Scientific American

FEBRUARY
1947

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Rusting Speeded to Test Preventive Measures . . . See page 49

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In This Issue • February 1947

INDUSTRIAL DRAMA: Synthetic sea-water, at a temperature of 100 degrees, Fahrenheit, forms a highly corrosive mist in this salt-spray cabinet used in the laboratories of the Gulf Oil Corporation for determining effectiveness of rust-preventive compounds. Here the effects of months of normal exposure are compressed into days.

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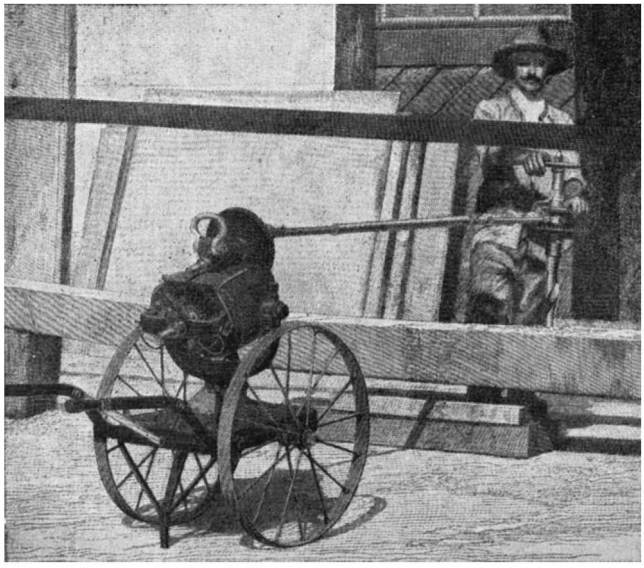
50 Years Ago in . . .

SCIENTIFIC AMERICAN

(Condensed from Issues of February, 1897)

SUPPLY AND DEMAND — "In the open market, the price of a commodity is practically the cost of production plus a fair business profit. If this result is not obtained, a business languishes or expires. If profits are abnormally large, capital is attracted and competition set up, and the availability of capital now brings about the modern fact that increased demand causes reduced prices."

POWER DRILLS — "In these days of labor saving machinery there are few fields in which greater ingenuity has been shown than in the manufacture of portable machines for boring, drilling and similar shop and yard work. . . A type of very compact portable electric drilling machine has been at work at the Arsenal in Trieste for over three years, and has given great satisfaction. It will be seen from the illustration that the motor, with its gearing, is pivotally suspended in a yoke which is carried on a suitable hand truck or car-



riage. . . When any holes have to be drilled in a piece of work, the portable drill is wheeled to the spot, and the wires attached. In this way the time formerly occupied in carrying the work to the drilling machine is saved. As instances of the economy of these machines, we are informed that where ten flexible shaft drills were formerly used in the boiler shop, four electric boring machines now do the same amount of work, with less hands than were formerly necessary. In the fitting shop they have saved much time and money in the handling of heavy work."

FIRE ENGINES — "There is now being constructed for use by the Boston Fire Department a horseless steam engine, of great size and power, having a contract capacity of 1,350 gallons of water per minute, but the builders, in view of recent tests, are confident that this engine will throw 1,850 gallons of water per minute."

WELD STRENGTH — "Some experiments made at the engineering laboratory of the University of Michigan to determine the strength of welded joints are especially interesting. Of a number of the specimens tested not one broke in the weld; as some of these were slightly larger at the weld, a new set of specimens was prepared and a cut taken from each in the lathe to reduce the piece to a uniform diameter throughout its length. . . From each bar four specimens were prepared, one solid, one lap welded, one butt welded, and one split welded. The results show that only two specimens, both lap welded, broke at or near the weld; the strength in no case departed widely from the strength of the solid parts."

SUBWAY — "A deep tunnel scheme for rapid transit between New York and Brooklyn is recommended by a commission which was appointed by the mayor of the latter city to arrange a plan for improving rapid transit facilities on certain of its streets. The plan proposed contemplates an electric line (partly in tunnel and partly on an elevated structure) from Cortlandt Street and Church Street, New York, to Ralph Avenue, Brooklyn."

NO METRIC SYSTEM YET — "The United States years ago legalized the use of metric weights and measures, but did nothing to enforce their use. Just now her merchants are working to increase their trade with the countries of Central and South America, and as all these use the metric system, there is a growing pressure for its formal adoption by Congress. . . In America the local weights and measures used in the various States are particularly numerous and confusing, and the substitution of the uniform French system for all of these would be of inestimable benefit."

SUGAR — "As to our country, it is declared that we spend annually about $135,000,000 for sugar, of which more than eight-tenths goes to foreign countries. We consume one-fourth of the exported sugar product of the world. Fifty years ago, 94 percent of the annual sugar product of Cuba found a market in Europe; now that proportion of its production is sold in the United States."

100 Years Ago in . . .

SCIENTIFIC AMERICAN

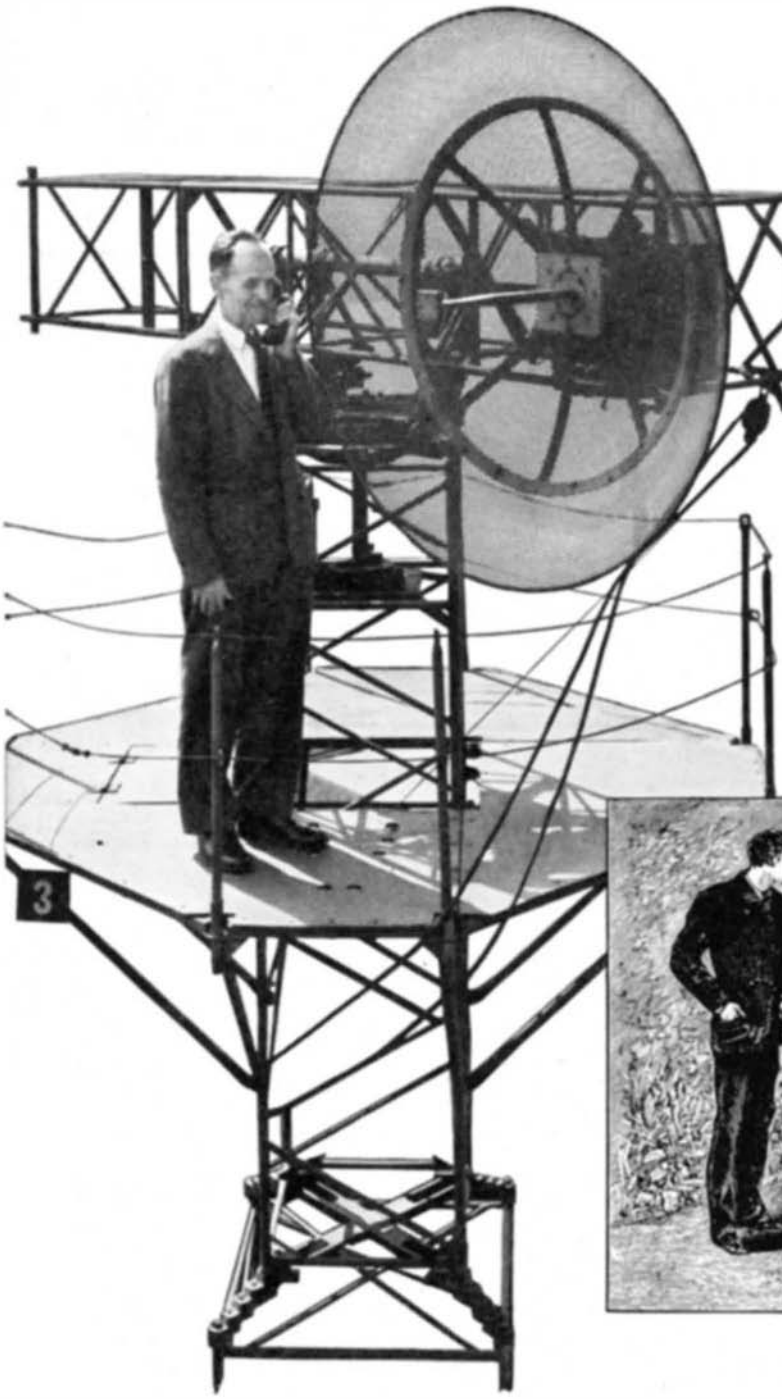
(Condensed from Issues of February, 1847)

FACTORIES — "Within a few years, there have been erected at Cohoes five cotton mills, two extensive axe factories, one large drawer manufactory, and other smaller factories which employ in all about fifteen hundred hands. The village is well spoken of for the excellent morals and steady industrious habits of its citizens."

PANAMA CANAL — "Prince Louis Napoleon is about to proceed to Central America, for the purpose of putting in progress the work of uniting the two oceans. The celebrated geographer, Professor Charles Ritter, has communicated to the geographical society of Berlin, the project of the Prince, which it appears, he conceived and prepared during his imprisonment at Ham."

INDIAN COTTON — "The cotton manufactory in India is not carried on in a few large towns, or in one or two districts; it is universal. The growth of cotton is nearly as general as the growth of food; everywhere the women spend a portion of their time in spinning; and almost every village contains its weavers, and supplies its own inhabitants with the scanty clothing they require. Being a domestic manufacture, and carried on with the rudest and cheapest apparatus, it requires neither capital, mills or an assemblage of various trades."

LOCOMOTIVE — "A locomotive has been constructed in South Wales, with eight wheels, all connected; thus constituting eight driving, (or traction) wheels. Its capacity of traction is of course proportionately greater than that of engines of ordinary construction."



Words that rode on a beam of light

If Alexander Graham Bell could look at the microwave antenna in the illustration, how quickly his mind would go back to his own experiments, 67 years ago!

For in 1880 the inventor of the telephone had another new idea. Speech could be carried by electric wires, as Bell had demonstrated to the world. Could it be carried also by a *light* beam?

He got together apparatus—a telephone transmitter, a parabolic reflector, a selenium cell connected to handphones—and "threw" a voice across several hundred yards by waves of visible light, electromagnetic waves of high frequency.

Bell's early experiment with the parabolic antenna and the use of light beams as carriers was for many years only a scientific novelty. His idea was far ahead of its time.

Sixty years later communication by means of a beam of radiation was achieved in a new form—beamed microwave radio. It was developed by Bell Telephone Laboratories for military communication and found important use in the European theater. In the Bell System it is giving service between places on the mainland and nearby islands and soon such beams will be put to work in the radio relay.

In retrospect, Bell's experiment illustrates once again the inquiring spirit of the Bell System.

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

PRELIMINARY REPORT ON BRAZIL

A NUMBER of factors have combined to prevent publication this month of the promised report on Brazilian industry. Here, however, is a preview from the writer's notes and other source material:

Brazil, covering an area greater than the United States, is today in about the same stage of industrial development as this country was some 50 years ago. But Brazil has the advantages of available knowledge and of being able to profit by mistakes made by others. Actually, Brazilian industry—other than in coffee, sugar, and the like—is only about 15 years old. In her factories it is incongruous to see antique machinery (obtained second-hand from other countries) working side by side with an occasional piece of fine precision equipment—and hand labor doing most of the work at that!

On the natural resources side of the picture, another parallel to the United States can be drawn, with a time span of 75 years, more or less. Much of the country remains unexplored. Precious metals deposits have been worked but even their approximate extent is as yet unknown. The same goes for coal, oil, bauxite, and so on. Much of Brazil is still inaccessible; roads are few and not too good. Railroad mileage is small and equipment is not standardized. Travel by air offers the best possibility of getting around the country, and wide-awake Brazilians are taking full advantage of its opportunities.

All in all, there looms south of the equator a rich and as yet undeveloped land which promises to go through much the same stages of industrial development as has the United States. And as it marches steadily toward that horizon it will offer tremendous possibilities for industrial co-operation with the United States—in ways that will be developed in more detail in a future issue of Scientific American.

OIL IN THE HOME

SOME MEASURE of the future possibilities of oil heat for domestic purposes—recently given a shot in the arm by the combined circumstances of the coal strike and renewed production of oil burners—is found in the following figures: Today there are about two and a half million domestic oil burners in use. By 1950, according to an engineer of Standard Oil Company (N. J.), there will be nearly four million units in service and close to five million by 1965. Here are great possibilities not only in oil-burner manufacture and fuel production, but also —and most important of all—in research on improved efficiency of fuel production and consumption.

PORCELAIN ENAMEL'S FUTURE

IF A PRESENT trend continues, porcelain enamel over steel bases is going to be found in many more places in the home of the future than merely the kitchen range, sink, and refrigerator. Some of the things for which horizon-eyed architects are considering the use of this material include shutters and other exterior trim, window boxes, prefabricated cellar stairs, chimney tops, and outside fireplace chimneys. Features of porcelain enameled steel which lend themselves to these and other uses are its dimensional stability, speed of production in the fabricating plant, possible variety of permanent colors, and economical up-keep.

THE FOREMAN IS IMPORTANT

IN THESE DAYS of unionism, job evaluation, and so on, the foreman in the plant is all too likely to feel that much of his authority has been removed, that he is being kicked around, that he is obsolete. Despite this feeling on his part, he is still one of the most important cogs in the human side of industry. He is the go-between, the representative of management to the men under him, the one who can keep his men happy or permit them to become disgruntled. And if he is unhappy, his men will be unhappy.

One thing that industry must do for its foremen is to let them in on the fundamentals of industrial economics. Show them how plant production is basic to their own—and the other workers'—daily lives. Be sure that they understand that they eat regularly because someone else buys the goods they produce—and that they won't eat quite so often if production falls off. Then, too, emphasis must be placed on the foreman's importance as a builder of worker morale. He can do far more to benefit the company by distributing praise to his men where it is deserved than by wielding a figurative whip.

All this is admittedly over-simplified: References to more detailed sources regarding the importance of foremen, and how to develop it, on request.

STRAWS IN THE WIND

SURVEYS of strike-free plants—not quite so rare as perusal of newspaper headlines would seem to indicate —show that incentive plans work well, that a bit better than average pay for workers keeps down unrest, and that a personal touch between management and workers pays out in the long run. . . Refrigeration in all its phases—home refrigerators, frozen food lockers, and hot-weather home-cooling—is a rapidly expanding industry which has a virtually unlimited future: it extends also into new and improved mobile units for highways and railroads. . . Attempts are being made to exercise Federal control over production of lumber from small forest holdings—highly important in our natural resources picture: better results can come through education of owners in the importance of adequate conservation methods, placing the emphasis on a dollars-and-cents profit basis for the long pull.

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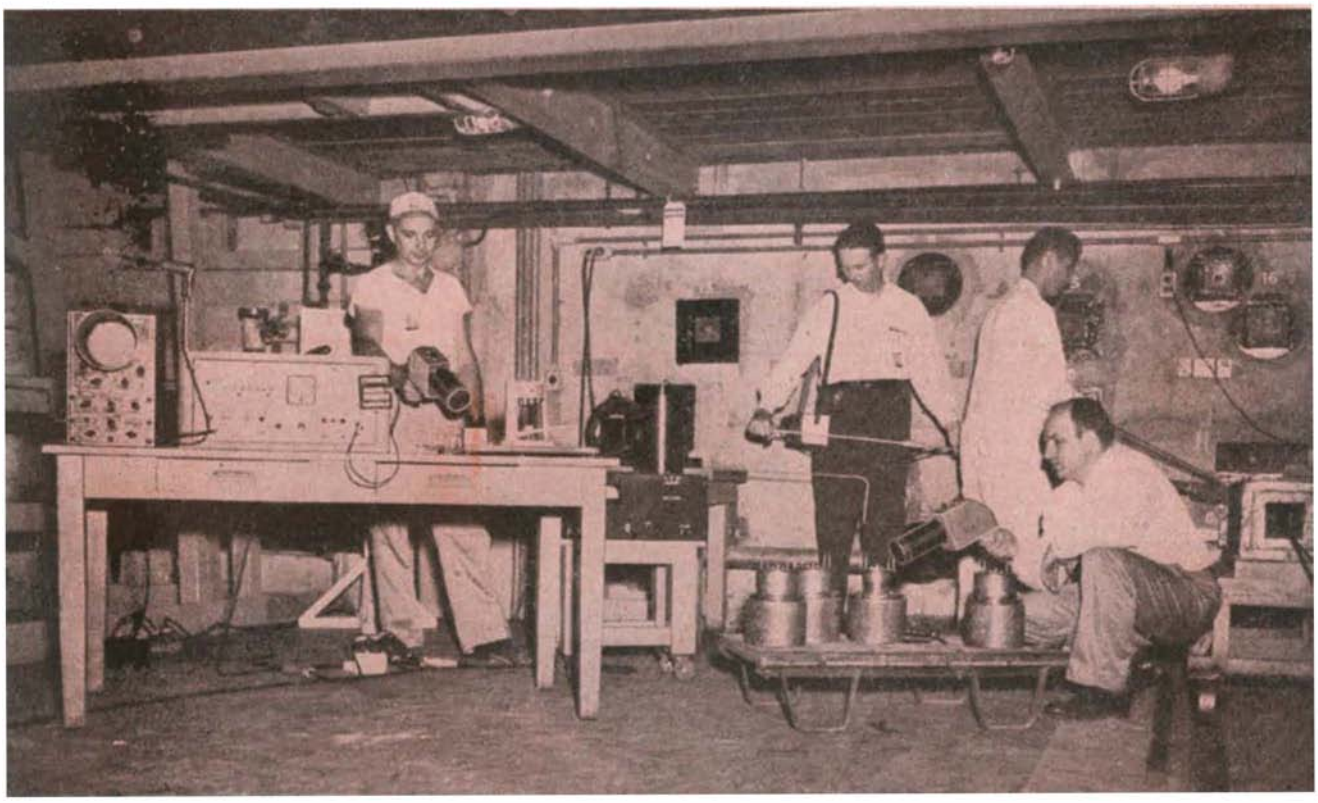


Portoble Geiger counters in use in atomic-research laboratory at Oak Ridge

RAY-TRACER of Atomic Fission

By SAMUEL BURGER

Developed 40 Years Ago as a Tool of Pure Science Research, the Geiger Counter Is Just Now Coming Into Its Own. Coupled With Man-Made Radioactive Materials It can Locate Insidious Cancer for the Surgeon's Blade, Point Out Potential Oil Pools Deep in the Earth, Stand Watch In Steel Mills, or Trace Chemicals Through Complex Processes

It was hours after the explosion of atomic bomb Number Four over the target fleet at Bikini. The odd-shaped, lethal cloud had drifted away upon the east wind, but grim Death still swam in the blue lagoon, walked the decks of the battered and burning ships, sifted like a ghost through the steel decks and bulkheads of ships that showed hardly any blast damage—Death in the form of the dread gamma rays released by plutonium fission.

Hundreds of goats, pigs, and white mice had already been pierced by that unseen blade. They had felt no pain, yet the wound was mortal. No power on earth could have saved their lives. They were as surely doomed as the thousands of Japanese fatally injured by radioactive rays at Hiroshima and Nagasaki.

Now men had to venture into that arena of burning ships and unseen death, for the fires raging on the stricken vessels had to be put out. But how could the fire fighters know which ships were safe, and which were still a source of the fearful gamma rays?

The answer was the Geiger counter, here used in the form of a black oblong box about the size of a miniature portable radio, and worth knowing more about if one proposes to understand, and to survive, the atomic age. Equipped with needles, dials, and a set of earphones, it measures the amount of radioactivity in the air, whether natural or man-made. If you put on its earphones, you will hear an irregular chorus of sharp ticks, like

a night full of metal crickets. The more frequent the ticks, the greater the radioactivity.

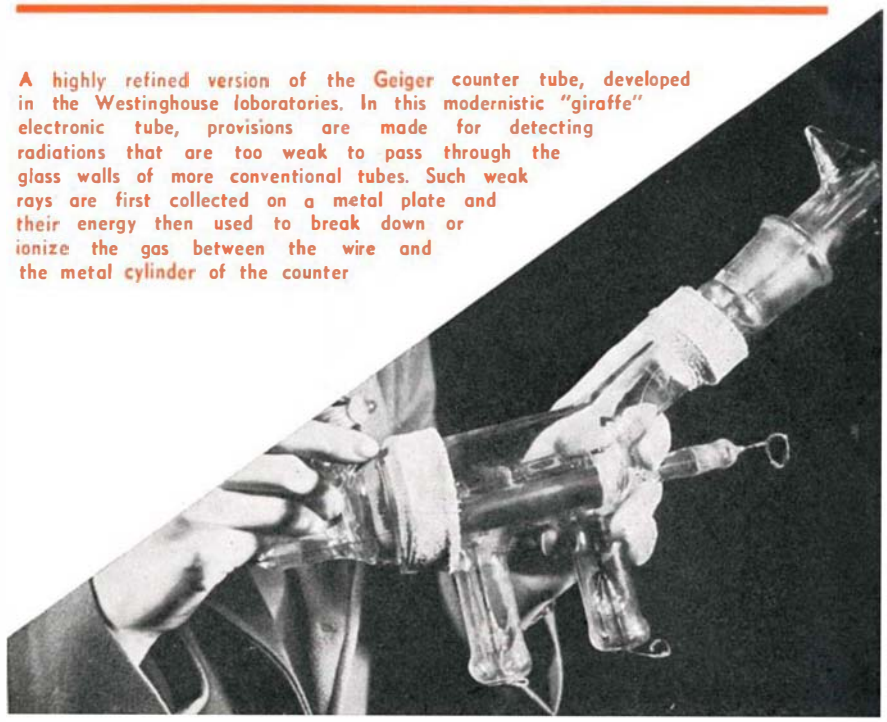
At Bikini the firefighters were preceded by small boats manned by the "monitors" of the radiological safety-party. Clad in olive drab fatigues and steel helmets, their only real protection was the Geiger counter, which each man clutched tightly and consulted often. From the press ship, I watched them as their launches moved over the contaminated water. At the bow of each boat stood an officer, taking frequent readings.

STILL "HOT" — When the correspondents were at last allowed to visit the *Nevada* and other target vessels, we found radiological safety parties still at work. They were ferreting out and marking, in angry warning red, objects aboard the ships which were still "hot." I remember standing near some cans of Foamite when a monitor approached. He went for them straight as an arrow, consulted the dial on his Geiger counter, and looked at me queerly.

"How long have you been standing here?" he asked.

"Only a few minutes," I replied, with sudden trepidation.

"Better move on," he said shortly. "The chemicals in these cans are 'hot' enough to give a man a graveyard dose in four hours."



A highly refined version of the Geiger counter tube, developed in the Westinghouse laboratories. In this modernistic "giraffe" electronic tube, provisions are made for detecting radiations that are too weak to pass through the glass walls of more conventional tubes. Such weak rays are first collected on a metal plate and their energy then used to break down or ionize the gas between the wire and the metal cylinder of the counter

Not long after the bomb went off, the winds of the upper air, five miles above the earth, were thrusting a lovely, gold-tinted cloud out to sea. Innocent though it looked to the casual eye, each tiny particle of dust and moisture in it was alive with killing energy.

The pilotless drone planes which had carried Geiger counters into the heart of the cloud returned to their base too "hot" to handle. Such was the potency of the cloud. And a sudden shift in the unstable Pacific winds might waft it into well-travelled air lanes. Or, worse still, changing atmospheric conditions might precipitate it to earth as death-laden rain over a populated island. So the deadly cloud had to be trailed, which was not easy in a sky full of natural clouds. More difficult yet was following it at night. There was great danger that the planes stalking the cloud might blunder through the blackness into the very teeth of their quarry.

Again, the Geiger counter proved its unique value. Scout planes equipped with counters rode herd on the atomic cloud until it was safely dissipated.

Using a Geiger counter to check possible radiation leakage from a lead container used for transporting radioactive materials in the laboratory

MOST SENSITIVE — Wherever you may be—indoors, outdoors, on a mountain top, or in a bank vault—the air about you is figuratively whizzing with bullets of unbelievable energy and speed. These infinitesimally tiny missiles, which pierce your body harmlessly (only because they are so few), are for the most part cosmic rays—space bullets shot at us from a source believed by some to be exploding atoms in the distant stars. Fortunately, the earth's atmosphere absorbs most of these bullets; otherwise, animal life on this planet might never have evolved. The Geiger counter, sensitive to cosmic rays, serves also to detect the lethal rays unleased by the explosion of an atomic bomb. Yet it was designed, not as a watchdog for the epoch that began with Hiroshima,

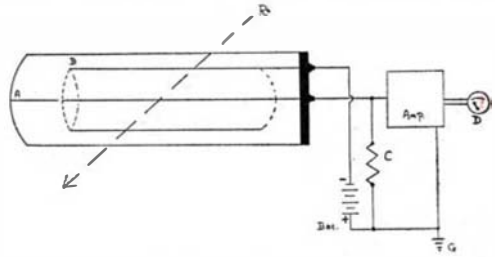
but as a tool of pure science research. About 40 years ago, when the great British physicist Rutherford was engaged in his historic studies on the newly discovered radium, his young German assistant Hans Geiger devised an instrument that would count the number of particles given off by radium. It was, and still is, the most sensitive instrument ever invented by man for the detection of radioactivity.

But even Hans Geiger never guessed how versatile a tool of science he had created. Scientists whose life work it is to track down the secrets of our solar system put the Geiger counter to work measuring the cosmic rays which constantly bombard the earth. Physicians use it in the fight against cancer and other deadly ills; petroleum engineers lower it down drill holes to map oil structures far below the surface of the earth; geologists use it in their search for uranium and other radioactive minerals. It is essential to nearly every branch of the young science of "nucleonics," which promises much for the future of all science and industry.

Recently, I had the privilege of talking with Dr. John R. Dunning, who split the uranium atom in January, 1939, and one of his colleagues, Hugh A. Glassford, in the underground laboratories at Columbia University. From Glassford I learned to think of a Geiger counter as a delicate electronic drum—a drum so sensitive that a particle of matter smaller than the atom will cause it to emit a sound. This sound, enormously magnified, is heard in the operator's earphones as a sharp "tick." Each tick means that another incredibly minute alpha, beta, or gamma ray has passed through the instrument. Even the infinitesimal amount of radium on your watch dial will cause the Geiger counter to tick vigorously.

It is never silent. Even when no man-made radioactive material is present, it will still be busy "picking up" cosmic rays, at the rate of about one a second.

HOW THE GEIGER COUNTER WORKS



IN ITS simplest form the Geiger counter tube (sometimes called the Geiger-Müller counter) consists of a glass envelope enclosing a thin central wire, A, and a metal cylinder, B, made electrically negative by the battery shown. Before the glass envelope is sealed off, gas at low pressure is introduced—one of the "noble" gases, usually argon. When a ray, R, from a radioactive source passes through the counter it ionizes the gas, giving rise to both positive and negative ions as well as electrons. Through a "multiplication" process, brought about by collisions between electrons and gas molecules as well as the release of electrons from the cylinder, a large surge of ions is built up until the wire and cylinder approach equal potentials. At this point ionization no longer occurs and the electrons on the wire pass through the resistance, C, to ground. The counter is now ready for the next ray, with the difference of potential re-established. The current surge in the external circuit is amplified to operate an indicator, D, which may be a meter, a mechanical-electronic counter, or an earphone. Time interval for each operation of the tube, measured in micro-seconds, is governed by the value of the resistance and the distributed capacity of the counter tube itself.

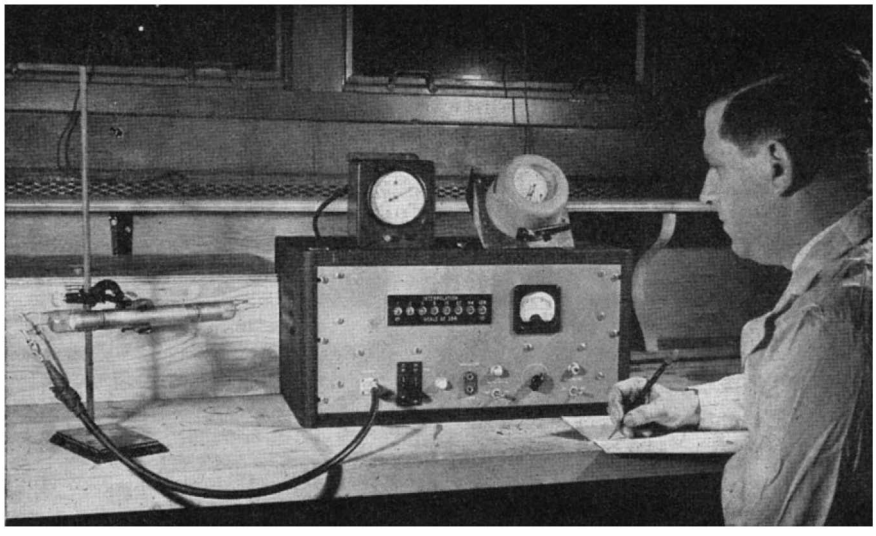
COUNTER AT WORK — With a long, tweezer-like tool, Glassford extracted a tiny sample of uranium from a lead storage box, and carried it to a small lead vault in which a Geiger counter was set up. As he prepared the instrument, Glassford—who has developed many varieties of counters himself—explained that although counters equipped with earphones were valuable in warning of dangerously high radioactivity, they were not accurate enough for exacting research.

He carefully deposited the uranium within the lead vault, and spun the door closed. Then, stepping to a machine which resembled an oversize walkie-talkie, he began to flick switches. "Let's set the scale to 32. This means that the machine will count 32 particles, and then send them along *all as one* to the dial. Ready? Here we go!"

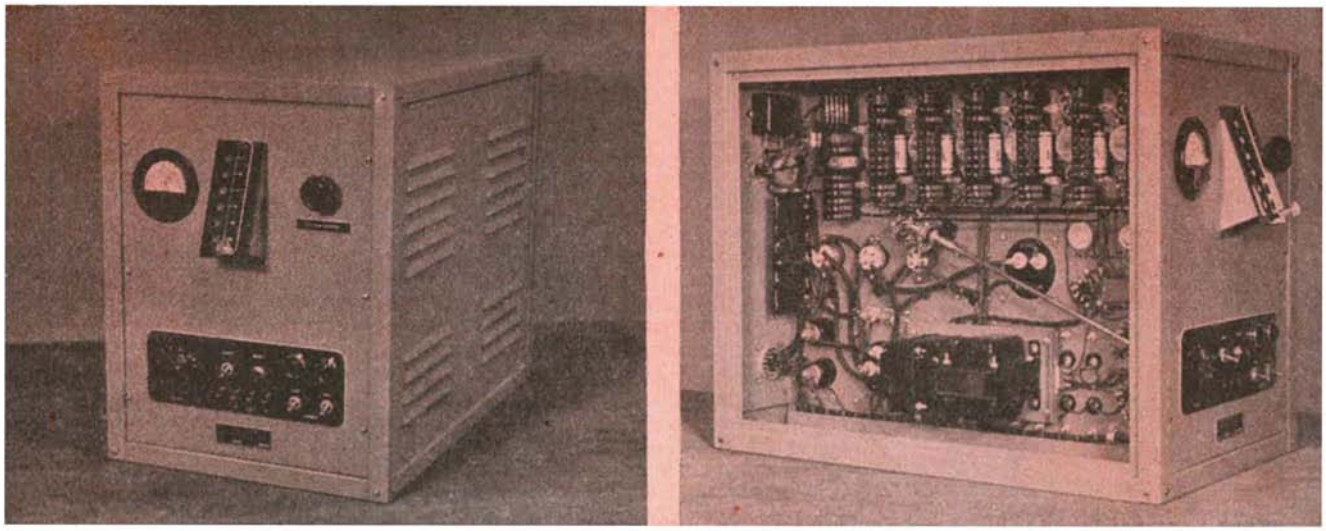
He started the machine. Almost at once, a light flashed. "There's one," he cried. Another light flashed, lower down the scale, beside the number four. "There's four more." Now the lights were flashing up and down the scale at such speed that no eye could follow them. Meanwhile, the needle on the dial advanced one notch each time 32 particles were counted. So fast was the count that within a few seconds the needle had registered a final count of 3188.

For emergencies, for the dangerous aftermath of such tests at those at Bikini, there are Geiger counters which measure the total amount of radioactivity in the air at any given moment, almost instantaneously. Without such warning counters the atom bomb tests would have cost lives—or not been held at all.

DISEASE FIGHTER — In recent years the Geiger counter has linked hands with the atom to fight diseases whose origins are still obscure and to blaze new pathways in industrial



Geiger counter (tube at left, mechanical recorder at right) set up in the laboratories of Socony-Vacuum Oil Company, Inc. Possibilities of these instruments are being fully explored for use in geological surveys and chemical processes



Photographs on this page courtesy Technical Associates

and medical research. Medical science, pioneering in the use of radioactive drugs, is finding remarkable uses for the counter.

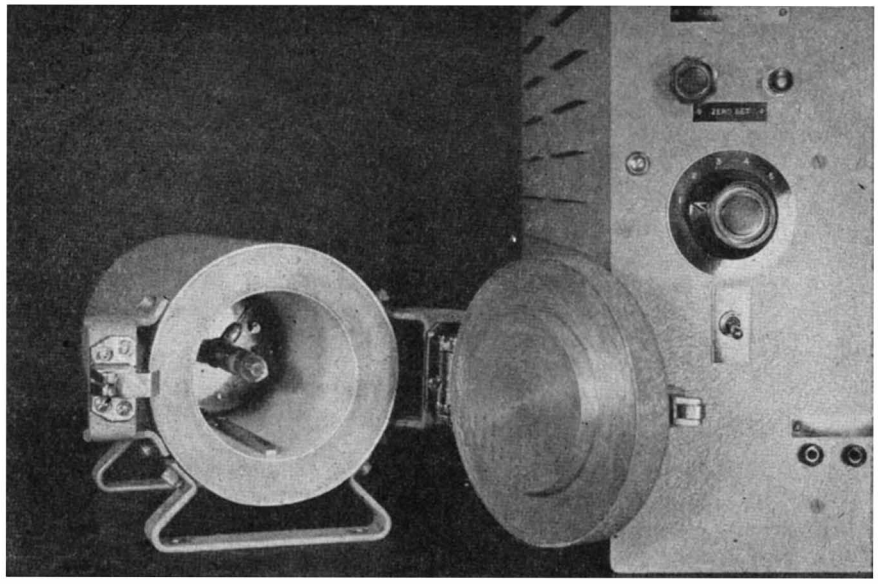
Take, as one startling example, the case of a middle-aged cancer patient in a New York City hospital. When he was operated on for cancer of the thyroid, it was found necessary to remove the entire gland. Thyroxin, the vital fluid which the thyroid gland secretes, had to be injected into him at periodic intervals in order to keep him alive.

One day this patient returned to the hospital in bad shape. A quick basal metabolism test revealed that he was suffering from an *excess* of thyroid activity. In other words, a man without a thyroid gland had far more thyroxin in his bloodstream than you or I!

Physicians soon discovered the reason. When cancerous tissue is removed from its seat, it sometimes reappears and flourishes elsewhere in the body. Somewhere in this patient's body (it could be almost anywhere) cancerous thyroid tissue had reappeared and was secreting thyroxin in abnormal quantities. But how to find this cancer and remove it?

The answer was given by a modern drug, radioactive iodine, plus the Geiger counter. Iodine is a drug which seeks out thyroid tissue just as a homing pigeon seeks out its loft. In this case, the iodine had been bombarded in a cyclotron and made radioactive. A tiny, harmless amount of this radioactive iodine was injected into the patient's body. In a short while, as physicians knew from experience, the drug would have found its way to the cancerous tissue. But where was that? A Geiger counter was brought close to the patient's body. The tell-tale "ticks" came slowly at first, then, as the counter explored the body's surface, faster and faster. And soon it had located the radioactive iodine —and also the fugitive and cancerous thyroid tissue, which was soon removed by an operation.

Upper left: Panel view of a recording unit used with a Geiger counter tube. The flashing lights referred to in the text appear at the upper center of the panel. Above: Side view of same unit. Below: The counter tube in a vault with thick lead walls and door to protect it from interference effects of radiation from external sources



BONE GROWTH — Other chemicals beside iodine have been made radioactive for use as biological tracers, and have opened brand new fields of research in medicine. Radioactive phosphorus can teach bone surgeons much they never knew about the body's mending powers. Scientists anesthetized laboratory rats and made tiny cuts in their leg bones. Afterwards, the rats were fed radioactive phosphorus. Since bones mend only as fast as they can absorb phosphorus, the rate of absorption could be used as a measure of healing. With the aid of Geiger counters, these scientists fairly *watched* living bone absorb phosphorus, and for the first time were able to determine the rate. The next step will be to use this knowledge in the treatment of human fractures.

Radioactive sodium, another wonder chemical of our atomic age, has proved invaluable for understanding the circulatory system. Injected into the bloodstream, radioactive sodium is carried to every corner of the body. By the use of a Geiger counter placed now here, now there, against the body, the circulation of blood can be calculated with uncanny precision. This is of tremendous importance, for instance, whenever a leg must be amputated. A surgeon would much prefer to take the leg off below the knee, if he has to take it off at all. But he also wants to know whether his patient's circulation is able to pump enough blood to the wounded area to help it heal. If the blood supply is

(*Please turn to page* 79.)

Air-Cleaning Efficiency Tested Electronically

Eliminating the Human Element, Vacuum Tubes Give Instant and Accurate Evaluation of Dust-Removal Equipment

By VIN ZELUFF

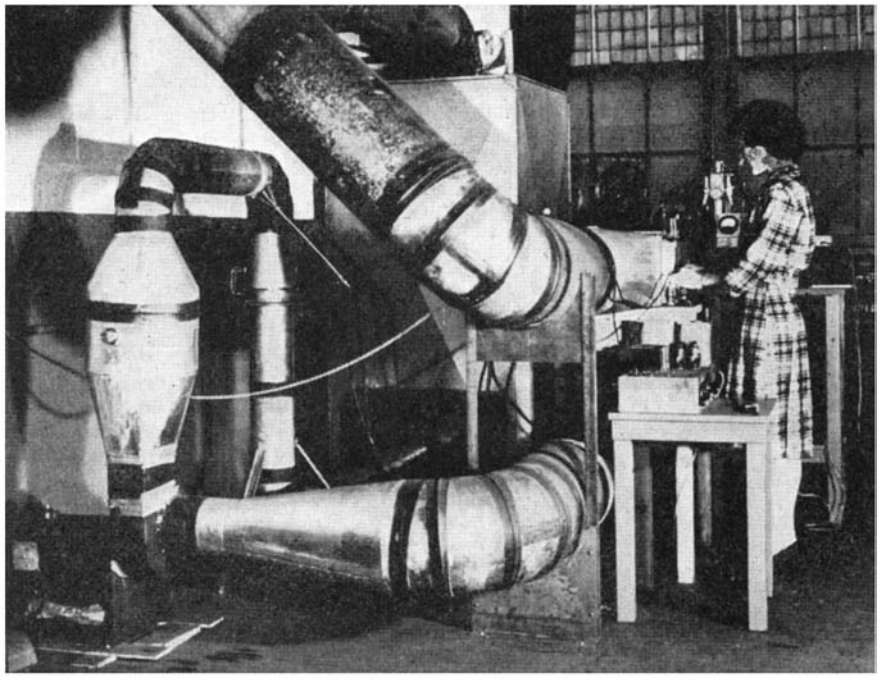
Associate Editor, *Electronics*

TESTING and rating the efficiency of air-cleaning devices is now being done by an electronic system which measures the residual dust content of the cleaned air. The method gives an instantaneous and direct indication simply and rapidly in the hands of an untrained worker.

The system, using a photoelectric tube and a lamp placed in an air duct, has been developed by Guy F. Barnett and A. L. Free, of Philco Corporation. The amount of dust in the air stream determines the amount of light which reaches the phototube and hence the current delivered by it. This effect, when electronically amplified, gives a continuous meter indication of the amount of dust in the air. The efficiency of the air cleaning device can then be determined by meter readings referred to a previously constructed calibration curve.

The first experimental electronic system for this purpose consisted of a closed air path as shown in an accompanying illustration. The air velocity was controlled by adjustable dampers in the line. After leaving the blower, air passed through a section of duct containing a pitot tube that measured the air velocity. It then encountered a dust injector connected to a compressed air line. The latter could be adjusted so that dust was fed into the system at a controllable and nearly uniform rate. After picking up dust, the air passed into the bottom of a settling chamber, three by three feet in cross-section and six feet high. While travelling this six-foot vertical path at a low velocity, any large clusters of particles which might have existed in the air stream tended to settle out.

The air next passed through an elbow on which was mounted a light source and a phototube. After this came the section in which the filter on test was placed. Following this was another elbow containing a second phototube arrangement and a return duct back to the blower.



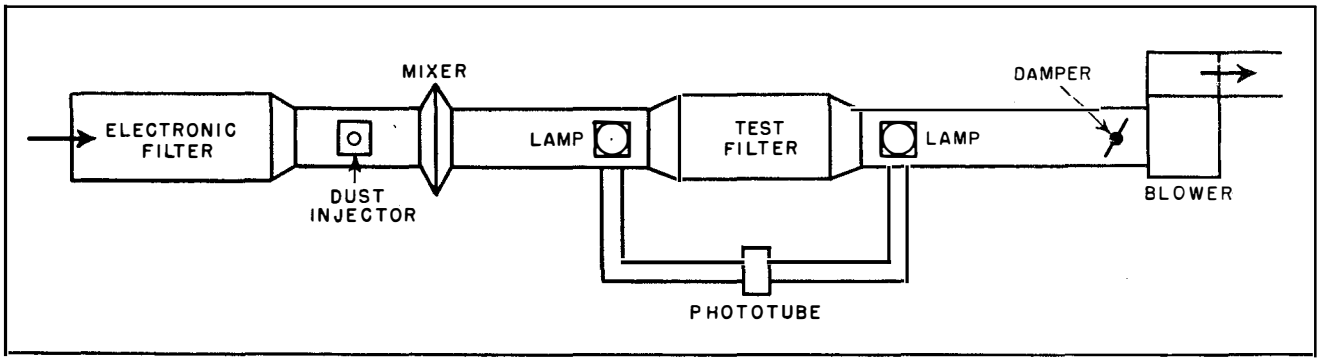
An experimental electronic dust measuring system

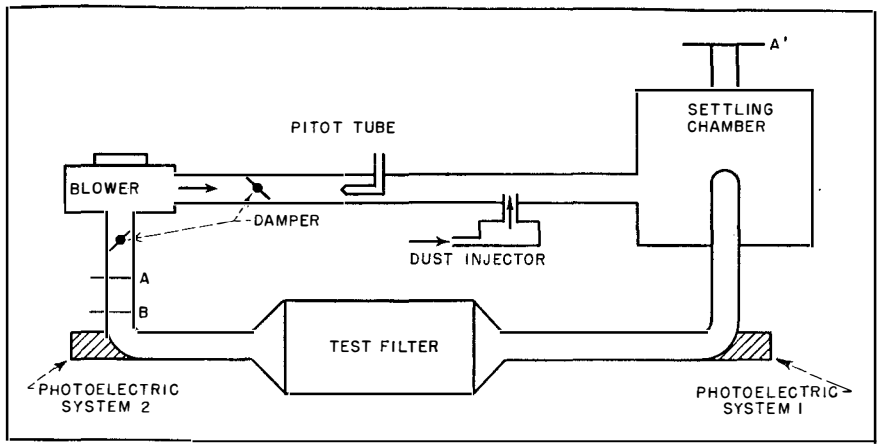
QUANTATIVE ANALYSIS — Two quantities can be measured by the photoelectric method of dust density measurement—either the quantity of light scattered to a phototube by dust in the air, or the quantity of light scattered *away* from the the phototube by the dust.

To use the first arrangement, the phototube is shielded from the direct rays of the illuminating source and from extraneous reflections so that the only light to reach the phototube is that scattered in the particular direction by the dust.

In the second method, a light beam shines directly at the phototube, which is arranged to look only at the source. Dust between the source and the phototube then causes a decrease in phototube illumination by scattering light out of the beam. The particle size and the wavelength of the light used determine the precise nature of the scattering.

In the case of direct viewing of the





First set-up (left) for testing electronically the efficiency of air-conditioning filters was modified until the final model (above) had evolved

illuminating source by the phototube, the change in phototube current caused by dust in the intervening air is small compared to the constant current corresponding to clean air. This is true unless the dust densities are excessively high or the light path exceedingly long. This results in a loss in effective sensitivity.

To minimize this difficulty, a lens might focus the light on a small absorbing target near the phototube, thus protecting the latter from direct rays. Another lens could then direct diffracted and reflected light to the phototube cathode. But in a dust-laden system of this sort lenses are generally undesirable since dust collecting on them scatters light just as does airborne dust. These factors and other practical considerations favor the adoption of the indirect-viewing method.

Using indirect viewing, the illuminated dust particles are viewed by the phototube at an angle to the illuminating beam. An optical system here would serve only to increase the sensitivity of the phototube system. This same function can be performed by a suitable electronic amplifier, which is more desirable than an optical system.

If the dust has a random particle-size distribution ranging from larger to smaller than the wavelength of the incident light, the light scattered normal to the beam would be made up of that due to reflection from the larger particles and that due to absorption and reradiation from particles smaller than the wavelength of the light used. Too, the particle distribution before the air passes through the cleaner would differ from that after cleaning, because any air cleaner is selective with regard to the ease with which it collects particles of a particular size. Thus the ratio of reflected to reradiated light would change after air cleaning.

• LOOKING AHEAD •

More efficient air-conditioning systems through precise measurement of dust removal. . . Determination of filter efficiency as a factor in design. . . More knowledge about the size of dust particles removed by a given method.

SELECTIVITY — For these and other reasons, the types of dust were restricted to those with particle diameters all larger or all smaller than the wavelengths of the illuminating radiation to which the phototube is sensitive. If the phototube current is to be directly proportional to the number of particles in the air, then they should also be sufficiently similar in size to make the selectivity of the cleaner negligible over the range of particle sizes.

The major design factor in air-conditioning testing is to have the intensity of illumination of the phototube cathode proportional to the number of dust particles in the air. Then if the relation between phototube illumination and phototube current is known, the phototube current as amplified and shown on a meter is a direct indication of the number of particles per unit volume of air.

Due to the high sensitivity of the response of the multiplier type of phototube to variations of electrode voltages, the use of an electronic power supply with good regulation is imperative.

The original dust injector system failed to give an entirely uniform feed at the low dust levels desired and a metering type of dust injector was finally adopted. This arrangement is also illustrated. In this, the dust content of the air is varied by changing the speed of rotation of a notched cylinder. Efficient filters clean the intake air to give a zero dust level. The whole measuring system is on the low-pressure side of the blower to facilitate the introduction of dust or smoke.

A single unit of phototube and associated electronic equipment is used to observe the dust level on both sides of the cleaning device. A panel-type meter is used as an indicator.

The air velocity is maintained at a sufficiently high value to minimize the retention of particles on the duct walls. A value of 6.5 feet per second was originally used, but experience indicated the advantage of somewhat higher velocities.

ACCURATE RESULTS — The final set-up gives quick and accurate results. Indication is continuous and shows the relation between any one of several variables and the quantity of dust in the air. When working in the region of dust levels where the phototube response is linear, efficiency readings are quite accurate, since they are obtained from relative readings. The technique is also applicable to factory

checking of air filters, since the equipment, once adjusted, will provide efficiency ratings simply and rapidly in the hands of an untrained operator.

The electronic dust meter is an answer to the problem of the air-conditioning industry, confronted with the task of testing and rating air-cleaning devices. It gives quick but accurate measurements for plant use. Previous measurement techniques did not give a direct and instantaneous indication of cleaning efficiency at all times and highly trained workers were necessary.

One older technique of measuring the amount of dust in air involves using a piston to pump the air onto a viscously-coated slide. The size and number of particles deposited per unit area are determined with the aid of a high-power microscope. This requires manual preparation and handling of the slide, adjustment of the pump orifice, and other complications. Considerable time is required to make the measurement, and a highly trained worker is required. At the same time, errors due to optical and mechanical discrimination against small particles are bound to creep in and the always-present human error in making the count introduces another variable that must be reckoned with.

A somewhat similar approach to the problem is to determine the increase in weight of the coated slide. This method reduces the human error, but in such a weight determination there is no way of knowing whether a given weight represents one particle 1000 units diameter or 1000 particles having one unit diameter.

A third method of testing dust-laden air is to force it through some filtering material such as a cloth at a uniform rate. The increase in weight or coloration of the filter over a given period of time then gives an indication of the dust content of the air. However, this method is also long and cumbersome.

The disadvantages of these methods have been overcome by the electronic method, another example of one new industry aiding another.

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DISHWASHER SOAP

Kept at Proper Level by Electronically Controlled Valve

A DETERGENT dispenser for dishwashing machines uses electronic circuits for constant and automatic regulation of the concentration of detergents in the wash solution. Operation of the device depends upon the change of conductivity of the solution which takes place when the concentration changes.

Basically the unit consists of an A.C. resistance bridge and an electronic amplifier and rectifier. One arm of the bridge is the resistance between two electrodes suspended in the cleansing solution, and the other arm consists of a cylinder containing a solution whose resistance approximates that which should exist between the electrodes in the tank.

A decrease in the concentration of wash-tank detergent produces an increase in resistance in one arm of the bridge. This unbalances the bridge and applies a signal to the amplifier controling a magnetic valve that opens only when the bridge is unbalanced. The valve is connected to the water input of the dishwashing machine so that opening it permits a small auxiliary tank to feed a super-saturated solution of detergent into the main tank. When detergent sufficient to rebalance the bridge has been added to the wash tank, the proper electrical conditions are established and the valve is closed.

ELECTRONIC DYNAMOMETER

Puts Production-Line Car Engines Through Paces Quickly

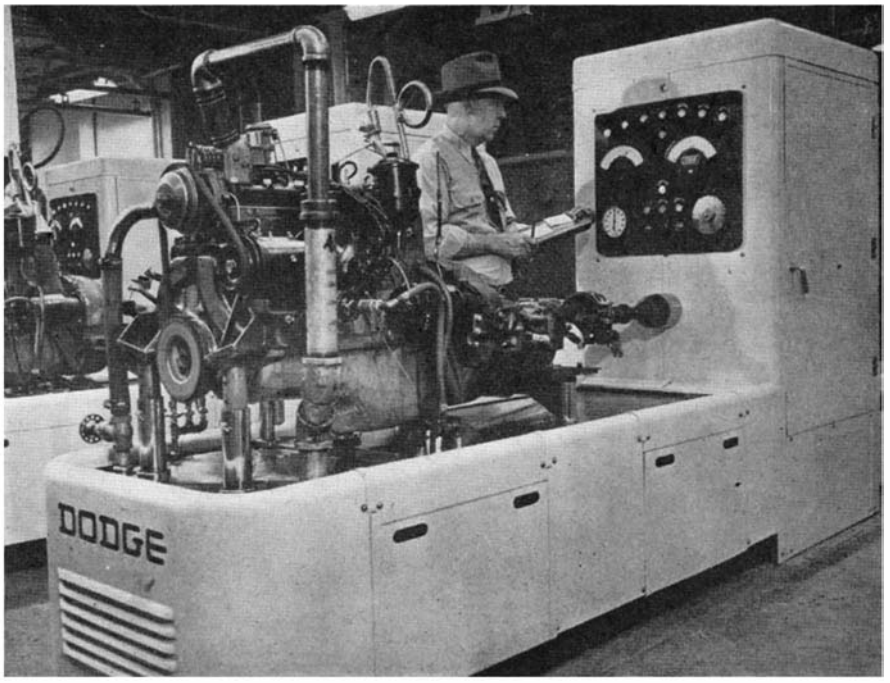
PROVIDING an automatic means of testing and adjusting newly built car engines, electronically controlled dynamometer test stands now take the place of the old block test which required an hour and a half, and the old dynamometer test, which took an additional ten minutes, not counting time to transfer the engines between stands. The time required for fully testing an engine has been reduced to 20 minutes.

Each test stand contains a generator and electronic controls that operate an instrument panel. Adjoining it is the base on which the engine is mounted. Fuel, water, oil, and exhaust-gas lines are concealed underground.

The engine operates for five minutes at an idling speed of 500 revolutions per minute, with filtered oil constantly flushing through the crankcase. Then the electronic controls apply a half load on the generator, the throttle opens up, and the engine runs for 12 minutes at half load. During the first seven minutes at half-load, externally supplied oil continues to flush through the crankcase, while a filtering system takes out any metallic traces remaining from the manufacturing process. The oil drain is then closed automatically, the crankcase is filled to operating level, and the last five minutes of the half-load test is run with oil circulating within the crankcase.

The engine runs at full load for the final three minutes of the test. During the run, the operator tightens all connections and cylinder-head studs, and an inspector checks each engine.

Flashing lights show instantly whether the oil pump, water pump, and thermostats are functioning and the ignition timing is correct. At the end of the 20-minute run the engine is shut down and oil and water are drained automatically. Five minutes later, the engine is on its way to be installed in a new Dodge.



Within 20 minutes a car engine is thoroughly tested—electronically

Fugitive Fluorine

Chemists Have Finally Succeeded in Taming Fluorine, the Most Unruly of the Elements. Now this Corrosive Gas Is the Principal Building Block of New Plastics, Lubricants, Insecticides, Fire Extinguishers, and a Potentially Large Host of Other Useful Materials

FLUORINE is a gas that is so reactive that even at —420 degrees, Fahrenheit, just a few degrees above absolute zero, it explodes upon contact with liquid hydrogen. Large chunks of wood will spontaneously burst into flame in a fluorine atmosphere, and steel wool will burn brightly in the gas.

It is no wonder, then, that chemists worked in vain for over 75 years to isolate the element from its compounds. A French chemist, Moissan, produced the gas in 1886, but it proved so unmanageable that little was done with it until recent years.

Unimportant industrially as the elemental gas has been, some of its compounds are extremely important. Cryolite, for example, which is a complex fluoride of sodium and aluminum, is essential to the production of aluminum and is also used as an insecticide. Fluorspar, a calcium fluoride, is the raw material for hydrofluoric acid, widely used in the petroleum industry to increase the yield of gasoline from crude oil. Sodium fluoride is a familiar enemy of rats and roaches, and the silicofluorides are used in ceramic manufacture.

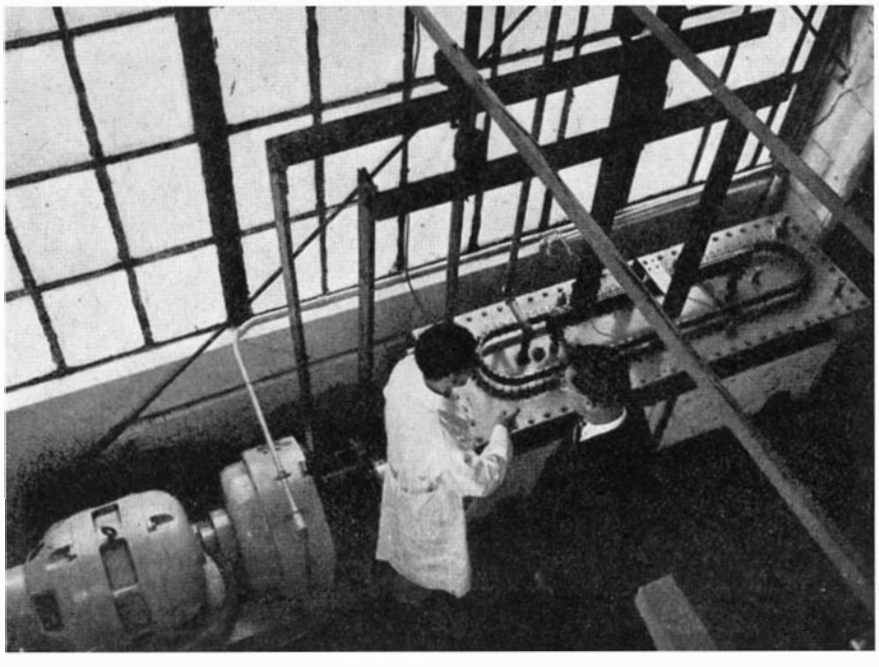
A few synthetic fluorine-containing compounds have been known for more than a decade under the tradename Freon. Because they are stable and non-poisonous, in addition to having desirable physical properties, they are ideal refrigerants.

An insecticide widely used in Germany was difluoro-diphenyl-trichloroethane, a fluorine analog of DDT, which is dichloro-diphenyl-trichloroethane. It is said to be even more effective against some insects than DDT.

Fluorine is not new, then, in the sense that until now it was totally unfamiliar. But the few fluorine compounds which have achieved industrial stature are only a very small proportion of the possibilities. What is new and important is the extent of the work now being carried on. Chemists have pressed on past the obstacles in the way of winning and handling the tricky gas, so that what was formerly a passing acquaintance has ripened into intimacy.

GETTING THE FLUORINE — In 1942, all the fluorine producing facilities in the country could not have made more than a few pounds a day for experimental purposes; three years later production was measured in tons a day. The atomic bomb program, which used great quantities of fluorine to make uranium hexafluoride, was responsible for much of the spectacular boost. Uranium hexafluoride is unique in that it vaporizes at 56 degrees, Centigrade, and can therefore be used in the separation of the uranium isotopes by diffusion. In order to get enough material for large-scale separation, a lot of fluorine had to be made fast. It was, and the dividend to industry is a new raw material available at a tenth of its former cost—with the accumulation of wide experience in handling and using it.

Fluorine today is produced by passing an electric current through a melt consisting of potassium fluoride and hydrogen fluoride. The latter material is broken up by the electrical energy into hydrogen and fluorine, which are discharged at the cathode and anode respectively. Because fluorine and hydrogen react explosively, the anode and cathode compartments are separated by a diaphragm to prevent contact of the gases. Additional hydrogen fluoride, which is obtained by treating fluorspar with sulfuric acid, is continuously added to replenish the cell. The anodes are of carbon, but the rest of the cell, fortunately, can be

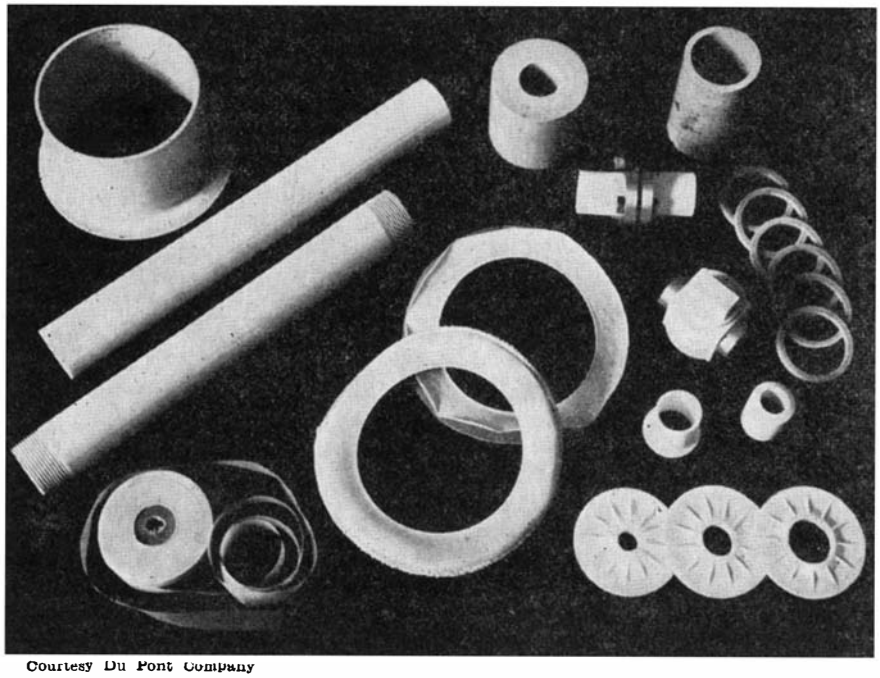


Courtesy Harshaw Chemical Company

Overhead view (below) of the commercial fluorine cell shows clearly the anode current distributing ring and gas outlet. The cell head, dismantled (right), showed no functional defects after a year's constant service

Works for Industry

By HOWARD C. E. JOHNSON, Ph.D.
Chemical Editor, *Chemical Industries*



Courtesy Du Pont Company

Made of Du Pont's "Teflon" tetrafluoroethylene resin, these articles offer great heat-endurance, unusual resistance to solvents, and excellent high-frequency insulation

constructed of ordinary carbon steel and Monel. These metals, as well as copper and nickel, form a protective surface coating of fluorides upon exposure to the gas, rendering them resistant to further attack.

Working out the production of fluorine was difficult, but the problems of handling and storing it were even knottier. In several instances fluorine chemistry lifted itself by its own bootstraps: The only satisfactory packing material for valves, pumps, gaskets, and the like was a mixture of a metal fluoride and tetrafluoroethylene polymer; and the only lubricant for pumps that wasn't attacked by the corrosive gas was a hydrocarbon oil in which all the hydrogen atoms were replaced by fluorine.

Remarkable engineering ingenuity is manifest in the design of one of the pumping systems. A regular commercial oil-operated diaphragm pump is arranged to transmit pulsations hydraulically to a second diaphragm pumping head in contact with the fluorine. The two pumping heads are connected by a pipe passing through a fire wall and containing a highly fluorinated hydrocarbon inert to fluorine. The expensive mechanical pump is thus protected in case of failure of the diaphragm or valves in actual contact with the highly corrosive gas.

The difficulties of handling and purifying fluorine have been surmounted, and now the gas—over 99 percent pure—can be purchased in steel cylinders containing half a pound at 400 pounds pressure.

The possibilities open to industry with fluorine available in convenient form are practically unlimited. The substitution of fluorine for hydrogen or chlorine in such things as solvents, polymers, resins, synthetic rubber, and so on, will provide thousands of hours of research and literally thousands of new compounds.

• LOOKING AHEAD •

Large-scale production of fluorine... Reduction of cost of the magic gas. . . . Compounds of the gas finding new uses in the electrical industry, as refrigerants, and even in textiles.

HAPPY PARADOX—Even more remarkable than the unequalled chemical activity of elemental fluorine is the stability of some of its compounds. It is seemingly a paradox, but it has a valid chemical explanation: The fluorine combines with other elements with such energy that once combination is effected, it takes a great deal of energy to break up the combination.

Some of the most interesting fluorine compounds, because of their stability, are the so-called fluorocarbons—hydrocarbons in which all the hydrogen is replaced by fluorine. Just as hydrocarbons range in properties from gases like methane to waxy solids like paraffin, so do the fluorocarbons consist of a large variety of structures varying in properties from gases through liquids up to solids.

These fluorocarbons, unlike the hydrocarbons, will not burn, and, indeed, will not react with any of the common chemical reagents. They are so stable that, if properly treated, fluorine itself will not attack them and, as mentioned above, they can be used in fluorine processing equipment.

Their stability to heat, oxidation, and chemical attack nominates them for thousands of potential uses, such as lubrication of heavy-duty bearings where normal oils and greases break down due to high pressures and temperatures; as inert solvents for chemical processes and extractions; and very possibly as heat-transfer agents. Protective coatings of fluorocarbons may in the future supplant all existing materials in rust-proofing, protection of paints and varnishes and preservation of wood, and in time may come to be the base of special-duty paints. Costly as these materials are at present, a large industrial demand would quickly reduce the price to compete with current materials in a great many specialized industrial fields.

Fluorine itself reacts too violently with hydrocarbons to give good yields of the corresponding fluorocarbons. In the presence of a silver-coated copper wire catalyst, however, the reaction is controllable and gives good yields. Another

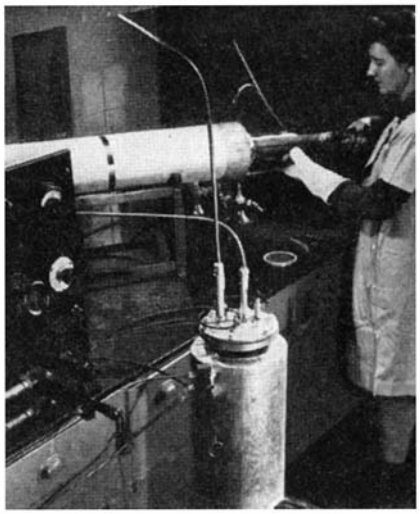
method which is being operated on plant scale employs the use of a metal "carrier." Here a lower fluoride of a metal such as cobaltous fluoride, CoF_2, is treated with fluorine to give the higher fluoride, CoF_3. This gives up its extra fluorine to a hydrocarbon, reverting to CoF_2, whereafter it is regenerated with additional fluorine. No fluorine is lost, for the hydrogen fluoride resulting as a by-product from the reaction with the hydrocarbon can be used to regenerate the electrolytic fluorine cell.

LONG-LIFE POLYMERS—The first commercial fluorine plastic is a polymer of tetrafluoroethylene—ethylene in which the four hydrogen atoms are replaced by fluorine. The gaseous monomer boils at −78 degrees, Centigrade, but the polymer—a translucent, waxy white plastics—is stable up to 250 degrees, Centigrade. The chemical resistance of Teflon, as the material is called, is outstanding, in that it withstands the attack of all materials except molten alkali metals. It can be boiled in aqua regia, hydrofluoric acid, or fuming nitric acid with no change in weight or properties. It is tough over a wide range of temperatures—from −75 to 250 degrees, Centigrade—and its excellent electrical properties point to its use in the power field, where one of the limiting features in design of electrical equipment has been the lack of a suitable insulation that will withstand high temperatures.

Because of its cost, the field for Teflon is limited. For uses which can take advantage of its unique properties, however, it is bound to find a market. In addition to its use in electrical equipment, it will very likely find applications in the chemical industry as a gasket and packing material and as chemically inert tubing.

Other fluorine compounds are also capable of yielding polmeric oils and plastics, but they have not yet advanced beyond the experimental stage. Among these are perfluorobutadiene and perfluorovinyl chloride. These are just like the familiar butadiene and vinyl chloride except that all the hydrogens are replaced by fluorine. In both cases polymerization can be controlled to give oils, waxes, or hard thermoplastic resins.

OTHER COMPOUNDS—The fluorocarbons represent, of course, only a small fraction of organic fluorine compounds. Chemists now have ways to introduce fluorine into all types of molecules, multiplying many fold the number of compounds which might improve dyes,



Operating on a laboratory scale, this Harshaw model cell supplies fluorine for reaction in an electric furnace

plastics, pharmaceuticals, synthetic rubbers, insecticides, and a host of other materials.

One of these new compounds, recently introduced, is sodium fluoroacetate, a highly efficient rat poison. Others, reported from the laboratory, are octafluoroadipic acid and octafluorohexamethylene diamine. The same compounds without fluorine are the basic constituents of nylon. Perhaps the next step is a perfluoro nylon!

A very stable gas, sulfur hexafluoride, may have a big future as a refrigerant, a fire extinguishing agent, and as an insulator in high-voltage generators and coaxial cables. Its physical properties, its outstanding chemical inertness, and its dielectric properties suggest all three of those fields.

FUTURE SCOPE — The industrial possibilities of fluorine chemistry are enormous. Fluorine itself can already be produced by the ton, and laboratories are continually finding new ways to use the magic gas and its compounds profitably. There is no gainsaying the fact that fluorine and its compounds are still expensive; they are still quoted in dollars per pound rather than cents per pound. But the price of fluorine will come down just as surely as the demand will go up, and with the falling price of fluorine will drop the cost of its derivatives. Chlorine, made by a very similar process, sells for less than two cents per pound and is the basis of a gigantic industry. It is safe to predict that fluorine will never be that cheap, but it will be cheap enough to become an industrial raw material of importance. The day will come—and it is not far off—when fluorine will be playing the big-time circuit.

URANIUM METAL

Suggested as Monetary Standard with True Value

PROPOSED as an international monetary standard to replace the silver and gold that have traditionally set the world's standards of values, uranium's claim to this position is based on the fact that atomic fission can convert a part at least of any mass of uranium directly into energy. Energy, the ability to do work, is suggested as a far more logical basis of economic value than any possessed by the precious metals.

Several properties of uranium metal preclude its use in actual coins, particularly its hardness and the ease with which it oxidizes. The various proposals for international control of fissionable materials as a means to control atomic bombs, however, might lend themselves readily to the issuance of an international currency backed by centrally controlled uranium metal.

Under such a scheme, atomic energy could be the basis of a reasonable currency whose value would be keyed to available energy, upon which depends production, the true modern measure of wealth. While we may never jingle uranium coins in our pockets, we yet may spend paper currency or coins of more adaptable metals backed by uranium as our present silver certificates are by bars of that metal.

ISO-OCTANE SOLVENT

Is One New Use For Reference-Fuel Now Surplus

THE once-rare compound on which the standard anti-knock rating of motor fuels—octane number—is based has now reached such a stage of production that its producers are looking for new uses for it. A bare dozen years ago, iso-octane, or chemically 2,2,4-trimethylpentane, could only be had from laborious synthesis of small lots in the laboratory, and its use was confined to the preparation of reference standards for fuel rating. This was because of the scarcity and high cost of the hydrocarbon.

The aviation fuel program during the war required the production of this compound on a large scale for use in the engines of military planes. Production skyrocketed, and now it is suggested that it may prove a valuable solvent in some special cases and that it will lend itself to chemical synthesis.

Aluminum Advances On All Fronts

Expanded Production Facilities, Lower Costs, Higher Strengths, and a Wide Range of New and Improved Alloys are Rapidly Opening New Markets. Uses Ranging from Door Keys to Railroad Cars Promise to Make Aluminum the Number One Nonferrous Metal of the Future

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

• LOOKING AHEAD •
More designers and manufacturers taking advantage of proved values of aluminum. . . New knowledge of the light metal and its alloys. . . Lighter automobiles and better engine bearings. . . Copper-coated aluminum for electrical parts.

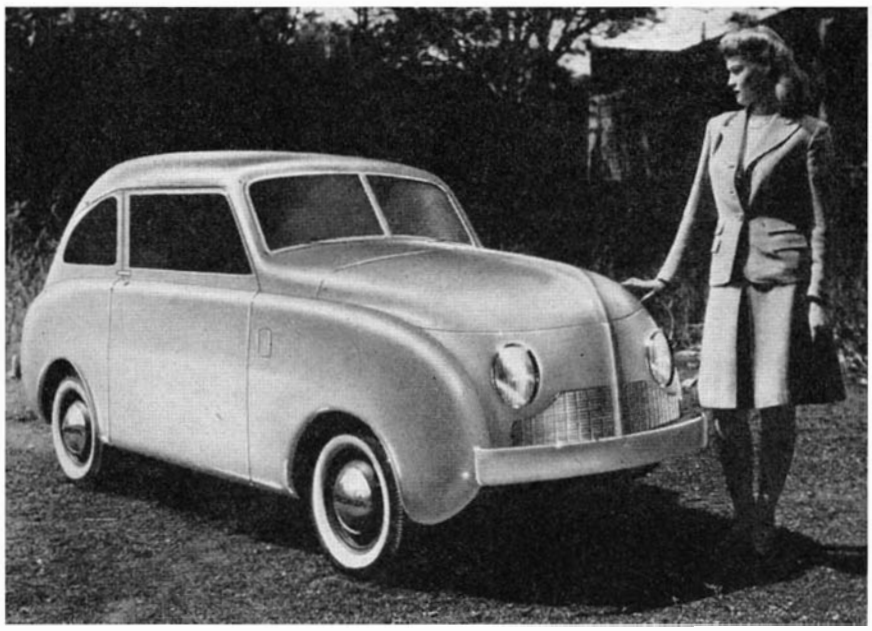
OF ALL the major metal-producing industries, none was so radically changed in commercial structure and in immediate post-war position by the war as was the aluminum industry. The former beneficent monopoly has become a highly competitive field, with the one-time sole producer in a dominant but not controlling position. The expansion of production facilities and the accompanying lowered price trend for the metal has placed it in position to become, within the foreseeable future, the Number One nonferrous metal from the standpoint of production and consumption.

Aluminum is now available in more forms and in a greater number of useful alloys than before the war. It has captured markets that were once the province of its heavier competitors, and is effectively invading a variety of others. The effect of the light metals onslaught on product design is evident everywhere—lawnmowers, ladders, electrical motors, automobile engines, furniture, railway cars, trucks, buses, high-tension lines, and so on are increasingly made with aluminum or magnesium. And aluminum, for the present and for a considerable period in the future at least, will receive the lion's share of applications divided among the light metals.

Before the war American production of aluminum amounted to 160,000 tons (1939), virtually all manufactured by Aluminum Company of America. During the war, to fill the fabulous demands of the airplane production program, aluminum production capacity was expanded many-fold. At present, production of aluminum is at the rate of 600,000 tons per year. Of today's aluminum reduction capacity, Aluminum Company of America has 52.5 percent, Reynolds Metals Company 30.1 percent, and Kaiser 17.4 percent. In addition to the Aluminum Company's long established research, technical service, publications, and market development departments, the industry now also has the analogous divisions of Reynolds working in a similar way to improve its products and expand its markets. The obvious and inevitable results of this double-barrelled effort should give rise to some quiet cogitation on the part of producers of other metals.

ECONOMICS — As pointed out in the article "Coming Changes in Metal-Economics," page 258, December 1946 Scientific American, the gradually falling price of aluminum and the rising price of copper have placed the light metal in a favored position for those applications for which either material is technically suitable. This is a fundamental reversal of their earlier positions and should have far-reaching effects on the use of aluminum for electrical conductors of various kinds and for corrosion-resisting and heat-conducting products.

While the expanded production facilities for aluminum have had much to do with its improved commercial position, technological advances must also share the credit for this metal's progress. Foremost among the latter in recent years have been the new aluminum-base alloys that have been developed for engineering uses. New high-strength sheet and extrusion alloys, new clad combinations, new forging alloys, and new engine bearing mate-



Crosley, first post-war automobile with an aluminum body

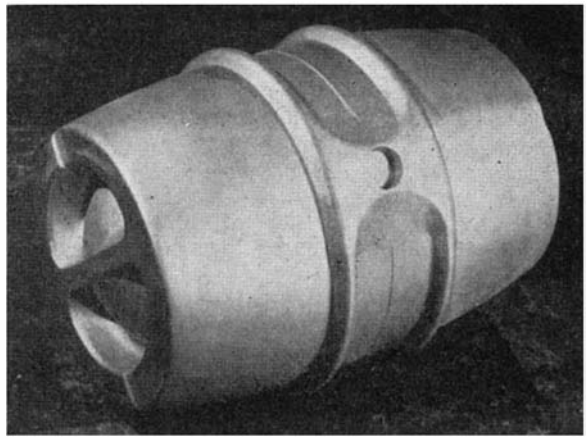
rials have made the lightweight advantages of aluminum even more attractive to engineers by increasing the strengths available in this series of alloys.

INCREASED STRENGTH—For example, before the war the strongest aluminum alloy available in sheet form was 24S, which in the heat-treated state developed a tensile strength of about 68,000 pounds per square inch. Since then Alcoa has brought out 75S and Reynolds, R303. These alloys are basically similar in composition and properties, each consisting of aluminum plus zinc, magnesium, and copper as the principal alloying elements, and each possessing tensile strengths in the heat-treated (that is, the precipitation-hardened) condition in the neighborhood of 82,000 pounds per square inch for sheet and 85,000 for extrusions.

Such tensile strengths are up in the range occupied by the plain carbon structural steels; the aluminum alloys, however, are only about one third as heavy as the steels, so that these new high-strength aluminum alloys have a tremendous advantage over the mild structural steels on a strength-weight basis alone. (Of course, other factors such as cost, weldability, fatigue strength, and so on must also be considered, and these are often favorable to steel. Also, the strength-weight ratios of special steels like stainless are much better than those of plain carbon steel.)

The 75S and R303 alloys have yield strengths that are double those of mild steel, and are not subject to the stress-corrosion cracking that had previously limited the applications of aluminum alloys containing zinc as the chief alloying ingredient. A good example of what the use of these alloys can mean to engineering design is afforded by experience with 75S in the B-29 bombers manufactured in the latter part of the war. Employed in the upper wing skin, for skin sheet and stiffening sections in place of 24S, the new alloy resulted in a saving of about 400 pounds per plane.

Light and sturdy, this aluminum beer barrel provides a shining example of the metal's versatility



Courtesy Reynolds Metals Company

No heavier than one of the 175 aluminum ingots stacked on its chassis, the Northrop Gaines aluminum hand truck, which easily bears the load, weighs only 30 pounds

NEW CLADS—Several new types of aluminum-clad aluminum alloy products have recently been introduced to supplement the standard Alclad (or Pureclad) 24S sheet. Special artificial aging treatments for aluminum-clad 24S, when combined with cold work, have given tensile strengths in the neighborhood of 70,000 pounds per square inch. Alclad 75S in the heat-treated condition has a tensile strength of 76,000 pounds per square inch and a yield strength of 72,000, both highly respectable figures for an aluminum-clad product. And Reynolds has an aluminum-alloy-clad-with-alloy product for which tensiles up to 75,000 in sheet form and 89,000 as extrusions have been reported.

An innovation has been the use of pure aluminum cladding on lower-strength aluminum alloy materials. For example, Alclad 3S sheet (a base of aluminum containing 1.2 percent manganese, clad with pure aluminum) possesses outstanding resistance to pitting corrosion, excellent workability, and satisfactory mechanical properties for many applications. During the war it was employed for gasoline tanks in airplanes and on PT boats, as well as for water tanks on the latter. It is now being extensively used for such products as mason jar caps and tea kettles.

ALUMINUM-TIN — The development of aluminum-tin alloys for bearing applications has been one

of the most promising of recent developments in the aluminum field. Alloys containing 6.5 percent tin, some nickel, copper (and, in one alloy, silicon), and the remainder aluminum are being studied and experimentally applied for main and connecting rod bearings in several new automobiles.

In addition, steel-backed aluminum-tin alloy bearings are receiving increased attention for similar applications. The solid bearings have a relatively large number of alloying ingredients to provide individually such desirable bearing properties as fatigue strength and general load-bearing characteristics. In the case of the steel-backed bearings, the bearing surface is a simple aluminum-tin composition and the required heavy-duty mechanical properties are provided by the steel backing. Established uses of aluminum bearings so far have been in the Rolls Royce engine and in Diesels.

OTHER ALLOYS — Another new aluminum alloy with a bright future in the architectural and building field is Alcoa's 63S. This is a medium-strength non-heat-treating alloy, which is corrosion resistant and takes a beautiful anodized finish without staining or streaking. A new aluminum alloy for roofing sheet also has been developed, which is now being increasingly used for farm roofing. Not strictly an aluminum-base product, but still one that depends heavily on aluminum for its service characteristics, is aluminum-coated steel, now being manufactured by the American Rolling Mill Company. As a competitor of painted and galvanized steel and of tinplate and terneplate, aluminum-coated steel may eventually represent a sizeable outlet for aluminum.

Advances in processing have also helped to push aluminum forward and to open new applications to it. For example, stepped extrusions are now available in aluminum alloys; these are especially useful for such products as aircraft wing spars, which are required to have variable cross sections. Larger machines and improved techniques for press forging and impact extrusion have lowered the cost and increased the sizes of aluminum alloy products available in these forms.

New casting alloys have also recently entered the aluminum field. A General Electric metallurgist has developed an aluminum-base alloy containing copper, beryllium, and cobalt, which has very high strength properties for a casting alloy, high thermal stability, unusual oxidation resistance, and good foundry properties. The Aluminum Company of America has brought out its A100 alloy, designed especially for use in rotors of low-resistance electric motors. And a new aluminum-magnesium casting alloy, Almag 55, developed by Acme Aluminum Alloys, Inc., has a tensile strength of 50,000 pounds or more, together with good ductility and impact strength; it is described as having the highest combination of tensile and impact strength available in aluminum casting alloys.

New materials and methods for brazing aluminum products have expanded the use of aluminum alloys in containers, electrical and radio parts, aircraft heat exchangers, and refrigeration and air conditioning units. Alcoa has developed an Alclad alloy brazing sheet—a composite product which carries on either one or both surfaces a thin layer of low-melting aluminum brazing alloy. Special brazing fluxes have also been evolved for use with this new brazing material. Reynolds is working on an aluminum sheet flash-coated with copper for easy-to-solder electrical parts (electric light sockets, wiring devices, and so on) that are now made of brass.

APPLICATIONS UNLIMITED—As a result of all this, aluminum and its alloys are being studied for or applied in several significant new fields. Aluminum alloys have been shown to be entirely feasible for the superstructure of passenger and cargo ships: the lighter weight of the aluminum superstructure brings increased stability, greater load-carrying ability, or greater speed. Some marine architects believe that even all-aluminum hulls may be advantageous for certain services.

In the automobile field there is intense study of aluminum for both bodies and engines. One well-known medium-priced car is now 500 pounds lighter because special attention was given in its design to the use of as much aluminum as possible. Readers are undoubtedly familiar with the efficient new Crosley car design and its all-aluminum body. Jack and Heintz are using light metals in every possible place in their engines, in the firm belief that everything which moves *must* be made as light as human ingenuity can devise, and that American industry has an obligation to make the light metals work for them even when the "bugs" may seem more numerous than the benefits.

Aluminum is making steady inroads on other materials for use in railway cars of all types. Streamlined all-aluminum passenger trains, modern lightweight passenger cars, and, most recently, boxcars and hopper cars made largely of aluminum are increasingly seen on the rails. The aluminum cars save weight, permit increased payload (or faster runs or less engine power for passenger trains), and are resistant to corrosion from sulfur in coal.

Aluminum keys, which are only 40 percent of the weight of brass keys and will not wear holes in one's pocket so fast, are already being specified for use with automobiles and should eventually spread to more general use.

Indeed, the list of products and industries in which aluminum and its modern alloys are finding new applications is virtually endless. As the generally favorable experience of these new users becomes publicized, more and more designers and manufacturers are going to incorporate these light materials in their products. The venerable Aluminum Company of America and its younger rivals are in for some busy years—and so are those product manufacturers who make the fullest use of the knowledge and materials made available by all the light metal producers.

DRAWING STAINLESS

Without Tearing or Shearing

A WAR-DEVELOPED process for inexpensively forming tough-to-work sheet metals like stainless steel into deep-drawn and sometimes complicated parts, without tearing or shearing the metal, is now being applied to several peace-time products.

Known as the Sol-A-Die process, and developed by engineers of the Solar Aircraft Company, the method is one of "staging" the metal drawing and shaping in such a manner as to reach the final absolute area of the desired form in the first stage —rather than the last—of a series of steps.

Up to a recent date the process had been used in producing the stage die patterns for more than 600 parts of some 60 different assemblies having a total value of approximately $25,000,000. The savings reflected in total production costs of assemblies is estimated at from 10 to 15 percent.

Beyond the aircraft industry this low-cost staging die process materially aids in reducing tooling charges on low-volume jobs; for example, for custom automobile bodies and experimental designs.

PLASTICS on WHEELS

All-Plastics Automobile Bodies are Still Largely in the "Talk" Stage, but New Laminated Plastics Panels are now Being Produced Fast Enough to Keep Up with Operations on One Station-Wagon Assembly Line

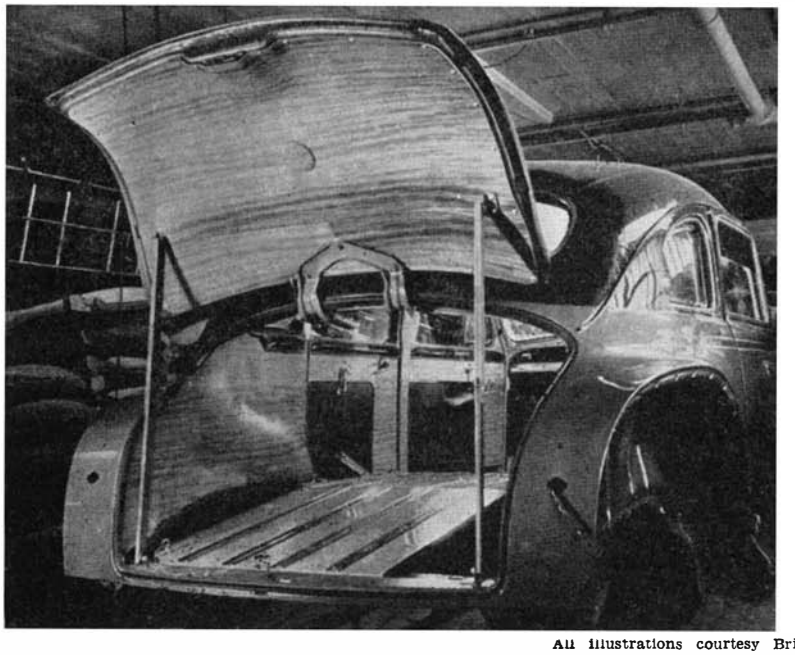
By CHARLES A. BRESKIN
Editor, *Modern Plastics*

PLASTICS, hardly strangers to the automobile industry, have long been used for interior trim and fittings, for instrument covers, kick plates, jump seats, and for numerous applications in the working parts of cars. On a larger scale there has been considerable talk, and some work in the custom field, on all-plastics bodies. But the most extensive use thus far made of plastics on an assembly-line basis is to be found in the work of the Briggs Manufacturing Company in paneling the major portion of the inside of an automobile with a plastics laminate.

This development makes plastics a material of major importance in the automotive field. It goes beyond the idea of mere decoration and places plastics in the class with wood, steel, and other traditional structural materials. Today the production of this paneling is geared to the requirements of the DeSoto station wagon assembly line. For each car there are turned out four door panels, two rear quarter panels, one rear deck, and two strips to be mounted between the doors. This volume, limited thus far to the one model car, is admittedly a small percentage of total automobile production. But if this method of processing decorative laminates for car interiors is developed to a point of large mass production, it will carry out the tradition of American mass production—a better product at a lower price with longer wearing qualities and improved appearance.

These plastics laminate panels not only are decorative but, tested side by side with traditional materials for wearing qualities, have come through with little if any signs of wear or scratching while the traditional materials showed scuffing and wear and were generally unusable when the test was over. Perhaps the best tribute to the resistance of this plastics material lies in the fact that its first application is in a station wagon.

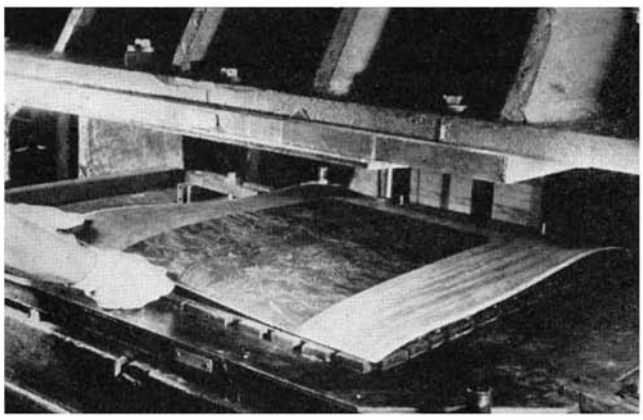
For some years, cost of resins and fillers and low speed of production were the principal hinderances to the commercial use of these laminates. When Al Prance of the Briggs company took over the development work about four years ago,

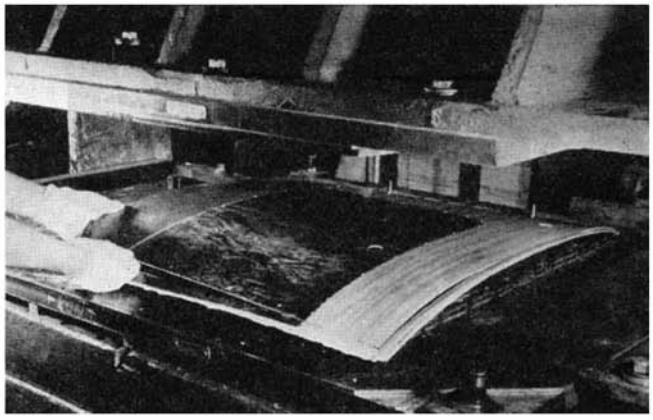


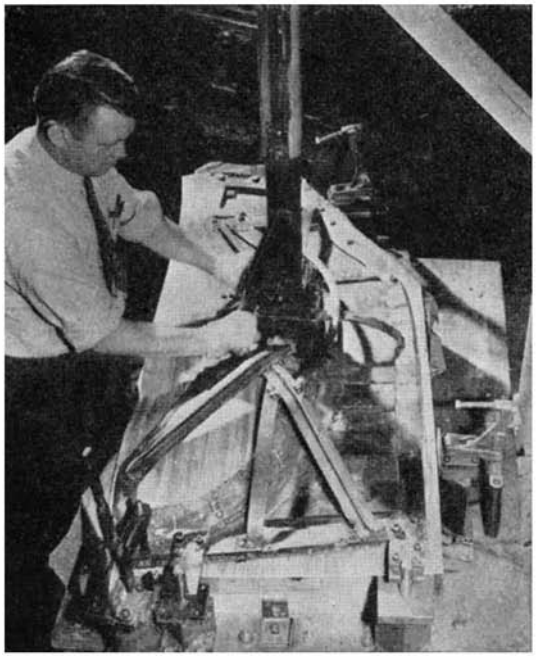
All illustrations courtesy Briggs Manufacturing Company

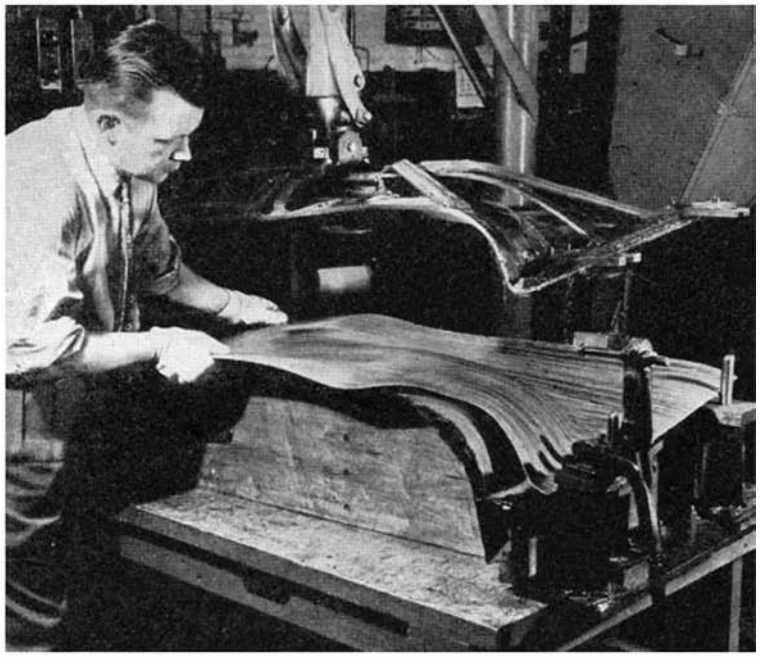
First to make such extensive use of plastics, this DeSoto station wagon has interior panels of long lasting wood-grained laminate

With real wood panels as their model, the laminates achieve amazing realism









Laminates for the door panels ready for die cutting are placed in the press (top, left) where all required holes are pierced and edges trimmed in a single operation (top, right). Rear quarter panels after die cutting are shaped on the forming fixture (bottom, left) and when removed (bottom, right) are ready for the final drilling

• LOOKING AHEAD •

Plastics laminates, resistant to wear and abrasion, competing with conventional structural materials. . . Decorative qualities "built-in". . . Strong, complex shapes formed on simple wooden molds. . . Better molding of laminates with metal parts inserted.

satisfactory panels were being produced experimentally. But a lot of work had to be done before production speed could be increased to a point where the processing could keep up with a standard automobile assembly line.

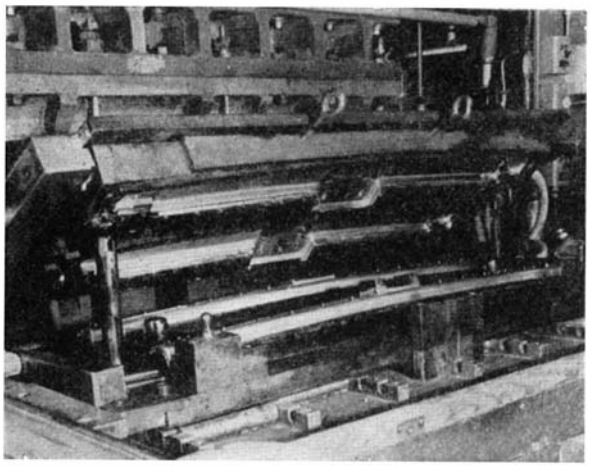
LAMINATE AND PROCESSING — The laminate used in this work comprises high-strength paper laminated to a core of heavy phenolic resin-impregnated alpha cellulose paper. The high-strength paper on the exposed face of the laminate is printed with a decorative grain effect; the second skin is of undecorated high-strength paper.

There are really two methods presently being used for processing this sandwich structure. In fact, one might say that there are two classes of laminates. A hot forming method is employed for the parts already described but for the garnish molding on the rear of the front seat of another car—the second and much smaller automotive part being made of the laminate—the process is very similar to that used for molded laminates.

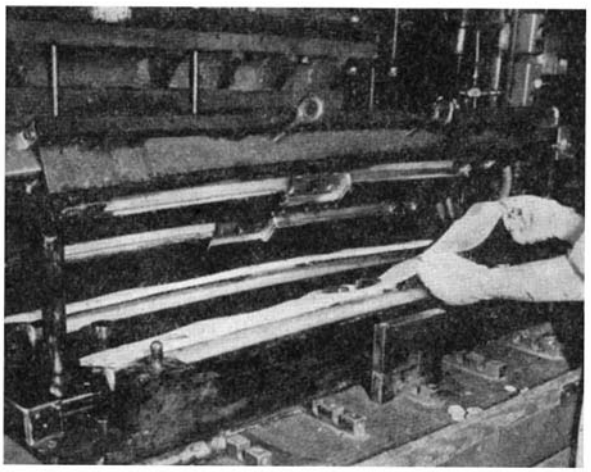
Any design in any combination of colors can be reproduced on the decorative sheet used for the exposed surface of the laminate by the use of standard rotogravure methods of printing. Since a transparent phenolic resin is used on this outer surfacing, the plastics does not effect the colors as printed. In the station wagon the effect is that of wood grain, the authenticity of the graining being assured by the use of actual wood as the copy from which the printing plates are made. Variation is achieved by the use of two colors and two grains of paper in the door paneling as contrasted to the single sheet of grained paper in the rear quarter panels, rear deck, and between-the-door strips.

FORMING PROCESS — The first step in producing the panels is laying up the resin-impregnated paper sandwich. The alpha-cellulose paper for the core is stacked up and sandwiched between the phenolic-resin impregnated high-strength paper that has been cut to the desired shape. This positioning of the skins requires some care when sheets with different graining are used in the same assembly.

The sandwich is then placed in a laminating press and cured. The cured laminate as taken from the press is held flat by a wooden form until cooled. This procedure is necessary because the laminate is



The length of the laminates to be shaped in this mold necessitated the unique hydraulically operated tilting head



After being die-cut to size, five sheets of impregnated paper are laid up in the press for molding

unbalanced during cooling and would warp if not held to shape.

The die stamping of these laminates, the next step in the process, is very similar to any stamping operation and the speed of the operation is the same. For this work the cured and cooled panels are reheated by a bank of infra-red lamps to a temperature of approximately 300 degrees, Fahrenheit. The clean cut achieved in this stamping operation practically eliminates further finishing work; also, the holes for mounting the metal trim and the larger hole for the window regulator shaft are completely punched out in one operation. The die cutting of the laminates for the rear deck and rear quarter sections is the same as for the flat panels, but these smaller panels remain to be formed.

From the die-cutting unit the hot sheets for the deck and rear quarter sections go directly, and while still hot, to a simple forming die. Here the laminate is placed on a wooden form which comprises the lower half of the die. The upper part of the die is merely a skeleton framework which presses the laminate at certain strategic points to make it conform to the shape of the lower male form. The formed panel, after removal from this jig, goes on to another station where assembly holes are drilled.

One of the factors that keeps down the cost of these interior panels is the low cost of the wooden dies that are used for shaping. Including the cost of the mold material and of the labor involved in the building of the dies, the molds for two left- and two right-hand panels cost about $1000 total. If the dies had been made of steel it is estimated that the cost of each die would have been approximately $20,000, making a total die outlay of $80,000 for the four molds.

MOLDED LAMINATES — The garnish molding on the rear of the front seat of one make of automobile—a part with more complicated contours than the panels and with molded-in assembly screws—is produced by the second method of processing these laminates. Steel molds are used for this work, but they are still not as expensive as metal stamping dies and the completed laminated parts require only simple finishing.

The same type of sandwich is used for this garnish molding as for the paneling, but it is used differently. Each mold charge of phenolic-resin impregnated paper is die-cut to size and loaded in the mold. The brass screws, used for assembly, have large heads and are molded directly into the piece.

The set-up of the mold for producing this part raised many problems when this job was undertaken and necessitated the development of unique equipment. In a sense this mold resembles somewhat a phonograph record press in that the mold has a tilting top. But whereas in the molding of records a tilting head press is used, the mold for the laminated garnish is not fastened to the press at any point and, in operation, is withdrawn from the press after each cycle. This set-up was made necessary by the length of the garnish molding which is 46 inches. Obviously the mechanical requirements for tilting the head of a press big enough for a piece of this size was out of the question.

The solution was found in the construction of a tilting head mold —achieved by hinging the top and bottom of the mold at the back— which is retracted from the press and held in the open position by two vertical steel rods operated by hydraulic cylinders.

When the curing of a laminated part is complete, the lower platen of the press drops enough to remove the clamping pressure on the mold. Two hydraulic rams then move horizontally to push the closed mold out of the press. When the mold has come to a stop over two vertical-acting hydraulic plungers these plungers move upward and open the mold. The mold tilts open enough to give ample clearance between the two halves for the removal of the molded parts and the reloading of the mold with a new charge. The layup complete, the vertical plungers retract, lowering the upper portion of the mold until it is in contact with the new charge. The horizontal plungers then move the mold back into the press and the molding operation is repeated.

Movements of the mold and press, as well as the timing of the molding cycle are all push-button controlled; even preheating of the material is automatic and the infra-red lamps for heating the panels are in an automatic time-switch circuit.

At the time of writing, all the operations on the inside station wagon paneling and on the garnish molding are being carried out in the plastics laboratory of the Briggs plant. The operations, however, are not at all in the laboratory class but are set up on a production basis. Equipment similar to that now in operation is being installed in one of the company's large production sections and, very shortly, these automotive parts will be produced at this new location.

PILOTS to PROFITS

Reducing the Time Gap Between Conception and Production, Pilot Plants Can Also be Profitable in Themselves. Flexibility of Pilot Plant Equipment Permits It to be Equally Valuable Whether Used in the Plant Laboratory or on the Active Production Line. Co-Operative Pilot-Plant Operation is Being Adopted by Many Industries Today

By EDWIN LAIRD CADY

Courtesy Lincoln Electric Company

Many forms of welding have become successful because of previous work and study conducted in pilot plants

• LOOKING AHEAD •

Quicker change-over of production to meet—or avoid—competition. . . Better understanding of economics of factory equipment operation. . . Broader diversification of machinery and product applications.

THERE was a time when the Hodgman Rubber Company could not take an order for anything but its few standard lines of rubber coated sheetings. Come good times or bad, plant speed-ups or plant shut-downs, big profits or cut-throat competition, the factory had to run on those few items or else make nothing. A number of competitors made the same goods and were hungry for the same orders. Lush years were few.

Pilot-plant operation changed all that, and is doing the same job for hundreds of other manufacturers. Now Hodgman can take orders for hundreds of different specialties, switch its production to the lines in greatest demand, enter dozens of new fields, pioneer.

There was plenty of justice for the older attitude. Hodgman uses heavy, slow moving machinery. Raw materials in powdered and plastic forms are fed and re-fed to huge rolling machines which patiently spend hours mixing and compounding a single batch. Colors are mixed in large tanks and again must be stirred for hours; the changing of a color which is being mixed in a tank requires that the whole tank be taken apart, its ponderous paddles lifted out by a chain hoist, and the tank barrel laid on its side so it can be scraped by hand. Almost no working mechanism turns at over 500 revolutions per minute, and 20 is more common. Changing a product meant experimenting with all of this machinery until the new line was running just right. The adjustments could take weeks of trial and error.

ERROR REDUCED — Under the present set up there is almost no trial and error at the big machines. The specifications of a new product are sent directly to the plant laboratory. Here the production procedures are worked out, by the use of test tubes and hand mixing apparatus if necessary.

In the laboratory are all the standard and special testing instruments that can be used for this line. The testing procedures to use these for complete control of the production line are worked out also.

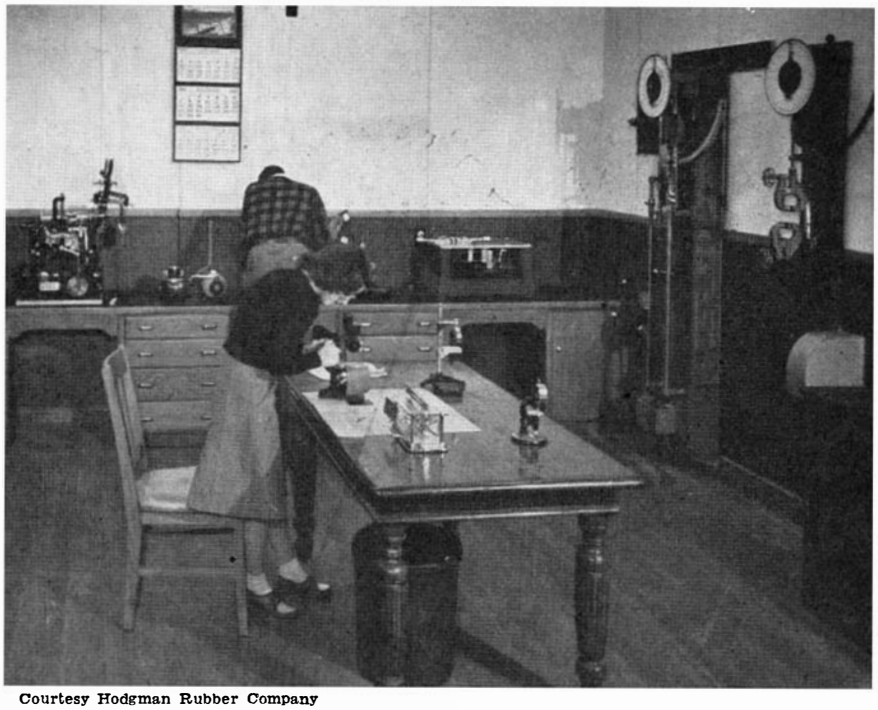
Now the development is ready for the pilot plant. Part of this is in the laboratory, other parts are in the main factory where they can be used for production lines when the laboratory does not need them.

The pilot-plant equipment in a factory of this kind is smaller in size and capacity than most of the main production equipment. But it is highly flexible. It can be used for minor variations of the main products and thus can permit the manufacture of small lots of highly profitable special products.

Once the pilot plant has shown just how to make and test or inspect a new item, the main production equipment supervisors can go ahead. They have clear instruction sheets. Very seldom do they have to make any major changes in procedures. And in the meantime almost all of the small lots made on a test and development basis in the pilot plant are saleable goods. The pilot plant very often runs on the basis of making profits in its own right. And the pilot plant has provided such flexibility of operations, such ease of changing from product to product, that almost never will this company have to produce goods on which it must meet cut-throat competition.

SCREW MACHINES — One of the major manufacturers of automatic screw machines started a pilot plant equipped with its own machines and those of its competitors just to see how all of them would perform. For years this plant has grown until now it is one of the largest screw-machine products contract factories in existence. Basic reason for this growth is the fact that this pilot plant has produced many new developments in screw-machine products and has created much new business for all contractors.

One new development is the machining of cast bars of special alloy steels. These bars can be made by precision investment casting, but only in lengths up to about 18



Courtesy Hodgman Rubber Company

Started in the laboratory (above), pilot-plant operations can keep trial-and-error troubles from huge machines

inches—much too short for fabricating in ordinary automatic screw machines.

The screw-machine maker has spent thousands of dollars and months of time developing butt-welding techniques so these cast bars can be joined into the long lengths profitable for screw-machine operation. Once this technique is ready (and it is nearly ready now), then an important gap between the techniques of precision investment casting all the contours of an alloy piece and of machining part or all of those contours out of solid bar stock will have been bridged. Makers of all varieties of automatic screw machines, and of lathes and other machine tools, will benefit. Precision investment casters will lose some business which they have taken from the automatic screw-machine contractors, but will gain a great deal of tonnage of partly formed or modified bar stock business which will come from those contractors. The alloy steel picture will be improved. Hundreds of brand new products will be created.

LESS SCRAP—Another costly problem will be reduced for the contractors. Right now their machines can work only to the last few inches of bars, especially when the machining operations are severe and require the machine chucks to have plenty of bar stock area for gripping. The bar "ends" which are too short to grip have to be pushed out of the chucks so new bars may be inserted. Those ends are high-cost scrap. Getting them down to the shortest possible lengths requires expensive tooling, chucking, and setting up of machines.

This new butt-welding technique will permit bar to be so welded to bar that in many cases there will not be any "ends." By following the welding process with a heat treatment which sometimes can be performed by induction heating or by gas flames while the stock is in the automatic screw machine, the welded area may be made so much like the rest of the bar stock that it can be machined into finished products and there will be no waste other than a little flash caused by the welding process.

Such a saving of high-cost alloy steel and of machine time could be developed only in a pilot plant that is paying profits out of which development costs can be met. And

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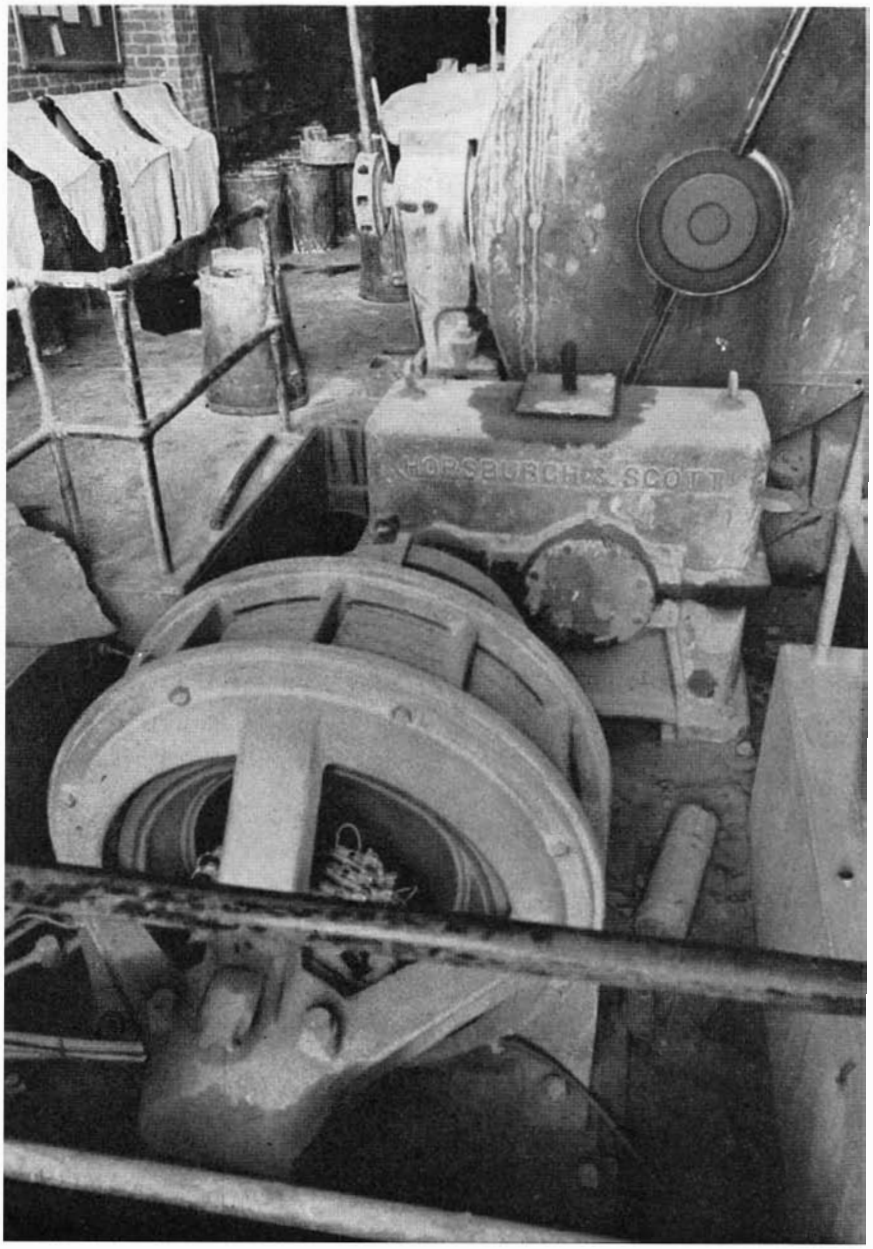
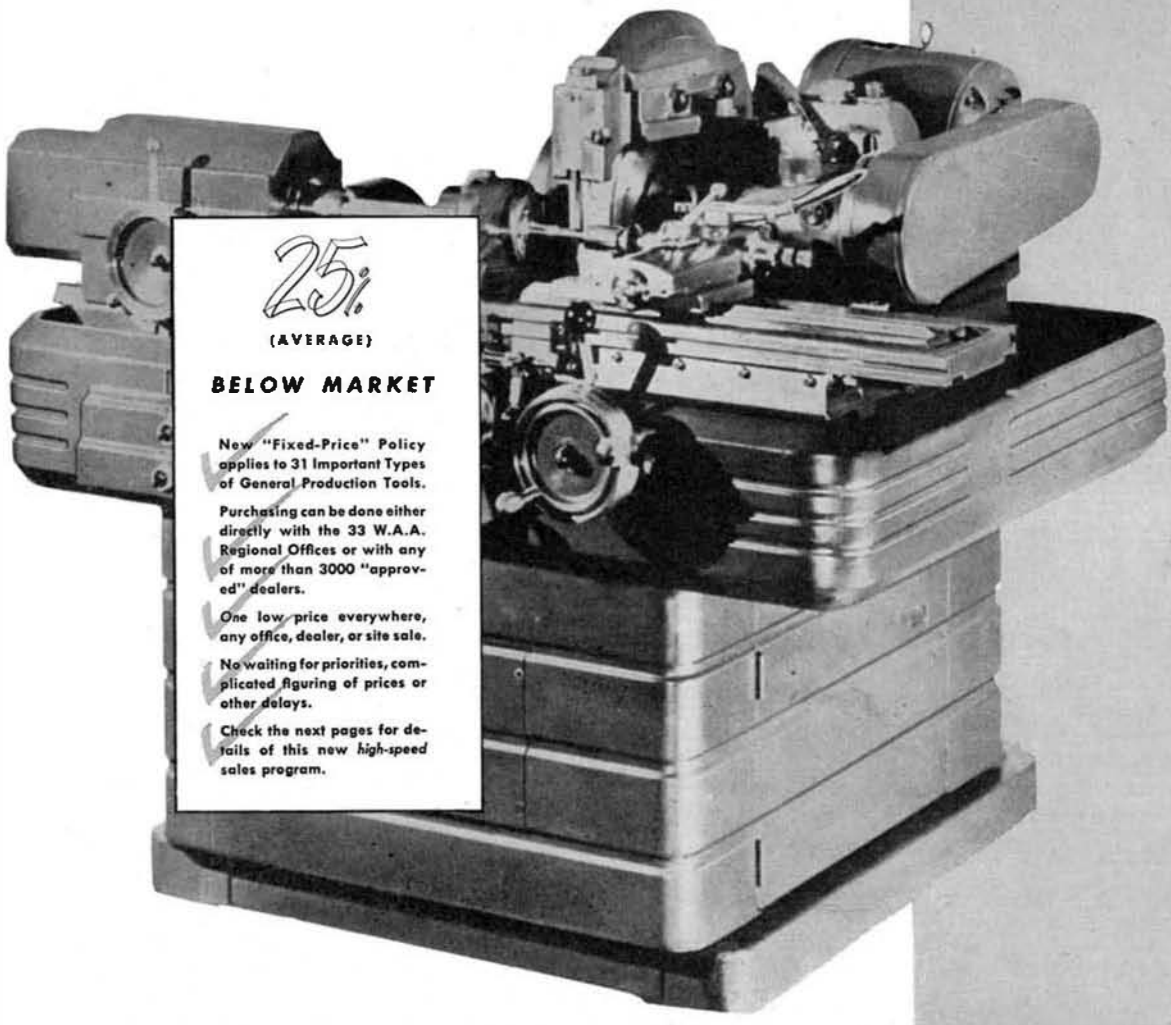
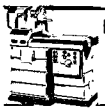


NOW YOU CAN REALLY BUY

SURPLUS MACHINE TOOLS

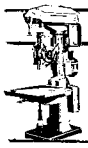




BORING MACHINE — HORIZONTAL, PRECISION, BRIDGE TYPE, SINGLE END

(WAA S. C. Code 3411-31)

MODEL	SIZE AND CAPACITY	SALES PRICE
Manufacturer: **EX-CELL-O CORPORATION, DETROIT, MICH.**		
2112-A Single End	6" diameter bore, x 12" table travel	$ 720.00
2112-A Single End	6" diameter bore, x 15" table travel	655.00
112-C Single End	8" diameter bore, x 16" table travel	1036.00
112-C Single End	8" diameter bore, x 20" table travel	1139.00
Manufacturer: **THE HEALD MACHINE COMPANY, WORCESTER, MASS.**		
45 Bore-Matic, Standard, Single End	12" diameter bore, x 16" table travel	$ 1993.00
46-B Bore-Matic, Standard, Single End	9" diameter bore, x 14" table travel	1451.00
47-A Bore-Matic, Standard, Single End	9" diameter bore, x 13-5/8" table travel	1178.00
47-A Bore-Matic, Special, Single End	9" diameter bore, x 15" table travel	1186.00
48 Bore-Matic, Single End	6" diameter bore, x 9" table travel	714.00
48-A Bore-Matic, Single End	6" diameter bore, x 12" table travel	714.00
49 Bore-Matic, Standard, Single End	6" diameter bore, x 12" table travel	1116.00
Manufacturer: **STOKER UNIT CORPORATION, MILWAUKEE, WIS.**		
Mod. 1 Horizontal Single End	4" diameter bore, x 9" table travel	354.00
Mod. 2-B Horizontal, Single End	8" diameter bore, x 15" table travel	444.00



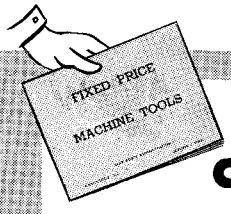
DRILL PRESS — FLOOR TYPE SINGLE OR MULTIPLE SPINDLE

(EXCEPT 110 VOLT, SINGLE PHASE)

(WAA S. C. Code 3413-21)

MODEL	SIZE AND CAPACITY	SALES PRICE
Manufacturer: **ALLEN—CHARLES C. ALLEN CO., BARRE, MASS.**		
HMD—Super Speed (Floor)	5/16" drill capacity, 16" swing, 3 spindle	$ 511.00
HMD—Super Speed (Floor)	5/16" drill capacity, 16" swing, 4 spindle	657.00
HMD—Super Speed (Floor)	5/16" drill capacity, 16" swing, 6 spindle	$ 948.00
HMD—Super Speed (Floor)	5/16" drill capacity, 24" swing, 1 spindle	229.00
HMD—Super Speed (Floor)	5/16" drill capacity, 24" swing, 2 spindle	382.00
HMD—Super Speed (Floor)	5/16" drill capacity, 24" swing, 3 spindle	535.00
2-KH (Floor)	5/8" drill capacity, 14" swing, 1 spindle	$ 177.00
2-KH (Floor)	5/8" drill capacity, 14" swing, 2 spindle	279.00
2-KH (Floor)	5/8" drill capacity, 14" swing, 3 spindle	381.00
2-KH (Floor)	5/8" drill capacity, 14" swing, 4 spindle	483.00
2-KH (Floor)	5/8" drill capacity, 14" swing, 6 spindle	687.00
2-KH (Floor)	5/8" drill capacity, 24" swing, 1 spindle	$ 185.00
2-KH (Floor)	5/8" drill capacity, 24" swing, 2 spindle	295.00
2-KH (Floor)	5/8" drill capacity, 24" swing, 3 spindle	394.00
2-KH (Floor)	5/8" drill capacity, 24" swing, 4 spindle	513.00
2-KH (Floor)	5/8" drill capacity, 24" swing, 6 spindle	732.00
2-MSV (Floor)	7/8" drill capacity, 16" swing, 1 spindle	$ 240.00
2-MS (Floor)	7/8" drill capacity, 16" swing, 2 spindle	449.00
2-MS (Floor)	7/8" drill capacity, 24" swing, 2 spindle	469.00
2-MS (Floor)	7/8" drill capacity, 24" swing, 4 spindle	910.00
2-MS (Floor)	7/8" drill capacity, 30" swing, 3 spindle	718.00
2-V Belted (Floor)	7/8" drill capacity, 16" swing, 1 spindle	$ 184.00
2-V Belted (Floor)	7/8" drill capacity, 16" swing, 2 spindle	266.00
2-V Belted (Floor)	7/8" drill capacity, 16" swing, 4 spindle	440.00
2-V Belted (Floor)	7/8" drill capacity, 24" swing, 3 spindle	382.00
2-V Belted (Floor)	7/8" drill capacity, 30" swing, 1 spindle	196.00
2-1/2 MSV (Floor)	1-1/8" drill capacity, 16" swing, 2 spindle	$ 449.00
2-1/2 MSV (Floor)	1-1/8" drill capacity, 16" swing, 4 spindle	810.00
2-1/2 MSV (Floor)	1-1/8" drill capacity, 16" swing, 6 spindle	1171.00
2-1/2 MSV (Floor)	1-1/8" drill capacity, 24" swing, 1 spindle	281.00
2-1/2 MSV (Floor)	1-1/8" drill capacity, 24" swing, 2 spindle	469.00
2-1/2 MSV (Floor)	1-1/8" drill capacity, 24" swing, 4 spindle	845.00
2-1/2 MSV (Floor)	1-1/8" drill capacity, 24" swing, 5 spindle	1033.00
3-V Belted (Floor)	1-1/4" drill capacity, 24" swing, 1 spindle	268.00
3-V Belted (Floor)	1-1/4" drill capacity, 24" swing, 2 spindle	449.00
3-V Belted (Floor)	1-1/4" drill capacity, 24" swing, 3 spindle	632.00
Manufacturer: **AVEY DRILLING MACHINE CO., CINCINNATI, OHIO**		
1-MA-6 Floor, Box Column	1/2" drill capacity, 15" swing, 1 spindle	$ 175.00
2-MA-6 Floor, Box Column	7/8" drill capacity, 15" swing, 1 spindle	243.00
2-MA-6 Floor, Box Column	7/8" drill capacity, 15" swing, 2 spindle	$ 448.00
2-MA-6 Floor, Box Column	7/8" drill capacity, 15" swing, 3 spindle	652.00
2-MA-6 Floor, Box Column	7/8" drill capacity, 15" swing, 4 spindle	856.00
2-MA-6 Floor, Box Column	7/8" drill capacity, 24" swing, 4 spindle	710.00
2-MA-6 Floor, Box Column	7/8" drill capacity, 24" swing, 5 spindle	877.00
2-MA-6 Floor, Box Column	7/8" drill capacity, 24" swing, 6 spindle	$ 1044.00
2-MA-6 Floor, Box Column	7/8" drill capacity, 30" swing, 3 spindle	729.00
No. 3 Belted, Floor, Box Column	1" drill capacity, 24" swing, 1 spindle	249.00
3-MA-6 Floor, Box Column	1-1/8" drill capacity, 24" swing, 6 spindle	2122.00
3-MA-6 Floor, Box Column	1-1/4" drill capacity, 24" swing, 1 spindle	390.00
3-MA-6 Floor, Box Column	1-1/4" drill capacity, 24" swing, 3 spindle	$ 1083.00
3-MA-6 Floor, Box Column	1-1/4" drill capacity, 24" swing, 6 spindle	2122.00
3-BMA-1 Floor, Box Column	1-1/4" drill capacity, 24" swing, 1 spindle	279.00
3-BMA-1 Floor, Box Column	1-1/4" drill capacity, 24" swing, 3 spindle	754.00
No. 3 Standard Floor, Box Column	1-1/4" drill capacity, 24" swing, 3 spindle	614.00
No. 3 Standard Floor, Box Column	1-1/4" drill capacity, 24" swing, 4 spindle	791.00
Manufacturer: **BUFFALO FORGE COMPANY, BUFFALO, N. Y.**		
Model 14 Pedestal, Box Column, "High-Speed"	1/2" drill capacity, 14" swing, 1 spindle	$ 120.00
Model 2 Floor, Box Column, "Motor Spindle"	7/8" drill capacity, 16" swing, 1 spindle	243.00
Model 2 Floor, Box Column, "Motor Spindle"	7/8" drill capacity, 26" swing, 1 spindle	266.00
Manufacturer: **CANEDY-OTTO MFG. CO., CHICAGO HEIGHTS, ILL.**		
No. 5000-FV Floor, Box Column	3/8" drill capacity, 16" swing, 1 spindle	$ 172.00
Manufacturer: **EDLUND MACHINERY CO., INC., CORTLAND, N. Y.**		
1-B-7" Floor Type	3/8" drill capacity, 14" swing, 1 spindle	$ 140.00
1-B-7" Floor Type	3/8" drill capacity, 14" swing, 2 spindle	239.00
1-B-7" Floor Type	3/8" drill capacity, 14" swing, 3 spindle	330.00
1-B-7" Floor Type	3/8" drill capacity, 14" swing, 4 spindle	391.00
1-B-7" Floor Type	3/8" drill capacity, 14" swing, 6 spindle	604.00
1-B-12" Floor Type	3/8" drill capacity, 24" swing, 1 spindle	$ 152.00
1-B-12" Floor Type	3/8" drill capacity, 24" swing, 3 spindle	348.00
1-B-12" Floor Type	3/8" drill capacity, 24" swing, 4 spindle	411.00
2-B- 8" Floor Type	3/4" drill capacity, 16" swing, 1 spindle	195.00
2-B- 8" Floor Type	3/4" drill capacity, 16" swing, 2 spindle	356.00
2-B- 8" Floor Type	3/4" drill capacity, 16" swing, 3 spindle	$ 524.00
2-B- 8" Floor Type	3/4" drill capacity, 16" swing, 4 spindle	691.00
2-B- 8" Floor Type	3/4" drill capacity, 16" swing, 6 spindle	1025.00
3-B-12" Floor Type	3/4" drill capacity, 24" swing, 1 spindle	208.00
3-B-12" Floor Type	3/4" drill capacity, 24" swing, 2 spindle	378.00
3-B-12" Floor Type	3/4" drill capacity, 24" swing, 3 spindle	$ 588.00
3-B-12" Floor Type	3/4" drill capacity, 24" swing, 4 spindle	775.00
3-B-12" Floor Type	3/4" drill capacity, 24" swing, 6 spindle	1019.00
2-MS-12" Floor Type	3/4" drill capacity, 30" swing, 2 spindle	468.00
4-B-12" Floor Type	1" drill capacity, 24" swing, 1 spindle	293.00

just look at these typical



CHECK THIS COMPLETE LIST

If tools of the type *you* need are included send today for WAA's catalog giving all sizes and models together with the fixed prices for purchases made anywhere in the U. S. Simply write, wire or phone the nearest WAA office listed on the 4th page of this advertisement.

- Boring Machine—Horizontal, Precision, Bridge Type, Single and Double End
- Chucking Machine—Automatic, Vertical, Multiple Spindle Type
- Chucking Machine—Single Spindle Automatic, Horizontal Turret Type Machine
- Chucking Machine—Six Spindle Automatic, Horizontal
- Drilling Machine or Drill Press—Bench or Floor, Single or Multiple Spindle
- Gear Cutting Machine for Straight Bevel Gears, (Not Planer Type)
- Gear Hobber—Horizontal
- Gear Hobber—Vertical, Universal
- Gear Shaper—For External Spur Gears Only
- Gear Shaper—For Spur Gears, External or Internal
- Gear Shaper—For Spur and Helical Gears, External and Internal
- Gear Tooth Shaver—For External and Internal Gears (Rotary Type Machine)
- Gear Tooth Grinder—Generating Type, for Spur and Helical Gears
- Gear Tooth Grinder—For Spur Gears, External and Internal (Formed Wheel Type Machine)
- Grinders—Centerless
- Grinder—Crank Pin Grinders
- Grinders—Plain External Cylindrical Grinder
- Grinder—Internal, Cylindrical, Automatic Sizing
- Grinder—Internal Cylindrical (Hydraulic Feed Machine)
- Grinder—Internal Cylindrical, Hydraulic Feed, for Hole and Face Grinding.
- Grinder—Surface, Rotary Table Type
- Lathe—Multiple Tool, Not Automatic, Manufacturing Type Production Lathe
- Milling Machine—Automatic and Manufacturing Knee Type
- Milling Machine—Plain Bed Type, Horizontal Spindle Machines
- Milling Machine—Vertical, Knee Type (Not Including Bench Type)
- Polishing and Buffing Machine—Bench and Floor
- Profiling Machine—Vertical, Fixed Bed Type, Single and Multiple Spindle
- Tapping Machine—Vertical, Single or Multiple Spindle
- Thread Grinding Machines
- Thread Milling Machine
- Turret Lathe—Ram Type, Plain and Universal

ALL TOOLS SUBJECT TO PRIOR SALE

Manufacturer: FOOTE-BURT COMPANY, CLEVELAND, OHIO

Mod. DE-1 Floor, Box Column	3/16" drill capacity, 14" swing, 1 spindle	$ 127.00
Mod. 2 Floor, Box Column	7/8" drill capacity, 16" swing, 1 spindle	147.00
Mod. 2 Floor, Box Column	7/8" drill capacity, 16" swing, 2 spindle	255.00
Mod. 2 Floor, Box Column	7/8" drill capacity, 16" swing, 6 spindle	$ 706.00
Mod. 2 Floor, Box Column	7/8" drill capacity, 24" swing, 1 spindle	156.00
Mod. 2 Floor, Box Column	7/8" drill capacity, 24" swing, 2 spindle	274.00
Mod. 2 Floor, Box Column	7/8" drill capacity, 24" swing, 3 spindle	$ 391.00
Mod. 2 Floor, Box Column	7/8" drill capacity, 24" swing, 4 spindle	510.00
Mod. 2 Floor, Box Column	7/8" drill capacity, 24" swing, 6 spindle	745.00
Mod. 3 Floor, Box Column	1-1/4" drill capacity, 24" swing, 1 spindle	$ 279.00

Manufacturer: THE FOSDICK MACHINE TOOL CO., CINCINNATI, OHIO

No. 4 Floor, Box Column	7/8" drill capacity, 24" swing, 1 spindle	$ 255.00
No. 4 Floor, Box Column	7/8" drill capacity, 24" swing, 3 spindle	601.00
No. 4 Floor, Box Column	7/8" drill capacity, 24" swing, 4 spindle	793.00
No. 4 B. M. Floor, Box Column	1" drill capacity, 16" swing, 1 spindle	$ 293.00
No. 4 B. M. Floor, Box Column	1" drill capacity, 16" swing, 2 spindle	293.00
No. 4 B. M. Floor, Box Column	1" drill capacity, 24" swing, 1 spindle	307.00
No. 4 B. M. Floor, Box Column	1" drill capacity, 24" swing, 4 spindle	1009.00
No. 5 B. M. Floor, Box Column	1-1/2" drill capacity, 24" swing, 1 spindle	$ 722.00
No. 5 B. M. Floor, Box Column	1-1/2" drill capacity, 24" swing, 2 spindle	790.00
No. 5 B. M. Floor, Box Column	1-1/2" drill capacity, 24" swing, 6 spindle	2219.00

IMMEDIATE DELIVERY bargains

20% (average) BELOW MARKET

Manufacturer: LELAND GIFFORD COMPANY, WORCESTER, MASS.

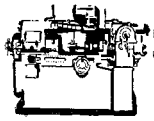
No. 1-LMS Floor, Motor Spindle	3/8" drill capacity, 12" swing, 1 spindle	$ 156.00
No. 1-LMS Floor, Motor Spindle	3/8" drill capacity, 12" swing, 2 spindle	274.00
No. 1-LMS Floor, Motor Spindle	3/8" drill capacity, 12" swing, 3 spindle	414.00
No. 1-LMS Bench, Motor Spindle	3/8" drill capacity, 20" swing, 1 spindle	147.00
No. 1-LMS Bench, Motor Spindle	3/8" drill capacity, 20" swing, 4 spindle	527.00
No. 1-LMS Floor, Motor Spindle	3/8" drill capacity, 20" swing, 1 spindle	168.00
No. 1-LMS Floor, Motor Spindle	3/8" drill capacity, 20" swing, 2 spindle	$ 308.00
No. 1-LMS Floor, Motor Spindle	3/8" drill capacity, 20" swing, 3 spindle	449.00
No. 2-LMS Floor, Motor Spindle	7/8" drill capacity, 14" swing, 1 spindle	275.00
No. 2-LMS Floor, Motor Spindle	7/8" drill capacity, 14" swing, 2 spindle	475.00
No. 2-LMS Floor, Motor Spindle	7/8" drill capacity, 14" swing, 3 spindle	691.00
No. 2-LMS Floor, Motor Spindle	7/8" drill capacity, 14" swing, 4 spindle	$ 907.00
No. 2-LMS Floor, Motor Spindle	7/8" drill capacity, 14" swing, 5 spindle	1109.00
No. 2-LMS Floor, Motor Spindle	7/8" drill capacity, 14" swing, 6 spindle	1312.00
No. 2-LMS Floor, Motor Spindle	7/8" drill capacity, 20" swing, 1 spindle	285.00
No. 2-LMS Floor, Motor Spindle	7/8" drill capacity, 20" swing, 2 spindle	491.00
No. 2-LMS Floor, Motor Spindle	7/8" drill capacity, 20" swing, 3 spindle	$ 714.00
No. 2-LMS Floor, Motor Spindle	7/8" drill capacity, 20" swing, 4 spindle	935.00
No. 2-LMS Floor, Motor Spindle	7/8" drill capacity, 20" swing, 6 spindle	1349.00
No. 2-LMS Floor, Motor Spindle	7/8" drill capacity, 26" swing, 1 spindle	297.00
No. 2-LMS Floor, Motor Spindle	7/8" drill capacity, 26" swing, 2 spindle	514.00
No. 2-LMS Floor, Motor Spindle	7/8" drill capacity, 26" swing, 3 spindle	$ 751.00
No. 2-LMS Floor, Motor Spindle	7/8" drill capacity, 26" swing, 4 spindle	984.00
No. 2-LMS Floor, Motor Spindle	7/8" drill capacity, 26" swing, 5 spindle	1206.00
No. 2-LMS Floor, Motor Spindle	7/8" drill capacity, 26" swing, 6 spindle	1426.00
No. 3-MS Floor, Motor Spindle	1" drill capacity, 24" swing, 1 spindle	$ 427.00
No. 3-MS Floor, Motor Spindle	1" drill capacity, 24" swing, 2 spindle	780.00
No. 3-MS Floor, Motor Spindle	1" drill capacity, 24" swing, 3 spindle	1154.00

Manufacturer: THE TAYLOR AND FENN COMPANY, HARTFORD, CONN.

Mod. S Floor, Box Column	3/8" drill capacity, 16" swing, 6 spindle	$ 477.00

Manufacturer: THE TOLEDO GENERAL MFG. CO., TOLEDO, OHIO

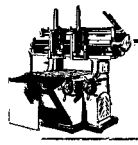
Model KTV Floor, Box Column	7/8" drill capacity, 24" swing, 4 spindle	$ 155.00



GRINDER — INTERNAL CYLINDRICAL, (HYDRAULIC FEED MACHINE)

(WAA S. C. Code 3415-23)

MODEL AND DESCRIPTION	SIZE AND CAPACITY	SALES PRICE
Manufacturer: BRYANT CHUCKING GRINDER CO., SPRINGFIELD, VT.		
Model 16-16 Internal Grinder, Hydraulic Feed	16" swing x 13" stroke	$1475.00
Model 16-22 Internal Grinder, Hydraulic Feed	22" swing x 13" stroke	1668.00
Model 16C-16 Internal Grinder, Hydraulic Feed	16" swing x 13" stroke	1647.00
Model 16F-28 Internal Grinder, Hydraulic Feed	28" swing x 13" stroke	$1766.00
Model 24-26 Internal Grinder, Hydraulic Feed	26" swing x 16" stroke	2051.00
Model 24-36 Internal Grinder, Hydraulic Feed	36" swing x 16" stroke	2427.00
Model 24L-26 Internal Grinder, Hydraulic Feed	26" swing x 24" stroke	$2589.00
Model 112M Internal Grinder, Hydraulic Feed	16" swing x 9" stroke	2292.00
Model 16-38 Internal Grinder, Gap Bed	38" swing x 9" stroke	1800.00
Manufacturer: THE HEALD MACHINE COMPANY, WORCESTER, MASS.		
Model 81 Plain Chucker, Internal Grinder, Hydraulic Feed	9" swing x 3" stroke	$1122.00
Model 72-A-3 Plain Chucker, Internal Grinder, Hydraulic Feed	11-1/2" swing x 12" stroke	1327.00
Model 72-A-5 Plain Chucker, Internal Grinder, Hydraulic Feed	11-1/2" swing x 20-5/8" str.	1415.00
Model 74 Plain Chucker, Internal Grinder, Hydraulic Feed	24" swing x 15" stroke	$1940.00
Model 172, Gap, Plain, Internal Grinder, Hydraulic Feed	36" swing x 13" stroke	1778.00



PROFILING MACHINE — VERTICAL, FIXED BED TYPE, SINGLE AND MULTIPLE SPINDLE

(WAA S. C. Code 3417-63)

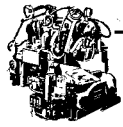
MODEL AND DESCRIPTION	SIZE	SALES PRICE
Manufacturer: THE FREW MACHINE COMPANY, PHILADELPHIA, PA.		
No. 6-A Single Spindle	24" x 36" table size	$ 793.00

Manufacturer: MOREY MACHINERY COMPANY, INC., NEW YORK, N. Y.

No. 12-M Single Spindle	23" table travel	$ 705.00
No. 12-M Two Spindle	23" table travel	742.00

Manufacturer: PRATT AND WHITNEY DIVISION, HARTFORD, CONN.

No. M-1693 Single Spindle, No. 12-B	20" table travel	$ 731.00
No. M-1693 Two Spindle, No. 12-B	20" table travel	844.00
No. M-1482 Single Spindle	32" table travel	1675.00



GEAR TOOTH GRINDER — GENERATING TYPE, FOR SPUR AND HELICAL GEARS

(WAA S. C. Code 3414-71)

MODEL AND DESCRIPTION	SIZE AND CAPACITY	SALES PRICE
Manufacturer: THE FELLOWS GEAR SHAPER CO., SPRINGFIELD, VT.		
No. 12 Spur and Helical, External only	12" pitch diameter x 1-1/2" face width	$ 1117.00
Manufacturer: PRATT AND WHITNEY DIVISION, HARTFORD, CONN.		
M-1635 Spur	10- 1/4" pitch diameter x 6" face width	$ 1791.00
M-1639 Helical	10-11/16" pitch diameter x 6" face width	2528.00
M-1679 Helical, Two Wheel	10-11/16" pitch diameter x 1-1/4" face width	3300.00
M-1838 Helical	18- 1/2" pitch diameter x 6" face width	4292.00

GOVERNMENT WAA SURPLUS

Sales to priority claimants, which include Federal Agencies, Certified Veterans, World War II, and subsequent priority claimants, will be made in proper sequence as required by law.

Exporters: Your business is solicited. If sales are conducted at various levels, you will be considered as a wholesaler. Any inquiries regarding export control should be referred to Office of International Trade, Department of Commerce, Washington, D. C.

. . . and no priorities needed

To make purchases visit any of the W.A.A. offices listed below; your regular machine tool dealer, or any W.A.A. Machine Tool Site Sale advertised in your local paper. You can arrange on the spot for immediate purchase. Remember, however, that the particular machine you want may be located elsewhere and shipping times these days are still uncertain. But you will *not* have to wait for lengthy clearances of priorities on nation-wide search of stocks. The machines *are* available for immediate sale.

W.A.A. announced last month its Important New Price Policy on 31 types of General Production Tools.

But just as a reminder here is how W.A.A.'s new price has been set for a typical machine; Model 2K Kearney and Trecker Milling Machine, vertical knee type; W.A.A. S.C. Code 3417-23-20-28.

Price (New)	$7,054.00
Previous W.A.A. Sales Price (based on depreciation primarily)	4,091.00
Average Market Value	2,556.00
New W.A.A. Sales Price	2,045.00
Available for rebuilding	511.00

GOVERNMENT WAA SURPLUS

THERE IS A
WAA REGIONAL OFFICE
NEAR YOU

(starred offices have the longest and most complete inventories of surplus machine tools—but stocks are extensive in *all* offices. Watch your newspaper for special machine tool sales in your area).

Offices located at:

Atlanta	Helena	Omaha
Birmingham	Houston	*PHILADELPHIA
*BOSTON	Jacksonville	Portland, Ore.
Charlotte	Kansas City, Mo.	Richmond
*CHICAGO	Little Rock	Salt Lake City
Cincinnati	Los Angeles	*ST. LOUIS
*CLEVELAND	Louisville	San Antonio
Dallas	Minneapolis	San Francisco
Denver	Nashville	Seattle
*DETROIT	New Orleans	Spokane
Fort Worth	*NEW YORK	Tulsa

MACHINE TOOL
SALES DIVISION

686-2

WAR ASSETS ADMINISTRATION
GOVERNMENT OWNED SURPLUS

(*Continued from page* 70.)
this same plant is working out new tooling methods, experimenting with cutting oils and with tool materials and designs, finding ways to machine steels that have been hardened by heat treating, solving plenty of other problems for the entire industry.

CO-OPERATIVE PILOTS—A maker of special oils, fiber products, and chemicals uses the pilot plants of nearby customers. This arrangement is good for both sides. It gives the maker the independent opinions of pilot-plant technical men outside of his own shop. And it gives the owners of those plants the first chances to benefit by the latest developments.

When the technical staff has a new idea the first steps are taken in the plant laboratory. Likewise, when a customer shows that he has need for an oil or other product which cannot be found in the open market the laboratory begins to look into its resources. Company sales engineers bring in ideas also. The laboratory, then, receives hundreds of ideas and requests; they come from automobile makers, rayon plants, steel heat treaters, cement mills, and every corner of industry.

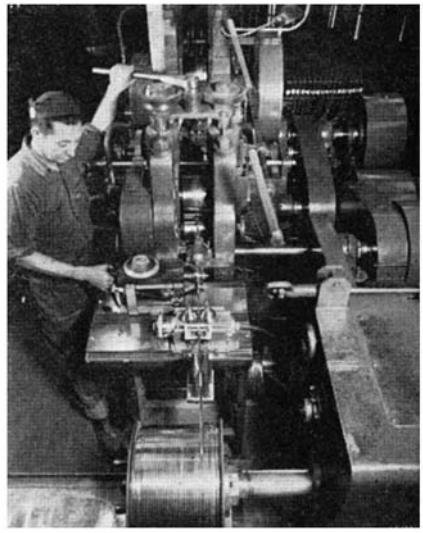
Out of these possibilities there always are a few which can be worked out immediately, and a much larger number which must either be discarded or else planned for slow development. Some experiments will be "luckier" than others with the result that the solutions of some problems are found sooner than others.

As fast as such a solution gets out of the laboratory stage it must go to a pilot plant for further study. The laboratory erects such pilot facilities as it can, but it is obvious that miniature steel mills, silk mills, paper mills, screw machine products plants, and so on can hardly be kept going side by side under the same roof.

The pilot plants of customer companies are asked to co-operate. But here another problem is found. Each pilot plant is set up to serve the production methods peculiar to its own factory. It is not designed for the broad purpose of studying the entirely different methods of competing factories.

A new product may be applicable to like problems in highly diversified industries. For example, a lubricant designed to operate at high temperatures while transmitting electric currents would find use in seam welding shops as well as in many an automatic instrument controlled chemicals industry—and the requirements of these two would be very little alike. Therefore the pilot-plant tests have to be broadened. Fortunately, the pilot-plant engineers get fun out of thinking about problems in industries other than their own, and often make discoveries profitable to their own factories in that way.

The pilot plants may show that the products need to go back to the laboratories for further study. They at least show what the product limi-



Courtesy Belden Manufacturing Company
A pilot plant first showed the best way to do this wire forming operation

tations are, and what techniques and methods must be changed when the products are applied to production lines. And, in the end, new and widely useful products are obtained.

This co-operative use of pilot plants has been fifty years in the development. It is being adopted by many companies. In the steel industry alone it recently has given the world the electropolishing process, the flame cutting of stainless steel, and the sodium hydride descaling process.

IN WELDING—Pilot-plant operations at the Lincoln Electric Company are based largely on the idea that arc welding success usually depends upon what one man can do with one electrode.

Such an operation as the arc welding of assemblies of laminations for electrical use without doing anything which will short circuit the laminations, for example, is developed in this way. The operation is engineered first, of course. But once off the drawing board the equipment is erected in an isolated part of the production floor and a highly skilled welding operator is told to run it. Slowly and carefully he develops his methods, talking them over with his supervisors and getting their suggestions as he goes, but making a great many of his own experiments.

When he has the job running at a satisfactory production rate his methods are studied and reduced to production standards. Lincoln then is ready for another announcement to the trade, another statement that a welding problem has been solved in such a way that any good welder can apply the techniques and go out and get business for itself.

Pilot-plant operations are as infinitely varied as is industry itself. One thing they have in common. Wherever they are found they are developing in months products and techniques which formerly would have been years in the study.

⊕ ⊕ ⊕

ABRASIVE BLASTERS

Separate Worn Grit
By Washing-Out Process

DUSTS will stratify in air. If the dusts are confined then their stratification can be controlled and some strata can be washed out while the desired ones are allowed to remain.

One use of this principle is for abrasive blasting machines which remove the spent and broken abrasive particles from the undamaged grains and permit the reuse of the good ones.

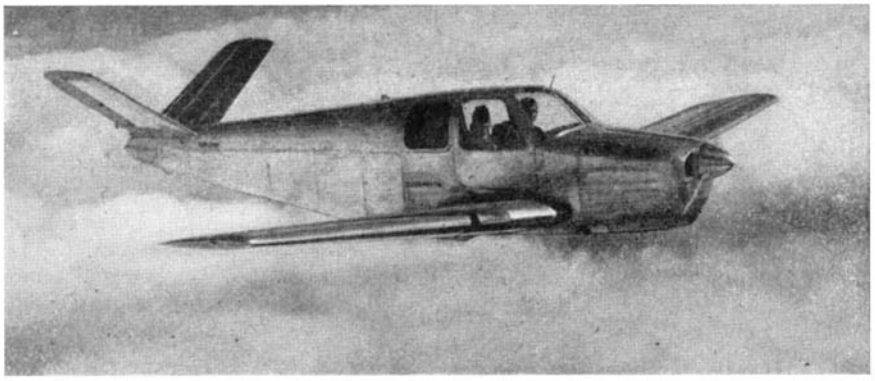
STEEL TROUBLES

Stem from Alloys
Found in Scrap

STEEL men are whispering among themselves that the "pure" carbon steels may very largely disappear from the market, with resultant troubles at metals cutting equipment and in the heat treating room.

A "pure" carbon steel, such as the widely used Number 1020, is one which contains no significant amount of any element other than iron and carbon. Such steels can be made only from pig iron and from scrap metals which do not contain other elements. Pig iron will constitute a somewhat reduced proportion of all melts as our high-grade ore sources are worked out. And as a result of the war, with its demands for high-strength alloy steels, unusually high percentages of all the scrap metals available contain significant amounts of nickel, chromium, and other nonferrous metals.

The problems which arise from this cause will be solved by sharpening the work of the metallurgical laboratory.



Clean-lined Bonanza in flight. Note V-type tail

Flying For Business

Personnel Transportation by Air Can be Achieved at Low Cost With Plane Designed for General Business Purposes. Economy, Through Time Saving, May Extend to Even Employees in the Lower Salary Brackets

MANY of the larger corporations have adopted company owned airplanes for executive use; up to the present time, however, there has been a tendency to restrict travel in these planes to the highest paid executives because of the expense of buying and operating the craft. Beech Aircraft, in bringing out the Model 35, called the Bonanza, seeks to popularize the use of the airplane for more general business purposes.

The Bonanza is a relatively small plane with room for four occupants, a range of 750 miles, and a cruising speed of 175 miles per hour. With a permanent pilot employed and a 165-horsepower Continental engine, the following cost estimate has been drawn up on a basis of 600 hours flight per year, including fuel cost, pilot pay, depreciation, maintenance, and insurance:

Total cost per hour of operation	$16.46
Total cost per passenger hour	5.49
Total cost per passenger mile	0.110
Total cost per passenger mile	0.028

If the plane were used 100 hours per month, the cost would go down to less than 1½ cents per passenger mile. Moreover, the statisticians of Beech Aircraft have made some convincing investigations of the commercial utility of the Bonanza. For example: "If a company pays an employee as much as $96 per week, then that company can better afford to send him on a trip in the Bonanza with a paid pilot than to have him take a train to his destination. When two employees travel together, their company can better afford to send them in a Bonanza rather than by the normal time-consuming surface means of transportation, even if the rate of earning is as low as $20 per week per individual."

Although this sounds rather startling, yet the calculations are apparently solidly and conservatively made. In this light, airplane transportation for salesmen would seem to be a promising field.—*A.K.*

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CARS FOR 1950

Now in Plan Stage, Have Genuine Innovations

ENGINEERS addressing a recent meeting of the Society of Automotive Engineers pictured what could happen in the design of future motor cars. Discussion subjects included cars equipped with supercharged engines, engines with extremely high compression ratios, and cars with independent wheel suspensions, hydraulic steering, and rubber torsion springs.

It was pointed out that present and prospective motor fuels offer real possibilities for high fuel economy and great power output. Gains potentially are similar, it was explained, whether superchargers or higher compression ratios are employed. Here, short, compact "V" or opposed engines of 8.5 compression ratio operating on fuels in the 100-octane range appear to be inviting, especially by way of fuel economy, which further could be enhanced by progress in designing automatic transmissions.

Exhibited and described by The B. F. Goodrich Company were "Torsilastic" springs consisting of rubber cylinders bonded internally to central shafts and externally to outer shells, either of which is held stationary and the other rotated by a wheel support arm. Front suspension of a car so equipped was disclosed to comprise single wheel-support arms mounted diagonally from the dash on the outer member of cylindrical, rubber torsion springs.

Steering was said to be accomplished by two balanced hydraulic circuits, one comprising a hydraulic tie rod between the front wheels, the other a pump circuit, with both kept under minimum positive pressure by a spring-loaded reservoir.

Rear suspension was described as of the independent, swinging-axle type, with a universal joint at each wheel. A hydraulic constant-level mechanism, applied to all four wheels, was reported to maintain the designed chassis height regardless of load or of movements of wheels and springs.

STEEL TEMPERATURE

Measured in Furnace By Water-Cooled Pyrometer

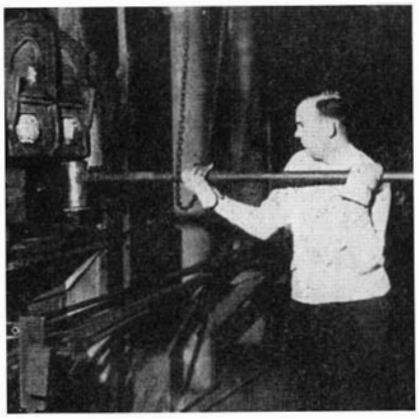
MORE uniform products of steel from the slab to the finishing processes are said to be assured by the use of a new steel surface pyrometer. This radiation-type heat recorder takes the external temperature of nearly white-hot slabs of steel as they pass in review in the heating furnace, preparatory to entrance into rolling mills.

In addition to making certain that slabs reach the prescribed temperatures in their progress to forming and fabricating operations, the new pyrometer will aid research in the design of effective furnaces, locating heat leaks and other points of inefficiency. The long-handled, mallet-like instrument, which may be operated by one man, is designed to perform successfully up to a slab surface temperature of 2400 degrees Fahrenheit.

As explained by the inventors of this instrument at the United States Steel Corporation of Delaware, the surface temperature of a furnace-hot steel slab is so great it must be measured by the radiation reaching a specially designed radiation tube

through a lens lodged inside the pyrometer's cylindrical head, the reading being transmitted by wires through the long handle to a recording potentiometer. The head itself, 8¾ inches high by about 4 inches in diameter, is water cooled. Except for the orifice containing the lens, the working surface is of polished stainless steel backed by asbestos and stands upon three squat stainless steel legs.

By means of its handle, the pyrometer is thrust through a door



Radiation head rests on heated slab

into the furnace to come to rest on its feet above the area whose temperature is sought. It is desirable that readings be taken quickly, and this can be done, it is reported, in three to five seconds when used with a high-speed recording potentiometer. Complete assembly of the radiation unit within the head was calibrated in the laboratory by using as a target a heated plate, whose temperature was measured by a platinum: platinum-rhodium thermocouple. It is believed that the accuracy of the assembled unit is about plus or minus 5 degrees, Fahrenheit, as long as the surrounding temperature of the radiation tube is kept within the range of 80 to 110 degrees, Fahrenheit.

VISIBLE INFRA-RED

Produced by Phosphor Containing Lead Key

INVISIBLE heat rays are made visible by the presence of lead in a material which glows after exposure to light, according to Dr. Gorton R. Fonda, of the General Electric Research Laboratory, and it is thought that this may help in equipment with which to see in the dark.

Waves of infra-red radiation are too long to affect the eye, while those of ultra-violet are too short. The latter, however, may be made visible by the phenomenon of fluorescence, used in the fluorescent lamp. Here, ultra-violet rays, generated inside the tube, fall on the "phosphor" with which the tube is lined, and there are changed into visible light.

Since changes of this kind must always be from shorter to longer waves, fluorescence by itself cannot make infra-red waves visible; it can only make them still longer. There is, however, an indirect way in which they can make a phosphor emit light.

Some of these materials show phosphorescence—the emission of light continues for a time after the original radiation has been removed. If, while the glow remains, the phosphor is exposed to infra-red, the brightness may be very slightly increased. After that it quickly fades out.

Dr. Fonda's research was concerned with a different type of excitation, reported originally by Franz Urbach, of the University of Rochester. Even after the original glow has faded completely, an exposure to infra-red causes emission of light. Dr. Fonda has found that the effect occurs with zinc sulfide, a common phosphor, provided it contains a fraction of a percent of lead.

With ordinary fluorescence, electrons in the atoms of which the phosphor is made are knocked out of their normal orbits and into higher states by ultra-violet rays. As they fall back to their usual position, fluorescence occurs. With phosphorescence, the electrons are delayed in their return. According to Dr. Fonda, in the kind of action he has been studying the electrons are "trapped" in a higher state, from which they are released only by infra-red rays, provided the lead "key" is present. The light given off is green in color.

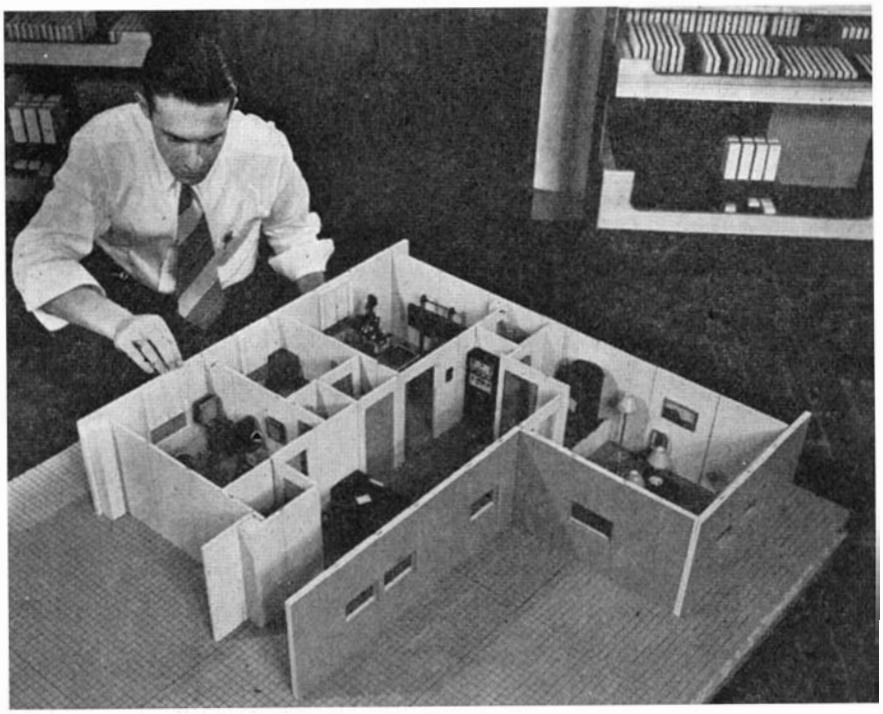
With the "sniperscope" and "snooperscope" developed during the war, vision in total darkness was possible. The subject was illuminated with infra-red, and a special electron tube combined with a telescope made the scene visible. It seems possible that similar effects could be obtained with the infra-red-sensitive phosphors.

X-RAY MODEL KIT

Permits Planning of Most Efficient Layout

COMBINING techniques of model builders and industrial architects with lessons learned in time-and-motion studies, a new system of "three-dimensional planning" has been devised to assist in rehabilitating and expanding presently inadequate X-ray facilities. The new system, to be offered first to the medical profession and under consideration for industrial X-ray users as well, eliminates the flat two-dimensional drawing or blueprint from early planning and substitutes, instead, tiny scale models of apparatus, partitions, floors, and outer walls.

The advantage of using models for this purpose is that it permits duplication of existing or proposed facilities in miniature and makes possible endless arranging and rearranging until each room and every unit of apparatus is located for best utilization of available space and maximum operating efficiency. According to the developers, Westinghouse X-Ray Division, three-dimensional



Based on a one inch to the foot scale, models aid in visualizing layout plans

planning represents a new approach to the location and use of X-ray facilities.

The planning kit resembles properties of a miniature theater with nearly 1000 individual pieces, each scaled so that one inch represents one foot of actual size. Floors—slotted to permit any wall arrangement—simulate coral tile; walls are of hospital green with tiny Venetian blinds at windows; and miniature X-ray apparatus, desks, files, and office and waiting room furniture add to overall realism.

PLASTICS MACHINE WAYS

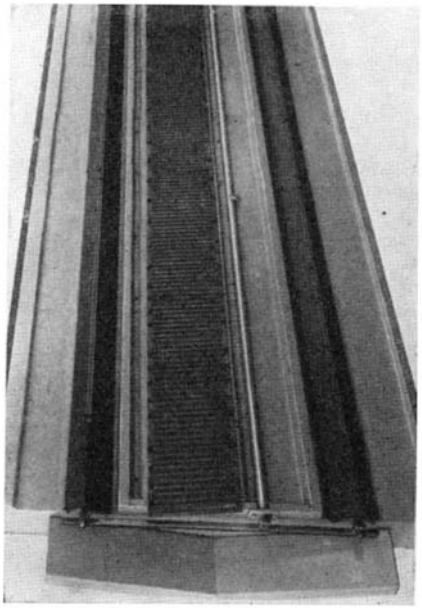
Outwear Metal, Retain Accuracy Under Heavy Use

IN THE metal-working industries, cutting, scoring, and undue wear of machine-tool ways has been an important problem for years—not only because of the constant maintenance necessary, but also because the accuracy of a machine tool depends upon the accuracy of its guiding ways. Now, it is reported that these troubles have been virtually eliminated by a new non-metallic table way developed by The G. A. Gray Company.

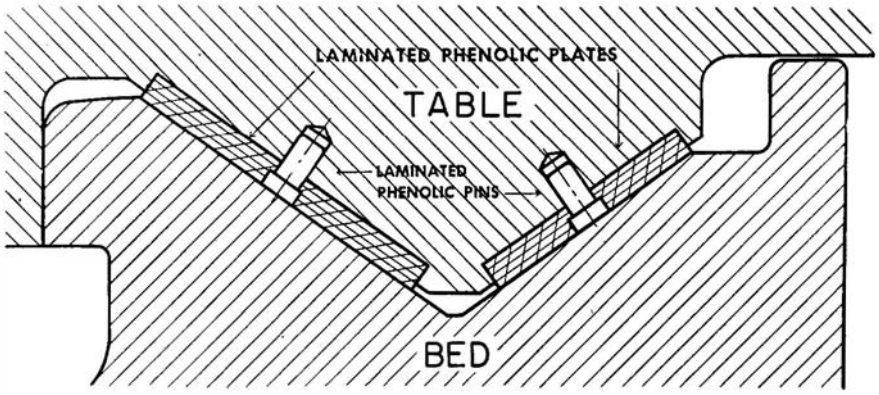
The bearing surfaces of the ways of the table consist of laminated plastics, produced by the Formica Insulation Company from fabric impregnated with phenolic resins. These plastics plates are secured to the table by laminated plastics pins. Exhaustive tests of laminated plastics in use as bearings in heavy equipment for mining and steel mills, on naval and merchant vessels, and on railroads, trucks, and buses, have shown that this material possesses excellent non-scoring and wear-resistant qualities.

Consequently, wear on the non-metallic table way is negligible and the danger of cutting and scoring is reduced to a minimum. One planer table, for example, with phenolic laminated plastics ways, was used continuously day and night for over a two-year period. Although used for the heaviest work with a normal return speed of 380 feet per minute, this particular planer showed no evidence of wear. In another test, a table with laminated-plastics ways was subjected to a load of 50 tons. Results from previous tests proved that this excessive load scored cast-iron ways in a short time but the plastics ways remained unaffected, even at high speed operation.

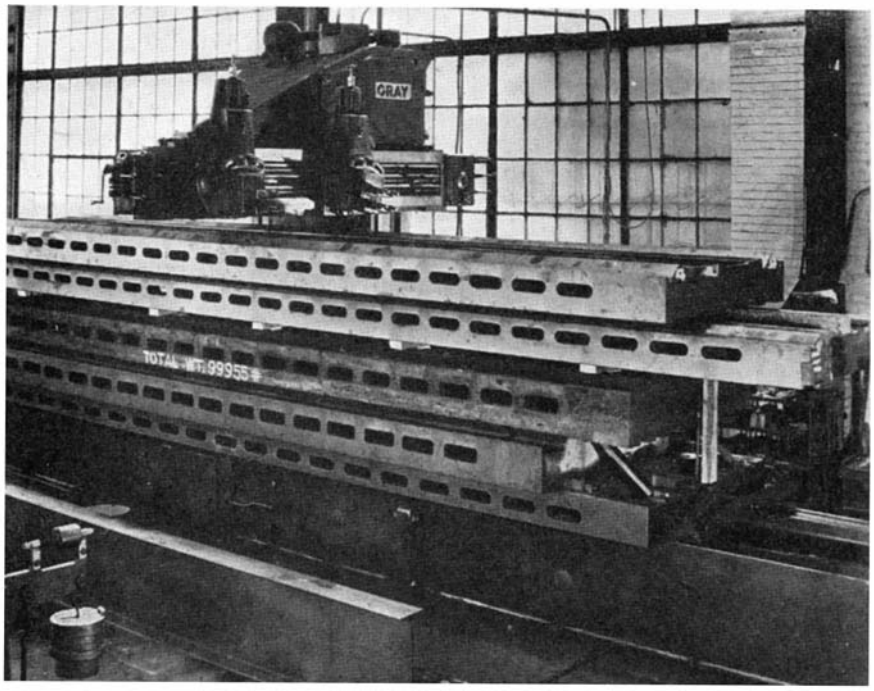
Due to the low friction of these plastics plates, and their low heat transmission, practically no heat is transmitted from the way surfaces to the metal table. Thus, accuracy of the planer work is not curtailed, and the table can be run at almost any feasible speed without danger of the table curling from the heat generated at the bearing surfaces.



Used continuously for two years, the planer (right) shows no wear. Laminated way plates retained by phenolic pins (below). Even under a 50-ton test load (bottom) ways were not worn



Illustrations courtesy Bakelite Corporation

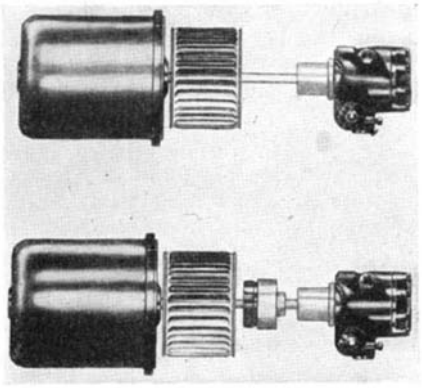


OIL-BURNER ECONOMY

Improved by Centrifugal Oil-Pump Motor Clutch

EQUIPPED with a foolproof automatic clutch which operates by centrifugal force, a new oil burner has been described as capable of saving 10 to 24 percent on fuel. Also, it promises greater cleanliness by eliminating the heavy deposits of soot which can rob oil-heating plants of considerable efficiency.

In describing the Economy Clutch, developed by the Gilbert and Barker Manufacturing Company, it was pointed out that with the operation of the conventional gun-type burner, the usual fan and fuel pump are attached directly to the motor shaft. Under this arrangement, when the thermostat calls for heat, all units—oil, air, and ignition—start up simultaneously. Thus, fuel oil reaches the combustion chamber before the fan has had enough time



Usual oil burner assembly (top). Same unit (below) with the clutch installed

to attain full speed and deliver a sufficient quantity of air to assure complete and even combustion. This poor, uneven initial combustion creates smoke and sooting of heating areas within the furnace or boiler. When the thermostat turns the unit off, smoking and sooting again take place, engineers declare.

To eliminate these conditions, the new burner's motor shaft is in two sections with the Economy Clutch separating the pump from the fan and motor. The starting of the burner motor simultaneously sets the air fan in motion. An instant later, when the fan is delivering sufficient air for complete and even combustion, the clutch goes into action and by centrifugal force engages the fuel pump. The purpose of the delayed-action operation is to guarantee an abundance of air when the fuel and air mixture is ignited, thus eliminating smoking and sooting from unburned oil.

The clutch action is reversed when the burner is turned off. The fuel pump is first to stop operating, while the fan is still rotating for several seconds after the fuel has stopped.

COOLANTS FOR CARBIDES

Seldom Needed, But Require Proper Handling When Used

THAT best results when machining with carbides are generally obtained by cutting dry, but that coolants may be needed on certain jobs where it is necessary to maintain a high degree of dimensional accuracy, was maintained by Fred W. Lucht, Development Engineer of Carboloy Company, Inc., at a recent meeting of the A.S.T.E. When used, however, coolants should be supplied in large quantities, never in "dribbles."

If a coolant is needed to prevent distortion of the workpiece, the use of a solution consisting of one part soluble oil and 30 to 40 parts of water was advocated. This variation in the proportion of water to oil is made necessary by the variations in hardness of water in various parts of the country. Also the mixture in such proportions keeps the ways of the machine tools free from rust.

It was further stated that when using this soluble-oil solution, a copious flow of the liquid should be directed towards the cut underneath the tool; or at the cut from the side of the tool where the chip flow has the least tendency to interrupt the path of the cutting fluid. An intermittent flow of the coolant—whether caused by an inadequate flow, an "umbrella" action of the chip, or any other reason—always tends to reduce tool life, it was pointed out.

Mr. Lucht added that the soluble-oil solution has given good results on all types of carbide machining operations except gun drilling. Here, experience has shown that the regular cutting fluids which are normally used for gun drilling give the longest drill life also with Carboloy drills.

RAY-TRACER OF ATOMIC FISSION

(*Continued from page 56.*)

insufficient, which often is the case, a *second* amputation will have to be performed to remove the knee. Radioactive sodium, and the Geiger counter, tell the surgeon just where he may safely amputate.

Medical circles today fairly buzz with talk of these radioactive tracers, and the work that is being done with them. From these studies a deeper understanding of the human body and its ailments is emerging. Doctors are finding out just what happens to a drug when it is injected into the bloodstream. "Tagged" with a tiny amount of a radioactive tracer, the drug can be followed to whatever part of the body absorbs it, and the amount and rate of absorption can be definitely determined. We know more about the bloodstream and its composition than ever before; more about the cell structure of living tissues; more about almost every nook and cranny of the human body, because now medical men can *watch* things happen, and need no longer guess. In a number of large hospitals where pioneer work with radioactive tracers is now in full swing, Geiger counters are already a common sight. But we are destined to see many more of them. The atomic age is upon us, and the curious little-heard-of invention of Hans Geiger is very much a part of that age.

IN INDUSTRY — Radioactive tracers have already been put to a number of industrial uses. They are uncannily successful in following the bulk movement of a gas, liquid, or solid. For example, by adding a small amount of radioactive gas and "tracking" it with a Geiger counter, engineers can follow the flow of gas through the most complex maze of pipes and reactors.

Or let us say that the engineers of a chemical firm are puzzled by the fashion in which copper disappears from a solution as it flows through a system of pipes. They want to find out exactly where the copper is being lost. A small amount of radioactive copper is added to the solution. It will travel with the normal copper and be lost in the same place. The region where the loss takes place is located by a Geiger counter, sensitive to the gamma rays emitted by radioactive copper.

In steel refining, the use of radioactive tracers simplifies the troublesome problem of frequent chemical analyses. In the past, these time-consuming analyses often delayed the process. Now, by adding radioactive phosphorus at the start of the refining process, it is possible to obtain simple and speedy analyses by radioactivity measurements.

Oil refineries have already used radioactive hydrogen as a tracer, and have obtained priceless information as to what goes on in the process of "cracking" petroleum. A broader knowledge of what occurs to the complicated hydrocarbon molecules during the cracking process may ultimately lead to amazing new developments in the petroleum industry.

The chemical industry, in large part based upon organic chemistry, should find a valuable ally in radioactive carbon. With it, chemists may discover just what happens to carbon compounds during a host of chemical reactions. Such a study is certain to result in basic advances in the field of organic chemistry, and eventually in new products from the chemical industry.

These are but a few examples of the part radioactive tracers can play in industry, just as they are playing in medicine. And, in using such tracers, the Geiger counter is indispensable.

Whatever the future brings, the Geiger counter will be used to save lives. Whether it is used in the fury of an atomic war, in hopeful, quiet laboratories and hospitals, or in industry, is up to us.

New Products and Processes

VIBRATION METER

Measures Displacement, Velocity, and Acceleration

WIDE acceptance of means of measuring vibration by electronic methods to determine the efficiency of a product or process has prompted development of a new vibration meter which accurately detects sources of wear, strain, and noise in new product development and in equipment manufacturing or

Vibration detected on production basis

test processes. Its use should help reduce rejections, prevent breakdowns, and aid in lowering production costs.

Called the Model 11-B Vibrometer, the device is an integrated, amplified vacuum-tube voltmeter with a cable-attached search prod. It registers all three types of vibration—displacement, velocity, and acceleration—on a calibrated meter scale. The Vibrometer prod is equipped with interchangeable fittings which permit numerous applications.

For field, laboratory, or production use, the instrument weighs 31 pounds and is 17 inches high, 12 inches deep, by 11½ inches wide. It operates on 105-125 volt, 50-60 cycle, current.

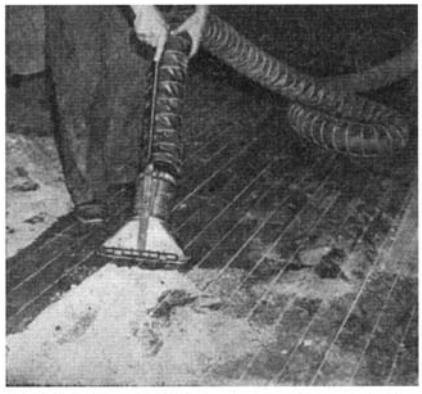
An output jack is available at the rear of the Vibrometer for use with phones, oscillograph, wave analyzer, or recording devices.

FABRIC-SPRING TUBING

Provides Light, Flexible Duct for Gases or Solids

A SIMPLE, inexpensive portable vacuum cleaning unit can be constructed by making use of the light weight and flexibility of a non-collapsible fabric tubing called Spiratube.

In one such application in the cabinet-making department of a clock manufacturer, the vacuum cleaner is used to pick up sawdust, shavings, and



Sharp turns, no crimps

chips and convey them to the main exhaust line. The flexible tube has on its discharge end a sheet-metal adapter with lugs which fit into a bayonet slot in the main exhaust line. The intake end of the tubing is clamped to a metal nozzle, on which a metal strap is bolted to serve as a handle.

Made by The Warner Brothers Company, the tubing is adaptable to a variety of semi-permanent and permanent installations for conveying air, gases, and light solids. It is self-extending and retractable. A thermoplastic-coated duck fabric is spiral-stitched around a single continuous helical spring core. The flexibility of this construction is said to permit extremely sharp turns with minimum crimping and reduction of free area. The wire-free inside channel prevents solids from collecting and obstructing flow.

DETERGENT LUBRICANTS

Reduce Wear on Marine Inboard Engines

LUBRICANTS with additive compounds completely soluble in the oil which keep engines clean by preventing undesired deposits and protect against corrosion of alloy type bearings are designed to improve performance of pleasure-craft inboard engines, both gasoline and Diesel, at reduced operating costs. They prevent rusting of the lubricated surfaces and reduce wear on cylinders and rings.

After refining from selected crude sources, the additive compound is incorporated in the oil, providing several important characteristics not obtained in straight mineral oils. The result is a lubricant which keeps new engines clean and provides a cleansing or dissolving action which reduces or removes previously formed deposits from used engines. In addition, the chemicals keep the finely divided particles resulting from fuel combustion and oil decomposition suspended in the oil so that instead of settling out in the engine they are removed at regular oil-change periods.

By promoting engine cleanliness, the new oils eliminate sticking of piston rings which causes scored cylinders or liners and wear on cylinders and rings. Maximum power output is attained with savings in fuel and lubricant consumption as well as the expense of frequent overhauling.

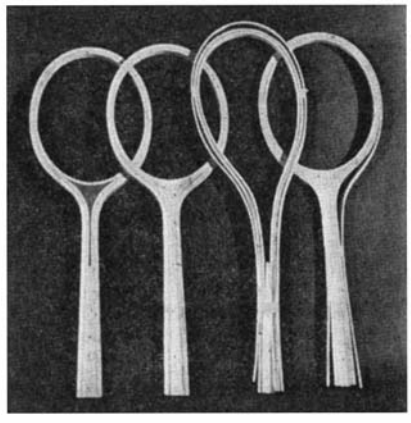
The new oils, produced by the Texas Company, meet the lubrication requirements of all gasoline inboard engines, from the small sizes with two or four cylinders to large engines of several hundred horsepower. In addition, they meet the demands of all high-speed Diesel engines in pleasure craft and many lower speed Diesels having a single lubricating system.

WATER-RESISTANT GLUE

Proves Superiority in Accelerated Tests

ANIMAL glues failed while a synthetic resin adhesive provided a perfectly satisfactory bond, when both adhesives were subjected to accelerated water resistance tests. Tennis racquet frames, which must be strong and durable, and highly resistant to deterioration from varied weathering conditions, were chosen as the medium for the test. Although tennis racquets were made from solid wood in years past, modern technique is to laminate them from thin strips of veneer in order to obtain greater strength and to prevent warping.

Either animal glue or Urac 185 can be used for the laminating operation



Racquet frames used in glue tests

inasmuch as both require little pressure and have "gap filling" characteristics, making possible the joining of parts where perfect fitting is not always feasible.

Test conditions were as follows: Synthetic resin bonded racquet (left) was soaked for 105 minutes in water at 160 degrees, Fahrenheit. There was no delamination and no discernible deterioration of the bond.

Animal glued racquet (second from right) after soaking for the same length of time at the same temperature showed complete delamination and had to be held together with tape.

The other two racquets in the picture were soaked for 24 hours in water

at room temperature with the results shown.

For such applications as the assembly of station wagon bodies, boats, sporting goods, prefabricated houses, and other uses where water resistance and permanence of bond are required, this resin adhesive has proved to be a worthwhile addition to the tools of the woodworker's craft.

LIGHT-RESISTANT BROWN

For Paint, Promises
Many Coloring Applications

BRIGHTER, cleaner, and more durable shades of brown colors for industrial enamels, trim paints, wallpaper and other coated papers, textiles, and possibly plastics are forecast in an announcement of a new pigment color under the name "Auric Brown."

The pigment—chemically hydrated ferric oxide—is characterized by an extremely small particle size, and promises outstanding resistance to light for a wide range of products. According to the Du Pont Company, it is non-bleeding in the usual paint, enamel, and lacquer finishes. Also, the new brown is expected to show less tendency to chalk from outdoor exposure than standard iron-oxide pigments.

All the possible uses of the pigment have not been explored, although it has been shown to give very fast-to-light shades on coated and other papers such as those used for wallpaper. In addition, this brown pigment is expected to find use in emulsion paints, showcard colors, and possibly plastics. Linoleum, tile, rubber, and printing inks remain to be investigated as possible fields of application.

FLOOR MACHINE

Built Low to Reach
Tight Spots, Avoids Bumping

AN EXTRA-LOW disk-type machine of new design, for floor polishing, scrubbing, steel wooling, and other maintenance, has a special side-polishing brush which cleans and polishes flush with the walls, even polishing the baseboard.

Brush cleans desk legs, baseboards

The brush, which has bristles extending beyond the circumferance of the disk and approximately two inches high, eliminates bumping and scratching furniture. It also permits fast, easy operation under crowded conditions.

The machine has been kept to an over-all height of less than 12 inches through the use of a "pancake-shaped" motor centrally mounted over the cleaning disk. This permits the machine to operate with ease in "inaccessible" places such as under desks and machinery.

Another advantage of the brushless, axial air-gap type motor is the ease of control it provides through a stabilizing "gyroscopic" action.

The floor machine, made by G. H. Tennant Company, has a handy wheel adjustment which allows it to operate in divided weight position with 50 percent of the weight on the wheels, or with the full pressure on the brush. The adjustment permits changing brush pressure to meet varied needs. Three-inch wheels swing up automatically when the handle is tilted for concentrated weight position.

Sturdily built for use on all types of floors, the machine accommodates—for rug cleaning—a steel tank which holds water and soap solution for scrubbing. The liquid feeds to the center of the brush on operation of a lever and flows uniformly through the bristles.

Other features of the machine include a positive gear drive, splash-proof protection provided by a stain-

less steel brush skirt, and an adjustable handle which moves easily to any operating height. Weight of the machine equipped for use is about 100 pounds.

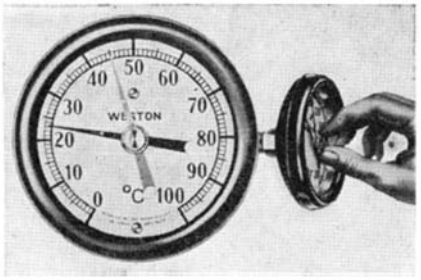
DIAL THERMOMETER

Has Manually-Set Index Pointer

INDICATING maximum or minimum temperatures reached, a new all-metal thermometer has an auxiliary red index which is manually set by a finger knob that protrudes from the center of the scale glass.

When a record of the lowest temperature reached is desired, this index is placed to the low side of the temperature pointer. The pointer will move the index to the lowest temperature reached during any operating period, and the index will remain at that low point until manually re-set. For a record of the highest temperature reached, the index is simply set at the high side of the pointer.

This new instrument, called the Max-Min, is now available in two models,



Temperatures reached are recorded

with scale diameters of three and five inches respectively. It is also available in all the usual ranges, and in stem lengths from 2½ to 48 inches.

It is claimed by the manufacturer, the Weston Electrical Instrument Corporation, that this thermometer fills the need for a low-cost device which will provide an accurate record of high or low temperatures, such as on transformers, sterilizers, ovens, chemical equipment, and so on, as well as in many processing operations throughout industry.

NEW V-BELT CONTROL

Provides Greater Speed Selection

TWO STANDARD cross-section V-belts and four variable-pitch pulleys make up a new planetary power transmission unit which provides infinite ratio, stepless speeds from full to zero and into full reverse at constant torque. Of two-horsepower capacity, a slight change in the variable-pitch pulleys of the Speed Selector brings a large change in output speed through the multiplying action of the planetary mounted on the motor or driven shaft of the machine on which it is used, eliminating need for special mounting brackets, or extra guards.

In operation, the Variable-V-Planetary Speed Selector system compares the ratios of two V-belt drives and applies the difference in speed to output

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.

shafts. With the ratios equal the difference in speed and output shaft speed is zero. If the ratio of one drive is greater than the other the output shaft rotates forward at a speed proportionate to the difference in ratios. If the ratio is less the output shaft operates in reverse in the same proportionate ratios. Speeds from 400 revolutions per minute to zero, forward and reverse, can be obtained.

All changes are made by a hand control wheel, which alters the pitch diameter of the center pulleys so that as one is increased the other is decreased and the change is imparted to the outer pulleys by the wedging action of the V-belts. The control is mounted on the input shaft of the driven machine by a tapered collet. The wheel thus controls diameter of all four pulleys without use of springs or complex linkages.

Frame construction of this Variable-V-Planetary, a development of the Speed Selector, Inc., and The B. F. Goodrich Company, is of light-weight aluminum with cast iron sheaves for long wear.

THERMIC FIRE ALARM

Offers New Safety To Farm and Industry

CONTROLLED by a network of thermostats, a new fire-protective system for homes, farms, and industrial plants warns of dangerous changes in temperature, in addition to serving as a fire-warden. The thermostats are spotted in 15 strategic locations about the property, with one control and indicator unit at a central point.

When outbreak of fire causes a critical temperature rise at any one of the "hot" thermostats, the message is transmitted to the control unit which rings a bell; switches on a red light; and designates on a meter dial the location of the trouble. The watchman or farmhand thus can render instantaneous attention, an important factor in fighting all fires.

Shows location of fire

Standard equipment includes 15 master thermostats, one for each of the locating areas on the meter, but extra auxiliary thermostats can be obtained, with virtually no limit on the number it is possible to use in the one system. Up to 300 auxiliary thermostats may be wired into a single area, each thermostat being effective for an area of 4800 cubic feet.

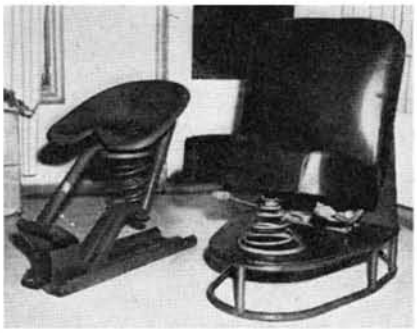
There are also "cold" thermostats which warn against dangerous drops in temperature.

A final safety feature provides that if a wire or thermostat is accidentally broken somewhere in the system, known as the Detecto-Master, the alarm bell will ring, the red light will flash and the dial-needle will register the area of damage, just as if a critical temperature change had occurred.

TRUCK SEAT

Eases Job for Long-Haul Drivers; Fits Most Cabs

COMBINING a direct, double-action hydraulic shock absorber, variable-rate coil spring to accommodate a driver of any weight, and an alloy torsion bar-steel sway bar, the entire assembly of a new truck seat is rubber mounted and guided, up and down, on friction-less bearings.



Spring adjusts for driver's weight

The truck seat is available for installation on most makes of trucks built since 1938 and on models ranging from light duty to heavy duty, cab-over-engine types, and others used as cross-country haulers, truck-trailer fleets, food trucks, oil trucks, farm trucks, and automobile carriers. The unit, made by the Monroe Auto Equipment Company, is a companion to a similar type of seat made for tractors.

MASONRY DRILLS

Use Carbide Tips, Now Cost Less

AN IMPROVED line of masonry drills now includes 15 sizes, ranging from 3/16 inch nominal diameter to 1½ inch nominal diameter—sufficient over-size allowances are provided for proper hole size required for installation of such devices as expansion shields, anchors,

and toggle bolts. The price on each drill size has been reduced some 40 percent below previous levels, and the new Carboloy drill design features a solid round shank without flutes which gives greater strength and maximum possible support to the cemented carbide cutting tip.

It is reported that the round shank actually gets dust out of the drilled holes better than the former fluted design. The drills come individually packaged, together with complete operating and service instructions. The six most commonly used sizes are available in a sturdy canvas kit, the set comprising 3/16 through 5/8 inch-nominal-diameter drills.

The Carboloy masonry drills are designed to be used in any rotary portable drill or hand brace, thereby eliminating noisy, time-consuming hammer-and-chisel work. This feature makes it possible for workmen to use the drill during business hours with a minimum of disturbance to the building occupants.

FLASHLIGHT CELL

Contains Improved "Mix," Doubles Former Capacity

A HIGH-ENERGY general purpose flashlight cell which is said to have double the capacity of its predecessors with no increase in size is based on an improved chemical mixture contained in the cell.

Each cell, of 1 1/2 volts, weighs only 3 1/3 ounces. In this limited space are packed 10,890 foot pounds of energy, according to the National Carbon Company, Inc.

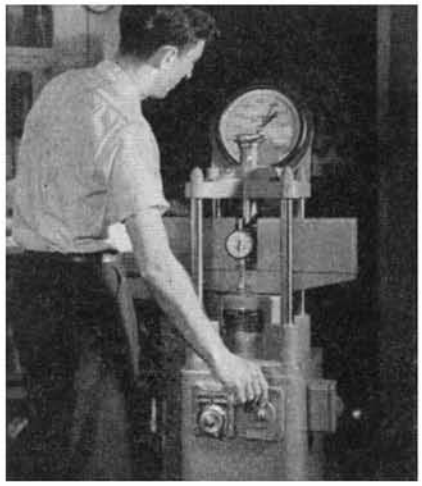
TRANSVERSE TESTER

Applies Load Automatically, Registers Breaking Point

A CAPACITY up to 10,000 pounds, hydraulic operation, and high sensitivity are features of a new transverse-testing machine with equal accuracy and efficiency on various specimens up to its full capacity.

The machine, Model TR-1, made by Steel City Testing Laboratories, is easily operated and supplied with electric-motor drive at voltages to suit available supplies. The load is applied automatically, at speeds selected by the operator.

A gage is furnished on which a maximum-indicating hand remains stationary when the specimen breaks, permitting the operator to get accurate readings even though he is not looking at the dial when the ultimate breaking point is reached. Gages may be calibrated in kilogram loads if desired.



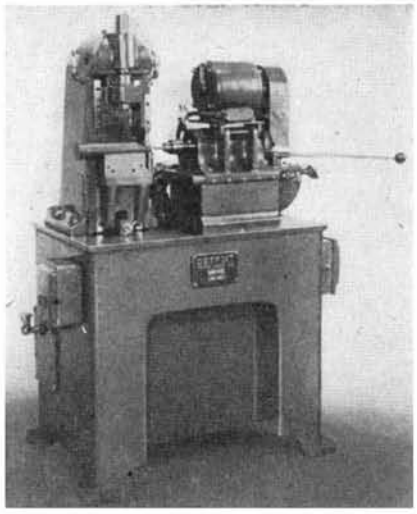
Controlled transverse loads

CENTER DRILLING TOOL

Features Automatic Centering To Simplify and Speed Production

A HIGH production center drilling machine with automatic centering and clamping is reported to be so simple in operation that a minimum of skill is required, enabling "green" operators to do concentric centering on a wide range of stock sizes. Contributing to the high productivity of the Detroit Tap and Tool Company's machine is the use of only a single lever to control all operations, including automatic positioning, clamping, and feeding the drill.

The self-centering vise automatically clamps the work in concentric alinement with the centering drill. The vise is actuated by an hydraulic cylinder, controlled by a three way valve actuated by an extension of the drill head feed lever. Two racks mating with a fixed pinion transmit opposed vertical motion of exactly equal amounts to the upper and lower V-block jaws of the vise. One of the racks is integral with the hydraulic cylinder plunger rod. True vertical alinement is maintained by mounting each of the jaws of the vise on hardened and ground adjustable ways.



Skilled operator not needed

The jaw opening for loading is adjustable to maintain minimum travel of the clamping V-blocks, thereby making the clamping of the stock practically instantaneous. The hydraulic cylinder is of special construction so as to give a "cushioned" grip on the stock.

The drill head is of the cartridge type with high precision ball bearings, and travels on hardened and ground adjustable ball bearing ways. The drill

has three speeds—1250, 2400, or 5200 revolutions per minute—obtained through a V-belt step pulley drive from the spindle drive motor. Another motor drives the gear type hydraulic pump through a flexible connection. Drilling depth is quickly adjustable.

BROACHING TOOL

Rotary in Action, Has Long Cutting Life

MADE with high spiral or helical cutting edges, a new broach, when end pressure is applied, is said to remove metal in a true shearing manner. Called a Shearcutter Rotary Broacher,

For producing true, round openings

the device is described as producing accurate holes with an excellent finish.

The cutting edge of the broach forms a circle, consequently there is no tendency to produce elliptical, bell-mouthed, or uneven holes. Savings in production costs and a cutting-edge life five to ten times longer than ordinary tools, before regrinding is necessary, are other features claimed for the tool.

GLASS-MICA PLASTICS

Formed to Variety of Shapes by New Techniques

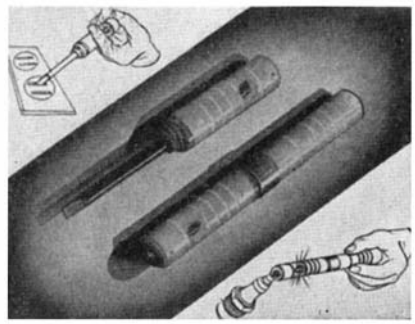
ADVANCES made in the injection-molding processes of mycalex, a ceramic-like plastics, and improved methods that have resulted in reduced tool costs, now promise to increase the material's economic practicability. Previously, the General Electric material in molded form was used almost entirely for electronic equipment because of the limited number of shapes which could be produced. Now, it is reported possible to mold the material into a much greater variety of shapes.

Suggested uses have been enlarged to include: rotating equipment, control equipment, heating devices, motor parts, welding equipment, and insulation for aeronautical ignition equipment. Mycalex is a stone-like product composed of ground mica and a special glass. It can be molded to the desired shapes with or without metal inserts by either the compression- or injection-molding processes and can be machined.

CIRCUIT TESTER

Combined with Screw Driver In Convenient Tool

ONLY one hand is needed to test house and commercial currents, appliances, electric fixtures, or automotive spark plugs with a new combination electrical testing instrument and screw driver. A neon bulb housed in the Catalin case of the tool lights up to indicate electrical current. When the cap, which also is constructed of Catalin, is unscrewed, the screw driver is exposed and made ready for use. The



Dual purpose, safe to use

tool-steel shank is covered with a plastics insulating sleeve.

In testing house and commercial current, the cap is removed and the screw driver tip placed in the socket or on the wire being tested. To test spark plugs the unit is left intact and the screw on top of the cap is touched to the plug. The glow of the neon bulb indicates a current flow. Called the Tes-L-Amp, the tool should be of aid to automobile and aircraft mechanics, electricians, and so on.

BLOWN RUBBER

Is Ideal as Refrigeration Insulator

LIGHTER than cork, and resistant to fire, rot, acids, oil, vermin, and termites, a new insulating material is available for use in refrigerators and freezing units. This material, known as cellular rubber, can be made in either hard or soft form, and is said to be more effective as an insulator than cork. It will not absorb moisture, and therefore is especially recommended for refrigerator trucks, where present insulating materials absorb hundreds of pounds of moisture, adding considerably to the gross weight of the vehicle.

Cellular rubber is made by an expanding process in which chemicals containing nitrogen are mixed into a mass of rubber. The nitrogen upon release acts as a blowing agent, producing thousands of microscopic cells, each one separated from its neighbor.

During the war cellular rubber was

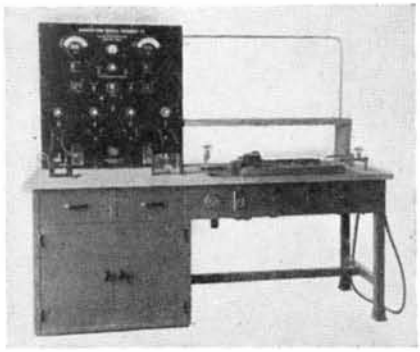
Light-weight insulating board

used in the production of light-weight domes to protect delicate radar equipment and in the wings of airplanes as supports for fuel tanks. Not until now has this product of the United States Rubber Company been available for civilian insulating purposes.

PLATING LABORATORY

In Miniature, Facilitates Control Tests

DESIGNED for either routine control of plating solutions or the most exacting research work on electroplating problems and processes, a new control table laboratory unit can plate test panels under closely controlled conditions so that the results of additions, impurity



Control table aids in close observation of electroplating operations

removal treatments, and variations in operating conditions can be observed.

The Diggin Electroplating Control Table consists of a modern laboratory table, constructed throughout of steel, with a special corrosion-resisting finish. The working surface is selected calcite-free alberene stone. On the control panel are mounted all instruments and service outlets required for electroplating tests. The current in each circuit is controlled by a stepless carbon-pile rheostat and an off-on switch. A heavy-duty switch makes it possible to connect the entire load to either generator or battery, and by flipping two toggle-switches the generator is connected to the battery for charging. An electric timer is provided for accurate timing of tests. A red pilot light is in operation during the test; when the selected time interval has expired, a green pilot light goes into operation simultaneously with a warning buzzer.

A convenience outlet is located at one side for operating motor-driven stirrers, electric hot plates, immersion heaters, and similar accessories. Two compressed air outlets with needle valves are provided for air agitation of electrolytes or for the operation of an air-driven stirrer.

INDUCTION HEAT ACCESSORY

Rotates Work Piece, Allows Immediate Quench

COMBINED in a single unit, a compact hydraulic rotary spindle and quench ring is designed for use with any type of induction heating equipment. This device simplifies the handling and heat treating of parts requiring rotation during the heating cycle and subsequent quenching while in position.

The work piece is located on a spindle which is actuated by a water-driven turbine, fed through standard hose and nozzle attachments at the base of the unit. The speed of rotation is controlled by varying the flow of water.

Portable, the combination unit can be moved from one coil to another. Wherever the operator places the unit, rubber suction cups hold it firmly in position, it is explained by the maker, the Induction Heating Corporation.

Further flexibility is achieved by interchangeable quench rings and adaptors, which are available in four sizes, 4¾, 7, 9, and 12 inches inside diameter.

Called the Ther-Monic rotary spindle and quench, the accessory through rotation of the work eliminates the necessity for precise location of the work in the coil and insures uniformity of heat treatment of such parts as gears, splines, pulleys, and similar circular pieces.

COATING MATERIAL

Supplants Vegetable Oils, Forms Tough, Rubbery Film

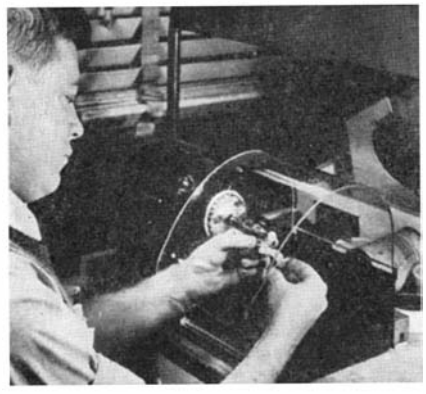
A NEW aqueous film-forming material holds special interest for the paint, paper, and textile industries. Called Dow Latex 512, it will provide an immediate source of supply to those industries who are facing short supplies of vegetable oils such as linseed.

The material is described as a combination of styrene and butadiene which when air dried forms a rubbery and tough film with excellent pigment binding properties and a high protective value. Its compatability with many aqueous emulsions or dispersions of resins, oils, varnishes, starches, waxes, casein, plasticizers, and water soluble gums and pigments is another of its important characteristics.

PLASTICS SHIELD

Guards Eyes While Permitting Recovery of Particles

TOUGH and transparent, a Plexiglas device which simultaneously protects workers' eyes from flying metal particles and provides for the efficient recovery of gold particles or "sweeps" in the production of dental appliances



Worker's eyes protected

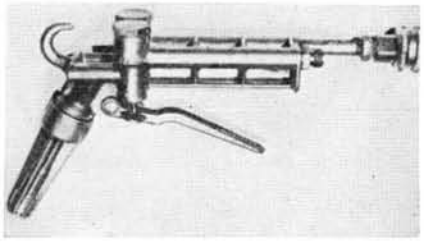
is typical of many guards now popular in industry, because they permit the operator an unobstructed view of his work.

Easily cleaned with soap and water, these transparent plastics shields are an answer to worker-protection problems in fine grinding. The shatter-resistant quality of Plexiglas combined with its light weight (one half that of glass) provides the worker with safety protection when working with fast-moving machines requiring delicate or precise operation.

AIR-WATER GUN

Speeds Cleansing of Inaccessible Parts

COMPLETELY controllable by a finger-tip lever without the necessity for valve adjustments, a new, light-weight air and water gun is designed for economical, time-saving, high-pressure



No valve adjustments needed

rinsing and removal of loosened dirt and grease from inaccessible parts of equipment and machinery. This compact gun is particularly suitable for use in all types of maintenance and repair units in the automotive and aircraft fields. It operates on regular air and water pressures and connects to standard fittings. Since there are no valves to open or close, no adjustments are required. The gun, manufactured by Turco Products, Inc., fits snugly in the hand of the operator, who merely depresses a single lever to produce a high-pressure spray.

SPRAY-WASH MACHINE

Is Rubber Lined, Carries Parts on Conveyor

INTENDED for continuous pickling and washing of any metal part requiring surface preparation for the application of enamel or other coatings or for the removal of scale, a new spray-type machine incorporates a conveyor onto which pieces are fed at the entrance to the machine and which carries them through the spraying and washing cycles. The pieces emerge acid-free and ready for the succeeding operations.

Each cleaning unit is designed individually to suit the particular manufacturing problem and is lined with rubber, according to The B. F. Goodrich Company. The machine has been used successfully for pickling cartridge cases and preparing steel hollow-ware for enameling. Advantages cited for the machine over the dip method widely used include: straight line operation; materials requiring minimum handling; and standardized production, no special

equipment being required for handling pieces of different shapes and sizes.

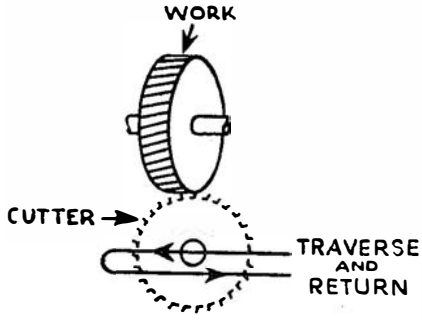
Also, it is said that the spray principle is most efficient, since under pressure it removes scale and foreign material faster and more thoroughly. Hollow-ware articles, which tend to float or develop pockets in a dip system, are cleaned completely by the spray process. In one operation, for example, time for pickling is reduced to four minutes from the 15 minutes it required in the old-type dip process.

UNDERPASS GEAR CUTTER

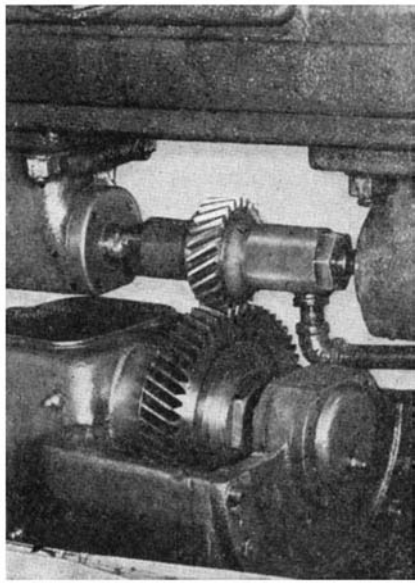
Steps Up Production, Reduces Tool Wear

AN INCREASE in output of 200 percent per gear-finishing machine—brought about by combining underpass shaving and "curve-shaving"—was recently reported by a motor-vehicle manufacturer. The gear on which comparative runs were made was a cast-iron timing gear for automobile engines, an 8-pitch, 24-tooth type with a ⅞ inch face. Stock removal is approximately .004 to .006 inch over pins.

Originally about 36 gears were turned out per hour, but the use of the underpass curve-shaver increased the output to 110 gears per hour. Operating on the principle of tangential rather than in-feed of the cutter, the machine does not use lateral cutter reciprocation. The cutter is reciprocated once tangentially to the gear while the two are rotating in mesh.



Underpass finishing method



Cuts on tangential principle

With axes of cutter and gear crossed, the cutter moves tangentially under the gear. Cutting starts on both tooth faces as well as at one end of the teeth as the cutter is moved along the tangent line towards the gear. The cut sweeps across the gear face as the cutter moves past the gear, then reverses and sweeps across the gear face to impart the desired finish to the gear teeth as the cutter returns to its original position. This shaving method is said to give a smooth, even cut and to distribute wear across the entire face width of cutter instead of concentrating wear on center of cutter, according to the Michigan Tool Company.

The cutter automatically produces the desired form without any mechanical action to change relative cutter-to-gear positions since the curve-shaving action that retains the correct involute form but thins the cross section down a few thousandths towards the ends of the teeth is built into the cutter itself.

BOTTLE LABEL GLUE

Resists Storage Moisture, Economical to Apply

DESCRIBED as a "jelly" glue, a new label-machine adhesive is reddish brown in color, odorless, and supplied in proper body making it ready-to-use in the gum pot. The jelly character of the glue provides a tough, flexible, non-crystallizing glue film that withstands considerable water immersion and resistance to the damp atmosphere of refrigerators and ice boxes. Its resistance to water makes possible its use on wet bottles, avoiding dilution of the adhesive when applied.

Called Cooler-Proof Label Machine Glue, the adhesive must be applied in a thin film to obtain maximum tackiness to hold paper labels in place on the glass. This is a distinct advantage resulting in exceptional mileage and coverage per pound. One filling of the glue pot is said to serve the average labeler on a full eight-hour shift. Returned bottles are easily cleaned of labels and glue through regular washers and soaker equipment without resorting to special cleaning compounds, according to Paisley Products, Inc., the manufacturers.

LAMINATED AIRCRAFT WING

May Prove Aid To Supersonic Flight

REPRESENTING a complete departure from contemporary wing design, an aircraft wing of laminated fiber-plastics, using cellular cellulose acetate as a core, has been successfully tested. Cellular cellulose acetate, a lighter-than-cork foamed plastics material, is bonded between skins of glass-reinforced laminates and provides a firm support for these thin, high-strength materials. The sandwich-type construction provides an extremely clean interior, entirely free of customary obstructions such as ribs and other structural bracing.

The wing, whose construction re-

quired only six structural parts, has withstood 105 percent of the required design load without any buckling or wrinkling.

The laminated cellular cellulose acetate, produced by Du Pont, has been found to be a good insulator against noise—a bane of pilots and passengers—and against heat or cold. The insulating properties were said to make the new type of construction especially worthy of consideration in the building of refrigerated freight planes.

Army Air Force engineers say the successful development of the wing demonstrates the practicability of using the new materials for the complete structure of an airplane. Higher speeds, due to the absence of rivets and bolts and the greater rigidity of the sandwich structure, are also predicted.

The plastics wing poses the possibility of finding a material which can withstand the rigors of supersonic flight better than metal. As aircraft speeds get faster and faster, the smoothness of the wing surface becomes more important, since the slightest scratch can set up violent turbulence when the verge of sonic flight is reached.

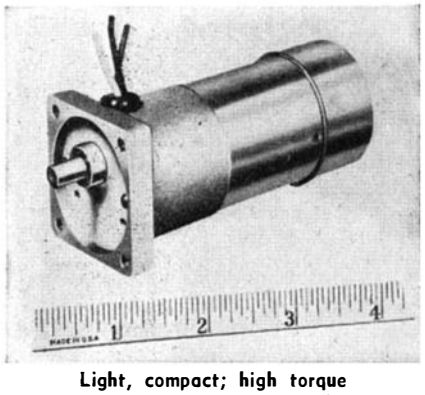
ACTUATOR MOTOR

Allows Remote Operation Of Controls and Switches

A NEW light midget rotary actuator for application in aircraft and other industries, where extreme light weight and small size are primary considerations, weighs only 0.60 pounds, and has been designed for loads ranging from 0.1 to 15.0 pound inches, and speeds from 2.5 to 375 revolutions per minute.

The Model 181 actuator incorporates the newest Lear motor of intermittent duty, split-series or single-field type, developed for either reversible or continuous rotation. It has output ratings varying from 0.4 to 15 watts at 24 volts direct current.

Because of the wide variations in applications for these rotary actuators, the maker, Lear, Inc., offers them with or without limit switches, and for multiple positioning. Where very accurate positioning is required, a brake can be provided between the motor and gear box. Also, a magnetic Diskonnect clutch can be supplied for special applications requiring a free running output shaft when the unit is not energized electrically.



Light, compact; high torque

A feature of the Model 181 is an extremely light and compact gear box, so designed that various gear ratios may be obtained with slight adjustments. Four standard gear reductions are available.

The light-weight actuator was developed for such applications as remote valve operation for fuel, oil, and air systems; tuning motors for radios; remote controls, such as operation of camera shutters, doors, and dampers of the butterfly and balanced types; business machines, computers, indexing machines, and so on.

MOISTURE-SET INKS

Are Safe, Rapid Dryers

RAPIDLY coming into use in the printing of wrappers and packages for food, candy, and tobacco is a new type of odorless, non-poisonous, and quick-drying ink.

These new inks must be wet to be dried, and consist of coloring matter held in a resin which is dissolved in a solvent, such as dipropylene or diethylene glycol. When water is added, the coloring matter drops out of solution and is deposited on the paper in a thin, hard film. If the inked paper is sprayed with steam, the ink will dry instantaneously, but the moisture in the air is sufficient to set it in 10 to 20 minutes. The new steam-set inks strengthen the paper instead of weakening it as do many other inks.

Unfortunately, the resins and solvents used in steam-set inks react harmfully with many desirable pigments, but pigment manufacturers are now said to be investigating to determine which of their products can be used.

PROTECTIVE PLASTICS

Passes Visible Light, Absorbs Infra-Red and Ultra-Violet

TRANSMITTING only visible light, a plastics material known as Infropake absorbs infra-red and ultra-violet rays. Similar in appearance to many of the regular plastics and available in several colors, it transmits approximately 84 percent visible light with practically no ultra-violet transmission and only about 15 percent infra-red transmission.

Several glass compositions are available which have similar absorbing properties, but it is reported that, with them, the relation of the transmission of visible light to the absorption of infra-red and ultra-violet rays is not as efficient as it is with the new plastics.

The uses for these plastics cover many fields in many lines of endeavor, including sport goggles, automobile windshields, and sun visors. In industry, wherever people work in the glare of lighting units that emit infra-red and ultra-violet in sufficient intensity to be harmful, industrial goggles and windows made of Infropake will fur-

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Applied with Spray Gun, Economical to Use

FOR SEALING corrugated paper cartons, a new adhesive has been developed to speed up packaging operations and lower production costs. The cement produces a permanent bond resistant to extremely high and low temperatures. It may be applied with a spray gun, thus saving time formerly required in applying adhesive materials by brush or in sealing the cartons with metal staples.

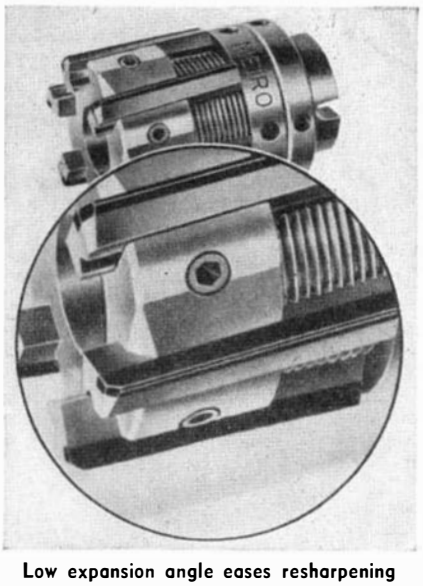
Economical to use because of the small quantity required for each carton, the product, made by United States Rubber Company, has a synthetic rubber base.

EXPANDING REAMER

Made With Carbide Blades for High-Production Use

HEAVY-DUTY, solid-shank, and shell-type expanding reamers, featuring full-length carbide cutting edges to permit precise reaming operations at high speeds, are also being made available with blades of high-speed steel.

According to the manufacturer, Metro Tool and Gage Company, the



Low expansion angle eases resharpening

reamers are designed with a low expansion angle to lessen the grinding when resharpening and have a 1/16 inch blade overhang to increase rigidity without loss of chip clearance. This permits longer reamer blade life.

Chrome plated and precision made of heat-treated alloy, the reamers are available in cutting diameters of from one to six inches. Shell arbors are furnished with straight or Morse shanks.

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.)

A CHALLENGE AND AN OPPORTUNITY, by Karl T. Compton, President, Massachusetts Institute of Technology, is a thought-provoking article contained in the Fall, 1946 issue of "The Educational Focus." The article deals with the bright future of engineering and science in industry and outlines the virtually limitless horizons. But it also points out the problems which must be solved if the future is to be as bright as it can be made. *The Editor, "The Educational Focus," 619 St. Paul Street, Rochester 2, New York.—Gratis.*

THERE REALLY IS NO MYSTERY ABOUT TURBO-BLOWERS AND ROTARY COMPRESSORS. Designed for student training, this 16-page booklet gives complete information on turbo-blowers, rotary compressors, and vacuum pumps. *Allis-Chalmers Manufacturing Company, 677, Milwaukee 1, Wisconsin.—Gratis.*

REYNOLDS ALUMINUM ALLOY SELECTOR is a slide-rule type chart designed to facilitate the selection by engineers and designers of the proper type aluminum for specific jobs. Listing the properties and characteristics of 18 commonly used alloys, this 8½ by 11 inch chart includes information on specific gravity, density, modulus of elasticity in tension and torsion, thermal and electrical conductivity, maximum forging temperatures, tempers, tensile and yield strength, and so on. *The Reynolds Metals Company, Louisville, Kentucky. —Gratis.*

FOREIGN TRADE, by Helen R. Blank. This six-page leaflet deals with the types of employment, prospects, qualifications, preparation, and so on in this field. Suggestions for further reading are included. *Occupational Index, Inc., New York University, New York 3, New York.—25 cents.*

PRECISION CASTING is the subject of a bulletin outlining the advantages of handling materials, which are difficult to machine or forge, by either the lost wax or plaster molding process. Request Bulletin 19B6451. *Allis-Chalmers Manufacturing Company, Milwaukee 1, Wisconsin.—Gratis.*

TESTING INSTRUMENTS. Six models of manually operated and portable type hardness testing machines are illustrated and described in six pages of catalog material. *Steel City Testing Laboratory, 8843 Livernois Avenue, Detroit 4, Michigan.—Gratis.*

ABOUT DU PONT NYLON. Explaining how nylon was invented, and how it is made, this booklet continues with information on how to care for nylon fabrics. A section is devoted to nylon's elasticity and resiliency, its strength and resistance to abrasion, its washability and quick-drying characteristics, and its resistance to moths and mildew. *E. I. du Pont de Nemours and Company, Promotion Section, Nylon Division, Wilmington 98, Delaware.—Gratis.*

THERM-O-TILE, THE PERMANENT CONDUIT FOR UNDERGROUND PIPE LINES. In four pages this bulletin gives a description of Therm-O-Tile and its numerous advantages. Details and specifications are also included. Request Bulletin 461. *H. W. Porter and Company, 825 Frelinghuysen Avenue, Newark 5, New Jersey.—Gratis.*

OPERATING AND MAINTENANCE MANUAL. Containing 39 pages of information and a folded chart of the circuit schematic and constants of a popular-priced oscillograph, this booklet serves as an instruction guide on the theory and operation of the cathode-ray tube and the oscillograph. *Allen B. Du Mont Laboratories, Inc., Passaic, New Jersey.—50 cents.*

"SURFACE" PREPARED ATMOSPHERE ROLLER HEARTH FURNACES. This four-page bulletin on installations for handling ferrous and nonferrous bars, tube, and strip gives complete data on the characteristics of these units. *Surface Combustion Corporation, Toledo 1, Ohio.—Gratis.*

HAVE YOU CONSIDERED OVERFIRE JETS FOR SMOKE ABATEMENT?, by William S. Major, is a reprint from the magazine "Finish," which outlines the methods and equipment requirements for effective smoke abatement through use of overfire air jets. *Technical Information Service of Bituminous Coal Research, Inc., 912 Oliver Building, Pittsburgh 22, Pennsylvania.—Gratis.*

METCO METALLIZING HANDBOOK. The fourth edition of this pocket-sized handbook, with 86 pages, contains recent data on the metallizing process itself—preparation of surfaces, application techniques, and finishing—in addition to data on corrosion resistance, specific gravity, hardness, bond strength, and tensile strength. *Metallizing Engineering Company, Inc., 38-14 30th Street, Long Island City 1, New York.—$2.00.*

THE RECORD OF RAYON CORD IN TIRES is a booklet containing information based on laboratory and road tests on cords and tires. Explaining the functions of both the cord and the tire itself, this booklet continues with analyses of tire performance and reports of large users of tires. *American Viscose Corporation, 350 Fifth Avenue, New York 1, New York.—Gratis.*

THE CHAIN HOIST OF TOMORROW, TODAY, AND YESTERDAY is a 16-page bulletin, complete with tables, illustrations, and sectional views, outlining an available line of spur geared and differential chain hoists. *Chester Hoist Company, Lisbon, Ohio.—Request this bulletin on your business letterhead.*

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.

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

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

FROM GALILEO TO THE NUCLEAR AGE

By Harvey Brace Lemon

ACCEPTING the fact that there are many students who, under the requirements of present-day college curricula, expose themselves only unwillingly to general physics courses, Dr. Lemon has designed what is truly a most amazing paradox—a light, readable, and often humorous physics text. Taking the most abstract principles, he graphically demonstrates them with homely analogies, making their practical applications in every-day experience obvious to even the most obtuse student. An interesting innovation is the use of many stereoscopic illustrations which provide three dimensional views of experiments, making them much more clear than if seen in the customary two dimensions. The book is sparked with hundreds of whimsical sketches which, combined with these other features, effectively accomplish the often difficult task of making physics attractive. (451 pages, 6½ by 9 inches, illustrated.)—$5.10 postpaid.—*N.H.U.*

HUMAN FACTORS IN AIR TRANSPORT DESIGN

By Ross A. McFarland

IN 1928 the author became interested in the effects of altitude on the mental and physical efficiency of airmen. Since that time he has been active in research in allied fields, and closely associated with aeronautical designers and manufacturers and with air transport operators and engineers. He has benefited by such work and has produced a book which will be of wide interest to men engaged in such activities. It is not a mere compilation of facts, though the facts are all there. Rather it is a reasoned, technical, yet clearly written and professional treatment of many related topics. Perhaps the best way to give an idea of the wide scope in a review which must be brief is to quote some of the chapter headings: High Altitude Operations and Pressurized Cabins; Control of Ventilation, Temperature, and Humidity; Control of Insects and Air-Borne Diseases; Carbon Monoxide; Noise in Cabins; Vibration, Acceleration, and so on; Passenger Accommodations; Prevention of Aircraft Accidents. The book concludes with some useful appendices. (670 pages, 6 by 9 inches, 146 illustrations.)—$6.10 postpaid.—*A.K.*

EMULSION TECHNOLOGY—THEORETICAL AND APPLIED

Edited by H. Bennett

SECOND EDITION of the book comprising the papers read as the second symposium on emulsions of the British Section of the International Society of Leather Trades Chemists. No date is given for this symposium. Added to the original contents is a section on Theory of Emulsions and Emulsifying Agents by George M. Sutheim and a tabulation of commercial emulsifying agents produced by American manufacturers. The information contained in the book will undoubtedly prove useful, but the whole gives the impression, even in this second edition, of having been hastily put together. (374 pages, 5½ by 9 inches, illustrated.)—$6.60 postpaid.—*D.H.K.*

THE NAVY'S AIR WAR: A Mission Completed

Edited by A. R. Buchanan, Lt. U.S.N.R.

DURING World War II, naval aviation developed new airplane types and new methods of operation, an efficient

air transport service over both oceans, coördination with surface craft in fighting the submarine, helped mightily in amphibious warfare, destroyed much of the Japanese fleet, improved catapults, and armed aircraft with powerful rockets, to mention but some of its achievements. Lt. Buchanan, with his associates, has done full justice to this fine subject. His book is not just another one of the many over-emphasized "death or glory" tales which have appeared recently, but is an accurate, readable, clear, and literate account—in some ways more exciting than semi-fictional would-be best sellers. It can be recommended to serious students of aviation and naval warfare and to members of the general public seriously interested in these aspects of World War II. (432 pages, 6 by 8½ inches, 32 pages of official photographs, and 3 maps.)—$3.60 postpaid.—*A.K.*

INDUSTRIAL ELECTRIC CONTROL

By E. S. Lincoln

FUNDAMENTALS of electric control of all types of mechanisms are here dealt with in relatively simplified yet comprehensive form. Specific equipment is discussed and examples are given for the use of each for various purposes. A complete set of definitions and standards given in the back of the book supplements the text and provides handy, compact reference material. (374 pages, 5½ by 8½ inches, over 200 illustrations.)—$3.10 postpaid.—*A.P.P.*

ORGANIC QUALITATIVE MICROANALYSIS

By Frank Schneider

DEALING primarily with the techniques and manipulations involved in identifying organic compounds, this book is a practical guide to those for whom an exposition of the theory underlying the reactions would be redundant. The author offers his technique on the basis that it will provide a working means to give chemistry students the advantages of a course in qualitative organic analysis without undue investment in equipment. A second advantage, that of time saving, is also cited by the author as obtainable by micro-methods. The time factor, he notes, is important not only because of the limitations of school time but also because of the ever-growing number of organic compounds. Sample preparation, elementary analysis, determinations of physical constants, and determinations of solubility are some of the subjects treated. Discussions of techniques are rather detailed. (218 pages, 6 by 9 inches, 135 figures, numerous tables, list of apparatus.)—$3.60 postpaid.—*E.F.L.*

INCENDIARY WARFARE

By George J. B. Fisher

BY WRITING with a wholly objective attitude, and by eliminating all but the bare facts, Colonel Fisher has created a compact text on the technique of using fire as a major instrument in a modern conflict. Discussing the science of producing, sustaining, or fighting fire, he presents facts and figures on many of the Allied and Axis raids, both incendiary and high-explosive, with a complete commentary on the whys and hows of their success or failure. There are diagrams of many of the most modern fire weapons, with descriptions of their operation, and the results they may be expected to bring. Much of the book's material has long been guarded under security regulations, and is now made available to the public for the first time. (125 pages, 5½ by 8 inches, illustrated.)—$3.10 postpaid.—*N.H.U.*

DESIGN OF REINFORCED CONCRETE STRUCTURES

By Dean Peabody, Jr.

THIS is a second edition and as such goes thoroughly into such modern matters as plastic theory, pre-stressing, beams curved in the horizontal plane, continuous frames where members have varying moments of inertia, and rigid frame bridges. It is a highly practical book of theories, tables, formulas, and illustrative problems. (532 pages, 6 by 9 inches, thoroughly illustrated.)—$5.60 postpaid.—*E.L.C.*

TERMINAL AIRPORT FINANCING AND MANAGEMENT

By Lynn L. Bollinger in co-operation with Alan Passen and Robert E. McElfresh

FOR SEVERAL years the Harvard Business School has been engaged in research dealing with the business aspects of aviation. This research has led to some remarkable publications, of which this one is the most ambitious and perhaps the most valuable and timely. Terminal airports are an indispensable element of air transportation; their charges are a vital element of air transport economies; their financing, costs, revenues, and management offer great opportunities but also great difficulties for municipalities. Professor Bollinger has covered the whole subject admirably, clearly, and impartially in Part I, Airport Financial Policy; Part II, Financial Analysis of Airport Operations; Part III, Rate-Setting Procedures for Financial Self-Sufficiency; and Part IV, Airport Management Controls. Each part is divided into a number of chapters and no topic of importance relating to the general subject has been left untouched. (385 pages.)—$4.35 postpaid.—*A.K.*

THE U.S.S.R., A GEOGRAPHICAL SURVEY

By James S. Gregory and D. W. Shave

A KNOWLEDGE of geography is essential to an understanding of history, especially the history that is being made daily in our own times and recorded in each day's newspaper headlines. Hence the great value of the present book which takes the reader behind the iron curtain barricading Russia from the rest of the world. In painstaking detail the authors

describe the geographic and ethnic features of the vast Soviet territories, comprising eight and one-half million square miles, and populated by some 190 million humans who speak more than one hundred different languages. The varied mass of useful information packed into the volume makes it a useful and timely handbook, in spite of its reliance in some places on questionable information furnished by Stalin's government. (636 pages, 5½ by 8 inches, many maps and diagrams.)—$4.35 postpaid.—*J.C.*

IF YOU MUST GAMBLE

By Maurice Lenihan

STATISTICAL safety, as practiced by insurance companies, is here applied to the age-old art of gambling—whether it be horses, dice, roulette, bridge, or whatever. While even a thorough understanding of the simple principles put forth is no guarantee that gambling can be reduced to an exact science, the lightness with which the subject matter has been handled makes this small volume interesting and enlightening reading. (127 pages, 5½ by 8 inches, illustrated.)—$2.10 postpaid.—*A.P.P.*

JANE'S ALL THE WORLD'S AIRCRAFT — 1945-1946

Compiled and edited by Leonard Bridgman

WITH the war ended, the latest edition of this book is of even greater interest than usual, containing as it does the most complete record possible of the world's progress in aviation during the war. In addition to the well-known aircraft of all nations, the majority of the war's top-secret planes, including the much discussed German rocket-propelled fighters, are presented here with photographs and specifications. The section on aircraft engines is equally complete, with considerable data on all the standard engines, including the jets and rockets. The pages on aviation history are devoted to a review of British and American air operations against Germany, summing up events leading to the complete collapse of the *Luftwaffe* in 1945. Also there is a summary of the important agreements reached by the International Civil Aviation Conference in Chicago in 1944. (709 pages, 7 by 12 inches, illustrated.)—$19.25 postpaid.—*N.H.U.*

AN INTRODUCTION TO MATHEMATICAL GENETICS

By Lancelot Hogben

MATHEMATICS in biology? Today the geneticist must swing a mean hand at calculus, since mathematical genetics is the crossroads between two sciences. These are lectures given by the author of "Mathematics for the Million" (a biologist) to enable student geneticists to interpret the abstruse literature of this new combination. They are far more mathematical than genetical. (260 pages, 6½ by 9½ inches, 17 figures.)—$5.10 postpaid.—*A.G.I.*

Telescoptics

A Monthly Department for the Amateur Telescope Maker

Conducted by ALBERT G. INGALLS

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

FOR THE amateur's first telescope a focal ratio of *f*/8 is recommended because that ratio is an optimum compromise between the long focus types best suited to study of the planets and other extended objects, such as diffuse nebulae, and the short focus types best suited to galactic star uses. The same compromise is recommended because of mirror-making reasons. Long or short focus mirrors are no place for the tyro to get first experience, each giving its own peculiar kind of extra headache, mainly having to do with the testing during the work.

For second and third telescopes the current style trend is toward the two types mentioned. First came the RFT and became well established. More recently amateurs have discovered the value of ratios like *f*/12 or *f*/15 for the planets. Experience of Robert E. Smith, D.D.S., Medico-Dental Building, Sacramento, California, with the 5″ *f*/15 shown in Figure 1 at the left compared with the 10″ *f*/8 at the right, is of pointed interest. He made the 10″ *f*/8 but with it he failed to find the canals of Mars. So he wrote Professor Clyde W. Tombaugh of the Lowell Observatory for advice and was told this: "Perhaps you have not succeeded in getting steady enough atmospheric conditions. Under very steady atmospheric conditions, I have seen the main canals around the Solis Lacus with a 5″ *f*/15 reflector at ×150, and with my 12″ *f*/12 I have seen about 15 or 20 canals.

Dr. Smith, with C. A. Fogus, respectively president and director of the Sacramento Valley Astronomical Society, set to work to build an *f*/15 and made it an 8″. This gave it a 10′ tube but the long-focus mirror wasn't itself so easy. "Don't let anyone tell you it is easy to bring a long-focus mirror to a perfect sphere," Dr. Smith shouts. "The slightest zone in a 'longie' shows up decidedly, owing to magnification, where the same zone in a short focus mirror would not be so noticeable. However, Carl E. Wells of Roseville, California, an authority on things telescopic, pronounced my mirror OK and its performance proved he was right. Not only is planetary detail wonderful but the Orion Nebula is a better sight, while definition on the moon is really out of this world. But Mars was too distant and as yet I've seen only the snow cap, no canals."

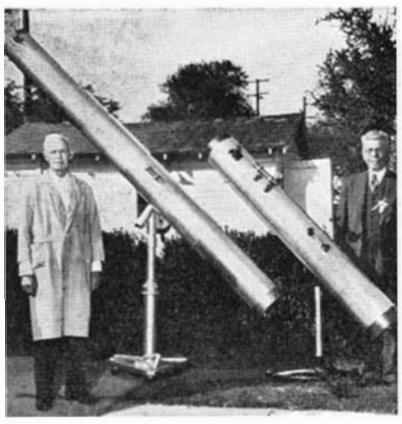


Figure 1: Fogus, f/15, f/8, Smith

Dr. Smith gives us the word "longie," so why not "shorty" also. Longies and shorties.

Professor Tombaugh also advised parabolizing the long focus mirrors if as large as 10″ in ratios like *f*/10 or *f*/12, but suggested that an 8″ *f*/15 might work well if left spherical (Parenthetically, he took the occasion to urge beginners to cold press, saying:

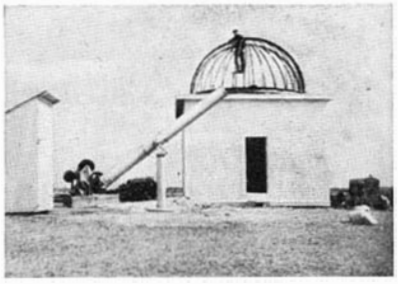


Figure 2: Milwaukee planetary f/15 and its roll-off housing

"When I learned to do this, my zone troubles practically disappeared. I always cold press with extra weight —two to three times that of the mirror for at least 15—30 minutes." "A.T.M." urges this often but the evidence is that many beginners and a few others skip it. Cold pressing is basic.)

Smith's 8″ *f*/15 seemed somehow familiar. Some other telescope, somewhere. Milwaukee! Digging down into one of our numerous towers of papers and files we come up with Figure 2, a telescope built some years ago by the Milwaukee Astronomical Society and it, too, proved, as suspected, to be an 8″ *f*/15. Twin brothers. E. A. Halbach, president of that organization, says this reflector, which they call their planetary telescope, gives much better planetary images than the larger (13″) *f*/8.3 within the dome in the background. More evidence.

This is a good occasion to publish the hitherto unpublished photographs of the unusually well built Milwaukee dome of welded steel construction. These show its detail better than many words.

Figure 3 shows the one-piece shutter and its simple track extending to the right, a piece of angle iron. No complication here.

Figure 4 details the solid dome ring of curved steel channel, with one of the rollers and a retainer. Again simple, effective. Worth copying.

Figure 5 shows in the background the framework of the shutter, which is in closed position. Extending to the left is a single straight length of angle iron acting as the track on which the

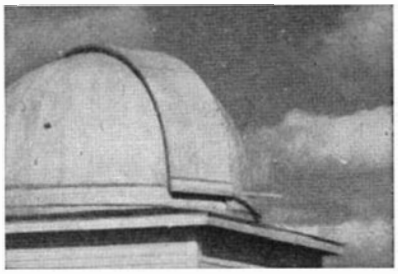


Figure 3: The shutter track

top of the shutter rolls to one side on the two rollers visible at the top. Two bent fingers of iron keep the shutter from lifting off in the wind.

Figure 6 is the bottom corner of the same shutter, with one of the two rolls running on the same angle iron track seen in Figure 3.

"The whole dome turns easily," Halbach states, "and a good wind will turn it when the shutter is open and acting as a sail."

No blueprints are available. None really needed. Study the illustrations, sketch up your own, proceed to make it.

HOUSTON'S BEAM SHIFTER is a simple auxiliary to the knife-edge as commonly used. It was devised by Walter Houston, R.F.D. 10, Box 323, Cincinnati 27, Ohio, and its purpose is to provide a kind of slow-motion control to the knife-edge, more delicate than ordinary hand control—not, however, by means of screws.

In the photograph (Figure 7) a telescope maker is shown testing a mirror.

At left is a housing for the testing lamp. The little projection on its right

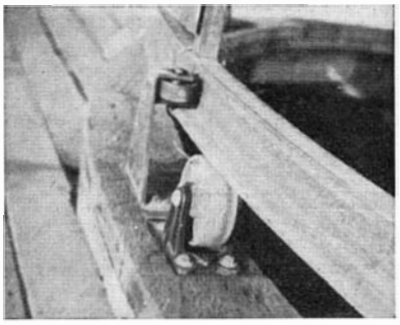


Figure 4: Steel channel dome ring

side is a right-angle prism with a slit (or could be a pinhole).

At right is the tester's hand on the base of the knife-edge.

Between the two objects just named is a loose cylindrical disk of wood. Mounted vertically on the top of this disk is a slip of plate glass—say a couple of inches or less in width and 3″ or so in height. In the half-tone these details do not show clearly but their exact shape does not matter greatly. This wood-plus-glass unit may be slid around the table at will. Its

slip of glass functions as a plane-parallel (sufficiently so for the purpose needed).

We now put it in use.

The mirror is set for the familiar Foucault test.

Then the plane-parallel is brought up and slid into the returning cone of rays and is turned so that they strike it perpendicularly.

Next, final adjustment of the knife-edge is made and the Foucault shadows are picked up—through the plane-parallel—perpendicularly.

Then the knife-edge is withdrawn a little to the user's left so that the mirror will be illuminated all over and is left there.

Finally, the plane-parallel is rotated so that the cone of rays no longer strikes it at right angles. Back come the shadows.

Here we have a delicate control. The underlying principle is simple. If a beam of light passes through a plane-parallel at normal incidence, no deviation of the beam will occur (although if it is a converging beam—and in this case it is—it will shorten the focal length about 2/3 of the thickness of the

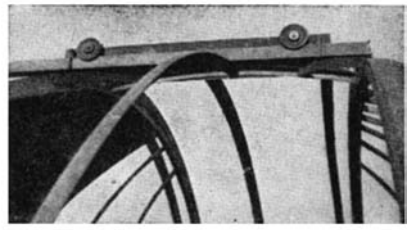


Figure 5: Shutter top on its track

glass but this is a minor effect in this test). If, however, the plane-parallel is *rotated*, so that the beam is no longer normal to its face, it then is shifted slightly—it sidesteps. It is offset a little.

Normally, in the Foucault test, we move the knife-edge into the beam. Here we move the beam into a stationary knife-edge.

"The rig," Houston reports, "works very well in testing by rolling the shadows to their crests. Its sensitivity is amazing, though it requires no delicate movements of the operator. I used it in teaching a class of beginners and some of them preferred it to the other method. It is the same principle as used in the line-shifter of the Hale spectrohelioscope. ('A.T.M.' page 196, at bottom) to bring the desired line on the slit. Advanced workers and sharks at theoretical optics will probably find in this arrangement an error of a millionth of a wavelength. Basically, the stunt is for helping tyros."

Others may like it, too.

WALKDEN'S various richest-field telescopes are designed from formulas based on several fixed fundamentals, as described in "A.T.M.A.," and one of these fundamentals is, or was, Chapman and Melotte's table of star densities. With these density data the richest RFT for refractors proved to be a 2¾" *f*/6 and for reflectors a 4" *f*/4. These are the figures in heavy type in the table on page 636 of "A.T.M.A."

But the Chapman and Melotte tables were for photographic magnitudes and more recent tables by Seares and van Rhijn are for visual magnitudes. This makes a difference in the richest RFT. Walkden has recently worked out the new data. The richest RFT for refractors now is a 5" instead of a 2¾"

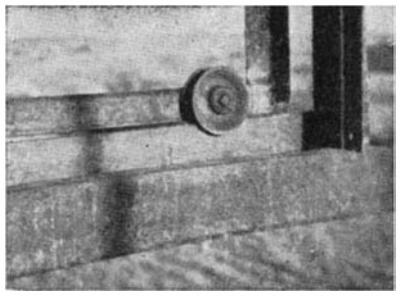


Figure 6: Shutter bottom, roller

and for reflectors it is a 7" instead of a 4".

Better fish out your "A.T.M.A." now, while you're reading this, and pencil in some new data.

Page 624, column 7, opposite 10, 11, 12, 13, 14, 15, write in: 7.85, 21.09, 55.03, 138.2, 334.5, 775.7, respectively. Column 8, for same numbers: 531, 571, 594, 593, 572, 524.

"The new maximum," Walkden writes, "is evidently at about mag. 12.4 of column 1, so a 5" instead of a 2½" RRFT is now indicated for column 3.

Now, on page 636, interpolate a new column between 6" and 8" reflectors and mark it *the* new reflector RRFT. The column: 7", 29½", 4.2, x24.5, 0.85", 1.20", 1.61", 0.40", 0.96", 1.07", 0.61", 0.45", 3.50", 1.57", 2.22", 35", 12.7", 107, 225.

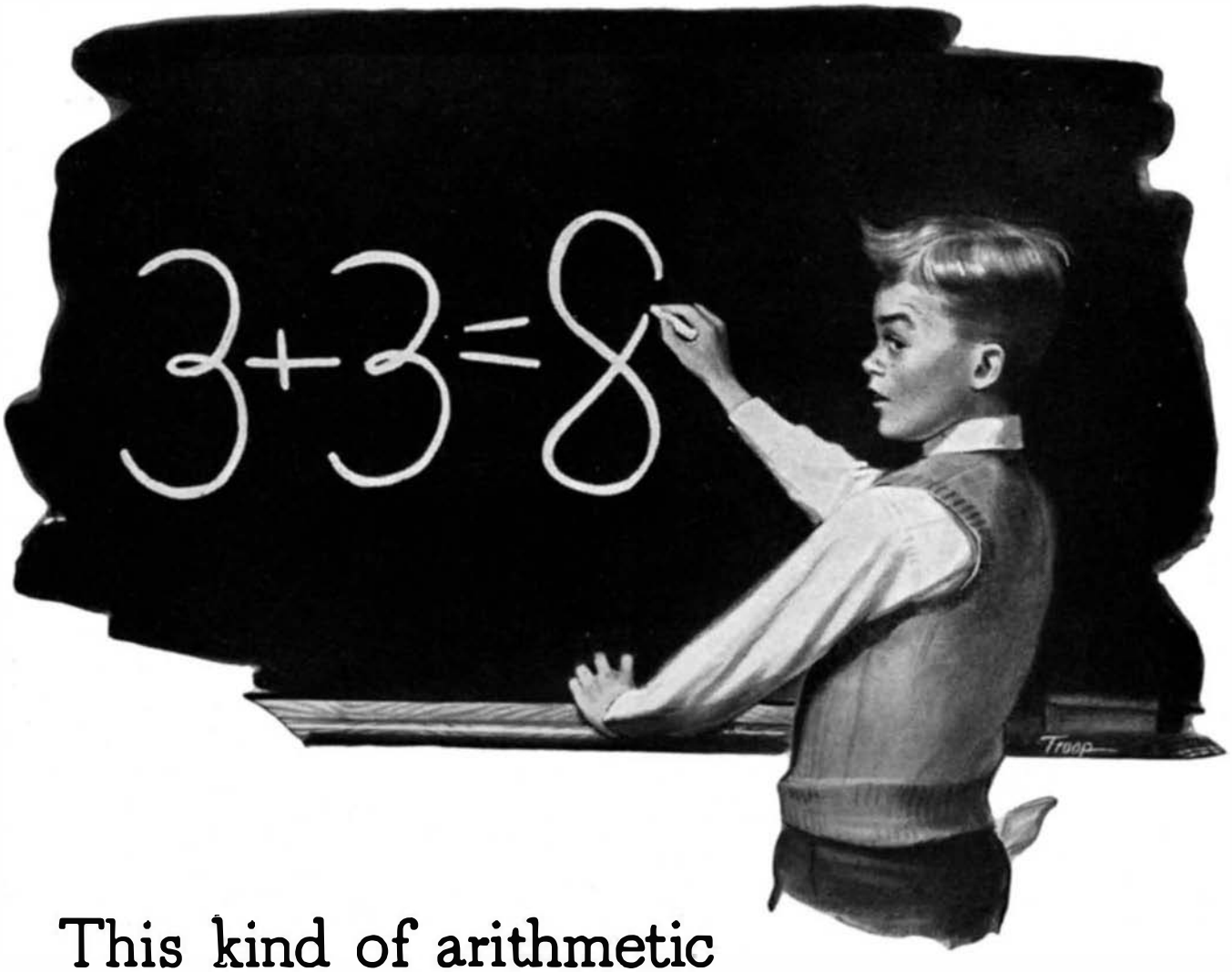
Next, in same tables, bottom line, change 244, 243, 241, 228, 215, 203, to

Figure 7: Houston's beam shifter

206, 217, 223, 224, 223, 221, respectively.

These small changes will be made in the next printing of "A.T.M.A."

Must you now toss out your present RRFT and commit suicide? A little study of the chapter, such as you probably have already made, will show that the old RRFT isn't so far off the bull's-eye as the above alterations may seem to imply. And, if making a new one, a 7" mirror blank will be unobtainable, at least in Pyrex unless you pay (plenty) to have an 8" blank ground down or trepan it yourself. However, fairly reasonable ATMs probably would settle for an 8" or a 6" RRFT as a pretty good approximation.



This kind of arithmetic may put Johnny through college

Here's how it works out:

$3 put into U. S. Savings Bonds today will bring back $4 in 10 years.

Another $3 will bring back another $4.

So it's quite right to figure that 3 plus 3 equals 8 . . . or 30 plus 30 equals 80 . . . or 300 plus 300 equals 800!

It will . . . in U. S. Savings Bonds. And those bonds may very well be the means of helping you educate your children as you'd like to have them educated.

So keep on buying Savings Bonds—available at banks and post offices. Or the way that millions have found easiest and surest—through Payroll Savings. Hold on to all you've bought.

You'll be mighty glad you did . . . 10 years from now!

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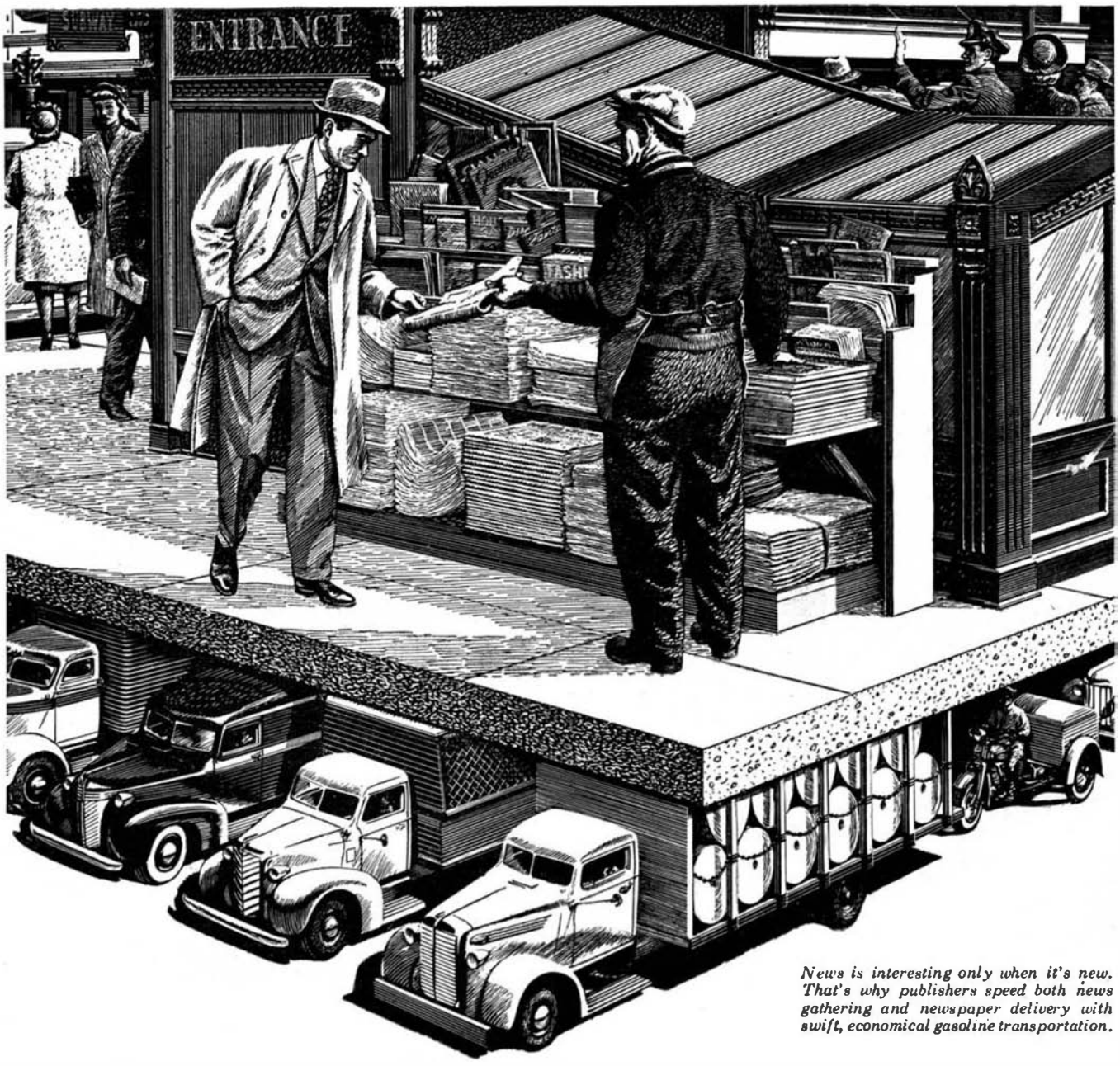

News is interesting only when it's new. That's why publishers speed both news gathering and newspaper delivery with swift, economical gasoline transportation.

News travels on gasoline

NEWS is the most perishable of all commodities. It must reach the consumer before it goes stale. That's why, at the slightest hint of a "story" about to break, reporters and photographers dash to the scene in press cars or taxicabs. And as the papers come off the press, dozens of trucks stand outside newspaper plants ready to rush the latest editions to your local newsstand.

The newspaper industry leans heavily on gasoline transportation, too, in the carrying of raw materials—newsprint, ink, printing plates of various kinds, and equipment. Thus, in a country that boasts 14,237 newspapers, everybody benefits from improvements in gasoline transportation.

Such improvements have come often. During the past twenty years the petroleum industry has developed many new refining processes and has made use of Ethyl brand antiknock compound to improve gasoline. Better gasoline, in turn, opened new opportunities for improving automotive engines—smoothed the way for designing more efficient, more economical cars and trucks.

As present "reconversion" difficulties are overcome the refining industry looks forward to gasoline of even higher quality. The automotive industry expects to make engines that are still more advanced in design. And Ethyl research engineers are already cooperating with both these industries in solving the technical problems that arise. Ethyl Corporation, Chrysler Building, New York 17, New York.

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