap, shaped and formed plugs are inserted in the tube openings and welded in position.

This closing operation can also be done in a number of other ways. The one most generally used for the older types of pens simply involves the welding of a flat top over the end of the tube. When shaped ends are employed, these can be turned out either by molding or by a forming operation in which a disk of heated nitrate is forced into a die and then molded to the desired shape. Another, and perhaps the most successful, method of closing off the end of the plastics tubing involves softening the cellulose nitrate and forcing the end section into a warm die which molds the material into a point—producing a one-piece cap or barrel.

Thus emerges a completed fountain pen. Some of the steps in its production are specialized, but the steps involving the compounding and manufacture of the basic material are indicative of the thought and planning that are so vital to the successful manufacture of any plastics article.

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ICE-CUBE TRAY

Retains Flexibility at Refrigerator Temperatures

ADDED to the list of improvements upon the venerable ice-cube tray is the Jiffy-Cube which comprises 12 compartments formed of ethyl cellulose sheet. The advantage of this material is that it remains flexible at low temperatures and does not adhere to the ice. Consequently, ice cubes may be removed from the compartments, each in a separate container of its own, simply by presing a dimple on the bottom of the cup. Both production and assembly of the ice-cube maker is done by Standard Products Company for Plastray Corporation.

Ice does not adhere to cups

EXCAVATOR WINDOW

Made of Plastics to Resist Vibration, Impact

REMINISCENT of the Plexiglas bomber noses and gun turrets that are standard equipment on so many military planes is the cab window on the Byers Machine Company's dirt shovel. This window, which has been found easy to install, is as transparent as glass and, unaffected by vibration, may be the forerunner of many more industrial uses of a similar nature for this plastics. Especially important in this particular application is the ability of Plexiglas to withstand heavy impact blows.

Cabins Can Be Quieter

Airline and Private Plane Manufacturers—More "Customer-Conscious" Than Ever Before—Are Striving Vigorously to Improve Cabin Comfort

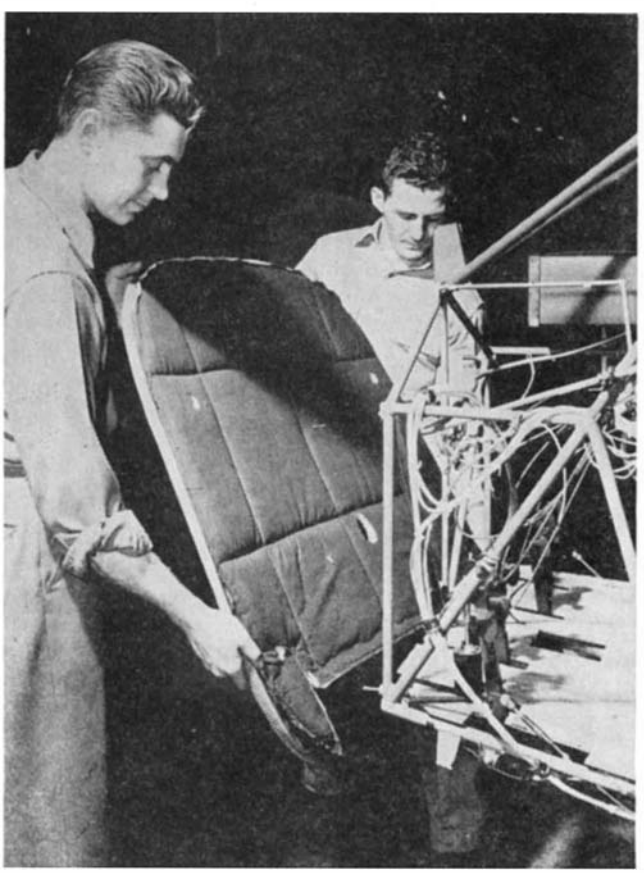
By ALEXANDER KLEMIN
Aeronautical Consultant; Research Associate, Daniel Guggenheim School of Aeronautics, New York University

As aircraft engine powers and airplane speeds increase, the need for noise reduction becomes ever more apparent. Here there are, in reality, two noise problems—one involving the protection of the plane's passengers against propeller and engine noise, and the other being the necessity for reducing the external noise of the plane so that it ceases to be a nuisance to the general public. This article confines itself to a discussion of noise reduction within the plane itself, leaving the second phase of the problem for future discussion

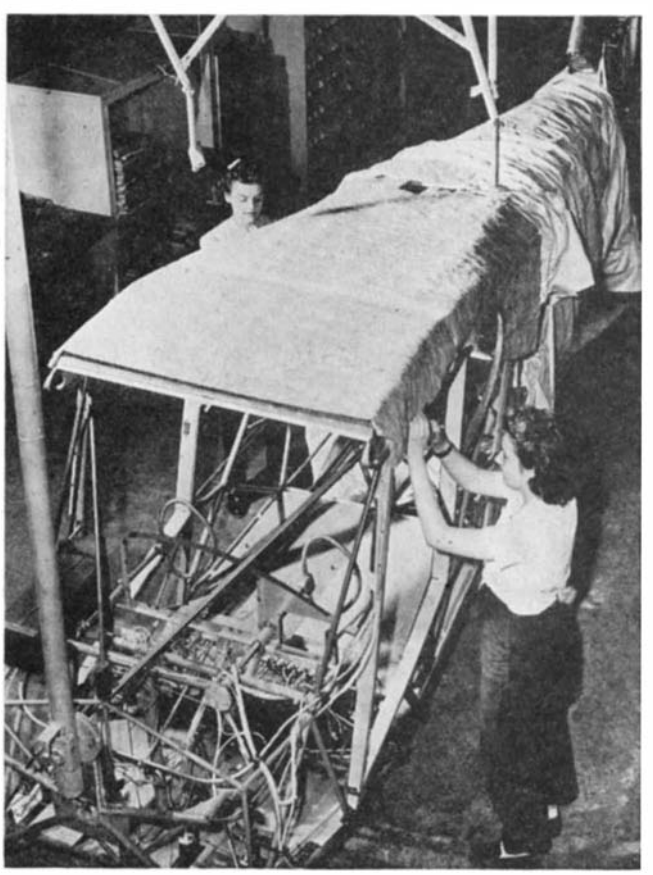
The sensation of sound is produced by alternating air pressures in the sonic range. But the measurement of these varying pressures is not a guide to loudness. The change of sound intensity, as the human ear feels it, is proportional to the fractional increment, rather than the absolute increment. Hence, the preception of sound increases far less rapidly than the pressure.

LOGARITHMIC SOUND—For this reason, sound intensity is measured on a logarithmic scale rather than an arithmetical one. The decibel is ten times the logarithm of the ratio of sound intensity to the intensity existing when the ear can barely hear anything—the threshold of audibility. Accordingly, a ten-fold change in intensity only adds 10 decibels, or ten times the log of 10, which is one. It is this curious mathematical concept that explains many of the difficulties of sound measurement and noise reduction.

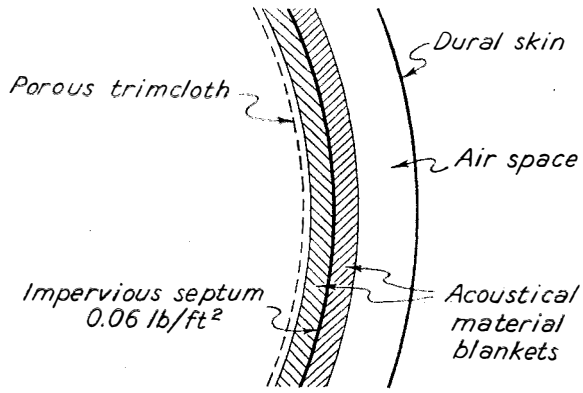
Furthermore, overall intensity or loudness is not a satisfactory indication of comfort or discomfort. The sensation varies with the frequency. A high-pitched noise of the same loudness as a low-pitched noise will



Only one inch thick, sound-absorbing fire-wall blanket will insulate engine noise and heat. It is also non-combustible



Sound-proofing light airplanes reflects new attitude on part of private flyers. Stinson "Voyager" has "airliner" comfort



Typical installation of sound-deadening blanket—often glass fiber—and its separating and trim medium. If a vacuum were possible instead of air space the efficiency would be much higher

• LOOKING AHEAD •

Airplanes more silent, eventually, than older forms of transportation. . . . Application of aircraft sound-proofing methods to automobiles, homes, industrial structures. . . Much wider acceptance of private aviation when quieter cabins become universal.

produce considerably more annoyance. Therefore, in addition to knowing overall sound levels, it is important to be able to measure the intensities of various frequencies in a noise containing a wide range of frequencies. Measurements taken on this basis indicate that noises may be much less distressing when the higher frequencies are suppressed—even if overall loudness is only slightly decreased.

In aircraft applications, a coarse analysis of the various frequencies present is sufficient. Here, the range of audible frequencies is divided into band widths of one octave, and the range from a very low 40 cycles per second to a shrill scream of 10,000 cycles per second can be covered in eight bands. Thus, noise levels may be defined in terms of decibels in a given frequency band and an entire technique has been developed for the measurement and analysis of aircraft cabin sounds. Considerable special equipment, including artificial means for producing pure sounds of varying frequencies and intensities, standard microphones, amplifiers, decibel indicators, wave filters, completely noiseless chambers, and so on, have been evolved and in some cases are being applied in other industries.

HIGH FREQUENCIES WORST—The permissible levels for noise in different types of aircraft must, of course, be established before manufacturers can enter upon sound-proofing programs in an effective manner. In a paper read before the Royal Aeronautical Society by Dr. N. Fleming, permissible sound levels for military, cargo, and civilian passenger airplanes were tentatively set forth. These recommended levels vary from 105 decibels in the 75 to 150 frequency range to 80 decibels in the 1200 to 2400 frequency range for military and cargo planes. For passenger transport, the comfort levels are reduced ten decibels at the lower frequencies and 15 decibels at the higher frequencies.

Examination of typical sound values as encountered under familiar circumstances will provide a concrete idea of what decibel levels mean. For example, a passenger car moving at 30 miles per hour measures 60 to 70 decibels; an air-conditioned railroad coach shows 85 decibels at 50 miles per hour; a trolley car registers 90 decibels; the New York subway may go to 120 or even more.

It is interesting to compare these figures with noise measurements (Table 1) made in the well-known DC-3 twin-engine airliner while the plane was flying at 160 miles per hour with the engines delivering 600 horsepower at 1850 revolutions per minute, and with a propeller tip speed of 740 feet per second.

It will be noted that the data presented cover one low-pitch band and one high-pitch band, thereby giving a truer indication of comfort than would single-level readings. The multi-level method has now become standard as the result of research at the Harvard Electro-Acoustical Laboratory. In both frequency ranges, the aft-center cabin of the DC-3 satisfies the previous recommendations as set up by Dr. Fleming. The forward-center cabin, however, particularly in the less annoying lower octave and to a small degree in the higher octave, does have noise levels above the recommended figures, regardless of the fact that the plane is generally considered satisfactory by most passengers.

Once the characteristics of cabin noises are established, the physical problem of reducing these noises usually embraces a plan of insulating those of external origin—engine exhaust, propeller sounds, and aerodynamic sounds. Also, internal noises due to electrical motors, pumps, gears, and the moving parts of the air-conditioning machinery cannot be neglected.

INSULATION "KNOW-HOW" — For successful sound insulation, it is important to avoid all cracks and openings in the insulating structure. The smallest cracks may nullify the best sound-proofing treatment. Apparently sound entering through a narrow aperture can produce almost the same sensation of loudness as an open window. Sealed openings around hatches, doors, windows, and ventilators, must be in good condition. As much of the area of the airplane structure as possible should receive acoustical treatment and the areas of untreated metal surface must be held to a minimum.

One successful sound-insulating method employs two blankets of sound-absorbing material separated by an impervious septum. The thickness of the two blankets may be as low as ¾ inch, and the treatment is so effective that the minimum weight is only .15 pounds per square foot, excluding the weight of the trim cloth, septum, and muslin container.

The sound-proofing material used in such blankets before the war was generally flame-proofed kapok batting. Later, when kapok was no longer available, a number of materials including pure milkweed floss were tried with varying degrees of success. Glass fiber finally won out because it is the most effective for a given weight of material, because it is not susceptible to attack by mildew and fungi, and because it is non-combustible.

Fundamental to the sound-insu-

Position	Overall Level	Decibel Level 75-150 Frequency Range	Decibel Level 1200-2400 Frequency Range
Pilot's Position	111	104	75
Forward-Center Cabin	110	106	66
Aft-Center Cabin	98	92	62

Table 1: Noise levels in a DC-3 at 160 miles per hour

lating idea is that the acoustical material should have as large an area of fibers as possible in proportion to its weight. Fiberglas "A" meets this requirement splendidly since it is made from thousands of glass fibers only a micron—1/1000 of a millimeter—in diameter. The glass fibers are coated with a plastics binder to produce a bronze-colored blanket which is ordinarily about half an inch thick and weighs only 1/40 pound per square foot.

NOT ONLY AIRLINERS — Sound-proofing need not be restricted to large transport airplanes. Private airplanes can be equally quiet, and the day when the private flyer "enjoyed" the full impact of propeller and engine noise is gone forever. The purchaser of a private airplane is coming to demand and obtain the greatest interior comfort, with cabin sound-insulation a "must" feature.

The Stinson Voyager 150, for example, is a private plane which has proved as quiet as most transports and in which almost identical glass-blanket methods of protection have been followed. During the manufacture of this plane, the sound-absorbing blankets are cut to size and shape and lightly attached to the superstructure. Skin and trim fabrics are then pulled over the blankets.

In large transports, the sound-proofing might be carried still further if, instead of placing the insulation about three inches from the dural wall of the plane as is done today, a vacuum was used as insulation in a manner somewhat similar to a thermos bottle. Structural engineers, however, advise that in the light of present knowledge the weight of such construction would be prohibitive.

The sound-proofing of aircraft offers many opportunities for the manufacturers of plastics materials, for instrument builders, for physicists. Its principles are applicable in numerous other structures and industries even though the actual materials and methods may differ. In an expensive building, for example, an adequate thickness of wall may obviate the need for additional sound-insulating material; yet in a low-cost pre-fabricated home, a thinner, less expensive wall might be quite satisfactory if it included acoustical material which also insulated against heat and cold. Truly, there are some fascinating prospects.

FLYING WING

Carries Heavy Load at Unusual Speeds

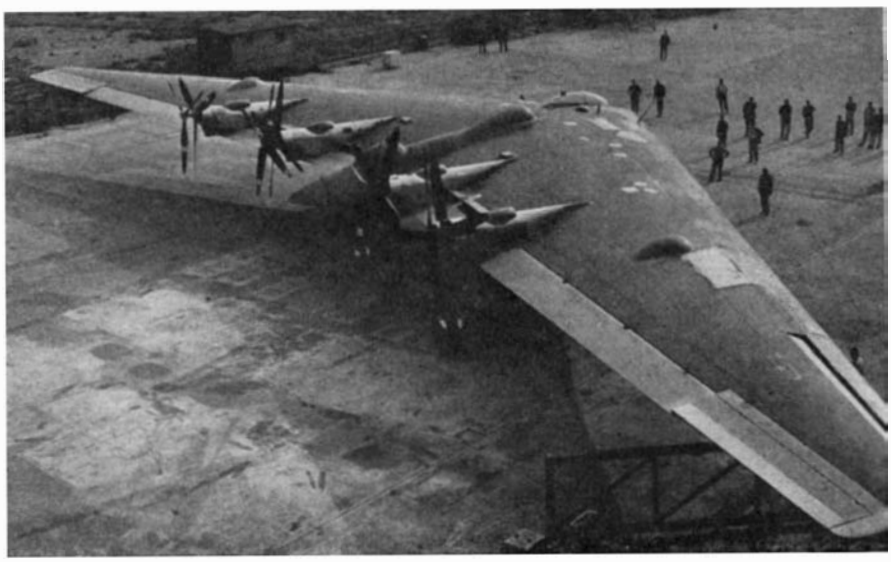
MINIMUM air drag resulting from the elimination of the conventional fuselage is reported to give the new Northrup Flying Wing — XB-35 — a speed 100 miles per hour greater than could be obtained from an ordinary type plane of equivalent power and capacity. Submerged within the wing structure itself are four Pratt and Whitney Wasp Major engines of 3000 horsepower each. The submerged mounting offers a considerable reduction in frontal area and makes major breaks in the airfoil contours unnecessary. In addition, eight propellers of the pusher type are used and are co-axially mounted — two per engine — with the engine drive gearing so arranged as to drive them in opposite directions. The latter feature allows each propeller to cancel the torque effect of its mate.

Crew accommodations consist of a long, narrow, pressurized nacelle equipped with a bubble-type canopy.

Control of the Flying Wing has been achieved without the usual tail surfaces. Landing flaps are provided in the normal manner and are supplemented by wing-tip slots to prevent tip stalls. Outboard on the wing are the so-called "elevons" which control longitudinal stability much as do conventional elevators but which have an additional aileron-like function when necessary.

Double, split flaps — opening like a clam shell — are located with a hinge line aft of the elevon hinge line and increase drag on one side or the other as needed for directional control.

The Flying Wing, representing 23 years of research, has a span of 172 feet, a wing area of 4000 square feet, an empty weight of 73,000 pounds, and a surprising useful load of 120,000 pounds.



Three-quarter rear view of the latest Northrup Flying Wing

PLANE COMFORT QUIZ

Indicates that Planes Could be Still Better

NOW THAT airplane travel has become as inexpensive as railway transportation, and is very much faster, it is fair to compare the two as regards comfort. Hence, the *Boeing Magazine* has made an opinion survey.

Asked which is less comfortable, a train or a plane trip, 50 percent of those queried answered "train"; 20 percent said the airplane was less comfortable; 11 percent said they were about the same; and 19 percent didn't know. Apparently the airplane had somewhat the better of it in this quiz, but it is not to be concluded that the airplane is above improvement in comfort.

Travelers by air, whether experienced or newcomers, often complain of lack of space to move around; roughness, bumps, and sinking feelings; air sickness; lack of berths; noise or vibration; and fear causing discomfort.

Some of these complaints seem likely to be removed by modern aircraft designs. Fear will be dispelled by still greater improvements in safety. Greater size of aircraft with separate dining quarters and lounge halls can remove the criticism of lack of space. Very fast, heavily loaded aircraft, flying at great heights, should avoid bumpy sensations and hence help to reduce air-sickness.

Lack of berths is a question of economics—if the public is willing to pay more for air travel, berths will be forthcoming.

Multi-Purpose Paradox

Until All Machines Use Similar Bearings Under Like Load Conditions, "All-Purpose" Greases Remain Impractical. Multi-Purpose Greases are Available, However, and When Common Sense Indicates Their Use They Can Save Time, Reduce Inventories, and Eliminate Confusion

By T. G. ROEHNER

Technical Director, Technical Service Laboratories, Socony-Vacuum Oil Company, Inc.

RECENT years have seen a greatly accelerated rate of development in the lubricating-grease field. Experience under service conditions forcibly demonstrated the need for greases capable of operating under extremely wide ranges of temperatures. Many aircraft bearings for example, may during the course of a single flight be exposed to temperatures as low as minus 65 degrees, Fahrenheit, at altitudes over 35,000 feet and as high as 200 degrees at low altitudes.

Conventional greases having the consistency of butter at room temperature may become so solid at sub-zero temperatures that movement of bearings packed with them can not be started even by application of pressures sufficient to twist light shafting. The use of a grease such as that commonly employed for the lubrication of ball bearings in electric motors would mean that at high altitudes trim-control tabs could not be operated nor could the cowl flaps and many other components of aircraft be actuated hydraulically.

Farm machinery shipped from Detroit might be used in the tropics or be exposed to winter conditions in Russia. The greases in tractor wheels have to resist the temperatures encountered, prevent entrance of dirt and sand, and protect the bearings from corrosion in wet areas.

Greases used on ship-deck machinery must perform satisfactorily both during winter storms and during summer trips around Cape Horn to India. Furthermore these greases have to stay put and serve as rust preventives when the machinery is submerged by heavy seas.

Superimposed on such varied performance problems as these, is the steady demand for reduction in the number of greases required to satisfy all operating requirements. At the start of World War II, for example, a survey showed that if the instructions of the manufacturers of ordnance equipment were followed rigidly, over 30 different greases would have to be supplied on practically a world-wide basis. Before V-E Day, this unwieldly number was reduced to four basic and about six special greases.

LOOKING AHEAD

Greater co-operation among machine designers, bearing builders, grease compounders. . . Further development of multi-purpose lubricants for non-mobile equipment. . . . Grease application devices with wider adaptability. . . More about water- and high-temperature-resistant greases.

The ideal, of course, would be the improvement of greases and their applications to the point where a single grease could lubricate all bearings, winter and summer, regardless of severity of operating conditions. Such "all-purpose" products have not been achieved. Progress, however, has been made in developing "multi-purpose" greases.

GREASE KNOWLEDGE NEEDED—New types of products have recently been developed, such as those made with lithium, strontium, barium, and high-melting-point calcium-base greases. These new greases possess water- and high-temperature-resistance features not found in conventional calcium-, sodium-, and aluminum-base greases. Advances have also been made in the formulation and manufacture of the latter.

Of equal, and perhaps greater importance is the recent progress in the methods for evaluating greases and securing more accurate interpretation of test data. This research led to a better understanding of the fact that all greases undergo critical changes in structure and consistency as temperatures change.

A sodium-base grease, for example, may have the consistency and structure of a conventional, auto-wheel-bearing grease at room temperature, but at sub-zero temperatures it may change to a product so hard that a pencil can be forced into it only with considerable difficulty, while at about 200 degrees, Fahrenheit, it may be converted to a soft, tough-fibered grease that will wind around a spindle, and when raised to 300 degrees, Fahrenheit, it may acquire the appearance of a jelly.

Greases may be quickly defined as soap-thickened mineral oils and an understanding of the fundamental differences in their behavior in service as compared with uncompounded lubricating oils—which remain as true fluids above their pour points—is valuable to those concerned with grease usage. This is particularly true with the more recently developed greases which may contain, in addition to soaps, components to improve their chemical and structure stabilities, to increase their rust-preventive properties, and to add to their load-carrying abilities.

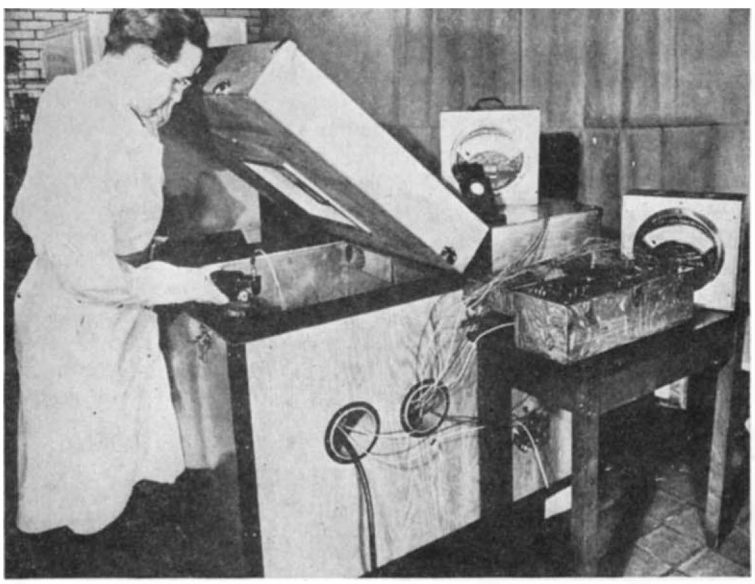
Large plants and mills with hundreds of machines are naturally interested in multi-purpose greases. Here, the machines in each plant often differ widely in design and operation, and their bearings also differ in type and lubrication requirements. Because of this, it is not unusual for such a plant to stock six or more greases. Hence, careful supervision becomes necessary to

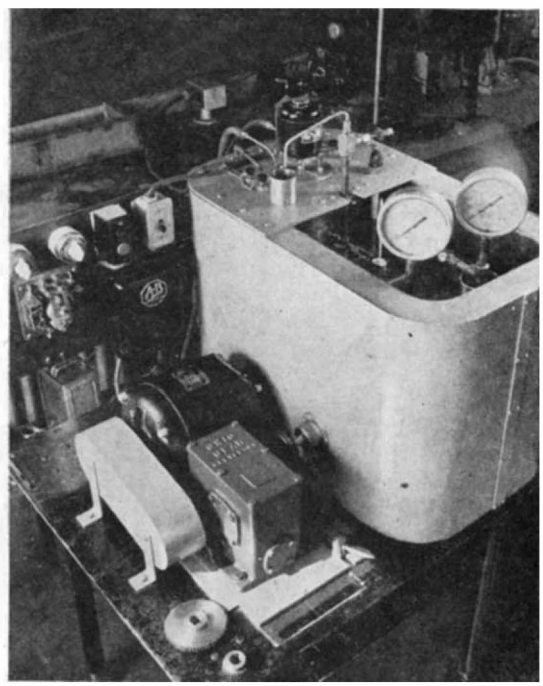
avoid bearing failures with consequent long-time shut downs of machines due to mistakes in application of the greases. Bearing replacements are often difficult to obtain and, more important, idle machines cut into production schedules. The use of multi-purpose greases coupled with training of greasers in correct application and maintenance has been proved effective in solving this type of problem.

AUTOMOTIVE DILEMMA — Operators of truck and bus fleets have also shown interest in multi-purpose greases. In this field, development has proceeded to the point where a single grease has been offered which will adequately lubricate bearings of trucks and buses from bumper to bumper.

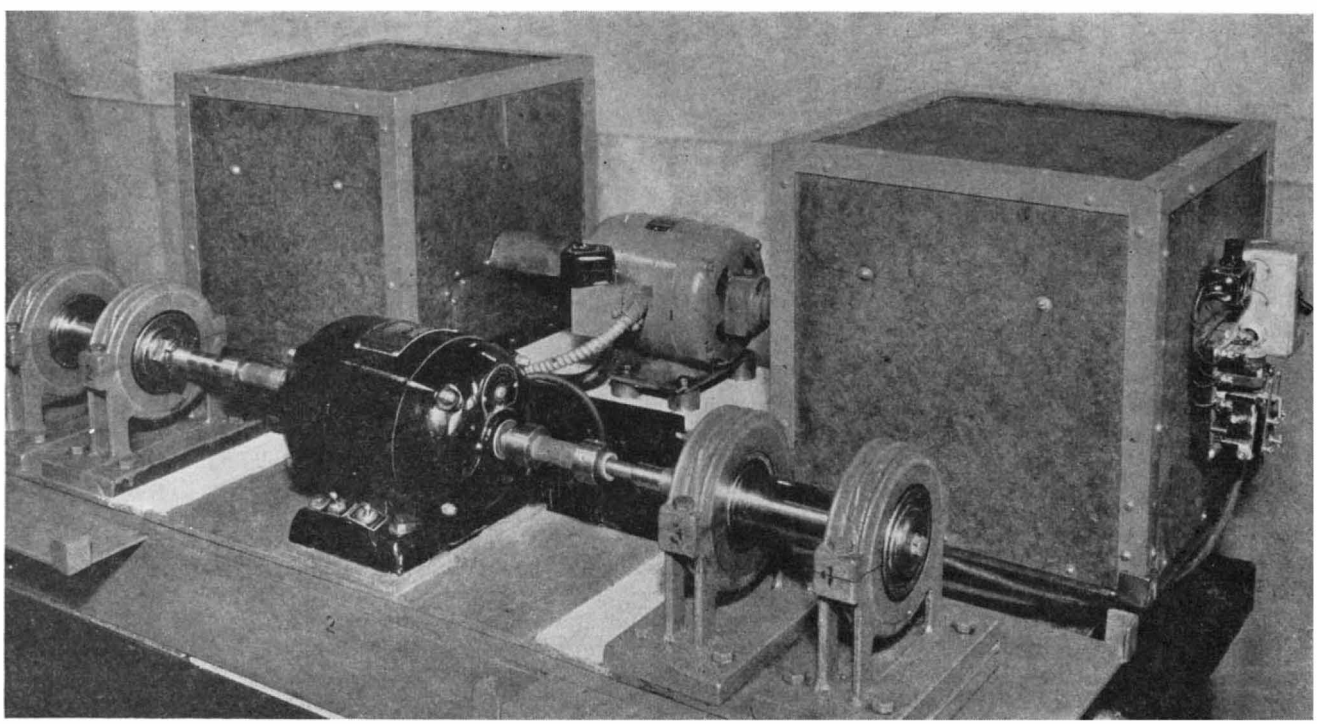
In this connection, however, the extent to which bearings of trucks and buses vary in design and operating conditions is seldom fully realized. In universal joints, for example, the bearings may be bushing, needle, ball, or roller types. Some water pumps are equipped with ball bearings while others use plain bearings. Also, in some water pumps the grease has to function not only as a lubricant, but as a seal to prevent water leakage, whereas other designs include spring-loaded seals which will operate properly only when greases of soft consistency are employed. The bearings which account for the largest consumption of grease are the so-called chassis fittings—spring shackles, king pins, tie rods, and drag links. Grease is also used as lubricant for wheel bearings, brake cams, clutch release bearings, constant velocity joints, and for certain designs of magnetos.

Essentially there are two ways to approach the truck and bus fleet's problem. Going down one path, the objective would be to analyze carefully the requirements for each type of bearing and operation, and design a product to provide maximum service for each type. The second path —use of multi-purpose greases—





Low-temperature cabinet (above), viscosity-determination unit (right), and ball-bearing grease evaluator (below) exemplify apparatus that is constantly devised as new grease research problems are encountered



leads to compromises. The objective here would be to provide a grease which, while not the absolute best for any one type of bearing, would still do a satisfactory enough job so that when coupled with the economical simplification of stocks thus made possible, a net, over-all advantage would be gained.

The news of unusual types of greases born during work on the requirements of the Armed Forces has prepared the way for wider acceptance of multi-purpose greases. Indeed, reports concerning lithium-base greases sometimes have been so enthusiastic that they encouraged conclusions that even an all-purpose grease is now available. An all-purpose grease would have to be, by definition, a product which not only had the correct chemical composition, but which would also have to have a consistency that would be satisfactory for all types of bearings and housings. The short review given above of variation in bearing designs will indicate that no one consistency is likely to meet that limitation regardless of composition. Thus, until there is more progress made toward uniformity of bearings, the most practical simplification possible is acceptance of multi-purpose greases.

PRACTICAL CONSIDERATIONS — The successful utilization of a multi-purpose grease is dependent on the installation of adequate dispensing equipment and on avoidance of extreme ranges of operating temperatures. The design of the grease guns must be dictated by the properties of the grease. In some cases, the grease technologist is often forced to fit his formulations within the limits prescribed by the grease guns already available rather than to develop the product demanded for most efficient lubrication of the bearings. Thus, if a multi-purpose grease is employed, the greasing equipment must be capable of handling not only the soft, often semi-fluid consistencies common for chassis greases, but must also take care of products considerably stiffer.

It is conventional to refer to consistencies of greases in terms of ASTM penetrations. An ASTM worked-penetration of 350 means that under conditions carefully specified by American Society of Testing Materials' Method 217-44T, a cone assembly weighing 150 grams sank 350 millimeters in the grease in five seconds after the grease had been worked by forcing it through a perforated plate 60 times at 77 degrees, Fahrenheit. High-pressure grease guns, built to handle chassis lubricants with ASTM worked-penetrations of 325 and softer will not operate satisfactorily with wheel bearing greases which normally have ASTM worked-penetrations from 250 to 300. Wheel bearing greases, however, must have that consistency because otherwise they may leak past the seals and possibly lead to burning and seizure of brakes. The ideal lubricant for wheel bearings would be a heavy oil or semi-fluid grease, but no seals have been produced in commercial quantities which will hold such fluid lubricants in position. On the other hand, firmer greases than now are used for spring shackles could be used to advantage for those and similar bearings as they would be more resistant to being squeezed out.

The importance of correct lubrication of wheel bearings is so obviously the controlling consideration, a multi-purpose grease would have to be based primarily on the consistency demands of that application. Experience has shown that most of the other bearings will be satisfied by that consistency if the composition of the grease is of sufficiently versatile character. The exceptions would be for bearings where only a soft grease can be used in order to insure proper distribution, as, for example, in constant-velocity joints and where extremely high, localized temperatures are expected, such as those characteristic of magnetos.

The use of multi-purpose greases quickly becomes more difficult if operating temperatures vary over wide limits, because of the consequent extreme variations in the consistencies of the greases. Aside from composition, which is determined by the manufacturer, the factor which has the greatest effect on consistency of greases is temperature. A certain widely used wheel-bearing grease having an ASTM worked-penetration of about 250 at 77 degrees, Fahrenheit, will harden to a penetration of about 50 at minus 20 degrees, Fahrenheit. Also, if a grease that is firm at low temperature were used in king pins, tie rods, and drag links, steering would become quite difficult. In brief, in some sections of the country it is advisable to use so-called "winter" and "summer" grade greases, the former specifically manufactured to meet cold-weather conditions. The use of a multi-purpose grease in such areas obviously introduces a serious complication.

In conclusion, it may be stated that grease technology has made important advances under the pressure of recent demands and that the fundamental information gained is being translated into benefits for industrial requirements. One evidence of this trend has been the offering of a multi-purpose grease which under certain conditions will enable an attractive reduction in the number of greases formerly employed for a complete grease service job. The ideal has not yet been achieved, however, where a multi-purpose grease may be furnished without careful study of all conditions and, certainly, the all-purpose grease has not yet arrived.

PAINT REMOVAL

Simplified by Oil On Spray-Room Walls

AN UNUSUAL use for a material known as Castor Machine Oil has been discovered by an automobile manufacturer. This oil is made to be adhesive and stringy, which properties make it ideal for its rather novel application.

The product is mixed with a soap and put on the walls of paint rooms in which automobile body parts are spray painted. Thus, paint from the various spraying operations which collects on the coated surface is easily removed each night with a putty knife, and excessive amounts of paint are prevented from collecting on the walls.

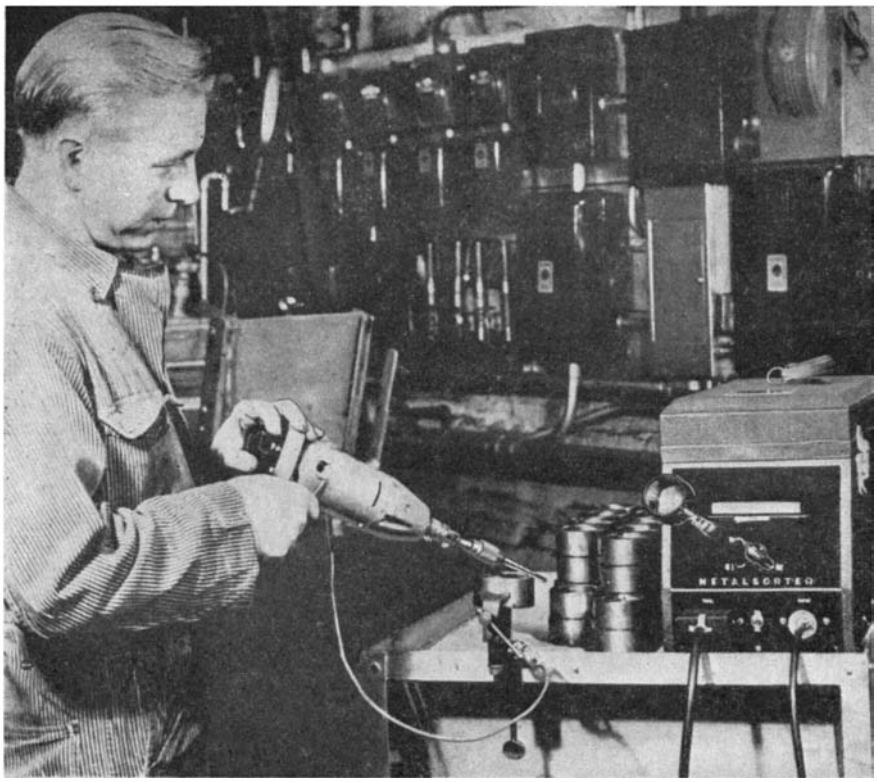
PLASTISOLS

Afford Economical Means of Applying Vinyl Resins

POLYVINYL resins, widely used for coating shower curtains, imitation leather, upholstery fabrics, and wires and cables, have usually been applied by complicated processes and expensive roll mills, calendars, and hydraulic presses. To eliminate this need for laminating thin sheets of the resins to the base material, newer means have been developed to apply the resins as liquids.

One such method makes use of a fluid mixture called a "plastisol," in which the powdered resin is dispersed in a liquid plasticizer by mechanical mixing aided by small quantities of a dispersing agent. The fluid film is easily applied by means of knife or roller coaters.

The requirements of such a plasticizer for polyvinyl resins are relatively complex since color, storage, stability, and volatility are but a few of the problems encountered. A synthetic material from petroleum has been developed for the purpose by Socony-Vacuum and carries the name S/V Sovaloid C. A fairly light colored, low viscosity, high-boiling oil, the plasticizer is compatible with most of the vinyl resins.



Triboelectric sorter in use—even heat-treated and non-heat-treated metals differ enough metallurgically to be identified by this practical instrument

Mixed Metal Magic

Jumbled Alloy Stocks and Parts can Now be Re-Identified by Using the Small Current Generated when Dissimilar Metals Rub Together. Direct-Reading Spectrometers Speed Analysis, Cut Down Costly Furnace Time

By JOHN MARKUS
Associate Editor, *Electronics*

INCREASED production rates, highly critical end uses, closer chemical specifications, and the need for conserving scarce alloy constituents have combined in recent years to focus attention on means for sorting and analyzing both ferrous and nonferrous alloys. Thus, precision and high-speed electronic methods of identifying metals and alloys are now available that will sort metal objects having identical size and appearance. The sorting is quick and accurate, and requires only that the metals be metallurgically dissimilar—even such a small change in metallic structure as that produced by heat treating can be detected. And now also it is possible to obtain an accurate analysis of a molten metal in less than one minute.

SORTING — One new electronic metal-sorting device employs the triboelectric principle—the same principle that makes sparks when a cat's fur is rubbed backward—to give a yes-or-no reading in a few seconds. It is small enough to be carried easily and is intended for use right in the plant.

Unavoidable mixups of steels and other alloys in various stages of fabrication have always existed in metal-working plants. For example, a stack of billets may upset and spill over, mixing with adjacent stacks having the same size and appearance but different composition. In other cases, machining operations obliterate painted, tagged, or stamped identification markings, and frequently unused portions of bar stock are returned to stock piles after the identified ends have been cut off.

The triboelectric instrument that will sort out such mixups depends on the fact that when two metallurgically dissimilar metals in contact with each other are moved back and forth a voltage ranging from a fraction of a microvolt to several millivolts, depending upon the metals, is generated. The voltage is caused by a re-distribution of electrons on the interfaces of chemically dissimilar substances that are rubbed together.

• LOOKING AHEAD •
Less expensive confusion in storing alloy metals. . . Reduction of scrap losses through inadvertent mixing of parts. . . Quick identification of metals in machines needing repair parts. . . Shorter non-productive interims waiting for furnace heats to be analyzed. . . Elimination of laboratory "bottlenecks."

Since heat treatment of most alloys produces chemical changes, the method can also be used to distinguish between heat-treated and hot-worked alloys coming from the same heat or melt. The manner of creating the moving contact is not critical provided it is carried on long enough to develop saturation potential. For a reciprocating tool operating at ten strokes per second the required period is about four seconds. A lubricant is used on the surface of the standard metal during tests to minimize chances of scoring, because scoring or erosion of metal during the test will introduce an error in indication.

In the commercial instrument, as made by Control Equipment Company, an electronic circuit controls the total operating time for a test

and provides a potential to balance-out stray currents. A motor-driven reciprocating tool having a 3/8-inch stroke provides the friction generating motion. In operation, a known or standard rod of metal is placed in the chuck of the tool and is held stationary on the unknown metal. A fork on the tool presses against the unknown sample to make electrical connection with it, completing the circuit through the two metals and a portable, mirror galvanometer. A control is then adjusted to bring the meter pointer to zero, after which a button on the tool is pressed to start the reciprocating motion of the known metal in the chuck. The reading of the microvoltmeter is taken after the tool has been automatically stopped. If the reading is substantially zero, known and unknown metals are identical; if the reading is different, the polarity and magnitude of the reading are indicative of the degree and nature of the dissimilarity.

In general, all metals and alloys may be arranged in a triboelectric series so that a metal which precedes another metal in the table will be positive with respect to the succeeding metal. Thus, if five metals—A, B, C, D, and E—are arranged in this way, C will be slightly positive with respect to D and more positive with respect to E. Conversely, C will be negative with respect to A and B. Once prepared, a table of this kind can be of great assistance in rapid sorting.

Since this instrument provides a non-destructive test, it may be applied to identification of built-up machinery, assembled vehicles, or any combination of metals. The fact that the pieces being tested are in metallic and electrical contact with adjoining members does not affect the accuracy of the test.

QUICK ANALYSIS — In the basic spectrometer, as used in an open-hearth steel mill, a small sample of the material to be analyzed is melted in an intensely hot spark and the resultant characteristic light spectrum is spread out for photographing. The density of the spectrum lines on the negative must then be examined visually or measured with a photoelectric densitometer to obtain the desired information. This is a tedious process with many drawbacks that may impair the quality of a melt and waste as much as an hour of steel-mill furnace time per day.

In the melting, alloying, and casting of metals, a new direct-reading spectrometer can lower costs by reducing the time a melt must be kept at temperature while waiting for an analytical report.

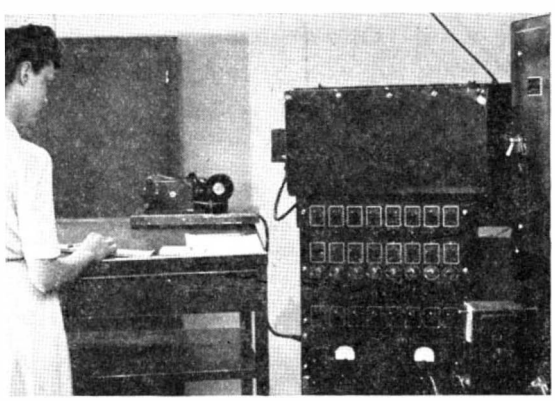
By eliminating the photographic process in the spectrometer and using a dozen or so strategically positioned multiplier phototubes to measure simultaneously the intensities of the desired spectrum lines, darkroom processing is eliminated. One such electronic version of the spectrometer, as made by Applied Research Laboratories, will determine the chemical analysis of a properly prepared sample in about 45 seconds.

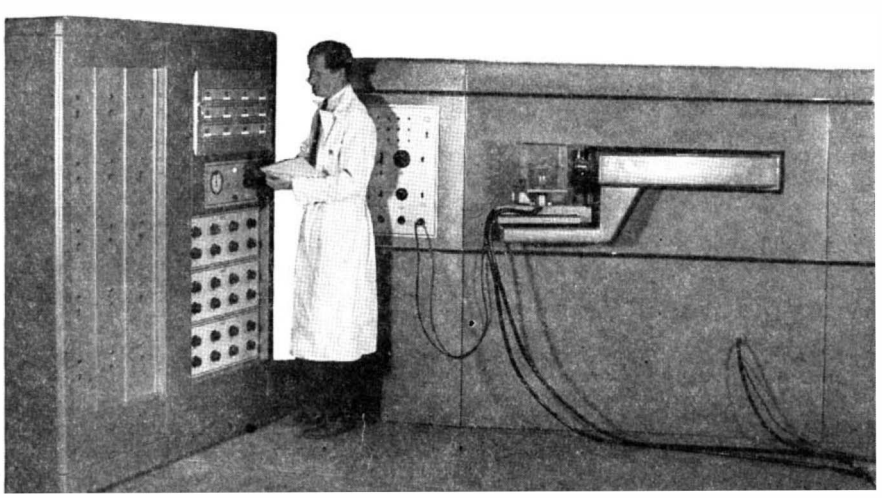
The spectrometer unit contains a spark source, a primary slit, and a diffraction grating to spread out the light into a spectrum, much as in a conventional spectrograph, but beyond this the resemblance ceases. There is a long focal curve along which slit-covered receivers can be moved to receive the light from any spectral line desired. As many as 12 receivers, each with its multiplier phototube, amplifier, and associated electronic circuits, can be positioned along this curve without serious interference between them and in such a manner that several lines close together in the spectrum can be measured simultaneously.

The radiation which passes through a receiver slit falls upon an electron-multiplier phototube. The output current of this tube, which is proportional to the intensity of the light falling upon the cathode, is then integrated and converted into a series of electrical impulses, the sum of which is proportional to the integrated intensity of the spectral line. These impulses are amplified by means of an electronic amplifier, which is a part of the receiver, and passed on to the recording console.

The spectrometer unit is about five feet high, nine feet long, and four feet deep, with enough room at the back for a man to sit inside and make focussing adjustments in the dark. Thus no special dark room is required to house the unit.

The recording console, a separate device almost as large as the spectrometer, furnishes the final analytical results. For each phototube there is a motor-driven electromagnetic counter driving a 50-inch tape on which is printed a percentage sequence corresponding to the typical spectrochemical working scale. Each tape starts at its reference point, and advances one number at a time at a rate determined by the intensity of the spectrum line it represents. The count is terminated at a definite integrated intensity on the standard spectrum line being used for reference. The chemical percentage for each element being measured can then be read off directly from the numbers visible on the tapes at the reading apertures. The operator only needs to enter





Magnesium alloys are analyzed (left) and the results recorded on paper by fully automatic spectrometer used at Dow Chemical plant. Similar unit (below), made by Applied Research Laboratories, is direct-reading, speeds steel-mill operations

these results on his analytical form, press a button to re-set the recorders, and the unit is ready to analyze the next sample.

In this manner has been solved one of the most annoying limitations of spectrography—the necessity of having the lines of the elements to be determined at about the same level of intensity. A still greater problem—variable contrast of the photographic emulsion with wavelength—also vanishes because the multiplier phototubes have a linear response.

With this direct-reading spectrometer, alloys can be analyzed at the rate of 25 seconds per determination, compared to three minutes per determination with the photographic method. Up to eleven elements can be analyzed at one time. Control circuits make it possible to have several different types of conditions ready for instant use, so that several alloys may be analyzed alternately without readjusting the machine.

ECONOMIES—The rapidity of operation provides a "pour or not-to-pour" analysis, in the case of metal production, in a minimum of time. Here, every minute saved is a minute less of furnace time required. Cutting such an analysis from ten minutes to less than three minutes from the time the sample is received provides real economies in fuel, overhead costs, and so on.

An example of these savings is the case of producing high-grade steels in an electric furnace. The furnace may be charged from scrap or with metal from an open-hearth furnace. In the former case, about three to five hours will be required to melt down the scrap. Just as soon as the charge is thoroughly melted, a preliminary eight-element analysis will be required to determine the residuals in the steel. Whether it takes one minute or ten minutes to perform this analysis is not particularly significant when just one furnace is being considered, as the main purpose of the analysis is to determine whether the steel needed can be made from that particular melt, or whether the residuals are such that another type must be produced. This analysis is usually followed with other preliminary ones to control the refining process.

The first important analysis from the standpoint of possible time saved is the one just prior to the "slag off." If the various residuals have been brought down to specifications, the oxidizing slag can be removed and the deoxidizing slag put on the heat. Thus, if carbon can be determined in a few minutes by a high-speed method and the other alloying elements by a method just as rapid, at least eight minutes of furnace time can be saved at this point. If the results of the analyses are such as to allow the slag off, these same analyses can be used to determine the correct additions to bring the melt to the desired steel specifications.

After making these additions, another half to three quarters of an hour prepares the steel for tapping. However, before the actual tapping can be done, the final sample must be analyzed. If this analysis can be concluded in two minutes—instead of ten or fifteen—at least eight minutes can be saved in determining whether to pour. Thus, in the operation of just one electric furnace, at least 16 minutes can be saved in every melt of from five to eight hours. In a 24 hour day, about one hour of furnace time could be saved per furnace by a direct-reading instrument over that required with a standard spectrographic installation.

Exactly the same kind of analyses are required in casting, forging, or fabricating with steel. Hence direct-reading spectrometers can be applied to any of these fields. Whether such applications will lead to large savings depends considerably upon the magnitude of the operations involved and their intricacy. In all cases where work must wait on laboratory analysis, the double saving of general operating costs and laboratory costs can often justify the installation of direct-reading equipment. Even in cases where only laboratory costs are involved, but where a large volume of testing must be handled, the greater speed of the direct-reading instrument over spectrographic methods or chemical methods often make its installation economically desirable. Likewise, savings have been shown for the aluminum and magnesium manufacturing fields.

A somewhat similar automatic spectrometer developed by the Dow Chemical Company for the same purpose records its results on paper. This machine has been in use in the company's magnesium alloying plant for several months, and can give an alloy analysis in 40 seconds, a fraction of the time required by former techniques. Amounts of up to 14 elements present can be determined simultaneously. Girl operators can be trained in one day to use the instrument efficiently since the entire operation is fully automatic from the time the metal samples are placed in the instrument until the analysis is recorded on paper for reference or filing.

PLASTICS BALLS

Sealed Air-Tight in Matter of Seconds

DIELECTRIC electronic heating is being used to join large strips of Vinylite in air-tight, water-tight seams for giant toy balls. The sections of the thermoplastics to be sealed are placed between metal electrodes supplied with radio-frequency power from an RCA, two-kilowatt electronic generator and fusion of the surfaces in contact is a matter of seconds.

According to the DuPage Plastics Company, this tough, lightweight 22-inch diameter ball could not have been made on a practicable basis by any other heating method. Conventional stitching would have required a separate water-proofing operation.

HORSESHOES

Made with Aid of Electronic Heating, Welding

AN ELECTRONICALLY controlled welding press is now being used to join the toe calks to horseshoes in a mass-production operation. Preheating of the shoes is done by another electronic unit, a 20-kilowatt electronic heating generator near the welder. In this first operation, it takes about eight seconds to heat the shoe to a temperature of about 1200 degrees, Fahrenheit. Resistance welding of the shoe to the calk is controlled by an electronic timer that determines duration of the current flow for each pulsation of welding current. The total number of pulsations and the cooling time between pulsations are controlled by a sequence timer. Output of the machine is 360 shoes per hour, and these contribute to the total of 20 million horseshoes manufactured annually.

TELEVISION TUBES

Ride Conveyor Line on Mass-Production Basis

COATING of the glass bulbs of large television tubes is now done on a mass-production basis, 10 workers turning out more than 1400 tubes a day.

At one end of the room the bulbs are washed and placed on a conveyor that carries them to a baking oven. After baking they go to an automatic spray machine that coats the face of the bulb with phosphor powder. Other conveyors take them to inspectors, wipers, and oven operators. None of these workers need move from their positions; the conveyors do all the transporting of the fragile bulbs from place to place at a North American Philips plant.

Looking To The Light

Refuting the Belief that Modern, Engineered Lighting Must Always be Costly and Involve Extensive Re-Building, the Bowditch Grade School Experiment is Cheerful Proof to the Contrary. Standard Fixtures, A Little Paint, and A Lot of Thought were the Keys to Better Seeing

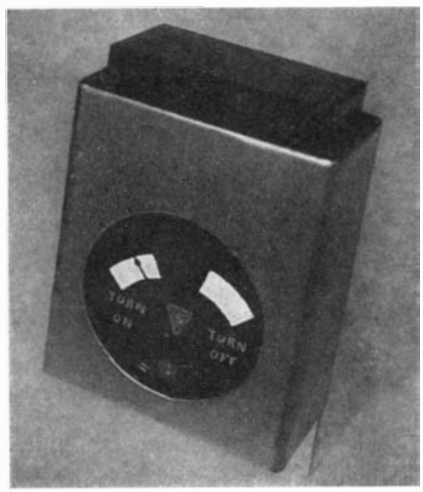
LIKE many another American grade school, the Bowditch School in Salem, Massachusetts was built 30 or more years ago. And, again in common with hundreds of typical schools, the lighting—both artificial and natural—was something less than all that could be desired. Blackboards were genuinely black and soaked up a good share of the available light. Reflections were hard to control, and the familiar cry of "Teacher, I can't see the board" was heard in spite of various combinations and manipulations of window shades and room lights. Windows that were intended to provide natural illumination did only half the job—the side of the room farthest from them was too dark—yet the glare from the sky was too bright. All in all, the problem was a difficult one, yet an old and common one. Its solution required the combined skills of functional painters, illuminating engineers, school-furniture designers, and educators.

Aimed at this solution was the establishment of Room 4 at Bowditch School as an experimental laboratory in the form of a working classroom. Here, the four windows faced southwest, reached within six inches of the ceiling, and had a glass area equal to 19 percent of the room floor area. Artificial lighting consisted of nine conventional open-shade lights with one 100-watt and eight 50-watt bulbs. Three standard blackboards lined as many walls, and the familiar school desks supplemented by a very ordinary color scheme and a picture of George Washington completed the scene of primary education.

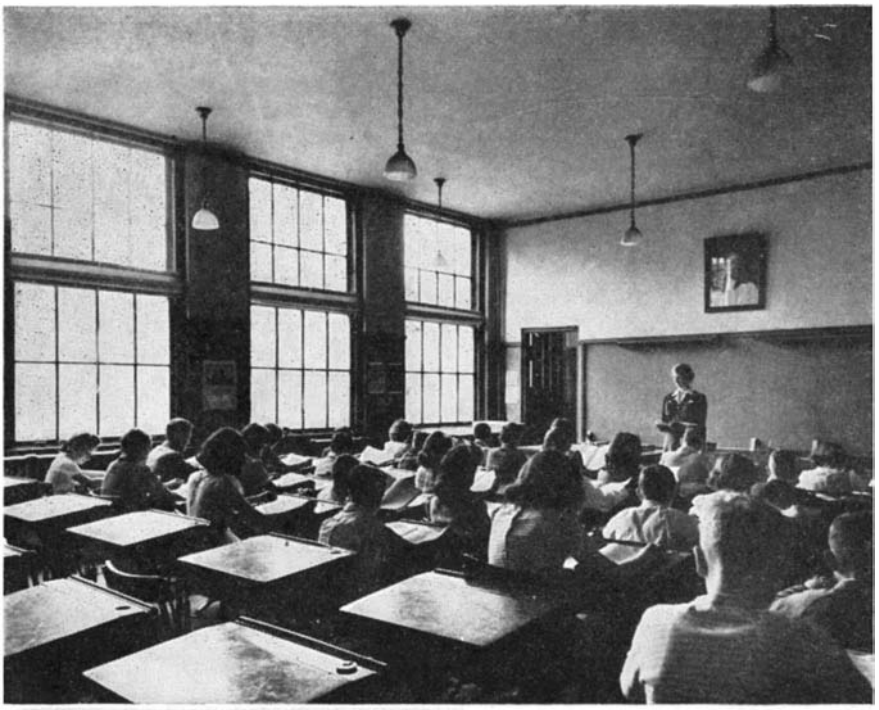
As outlined originally, the plan for remodeling Room 4 for "laboratory" use involved five basic factors. For one thing, it was important that the artificial lighting equipment or "luminaires" would not be so different from the standard fixtures as to require special installations and construction. Other equally important points included the necessity for controlling the entrance of daylight; high reflection factors for the main surfaces in the room; furniture conducive to correct body positioning for optimum light utilization; and a color scheme contributing both to a pleasant atmosphere and correct mixing of artificial and natural light.

LUMINAIRES — In the schoolroom as it was remodeled, the foregoing factors supplemented each other and blended together to produce a harmonious and efficient result. Each, however, presented individual problems and the arrangement currently in use is not regarded as a final solution to schoolroom lighting but rather as a working stage in experiments to that end.

The fluorescent luminaires selected were of a standard, triangular-shaped type and mounted two feet below the ceiling. To reduce the brightness of the sides of the lights facing the students, however, the glass on that side was replaced by a modified glass of greater density. This resulted in a satisfactory general brightness level and also produced an asymmetric light distribution with the greatest illumination coming from the sides of the lights toward the blackboards. Thus, with the brightness on the "blackboard" side having nearly twice the value of the brightness on the "pupil" side, no extra lighting was needed for good blackboard illumination.



School-room light meter (above) fixed to monitor's desk, tells when extra, or less, light is needed from fluorescent lamps (left). Louvers on windows in the background control sky glare, team with asymmetric light distribution from lamps to boost blackboard visibility

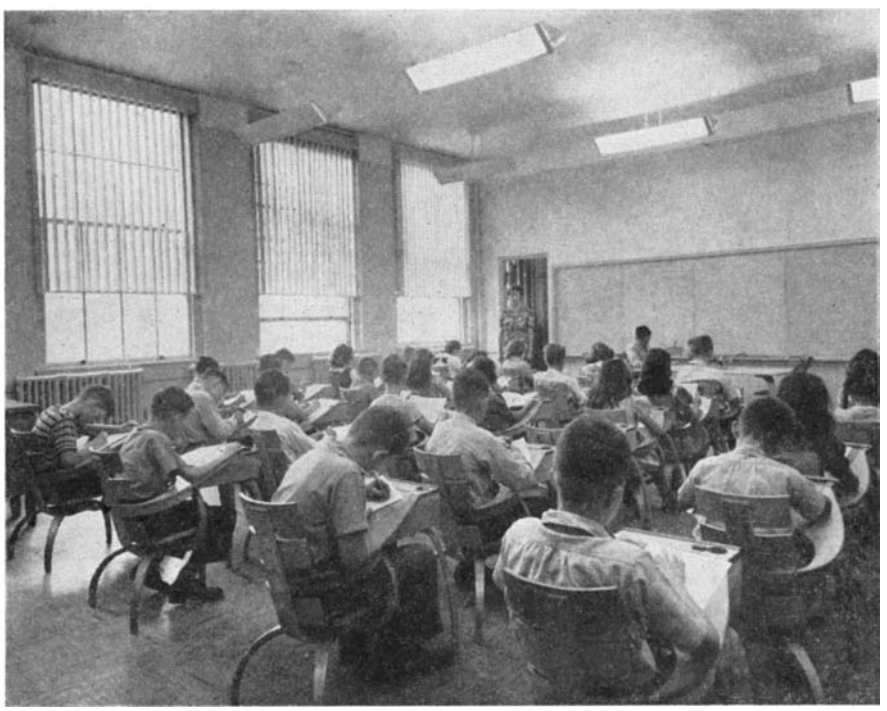


Photographs courtesy Sylvania Electric Products, Inc.

Poor light and sky glare (above) mark original fifth-grade room. Re-modeled room (right) lost old faults, gained in appearance, took no major changes

• LOOKING AHEAD •

Fewer mistakes, more accurate work in schools and industry alike with better light. . . Recognition that light control is as important as light intensity. . . Paint experts and lighting engineers merging knowledge. . . . Careful planning for use of economical standard fixtures in better-than-standard arrangements.



It should be pointed out, however, that if the children had been seated around tables rather than facing the front of the room the asymmetric light distribution would not have been installed. A similar situation is found in industrial lighting installations where, for example, a shop may have areas where a number of workers are seated and facing a given direction; and other areas where machines are placed at a variety of angles to provide aisle clearance and so on.

Control of the fluorescent lights is based on three rows of fixtures running longitudinally of the room ceiling. The lamps in the row nearest the wall burn at all times when the room is in use. This is necessary to provide a minimum of 40 footcandles at desk-top level. The central row of lamps, and the row nearest the windows, are controlled by a "monitor" pupil who switches them on according to the indications of a simplified light meter fastened to the desk. The meter is not calibrated in numerical marking but rather has two windows—marked "turn on" and "turn off"—through which a needle shows when lamp control is necessary.

Ordinarily, the monitor is called upon to operate only one switch which controls the lower lamps in the middle row of fixtures and the upper lamps in the fixtures adjacent to the windows. Another switch controls the lower lamps in the window row and is used only at night or on unusually dark days. An interesting sidelight on the actual lighting is furnished by the morale factor associated with the monitor's operation of the lighting switches.

Here it is apparent that even at an early age, members of a group take pride in having some degree of control over their working environment. In this case, the work time lost is negligible since the indicator needle is ordinarily unseen behind a blanked-off area of the meter face and only appears when the light level falls below the desired 40 footcandles or passes above the 60-footcandle level. The success of the plan indicates that a similar arrangement might well be adapted for lighting, ventilating, and like controls in industrial plants.

WINDOW LOUVERS — Coupled with the need for a well controlled artificial lighting system was an equally important demand for regulating the daylight entering the room through the side windows. In this case, the problem resolved itself into four major considerations. Excessive sky brightness at forward angles had to be eliminated. At the same time, however, provision had to be made to allow the children to view the sky by looking towards the windows—this to avoid any undesirable atmosphere of a "closed" room. In addition, it was important that as much daylight as practical reach the side of the room away from the windows and, moreover, that the first three objectives be attained without installing devices that required adjustments more involved than the usual management of a roller shade.

Some experimenting was done

with Venetian blinds but these were discarded in favor of vertical steel louvers oriented by non-adjustable fastenings at 90 degrees to the window glass. It was decided that minor gains in effectiveness that could be obtained through the use of adjustments for the louver angles were outweighed by the possibility that the louvers would be left in the wrong position. The four-inch wide louvers—spaced at 3½ inch intervals—were formed in a slight "S" shape and possessed the advantages over Venetian blinds of both strength and easy cleaning. As further convenience factors, the louvers were hinged to swing outwards for window washing and afforded enough space between them to eliminate any troubles in reaching the window latches.

Viewed at a 45-degree angle, the louvers completely screen any direct view of the sky, thus cutting off the glare for the students whose line of sight is directed towards the front of the room. From this angle up to 90 degrees the brightness of the sky increases gradually and thus provides the desired result of not screening the pupils entirely from a view of the outside.

When conditions are such that direct sunlight would penetrate the room, a light, translucent, roller shade located directly behind the louvers may be adjusted to prevent excess illumination.

After installation of the louvers, the daylight illumination within the room was checked with a footcandle meter and found to be much more uniform than it was before. Expressed in brightness ratios, the contrast between window and sidewall — narrow sidewall between windows—was 150:1 before providing the louvers. Similarly expressed, the ratio of the windows to the front wall was 55:1 without louvers. After the louver installation, these ratios dropped to 7:1 and 2 1/3:1, respectively. In all cases the brightness measurements of the windows were taken at an angle of 45 degrees. The effectiveness of the louvers is apparent from these figures and, in addition, it was pointed out that their cost would be less than that of Venetian blinds if they were made on a quantity basis.

PAINTING FOR LIGHT — To gain the fullest value from the new lights and window louvers, a change in the school-room color scheme was worked out with a particular eye to both color harmony and reflectivity values. Another factor, that of warm and cold colors, was decided in favor of the warmer colors both because of the fact that the room was most used during the cooler months and because the warm colors selected retained the same general appearance under white fluorescent lighting as they offered under daylight.

In attempting an accurate description of the colors finally evolved for the room, the engineers encountered the traditional lack of exact color terminology. In general, the upper wall is a light coral and the lower wall or dado a slightly deeper coral. The exact proportions of paints and colors were determined by experimental mixing under both natural and fluorescent lighting. The ceiling area was white with a trace of wall color, and the louvers were treated the same as the lower walls. Further efforts to obtain a good reflection factor in the room involved the installation of a light grey, asphalt-tile floor with a marbelized pattern to make heel marks less prominent.

FUNCTIONAL FURNITURE — Recognizing the necessity for proper posture if lighting and vision were to be held at efficient levels, the Bowditch School removed the old-style desks and installed the modern "functional" type of seat. The seat, designed to fit the body quite closely, and adjustable to accommodate students of varying size, incorporates a 18½-degree tilt in both desk top and back. The seat automatically tilts forward and back to meet shifts in body position.

The entire re-modeling job has brought about a surprising increase in light uniformity and effectiveness. Moreover, the results were achieved without deviating towards expensive and custom-built lights and equipment and is, therefore, adaptable to the needs of many schools both old and new. The same essential lighting problems appear in many industrial plants and offices and may well be solved by following similar lines of approach.

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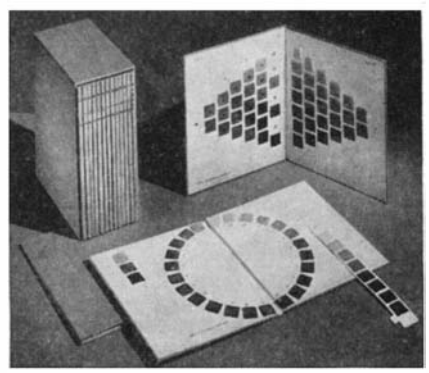
COLOR CHIP MANUAL

Re-Issued In Large Edition for Better Visual Impression

OF INTEREST to all persons who work with color is the publication of a Large Chip Edition of the Color Harmony Manual by Color Laboratories Division, Container Corporation. In this edition, the individual color chips are one-inch square plus a tab, providing two and one-half times more working area than the chips in the first, 1942 edition. Some advantages of the larger working area of the chips are the increased speed with which a visual impression of a color is gained, and the ease with which color matching is accomplished. Also, the necessarily larger charts—11 by 18¾ inches when open— are more appropriate for teaching and for presenting color schemes before groups of people.

The shape of each chip incorporates a tab on which is printed the complete Ostwald notation for that color. All chips are removable from their positions, which are marked accordingly for easy return,



Manual includes 12 books, 680 chips, work chart, gray-scale holder, and text

and the location of any Ostwald notation is evident from a glance at the transparent flyleaf which is printed with all letter notations.

The chips in both editions of the Manual are identical in color. Thus, the colorimetric specifications for the dull sides of all 680 chips apply equally well to both editions.

A new feature of the Large Chip Edition is a work chart in which the chips may be arranged for study in circular or linear series. Also included is a 24-page text which explains the basic Ostwald principles of color order in non-technical language, and tells how to use them to obtain harmony in color.

SPOT-WELDER

Adjusts Work Table, Controls Electrodes Electronically

ONE OF the largest of its type known in existence today, a new multiple-spot-welding machine has been placed in operation at a Pullman-Standard Car Manufacturing Company's plant and is expected to increase production in the department about 30 times over present processes.

Weighing more than 90,000 pounds, the huge machine was built by National Electric Welding Machines Company after extensive study of the operations involved in welding "stiffeners" to the interior of car sides to give them the sleek appearance dictated by today's

streamliners. A stiffener is not visible, but is a sheet of light-gage corrugated metal which is welded inside the walls of the car to lend strength and smoothness—much on the same principle as the corrugations on the interior of a cardboard box.

In operation, a metal table 30 feet long and 10 feet wide travels beneath a battery of 48 stationary welding electrodes. The work to be welded is laid flat on the table, which has been covered with a copper plate. As the table moves slowly beneath the row of spot-welding electrodes it is adjusted to stop at proper intervals; the electrodes then automatically lower, making contact with the work and securely welding the stiffeners to the car side. The electrodes then lift up and the table moves on to the next position, where the process is repeated.

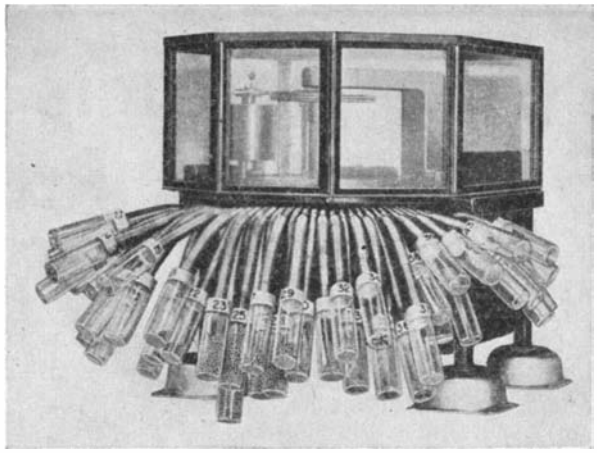
A photo-electric cell control makes the operation largely automatic. Along one side of the moving table are drilled two rows of small holes about a quarter of an inch apart. A beam of light is directed from beneath the table, through these holes. When the beam strikes the photo-electric cell above the holes, the control circuit is completed which stops the table, lowers the electrodes, makes the weld, lifts the electrodes, and starts the table into operation again.

By dropping loose rivets into all the holes not needed in the operation, the position of welding is preset.

ATOMIC POWER

For Electrical Generators Unlikely to Lower Current Costs

FUEL costs are such a relatively small figure in the over-all expense of generating electricity that atomic power plants would reduce residential electric bills only slightly, according to a recent Westinghouse estimate. The cost of carrying the power into homes and industries, the investment required for central generating stations and distribution stations, and equipment maintenance, far outweigh the fuel bill, it was explained.



After four successive washings, steel balls pass through sorter and are directed to glass vials. Any one bearing is assembled with balls of similar dimensions

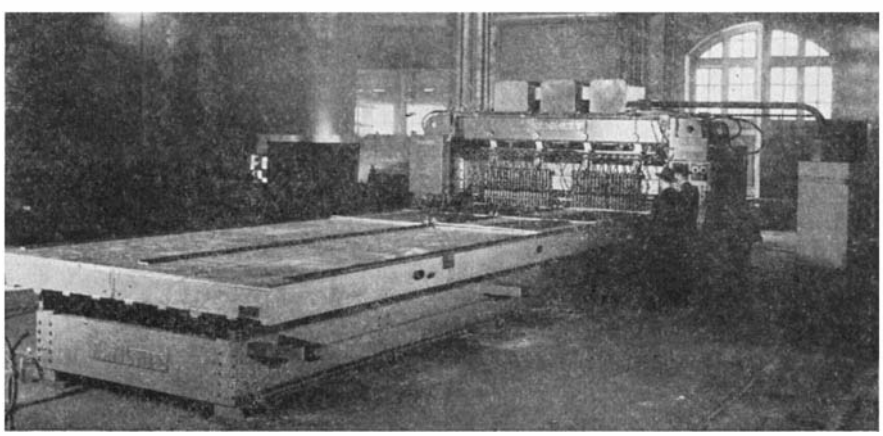
BALL-GRADER

Holds Unusual Tolerances To Aid Bearing Uniformity

PRODUCTION-line precision evidences a high stage of development in a new machine designed for sorting and grading the tiny steel balls used in bearings on movie projectors—the machine is accurate to within .00002 inch. The close measurement is said to be necessary in order to effect maximum uniformity among all the balls used in any one bearing assembly.

Before being placed in the grading machine, according to the Bell and Howell Company, each group of balls undergoes four successive cleaning baths, to remove any trace of oil or other foreign matter which might cause erroneous measurement. After being passed through the glass-enclosed grading machine and sorted, the balls are guided into numbered chutes, the ends of which are connected to glass vials by means of flexible tubes. The various vials are carefully labelled, and their contents are kept separate, so that only balls of the same size are used in assembling any one bearing. Following grading, the balls are re-lubricated with high-grade, acid-free oil, and the vials then are sealed and marked with the size numbers.

Placement of light-blocking rivets (above) controls welding positions. Full view of welding machine (below) shows 10- by 30-foot traveling table



GLASS FILTERS

Help Purify Air in Penicillin Plant

IN FIBER form, glass is being employed to filter bacteria and other foreign properties from the air used in the production of penicillin.

At the E. R. Squibb and Sons penicillin laboratories, a loose, fine-fiber type of Fiberglas is used since it does not pack down under steam sterilization. The fibrous glass operates under pressure. Outside air, drawn through intake filters, passes through compressor, after-cooler, and separator, thence through a glass filter bed and into the fermenter tank.

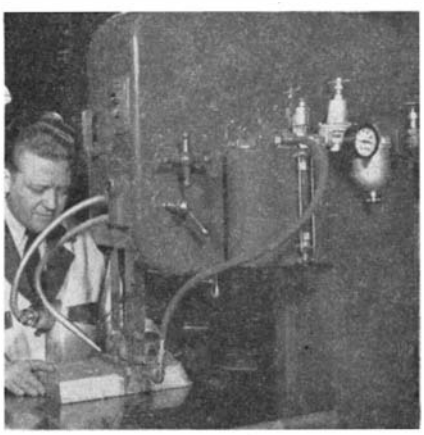
The glass fibers used in the penicillin application are only .00028 of an inch in diameter, as compared with the much coarser fibers used in warm-air heating systems in homes and industries.

New Products and Processes

BAND-SAW LUBRICATOR

Sprays Metered Mist, Avoids Messy Work Table

AN ECONOMICAL, clean method of heat dissipation is the description applied to a new spray lubricator for attachment on high-speed band saws. Faster cutting rates, improved finish, and increased saw life are the results claimed for its use. The attachment, for DoAll saws, is simple to install and is a



Saw teeth lubricated at point of work

rugged, heavy-duty, fool-proof device operating from a standard air-pressure line.

The spray head straddles the saw blade from the back and directs twin streams of lubricated air against the teeth of the saw. Lubricant is thus forced in the form of metered mist into the saw teeth as they enter the work. Use of coolant is regulated by a metering valve. It is said that the work table thus does not get wet or messy.

The DoAll Spray Lubricator has been designed primarily for use in cutting nonferrous metals, but also works on many types of plastics and laminated material where friction between blade and work softens the material to a gummy state.

HUMIDITY TESTER

Simply Made with Variable-Color Ink

SUITABLE for brushing, spraying, or printing on paper, cloth, metal, or other surfaces, a humidity-sensitive ink dries in a few minutes at any temperature from 110 to 150 degrees, Fahrenheit. At room temperature it dries in about an hour if the relative humidity is below 50 percent.

Called HygroInk, the ink, when dry, turns from blue-green to pink as the humidity increases. The color change is distinct, definite, and reversible. When conditions are suitable for mold, mildew, corrosion, rust, and so on, the ink mark shows a warning pink.

As a simple testing device a tab of paper marked with the ink may be buried in powder, flour, cereals, tobacco, and similar products; or it may be used to check the atmospheric humidity of work rooms or storage areas.

FLOOR CLEANER

Reduces Slipping Hazard, Improves Cleanliness

OIL, grease, and water absorbent, a product made from an alumina silicate material is said to be capable of absorbing from 120 to 140 percent of its own weight. Used on oily, greasy, or wet floors, the absorbent helps eliminate the danger of accidents due to slipping, at the same time keeping floors clean and reducing fire hazards.

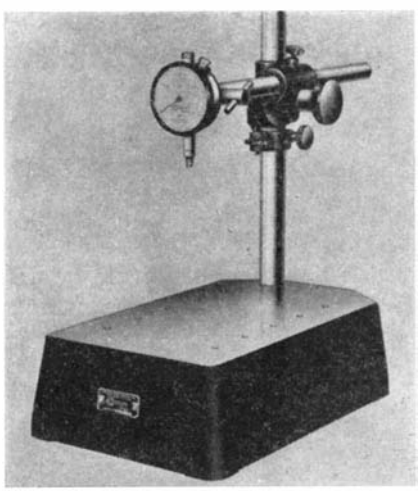
The granular, absorbent material is free of dust, non-abrasive, and "tailor-made" to give maximum service to the user without sacrificing its absorption qualities. Weighing up to 30 pounds per cubic foot, the manufacturers, Blue Mountain Clay Company, Inc., maintain it gives a greater coverage per pound than ordinary mineral products.

DIAL COMPARATOR

Adjusts to Position Easily, Accommodates Work Clamps

ANNOUNCED by Standard Gage Company, a new dial comparator model is described as suited to a wide variety of uses due to the extensible indicator support arm and the tapped holes in the platen for securing the work. Any dial indicator having a standard lug-type back may be used.

By means of a double clamp arrangement, the indicator support arm may be slid up or down on the vertical column, swung to any angle in either a horizontal or vertical plane, and moved to place the indicator at the desired distance from the column. Setting is facilitated by a vernier screw. A friction washer concealed in the swivel prevents the indicator arm from dropping unintentionally when the clamp is loosened for adjustment.



Vernier screw facilitates setting up

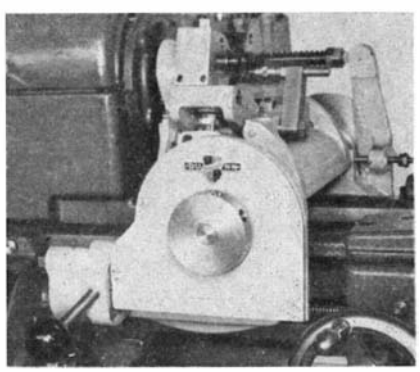
Working area of the platen is 6 by 9 inches. Five tapped holes on either side are spaced at 1½ inches and will receive ¼ inch-20 bolts for securing the piece being checked.

LATHE ATTACHMENT

Converts Standard Machine for Automatic Small-Parts Use

DESIGNED as an accessory for either the Atlas or Logan lathe, a recently developed device provides a new means of producing small parts automatically, and with good accuracy, at very low cost. It is claimed by the manufacturer that many small parts, particularly those that require only form and cut-off operations, now being produced on the large and expensive automatics, can be produced just as rapidly, and with equal precision by using this lathe attachment, called "Dunamatic."

The attachment employs face cams to control the operation of rocker



Material feed and closing of collet are automatic and timed to operation

arms which, in turn, control the operation of forming an cut-off tools attached to them. Either circular or flat form tools or a combination of both may be used, the selection of type depending upon size of the production run. The rocker arms operate on pivots instead of slides, thus eliminating the necessity for constant adjustment. A means of adjustment is provided, however, when long usage might make simple adjustments necessary. Since all the pivot parts are precision ground and hardened, adjustment is said to be seldom necessary.

The stock is cam fed through a tube by feed fingers, into a collet, automatically, and a moving stock stop determines the length of the part to be either formed or cut off, or both. Closing of the collet, which is also an automatic operation, is timed to coincide with the start of operation of the work tools.

The attachment is complete and, it is said, can be affixed to the lathe with-

out it being necessary to drill holes or in any way harm or deface the latter, within one to two hours time. It can be removed at will and the lathe restored to normal service.

Power for operation of the Dunamatic is taken from the standard lathe lead screw and transmitted, by means of a roller chain and steel sprockets, through a steel worm and bronze worm gear, providing efficient and, at the same time, quiet operation.

CONICAL CANS

Nest for Compact Shipment or Storage

FIVE TIMES the number of nesting, conical tin cans can be packed for shipment, storage, or handling in the same space as required for ordinary cylindrical cans, according to the manufacturer of a new can with slightly tapered sides. Other features of the can are that near the bottom the wall is swaged, providing a shelf around the entire inside on which the can above rests, preventing jamming or sticking.

Forty eight of the coned cans nested one in another form a stack about 42 inches high. This makes possible mechanical wrapping of 48 cans in one small package, and loading them quickly and economically. In this compact form of package, it is said that the cans are much better protected from denting or injury in transportation and storage. The cans were developed by The Francis Company.

RECORDING DILATOMETER

Operates on 12-Hour Cycle, Eliminates Plotting Instant Values

FOR CONTINUOUS recording of the thermal expansion and contraction of a wide range of materials including metals, glass, ceramics, and plastics, an improved automatic dilatometer has been developed. Graphic recordings of the 12-hour expansion and contraction cycles of samples are provided with a high degree of both sensitivity and accuracy, and operation does not require supervision of a laboratory assistant. Thus both time and labor required for specimen study are reduced.

Measures heat reactions automatically

Measurements begun during the afternoon of one day may be automatically completed overnight. Except for set-up time, the laboratory assistant is free for other work during the 12-hour recording cycle.

In addition to eliminating the tedious plotting of instant values by older methods, the recording instrument permits determination of true variations in length even when samples exhibit exceptions to the rule of elongation as a function of temperature. This makes the equipment particularly useful in connection with the laboratory study of ferrous alloys at thermal critical points.

The improved instrument is fully enclosed in an attractive steel cabinet permitting ready access for set-up of specimens. Recording meter and other instruments are flush-mounted, permitting visual indication of operating temperatures and the progress of thermal expansion curves plotting elongation against temperature.

The dilatometer includes a furnace or sub-zero cooling chamber; furnace thermocouple; concentric quartz tube; specimen thermocouple; gearbox and support; transmission; contact mechanism; electronic relay; and recorder. Each one of these principal units performs a separate function but all functions are closely coördinated to hold specimen temperature uniform within 1 degree, Centigrade, and to provide uniform heating and cooling with the specimen in an inert atmosphere, automatic shut-off, and an overall accuracy of 0.2 percent.

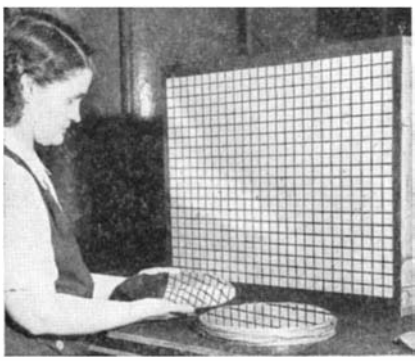
Accommodating three-, four-, or

five-inch specimens, the dilatometer will allow temperatures up to 1000 degrees, Centigrade; weighs 450 pounds; and measures 56 inches wide, 50 inches high, and 26 inches deep. It is designed for use on 110-120 volt, 50-60 cycle supply, and is rated at 900-1000 watts. The manufacturer is the Electronics Division, Sylvania Electric Products, Inc.

DISK INSPECTION

Facilitated by Reflection of Ruled Grid Lines

IN A recording-disk base, dimples or deviations from true flatness are defects that might ruin a priceless re-



Imperfect disk (left) and flat disk (right) are quickly spotted by lines

cording or transcription. This is because an instantaneous recording disk must be perfectly flat. A dent or dimple in the base before it is lacquer-coated to form a recording blank may cause a "skip" or other imperfection in the sound track of the finished recording.

In the past, accurate tests for disk flatness have been difficult. Eye scrutiny of the bases is inaccurate and time-consuming. Mechanical tests are out of the question, because any instrument that touches the disk's surface is practically certain to create its own blemish.

Audio Devices, Inc., manufacturers of recording disks, has recently initiated the use of a ruled board by which the bases mirror their own defects. Employing this so-called "mirrorgraph," the inspector is able instantly to detect flaws in the bases, thereby forestalling many of the difficulties formerly encountered by recording engineers.

STOPCOCK LUBRICANTS

Removed by Use of Naphthalene Solvent

THE many advantages to be gained through use of silicone stopcock grease and silicone high vacuum grease, made by Dow Corning Corporation, have been reluctantly given up by some micro-analytical laboratories because of the difficulty encountered in removing the non-wetting film formed on laboratory equipment by these lubricants. The best cleaning methods previously developed involved use of caustic solutions which had to be carefully watched to avoid etching the glass. Recently, however, a hydrocarbon solvent has been found which quickly and efficiently removes silicone films from laboratory glassware.

It is reported by G. Constabaris of the Department of Chemistry of the University of British Columbia that the stopcock grease can easily be removed from laboratory glassware by decahydronaphthalene, also known as decalin or naphthalene. The effectiveness of this solvent has been verified in the laboratories of Dow Corning Corporation.

The recommended procedure consists of filling the apparatus with warm decahydronaphthalene (decalin) and allowing it to stand for two hours or more if necessary, subsequent draining and rinsing once or twice with acetone, and drying with a stream of filtered air. It is noted that the decahydronaphthalene can be re-used several times before it becomes ineffective.

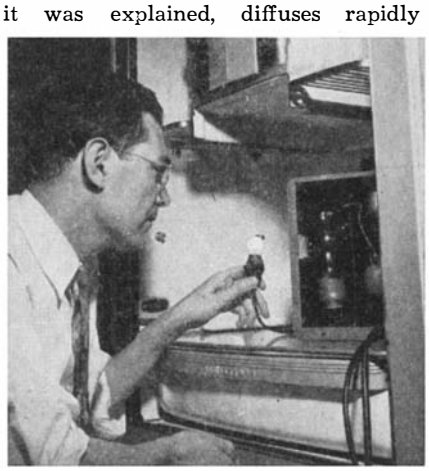
In using the lubricants, only a very thin film is necessary to provide effective lubrication, and judicious use of the greases and frequent cleaning should prevent surface contamination.

BACTERICIDAL LAMP

Stops Refrigerator Odors, Occupies Little Space

A MIDGET ultra-violet lamp, the size of an automobile headlight bulb, has been developed as a bactericidal unit to be screwed into a niche of a refrigerator cabinet's interior. The new lamp simultaneously pours forth a barrage of bacteria-killing rays and produces ozone in the cabinet's air. It is recommended for both high humidity and low humidity types of mechanical refrigerators, according to the Westinghouse Sterilamp-Tenderay Department.

Advantages of the bactericidal radiation are said to be odorless refrigerators, improved sanitation, longer preservation of food in its original stored state, and checking of the growth of mold and bacteria on food. The ozone, it was explained, diffuses rapidly



Lamp provides ozone, ultra-violet rays

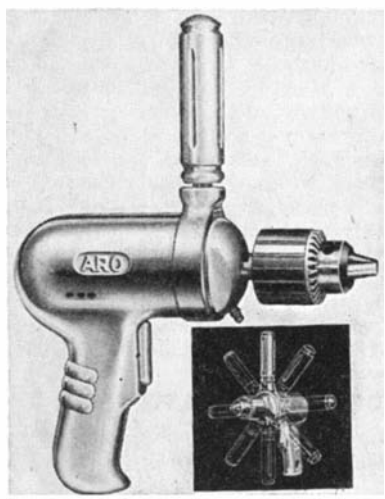
throughout the entire cabinet, purifying the food vapors by breaking down the vapor molecules. The ultra-violet destroys air-borne bacteria, viruses, mold, and food odors within the range of its radiation.

Burning only when the refrigerator compressor is operating, the three-and-one-half-watt miniature Sterilamp compresses a specially-designed tungsten filament, lead wires, and stem assembly into a walnut-size interior. The transformer required to step down the household electric voltage to the 12-volt lamp consumes only three and one-half watts. At least a year's life is assured for the lamp because its filament glows only for three seconds, insufficient to attain incandescence, each time the lamp burns. The filament serves as a starter for the arc which, when struck in a mercury atmosphere, produces the ultra-violet radiation.

AIR DRILL

Gives Heavy-Duty Service Without Heavy Weight

AN AIR-powered, half-inch drill is described as built to the specifications demanded for heavy-duty, continuous-



Auxiliary handle shifts to any angle

production jobs requiring tool stamina and accuracy, yet is said to be 40 percent lighter in weight than ordinary drills of the same capacity. It is claimed that ample power is provided for stall-proof operation on most jobs of drilling, reaming, and countersinking.

The drill, made by Aro Equipment Corporation, is equipped with an auxiliary handle that can be located in any position around the nose of the tool. The handle threads into a shoe located in a ring on the nose housing. To locate the handle in a new position, the operator loosens the handle with a ⅛ counter-clockwise turn, moves it to the desired position, then locks the handle by a ⅛ clockwise turn. This feature saves time and increases the versatility of the tool.

A safety-throttle trigger allows start-

Editorial purpose of Scientific American is to provide its readers with thought-provoking feature articles and shorter items on all phases of industrial technology. In every case the material is drawn directly from industry itself. The Editor will be glad to refer interested readers to original sources and, when available, to additional literature giving further details of a more specialized nature.

ing and stopping the tool with a minimum of effort, and controls the operation. Other features include heavy-duty ball bearings; rotors, cylinders, and gears made of alloy steels ground to precision tolerances; and a built-in automatic oiler. Drill speed is 1000 revolutions per minute, weight 6¼ pounds, overall length, 8⅝ inches.

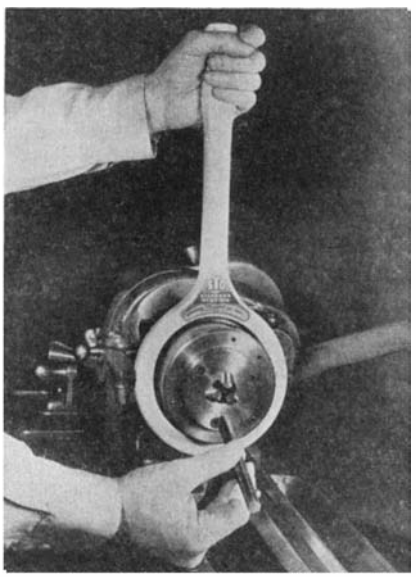
SPEED CHUCK

Opens and Closes Without Stopping Spindle

A NEW, inexpensive high-speed chuck, intended to increase production and lower cost on short-run operations, is designed so that it can be opened and closed by slight movement of a handle without stopping the motor or spindle. If desirable to stop the spindle during operation, the handle can be used as a positive and efficient brake for instant stoppage.

The chuck, known as the "Standard-Hampton Speed Chuck," will compensate for spindle run-out and in most instances will allow close-tolerance chucking on any type lathe. Adaptable to fast, feed-through operations, the machine will permit chucking to full spindle capacity up to one inch.

For facing, threading, centering, drilling, or any turning operation, an adjustable spacer or stop accessory may be installed and used as an inherent



Adaptable to feed-through operations

part of the chuck. The jaws can be adjusted for close tolerance concentric or eccentric turning operations, and will hold any size or shape of bar stock within its minimum and maximum range, according to the manufacturers, Standard Tool and Gage Company, a subsidiary of Jack and Heintz Precision Industries, Inc.

PRE-FABRICATED RAFTERS

Eliminate Load-Bearing Partitions, Save Lumber

A NEW type trussed rafter that saves up to 400 feet of lumber in a two-bedroom house is now being used in a number of houses under construction, and has only four basic members plus two scabs. There are no right or left-hand members.

The rafters can be fabricated at job site or in a shop with a minimum of equipment consisting of a cut-off saw and a portable or stationary drill and four simple patterns. Experienced labor is said to be unnecessary.

According to the developers, the Timber Engineering Company, there is no complicated notching and no spiking—which eliminates possible splitting. Ring grooves and bolt holes are cut in one operation and production-line methods can be employed. The method is adaptable to both single and multiple housing units.

Lumber savings are reported to be accomplished by eliminating heavy bearing partitions and using non-bearing partitions such as light studs. Also there is less waste by pre-cutting and the ridge board is eliminated.

The rafters, pre-assembled on the ground, are erected as a unit, thus giving faster erection and affording interiors quicker protection from weather. A movable jig table speeds assembly so that rafters for one four-room house can be assembled by two men in an hour.

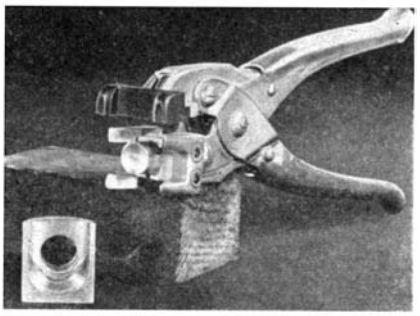
With standardized exterior walls, roof, and ceiling it is pointed out that any interior layout can be developed. The designer does not have to build rooms around bearing partitions as the partitions can be placed anywhere

without regard to ceiling framing. This flexibility makes it possible to provide three to six-room houses with the economy of standardized structural frame work. Here, prefabricated storage wall units will increase storage space in small homes without the expense of on-the-job framing of closets. The storage units form partitions but are moved into place after plastering.

TOOL ABRASION

Stopped with Hard-Metal Inserts

A SOLUTION to the problem of securing satisfactory life of hand tools used under highly abrasive conditions can sometimes be found in the use of Carboloy inserts. An example of such an



Jaws wear months instead of hours in holding parts for abrasive-brush job

application is the brazing of two inserts to pliers used for gripping parts applied to a revolving abrasive brush. It is claimed that two months of continuous service caused no appreciable amount of wear on the hard inserts in the plier jaws, whereas plier jaws made from conventional materials would stand up for only four hours on the same job.

PORTABLE WELDER

Uses Standard Current, Handles Most Light Jobs

RECOMMENDED especially for light-duty welding and general maintenance, a small, portable electric welder operates on 110-volt, alternating current. The manufacturer describes the welder, called Zipper-Et, as able to handle all maintenance and repair work that does not require the heavy-duty, industrial-type welders of high amperage.

The welder, complete with all accessories, is self-contained and has a

For general maintenance applications

total weight of approximately 40 pounds. A heavy-gage metal case with carrying handle provides portability. Also within the case is a transformer which is burn-out-proofed, with spun-glass insulation. It has a separate primary winding and a separate secondary winding, without any electrical connection between them. The manufacturer offers this point as an advantage over other welders which require a polarized-type plug and special care in welding grounded objects such as water pipes, radiators, and so on.

The accessories described include long cables with insulated taper plugs and sockets; a separate electrode holder and rugged ground clamp; aluminum, brazing, and steel welding rods; together with starting carbon and complete instructions. Also included as standard equipment is an arc torch which provides an electric flame, and an approved full-size helmet.

The Zipper-Et will accommodate five sizes of welding rod, from 1/32 through and including 3/32 inches, and will handle ⅛ inch carbons in the arc torch.

HAND LAMP

Throws Spot or Beam, Fixes to Cars or Boats

PORTABLE and weather-proof, a new electrical hand lamp has a single focus adjustment whereby it will deliver a spread or spot light—the latter a brilliant 1500-foot beam. Powered by two standard drycells with pressure type connections, the unit weighs approximately five pounds.

A special feature is that the lamp may be set down anywhere or clamped in a special hold-down fixture accessory for automobile trunks or prows of boats. In addition to sportsmen, motorists, and other personal users, industrial, commercial, utility, and emergency organizations are expected to find the Big Beam light convenient. The maker is the U-C Lite Manufacturing Company.

Uses two dry cells, weighs five pounds

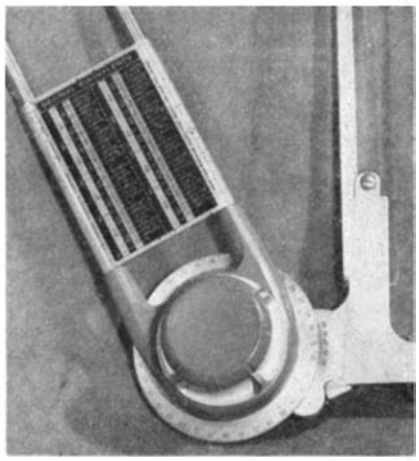
DECIMAL CHART

For Draftsman's Reference, Fits on Drafting Machine

INTENDED for attachment to standard types of drafting machines, an etched-aluminum chart of decimal equivalents is a new convenience for engineering workers.

The chart proper is three by five inches, has large legible lettering, and is protected by a durable Alumilite finish. Edges are formed to snap over the two parallel tubular support bars on some drafting machines, and garter spring attachment is provided for the single center bar machines.

When mounted on the machine, next to the protractor head, the chart is in position for constant ready reference. Less fatigue for the draftsman, reduced chance for error in decimal conversions, and a higher work output are among the advantages in the use of this chart.



Errors made in decimal conversion are reduced by this easily attached scale

TILE AND BRICK SAW

Eliminates Dust Hazard, Can be Carried to Work Site

A PORTABLE, dustless masonry saw for accurately cutting tile, brick, and concrete block on the job is described as bridging the gap between wood cutting and metal cutting. Built with a self-contained water supply system, the new masonry saw is said to gear tile and brick cutting to keep pace with bricklayers on the wall. Stair rakes, jambs, fountain niches, trim, and outlets are all handled and construction for heat-annealing ovens, sanitary dairy plant rooms, and similar jobs is speeded up.

The Champion saw, made by the Champion Manufacturing Company, combines many features which contractors, faced with such problems, required in high speed construction. Portability makes possible cutting tile, brick, glazed tile, and firebrick at the spot it is being used. This has been gained by mounting the saw, cutting platform, belts, and motor on a stand with removable legs, similar to an ironing board, which makes it easy to pull it through windows, inside kilns, and so on. Weight is held down through use of a new type electric motor of two horsepower weighing but 72 pounds.

To counteract the clouds of choking dust created by some saws, the new saw incorporates a self-contained water system, and a circulating pump belt-driven from the motor, which through a concealed nozzle sprays a fine mist over the cutting surface, both prevent-

ing dust and cooling the circular blade. The blade itself is provided in several degrees of hardness for various brick and tile products, including a diamond blade for cutting fine aggregates.

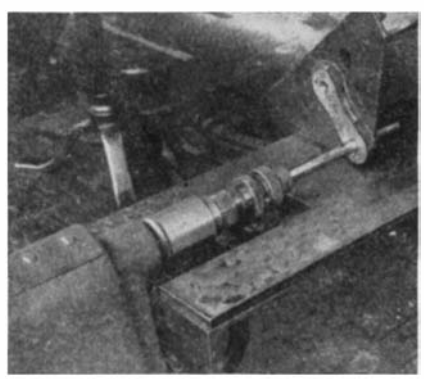
Another feature is reduction of operator fatigue. Whereas some masonry saws require the operator to push the tile being cut back and forth for a light, distributed cut, this saw is designed with a conveyor cart, which is pushed through with steady pressure. A spring oscillator on the blade mounting alternately applies and relaxes the cutting pressure. Thus only one operation is necessary after the saw is set and running. The oscillating action also eliminates the need for a foot pedal to apply pressure to the work, and the operator may stand any way desired and concentration of the water spray is splatter-proof.

Blades, chisels, marking pencils, hammers, and other pertinent tools are kept in a cabinet under the carriage of the saw.

DE-BURRING

Accomplished More Conveniently With Permanent Set-Up

FOR USE in de-burring the stray edges around holes, Nobur Tools are generally used in the spindle of a drill press or a lathe. Recently, however, it was reported that an obsolete tool grinder base offers the advantage of a



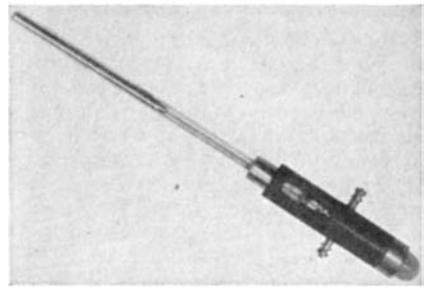
Obsolete tool-grinder base rebuilt for use with standard de-burring tools

special de-burring machine always available for immediate use. This arrangement, in use at the Chain Belt Company, is claimed to have resulted in an increase in production and a substantial reduction in labor cost for de-burring operations.

TEMPERATURE CONTROL

Provides Visual Check of Proper Functioning

A SIGNAL light, either red or white, glows brilliantly on a new mercury temperature regulator while temperature is rising, and shuts off when the setting temperature is reached. The glowing signal light can be seen at a distance, hence permits the operator to perform other duties and still determine at a glance when the temperature in a bath or oven has reached the desired temperature and when the regulator is operating properly.



Controls oven temperatures accurately

Called the Mercuroplat Thermoregulator, the unit is intended for accurate control of temperatures in water, oil, or air baths; ovens; and so on at any temperature within the setting range from minus 30 to plus 500 degrees, Fahrenheit. It has a sensitivity of plus or minus 0.02 degrees, Fahrenheit, or better.

The Thermoregulator is available in 6, 8, or 12 inch lengths, and its features include a machined plastics head whose design provides full visibility for setting, a convenient means for mounting, and an appropriate mounting for the signal light.

Contributing to accuracy and long life, is the distilling and filling method by which the mercury is distilled directly into the regulator without being exposed at any time to atmospheric air, thus providing higher purity of mercury. The Mercuroplat Thermoregulator is made by the Washington Glass Laboratory and Instrument Company.

ALUMINUM TOYS

Feature Lightness, Durability, Ball Bearings

EXPANDING applications of aluminum fabrication are exemplified in a new line of all-aluminum bicycles, scooters, and other playthings. Of these, perhaps the greatest interest surrounds the cycle, called the Park-Cycle. Its total weight is only 19 pounds, or about half the weight of similar cycles fabricated of conventional materials. The aluminum used in the frame will not rust and is finished with baked enamel in several available colors. Other features of the cycle include wheels of

Total weight 19 pounds; will not rust

the contained ball-bearing type with semi-pneumatic tires, a Goodyear V-belt drive provided with a guard, front and rear fenders, and a kick-stand.

Also featured by a division of the Reynolds Metals Company are all-aluminum scooters and wagons. Still undergoing final tests, it is reported, is an all-aluminum bicycle engine.

MICA-CERAMIC INSULATORS

Have Precise Dimensions, Good Electrical Properties

AVAILABLE in a size range of ¾ to 5 inches,, and molded entirely of an improved glass-bonded, mica ceramic, a new line of feed-through insulators are said to be exceptionally strong, mechanically as well as electrically. Produced by injection molding to precision tolerances, the insulators have accurately flat shoulders without high pressure spots which might cause cracking when the nuts are tightened. Nuts and studs are cadmium plated to resist rusting.

In addition, a new high-voltage

Strong, non-carbonizing insulator

transformer bushing with excellent dielectric properties and small bulk is designed of the same material for high-voltage secondary leads of transformers used in neon signs, cold-cathode lighting installations, oil-burner ignition systems, and similar applications.

Called Mykroy, the insulating material is made entirely of inorganic materials, hence will not carbonize in the presence of arcs, flashovers, or excessive temperatures. Its surface resistivity is said to be of a very high order. The surface is homogeneous and thus eliminates cracking, crazing, or checking due to thermal cycles.

COLD-RUN GLUE

Workable After Short Time, Always Ready to Use

COLD-run and fast-setting, a new resin wood glue is claimed to be the only type of resin glue that can be handled and machined after 20 to 30 minutes clamping time, instead of the usual six to eight hours. Called Wood-Lok, the manufacturer, National Adhesives, advises that the glue produces a strong,

resilient bond unaffected by usual humidity changes.

Other features are that it is a liquid, ready for use, and nothing has to be added, soaked, or heated. It does not harden in the pot, nor do its characteristics change during shipment, application, or use. Storage and working life is months, and Wood-Lok has no odor.

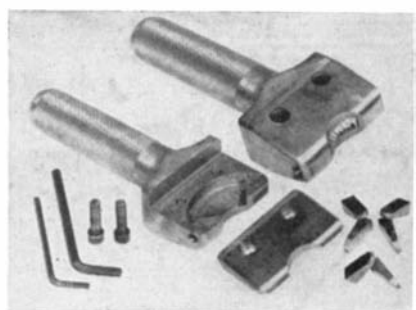
In addition, there is no need to heat the room above a comfortable working temperature; the glue does not embrittle or form a rock-hard abrasive film that might dull saws and knives; and the fast setting speed shortens assembly lines and frees working space.

Glue colors range from uniformly controlled pure white, which dries colorless and leaves no glue line, to darker shades for special uses.

STAMPED-IN LETTERS

Applied to Round Parts with Single Hammer Blow

CONVEX marking devices are now available for stamping part numbers, serial numbers, dates, and similar identifications on the peripheries of cylindrically shaped parts. A feature of these new devices, for hand or machine stamping, is the speed with which interchangeable steel type characters may be changed.



Steel characters are interchangeable; all letters register to same depth

It is reported that impressions of equal depth and clarity for all characters are obtained with one blow of the hammer.

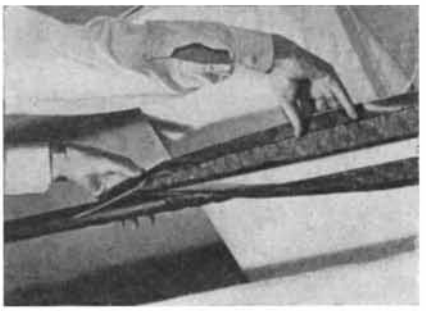
The markers are of "semi-standard" design, since parts to be marked having different radii require different holders and type according to the manufacturers, New Method Steel Stamps, Inc.

PIPE INSULATION

Stops Condensation Drip, Applied with Own Adhesive

TO STOP sweating and dripping from cold water pipes caused by condensation under warm, humid conditions, a new material works by jacketing the pipes with a thick blanket of insulation and an exterior vapor barrier. This prevents warm, humid air from striking the cold pipe.

Called Dri-Pipe, the jacketing is made of a water-repellent, pliable insulating material with a moisture-proof backing. The backing does not require painting, but will take paint for deco-



Blanket wraps around water pipe

rating purposes. Also, the backing has "self-stik" adhesive edges on both sides of the insulation for attaching to pipes.

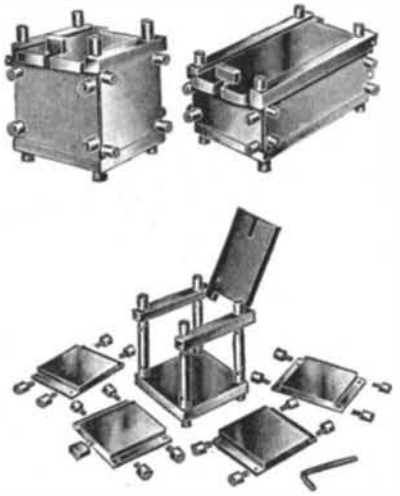
Installation is said to require no technical knowledge, and the only tool needed is a pair of scissors. Application is lengthwise to the pipe, not spirally.

BOX JIGS

Provide Toolmaker with Basic Working Unit

SAID to offer substantial savings in the cost and time ordinarily required for constructing a jig body, new box-jig units can be used in many phases of drill-press operations such as drilling, reaming, counter-boring, countersinking, spot facing, tapping, and so on. Called Drillet Box Jigs, they are available in 150 different sizes—square and rectangular shapes—to accommodate variations and ranges of shapes and sizes up to six inch capacity.

Another advantage claimed for the Drillet is the fact that it is possible to use the jig on all of its six sides, thus taking advantage of its full capacity. This is accomplished by means of re-



Independent jig parts allow convenient addition of locators, clamps, or holes

movable sides together with a thumbscrew and leaf arrangement.

In operation, turning the thumbscrew and raising the leaf opens the jig to receive a part. After the part has been placed in the jig and properly clamped, the leaf is brought into position, locked by the thumbscrew, and the set-up is ready for the tool.

All parts of the jig are independent and can be worked on separately when mounting locators and clamps, or boring holes for drill bushings.

The Editors Recommend

PROCEDURES IN EXPERIMENTAL PHYSICS — *By John Strong, Ph.D.* A wealth of useful data of a practical kind for the constructor, experimenter, and skilled craftsman. **$7.10**

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

TOOL MAKING — *By C. M. Cole.* Instructions for making and using all kinds, from personal tools to arbor presses, lathes, planers, etc., in different metals. **$3.60**

THE PSYCHOLOGY OF SEEING — *By Herman F. Brandt.* From motion-picture data of eye movements and use the author has revised many concepts of seeing. His interpretations will be of value to everyone—editors, advertising men, product designers, safety engineers, and so on—whose living depends on the use which people make of their eyes. **$3.85**

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

EXPERIMENTAL SPECTROSCOPY — *By Ralph A. Sawyer.* Covers theory and types of spectrosopes and spectrographs, mounting and use of gratings, determination of wavelengths, infra-red spectroscopy, spectrochemical analysis, and so on. Somewhat elementary but requires knowledge of physics and some physical optics. **$5.10**

ATOMIC ENERGY FOR MILITARY PURPOSES— A General Account of its Development Under the Auspices of the United States Government, 1940-1945. The famous Smythe report, telling in relatively non-technical language of the developments in nuclear physics that lead to the manufacture of the atomic bomb. **Paper cover, $1.35; cloth $2.10**

PLASTICS — *By J. H. Dubois.* Third edition, again revised and enlarged, with two four-color plates. This is an important book on the whole general subject of plastics, plus much brand new material on synthetic rubber, manufacturing processes, and plastics moldings. **$4.10**

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

EXPERIMENTAL ELECTRONICS — *By Ralph H. Muller, R. L. Garman, and M. E. Droz.* A solid book of eminently practical information on the characteristics and non-communication applications of electron tubes. The text describes experiments and presents results. For students, radio engineers, communications experts, and the serious general reader. **$5.10**

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

A SMALL BUSINESS OF YOUR OWN — *By Harold S. Kahm.* Simplified, compact, paper-covered book that sets out to tell persons with capital ranging from $10 to $2000 how they can get started in the right direction. **$1.10**

Best Sellers In Science

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SLIDE RULE SIMPLIFIED — *By C. O. Harris.* How to use a slide rule, without any of the mystification that often surrounds this important tool of the engineer. Excellent illustrations make everything clear. **$3.60** including a slide rule; for book alone, **$2.60**

HOW TO SOLVE IT — *By G. Polya.* The text deals with the general method of solving problems. It will be of value to teachers but will also find wide use by those who have to solve problems requiring scientific reasoning. **$2.60**

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

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

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

ELECTRONIC PHYSICS — *By Hector, Lein and Sconton.* A simplified text for those who desire to acquire a sound basis for following the advance of applied electronics. **$3.85**

TESTING PRECIOUS METALS — *By C. M. Hoke.* This guide for those who buy and sell precious metals describes testing methods and gives important facts that such people should know. **$2.10**

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

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

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CURRENT BULLETIN BRIEFS

Conducted by K. M. CANAVAN

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

KOROSEAL, THE MODERN FLEXIBLE MATERIAL FOR INDUSTRY, gives a short history of the development of this plastics and outlines its resistance to destructive elements. In the 18 pages of the book are also presented mechanical properties, physical aspects, and numerous industrial applications. *The B. F. Goodrich Company, Akron, Ohio. —Gratis.*

A CHRONOLOGICAL HISTORY OF ELECTRICAL DEVELOPMENT. This hard-covered book presents the running history, by dates from 600 B.C. to 1944, of the highlights of electricity and the industry that has been built around it. It contains much biographical data and is designed as a reference work to provide, in its 106 pages, an extensive collection of background material. *National Electrical Manufacturers Association, 155 East 44th Street, New York, New York. —$2.00.*

AXONOMETRIC DRAWING . . . THE UNIVERSAL PICTURE LANGUAGE outlines clearly, in 20 illustrated pages, the fundamental principles of pictorial engineering drafting. It also gives details of stencils developed to make this type of drawing faster, easier, and more accurate. *John R. Cassell Company, Inc., 110 West 42nd Street, New York 18, New York.—Gratis.*

JESSOP STAINLESS STEEL WELDING ELECTRODES is an eight-page booklet covering information on the selection and application of stainless electrodes for welding stainless steel. Current range, for each type of rod in varying diameters, is included. *Jessop Steel Company, Washington, Pennsylvania.—Gratis.*

"CUSTOM" FLUORESCENT LIGHTING WITH STANDARDIZED FIXTURES. Specifications and installation data on 11 standardized commercial fluorescent fixtures for lighting offices, drafting rooms, laboratories, stores, schools, and institutions are given in this catalog packet. *Sylvania Electric Products Inc., Salem, Massachusetts.—Gratis.*

THREE NEW ABRASIVE BELT GRINDERS are fully illustrated and described in this eight-page bulletin, together with standard equipment specifications. Request Bulletin 310. *Hammond Machinery Builders Inc., 1600 Douglas Avenue, Kalamazoo 54, Michigan.—Gratis.*

YOU CAN TAKE IT WITH YOU. This four-page brochure describes how loads up to 2000 pounds can be carried safely, conveniently, and economically by a specially designed trailer. An illustration of this trailer, particularly suitable

for handling farm or industrial supplies, is included and shows all of this trailer's features. *Mount Vernon Implement Company, Mount Vernon, New York. —Gratis.*

A PRODUCTION PLANT IN MINIATURE. This four-page bulletin describes the new Fansteel laboratory pilot plant which was designed to aid in the development of full-scale chemical plant equipment. A wide range of uses is included in this bulletin. Request Bulletin F-540. *Fansteel Metallurgical Corporation, North Chicago, Illinois.—Gratis.*

ONE PLASTICS AVENUE. This brochure, containing 20 pages done in four color, explains complete plastics facilities—research, development, design, manufacturing, and so on—performed at plants throughout the country. *General Electric Company, Chemical Department, Pittsfield, Massachusetts.—Gratis.*

SPLIT BALL BEARINGS. In this 30-page catalog are illustrated and described the applications of divisible-race ball, roller, and thrust bearings in power plants, printing equipment, paper making machinery, and other machinery equipment. Catalog and complete engineering service is available. *Split Ball-bearing Corporation, Lebanon, New Hampshire.—Gratis.*

SUCCESSFUL WIRE PRE-STRETCHING AND STRINGING. Based on clear and simple wire-stretching instructions, this single sheet bulletin contains engineering information that is useful for security, efficiency, and saving. *W. C. Dillon and Company, 5410 West Harrison Street, Chicago 44, Illinois.—Gratis.*

POWER CIRCUIT TRANSFORMERS. For those interested in reducing plant wiring costs, upkeep, and maintenance, this 12-page illustrated bulletin contains wiring diagrams and mounting suggestions as well as a detailed table of dimensions and data on double-wound and single-wound autotype transformers from 100 KVA to 10 KVA capacity for reducing from 575, 460, and 230 volts to 230 and 115 volts. *Jefferson Electric Company, Bellwood, Illinois.—Gratis.*

BELT CONVEYOR IDLERS is a 26-page bulletin containing charts, tables, and diagrams to aid in the proper selection of idlers. Descriptions of two new types—the impact-cushioning troughing idler and the rubber covered spiral return idler—are included. Request Bulletin Number 463. *Chain Belt Company, 1600 West Bruce Street, Milwaukee 4, Wisconsin.—Gratis.*

ELECTRICAL PORCELAIN. In 20 pages this booklet presents the history, uses, and adaptability of electrical porcelain for insulation. Many properties and applications are listed showing how this product can meet exacting demands for dielectric, mechanical, and compressive strengths. *National Electrical Manufacturers Association, 155 East 44th Street, New York 17, New York. —Gratis.*

Our Book Corner

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

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WHY SMASH ATOMS?

By Arthur K. Solomon

OF ALL the books on atom smashing, the initial edition of this volume was the first to appear. Now it has been revised completely and brought up to date to include important data released by the government on the atomic bomb. Here the general reader will find the whole subject of atom smashing in language which he can understand, complemented by a number of simple but excellent drawings and a group of outstanding photographs. Various methods of atom smashing are described and considerable attention is given to the importance of atomic disintegration to fields other than destruction. (204 pages, 6 by 9 inches.)—$3.10 postpaid.—*A.P.P.*

PHYSICAL METHODS OF ORGANIC CHEMISTRY

Edited by Arnold Weissberger

VOLUME II of this important work has now appeared. It completes the treatment of this subject of likely current interest by adding 10 more chapters to the 16 making up the first volume, noticed earlier in these pages. The subjects treated in the current volume are Spectroscopy and Spectrophotometry, Polarography, Radioactivity, Mass Spectrometry, and six others. (630 pages [737 to 1367], 6 by 9¼ inches, illustrated.)—This volume $8.60 postpaid.—*D.H.K.*

UNDERSTANDING MICROWAVES

By Victor J. Young

UNDOUBTEDLY much of tomorrow's radio technique will involve microwaves—waves measured in centimeters and millimeters. The present book sets out to explain the new and different equipment which will be used in the generation and reception of these waves. In solid, semi-technical text it accomplishes its purpose. Starting with the fundamentals of ultra-high frequencies it continues through a discussion of stationary charges, magnetostatics, transmission lines, waveguides, antennas, and microwave oscillators. Designed to give engineers a fairly complete picture of the whole subject of microwaves, the text will also be helpful to students of radio and those who are or will become concerned with the servicing or operation of ultra-high frequency equipment. Some knowledge of mathematics is essential to a mastery of this book. Almost 100 pages of the book are devoted to microwave terminology, ideas, and theorums. (385 pages, 5½ by 8½ inches, well illustrated and indexed.)—$6.10 postpaid. —*A.P.P.*

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

The Editor

PLANNING FOR JOBS

Edited By Lyle C. Fitch and Horace Taylor

THAT the American people, in the midst of plenty—as regards jobs—can still think carefully, although divergently, about unemployment is proved in this volume. Presented as a sampling of American thought and opinion on methods of preventing wholesale unemployment in the future, the material contained in the book derives from a great number of essays submitted for The Pabst Postwar Employment Awards. The editing, accomplished by members of the Columbia University Department of Economics, serves mainly to classify the subject matter for ease of comparison and to bring discussions tied to a basic theme onto common ground. Taxes, small business, big business, tariffs, restrictive practices, labor,

and so on are all brought into focus from a number of different standpoints. (463 pages, 6¼ by 8¾ inches, unillustrated.)—$3.85 postpaid.—*E.F.L.*

AVIATION EDUCATION SOURCE BOOK

Prepared by School of Education, Stamford University, in Co-operation with CAA

WITH a subtitle of "Subject Matter and Activities Drawn from Aviation Suitable for Inclusion in Text Books for Elementary and Junior High Grades," this enormous volume, with 1000 carefully selected photographs, maps, charts and diagrams, constitutes a fruitful source of information for teachers in all subjects—sciences, music, languages, social studies, arts, mathematics, and so on. For example, a teacher of mathematics will find the aviation references make his algebra and mathematics live for his pupil. Besides professional teachers, people in general who are interested in aviation will find this a species of attractive and accurate encyclopedia. (855 pages, 8½ by 11 inches.)—$12.60 postpaid.—*A.K.*

THE LOST AMERICANS

By Frank C. Hibben

POPULAR account of the discoveries pertaining to Folsom man, Yuma man, and Sandia Cave man, written by the principal of the last-named find. Elementary, readable, yet scientifically unexceptionable, this book is a selection of the Scientific Book of the Month Club. (196 pages, 5½ by 8 inches, lightly illustrated.)—$2.60 postpaid.—*A.G.I.*

THE WORKING ELECTRON

By Raymond F. Yates

THIS LITTLE book is aimed at the practical man; that is, at all who are not steeped deeply in the lore of what has been lately called electronics. It describes for the one who may be interested in using them, a vast number of appliances that operate with the aid of electronics and supplies just enough of the basic theory to make the whole thing understandable by an intelligent person with an interest in the subject. The author includes clear diagrams of most of the things he describes and occasional experiments that one might wish to perform. These will delight many readers, as they have this reviewer, and will make the whole subject easier to understand and to apply to one's own problems. Even burglar detectors rate a chapter! (247 pages, 5¾ by 8¼ inches, illustrated.)—$2.60 postpaid—*D.H.K.*

PRINCIPLES OF FIELD AND MINING GEOLOGY

By J. D. Forrester

TREATISE, solid and substantial, on the wholly practical work of the mining geologist, whose function is to recognize, survey, and record ore-bearing properties. Typical chapters deal with economic mineral deposits, correlation of geological phenomena, field equipment, survey procedures, mapping, sampling, claim location, development practices, library and laboratory research. The user should already know elementary geology; this much is assumed by the author. Thus this is not an elementary pocketbook for would-be sourdough prospectors without technical background—for him there are other books. Nevertheless, much insight would be gleaned from it by anybody. The author is head of mining and engineering at the Missouri School of Mines and Metallurgy. (647 pages, 5½ by 8½ inches, 316 illustrations.)—$7.10 postpaid.—*A.G.I.*

ATOMIC ENERGY IN COSMIC AND HUMAN LIFE

By G. Gamow

THIS BOOK is unique in denying in its preface that it contains any information of a secret or confidential nature. Professor Gamow bases his discussion principally on information that has been available to any one, enemy and ally alike, in the world's scientific literature, with only such reference to the Manhattan Project as his scientific approach requires. The book, consequently, is a scholar's exposition of an abstruse and absorbing subject for the benefit of intelligent laymen. The exposition is clear and the style is interesting. The book opens with an explanation of atomic structure and the modern alchemy based on this which converts atoms of one kind into those of another with energy formed in the conversion. Next, the great function of the energy of atomic fission in keeping the sun and the stars alive is discussed. The final section of the book describes what man has done about atomic energy and looks ahead to what he may accomplish by control of this newly discovered and tremendous force. Decidedly worth while for the intelligent general reader. (5½ by 8¼ inches. 159 pages, illustrated.)—$3.10 postpaid.—*D.H.K.*

THE EINSTEIN THEORY OF RELATIVITY

By L. R. and H. G. Lieber

BOOKS on relativity have nearly all been of two opposite types: (1) too mathematical even for average university graduates or else (2) written without mathematics. As Professor Knowlton has said, in "Physics for College Students", everyday language has no words in which relativity can be explained without certain misunderstanding. Just in the measure that relativity is "simplified," so is its very essence lost and the metaphysical, sensational side played up. In plainer words, unless one is mathematical he cannot really reach relativity. Besides, nearly all of both types of books are today out of print. Now comes this intermediate book, partly in language—and not baby language—but largely in college mathematics, mainly calculus. Thus thousands

of engineers and the like can now expect to get their teeth at least deeply into relativity. Of the book, Professor Einstein says: "Not only stimulating to the layman, but also will tend to counteract a too narrow specialization on the part of the professional mathematician." (324 pages, 5½ by 7 inches, illustrated.)—$3.10 postpaid.—*A.G.I.*

ROCKETS

By Robert H. Goddard

FUNDAMENTAL to the whole subject of rocket and jet propulsion is the work of the late author, two of whose famous reports are here presented in exactly the way in which they originally appeared. Although these reports were first published in 1919 and 1936, they are replete with data of vital importance to engineers now concerned with the rapidly growing science of jets and rockets. The book also contains more than 50 pictures of the author's experiments and a foreword written by him shortly before his death. (70 pages, 6 by 9 inches, plus illustrations and a biographical note.)—$3.60 postpaid.—*A.P.P.*

INTRODUCTION TO EMULSIONS

By George M. Sutheim

INTENDED as a practical treatise on the subject of emulsions, this book opens with a discussion of the theory of emulsification, giving a satisfactory basic treatment, and continues with various practical aspects of making and using products of this important class. The subject is rounded off by a glossary of terms, a list of commercial emulsifying agents, and a bibliography of 159 titles. (260 pages, 6 by 9 inches, illustrated.)—$4.85 postpaid.—*D.H.K.*

MODERN ORGANIC FINISHES

By R. H. Wampler

AIMED at furthering the knowledge of industrial finishing methods, this book is particularly timely in the light of the fast-dawning day when the appearance of a product as determined by its finish will count on the competitive market. Characteristic of the entire book is its straight-forward handling of the complex organic finish field. Where high-flung formulas and 30-letter names might have been used, the reader will find practical, usable data that should aid in selecting both materials and methods to match a specific set of finishing problems. Enamels, lacquers, varnishes, stains, fillers, and primers are thoroughly covered as are spraying, dipping, roller and knife coating, tumbling, and special processes such as decals. From the production-flow standpoint the drying equipment, handling racks, overheads, conveyors, and other facilities are adequately discussed. Sample treatments for all of the more common finishing jobs on wood, paper, metals, plastics, and so on are also included. (452 pages, 6 by 9 inches, 77 illustrations, index and bibliography.)—$8.60 postpaid.—*E.F.L.*

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"

TWO FEATURES of a 12½" reflecting telescope built by Edward Lenard, 4854 N. Austin Ave., Chicago 30, Ill., deserve close study by readers who plan second or subsequent telescopes. These are the mirror cell and the focusing arrangement for use in celestial photography.

The mounting (Figure 1) is temporary. Its axes are close pipe nipples pivoting in standard pipe flanges.

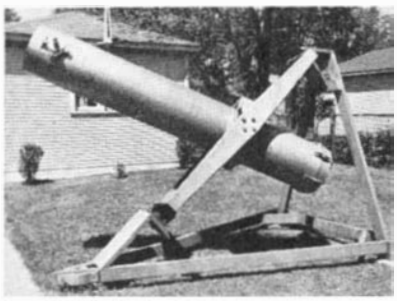


Figure 1: Lenard's 12½" reflector

The tube is 15⅛" by 93", for a 12½" Pyrex mirror of 92½" focal length. It was rolled up from sheet aluminum designated as 3S½H .065 (3, alloying composition; S, wrought; ½H, one-half hard; .065, thickness in inches), a grade which takes welding well. However, the three lengths composing the tube are riveted together. The tube is braced internally by four U-channels formed in a hand brake and then bent to diameter over various round objects. "The reasons I chose aluminum," Lenard writes, "are its very desirable working properties, resistance to weather, heat-conducting qualities, reflectivity, and strength-weight ratio. It is somewhat expensive. However, it makes a pretty tube."

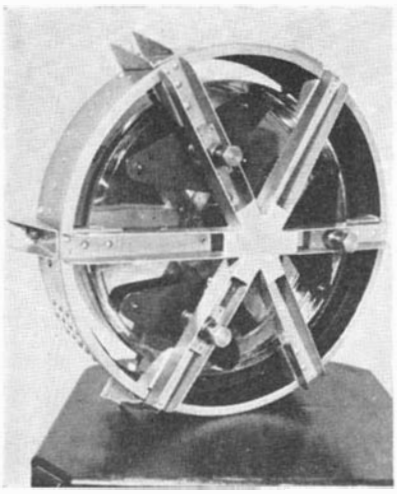


Figure 2: The cell from below

The cell and attachments (Figures 2 and 3) are made of the same sheet stock. Within the cell is a 9-point flotation system carried on a spider of six legs bent from sheet and welded at their common center.

To three of these spider legs are attached short brass blocks through which three bolts (SAE ½-20) pass and are tightened up by nuts on the outer sides.

Silver-soldered to the ends of these three bolts are ⅝" ball bearings. These balls are pressed into the ⅛" triangular, aluminum, 3-point plates which carry the mirror, and the depressions serve as the primary pivots. Bolted through the corners of the respective plates are 3/16" brass bolts on which, as secondary pivots, the mirror is carried.

Such a system will float a mirror but the triangles would soon become turned in different directions and destroy the intended distribution of weights. Some kind of preventers therefore must be provided and these must not interfere with the actual balancing. Lenard's system consists of three links, each with a T-head on either end and the ends of the T's pivoted at the central hub of the spider and at one of the triangular plates. This affords them freedom in the up-and-down plane (one degree of freedom) but there must also be a little end play and thus two degrees of freedom are needed. Lenard has provided this by composing the stem of each link of two small brass tubes, one telescoping within the other. He points out, however, that for ideal performance a ball-and-socket joint should be substituted at the triangle end and makes a comparison with a ship, where the motions are theoretically either pitching or rolling but usually are a composition of the two—yawing. Theoretically, he points out, the linkages should permit yawing.

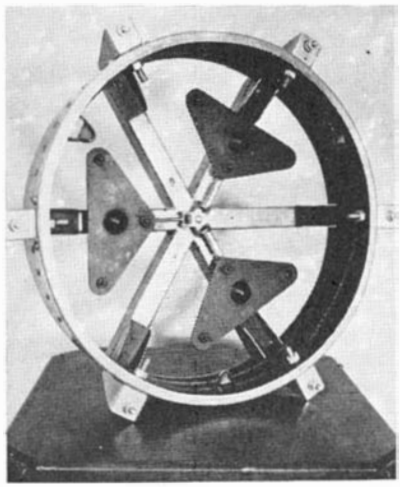


Figure 3: Same cell from above

As edge supports for the 12½" mirror the ends of the six filister-head machine screws shown in Figure 3 suffice. "The inclined mirror then has two points to rest on in any position and in some positions three," Lenard states, "though the lower one in such cases takes most of the weight."

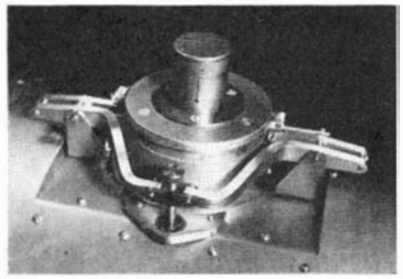


Figure 4: The focusing mechanism

To prevent the mirror from falling out of the cell when the tube is dipped below the horizontal, three simple retaining fingers having little leather pads reach around its edge.

Lenard's focusing arrangement is shown in Figures 4 and 5. He states that perfect control is here not easy to attain. "The problem of raising and lowering the barrel without rotation and without sticking was solved," he states, "by using at least two points to which to connect the hinge. This arrangement comes up and down evenly and without sticking, and affords very fine adjustment as well. The single thumbscrew actuates the whole system. The travel of the barrel is not more than ⅜". I use various lengths of brass tubing to suit the focal length of each eyepiece and changing over thus does not require refocusing. [Parfocal. —Ed.] The reason for countersinking the assembly is to permit mounting a Packard shutter directly below, on the inside of the tube, for photographic work. This shutter is operated by a bulb. The entire assembly was made by hand from brass and aluminum."

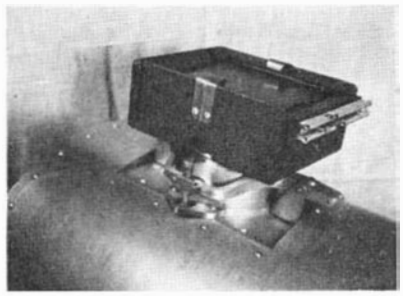


Figure 5: Focusing the camera

PUZZLED readers often ask this department why Pyrex telescope blanks have tapered edges and why they have a narrow rim on the back. These features don't just happen and are not mere whims. Corning Glass Works was asked for a blueprint of

one of their metal molds and from this a reproduction draftsman redrew Figure 6, which should be studied in detail before reading on. It explains a number of things which make sense once you are shown their reasons.

Now let's cast a blank. The plunger is raised and the ring is lifted off. The workman, known as the "gatherer," pours into the mold a gob of molten Pyrex. This is not like water but viscous, molasses in January, even at 2800° F., its softening point. Now he claps on the heavy ring part and down

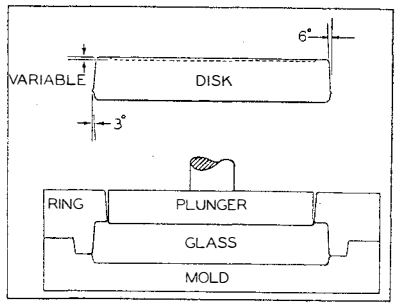


Figure 6: Molding Pyrex blanks

comes the plunger. It is nice if, when the plunger is all the way down and the mold is filled out, the plunger bottom comes to rest as shown—very near the level of the rim. Making it so depends on the estimative skill of the gatherer and he is very good at this knack but is only human. If it is a bit over or under he can't add more Pyrex with an eyedropper; it's too viscous. Get it hotter? Easier said than done. The softening point of Pyrex is already much above that of common varieties of glass.

The molded disk is removed from the mold very soon and turned over. Its exterior is already relatively cool but its interior, seen through the glass, is still red hot. As this interior cools the center of the wider face of the disk falls a little and this explains the slight concavity usually found on Pyrex blanks.

The 6° tapered side is the draft, so that the ring can be slipped off—see the drawing, which also shows a 3° draft on the part that lies in the mold.

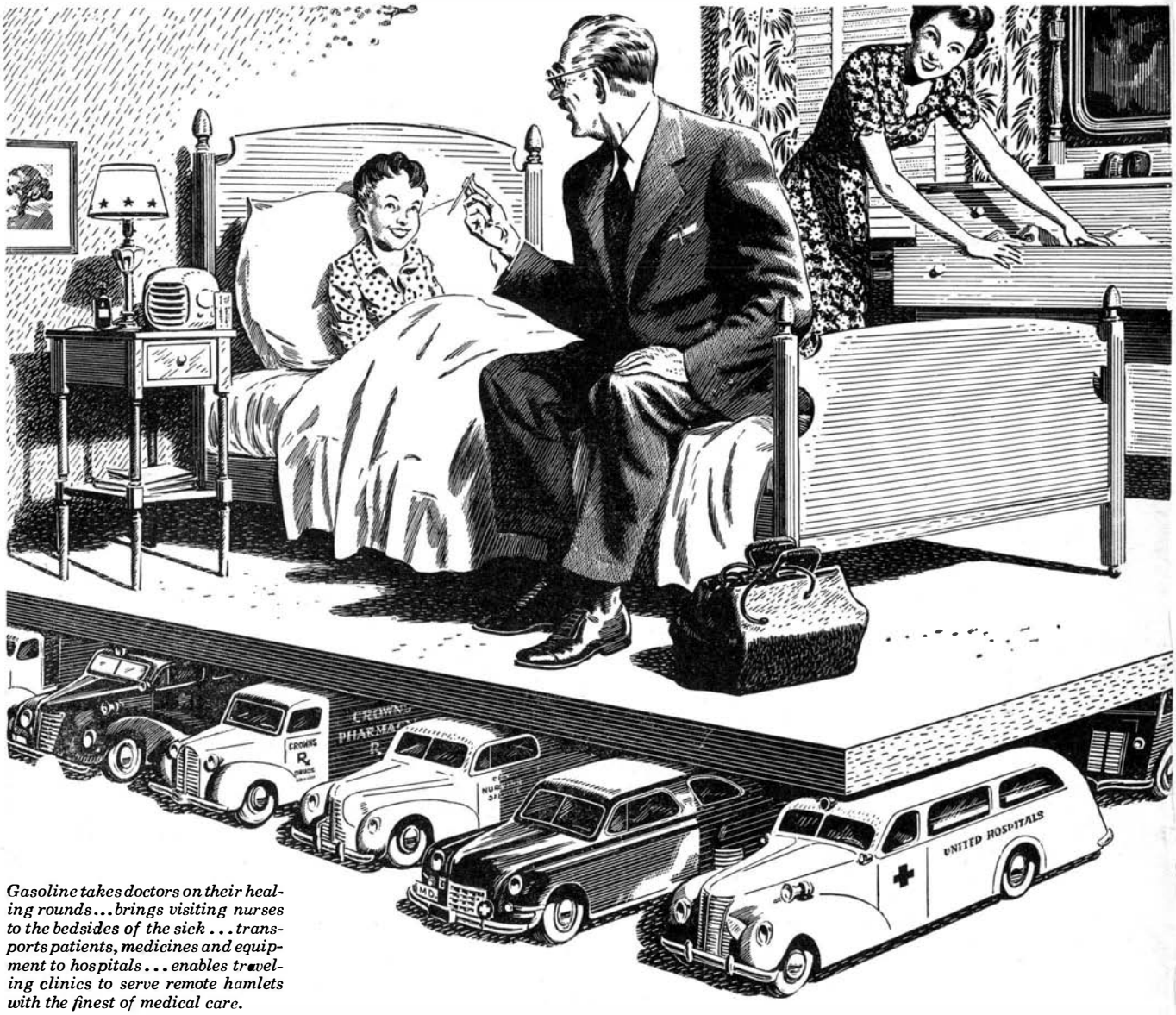
Visit Corning Glass Works and you may be shown several shelves filled with these heavy metal molds.

The bubbles often found in Pyrex blanks would rise and escape if Pyrex were not so viscous. The bubbles you don't see are the bigger ones that were able to escape. Little ones can't rise so easily. Case of surface-volume ratio. No practicable way to eliminate all the bubbles is known. Corning would be glad to find one but it isn't as if they hadn't given the problem a great deal of thought.

SEQUELAE of the seldom curable telescopical addiction are sometimes serious, and may even include outbursts of light verse. The following is how the hobby affected M. J. Irland, 916 N. Rosevere, Dearborn, Mich. He entitles it "Paradise Lost, or Ignorance is Bliss," and dedicates it to your (blissful) scribe:

There was a man in days gone by
Who loved to watch the skies.
He'd learned the constellations well,
With his unaided eyes.
He bought a book called "A.T.M."
A first edition slim,
And set to grinding disk on disk
With diligence and vim.
With windshield glass and pocket lens
The optics he completed,
And learned to silver Brashear's way,
Through trials oft repeated.
With joy he gazed at Saturn's rings,
Made lunar observations,
Watched Jupiter's bright satellites,
And noted occultations.
Then "Telescoptics" told of tests
On Lyra's double star;
He drooped with disappointment when
He couldn't split Mizar.
So back to Carbo, glass, and pitch
He turned in wounded pride,
With "A.T.M." (edition two)
Well rouge-stained, by his side.
With slits and Ronchi gratings, culled
From Telescoptics' pages,
He strove to get the doughnut shape
Commanded by the sages.
Came "A.T.M."—edition three—
With Greg and Cassegrain;
Our hero could not well ignore
This challenge to his brain.
On Hindle sphere, paraboloid,
And convex hyperbolic
He lavished rouge, and sweat, and tears,
In frenzy diabolic.
Edition four, with bottlenecks
In declination shafts,
Impelled him in despair to learn
All metal-working crafts.
But when he thought he'd made a 'scope
Without an imperfection,
"A.T.M.A." depressed him into
Deep and dark dejection.
For there he found expounded,
As a matter most essential,
New doughnut mathematics
In equations differential.
So, weary but undaunted, he
Performed manipulations
For testing astigmatic curves
And spheric aberrations.
At setting circles, clockwork drive,
And domed observatory
He labored with the fury of
A fiend from Purgatory.
But when he'd run the gamut, in
The hope of satisfaction,
Infinitesimal defects
Still drove him to distraction.
No longer did he scan the skies
To revel in their beauty;
Detecting telescopic faults
Was his fanatic duty.
Instead of watching clusters for
The pleasure of their glitter,
He studied star diffraction rings,
Despondent at their jitter.
The seeing made him grind his teeth,
Air currents plagued his vision.
No collimation could attain his
Notion of precision.
And as he sat with head in hands,
Bystanders heard him mutter:
"I'm gonna junk the whole dam' works
And throw it in the gutter."

The moral for beginners is:
Lest knowledge disconcert you,
Recall the aged maxim, viz.,
What you don't know won't hurt you.



Gasoline takes doctors on their healing rounds... brings visiting nurses to the bedsides of the sick... transports patients, medicines and equipment to hospitals... enables traveling clinics to serve remote hamlets with the finest of medical care.

The nation keeps healthy on gasoline

BEFORE medical knowledge and skill can be put to work, the distance that separates doctor and patient, home and hospital, must be bridged. Over the years automotive transportation has progressively shortened this distance. Better fuels and better engines have helped the nation benefit more widely from the great advances that have been made in medical science.

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