Scientific American

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"Tin Fish" in Mass Production . . . See Page 194

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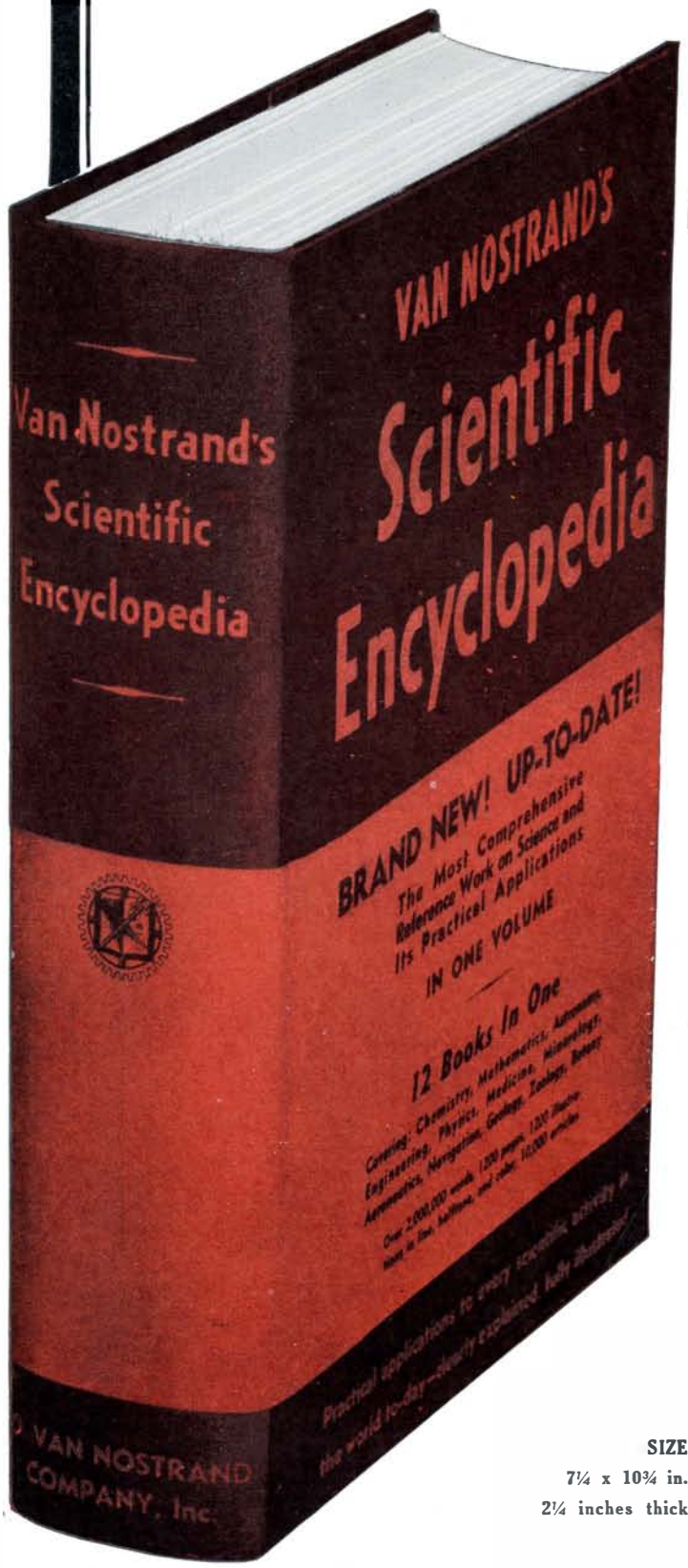

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Scientific American

Founded 1845

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COVER: In the airborne-type torpedoes, shown in our front cover illustration, there are 75 different pressed metal parts, totaling several hundred pieces, in each. (See also article dealing with methods of producing pressed metals, starting on page 208.) The photograph was taken in one of the plants of the American Can Company where these "tin-fish" are being turned out under mass production conditions. The torpedoes are shown, ready for shipment, minus their explosive war heads, which are shipped and loaded separately.

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Previews of the Industrial Horizon

A. P. Peck

INDUSTRY'S JOB TOMORROW

ADDED emphasis to the now wide-spread realization that industry's future as the guiding force of the American way of life depends on how well it plans for the days immediately following the end of the war is given by a governmental report recently released by the Labor Department's Bureau of Statistics. In this well documented report, where main emphasis is placed upon employment in post-war times, a statement is made to the effect that industry's part will call for real courage and intelligence.

Surely industry in general has shown "real courage and intelligence" in the race of production, in adapting itself, its men and materials, to a gigantic war program such as has never before been faced in history. It has shown its ability to develop and use new ideas, new methods, new products, and to do this with a speed that has today succeeded in making much brighter the picture of the war's progress.

If, when post-war times arrive, the same initiative is applied to building a new and better world on the basis of past failures and successes, there can be no question of the outcome. But this initiative can be applied only if the attitude of government toward industry is one which shows plainly and without reservation a belief in the honesty of private enterprise. Without such belief, industry's efforts will be severely handicapped.

MORE ABOUT RECONVERSION

ONE OF the dangers of words is that they sometimes are too limited in scope. Much is being said these days about reconversion of industry; "reconversion" is one of those limited words. Strictly speaking, reconversion would indicate aiming at pre-war levels of production when the whole thinking trend of the present should be in terms of post-war expansion.

On the horizon are days when a pent-up flood of buying will be released, when savings of millions will be poured into markets now closed by war-production requirements, when men now in the armed forces will be readjusting themselves to civilian life. Such days call for a raising of industry's sights, for post-war planning that is much more than mere reconversion, for production in many fields on a scale that before the war would have been in the realm of the unthinkable.

When this great expansion period starts, it is safe to predict that industry will be well on the way to keep its faith with the people of the world. The contributions of science and technology will be available for civilian use and will be turned into the channels of trade just as rapidly as possible, subject only to such possible handicaps as are mentioned in the preceding item.

CONSERVATIVE THINKING

LEST SOME of the foregoing be interpreted as meaning that the day after the end of the war will see production start on helicopters and airplanes for every garage, high-octane gas in every filling station, fantastic automobiles that glide along the highways at a hundred miles an hour, robot kitchens where a turn of a knob will cook a ten-course meal and then wash the dishes without human intervention, and other similar dreams so dear to the heart of the Sunday supplements, a few words of conservatism should be added to the views expressed.

Reconversion and expansion must go hand in hand. Industry must plan its operations so that it can, with the least possible delay, start civilian production. This will mean that many of the things obtainable before the war and not available now will be the first to reappear in the markets. Then, but gradually, will come the new products—the new automobiles, the airplanes, the home comforts, the new building materials, the hundred-and-one other looked-for developments.

Viewed as a whole, the picture on the horizon is a composite one in which the production of the old and the new will progress side by side, supplementing each other and welding themselves firmly into the necessary expansion program which will spell economic security assured by industrial and technological coördination.

LIGHTER THAN AIR

WILL some part of the air-borne cargo of the future be carried in lighter-than-air ships similar to the ill-fated *Hindenburg* of a few years ago, or even greater in size and capacity? Some basis for an affirmative answer to this question is to be found in the successful use of blimps by the United States Navy during the present war. These ships of the air have been highly successful in the work to which they have been put, carrying out their missions in fair weather and foul, often under conditions when heavier-than-air ships were grounded.

The *Hindenburg*, it will be remembered, was a victim of inflammable hydrogen; helium, it will likewise be remembered, is available in commercial amounts only in the United States and is the lifting gas that spells safety for airships.

With our supplies of helium and with the knowledge that has been gained through the construction and operation of many Goodyear blimps during the past two years, it is entirely conceivable that large, rigid airships will someday become an integral part of our air transport system. Slower than planes, unwieldly though they appear, they have advantages over the swifter craft in payload and in the fact that they do not depend upon their motion through the air for lifting power.

Dirigibles have military uses as well as commercial, and it is entirely possible that we may yet see, during this war, the launching of one or more giants of the air. If this comes to pass, keep an eye on lighter-than-air development for passenger and cargo transportation in the future.

HEAVIER THAN AIR

BEFORE leaving the subject of aerial travel for this month, reference should be made to the article on future private planes, page 199 of this issue. Last month's Horizon Preview of this subject sounded a note of conservatism that still stands, yet becomes even more thought-provoking in light of Dr. Klemin's thorough analysis of the present and of the possible future. Without doubt, the aviation industry is going to do all in its power to make reasonably priced planes, with a maximum of safety, available to all those who would fly the skyways of the world.

THE SERVANT IN A WIRE

RADIANT heat lamps for home heating, increased use of fluorescent lamps for better seeing, plant growth stimulated by artificial light, improved electric home appliances — these are some of the things to come that will make for tremendously increased demands for electric power in the future. So states Samuel G. Hibben, director of applied lighting at Westinghouse. Basing his statements on war-time uses of

(*Please turn to page* 231)

50 Years Ago in . . .

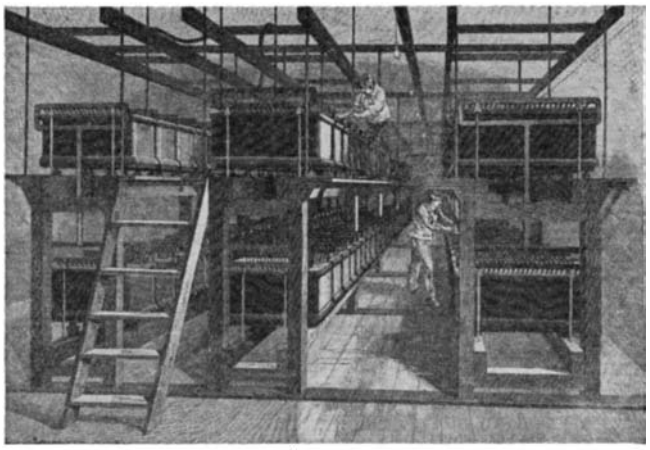
SCIENTIFIC AMERICAN

(Condensed from Issues of November, 1893)

UNIVERSAL LANGUAGE — "Attempts to introduce artificial languages are not only hopeless, but they are unnecessary, for, says Dr. Schroer, there is already a universal language, and that is English. But in what sense is English a universal language? It is, says Dr. Schroer . . . in the Preussische Jahrbuecher . . . one, which, by its spread over the whole earth and by the ease with which it may be learned, has reached a position so far in advance of all others that neither natural nor artificial means can deprive it of its assured position as the future means of international intercourse. He therefore concludes that 'the English language is the world-speech, and will, to all appearance, become more and more so every year.' "

BRAKES — "A Rochester man has devised a plan by which a trolley street car can be stopped almost instantaneously, or within a space of three feet, while the car is going at full speed. As he omits, however . . . to provide for stopping the passengers, it is only fair to presume they will object."

STORAGE BATTERY — "Recently the [Plante storage battery] system was introduced into this country by the Edison Illuminating Company, at the 53rd Street central station,



Storage battery plant of the Edison Illuminating Company

where it is daily used to help out the dynamos when the demand for current is very great. It is also used for supplying current when the engines and dynamos are at rest. The charging is done when the dynamos would otherwise be running with a light load. This station is provided with two batteries, each consisting of a series of 70 cells of 61 plates each . . . Each cell has a capacity of 1.000 ampere hours."

ARTIFICIAL DIAMONDS — "At the Academy of Sciences, M. Moissan announced recently that, in continuing his researches on the synthesis of the diamond by means of the electric furnace, he has just obtained two compounds well worthy of attention. These bodies are silicide of carbon and boride of carbon. They are of excessive hardness, and cut rubies, steel or diamonds."

TELESCOPE — "A great refractor is just finished and placed in position for Dr. Janssen at Meudon. It is a combined photographic and visual telescope. The two lenses were made by the celebrated Henry Brothers, of the Paris Observatory. The mounting is by Gauthier, of Paris. Both lenses will be mounted in the same tube, which is square and of steel. The visual objective is 82 cm. (32.3 English inches) in diameter, while the photographic objective is 63 cm. (24.8 English inches) diameter. Both lenses are of the same focal length, 17 meters (669 English inches) . . . The dome is to be moved by a gas engine of 12 horse power."

CIRCLE OF CONFUSION — "If any point in an object is represented by a disk about 1/100 of an inch in diameter, it is sharp to the eye. If, therefore, all movement of the object can in the image be confined to this amount, it will appear sharp. Now, with a hand camera, the focus of the lens is usually about 5½ inches—let us say 6 inches. At 50 feet off, therefore, an object may move through 1 inch and still appear sharp—that is, the motion during the time of exposure may be that amount."

FROZEN FISH — "Science has conquered nature and has demonstrated that to preserve fish it is not necessary to salt them. Freezing is the thing in the future, and Sandusky, Ohio, is the place where the first attempt has been made to carry on the business in a general way . . . About three years ago A. J. Stoll, a fish commission dealer in Sandusky, began to experiment with freezing fish, and soon found that the invention of the ice-making machine would be his salvation. Last year he completed his scheme and now he has a plant in full operation, employing twenty-five men and a capacity for freezing and preserving twenty tons of fresh fish each year."

ALUMINUM — "The Aluminum-Industrie-Actien-Gesellschaft, of Neuhausen, in Switzerland, owing to the increase of its dynamo capacity to 4,000 horse power, and some improvements in the processes employed enabling it to increase largely the production of aluminum, announces that the price from January next will be 45 cents per pound . . . At present, 75 cents a pound is the ruling price for aluminum."

COPPER — "At the time of the discovery of America, copper was used by the North American Indians only as a precious metal and for ornamental purposes, and had not reached the stage of industrial use, as it had among the Aztecs in Mexico. There is, moreover no evidence to show that the Northern Indians had any knowledge of ore working or smelting, and it is almost certain that all the copper they possessed was found in the metallic or native state."

LONG DISTANCE — "The American Telephone and Telegraph Company recently gave an exhibition of their long-distance telephone lines to a small party of guests who assembled at the Telephone Building in Cortandt Street . . . A number of receivers were arranged so as to give each party a connection to the line. Connection was made with Boston, Chicago, and Washington in turn, and conversations were held with the officers at those points."

SOAP — "Washing powders or soap powders, which have latterly become important artices of commerce, always contain sodium carbonate, generally in the form of dried soda crystals."

WILLOWS — "A new industry has been established in St. Louis county near the little town of Allenton . . . which, if successful, will furnish employment to thousands of unemployed laborers. The enterprise is for the cultivation, on a large scale, of willows suitable for the manufacture of willow ware . . . The willow plants last about twelve years, after which they are grubbed up and the ground replanted. The plant does not attain its full growth until the second year, as the greatest part of its energy is spent the first year in making roots."

OIL VERSUS COAL — "Mr. Stone Burbury, of Cowes, Isle of Wight, owner of the yacht Venture, which was fitted with steam machinery, had this removed and replaced with an oil engine, made by Messrs. Vosper & Co., of Portsmouth. The vessel would not before steam against the strong tides in the Solent, but does so now with ease; she could also only conveniently carry sufficient coal for six hours, but is now fitted for running forty-eight hours."

RAINBOW IN THE SKY

There is good news in the work of American laboratories. It is a reason for confidence in the war and a promise for the future.

Little is said about our scientists because they labor behind locked doors and their work is secret. But the topside of the German and Japanese armies and navies know about them. Things they do turn up at the front and make life harder for our enemies.

After the war, from these same scientists and their laboratories, will come the things that make jobs, comforts, conveniences and luxuries for the American people. They hold out prospects for good use of the opportunities victory will bring.

The Bell Telephone Laboratories, with some seven thousand workers, are among the many research groups that are devoted to winning the war.

When that is done, Bell System scientists will be back on their old job of making your telephone service, and your human contacts over the distances, easier and better than ever.

BELL TELEPHONE SYSTEM

• HELP THE WAR BY MAKING ONLY VITAL CALLS TO WAR-BUSY CENTERS. THAT'S MORE AND MORE ESSENTIAL EVERY DAY.

An Important Message to

Technical Men

The war has carried the manufacturing age to a new peak! Production demands have created technical problems the like of which the world has never seen before! The services of engineers are at a premium. Especially the services of one particular class—executive engineers—*engineers with business training;* engineers who can "run the show."

In these critical times, the nation needs engineers of executive ability *now, today*—not five, or ten years from now! The shortage of such men is acute—even more acute than that of skilled production workers. And company heads, aware of this situation, are offering high rewards to engineers who have the necessary training in industrial management.

Golden Opportunity for Engineers

In this new era, the engineer with vision and foresight has a golden opportunity. He will realize that out of today's tremendous production battles will emerge technical men who not only will play a major role in winning the war, but who also will be firmly entrenched in key executive positions when peace comes.

However, before the engineer can take over executive responsibilities, he must acquire knowledge of the other divisions of business—of marketing, accounting and finance. He has of necessity a vast amount of technical training and experience. But in order to grasp the opportunities that present themselves today—to assume leadership on the production front—he must *also* have an understanding of practical business principles and methods.

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Ever since the war began, there has been an unusually heavy demand on the part of our technically-trained subscribers for the Institute's special guide on "How to Prepare an Engineering Report". Extra copies of this practical, helpful 72-page Guide are now available and, for a limited time only, will be sent free to all technical men who use the coupon at the right.

134,000 men on the operating side of business have enrolled for this training. More than 37,500 are technical men—engineers, chemists, metallurgists—many of whom are today heads of our huge war industries.

This training appeals to engineers because it gives them access to the thinking and experience of the country's great business minds. It is especially valuable to such men because it is basic, not specialized—broad in scope, providing a thorough groundwork in the fundamentals underlying *all* business. It covers the principles that every top executive must understand. It applies to all types of industrial organizations, because all types of organizations are based on these same fundamentals.

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"Quotes . . ."

"IN FUTURE years, we will do even better [in the field of air transportation]. The war has been a bitter laboratory for air transport but a laboratory none the less. Wartime research and inventions will be reflected not only in improved passenger transportation but also in faster air mail schedules and in lower cost cargo transport." *Juan T. Trippe, President, Pan American Airways Corporation.*

" " "

"RESEARCH is seldom wasted, and few developments are ever valueless. It is true that today the electrical manufacturing industries are concentrating on the rather grim articles of defense. But we never lose sight of the fact that any new improvements we make in our equipment can and will be applied to the products of peace." M. W. Smith, Vice President in Charge of Engineering, Westinghouse Electric and Manufacturing Company.

" " "

"POST-WAR planning is going on. It seems to me that this planning is in two categories. If I may be permitted to use an aerodynamic phrase, some of it is in the stratosphere. On the other hand, we have sea-level planning. To my mind, one is the planning of spenders and the other is the planning of producers." *Alfred P. Sloan, Jr., Chairman of the Board, General Motors Corporation.*

" " "

"A PILOT on the South American-Africa run recently flew the Atlantic four times within three days. Another pilot recently crossed the ocean twelve times in thirteen days, making one round-trip in less than twenty-four hours." Office of War Information.

" " "

"THE [POST-WAR] pressure created by either too much unemployment or by too much government may mean that regimentation will displace free enterprise; that our free society will give way to some form of State socialism." *Paul G. Hoffman, President of the Studebaker Corporation.*

" " "

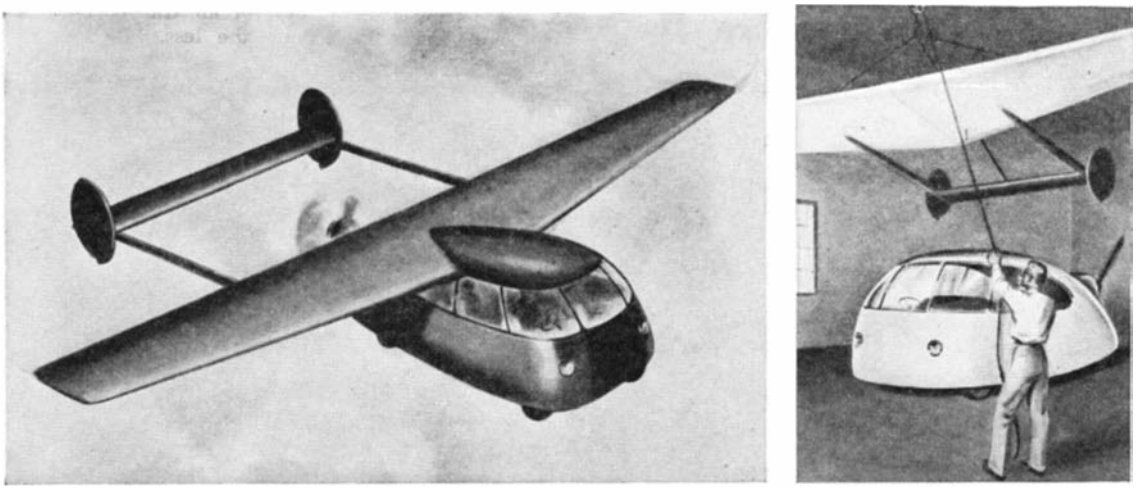
"WE ARE producing synthetic in the same quantity as we were getting natural rubber in a normal year before the war. We will soon be producing synthetic in about the same quantity that the entire United Nations group was using natural rubber before the war." P. W. Litchfield, Chairman of Goodyear Tire and Rubber Company.

" "

"IN CONTRAST to ships, planes, and tanks, the production of military explosives since the beginning of the war has always been as much as the Army and Navy could ship, load, and fire." *Charles A. Higgins, President of Hercules Powder Company.*

AVIATION

Conducted by ALEXANDER KLEMIN



As the artist sees the proposed Stout Aerocar, described in the text. At the left is shown the double-duty airplane and automobile, as it will look in flight. At right, wings and tail are being lowered onto the "body"

Post-War Private Planes

The Aviation Industry is Basing Plans for the Future Largely on Pre-War Models, Plus Knowledge Gleaned from War-Time Production and Operation. Will the Post-War Private Plane Follow Conventional Lines or Will it be a Radical Departure From Present Forms?

NEWSPAPERS and magazines of today abound with references to private flying of the post-war future and frequently predict an airplane in every garage. And while the end of the war is not yet in sight, and private-plane manufacturers are co-operating to the fullest extent in building training planes or parts for combat aircraft, they are all thinking of the "family" airplane which they hope to be building soon. No one can foresee the exact future of private flying, but the following established factors tend to optimism: The tremendous achievements of the airplane in war; the large number of war-time pilots who will return to civilian life with an interest in flying; the millions of people who have become aviation-minded by virtue of their war-time labors; and the improvements in the airplane itself and in methods of production.

On the whole, we can look forward with confidence to an expansion of civil aviation after the war. We can be certain of only one thing, however: Pre-war flying was mainly a hobby or a sport; after the war there will be more flying of the family type, with a purpose not unlike that of the family automobile. Therefore the buying public will quite reasonably demand more speed, increased safety, greater strength, extended range, and more comfort.

The small airplanes of today (or rather of yesterday) were good craft and it is sad to examine circulars and see them marked "Not now in production." Naturally, their makers today are building military trainers, gliders, or parts. The automobile industry appears to expect that its first post-war models will be quite similar to those it scrapped soon after Pearl Harbor. Perhaps the airplane "flivver" of 1942 will also be the type first offered to the public in post-war days. At any rate, it is interesting and perhaps prophetic to note details of some of these fine little ships, as well as of some of the small planes which are doing outstanding military work today.

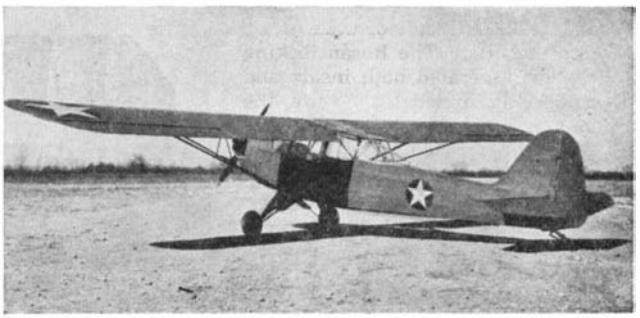
The Aeronca Super Chief, for example, is a closed-cabin two-seater, of the high-wing type, trim and neat in appearance, with fine visibility through its rounded plastic windshield. This ship has a gross weight of 1250 pounds and a wing loading of only 7.4 pounds per square foot. It is powered with a 65-horsepower Lycoming or Continental four-cylinder engine, has a top speed of 109 miles an hour, and cruises at 100 miles per hour. Its range is 500 miles. The photograph of the cabin indicates that even our small pre-war airplanes are comfortable and well equipped, with plastic instrument board, and handy, small control wheels. Doors swing wide, and everything looks comfortable though a trifle compact.

The Taylorcraft L-2, which Taylorcraft Aviation Corporation believes it will build after the war, is an adaptation of the tandem trainer used so widely in the Civilian Pilot Training Program. In the military version there is extension of the windshield and window area to enlarge the field of vision. The observer's seat in the rear is full swiveling. Equipped with two-way radio, the observer can keep in communication with ground forces, particularly the artillery. Here is a hint that even the small plane can carry two-way radio for civilian use. The L-2 has given fine service in restricted terrain in military maneuvers, which is also a hopeful indication for the future.

The photograph of the Luscombe Silvaire gives the proof that a small, trim, two-seater can be built entirely in metal, and be equipped with trimmer tabs and other appurtenances which have proved so valuable to the airliner and the military machine.

The Piper Trainer of Piper Aircraft has some interesting features. This is a machine which has evolved from the conventional two-seater light plane into a training plane with a canopy to give wide vision, and with a low wing of the cantilever type to replace the braced high-wing monoplane. With slotted flaps and retractable landing gear, and 130 horsepower in a bigger engine, the Piper Trainer can fly at 150 miles an hour and has a range of 700 miles.

Plane manufacturers are naturally somewhat reticent on the subject of expected post-war performance. Of course, when the war is over, the full industrial co-operation of today will be replaced by healthy competition. There is a fair unanimity of opinion, however, in regard to speed in the future. The public will probably never be satisfied with a top speed of only 100 miles an hour, which means perhaps 75 when



Upper left: The Aeronca Super Chief and, at left, a view of the interior of the cabin of the same ship. Upper right: The Taylorcraft model L-2, an adaptation of the Taylorcraft tandem trainer now being used by civilian pilots

cruising or when bucking a head wind.

There are decided advantages in the low landing speeds of the Piper Cub or the Taylorcraft, which are around 38 miles an hour, but low landing speed also means low loading in pounds per square foot of wing area. This, in turn, means that gusts affect the airplane appreciably. To counteract this condition, we may expect higher wing loadings, and at the same time more liberal use of flaps to increase the lifting capacity in landing and thus reduce landing speeds. Top speeds will certainly pass the 150-mile-an-hour mark. That means cleaner craft, and the introduction of the controllable pitch propeller.

Some authorities today speak of a cruising range of 1000 miles, but this seems higher than needed. Of course, there will never be unanimity in selection: Some people will buy the slower, long range, slow landing, craft; others will want speed above everything. In all probability there will be more opportunity for diverse specifications in the airplane than in the automobile—which is limited in performance by road and traffic conditions and speed laws.

Much of the thinking regarding instrumentation and comfort in private planes of the future can be based on the past of the automobile. As soon as the novelty of the early automobile had worn off, the buying public demanded comfort and gadgets, and got them. So it will in the airplane. Two-way radio will be a necessity on every airplane so that the pilot can keep in touch with the airport control tower. There should be sufficient instruments for blind flying, parachute type seats, hydraulic brakes, controllable or constant-speed propellers, and so on. In the family plane, women will have a great deal to say and will insist on interior finish and comfort comparable with that of the automobile. The noise level of the present private plane is apt to be somewhat high, but this does not disturb keen sportsmen of the air. The more prosaic travelers of the near future will, however, insist on less noise.

It is often said that there can be no private flying until the airplane is safe, and that some miraculous invention is needed to make the airplane safe. A more reasonable view is that the safety of flying is compounded of many factors, and that constant improvement has already made the airplane safe in competent hands, just as the automobile still is safe only in competent hands. There will probably be reached a compromise between ultra caution, too low a landing speed, non-spin, non-stall, and limitation of maneuver, and the very fast, ultra-controllable sportsman's dream.

There is every reason to believe that prices of post-war planes will be very much lower than pre-war. This will be true partly because engines will be so plentiful and cheap, partly because our production methods have been so greatly improved. John M. Hagan, of Aeronca Aircraft, estimates that this reduction should be of the order of 30 to 40 percent. Some well informed people think that a four-seater airplane with a speed of 150 miles an hour will be available at a price of $1500. That would be the aviation millenium and is a little too much to hope for. Mr. Hagan more conservatively estimates the two-seater as likely to cost between $1000 and $2500, and the four-place job between $3550 and $6000, the latter figure to cover the use of two engines in the power plant. One thing is certain: The public will be able to get exceedingly good value for its money. An important point for manufacturers: They should provide wholly adequate facilities for maintenance and repair, and spare parts should not be on the expensive scale of those for military aircraft.

General Aircraft Corporation has opened up a bit in regard to its post-war plans and has released some information regarding a new design which is both interesting and "futuristic."

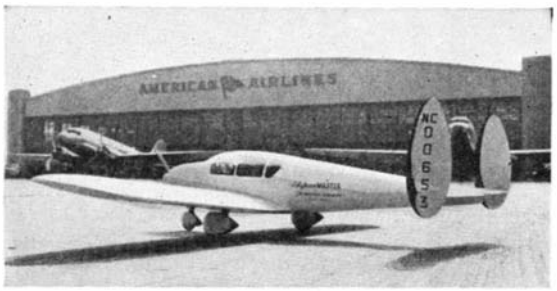
This is a "roadable" machine whose flying characteristics will be similar to those of the Skyfarer Master shown in one of the illustrations. This ship is to have two-control operation: that is, elevator and ailerons only. The same controls are to operate the machine both as a car and as an airplane. The wings are removable and, after having been taken off, are checked at the airport. The plane then becomes a modern streamlined car with a ground speed of 60 miles, powered through its rear wheels. Here is a prophetic quotation: "Our business man leaves his home in the morning in his 'car,' drives to the airport. While having his 'car' filled with gas, the attendants put on the wings, a five-minute job. After flying to his destination, he has the wings removed, drives his 'car' downtown, makes his necessary calls, drives back to the airport, and, donning his wings, goes on to his next destination by air."

The Skyfarer Master itself, as now designed, can provide comfortable air travel for a family of four adults. It is to cruise at 135 miles per hour, have a cruising radius of 600 miles, and gasoline consumption of eight gallons per hour. Here the designers have gone all-out for "two-control," with rudder eliminated, and the airplane is "non-spinnable." A tricycle landing gear, the same controls for the steerable front wheel as for flight, and a landing speed of 40 miles an hour are other features.

W. B. Stout, of the Stout Research Division of Consolidated Vultee, has opened up even more and has given another fascinating picture of the family car-and-airplane of the future. Mr. Stout, famous for his vision, his design ability, and his perfect command of Minnesota Swedish in after-dinner speeches, sees flying autos and trucks — planes that fold their wings on alighting and then run along the highway on their four-wheel landing gears.

Howard Stephenson, in "Plane Talk" gives this view of the future: "Your three-passenger family car, which takes wing for week-end trips and vacation jaunts, will weigh 1500 pounds, half as much as a pre-war Ford coupe. It will have a standard 60-inch wheel tread, will do 60 to 70 miles on the highway and will use about as much gas as your old car. Its tires will be standard. Its transparent body will enable you to see everything in sight, including the envious neighbors. For a flying trip, you back the car into a nearby garage, let down the combined wing and outrigger tail assembly, and hook 'er on. The wing spread is 35 feet. A pusher prop is at the rear of the body in order that you may get maximum vision. You taxi across the runway and take off, soaring over treetops . . . at 100 miles an hour. Your cruising range is about 250 miles." The two imaginative pictures on page 199 make the story even more graphic.*

*Some of the more conservative views of the future of private flying were presented in the note "Airplanes of the Future," page 146, October 1943, Scientific American.—*The Editor.*



Above: The Luscombe Silvaire in flight. Upper right: The Piper trainer, with a high speed of 150 miles an hour. Right: The Skyfarer Master, on which will be based a "roadable" plane

In the matter of private flying, as in everything else, the Government must come into the picture. The requirements of the Civil Aeronautics Administration for private pilots' licenses should be reduced somewhat. The states should not be permitted to license, as the private owner would then have to deal with two licensing bodies. More auxiliary and emergency fields should be government-built. W. B. St. John, of Piper Aircraft, says: "The post-war expansion in flying will be limited only by the utility to which the airplane can be put. Thousands of new airports, landing strips, and seaplane bases must be constructed throughout the country to increase the utility and safety of flying."

The foregoing gives, perhaps, only a shadowy picture of the private plane of the post-war period. But one conclusion is far less shadowy. The American airplane industry has done a splendid job in building a magnificent military air fleet. It certainly will meet the challenge of post-war developments equally as well. Whatever the final form of the private airplane of the future may be, we can be sure that a number of ships having the utmost in popular appeal, safety, utility, and performance will make their appearance in the competitive markets of peace.

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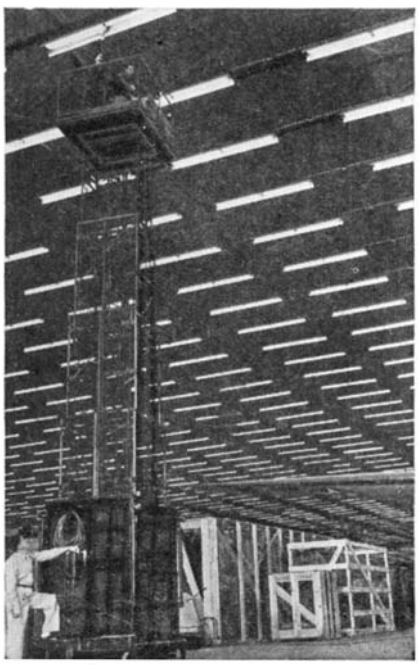
FACTORY ILLUMINATION

Kept at High Levels by New Servicing Equipment

LITTLE information is available concerning the advanced types of airplanes now being produced in our factories. That is as it should be; only when aircraft have been brought down over Germany and the enemy can analyze them, should the veil of secrecy be lifted.

But we can learn much from new production methods applied in the airplane plant. Such methods cannot be transplanted, and that explains why production wrinkles, ranging from automatic riveting to conveyor systems for the construction of single-seater fighters, can be more freely discussed.

One of our photographs show a newly developed method of servicing electric lamps, which, while a minor achievement, is a helpful one. The 40-watt lamps are placed 35 to 40 feet above the floor and must provide 33 foot-candles of illumination at working levels, night and day, without a moment's interruption in a completely blacked-out plant. The photograph shows two members of the service crew high in the air at their vital task. The platform, motor driven, has greatly speeded up the work of servicing these lamps in a factory where every inch of space must be brightly illuminated for efficient operation.



Servicing lamps in an airplane factory

DE-ICER

Uses Heat of Exhaust Gas from Engine

THE DEVELOPMENT of a new type of de-icer, in which the heat of the exhaust gases is used to prevent the formation of ice on wings, tail surfaces, and windshield of the airplane, has just been revealed by Tom Girdler, Chairman of the Board of Consolidated Vultee. The idea is not new; experiments with exhaust heat de-icing were made by the National Advisory Committee for Aeronautics several years ago. Nor is the principle at all complicated. Air heated by the exhaust pipes is distributed inside the wing and tail surfaces by suitable ducts, one duct being disposed along the leading edge of the wing. From there the heated air is led to an outlet duct and is discharged in a rearward direction.

Of course, care has gone into the design of a ram air scoop for the heat exchanger, the pump for driving air into the tail unit, the provision of a control gate, and the like. But, on the whole, the application of exhaust heat to de-icing is a matter of straight-forward engineering.

Many other methods of eliminating icing have been tried as, for example, by smearing the leading edge with various anti-icing liquids, but this was not very successful. The Goodrich rubber overshoe, now in general use, has been far more useful. In this method a rubber section is fastened to the leading edge of the wing and, by the aid of air under pressure, the ice is broken away from the wing by inflation of the sections. This method has worked quite well, but is apt to be useless after a certain amount of ice has formed. Also, the inflation of the leading edge and the provision of the overshoe had some detrimental effects on over-all efficiency.

AIRCRAFT HYDRAULICS

Studied With Mock-Up of Standard Parts and Lines

THE airplane began with the utmost simplicity of equipment and accessories; the air liner of today is almost as complex as a huge passenger steamship. The hydraulic system in particular is a complicated part of the whole. Thus, the Boeing School of Aeronautics has had its students construct a mock-up of the hydraulic system of the Douglas DC-3 with all standard parts and lines clearly visible. Such a hydraulic mock-up should be generally available also for training airplane mechanics.

Conducted by JAMES M. CROWE

From The Pine

Naval Stores Production is Taking a New Lease on Life. Applied Research, Providing a New Industrial Approach, Has Also Provided New Markets for the Products of the Pine, Promising an Important Future for Terpene Chemistry

Both rosin and turpentine are produced from sap taken from pine trees which are "stripped" once a month to keep the sap flowing. The workman in this picture is cutting parallel gashes that slant downward and toward each other. Keeping surface open assures steady sap flow

In the days when men went down to the sea in wooden sailing ships, tar and pitch, obtained from pine trees, were absolutely necessary to maintain the seaworthiness of ships. Tar was used to preserve the all-important hemp cordage and rigging from the destructive corrosion of salt spray and damp air. Pitch was used for caulking seams with oakum, for ship bottoms, and for many other nautical uses.

Because of this close association with shipbuilding and maintenance, it was natural that such a name as "naval stores" be applied to these materials, and this term has stuck to this day, in spite of the fact that they have long ago lost their intimate connection with the shipping industry.

As the uses in connection with ships declined, other uses took their place and the naval stores industry developed. In a broad sense naval stores today include various kinds of turpentines, rosins, pine oils, rosin oils, tars, and pitches, obtained from the oleoresinous secretions of various species of coniferous trees, notably the long leaf and loblolly pines found in our southern states.

From 60 to 70 percent of the world's production of naval stores comes from the United States. Of the remainder about half comes from France, with Spain, Greece, Portugal, Mexico, and India following in order. Smaller amounts come from Austria, Russia, Finland, Scandinavia, the Philippines, and Japan.

Naval stores are made by four principal methods which differ fundamentally in the methods of extracting the resinous material which is produced by the metabolism of the living tree and is stored up in microscopic channels called resin-ducts, from which man drains it.

In the first method the gum is obtained by tapping the tree. Travellers have often been impressed by the sight of thousands of white-faced pine trees with metal pails or baked clay cups, shaped like flower pots, fastened to their trunks. These trees are the production plants for oleoresin, a grayish white secretion given off when the tree is wounded or cut. How this resin is formed, or what part it plays in the life of the tree is little understood. It is not to be confused with the sap in the tree which circulates through the fibrous cells of the sapwood and cells of the soft inner bark. The oleoresin is sometimes thought to be a by-product of cell metabolism—waste or excreta. So long as it is done properly, tapping seems to have no ill effect on the health of the tree.

If the tree does not have vital uses for this excreta, man certainly has, and thus the turpentiners start their operations by chipping a "face" of the tree with a wide v-shaped incision and inserting a gutter to carry the secretion to the cups attached to the tree. Each week, beginning in March and continuing through October, the chippers make a new incision in the bark, each one a little higher than the previous one, to start a fresh flow of oleoresin.

Experiments in the last year or so have shown that the flow of this material may be stimulated by the application of sulfuric acid or caustic soda to the incisions, and thus make possible more efficient production and higher profits.

Collecting gum in a pine forest

At regular intervals, a crew of dippers makes the rounds, gathering the raw gum from the cups, which is poured first into buckets and then into barrels. These barrels are then hauled to central plants where the contents are separated by simple distillation into the liquid fraction, gum turpentine, and the resinous residue, gum rosin. The rosin so produced is then filtered hot to remove foreign materials. The products thus obtained are collectively known in industry as "gum naval stores."

The second method is known as solvent extraction. By this process, discovered about 1906, wood and stumps rich in oleoresin are shredded, steamed to open the pores of the wood, and then processed with hot mineral solvent. The extracted material, consisting of terpene liquids and resins, is separated by distillation and further refined. Products made by this process are called "wood naval stores."

The development of this process has been of great importance to the South because, through it, the wholesale butchery of southern forests by early wasteful lumbering operations has been partly alleviated. It has made it possible profitably to clear and reclaim vast areas of cut-over timberlands where lumbering operations had left nothing but stumps and refuse. These cleared lands can then be reseeded in quick-growing pine, used as pasture land for the South's growing dairy industry, or planted to some other new crop, such as the tung tree which yields tung (chinawood) oil, a valuable raw material for paints and varnishes.

The third source of naval stores is the sulfate process of making wood pulp. In this process the oleoresinous components of the wood are removed by chemical action. Sulfate wood turpentine is recovered by condensing the vapors released from the pulping digestors. The crude by-product is heavily contaminated with sulfur compounds which are removed by chemical treatment and fractional distillation. The spent cooking liquor obtained from these paper mills, commonly called "black liquor," is treated to recover a

mixture of fatty and resin acids called "tall oil." With the increasing development of southern paper mills, new processes will undoubtedly be discovered to utilize more efficiently both the fatty acid and resin constituents of tall oil, and thus create new wealth from a material formerly largely wasted.

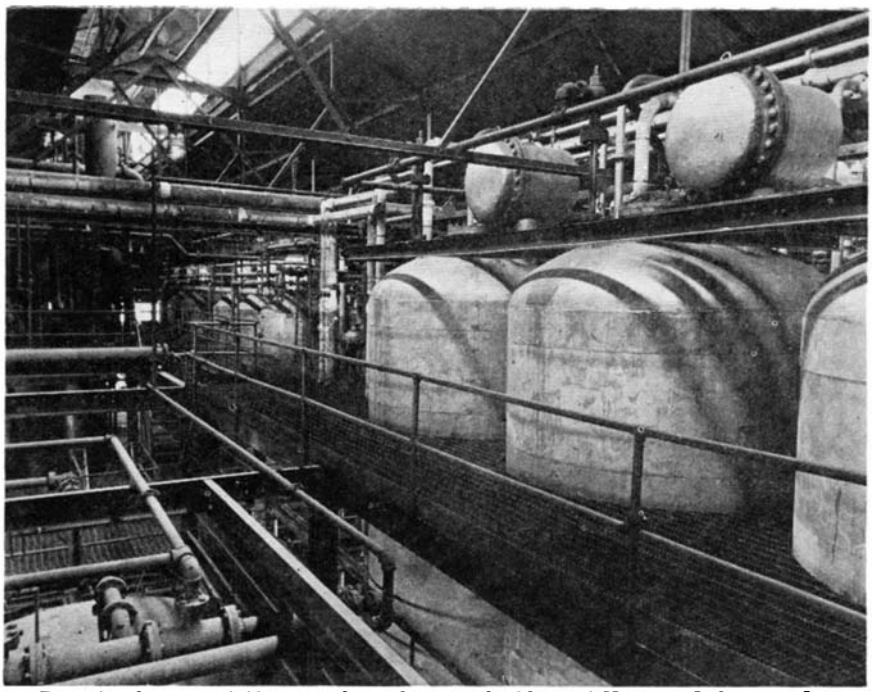
The fourth method of obtaining naval stores is by destructive distillation. In the early Colonial days this was a popular method because it required no equipment. Dead pinewood, which seldom decayed because of its high resinous content, was gathered and cut into convenient sizes. A circular mound of earth was made and packed hard and coated with clay, except for a hole in the center which was connected by a conduit to an outer basin dug in the earth. The wood was stacked on this base and the kiln was completed by covering the wood with pine leaves and then with clay or sod. The pile was then kindled at the top and the fire gradually penetrated to the bottom in slow combustion with insufficient oxygen. It often took eight or nine days to complete combustion. In the meantime, the tar collected in the outer basin and was drawn off and strained.

In the modern destructive distillation process, the stumps and branches are loaded into steel cars which are run into retorts. After sealing the retort to prevent the entrance of air, heat is applied from the outside and the volatile products from the decomposition of the wood and resinous material pass off and are condensed.

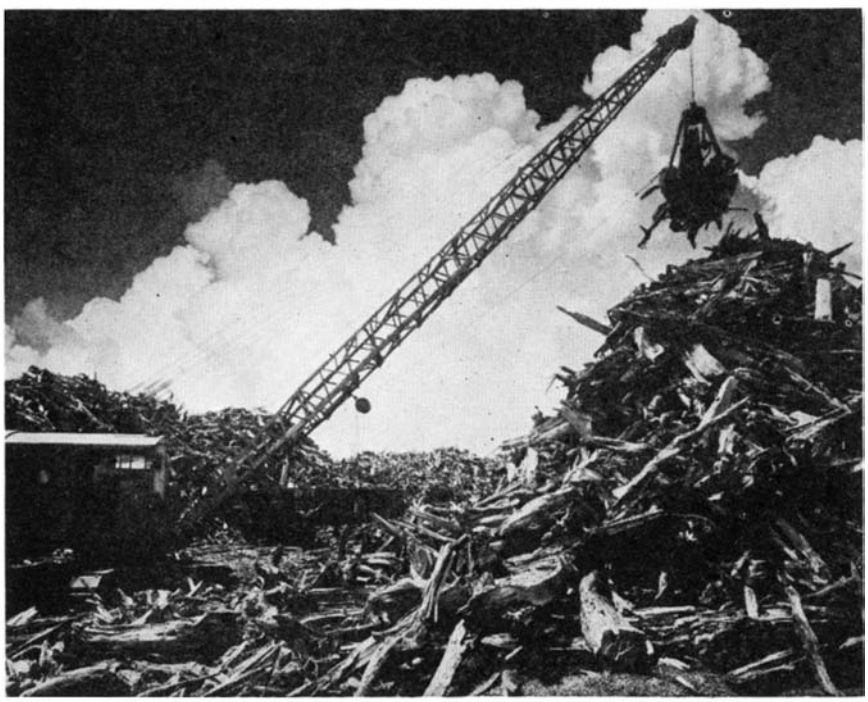
Naval stores are used today in almost every industry: To name a few—paint and varnish; soap; oils, greases, and printing inks; shoe polish and leather dressings; sealing wax and insulation; linoleum, oil cloth, and roofing; foundries and foundry supplies; paper; shipyards; pharmaceuticals and chemicals.

The paint industry still consumes the largest amount of turpentine, although changes in formulation of protective coatings in recent years have made petroleum and other solvents more desirable and have reduced the demand for turpentine. As a solvent for waxes, turpentine is still extensively used in shoe polish and stove polishes. It is an ingredient in many insecticides, both because of its solvent and insecticidal properties. A large amount is still sold direct to households in small retail packages.

Consumption of rosin is spread over diversified fields. Tremendous quantities go to the paper industry for use as a sizing material to improve greatly the strength and surface of papers. More than 135,000,000 pounds of rosin are used in the United States each year in the manufacture of soap. For many years, rosin was used only in laundry and industrial soaps—the familiar, cheap, dark brown variety. Its use depended to a large extent on the price of soap oils. When these oils were dear, more rosin was used; when cheap, less rosin was used. Recently, however, a large naval stores producer, through intensive chemical research, has developed grades of chemically modified light-colored rosin which actually improve both bar soap and soap powder, and may be used in amounts up to 15 percent. Before the war the use of rosin in soap was declining, but it now looks as if it will come back strong when chemical manufacturers are able to go into production on these new rosin compounds after the war.



Top of a battery of filters in the pale rosin building of Newport Industries, Inc.



A stock pile of pine stumps, at the Brunswick, Georgia, naval stores plant of Hercules Powder Company, used in production of turpentine, pine oil, and rosin

In fact, it is to similar chemical research that the naval stores industry in general has turned in the past decade in an attempt to pull itself out of the doldrums and to develop new uses for these materials.

One of the most noteworthy of these research developments is the manufacture of synthetic camphor out of chemicals from the pine tree. This process, perfected in the last ten years, broke the back of the high-priced Japanese monopoly on natural camphor and assured us of a continuous supply of an important medicinal and industrial material. Turpentine also serves as the raw material for the production of dipentene, terpineol, and pharmaceuticals such as terpin hydrate, terebene, and a number of other pure compounds.

In the paint and varnish field rosin was fighting a losing battle, because it gave finishes that lacked hardness and water resistance and because its acidic nature caused trouble with certain basic pigments. The chemists got busy and combined rosin with alcohols to form chemicals called methyl and ethyl abietates, and with glycerine to form ester gum. These products now find

great favor in the trade and with other ingredients form many of the better type of water-resistant varnishes.

In the last few years naval stores have also become raw materials for a great many new chemicals, with a wide range of uses as varied as in perfumes, synthetic rubber, and drugs.

In the light of what has been done, it is reasonable to believe that before long this new branch of terpene chemistry will take a more important place alongside the fields of coal tar, cellulose, and petroleum chemistry. Thus with its new approach to progress through research, the naval stores industry may regain much of its early prestige and importance as one of America's oldest, and the South's greatest, enterprises.

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CHEMICAL CLEARING HOUSE

Assists Research Workers in Quest of Rare Chemicals

Most workers in chemistry have often wished for some sort of clearing house to which they could turn when they needed a rare or uncommon chemical compound. They quickly found out that there was no such place and either had to turn detective and hunt down a source or roll up their sleeves and synthesize a small quantity of the compound for themselves. In either case it was a hard job and wasted much valuable time.

Thus it was a happy day for research workers when the Armour Research Foundation decided to do something about the situation. What they did was to form a National Registry of Rare Chemicals, a clearing house for information to be maintained, without charge, in the interests of the scientific work of the nation.

The object of the service is to inform a chemist, or for that matter any research worker, where he can get a rare or unusual chemical. The Registry is not a "chemical bank," inasmuch as it does not buy or sell materials, but merely maintains an indexed file of sources. Chemicals which can be found in the catalogs of regular suppliers are not included in the file.

The Registry passed its first birthday a few months ago and was able to look back on a year of successful service during which it has saved the valuable time of research in nearly every industry in private laboratories, and in educational institutions.

BATTERY RETAINER

Made from Byproducts of Plastics Manufacture

A plastic storage-battery retainer manufactured from polystyrene, for use in certain types of Exide batteries, not only has technical advantages, but is also said to be more permanent than the former type of retainer, according to the Electric Storage Battery Company. In addition, as it is now being manufactured, it uses less critical material.

"Development work on the new retainer was started in the Exide laboratories before the outbreak of the war," states L. E. Lighton, Manager, Development and Design Department. "The object of this experimental work was to find a material superior to existing retainers from both the performance and manufacturing costs angle. Extensive field tests were undertaken and Exide was virtually ready to put the new plastic retainer on the market when the war effort of our Allies began to demand the raw material from which it was to have been made.

"This presented a double problem, as the shortage of rubber later made it even more urgent that some way be found to produce the new plastic retainer without drawing upon the supply of another critical material. Work on this newest phase of the development was begun in spite of what seemed a hopeless task with so many plastics being rapidly put on the critical list. However, our research laboratories again went to work on the problem, and the result is the new slotted polystyrene retainer which Exide is now putting on the market.

"Although the basic raw materials are still on the critical list, the new polystyrene retainer can be manufactured from secondary materials, byproducts from the use of this material for other war purposes. The result is a retainer that marks a distinct step forward in battery design just as the slotted rubber type, which was developed years ago, did in its day."

CHEMICAL PEELING

Potato Skins Removed Rapidly By Use of Caustic Soda

This seems to be an age of freedom from this and freedom from that. President Roosevelt proposes four freedoms, then someone else ups him to six or eight, and so on. Not to be outdone, industry is also seeking new freedoms. One of the latest is freedom from peeling potatoes. According to recent research work, definite progress is being made on the removal of vegetable skins by the use of solutions of lye, or caustic soda.

The increasing demand for canned potatoes and especially the huge requirements of dehydrated vegetables for the armed forces and Lend-Lease has stimulated the investigation of methods for improving lye-peeling processes which for several years have been used in a very limited way for the peeling of small, freshly dug potatoes used by canneries in Delaware, Maryland, Virginia, and southern New Jersey.

During the past two years several new lye-peeling installations have been made for larger and tougher skinned potatoes. The work thus far has indicated that, for large tonnages, peeling with a lye solution is more economical than by any other method. Skin and eye removal is accomplished with a minimum weight loss ranging from about 10 to 15 percent, depending upon the condition of the potatoes.

The peeling is carried out by the following operations: Potatoes are dusted and washed in water and then immersed in a caustic solution of just the right temperature and concentration. They then go to a washer which provides mechanical action and water to carry away the skin and thin, yellow, gelatinous layer formed in the lye bath. When the potatoes are finally rinsed, they appear gleaming white, with no trace of lye left. They are then ready for canning or for slicing and dehydrating.

ANTI-FREEZE

Reconditioner Restores Anti-Rust Properties

A new chemical inhibitor for reconditioning last winter's anti-freeze solution is now available to car owners, according to G. W. Sherin, Director of the Chemical Specialties Division of the Du Pont Company. The new compound, developed last year for the United States Army, is being released for civilian use in co-operation with a WPB request that motorists conserve their old anti-freeze solutions.

"Many car owners have removed their last winter's anti-freeze, and stored it for re-use," Mr. Sherin says, "in anticipation of the anti-freeze shortage expected this winter. This is a sensible plan, but anti-freeze should not be used a second season unless it is reconditioned.

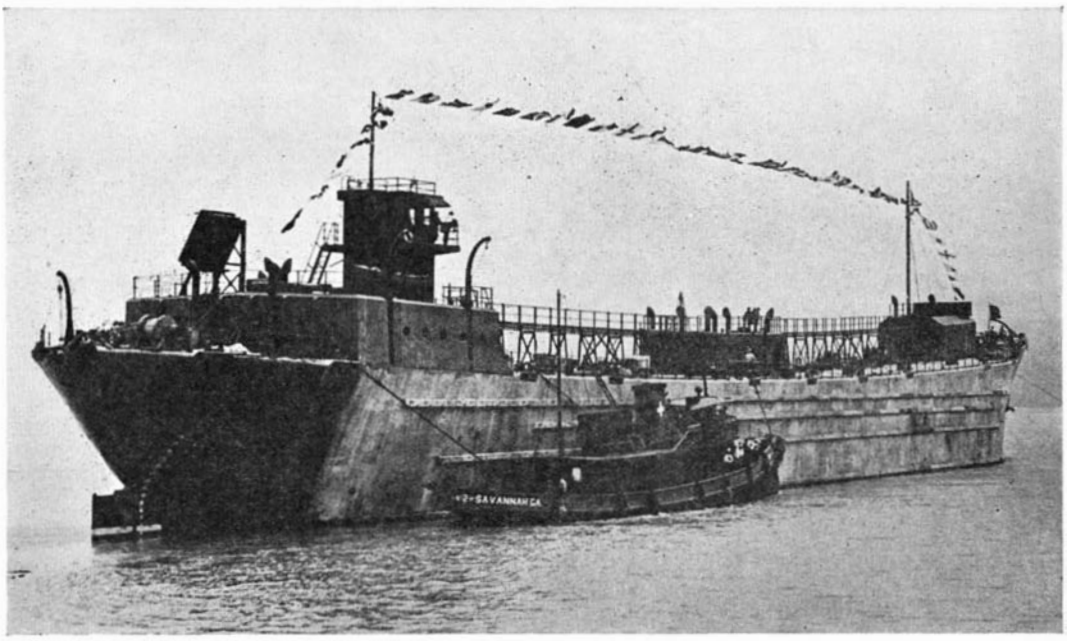
"Automotive engineers have learned that some types of anti-freeze lose their rust-inhibiting properties and become acid after extended use. If they are reintroduced into a cooling system without being treated with an inhibitor, they will promote rust and corrosion. The acid may attack the metal parts.

"The WPB Conservation Division, aware of this danger, recently recommended that a re-inhibitor be added to the stored anti-freeze to make it safe and efficient for future use," Mr. Sherin says.

The new product does not contribute to the anti-freeze properties of a solution, Mr. Sherin cautions, but simply neutralizes any acid formation and restores the lost rust inhibitor. When treating the anti-freeze, it is advisable also to filter it in order to remove dirt and rust particles.

Ethylene-glycol "permanent" anti-freezes need reconditioning more than the alcohol types, Mr. Sherin adds, but the new inhibitor can be safely used in any standard anti-freeze solution. In fact, it may also be used as an anti-rust with plain water during the summer months.

"If the car owner has allowed his anti-freeze to remain in the cooling system during the summer, it is wise to add the reinhibitor. While most standard anti-freezes retain their rust inhibitors as long as they remain in the cooling system, the inhibitors may lose their strength, and acids may develop. It is best to play safe and recondition the anti-freeze solution," Mr. Sherin says.



A concrete tanker just after launching at a Georgia shipyard

ENGINEERING

Conducted by EDWARD J. CLEARY

Seagoing Concrete

Many Lessons About Good, Light-Weight Concrete are Being Learned During the Construction of Large Vessels, Both With and Without Power, for the Current United States Maritime Commission's Program. Some of these Ships are Already Aiding the Allied Cause

By HAL W. HUNT

AFTER a lapse of more than 20 years, concrete ships are again sailing the seas as cargo carriers. Constructed for the United States Maritime Commission as a war measure, they are one third the length of any ship afloat and their overall dimension of 366 feet at the water line compares with 441 feet length of the well known Liberty freighters of steel. With a beam of 60 feet and a depth of 40 feet, their cargo-carrying capacity ranges up to 6000 long tons. Flying the American flag, some of these vessels of "stone" and steel already are playing a part in moving war goods.

Some of the new concrete units are called barges because they are not equipped with individual power units. But all of them are conventional, ship-shaped vessels, and the barges are capable of being towed to any port in the world.

In this war, as in World War I, concrete ships were adopted because sufficient steel plate rolling capacity was not available for fabrication of all the ships required for full prosecution of the war. Then, too, the use of concrete, a material with which many construction men are familiar, opened a new source of skilled manpower to supplement the army of workers being trained for the specialist tasks in shipbuilding.

The first cost of a concrete ship is substantially less than that of a comparable steel ship. For example, a Liberty freighter (E.C. 2 type) costs $1,800,000 to $2,000,000. A concrete ship with two thirds the carrying capacity can be built for about $1,000,000. However, concrete ships are considered less economical to operate than are those built of steel. Since they have much greater hull weight than steel ships of comparable carrying capacity, they require more power for propulsion and they are slower and less maneuverable.

During and immediately after World War I, twelve concrete ships were completed for the United States Shipping Board, the equivalent agency of the present Maritime Commission. Several more concrete vessels were constructed by other governmental and private interests. The Shipping Board vessels ranged in size from 3000-ton cargo boats to 7500-ton tankers, the latter more than 450 feet in length. One of these vessels, *Faith*, voyaged to Vancouver, Honolulu, Chile, New York (via the Panama Canal), and later to London. Other concrete ships made numerous coastwise voyages and were engaged in the West Indies and South American service.

The current Maritime Commission program of concrete ship construction includes 65 reinforced concrete tanker barges under contract; 77 more are authorized. Each of these vessels has a capacity of 40,000 barrels (about 2,000,000 gallons), and is intended to carry medium-density fuel oil, such as is used in homes and small industries.

Also under construction are 26 dry-cargo barges intended for operation between the United States and Latin-American countries, and 24 self-propelled reinforced concrete freighters, intended primarily for transportation of bauxite ore from which aluminum is made.

More than 50 sea-going tugs, some of the most powerful ever used, are being built to tow the 91 non-powered vessels.

Concrete is a material that is almost as easy to mold into shape as clay, but the forms required to mold it in the desired thickness and prescribed lines for a ship are difficult to build and hold in place.

Since concrete can be formed into any type of streamlined shape, some proponents of concrete vessels feel that designs following the conventional ship lines established for steel vessels should be abandoned in favor of a circular or semi-circular compartmental design. They point out that in the period immediately following World War I, two tankers based on this type of design were constructed and were in satisfactory operation for some time.

Concrete for ships must be watertight, unusually strong and durable, and light in weight. All concrete, of course, does not meet these specifications.

Ordinarily, the best concrete is the heaviest, since it is made of the densest

ingredients. The aggregates used are so proportioned that every space between larger pieces is filled by smaller ones down through the finest sand. Then the cement, finer than flour, serves to coat all the particles with a fine grout that binds all of the materials together.

Good concrete, prepared by conventional methods and vibrated so that it forms a dense mass, weighs about 150 pounds per cubic foot. Walls 4 to 6 inches thick are necessary to provide the required strength and to cover the steel needed for the tensile reinforcement of a ship. Concrete in the bottom, side-shells, and decks of a ship would then weigh 50 to 75 pounds per square foot of surface, compared with about 25 pounds per square foot for ⅝ inch thick steel plating usually used on a freighter.

NEARLY half of this weight differential can, however, be overcome by using lightweight material from which to make the concrete. The aggregate most commonly used is sold under the trade name Haydite, and is a burned and crushed clay product. This material, developed during World War I although not widely used in the ships built at that time, has found many industrial and commercial uses.

Coarse Haydite, up to ⅜ and ½ inch in diameter, weighs about 35 pounds per cubic foot (comparable gravel or stone aggregate weighs 90 to 105 pounds) and the fine aggregate, smaller than ¼ inch diameter, weighs about 42 pounds per cubic foot. Concrete weighing about 108 pounds per cubic foot and having a strength of 5000 to 6000 pounds per square inch, when tested in compression at the age of 28 days, can be made from this material using 9 to 10 sacks of standard Portland cement per cubic yard.

A new type of lightweight aggregate is now being made at a plant in Florida using a nodulizing process on pulverized fullers earth. In this process a fine spray of water, with different size droplets, is impinged on dust-dry fullers earth particles. This forms different size nodules, much as raindrops gather dust. Moisture holds the nodules together until they are burned into a hard clinker from which the lightweight aggregate is made. Developers of the process claim that the aggregate is more satisfactory than the clay product, as it is less absorptive. Furthermore, it is said that the rounded particles flow better than the crushed particles of clay and thus will "fill-in" better around the reinforcing bars.

Both types of lightweight aggregate require the addition of a small amount, about 15 percent, of natural sand aggregate because manufacturing processes now in use do not produce enough fines to make the required watertight, dense concrete.

Use of the lightweight aggregate makes it possible to build concrete ships that will carry an average of 5500 long tons of cargo, compared with the limit of 4300 tons that would be carried in a similar ship made of "stone" concrete.

Considerable reinforcing steel—about one-half or more of the weight of plates required for a steel ship of the same carrying capacity—are needed to give structural strength to a concrete vessel.

The design followed in Maritime Commission ships calls for very heavy reinforcing steel, particularly in the bottom of the vessel. The principal reinforcing consists of two layers of 1 inch square bars spaced 2½ inches part and welded so that they are continuous throughout the full length of the vessel.

Bars in the side-shell are smaller, spaced farther apart, and are lapped instead of welded for continuous strength. Deck bars are welded to take the greater stress caused by "beam action," such as would occur when waves roll under the vessel. Wave action of this kind sometimes causes the entire ship to be supported in the center only, and the two ends are left "hanging" in the air, thus producing high reversed stresses.

The exterior shell of the ship as well as the deck are stiffened and supported by frames of reinforced concrete at about 10 feet center to center. A solid transverse bulkhead or wall at intervals of about three frames, and one or two solid longitudinal bulkheads, are used to stiffen the ship further. These bulkheads serve as watertight barriers should one section of the hull be damaged. Between the widely spaced frames in the bottom, sides, and deck, the shell is strengthened by longitudinal concrete beams placed integrally with the hull.

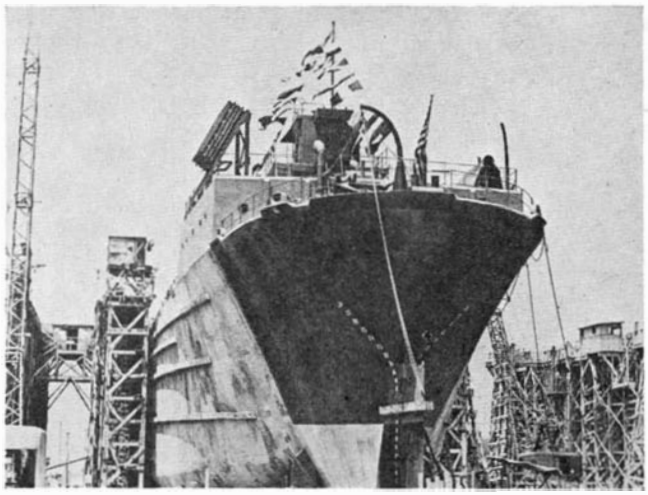
Concrete ships are constructed on end-launching or side-launching ways, also in building basins, which are similar to graving docks. Use of the building-basin method is preferred, because when the ship is completed it can be floated off the supporting structures without strain.

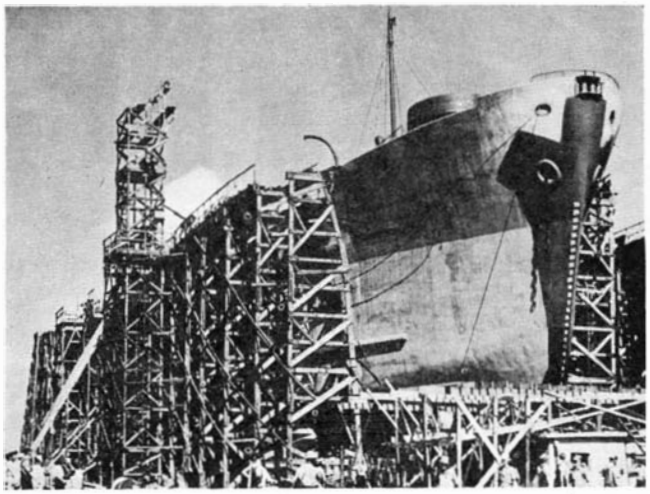
Concrete is placed in wood forms that are carefully tied and braced to hold them in exact position to assure smooth lines for the exterior of the hull as well as correct alinement for all parts of the vessel. Forms usually are made of plywood, backed up with heavier wood members. Some of the more intricate and small interior forms are metal faced.

The usual procedure is to erect the exterior form complete, then place the reinforcing and forms in the bottom of the hull and up to a height of 3 or 4 feet above the lowest point of the keel. Concrete is then placed to this level, followed by the placing of reinforcing steel and forms for an additional lift up to about the deck line. The decks are placed in later pours.

GREAT care must be exercised to assure watertight concrete and watertight joints, particularly below the water line. Therefore the concrete for ships must be of the highest quality, achieved by careful control in mixing and placing. It is always placed in small quantities, largely by hand, then carefully vibrated to minimize the occurrence of voids.

To increase the strength of the concrete and harden the exterior surface, some builders of ships are using a "vacuum" process for removing water from the concrete in excess of that needed for hydration of its cement. This is accomplished by building into the exterior form for the ship a "vacuum mat" of expanded metal mesh, a layer of screen wire, and a non-waterproof canvas cover. A pipe-flange is attached over a hole in the plywood form and a vacuum, equivalent to 20 inches of mercury, is "pulled" on the concrete by special pumps. The bottom and other horizontal surfaces of the ship are processed





Left: Stern of a concrete barge. Although the vessel is ready for launching, the frames supporting the form have not been removed. Right: The forepeak of a concrete barge uses a small amount of steel plate, as shown in this picture

by portable mats of similar construction, which are used for a few minutes to draw the excess water from a small area and then moved ahead to follow the concrete placing.

Despite all precautions taken to assure perfect concrete, it is found that some patching usually is necessary where "honeycomb" or minor cracks or foreign matter are found in this material. Patching is done by cutting out the objectionable concrete and refilling the opening, being careful to pack the new material tightly into place.

Each compartment of the tanker hulls is tested for watertightness with a static head of 46 feet of water on the bottom, equivalent to a force of 2880 pounds per square foot. This pressure and the stresses from filling the tank with water, opens up any minute channels that may exist or be incipient through the concrete. Even a little sawdust dropped on the concrete while it is being placed may create a channel that will permit a small amount of oil to escape or salt water to enter. At every point where there is indication of moisture, small holes are drilled into the concrete, as deep as the reinforcing will permit, and cement grout is forced in with an impact grout gun.

The United States Maritime Commission, under whose direction the concrete ships are being built, is headed by Admiral Emory S. Land, USN (retired), chairman, and Rear Admiral H. S. Vickery, USN, Vice-Chairman. Chief of the concrete construction section is R. D. Karr who works with James L. Bates, director of the technical division.

The concrete vessels are being built at yards on the Atlantic, Gulf, and Pacific Coasts. Concrete Ship Constructors, in California, are building tankers in basins; original contract for 22 ships has been augmented as completion of vessels indicated the need for ordering further materials. The Mac-

The engineering level is set on the rudder post. Note forest of reinforcing bars

Evoy Shipbuilding Company, in Georgia, is building **23 tankers on six** end-launching ways while San Jacinto Shipbuilding Corporation, in Texas, have four side-launching ways in use.

Dry cargo barges, 26 are under contract, are being built by Barrett and Hilp in basins on San Francisco Bay. The only powered concrete ships so far contracted are 24 units being built by McCloskey and Company in basins in Florida.

In contrast to World War I, when hostilities ended before any concrete ships were completed, we are now using concrete ships in active theaters of operation. Some of the tankers, for example, have been towed loaded to the South Seas where they are now serving as mobile emergency storage tanks for the Navy. And, recently, dry-cargo boats have also been put into service.

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TIMBER CONSTRUCTION
Reaches All-Time
High During 1943

ALL-TIME records for timber construction were established during the first half of 1943, when the largest amount of wood ever used in a building—27,000,000 board-feet—went into a cargo-plane assembly plant. Largest clear-span timber arches ever erected were used in a blimp hangar; they rise 153 feet from the floor and span 237 feet.

CHLORINATED WATER
Tested by New
Simplified Method

TESTING water purified with calcium hypochloride for residual chlorine is simplified by a new method developed by the Quartermaster Corps in collaboration with the Medical Corps and several industrial chemical companies.

The testing method employs orthotolidine in a newly developed tablet form rather than in solution, each tablet representing one cubic centimeter of the liquid. Orthotolidine, a chemical reagent that produces an intense yellow-green color in the presence of chlorine, is widely used for determining the extent of chlorination of water.

The tablets are packed in a nested double tube, the inner one of glass containing 50 tablets, and the outer one of plastic serving as a tube for the testing operation. The outer tube has a ¾-inch transparent yellow band at the top showing the exact color the water should have when tested after chlorine treatment.

In the testing operation, the outer tube is filled to the lower edge of the yellow band with the treated water and the tablets are dropped into it and allowed to dissolve. If the resulting color of the liquid in the tube is lighter than the color of the yellow band, the water requires more treatment with chlorine, while an equal or slightly darker color indicates the water has been satisfactorily purified and is safe for use. If the liquid turns an orange color, the water is too heavily treated with chlorine and more untreated water must be added to the supply being tested.

The new testing method was devised to replace the more complicated conventional method employing orthotolidine in liquid form.

TIMBER MOISTURE
Removal With Solvents
Now Being Tested

A PLANT for checking commercial possibilities of a process for extracting oil, resin, and moisture from timber by means of solvents is being built by the Western Pine Association in Portland. Oregon.

The idea for this unique curing method came about as a result of experiments on removal of oil and resin from knots to prevent "bleeding" through paint. During these experiments it was discovered that the solvents reduced moisture content to a surprising degree, keeping the wood lighter in color than when dried in a kiln.

A notable characteristic of wood treated by the extraction method is said to be its readiness to absorb liquids, such as preservatives, water repellents, fire retardants, and coloring matter or stains.

SHIPBUILDING SPEED
Is Producing Vast
Merchant Fleet

A THUMBNAIL sketch of our shipbuilding progress reveals that we will produce 19,000,000 deadweight tons of dry cargo ships in 1943, almost the equivalent of the entire British merchant fleet at the start of the war. Over 700 ships have been turned out so far this year. Expected to require 210 days to produce. the average time from keel-laying to delivery has been cut to 50 days per ship.

Conducted by FRED P. PETERS

Pressing Metal Into Service

As a Result of Production and Conservation Requirements, New Technical Knowledge has been Acquired on the Use of Pressed Metals in Jobs that Formerly Have Been Done by Other Methods. Time and Materials are Saved Without Sacrifice

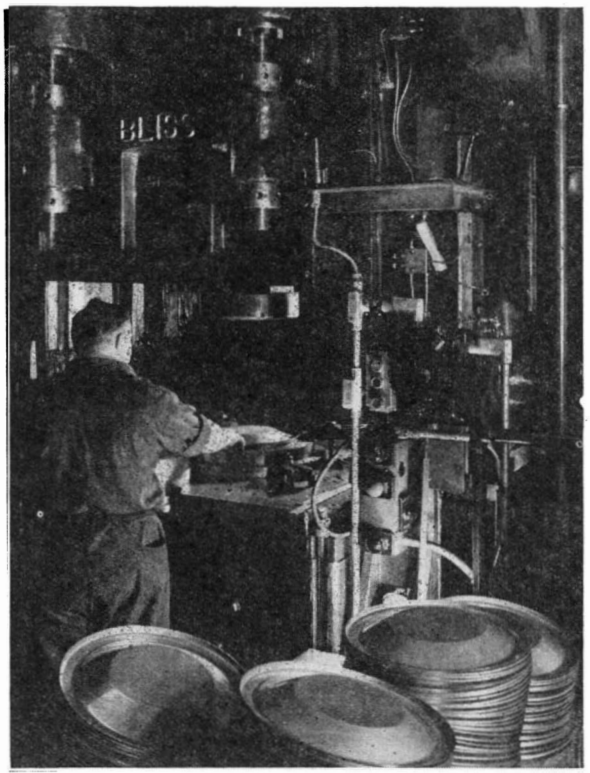
THE PRESSING problems of modern war production have been solved in hundreds of instances by nothing less than presses themselves—presses applied to shaping and forming metal into vital munitions or machinery components. Three of the war's biggest production engineering developments have involved the working of metal in presses, and a large segment of our over-all conservation achievement is directly attributable to the availability and use of metal-stamping presses on a wide scale.

New technical knowledge of press-working has contributed to these uses. And conversely, out of this broadening application have emerged new techniques taught by war-production, as well as increased respect among engineers for the utility of pressed-metal fabrication as a manufacturing tool.

The versatility of presses as metal-working tools is partly the result of considerable diversity in types and designs available. For almost any purpose requiring presses one may employ either a hydraulic press or a mechanical press. Presses are rated in capacity according to the maximum load that can be applied; the largest presses in use today have capacity ratings in the neighborhood of 6000 tons.

In its essence, a metal-working press is a machine with a sturdy stationary component, in which the metal being formed is held, and a moving component that applies pressure to the metal. Dies are often employed to reproduce contours to accurate dimensions. Some familiar types of presses are (a) blanking presses, which knock flat shapes out of flat sheets of metal; (b) forming presses, which make bulges, turned-up edges, flanges, cups, domes, and so on, in what was once a flat sheet; (c) stamping presses, which do both of the foregoing in one operation, knocking out finished parts in many cases from a flat piece of metal; (d) drawing presses, which form cup- or bowl-shaped parts, tubes, or cylinders out of flat pieces; (e) forging presses, which push hot metal into desired shapes, with the aid of dies; (f) extrusion presses, which draw out solid billets of round or rectangular cross-section into long bars of often intricate cross-section; (g) piercing and drawing presses, which convert a *solid* bar or billet into a longer *tube* or *pipe;* and (h) powder metallurgy presses, which press metal powders held in dies to "briquettes" of roughly finished shape, ready for a consolidating heat treatment.

There are other important types of presses and metal-pressing operations, but out of the aforementioned group have come some of the most significant technical achievements of our war production effort. For example, the development and present manufacture on a large scale of steel cartridge cases has been called by Major General Campbell, Ordnance Chief, one of the outstanding mechanical accomplishments of this war, and it all centered about the successful use on *steel* of press equipment originally designed and built for drawing *brass* cases.



Courtesy American Magnesium Corporation

Magnesium wheel covers for airplanes receiving the second cold draw in their production

In World War I the Germans had tried with only limited success to produce cartridge cases of steel instead of the traditional brass. American success with the problem in this war has been complete, for steel cases are being made in practically all calibers, the ammunition on which they are used can be employed in barrage fire (German steel cases of World War I could not, because cases could not always be extracted properly), and several hundred thousand tons of copper and zinc per year are being saved for other uses.

The technical problem involved the production of a case (1) made of steel, (2) on presses like those used for brass, (3) economically and on a high-production scale, (4) whose wall would be elastic enough to expand at the moment of explosion and make a tight seal against the breech of the gun, and then to contract to permit ejection; and (5) whose body must be strong to resist the stresses of firing but whose mouth must be very soft to insure complete seal against back-fire of the propellant.

These physical properties in the steel are obtained by the cold work of the pressing operation. The operations had to be modified, additional draws introduced, new types of dies employed, and so on, for steel draws less easily than brass (the stress within the elastic range to produce a given amount of extension in brass is approximately one half that of steel), "picks-up" on the dies to a greater extent, and corrodes more rapidly.

Yet more than 50 manufacturers are now making steel cartridge cases, thanks to the co-operative efforts of scores of American manufacturers, engineers, and Army and Navy ordnance officers.

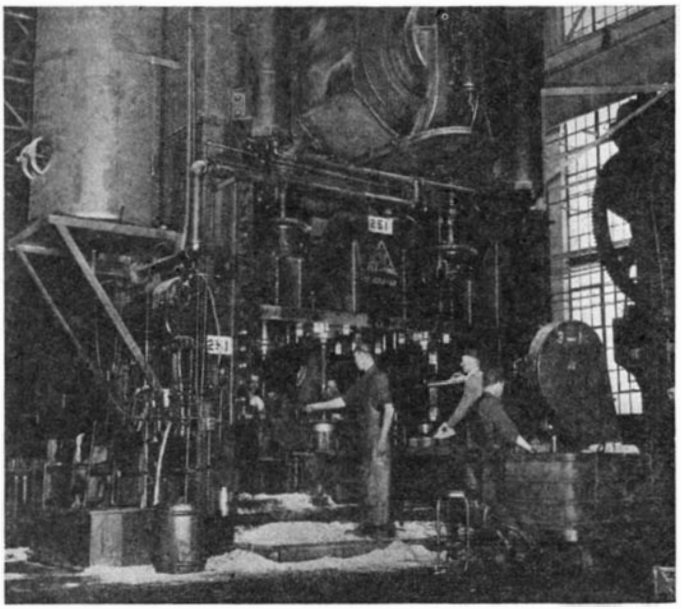
Steel cartridge cases and pierced-and-drawn gun tubes are two single large-scale applications of metal-pressing to the winning of the war. Of at least equal importance as a contribution to Victory has been the systematic and widespread conversion to stampings of numberless ordnance products formerly made by methods involving much waste metal, excessive machining, or inordinately long production-time.

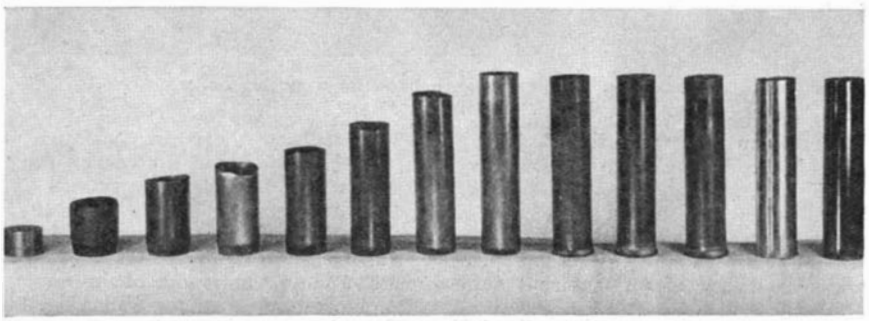
Stamping and allied metal press-working operations provide several advantages over casting, forging, or machining for many military items. Once the dies for stamping have been made, production is rapid and economical and parts are interchangeable. The parts as they leave the stamping press often require no machining, so that the slow and wasteful removal of surplus metal is largely eliminated. Scrap from stamping operations is usually much less than that from machined bar stock, castings, or forgings. Very often, too, steel stampings are able to provide sufficient strength even in thin sections to match the properties obtained conventionally in thicker sections of more critical brass or

aluminum forgings or castings.

These are the same advantages that enabled pressed metal fabrication to cut costs in peace-time mass production. Early automobiles, for example, used rolled shapes, castings, forgings, and wood in their construction. The modern car is made largely of pressed steel—especially the frame, body, wheels, and fenders. To a large extent, so were refrigerators, washing machines, oil burners, electrical appliances, and so on, and these and similar markets kept 880 stamping and press-forming plants going to the tune of $277,000,000 worth of business in 1941.

But in 1942 the stamping





Photographs courtesy Buick Motor Division, General Motors Corporation

Illustration at the top of the page shows a general view of a press used for drawing steel cartridge cases. At the left is a close-up of the same unit. Directly above is a line-up of the forming operations from bar to finished cartridge case

industry's level of operation had fallen to 25 percent of capacity through curtailment of manufacturing in the automobile and other consumer product fields, and the situation of many of the plants, with idle machines and equipment, yet plenty of "know-how," was desperate indeed.

Then came The Great Conversion, one of the truly great production achievements of this war. Ordnance items were largely designed as castings or forgings, or to be machined from bar stock. It became apparent to ordnance officials and WPB early in the war-production program that facilities for these types of fabrication would be swamped. Alert stampings manufacturers saw these casting, forging, and machining bottlenecks on one hand and their own idle presses on the other, and determined to do something about it.

One of them redesigned a number of ordnance parts to permit fabrication by stamping and submitted the new designs to the Chief of Ordnance in Washington, where they were enthusiastically received. Then, to facilitate the redesign on a large scale of other ordnance and aircraft products, the Ordnance Department established in May 1942 a Suggestion and Conversion Section in Washington and in the 13 Ordnance District offices, while the stamping manufacturers formed the Pressed Metal Institute to assist in surveying available equipment and in subcontracting.

This collaboration has been tremendously successful. During the first month 50 ordnance products were studied and 17 approved for conversion from forgings, iron castings, or machined bar stock to metal stampings. Suggestions are "screened" and processed in the district offices before being sent to Washington; up to the middle of this year 2708 redesign suggestions had been thus handled, of which 1042 are now in production.

THESE conversions to stampings have been limited chiefly to small parts, which also happened to have been the biggest bottlenecks. Frequently metal has been saved by reducing the weight of the finished part. At times a press assembly or a brazing operation or spot welding has joined several small stampings to duplicate a machined piece.

Irregular shapes that could be machined only with great difficulty are now produced in a single rapid operation on stamping presses. Locating-holes are punched in the same operation that produces the stamping, and the cost of a jig for drilling and the extra machine-time are obviated. And, as mentioned earlier, aluminum, brass, Monel, and other critical metals are replaced by steel with no sacrifice in strength and often with a lowering of weight.

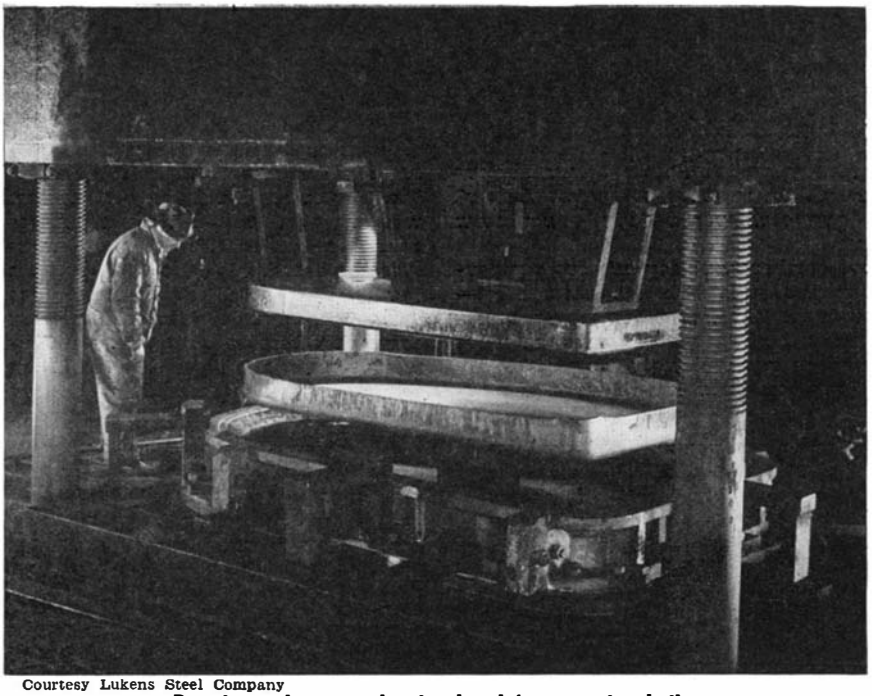
Typical of what has been done is the redesign of the earpiece for an artillery sound-locator helmet. Originally this piece was cast of aluminum alloy into metal molds and required 0.63 machine-hour for its production and 0.5 assembly-hour. Projecting from the convex surface of the earpiece was an eccentrically located, integrally cast, machined, and tapped tubular member to which the sound tube was attached. Near the edge of the casting 48 small holes were drilled to permit sewing-on a sponge rubber, chamois-covered pad.

As redesigned, the new earpiece is a sheet steel stamping covered with a low-grade molded rubber pad, and with an attached tubular member turned from steel tubing on a lathe, but suitable for ultra high-speed screw-machine production. The new piece is sturdy, light in weight, comfortable, and every bit as effective as the original model.

The trigger housing for the .30-caliber carbine was formerly made from a steel casting or forging weighing 1.3 pounds. It is now made as a steel stamping weighing 0.675 pound, and costs $2.00 as against $6.00 by the previous method. Machining operations were reduced from 36 to 14 and machining time from 40 to 7.2 minutes. For every million carbines made it is estimated that enough steel will be saved to make 135,000 additional carbines of the same type.

The files of the increasingly influential Pressed Metal Institute and of the Ordnance Department are replete with case histories like these. For example, the sight for the now-famous "bazooka" is an assembly of stampings, and its design-development set a record for speed, only 14 days (instead of the expected 60) being required. Two prime contractors were signed up; the first found five small companies to make the dies and handle the stampings and assembly. Two of these had only 8 employees, two others had 10 and one had 50. One was a tool shop on a chicken farm. The second subcontractor sublet to three concerns, one with only 5 employees.

Late in July of this year the Operating Committee on Aircraft Materials



Courtesy Lukens Steel Company

Pressing a large combustion head for a marine boiler

Conservation (a creature of WPB's Aircraft Production Board, the Army Air Forces, and the Navy Bureau of Aeronautics) announced that greater emphasis was required on conservation through improved manufacturing processes as distinct from materials substitutions. The committee cited a number of conversions to stampings that have been most economical of time, material, and cost. Savings on one order were estimated at $660,000 when an aircraft engine component formerly machined from stainless steel bar stock and tubing was converted to a sheet metal stamping.

In another case the substitution of a drawn plain carbon steel aircraft part for one machined from stainless steel bar stock reduced the material consumption per 1000 units from 285 pounds of stainless steel to only 62.5 pounds of the far less critical carbon steel. In addition, scrap production was lowered from 83.5 to 24.5 percent.

The results of the Ordnance Department's Suggestion and Conversion program to date have been evaluated by the Department on the basis of the 1943 ordnance procurement program. It is estimated that 64 million pounds of nickel, 17.5 million pounds of chromium, 5.2 million pounds of tin, and 4.3 million pounds of molybdenum will be released for the manufacture of other war material by substitution of low-alloy or carbon steel stampings for stainless or other high-alloy metals.

The three primary war-production raw materials will be heavy beneficiaries of the program, too. Substitution of steel stampings for aluminum die castings and other forms will make available enough aluminum for 25,500 fighter planes. Copper equivalent to more than three billion rounds of .50-caliber aircraft ammunition will be freed, while enough steel for the construction of 31,000 railroad oil tank cars is the estimated saving of that metal.

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WARPED ARMOR

Plates Now Held Flat During Quenching

A MAJOR problem in heat treating armor plate—especially the light plate now so widely used—is the warping that occurs, during quenching, when the steel plate passes through its "critical" range. Overall flatness specifications are such that armor plate which has been quenched by ordinary tank or spray methods must be mechanically straightened afterwards. In many armor-treating shops that portion of the total time, labor, and expense consumed by straightening alone is the largest single item on the work or cost sheet.

To overcome this, about a dozen American armor plate manufacturers are now using a new type of "pressure quench," or some modification thereof, that automatically keeps the plate straight during the quenching process and obviates a large part of the separate straightening operations. It consists essentially of an ingenious but simple arrangement for pressing the plate uniformly on both faces and simultaneously spraying both faces with water from the pressing unit as the plate emerges on a conveyor from a continuous-type hardening furnace.

In detail, the pressure quench comprises a rugged structural steel framework with a horizontal stationary upper press platen and a movable lower platen. As the armor plate emerges from the hardening furnace it passes onto separately driven conveyor rollers, which are stopped at the moment the plate is entirely on them and located directly between the platens. The lower platen then rises and its upward projecting lugs lift the plate off the rollers and press it against the downward projecting lugs of the upper platen. With the plate in this position the quench water is sprayed out of the platens on to both surfaces of the plate. When quenching is completed, the lower platen is lowered, the plate is deposited on the roller conveyor, which then carries the plate away.

Hardness tests show an astonishing uniformity of production quality. In one case observed all but three out of 210 hardness tests on successive plates gave *exactly the same* hardness reading, and even those three were well within specification limits.

But the big advantage is the saving in straightening time and labor the pressure quench provides. In one plant this amounts to 35 percent of the total man-hours formerly consumed in the handling, treating, and straightening of armor plate. In another, 75 percent of the straightening work—itself a major part of the total fabrication—was eliminated through use of the pressure quench.

Most of the pressure quenches in use were designed and built by The Drever Company. The Ford Motor Company has built its own units along lines similar to Drever's.

PLATING PROBLEMS

Call for Exercise of Good Technology

THE WAR has simultaneously accelerated the application of science in the electroplating industry and increased the electroplaters' awareness of the formidable technical and commercial problems ahead of him.

E. W. Cochran, of National Cash Register Company, for example, expects platers to be more conserving of the vital ingredients of their baths after the war than they were before. Formerly it was standard practice to dump down the sewer used plating solutions containing 20 to 50 percent of their original metal content. Now there are available and in use resins with absorptive properties that are controllable and by which a large measure of the previously wasted bath metals can be recovered.

Chromium plating of tools, anodic treatment of aluminum, and electrolytic polishing of various metals to secure a bright finish or to remove burrs are processes new to many electroplaters and are expected to be commonplace in the post-war picture. These and others may be needed, though, to solve some of the new problems the plater will face.

Thus electroplating will find itself in competition with the new oxide and phosphate coatings that have been highly developed during the war. Hot-dipped tin may return to compete with the "emergency" electrolytic product. So it isn't going to be all clear sailing and good technology plus good business will be very much required.

A New Industrial Frontier

This Nation is Waking up to the Increased Speed and Economy of Production Implicit in the Practical Cultivation of a Variety of Supposed Theorist Hitherto Thought to be a Luxury—The Applied Mathematician. Things are Being Done About It

By FRANKLIN P. HUDDLE

IN THE late 'twenties I heard a Commander of our Navy describe a difficult and expensive test he had recently completed on the effects of depth bombs upon the hull of a submarine. He had taken one of the obsolete "O"-Boats from an Atlantic base out to sea, submerged it, dropped depth charges alongside, and then raised it to see what damage had been caused. The inspectors risked their lives to examine the interior of the damaged submarine in the choppy waters of Long Island Sound. More recently I read an exciting narrative, written by a test pilot who risked his life frequently to determine the characteristics and performance of new designs and models of aircraft.

Although such hazardous experiments have long been regarded as virtually the sole way to learn facts about submarine and aircraft design, Europe has long used a short-cut which America, with its great wealth of raw material and time, has ignored. Many questions which we have answered by expensive and dangerous experiment could have been answered more cheaply and safely by a mathematician with experience in engineering techniques.

The United States is by no means laggard in the entire field of mathematics. To the contrary and beyond reasonable doubt, this country leads the world in the theoretical branch of the science. However, abstract mathematics has gone far beyond the scope even of most graduate engineers; almost all of them, while perfectly competent in the mathematics of known designs, are unable to take full advantage of new developments in this highly complicated, wholly theoretical, field. On the other hand, engineering science has progressed so much that the theoretical mathematician cannot easily see the relationship between the abstract formulas and the practicality of new designs.

This gap between the abstract and the concrete is bridged by the applied mathematician.

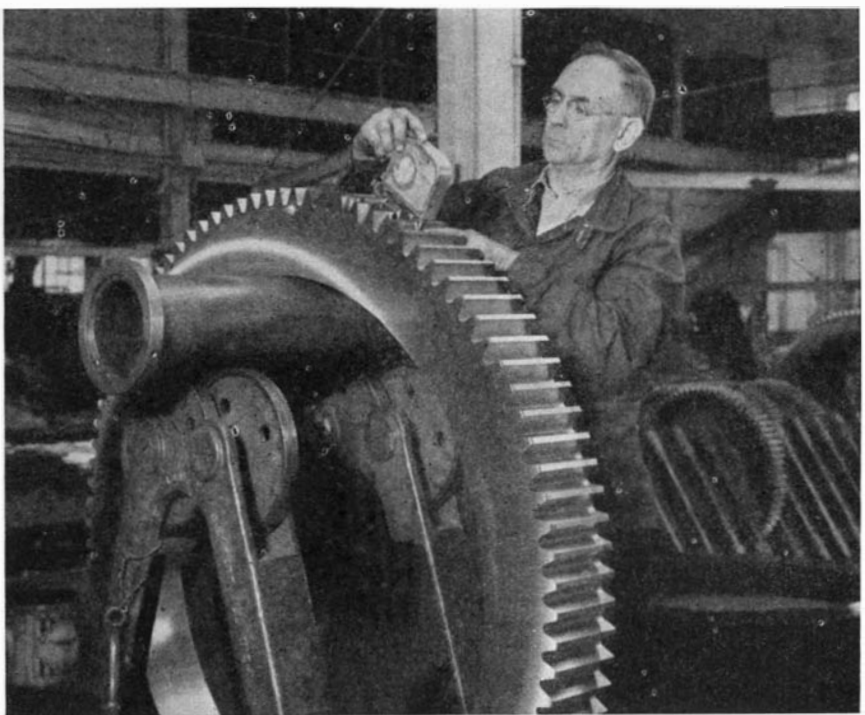
Speaking mathematically, the average engineer is versed almost exculsively in the application of familiar, prepared formulas to specific situations, and perhaps in occasionally adapting such formulas to new uses. In building a bridge or a ship hull or a conveyor system or a production line he computes by substituting known quantities within established formulas. Thus he can determine how large stringer *A* should be, how to neutralize the effect of the torque at point *D*, or how rapidly the system should pass a given point and how to build accordingly. (This description is not however, intended to imply that the engineer is a mathematical babe in arms. On the contrary, he must have a pretty solid working knowledge of the subject, in order to use some of the formulas of his vocation. Most engineers themselves do, nevertheless, regard mathematics as only one of the tools of a highly varied and highly integrated profession.)

The theoretical mathematician, on the other hand, almost never relates the development of his formulas to concrete, material objects. He starts with an assumption *in vacuo* and develops its relativity according to mathematical principles. He cannot be expected to perceive the application of his ideas to reality—that would hold him down. If he can express entirely theoretical relationships he is content.

The third member of the trio—the applied mathematician—is something of an engineer and something of a theoretical mathematician. He is able to juggle theoretical mathematical relationships, yet, at the same time, he is concerned with their practical application. While working with theoretical concepts he is continually alert for ways in which they can be practically applied. This over-simplification (like most over-simplifications) is misleadng if taken too literally. Some of our applied mathematicians are perfectly competent to produce brilliant theoretical papers; the converse is also true. But such men are all too rare, and in this age of specialization perhaps it is best to speak of the departments as if they were indeed water-tight.

The emphasis of this article is that by specializing in the application of abstract theory to specific problems the applied mathematician is able, often, to answer questions that might go unanswered or might be solved only at the cost of long experimentation. America is only beginning to realize the advantages to production inherent in this subject, but it becomes increasingly true that many types of production in this country could be helped in one way or another by the services of an applied mathematician. One illustration of this statement comes from the field of aircraft design.

For a number of years airplane wings were built perpendicular to the axis of the fuselage. Information about air-



Courtesy Westinghouse Electric and Manufacturing Company

Applied mathematics solves problems of production; it tells exactly how close a tolerance is needed in some kinds of products, and thus saves time and money, both of which are lost when the tolerance is set by the old method of playing far on the safe side, in order to be assuredly within the actually needed tolerance. Measuring tooth contour of high speed gears for electric locomotives.

plane design was built around the premise that this principle was constant. Now, for military reasons, it has become desirable to introduce a "sweep-back," so that the wing tips are further aft than is the "root" of the wing where it joins the fuselage. Necessarily this considerably changes the wing properties. A disproportionate amount of the support of a wing is contributed by the wing tips. When an airplane is about to land or take off, its tail is lower than in flying position; at that time the wing tips may be "stalled," and since this rarely happens simultaneously for the two wings, one tip is likely to droop. When this happens close to the ground and while the airplane is still traveling at high speed, the craft and pilot are in considerable danger. The airplane designer compensates for this by twisting the wing tips very slightly so that the leading edges are lower by a hair than are the trailing edges of the wing tips. Thus when the airplane is landing or taking off, with its tail low, the stalling of the wing tips will be delayed. The disadvantage of this expedient is that in normal flight position the twisted tips become inefficient. The mathematician's problem is to discover the optimum point at which the greatest flying efficiency is consistent with landing safety.

Ten or twenty years ago this problem would have been solved by building a considerable number of experimental airplanes, each with a different twist to the wings. Perhaps a portion of these would be destroyed in tests and two or three test pilots would have been endangered, but the information would have been learned experimentally. Today the applied mathematician takes the problem, develops it, and sends in his answer. The aeronautical designer follows these figures in building his planes. Models are still subject to wind tunnel and practical tests but the margin of error is diminished, and speed, efficiency, and economy of construction are increased.

Another problem in aerodynamics that is today engrossing the attention of applied mathematicians is that of "flutter," the self-excited vibration of airplane wings in flight[1]. With modern speeds this flutter problem has become much more important than it was in the early days of flying because extreme speeds accentuate its damaging effect. The result of flutter is closely analogous with the magician's shattering a pane of plate glass by sounding a single note on a violin. Wings under the stress of flutter have actually been known to disintegrate in flight. Since the premium today is on speed, this problem is an imminent one for designers and hence for applied mathematicians.

If the wing of an airplane is considered complex, then the propeller of an airplane is at least equally so. In principle the two are identical. However, while a wing progresses in a straight line, a propeller revolves in a fixed circle. Naturally, the speed of any part of a propeller blade is directly proportional to its distance from the hub.

It is an established fact of aeronautical design that wings of airplanes must be designed to reach maximum performance at the speed at which they most frequently travel. But every point on a propeller blade, when the speed of revolution is constant, has a different rate of speed. Therefore it follows that if one were to pass planes perpendicular to a line drawn from the hub of the propeller to the tip of one of the blades, each plane section must be slightly different in design from its neighbors. As a matter of fact, the section of the propeller blade near the hub is very similar in miniature to the cross-section of the wing of a slow-speed high-lift airfoil, while the tip follows quite closely the section of a high-speed low-lift airfoil. In addition, the angle of blade setting also must vary with each section of a propeller blade, such that from the extreme at the hub of perhaps 45 degrees the angle approaches six or ten degrees at the tip. Finally, the airfoil structure which is most aerodynamically perfect, is not necessarily the most sturdy in construction. It is necessary, therefore, to consider compromise of design to secure an optimum between maximum rigidity and maximum aerodynamical efficiency.

[1]Dr. Theodore Theodorsen, National Advisory Committee for Aeronautics and a member of the Brown University Advisory Committee, has worked out the fundamental mathematical theory so that not only can the "critical speed"—speed at which flutter begins—be accurately foretold, but designs may also be modified, theoretically, so that flutter will not occur within the contemplated speed range.

Official U. S. Navy photo from OWI

As explained in the text, when an airplane wing is "swept-back," so that the tip is farther aft than the root of the wing where it joins the fuselage, the wing properties are altered. To avoid building a whole series of experimental models, the applied mathematician works out the optimum design by theory, saving time and money. Navy's Coronado PB2Y-2, designed by Consolidated

ALTHOUGH this itself is an extraordinarily complex problem, it becomes even more complex when one realizes that each propeller blade in actual flight creates a sort of "interference" for the blade behind it, and that this interference is relative to the speed pitch, and number of blades.

When one has mastered the mechanics of these problems, then one is ready to graduate to the infinitely greater intricacies of controllable pitch propellers in which the angle of blade setting of the propeller may be varied in flight. To find solutions to all these problems by purely experimental means would take a lifetime. The mathematician's approach is difficult and complex enough but it has the great virtue of relative speed and economy.

Applications of mathematical methods are by no means limited to aeronautics. A captured German submarine, recently examined by a group of government experts, revealed that it had been built to withstand the shock of a depth bomb going off relatively close to the hull. This refinement of design indicates that in the problem of submarine construction the Germans have already consulted their applied mathematicians and hold an advantage over us. Our ship designers have appealed to applied mathematicians in this country for facts about structural elasticity and plasticity to enable them to build ships more resistant to the shock of a torpedo, depth charge, or bomb explosion. In this way the applied mathematician has played a part in the "Battle of the Atlantic."

Applied mathematics has been used to solve problems of production as well as design. About 20 years ago Dr. Walter A. Shewhart, now a consultant for Bell Telephone Laboratories, developed a system known as "statistical quality

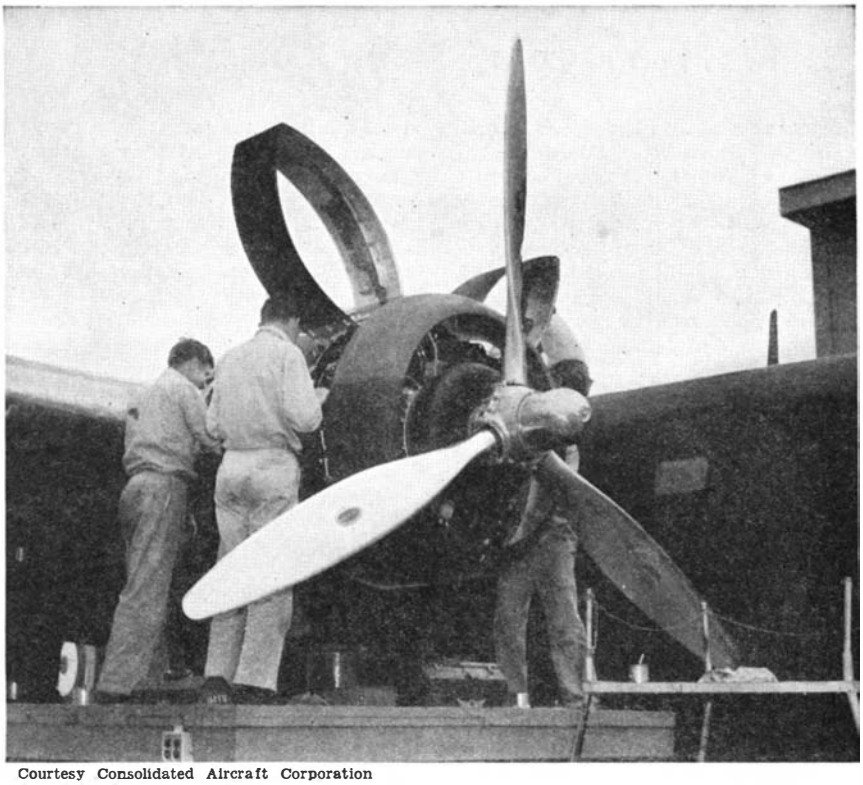
control." This method, which is applied to mass-production techniques, combines the statistical approach with the science of engineering to effect both economy and uniformity of production in industry.

Certain products of industry cannot be tested without destroying. A match company that insisted on testing all its products would not be much of a success. Likewise, in the manufacture of bomb fuses or explosive shells, tests must be run continually; yet, the more tests the less efficient the production. It becomes the job of the statistician to determine how often samples should be taken from the production line for testing. If too few are taken, uniformity may not be assured; if too many, the expense becomes prohibitive.

The same method is also applied to the determination of tolerances. We know, for example, that a bolt must be designed within narrow limits or tolerances in order to fit inside a bolthole. It is manifestly impossible for bolts, however precision-made, to duplicate with perfect exactness the original model. Yet how far away from the original model does the engineer dare to go? To decide such questions is important from the point of view of operation of the finished product but it is also important from the point of view of production. In practice the engineer usually plays safe by ordering a tolerance far smaller than is really necessary. If the company follows his tolerance limits rigidly, as it is supposed to do, a great many pieces will be rejected as faulty. On the other hand, if the statistician is handed the same problem, he will be able to compute what the tolerances should be to maintain the maximum degree of safety in relation to a minimum degree of spoilage. Perhaps nine tenths of the parts thrown away in response to rigid and over-close tolerances are in actuality perfectly acceptable and useful.

IT IS easy to see that such a process makes production more efficient, lowers the cost of the item, and increases the speed with which it may be produced. Dr. Shewhart's method is widely used in the United States, Great Britain, and Russia. The United States government has trained hundreds of people in the application of the theory at its Aberdeen, Maryland, Proving Ground and at other production centers.

A considerable impetus has been given to the development of applied mathematics in America by the social unrest in Europe, beginning in 1933. Since that time a large number of European scholars have migrated to this country to add their enormous contributions in science to the domestic product, with the natural result that the combined outpouring has elevated our own standards immeasurably. Mr. Arnold Dresden in *American Mathematical Monthly* (Aug.-Sept., 1942) lists 131 mathematicians who came to this country between 1933 and the first half of 1942. Generally speaking, America has been able to welcome and to place such scholars quickly, and to profit by a type of training which hitherto has been largely peculiar to Europe. Nevertheless, America still has a long way to go.



Courtesy Consolidated Aircraft Corporation

In principle, the wing of an airplane and the blade of a propeller are identical —each is an airfoil. Just as the wing is designed for maximum performance at a given speed, so each section of a propeller blade from the hub to the tip is slightly different in design. Here the applied mathematician outshines experiment

For a very good reason Europe is far ahead of us in techniques of applied mathematics. We have set a high value upon brains and a low value upon time and materials, while Europe's sense of values reverses these commodities. Consequently, European technicians make a practice of reducing the chance of error before they begin to build. They discovered that the possibilities of this method were limitless in extent and have made it a point of honor to develop a sound theory before experimenting with new construction designs.

Applied mathematics had its modern origin when Napoleon realized the military value of mathematical officers. The scientific work of the French in the early 19th Century was a major contributing cause to their military successes. The Germans quickly realized the importance of the applied mathematical technique and, about a hundred years ago, established institutes at Wien and Prague, based upon the original institute—L'Ecole Polytechnique—at Paris. After these two came a large number of other so-called "Technische Hochschule." The Germans explored the subject of applied mathematics with customary thoroughness. They created a number of highly specialized institutes in hydrodynamics, aerodynamics, electricity, and related subjects. To obtain the best possible instructors for these institutes they maintained a high rate of pay for the faculties. In recent years the Kaiser Wilhelm Institutes at Berlin and Göttingen, and the Aerodynamical Institute at Aachen, supported in part by the government and in part by private industries, have made great progress in industrial mathematics. As an example of the proportions: At the three institutes attached to the University of Göttingen[2], in the year 1938, fully 2000 persons were employed in aerodynamical research, including scores of mathematicians.

For comparison with this figure is a report made late in 1940 before President Roosevelt and the 77th Congress[3] by Dr. Thornton C. Fry, mathematical research director of the Bell Telephone Laboratories. Dr. Fry states that the number of mathematicians in this country employed in communications, electrical manufactory, petroleum industries, and aircraft, is estimated at about 100. He estimates that another 50 are engaged in other mathematical problems relative to production. In addition, the government employs about as many mathematicians as does private industry.

Considering the enormous industrial productivity of the United States it is truly striking that this number is so small. It is likewise extraordinary that the valuable contributions of this small group are so disproportionate to its size. According to Dr. Fry: "The group (of applied mathematicians employed at Bell Telephone) has functioned successfully for a number of years. . . . Information regarding their activities reaches management almost entirely

(*Continued on page* 235)

[2]Largest of the three is the Aerodynamic Experimental Station with about two thousand technicians. The other two are the Kaiser Wilhelm Institute for Flow Research with about 50 and the Institute for Applied Mechanics with about 15.

[3]The Committee on Survey of Research in Industry, appointed by the National Research Council, submitted a report to the National Resources Planning Board and to President Roosevelt. Dr. Fry's contribution is *House Documents* Section 6. Part 4, pages 268-288.

Conducted by KEITH HENNEY

Super-Sight With Phototubes

Printed Designs Moving Through a Paper-Handling Machine at High Speeds Are Invisible to the Eye, but the Phototube in a Modern Control System "Sees" these Designs and Makes Each Arrive at a Particular Point at a Particular Instant. Other Industrial Uses

By JOHN MARKUS
Editorial Staff, *Electronics*

WHEN IT comes to speed, the human eye is a piker compared to a phototube. Just watching the evening paper rolling out of a modern newspaper printing press will prove that; our eyes can't read a single line on pages moving past at such high speed, and even have difficulty in distinguishing one page from the next. The modern phototube, on the other hand, can read those moving lines of print right down to a hundredth of an inch even if they are moving past at nearly a thousand feet a minute, and can issue electrical commands which make each line or mark arrive at a particular spot in the machine with that same accuracy of 1/100 of an inch.

When it comes to reliability, also, the phototube wins out. Consider, for example, a man who is watching an ordinary automatic candy-wrapping machine to make sure that each piece of wrapping cut from the roll is cut between printed designs. Watch his eyes while a comely, sweater-bedecked blonde walks down the aisle past his machine. A hundred chocolate bars could be wrapped with half the design cut away during this distraction. No woman on earth, however, can make a phototube turn its eye.

When dealing with color, your eyes now and then can put up a better all-around showing. When, however, a phototube is designed especially for a particular color or a particular job, it will respond even to those yellows or purples that might fool some other phototube. As a matter of fact, there are photoelectric units which can distinguish and identify as many as 2000 different colors with an accuracy that can be matched only by a very few of the country's best color experts.

One of the important industrial uses for these qualities of the phototube is implied in the foregoing description of characteristics—the control of high-speed motion, known technically as photoelectric register control. It applies to all machines handling a continuous web or strip of paper, cellophane, or other material, and performing some operation on that paper.

This operation may involve printing on the paper in correct relation to previously printed matter; it may involve cutting the paper between repetitive printed designs; it may involve perforating the paper with rows of holes between designs; it may involve folding at a particular point in a printed design, or any other operation that must be performed with accuracy at a certain point in each repeated section of the web.

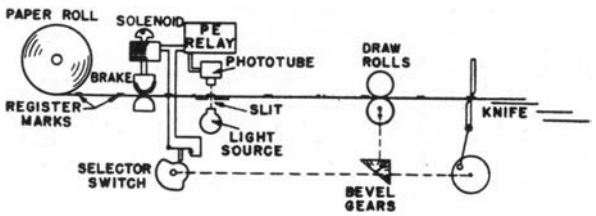
Machines can readily move paper at high speed and simultaneously perform any or all of the above operations, but minor errors of all kinds multiply rapidly at such speeds. The slightest error in the relation between the spacing of the printing and the distance traveled by the feed roll per revolution of the cutting, perforating, or folding device can quickly cause trouble even though the machine is started up in exact synchronism. Shrinkage of paper with changes in temperature or humidity can cause just as serious errors even in a perfect machine.

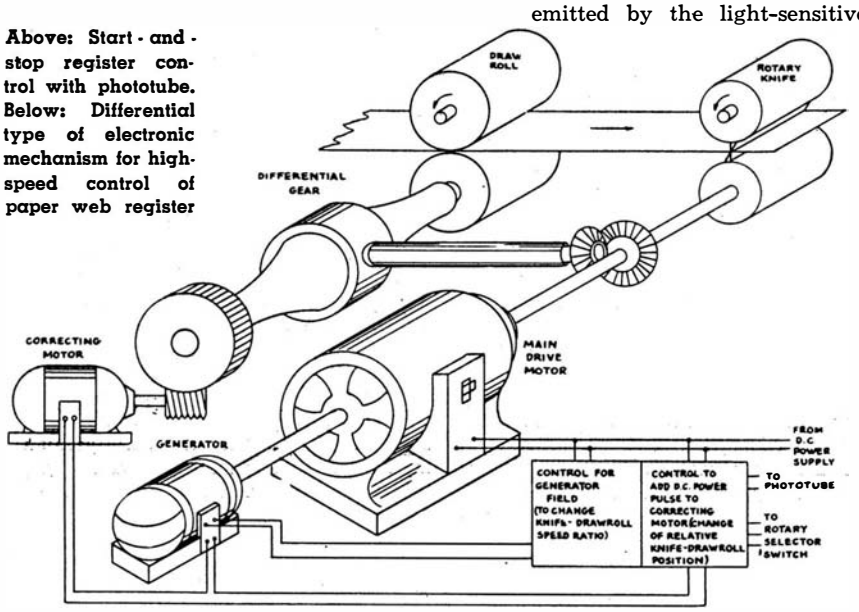
To utilize the many advantages of a unit design for wrapping a product, together with the economy of printing from a continuous web of paper rather than individual pre-cut sheets, some sort of register control is absolutely essential. The form taken by this control depends upon the speed of operation and the accuracy to which the register must be held.

Starting from zero speed and no accuracy, we soon get beyond the usefulness of the human eye as a register-controlling means. Holes punched in the paper at correct positions to pass between contact fingers of an electric circuit permit greater speeds, but holes, too, have their drawbacks. This brings into serious consideration the modern photoelectric device for controlling register without even touching the moving sheet.

To furnish an understanding of this operation, one application will be followed through, with the brief explanation that the principles will apply with only minor modifications to many other possible applications. A good example is the cutoff control, as required in packaging machines to cut one complete design unit from a roll of printed paper and pass it to the ingenious mechanical mechanisms that wrap and seal this paper around such things as candy bars, sticks of gum, and so on.

In the simplest form of photoelectric register control, a small register mark is printed in the margin of the sheet at each point where a cut is to be made. A light beam and phototube are arranged side by side so that the beam is reflected into the phototube from the moving paper. Since the marks are darker than the rest of the paper, less light is reflected whenever a mark intercepts the path of the light beam. This reduces the amount of light falling on the phototube, thereby changing its electrical characteristics. (Technically, reducing the light increases the electrical resistance of the phototube because it reduces the number of electrons emitted by the light-sensitive





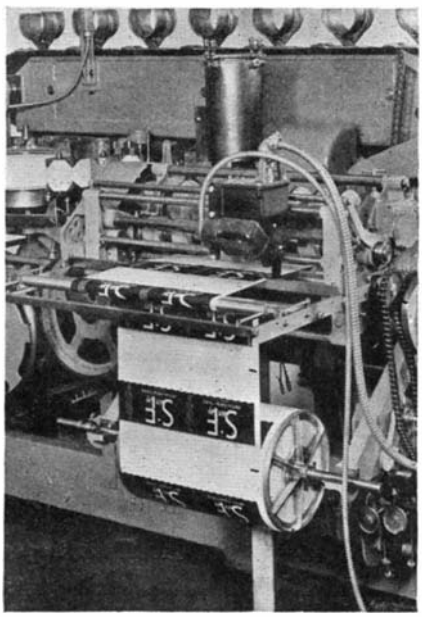
Above: Start-and-stop register control with phototube. Below: Differential type of electronic mechanism for high-speed control of paper web register

cathode of the tube.) Amplifiers respond to this change and actuate a magnetic brake that stops the paper right at that mark so it can be cut off. The brake then releases, the paper moves till the next mark is seen by the phototube, and the process repeats.

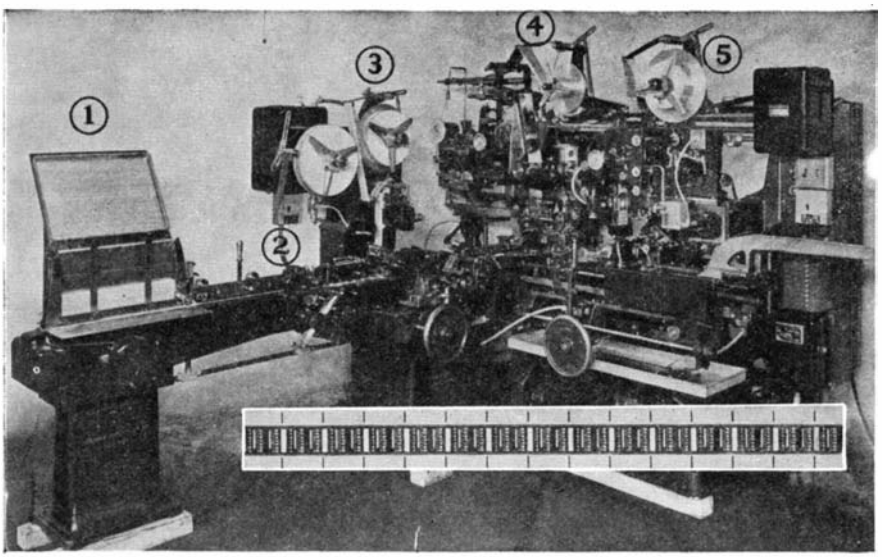
SIMPLE stop-and-start control is all right for many applications, but not for high speeds. To get increased output, the paper must be fed continuously and cut by a rotary knife. On the knife shaft is placed a rotary selector switch with two sets of contacts. One set stays closed during part of a revolution and opens just before the knife makes its cut, while the other set closes just after the cut is made and stays closed during part of the revolution. The phototube watches the register mark go by, just as before, but now its impulse does not stop the paper. Instead, the impulse due to a register mark is fed through one or the other of these rotary switch contacts to mechanisms that cause the knife to cut a little earlier or a little later than normal, as called for by the phototube. If the register mark comes by right at the correct instant, both sets of contacts are open and so nothing happens except that the paper is cut at the correct point.

To eliminate the necessity for the photo tube to continue "looking" at a register mark while the mark is being cut, the so-called scanning head containing the phototube and light source is placed a full wrapper length ahead of the knife, where it watches one spot ahead of that which is being cut.

The knife and spot are brought into register without stopping the machine, by means of other electronic devices. Inside the control cabinet are two thyratron tubes like those used in push-button electronic motor control equipment—electronic tubes that trigger-off on an electrical impulse like that produced by the scanning head. One thyratron is connected through the too-early contacts on the rotary knife, and

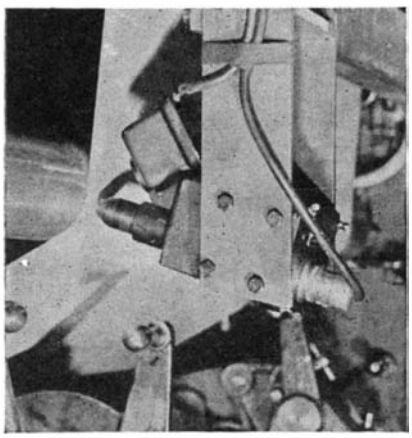


Photocell scanning head installed to control application of a printed wrapper to individual paper rolls



In this American Chicle Dentyne-gum packaging machine, unit 1 feeds strips of gum to unit 2, which cuts individual sticks. Unit 3 wraps each stick in a printed paper wrapper under supervision of phototube register control. Unit 4 wraps six sticks at a time in tinfoil with easy-opening tape, and unit 5 puts on the final printed wrapper, also with register control. Inset shows sample wrapping strip for individual sticks, with dark register marks, which actuate the photocells, at edges

the other thyratron is connected through the too-late contacts. One thyratron causes an auxiliary correcting motor to move forward, and the other thyratron makes the motor turn backward, as required to produce the required correction. A simple timing arrangement stops the motor, allowing only a given amount of correction, and resets the entire apparatus so that it is ready for more correction at the next register spot, if necessary.



The scanning head "watches" register marks on the margin of a sheet of printing paper going through a high-speed multicolor gravure press

The correction can be made in a variety of different mechanical ways, depending upon the machine and the ideas of its manufacturer, but these fall into essentially two basic types—the compensating roll and the differential.

The compensating roll comes from rotary press practice. After passing through the draw-rolls (which pull the paper from its roll), the paper is looped over the compensating roll, then run down through direction-changing take-up rolls to the rotary knife. The thyratrons here operate a reversible motor that moves the compensating roll either up or down, to shorten or lengthen the loop of paper going over the compensating roll and thus make the necessary correction of position at the knife.

The differential drive is similar to the differential of an automobile, which permits the inner rear wheel to turn slower than the outer rear wheel when going around a curve. The differential is placed in the drive between the rotary knife and the draw-rolls. At one end of the differential shaft is a draw-roll, and at the other is a gear that can be turned in either direction by a worm gear on the shaft of the reversible auxiliary motor. When register is correct, this motor stands still, and the draw-rolls turn at the same speed as the rotary knife. If the phototube calls for a change in position, the auxiliary motor provides just the amount of the change, with the main drive motor doing all the work all the time.

The simplest differential systems are arranged to provide a definite change in the relation of draw-roll to knife for each impulse reaching a thyratron, such as 1/32 inch either forward or back as required. In higher-speed systems, however, the main drive motor is geared to drive the draw-rolls 1 to 2 percent fast through the differential when the control motor is stopped. Now, when the control motor runs at half speed, the knife and draw-rolls run at the same speed. When the control motor runs at full speed, the draw-rolls run 1 or 2 percent slow. Power for the control motor is obtained from a small generator driven by the main motor, so that this percentage ratio holds true for a wide range of speeds of the entire machine. Also, field-control means are provided on the generator to counteract the cause of loss of register automatically. In this deluxe arrangement, register may be held so exactly that a hundred cuts or more may be made before any correction is required.

Now for a few everyday uses of auto-

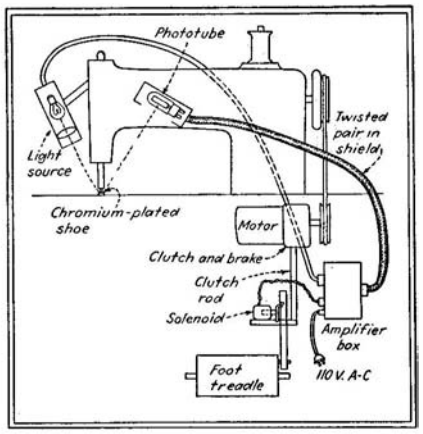
matic photoelectric registry control:

In Washington, the government has a rotary perforating machine that punches 3000 rows of holes a minute in sheets of stamps with an accuracy of 1/64 inch, guided by register marks printed in sheet margins to actuate a scanning head. Look for these marks the next time you get stamps with part of the sheet margin attached.

At a printing plant in New York City, four-color printing on a gravure press is registered so accurately by the phototube equipment that four different colors of dots can be struck with an accuracy of better than four or five thousandths of an inch, as required for high-quality color printing.

When dealing with cellophane, such as is often used for wrapping candy bars, the light beam is sometimes sent right through the material, with the light and phototube on opposite sides. Here again, registry spots reduce the amount of light reaching the phototube, so the principle of operation is the same as for reflected scanning.

Fitting the right photoelectric register control to a particular application is a job for a good electronic engineer. The many successful applications already made foretell an important role for this intriguing branch of electronics in the years to come, making better products at lower prices through electronic control.



A phototube system makes this sewing machine safe for the sightless

PHOTOELECTRIC GUARD

Protects Fingers of Sightless Seamstresses

TO PROTECT the fingers of sightless workers operating electric sewing machines, a photoelectric safety system has been developed by J. O. Kleber of the American Foundation for the Blind. The control system brings the machine to a complete and sudden stop whenever the fingers of the operator come dangerously close to the needle.

From the left side of the machine a beam of light is projected into the chromium-plated "shoe" of the sewing machine by a light source consisting of an automobile stoplight bulb and a lens in a tubular housing. The reflected beam is picked up by a standard phototube in a housing at the right of the shoe. The beam is thus about half an inch ahead of the needle, in a region through which the fingers of an operator might normally approach the needle.

All connections to the amplifier housing are made through four plugs, making it possible to install a new amplifier unit in a few minutes if trouble develops. This is a highly desirable feature when workers are paid on a piecework basis.

The sewing machine is a standard commercial model, in which the motor runs continuously. Pressure on a foot treadle connects the motor to the machine through a clutch and simultaneously releases a brake. Releasing pressure on the foot treadle, or equivalent "breaking" of the rod which links the treadle to the clutch, will therefore disconnect the motor and apply brakes to the machine.

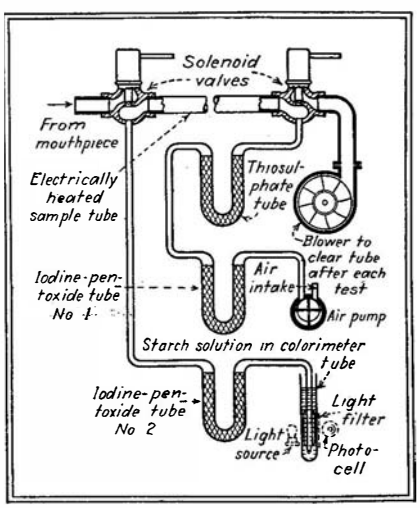
The relay in the plate circuit of the amplifier tube controls a solenoid which, when energized, "breaks" the clutch rod and thus stops the machine. As soon as the obstruction is removed from the light beam, the clutch rod can be restored by momentarily removing foot pressure from the treadle.

INTOXICATION

Indicated by Photoelectric Analysis of Breath

AN ELECTRONIC method of diagnosing moderate intoxication at the time of an accident or arrest has been developed at Yale University. The apparatus is fully portable, requires only a sample of air, and gives a result in terms of alcohol concentration in a few minutes.

The essential features are shown in the diagram. An exactly measured sample of the suspect's breath is collected in a glass tube that is electrically heated to prevent condensation of moisture which might contain alcohol. The exhaled breath automatically passes through a tube of iodine pentoxide which oxidizes the alcohol and liberates iodine in proportion to the amount of alcohol oxidized. The iodine is carried in a stream of warm air to a glass tube containing a solution of starch. This starch turns blue in proportion to the amount of iodine present, and a photoelectric cell indicates the intensity of the blue color on a meter in terms of percentage of alcohol in the blood.



Electronic judge for drunken drivers

The various operations are timed and kept in proper sequence by a synchronous motor, hence the test is automatic once the motor is started. To use, the operator presses the starting button. When a green light appears, the suspect blows his breath into a mouthpiece. The operator then inserts a small glass tube of solution into a holder and waits five minutes for the meter reading.

If anything goes wrong, the apparatus fails completely—an essential requirement if the test is to have legal status. It cannot give an erroneous reading. The tube of final solution can be taken into court as evidence, and can be reinserted in the apparatus at any time to verify the concentration of alcohol.

MARINE GEARS

Controlled During Balancing By Electronic Means

AUTOMATIC control of the accelerating rate in bringing 17-foot diameter marine propulsion gears up to full speed of 200 revolutions per minute for dynamic balancing is now obtainable by means of electronics. The 50-ton gear to be tested is supported by bearings which permit the gear to vibrate freely in a horizontal direction. Pick-up coils convert this movement into electrical impulses which energize a wattmeter in a dynamic balancing circuit that indicates where correction of unbalance is required.

Electronic control equipment was chosen because both squirrel-cage and wound-rotor induction motors heated excessively during the required long acceleration time of 10 minutes.

EXPLODING GUNPOWDER

Makes Record of Uniformity On Cathode-Ray Tube

ELECTRONIC testing of gunpowder to insure uniformity in production runs, and thereby to eliminate errors in fire-control calculations due to variations in propelling charges, is one of many new wartime applications for the cathode-ray oscillograph.

A powder sample is exploded in a strong sealed container, and the voltages derived from pressure elements affected by the explosion are applied to the cathode-ray tube of a Dumont type 235 oscillograph. This causes the electron beam to trace on the fluorescent screen a path that constitutes a graph of pressure variations. This oscillogram is photographically recorded and later analyzed.

The entire process is automatic once the closed container or bomb has been charged and the circuit voltages adjusted. Pressing a plunger then automatically opens the camera shutter, turns on the cathode-ray beam, fires the charge, turns off the electron beam, and closes the camera shutter.

Conducted by The Staff

Packaging Delivers the Goods

Protection Against Heat, Cold, and Humidity, Mildew, Insects, and Vermin Is Demanded for the Safe Delivery of Supplies to Our Troops all Over the World. Developments to Meet these Rigid Requirements, Made by the Packaging Industry Will Carry Over into Post-War Days

By STEVEN M. SPENCER
E. I. du Pont de Nemours and Company, Inc.

GETTING the goods to the fighting front and to our allies is one of the war's most challenging tasks. It involves not only the problems of transport over crowded rail lines and through submarine infested waters; it requires also the strongest, toughest, most weather-proof packages ever produced, and these in tremendous quantities.

Supplying these, despite shortages of steel, tin, and rubber, has brought about something of a revolution in one of man's oldest industries. And to a certain extent it has meant a return to first principles, a shift from eye-appeal to solid utility.

Roots of the packaging industry go far back into prehistory. Crude clay pots came soon after the stone hand-axes of the Old Stone Age. Those of the Middle Stone Age even had painted and engraved decorations, a primitive concession to eye-appeal, perhaps, but not one which subordinated the main function of a container, the protection of its contents—wild grain, fruits, nuts, perhaps dried meat.

Some authorities believe that basket-making antedated pottery, that it may have been the earliest human industry. Because of their perishable nature, however, no baskets from the Stone Age have been found. The earliest ones that can be approximately dated are the large round grain baskets of Egypt, from 4000 to 5000 B.C.

Even the impregnated fiber materials of today's water-proof containers had their ancient prototypes, including one of the most famous baskets in history. For it will be recalled that when the mother of Moses could no longer hide the infant "she took for him an ark of bulrushes and daubed it with slime and with pitch and put the child therein." And the basket floated along the edge of the Nile.

But today's packages must withstand much more than the slow-flowing waters of Egypt's ancient river. Food, machinery parts, guns, bombs, ammunition, clothing must be packed in boxes than can be unloaded at Pacific Island destinations which boast no wharves, docks, or warehouses. Many of them are simply dumped into the ocean and landed by the tides or hauled up on the beach by soldiers and natives. Sometimes they must stand in the sun, buffeted by the waves, until men busy with fighting can take time off for stevedoring.

The heat and humidity of the tropics (which may be even more penetrating than the ocean water), mildew, insects, and vermin—these are other enemies which America's packaging industry is called upon to battle. And at the other end of the climatic scale is the North Atlantic, and the routes over the Scandinavian shoulder to Russia's Arctic gateway.

A general idea of the conditions these wartime packages must meet can be obtained from two sentences taken from an Army officer's description of an ideal package:

"The case should withstand a temperature of 100 degrees, Fahrenheit, and 95 percent relative humidity for at least 20 days without appreciable effect on the packaging or contents. The case and contents should withstand dropping twice on each flat surface (it had previously been dropped to a concrete floor once on each of two diagonally opposite corners, once each on all six edges and twice on each face) after being stored at 0 degrees, Fahrenheit, for 48 hours without the packages being appreciably damaged."

This, then, was the problem tossed in the lap of the nation's $4,000,000,000 packaging industry which had progressed from the pottery and basket age up through the cracker-barrel and sugar-sack era to the sophisticated modern period of cellophane, multi-color printing, and transparent plastics.

One of the first principles of 20th Century packaging has been attractiveness. The container was designed to induce people to buy. The accent was on merchandising, with protection of the contents more or less taken for granted.

If the package held up under normal conditions, it was considered satisfactory. But the war put all emphasis on protection and subordinated beauty and salesmanship, particularly in military and Lend-Lease goods and to a somewhat lesser extent on products for civilian sale.

Steel was reduced in military packaging and, except for very special purposes, was out of the civilian picture. So was tin. Rubber could be had only in limited quantities. Plastics were needed for more specialized war uses. This left glass and wood as the main raw materials for the nation's containers. And wood has performed yeoman service, indeed, not only in the form of boxes, crates, and barrels, but in the many products made from wood pulp including cellophane, paper, and fiber-board.

Cellophane, which at the time of World War I was a luxury item reserved for such glamor roles as wrapping expensive perfume bottles and candy boxes, had in the intervening quarter century become widely used to protect food from moisture loss or moisture penetration as well as from dust and germs. But in most cases it was still the package you could see through and for that reason its great popularity rested to a large extent on eye-appeal as well as on protection.

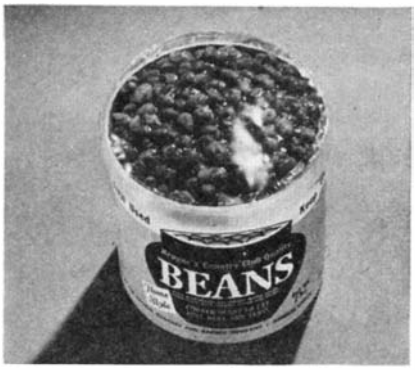
Today cellophane has put aside glamor to perform important war tasks in which its utility is the first consideration. Very often it is laminated to an opaque material—kraft paper or fiber-board—and its transparent properties are entirely lost sight of. It is the moisture-proof and grease-proof layer of the package, and the other materials

Official Signal Corps Photo

Wooden and fiber-board boxes, and multi-walled paper bags, in New Caledonia

are used to supply body and strength. Thompson sub-machine guns, Garand rifles, Browning automatics, are being wrapped in a laminated material, including cellophane and paper or scrim, impregnated with highly moisture-proof waxes. The wrap is heat-sealed at the edges and the guns are placed in wooden boxes. Only a very light coat of oil is needed, beneath this rust-proof wrapper, instead of the thick coating of grease formerly used. The new style of gun wrap thus obviates hours of tedious de-greasing, and the weapon is ready for immediate use at the front.

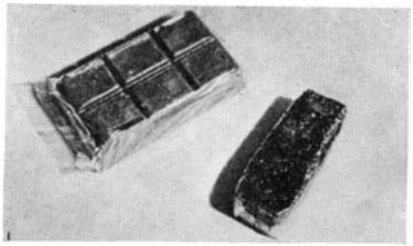
Replacement parts for aircraft, tanks, trucks, and ordnance—all of which must be protected against rust-producing moisture on the high seas and in the humid tropics—are even more painstakingly packaged. One widely used method is to wrap the part in one of the laminated cellophane materials just described, then dip it in a special wax, place the wrapped and dipped article in a strong fiber-board container, wrap the container with the laminated material, dip the wrapped container, and finally place this in a second fiber-board container, which is then sealed with cellulose tape. Pistons and connecting rods are among the many articles given this multiple protection against rust ond corrosion. Replacement parts for high-speed motors must fit with extremely close tolerances, and the damage which could be done by a spot of rust makes all too plain the need for such super-care in packaging.



Many parts are placed in transparent cellophane bags, some carrying the name and number printed on the front, for easy identification during assembly in the factory.

To safeguard whole airplane motors from damage by moisture they are wrapped in transparent rubber film, with bags of silica gel tucked about inside to soak up any moisture that may be present during packaging. Chemical moisture indicators are also placed within the bag to reveal at a glance when the moisture content has become too high.

In the food field the packaging revolution perhaps reached its height; the restrictions on tin, steel, and rubber have necessitated sweeping changes. Paper, fiber-board, and cellophane have been brought prominently into the picture. In the packaging of Army emergency rations, cellophane is being widely employed for sealing in the moisture content of some components, such as the fruit bar and cigarettes, and keeping excess moisture out of others, such as the biscuits, D-bar (enriched chocolate), powdered bouillon, and lemon juice. Several of these items then go into what is termed the K-bag, a double thickness material frequently consisting of two layers of cellophane laminated together. All of the components are packed in two cardboard boxes, one inside the other, and the whole package is then wax-dipped, to give extra moisture protection.



Left: Quick-frozen beans packed in a cellophane-lined fiber "can." Above: Heat-sealed cellophane protects chocolate bar and fruit bar, parts of Army "K" rations. Right: Precision parts and dehydrated carrot-juice cocktail in printed, transparent envelopes. Below: Dressings and medicines packed in moisture-proof, sealed wrappings. All photographs courtesy Du Pont Company

Lend-Lease and Army export shipments of dehydrated food are usually packed in fiber-board boxes, and are often given extra protection against moisture through the use of a wrapping material made of cellophane, lead foil, and asphalt-impregnated kraft paper, laminated together. Vegetable shortening is being carried aboard Navy vessels in grease-proof cellophane bags inside fiber-board boxes.

A new step which has created much interest in the food field, and which is being tested by Lend-Lease and Army authorities, is compression or de-bulking of food. The method, which squeezes out space-consuming air, not only saves 30 to 75 percent in precious cargo space but greatly simplifies the packaging problem. Metal is not needed, and smaller amounts of other materials are required because of the greatly reduced surface area. The little cakes and bricks of "nutritional ammunition" can be easily and rapidly packaged in standard cellophane wrapping machines, which heat-seal the film. Individual units are then boxed in fiber-board containers. Potatoes, ground meat, dried eggs, whole cranberries, diced or sliced carrots, beets, onions, and a variety of other foods have been prepared in this manner. A package the size of a small shoe box will hold enough meat for servings for 100 men. The food is quickly reconstituted or "freshened" in hot water and is soon ready for use.

Throughout the war packaging picture the fiber-board cartons, some corrugated, others solid, are doing an excellent job. In has been estimated that approximately 7,800,000 tons of paper-board will be used this year in the manufacture of these versatile shipping cases, cartons, and other types of fiber containers. One of the interesting developments in this field is a paper-board containing an inner layer of jute impregnated with urea-formaldehyde resin, which makes a very water-proof carton that has withstood long immersion tests. The Marine Corps exhibit at the recent Packaging Exposition in New York showed how a carton made of this new material and containing some light material, such as clothing, could serve as an emergency life-buoy in case of shipwreck, supporting one or two men in the water.

When the tin can and, later, ordinary black-plate metal were ruled out of the packaging picture, paper-board "cans" came in for packaging many consumer foods, from baking powder to shortening, syrups, and toothpowder. The paper-board is in some cases laminated to cellophane or glassine, or is coated with a water-proofing material such as wax. A sealed cellophane bag inside a paper-board box is a popular food packaging combination.

Glass is another replacement material that has found extensive wartime use. Most of the household-size paint items have had to shift from metal to glass jars. Coffee, fruits, and many other food products have also gone into jars. No sooner had the food industry expanded its use of jars than it found itself faced with a shortage of metal for tops, and of rubber for sealing rings. This has meant more shifts, and today some of the coffee jars are capped with stiff paper-board tops, impregnated with wax and sometimes given an outside seal with cellulose bands. Special gasket compounds for sealing had to be worked out. Jars of shortening are in some cases sealed with a cellophane drumhead to prevent oil absorption by the paper-board lid which fits over it.

In the bulk packaging field the shortage of steel for drums forced many products into wooden barrels, which also became short because of the difficulty of obtaining staves, and then into fiber drums. The demand for these far exceeded the supply. While the industry made only 3½ to 4 million fiber drums in 1941, it had stepped up its output by

early this year to a 12,000,000 per annum rate. There is an anticipated demand by paint, petroleum, chemical, and food industries, however, for some 30,000,000 fiber drums this year.

Cotton has replaced burlap, which comes mainly from the Far East, in much of the bulk packaging. Combinations of cotton fabric with water-proofed crinkled kraft paper linings have been widely used. Finally, multi-walled bags, all of paper, some treated with water-proofing materials, have found important use.

The American packaging industry has indeed been hard pressed by the greatly increased need for its products and the drastically reduced supply of raw materials required to make them. But with typically American ingenuity and resourcefulness it has drawn upon home-grown ingredients to fashion stronger, better packages in which to deliver the goods around the world.

There is no question, packaging authorities believe, that the new emphasis on protection of the contents will carry over to peacetime economy, with resulting conservation of shipped goods and greater satisfaction on the part of the consignee and the ultimate consumer. Development of new and satisfactory packages of paper-board, cellophane, and other organic materials is also expected to have wide post-war influence, saving metals for other uses and saving shipping weight as well.

British Official Photo

Women in an English Ordnance Depot removing American-made revolvers from paper and fiber-board protective transportation packages

Designing the container to catch the consumer's eye and persuade him of the desirability of the contents, is a packaging principle that will prevail in the post-war period, but the war-time lessons of protection will not be forgotten. The post-war package will not only proclaim the worth of the product; it will insure it in many war-tested physical ways.

PLANT HORMONES

Now Used in Dusting Powder for Seeds

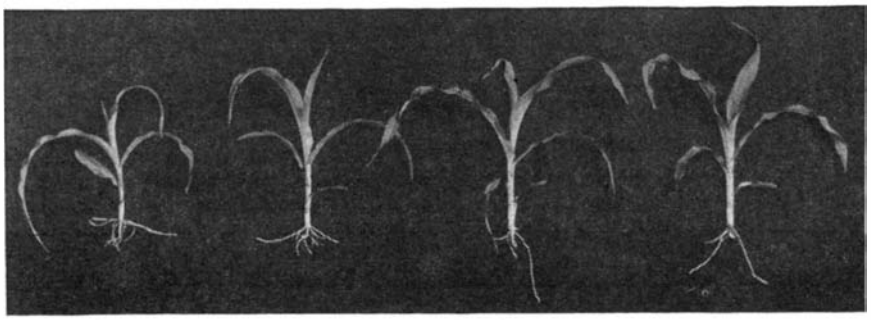
CONTINUED research on the use of plant hormones (growth-promoting substances), first reported in these pages in the issue dated November, 1941, has revealed that these substances can be stabilized in seed-dusting powders as well as in the fertilizer form previously described.

While hormones in the fertilizer (Hormo-Fert) are of greater benefit to growing plants than hormone seed treatment, experience has indicated the value of Hormo-Fert Dust for seed and root treatment of seedlings.

The joint use of hormones in the foundation fertilizer and in dust on the seed gives the plant a more complete and closer coverage of hormones with consequent better growth stimulation. One method supplements and reinforces the other. These two methods were jointly used during the past season on nearly 300 acres of barley, wheat, rye, and oats with markedly better results than by using one method alone.

Hormo-Fert Dust is a fibrous organic powder with the properties of a fertilizer plus extra growth substances, or hormones, evenly distributed throughout its mass. When dusted on seed or roots of seedlings, it promotes a quicker growth and better root system. Rougher seed, like barley, or oats, may be dusted successfully with dry dust. On smooth seed, such as corn and soybeans, the seed should first be slightly wet and then rolled in this mixture so as to secure a more complete coverage.

Seed dusted with the dust grows stronger roots than untreated seed. The treated seed grows faster and, it is reported, the plants will better withstand severe climatic differences—drought and heavy rainfalls. Not only are stronger roots and plants developed but there is a greater and earlier yield of bloom, seed, and fruit.—*Lionel Weil.*



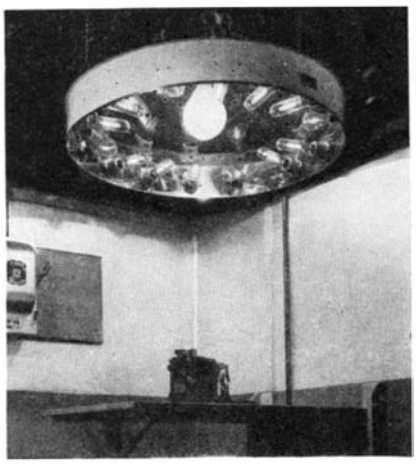
Left to right: Fertilizer without hormones; Hormo-Fert; Hormo-Fert and seed dusted with Hormo-Fert dust (dry); Hormo-Fert and seed dusted wet. All are same age

SIMULATED SUNLIGHT

New Generator Used for Testing Purposes

DEVELOPMENT of a "simulated sunshine generator," which for the first time closely approximates standard summer sunlight through a combination of 15 lamps of various spectral energy emissions, is announced by the Hanovia Chemical and Manufacturing Company. One of the first units produced is being used successfully by the Folmer Graflex Corporation to test the light-tightness of photographic apparatus being manufactured for the armed forces.

Other applications for this light source are accelerated fading, aging, and weathering tests, such as are conducted in many industries, for dye stuffs, paints and varnishes, roofing materials, textiles and rubber, or wherever materials are involved that should be tested to determine the influence of sunshine.



Simulated sunshine generator

The 15 lamps in the unit are a combination of four S-4, ten H-5, and one 1000-watt tungsten incandescent lamps. They are mounted on a chromium reflector so that the radiation covers an area of 1256 square inches.

AIR-CONDITIONED SUBS

Now Possible With New Fluorine Refrigerant

AIR-CONDITIONING of submarines is now possible through the use of a non-toxic, non-explosive fluid, called "Freon-12" fluorine refrigerant, which is non-poisonous, has no odor, and will not support flame. It does not explode should it come in contact with a sub galley's electric stoves, nor does it interfere with the chemicals which purify the air.

Air-conditioning equipment employing this refrigerant assures submarines fresh, cool air after long submersion. The men aboard the underseas vessels

so equipped can even smoke. This was an impossibility in other days when the precious air supply was carefully guarded against fouling.

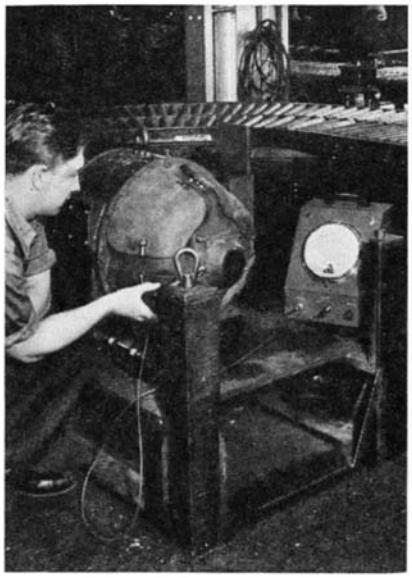
When a submarine surfaces in the South Pacific on a hot day, this modern equipment keeps the interior cool and comfortable. Furthermore, the machinery is of the reverse-cycle type, so that it can be "run backwards" to warm the air when the vessel is operating in cold weather.

"Freon-12" is one of a series of refrigerants made from the basic raw materials of carbon, chlorine, water, and the mineral fluorspar.

TEST STAND

Permits Checking Motor Vibration to Close Limits

A SIMPLE device for testing the vibration of an electric motor to standards of balance agreed upon by the National Electrical Manufacturers Association



Vibration isolator

has been devised by the Reliance Electric and Engineering Co.

Although NEMA recognizes only commercial balance, many manufacturers set three classes of allowable vibration for a motor, which are termed commercial balance, dynamic balance, and precision balance. For the proper measurement of vibration within the limits defined for each class, it is recognized that the motor must be isolated from surrounding conditions by means of an elastic mounting; otherwise vibrations from the building, surrounding machinery, or the test rack itself would be "reflected" in the readings taken.

The elastic mounting devised by Reliance engineers utilizes four rubber columns depending from the triangular cap plates of angle-iron corner posts rising from a base plate like the four legs of an upside-down table. The test plate or mounting is attached to the other end of the rubber columns. The columns are secured to their supports and to the plate itself by means of nuts which fit onto threaded inserts bonded into the rubber.

Since rubber columns of different thickness are required in order to give the proper degree of isolation to motors of different weight, three test sets are provided to accomodate motors ranging from 1 horsepower to 200 horsepower.

Every motor produced at Reliance is given a regular commercial check which permits, for example, an amplitude of vibration of .001 of an inch in a 1 horsepower motor. It is noteworthy that this minimum standard was a maximum degree of balance only five years ago.

Purchasers often call for dynamic balance specifications, which would permit an amplitude of vibration amounting to only .0005 of an inch in a 1 horsepower motor. Precision balance, the final classification, would allow only .0002 of an inch vibration in the same motor.

With the motor running under power on the test plate, as shown in the illustration, a pick-up or probe is used to take readings from the frame, bearings, and mount. The dial of the Televiso Vibrometer shown in the picture will indicate amplitudes of vibration of less than .0001 of an inch.

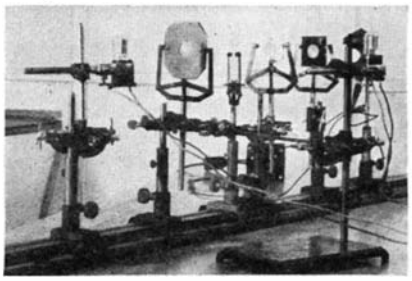
OPTICAL SYSTEM

Quickly Set Up With Adaptable Magnets

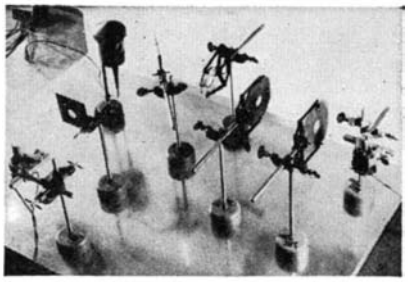
SETTING up and adjusting a standard optical system, with its maze of metal clamps and rods, has been considerably simplified by the use of the alloy alnico, made into magnets and inserted into the base of the standards. Whereas it often required several minutes to adjust the various lenses or light sources, it now is but a matter of seconds to move about the magnetic standards to the desired locations. Similar systems are applicable in other laboratory and research department work.

This new method was devised by Norman F. Barnes of General Electric's laboratory in Schenectady. All that is required is a metal top to the table on which the system is placed, and metal walls, if a vertical set-up is desired.

"Getting the proper dimensional adjustments with the old type optical system was often a tedious job," according to Mr. Barnes. "The slightest movement would throw the entire system out of adjustment and this often occurred when you attempted to tighten a holding screw on one of the standards. And if you required a vertical system, it was a real job to get the various lenses into proper line by clamping them onto wooden or metal



The present type of optical system with metal runway, clamps, rods



Same optical set-up as at bottom of page, but using magnetic system

uprights. With the alnico standards, it's no trouble at all. The standards stick wherever you place them.

"There is plenty of alnico for war jobs but until the war is won, it's not going to be an easy matter for persons or laboratories to get alnico stands for such purposes. But once the war is over, it will be quite a different matter. Such magnetized systems promise to become extremely popular."

GLASS TANK USES

Are Spreading Rapidly in Many Indnstries

ONE of the most important advances in the glass industry has been the recent development of glass tanks or vats for industrial use, according to R. B. Tucker, a director of the Pittsburgh Plate Glass Company. Dozens of industries are turning to glass for their tanks, and the installation of new tanks and the relining of existent units with glass is increasing rapidly, says Mr. Tucker. Because the glass used for these tanks is tempered and strengthened, making for permanency, he believes the acceptance of readily installed glass tanks will be widespread in the post-war period.

"The development of the glass tank has opened new avenues for us," Mr. Tucker declares. "The progress made in this field during the past 12 months and the interest displayed by industry has been remarkable. Obstacles faced in procuring materials worn by the increased volume due to war production has created a definite interest in glass tanks. That interest is increasing constantly and the post-war years should see even greater production of readily installed glass tanks. Glass tanks are in no way to be considered as temporary. They are made strong enough and resistant to quick temperature changes, by a special tempering process which assures tanks that are permanent."

Pittsburgh officials are enthusiastic regarding their new product, which can be fashioned in many shapes and sizes. They point out that the glass is impervious to acids, alkalis, and liquids of almost any type. Glass tanks are of high tensile and compressive strength, and are said not to rot. They are also non-absorptive and non-porous, and present a hard, level, sanitary surface requiring practically no maintenance. Standard tanks are built of opaque Carrara structural glass or of clear plate glass where transparency is desirable.

The tanks are manufactured complete

This one's going to hurt!

Invasion comes high—in blood and money.

Part of the cost must be paid with human life. That means deep and lasting hurt for many and many an American family.

Part of the cost must be paid in cash . . . this September. And *that's* going to hurt, too!

The 3rd War Loan Drive is here!

To pay for invasion—to get the money to keep our fighting machine going—you, and every man or woman in America, are asked to invest in at least one extra $100 Bond in September.

$100 EXTRA, mind you—for *everybody!*

No man or woman can hold back. No man or woman can point to his Payroll buying and say, "They don't mean me!" No man or woman can say, "I'm already lending 10% or 12% or 20%—I'm doing enough!"

Sure—it's going to hurt. It's going to take more than spare cash this time—more than just money that might have gone for fun. It's going to take money you have tucked away. It's going to take part of the money we've been living on—money that might have meant extra shoes or clothes or food! Money that might have gone for *anything* that we can get along without!

Sure—it'll be tough to dig up that extra money. But we've got to do it—and *we will.*

We'll do it partly because of the look that would come over the faces of our fighting men if we should fail. We'll do it partly because the cheapest, easiest way out of this whole rotten business is for everybody to chip in all he can and help end it quick. We'll do it partly because there's no finer, *safer* investment in the world today than a U. S. War Bond.

But mostly, we'll do it because America is right smack in the middle of the biggest, deadliest, dirtiest war in history.

And we're Americans.

Back the attack with War Bonds

This space contributed to the Third War Loan Campaign by

SCIENTIFIC AMERICAN

at the factory, but if new linings are required for existing tanks, crews of installers move into plants for the relining of tanks previously utilizing copper, rubber, or other materials now curtailed by war demands.

PACKAGE "EYE-APPEAL"

Increased by Attention to Color and Shape

THE MEN who design the packages for soap, breakfast foods, and other products pay great attention to the relation of color and shape to eye appeal, says the Better Vision Institute.

Most companies selling packaged goods to the public have redesigned their containers in recent years so as to obtain better color combinations and greater legibility of names and trademarks, thereby facilitating easier retention of the pictures of packages in the public's memory, and quicker identification of packaged goods on the shelves of retailers. Designers have given special consideration to shape of containers. Boxes that are long and narrow seem to contain more than those that are low and wide, thus leading consumers to believe that they are getting "more" for their money. This optical consideration is one of the chief reasons why most containers of packaged goods are oblong. Bottles containing perfume, catsup, and so on, have their height greatly exaggerated to create the illusion that they contain more of the goods than they do. Through the adroit use of long lines of type, eye-carrying designs, and colored stripes, many packages take on greater size in the eyes of consumers.

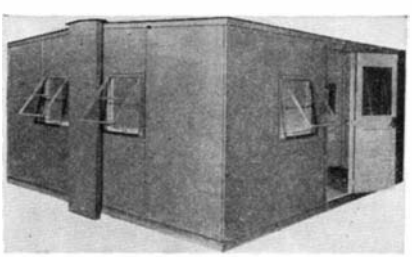
FOLDED HOUSE

Can be Used Where Pre-Fabricated Units are Impractical

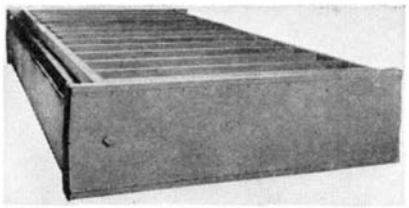
MOST mobile and soonest available housing unit for the armed forces or the Red Cross is the "suitcase house," which can be made ready for use three minutes after arrival at the site.

Shipped folded into a "suitcase" less than 26 inches thick, 8 feet wide, and 16½ feet long, the basic model of this house opens to provide 250 square feet of floor space. It weighs less than 2500 pounds.

There are almost unlimited possibilities for modifications of this unit, including variations in size, double-wall, all-steel, air-tight, or windowless construction. It utilizes an accordion-opening technique developed by William B. Stout, noted industrial designer, for which the Palace Corporation has exclusive manufacturing rights.



Ready for use in five minutes



A house in a "suitcase"

The house is designed for transportation by plane, truck, or rail, and can be shipped overseas in quantity to points where material or labor shortages make construction or even assembly of prefabricated houses impractical.

The exterior on the basic model is Homasote, and non-critical lumber is used throughout. The only metal is in joining parts, wiring, and screens. Built on assembly lines, it requires fewer than 50 man-hours to complete.

Contemplated and applied uses for these units by the armed forces include field kitchens, first-aid stations, aviation repair shops, photographic laboratories, and communications and supply offices.

HIGH-SPEED CAMERA

Used in Studying Motions in Industry

ONE hundred and sixty times quicker than a wink — eight thousand "winks" a second — is the speed at which a new movie camera can photograph the split-second action of our high-speed war machines.

Using 8mm and 16mm film — sometimes at the rate of 70 miles an hour — and appropriately called the Fastax, this new camera is driven by its motors at a top speed of 8000 frames a second — an exposure period of 33 millionths of a second — making it an invaluable tool for the research engineer. This speed means that the Fastax can photograph action far too fast for the ordinary slow motion camera. It means that "movies" made with the Fastax and projected in slow motion can lay bare the innermost secrets of mechanical parts moving at lightning speed — that it can even "slow down" electricity itself. Thus the Fastax, developed by Bell Telephone Laboratories, and manufactured by Western Electric, has revealed to engineers frailties in communications and other equipment never before beheld by the human eye.

The first time the Fastax camera was used to make research films, it revealed a heretofore undetected cause of false signals in telephone equipment. In an investigation of the action of signal relay devices used in the transmittal of telephone messages, the all-seeing lens reported that a rebounding of the movable part of the relay after initial contact sometimes caused this annoying malfunction.

Bell Telephone Laboratories' scientists have made such diverse cinematic studies as the action of the vocal cords in producing speech and the explosive short circuiting of wires carrying heavy currents of electricity.

The Fastax camera is marked by its versatility — a film travel ranging in speed from less than three to almost seventy miles an hour, adaptability to black and white and color photography, and the photography of self-luminous objects. The slower speeds have been invaluable in determining stress and impact conditions of new equipment designs under test—color, black and white, and polarized light pictures having been taken of these tests. The middle speeds (1500 to 4000 frames per second) have been used to study automatic operations, to record laboratory-controlled breakage of parts and the causes of noisy operation in machines.

The Fastax employs continuous film drive, as distinguished from the stop-expose-advance cycle of the professional and amateur slow-motion cameras. Exposure of successive "frames" in the camera is accomplished by a revolving prism acting as an optical compensator. Hence the images travel in synchronism with the film past the film gate during the exposure period.

SUBMACHINE GUN

Redesigned to Save Materials, Cost, and Tool Requirements

ONE OF THE most outstanding developments resulting from the program of redesign for materials' conservation, inaugurated by the Ordnance Department of the United States Army, responsible for the development, manufacture, procurement, and maintenance of the soldier's fighting weapons and his vehicles of transport, is a submachine gun of revolutionary design, called the "Riveter" but standardized by Ordnance as the M3. The experimental model was produced and accepted for test within four months' time, and these tests proved that the new design had extraordinary possibilities. Of .45 caliber, it weighs only eight pounds (less magazine) and is so small that, when taken down, the parts will fit into a soldier's pockets. It can be used as a full automatic for rapid fire or as a single shot weapon.

Official photograph, U. S. Army

Made principally from steel stampings

A material reduction in critical manufacturing operations was effected in the redesign of this weapon. There are only 25 component parts and 73 pieces (less magazine). Instead of hogging and machining the parts out of heavy steel forging, thereby utilizing critical machine tools and creating much scrap metal, manufacture is principally from steel stampings. In fact,

all parts except the bolt and barrel are made from such stampings. Not only does this free many machine tools for other uses and eliminate much of the waste scrap but it also puts the manufacture right into metal fabricating shops equipped with power presses that were heretofore unable to obtain war contracts. (See also article on pressed metals and their present-day industrial applications, page 208. *Ed.*)

The M3 submachine gun was in production in less than six months from the time the first experimental model was tested. This engineering triumph was achieved in spite of the fact that the gun represents a complete and radical departure from all other models. Fifteen years ago the approximate cost of machine guns was $200 and under mass-production this price had been cut to something like $40. The present M3 submachine gun is being made for less than $20 and with a 50 percent reduction in man hours and 25 percent cut in machine tool requirements.

The stock of the new gun is skeletonized and can be slid onto the gun proper so that the arm can be used either as a gun or a pistol. The barrel is only eight inches in length and no tools are necessary when assembling.

The new M3 submachine gun has received many tests by various service boards, and is reported to have been acclaimed as superior not only to those of the Axis but also to other American and Allied submachine guns.

RUST PREVENTERS

Aid in Salvaging Normandie's Equipment

SINCE the beginning of salvage operations on the great Navy transport the *Lafayette*, formerly the French Line luxury ship *Normandie*, a petroleum specialty group which has the unusual property of displacing water from metal surfaces has been used to protect the vessel's fittings and machinery from the heavy loss which would otherwise have inevitably occurred from rusting.

The petroleum specialty is actually a series of several rust-preventing products, two of which have been used on the *Normandie*. These products penetrate water in contact with metal surfaces, spread out on the surface so as actually to push the water away, and effectively seal the metal from oxygen.

As soon as it was decided to salvage the ship after she had burned and turned over in the Hudson River, the use of the rust-preventives was suggested to officials of Merritt-Chapman and Scott Corporation, conducting salvage work for the Navy. As a consequence, equipment removed from the great ship, as she was stripped to lighten her, was washed in one of the rust-preventives before being stored for later use.

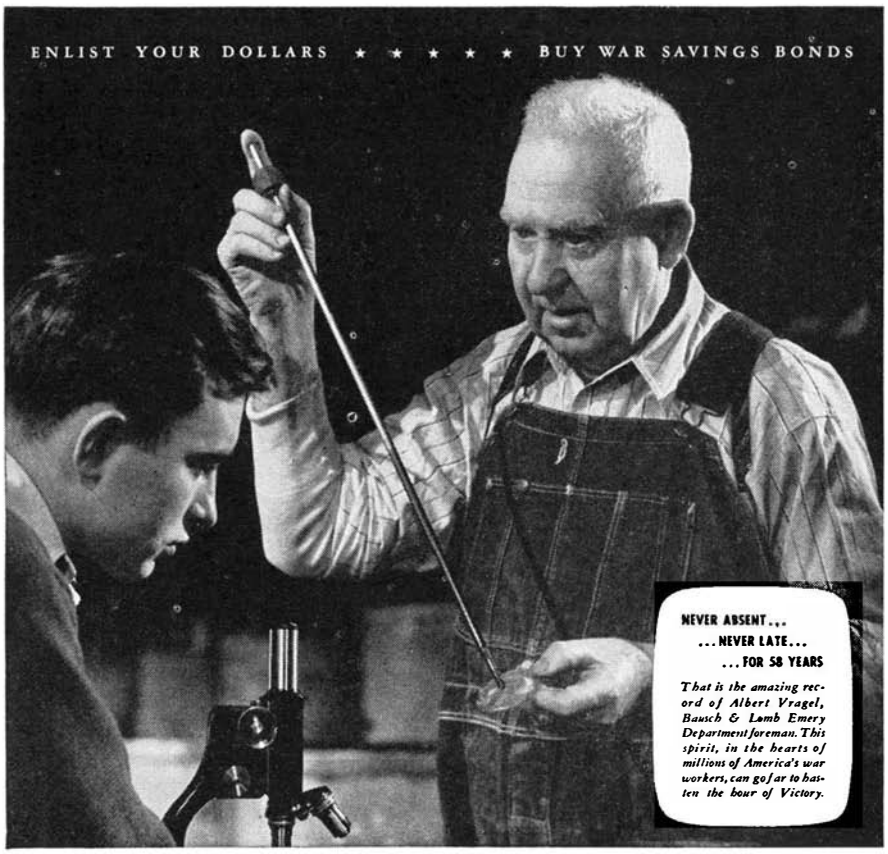
When water began to be pumped from the hull, new problems were presented, and an entirely new type of the rust-preventive was developed for protecting the machinery deep in the ship's interior. This product had the same water-displacement properties as the product used for parts removed from the ship, but was changed in such a way as to avoid fire hazard when using an oil product in the ship's enclosed spaces.

As the level of the water inside the hull was lowered by pumping, the ship's tremendous turbines and other machinery were sprayed with the new rust-preventive as they were exposed to air. As a result, it is understood that the only turbine which will show substantial damage from corrosion is one which was alternately in water and in air, due to rise and fall of the tide, before it was possible to treat it.

Standard Oil (N.J.) technicians point out that little rusting ordinarily occurs on metals which are as deeply submerged as was most equipment of the *Normandie*. Rusting does not take place except in presence of oxygen, and the oxygen content of water decreases rapidly with increase of depth. However, as soon as long-submerged metal is brought to the surface, it is attacked by oxygen very actively. Then rusting occurs at an almost visible rate.

Much of the *Normandie's* equipment was of such nature that it could not be readily dried. Encased or complicated machinery, for example, could not be disassembled promptly enough to be protected from rust in the usual ways. It was for this reason, and because of the more certain protection, that equipment was dipped, swabbed, or sprayed with one of the two types of rust-preventive.

Even electric motors were so treated,



Knowing how . . . and Showing how

Building optical instruments is a job for skills built on experience. Bausch & Lomb has the skills, and the experience. Albert Vragel, emery expert, is one of 39 men and women who, with 50 years or more at Bausch & Lomb, have helped America through three wars. They are part of the organization known as the Early Settlers—the Bausch & Lomb 25-year-service club—with 518 members.

Such experience is irreplaceable today. It indicates why Bausch & Lomb was ready, when war clouds gathered over Europe, to supply the United Nations with the optical instruments of war. It provides the "know-how," too, to meet ever-increasing production demands, by training thousands of new workers . . . for our own plant and plants of other manufacturers, to whom we have made available Bausch & Lomb specifications, methods and experience for certain military optical instruments.

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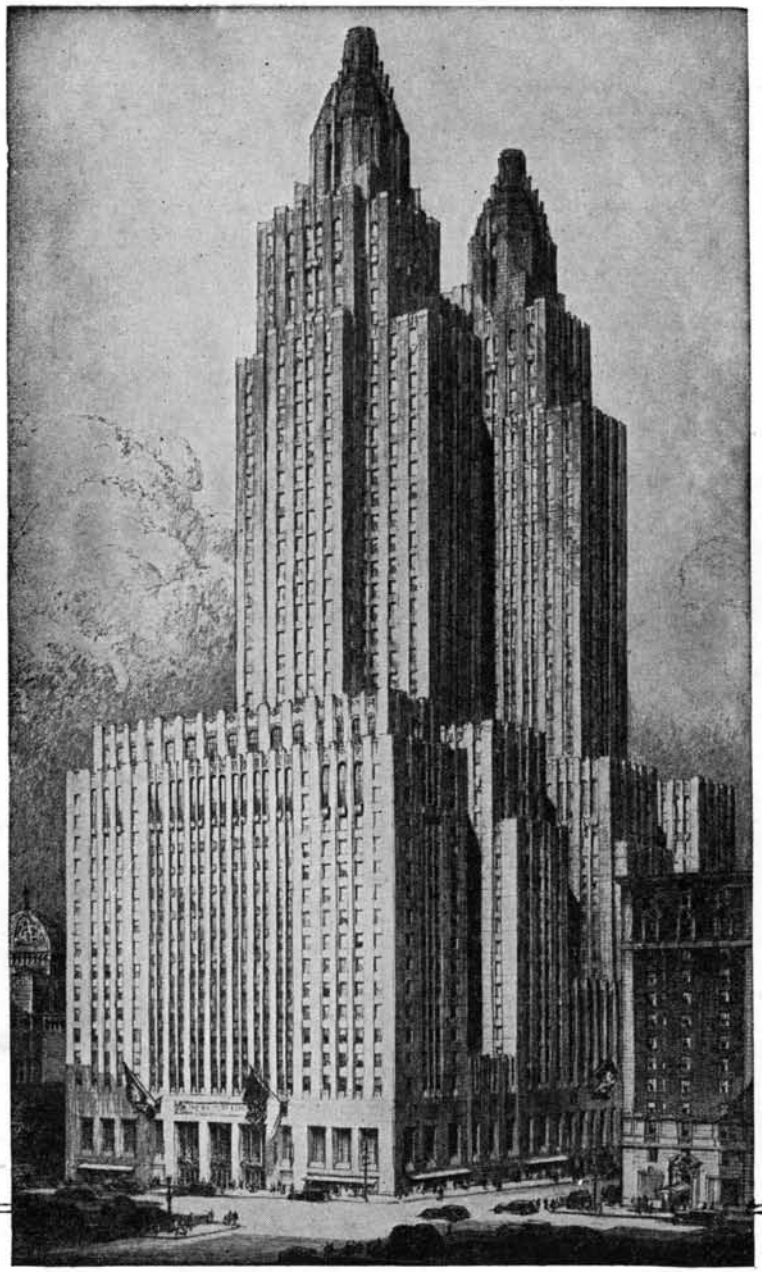

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although ordinary oils are injurious in motor armatures. As a preliminary test, a motor was treated with the more volatile rust-preventive and stored. At the end of a week, the rust-preventive had evaporated, and the dried motor was started and ran.

The ship's gyroscopic compass, a delicate and complex piece of equipment, was so successfully protected that replacement of only two parts and motor was required. It was then installed in the vessel after being taken from its long soaking in the depths of the river's muddy water.

In addition to main turbines, motors, and gyroscopic control devices, the equipment treated with the rust-preventive included hundreds of tons of pumps, lamps and lighting fixtures, kitchen utensils, laundry equipment, ice machines, and a variety of other mechanisms.

By preventing destruction of these materials from corrosion, a quantity of critical materials, and innumerable man-hours of manufacture have been saved, and the return of the *Normandie* to service has been greatly hastened.

INDUSTRIAL CORNCOBS

Main Uses to Date are Based on Physical Properties

A GREAT many industrial uses have been proposed for corncobs and, although the subject has already received a considerable amount of attention, further studies are being made by the Northern Regional Research Laboratory. The small industrial utilization of cobs is attributed more to economic factors than to a lack of knowledge as to the means for preparing useful articles, chemicals, or chemical derivatives from them.

Since cobs, and most other agricultural residues, waste wood, sawdust, and so on, are of similar composition, chiefly cellulose, hemicelluloses, and lignin, together with ash and small amounts of nitrogenous and soluble materials, they are competitive waste materials from the standpoint of composition. The permanent use of any specific residue for any desired service will, therefore, be based on the greater suitability, as regards other factors, of that residue to perform such service. Because of their physical characteristics, particularly because of the hard, tough nature of their woody portion, ground cobs have found use in industry for certain special purposes. Such uses, up to the present, are based entirely on their physical rather than on their chemical composition.

Ground cobs, for some 20 years or more, have been marketed for the purpose of cleaning furs, for burnishing metals, for removing oil from tin and other types of metal plates, and for making sweeping compounds.

Ground cobs of about one-quarter to one-eighth inch in size make a very suitable fill in farm and other buildings for heat insulation because of their low thermal conductivity. They may be used as a loose fill over ceilings

between the joists or in walls between the studding. However, they have the disadvantage of not being fireproof, and while they do not attract vermin, they are likely to be a good harbor for them because of the looseness of the fill.

Ground cobs have been used in making light-weight ceramics and tile. The procedure consists of incorporating in the clay particles of cobs which, on burning, leave empty air spaces. Many types of ground ligno-cellulose materials will perform the same service.

Ground cobs seem to be suitable as a filler for plastics, except that the luster and waterproof qualities of the phenolic plastics made with cob flour do not seem to be as high as with wood flour. These requirements are not so important in certain plastics. In such cases the question of price would be the controlling factor for the replacement of wood flour by ground cobs.

Due to war conditions consideration has been given to ground cobs as a replacements for granulated cork. The cob particles are much harder and less resilient than cork, and where resiliency is required the ground-cob particles are not an equal substitute. However, their resistance to abrasion and wear would indicate suitability of use in materials such as composition shoe soles, stair treads, and the like. It has been reported that ground-cob flour of about 50-mesh size is suitable as a replacement for cork in linoleum manufacture. Another use for cobs, although rather small, is as a replacement for beech or other wood shavings as a bacterial-film-supporting medium to provide maximum oxidation conditions in the manufacture of vinegar.

Cobs may be used as an absorbent in the manufacture of dynamite. Pithlike particles, such as those from sugar cane or cornstalks, make a good absorptive material for nitroglycerine in the manufacture of low-density permissible dynamites. An apparent density of from 0.15 to 0.10 is required for such material, and the material must be free from sand and metal particles which would cause formation of a spark in compounding. The ordinary woody material of the cob is too dense to meet such specifications, but it is reported that by suitable extraction of the cob particles, the apparent density can be lowered to the specific limits indicated. —*The Chemurgic Digest.*

GAS SHORTAGE

Met in Brazil by Use of Producer Gas

THE use of "producer gas" for powering automobiles in Brazil, to meet a shortage of petroleum products more acute in that country than in the United States, was described recently by Dr. Tharcisio D. de Souza Santos, an engineer from the Institute of Technological Research of the University of Sao Paulo, Brazil.

"As a result of substitutes adopted to combat the shortage of petroleum products, Brazil has not suffered to any material extent," Dr. Santos says.

Wood and native coal have displaced a large fraction of the fuel-oil consumption in industries, he explains. Producer gas and pulverized charcoal are extensively used as substitutes for fuel oil in industrial furnaces. Fuel oil is severely rationed and quotas are granted only to some industries essential to the war effort where substitution is difficult. Much has been accomplished in Brazil in this field and further progress is being made.

"Automobiles were first to be sacrificed when the shortage developed. Gasoline has been under strict rationing throughout Brazil since May, 1942. After July 9 of that year, no private cars of any kind were allowed to run. Bus lines have been cut to the minimum absolutely necessary. Taxicabs and trucks are entitled to ration coupons only for essential transportation. Even before Brazil entered the war, the government encouraged the use of producer gas or 'gasogenio' and dehydrated alcohol as native fuels to substitute for gasoline in engines. The latter is produced in substantial amounts from sugar cane.

"Had it not been for the large substitution of producer gas, the transportation situation would have been crippled badly," declares Dr. Santos.

"Today one sees in Brazil a large number of vehicles producer-gas powered," he says. "Since August, 1942, private cars can get a license only if they have a gas producer. In order to preclude their obtaining gasoline in the black market, the gas tank is removed from the car and frequent inspections are made."

Producer gas is obtained from the partial combustion of charcoal in a reducing atmosphere which takes place in a generator placed at the back of the car. Charcoal is the ideal fuel as it has a low ash content. The gases contain in suspension fine particles of charcoal dust as well as distillation products which have not been completely removed in the wood distilling. Both of these must be removed through filters before the gases go to the engine.

Also, as the gases are hot and give a low heat value per unit of volume, they must be cooled to increase it accord-

The Man at the Lathe Fights Too!

. . . and every turn of the spindle, as he guides his work through many precision operations, helps bring Victory one step closer.

Hours spent at a lathe may lack the dangerous excitement of combat—but the valorous men on the battle fronts breathe a prayer of thankfulness for guns, shells, planes, tanks—for all the superb equipment which is helping them swing the tide against the Axis.

So the man at the lathe is a soldier, too, as he bends his shoulders to the task of pouring out weapons in an ever-increasing stream. He faces his task grimly . . . proudly . . . proclaiming by the gleam in his eye and the jut of his jaw that he will not be outdone in service to his country, and knowing that America's production is a decisive factor in the war.

To help America "tool up for Victory," the output of South Bend Lathes has been increased (we can't say how much) in the last year and a half—giving the man at the lathe the efficient, dependable production weapon he must have to win.

There is a South Bend Lathe for every class of work—engine lathes, toolroom lathes, and turret lathes. Write now for our new catalog No. 100C in which the entire line is illustrated and described.

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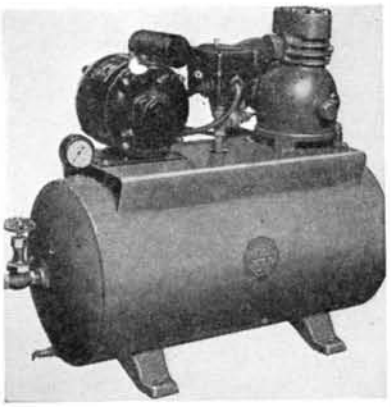

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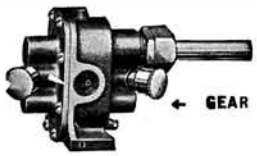

		Inlet	Outlet	Price	With A. C. motor
No. 1	Centrifugal	¼"	½"	$ 6.50	$25.00
No. 4	"	¾"	½"	13.50	32.00
No. 9	"	1¼"	1 "	16.50	35.00

No.	1½	Gear	⅛"	Price	$ 9.00	With A.C. motor	$25.00
No.	2	"	¼"	"	10.00	" " "	27.50
No.	3	"	⅜"	"	11.50	" " "	28.50
No.	4	"	½"	"	12.50	" " "	32.00
No.	7	"	¾"	"	15.00	" " "	37.50
No.	9	"	1 "	"	16.50	" " "	49.50
No.	11	"	1¼"	"	48.50	" " "	on request

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This metal mercury switch overcomes faults of usual mercury switches. May be turned a full 360°. Has thousands of known applications from tiny lab instruments to gigantic power controls.

1 Amp.	$1.10	20 Amp.	$3.15
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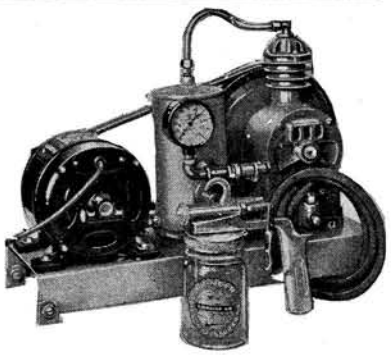

Ideal spraying outfit for all liquids such as paints, enamels, etc. Can also be used for cleaning, tire inflating, and general purposes. Equipped with General Electric ¼ HP. a.c. motor. Quincy air compressor, adjustable safety valve, and 100 lb. air gauge A heavy duty Plummer spray gun with 15 feet of hose. Weighs only 60 lbs.

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Synchronous Motors

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FORCED DRAFT BLOWERS COMPLETE WITH MOTOR

TYPE	H.P.	R.P.M.	CU. FT. MIN.	INLET	OUTLET	PRICE
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0½	⅛	1750	350	6½"	3¾"	25.00
1	1/6	1750	535	6 "	4½"	30.00
1¼	¼	1750	950	7½"	6 "	37.50
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ingly. From the generator the gases are drawn through cooling chambers where the charcoal dust is deposited and then through a fine filter medium, generally a woolen cloth, where the fine dust is precipitated.

As the heat value of the gases is lower, the power output of the engine is about 50 percent of the power produced by gasoline. The consumption of charcoal is low — about 1½ pounds per mile.

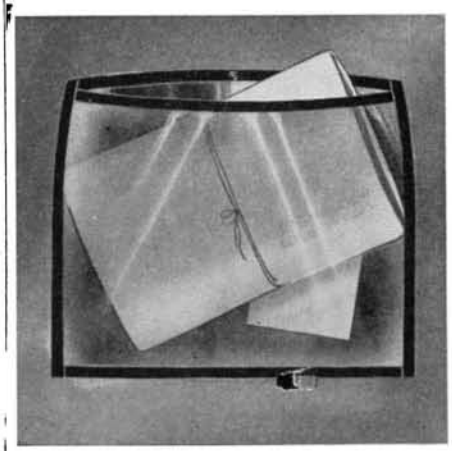
Trucks using producer gas are allowed to retain gasoline tanks and switch to their use if necessary.

The system of generator, cooling chamber, and filter is contained in a cylinder about 12 inches in diameter and four or five feet high. This is made of scrap sheet steel, about 300 pounds being required. "It makes a bulky load," says Dr. Santos, "and producer-gas powered cars are certainly not good looking, but they have been found a good solution for wartime to save gasoline for the essential requirements of the country."

PLASTIC ENVELOPE

Keeps Blueprints, Factory Orders, Office Forms Clean and Neat

MADE of cellulose acetate plastic and designed as a protective covering for work orders, blue prints, maps, charts, diagrams, and other factory and office



Keeps papers clean yet visible

forms, a new envelope keeps the contents clean, neat, and visible at all times.

Bound leatherette edges on all sides prevent the envelope from tearing or breaking; patented lock-stitch on binding will not unravel; envelope is flame-proof, moisture-proof, oil-proof. Eyelets or straps can be provided where required.

TUBE INDENTIFICATION

Made Simple by Use of a Standard Business Machine

A NEW process for printing part numbers rapidly on appropriately colored calendar tape used in the identification of warplane tubing, thereby saving time and cost as well as speeding repairs on vital war fronts, has saved approximately 76 percent of the cost of a

former method of identification in one of the warplane plants of Curtiss-Wright Corporation.

An achievement of the labor measurement department of the organization's Airplane Division, the new process utilizes an ordinary office machine—the addressograph—to print the vital part numbers on each strip of colored calendar tape before it is pasted to a piece of tubing destined for the internal system of either a Curtiss Warhawk (P-40) fighter or a giant Curtiss Commando (C-46) military transport type.

Because of the wide variety of liquids and gases needed to operate the airplane of today, American plane manufacturers have standardized on a color coding which must permanently identify each length of tubing installed. As examples: A tube banded with red indicates that it is conveying gasoline, a yellow band means lubricating oil, a combination of red, yellow, and blue stripes indicates hydraulic oil used extensively to operate brakes, landing gears, wing flaps, and numerous other essential equipment.

The complex nature and limited space available in a modern plane have made the job of factory tubing assembly and the replacement of damaged tubing by field crews an extremely trying one. The identification of these tubes by part numbers is a constant source of trouble since many tubes carrying similar liquids and gases are almost identical in pre-formed shape.

The new procedure combines the identifying part number with the appropriate colored tape and all tubes now being used at one of the Curtiss-Wright plants are permanently coded and numbered in the tube-forming department by this new method.

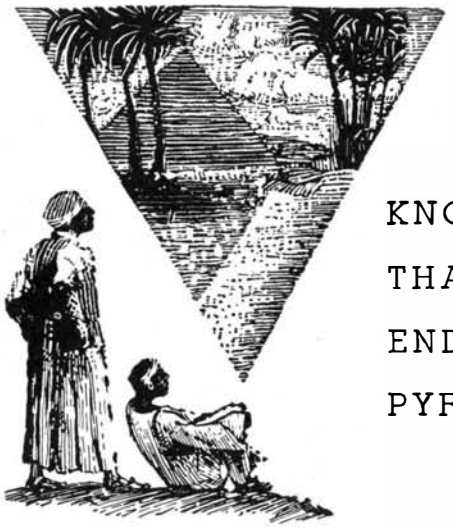
Previous identification methods included the use of rubber stamping and metal tagging for part numbers but both of these methods required the addition of colored cellulose tape.

To the Nashua Package Sealing Company goes the credit of developing a paper tape with an adhesive which is standing up well under rigorous tests and which is also lower in cost than the tape which it has replaced.

The printing of the tape is accomplished on a standard Addressograph and the only special equipment required is the simple device which automatically feeds and rewinds the tape.

The following comparison between the old and the new method gives fig-

Speeding identification of tubing



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THAT HAS
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PYRAMIDS

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WHENCE came the knowledge that built the Pyramids and the mighty Temples of the Pharaohs? Civilization began in the Nile Valley centuries ago. Where did its first builders acquire their astounding wisdom that started man on his upward climb? Beginning with naught they overcame nature's forces and gave the world its first sciences and arts. Did their knowledge come from a race now submerged beneath the sea, or were they touched with Infinite inspiration? From what concealed source came the wisdom that produced such characters as Amenhotep IV, Leonardo da Vinci, Isaac Newton, and a host of others?

Today it is known that they discovered and learned to interpret certain *Secret Methods* for the development of their inner power of mind. They learned to command the inner forces within their own beings, and to master life. This secret art of living has been preserved and handed down throughout the ages. Today it is extended to those who dare to use its profound principles to meet and solve the problems of life in these complex times.

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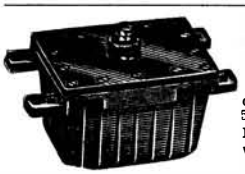

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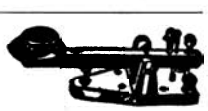

U. S. Army Generators, Signal Corps double current, hand driven; delivers 8 volts at 5½ AMPS and 350 volts at 25 AMPS.
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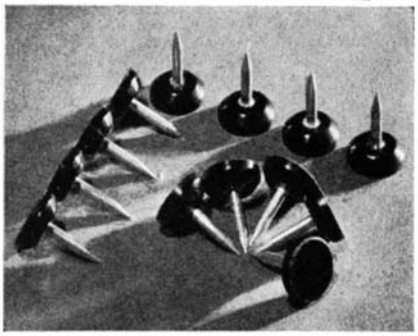
These money savings, while substantial, do not tell the whole story, since the identification of each tube cannot be valued intrinsically.

FIRING PINS

With Molded Plastic Heads, Metal Alloy Shanks

THEY LOOK like thumbtacks—in fact, might even be used for thumbtacks—and are being used to prod the Axis. They are firing pins—and something rather new in the way of firing pins. The head is molded of a medium impact Durez plastic by Globe Tool and Molded Products Company. The pin



Firing pins, not thumbtacks

itself is of a metal alloy and molded solidly in the Durez head. It is surprising when one thinks of the big jobs these little pins perform, yet a firing pin is just as vital to certain types of shells as the explosive, the container, the fuse.—*Durez Plastic News.*

CONCRETE PROTECTION

Afforded by Freeze-Resistant Resin from Pine Wood

HIGHWAYS in at least 15 states, and concrete runways on airplane landing fields, have been made resistant to severe winter conditions through the addition of about a tablespoon of Vinsol, a pine wood resin, to each sack of cement.

To eliminate surface scale caused by freezing, thawing, and applications of salt for ice removal, chemists of Hercules Powder Company have worked for five years in co-operation with various state highway departments, federal agencies, and the Portland Cement Association.

Fractional amounts, ranging from 2½ to 4½ parts in 10,000 (.025 to .045 percent) of the resin are added by cement manufacturers to the clinker during grinding. The resin is extracted from southern pine wood.

Test roads, on which strips of resin-

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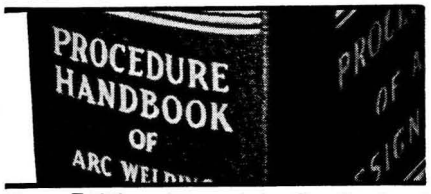

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treated portland cement concrete were laid side by side with untreated concrete, have been constructed in Delaware, Illinois, Indiana, Kentucky, Maine, Massachusetts, Michigan, Minnesota, Missouri, New York, Ohio, Pennsylvania, South Carolina, Utah, and Wisconsin. The Queen Elizabeth Way in Canada, from Niagara Falls to Toronto, also has sections containing resin-treated cement.

These roads show that in states where the strip of untreated concrete has deteriorated due to winter conditions, the section of resin-treated cement concrete alongside it remains unaffected. Laboratory tests show that in all cases this resin-treated portland cement has superior resistance to freezing, thawing, and applications of salt.

Vinsol-treated cement has also been used extensively by the United States Corps of Engineers for numerous jobs, principally in the construction of military airports throughout New England, New York, Michigan, and Illinois, the company disclosed.

SECRET ADHESIVE

Combines Thermoplastic and Thermosetting Qualities

WHAT IS reported to be a radically new type of adhesive developed by the Du Pont Company, is being used to bond the thin sheets of wood that are molded to form the bodies of military helicopters, the planes with the rotary wings, it was announced recently.

"The most important of several unusual qualities of this new plywood glue is that it is both thermoplastic and thermosetting," says R. C. Peter, Du Pont Finishes Division chemist. "This means that when ply-covered forms are heated under pressure in ovens, the adhesive at first becomes fluid and permits the layers of thin wooden strips to move into intimate contact. After only 20 minutes the adhesive sets as a permanently tough, heat-resistant, insoluble material."

Plywood bonded with Adhesive No. 4624—its composition is still secret—is unaffected by the high temperatures that build up in the interior of airplane surfaces under a tropical sun. In fact, plywood of this type will withstand being boiled in water for three hours.

Adhesive No. 4624 is more costly at present than previous commonly-used plywood bonding agents. "Yet its relative costliness is compensated for by its properties," says Mr. Peter. It retains its flexibility at low temperatures when most adhesives become brittle. Moreover, its weight as a plywood bonding agent is almost one fourth less than other suitable materials, an important factor in plane construction. Its initial plastic quality in the bag-molding process, permitting perfect contact of the laminations, not only greatly reduces the number of rejects, but improves the aircraft safety factor.

Mr. Peter revealed that No. 4624 contains none of the substances previously common to adhesive manufacture. The product is available today only for military use.

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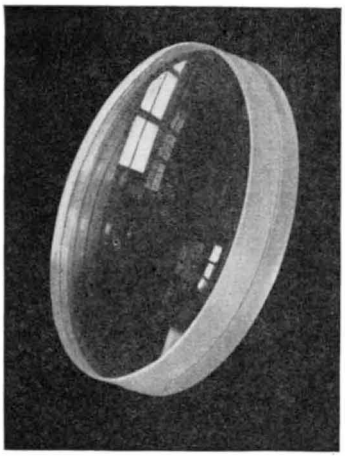

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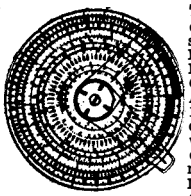

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Current Bulletin Briefs

Conducted by
K. M. CANAVAN

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

BLUEPRINTS FOR FASTER, BETTER PRODUCTION is a 16-page illustrated pamphlet which lists sizes and uses for various types of units made of abrasive cloth. Included are spiral-wound bands, points, cords, pencils, slotted disks, pads and cones, and so on. *Behr-Manning Corporation, Troy, New York.—Gratis.*

PENICILLIN is a pocket-size booklet containing abstracts of 81 papers on the subject published since 1929. *Winthrop Chemical Company, Inc., 170 Varick Street, New York 13, New York.—Gratis to interested scientists.*

HANDBOOK FOR THE WELDING AND CUTTING OPERATOR is a 20-page pocket size booklet which instructs users of the oxy-acetylene process in methods for prolonging the life of their equipment. Short, pertinent suggestions are illustrated with explanatory drawings. *The International Acetylene Association, 30 East 42nd Street, New York, New York. —Gratis.*

MUSIC AND MANPOWER is a 16-page pamphlet outlining the effectiveness of music in terms of mass production with minimum man-hours. *Operadio Manufacturing Company, St. Charles, Illinois.—Gratis.*

WHITING PRODUCTS FOR INDUSTRY is a 24-page illustrated book giving condensed facts on a line of cranes, railroad and aviation equipment, cupolas and foundry equipment, evaporators and filters, and so on. *Whiting Corporation, Harvey, Illinois.—Gratis.*

DUST AND FUME CONTROL EQUIPMENT is a 42-page plastic-bound, fully illustrated bulletin which describes typical installations of all kinds of equipment for dust and fume control, including spray booths, mechanical washers, industrial ovens, and sheet metal equipment and accessories. A series of tabulations presents pertinent and useful engineering data. *Schmieg Industries, Piquette at Brush, Detroit, Michigan.—Gratis.*

MANY PROBLEMS INVOLVED IN THREAD GRINDING ART is a four-page folder presenting an informal discussion on these problems and on the selection of grinding wheels for specific jobs. *Macklin Company, 42 Lawrence Boulevard, Jackson, Michigan.—Gratis.*

ELEMENTARY ELECTRICITY FOR RADIO STUDENTS, by W. E. Flood, M.A., is a 64-page pocket-size booklet written in England but published in the United States, which offers a sound background of basic facts which will aid students and others in understanding the principles of radio operation. Problems are offered to afford practice on the work described. *Longmans, Green and Company, Inc., 55 Fifth Avenue, New York, New York.—40 cents.*

IDENTIFICATION OF CONSTITUENTS OF ALUMINUM ALLOYS, Technical Paper No. 7, by F. Keller and G. W. Wilcox, describes the steps necessary for such identification. These steps include preparation, polishing, etching procedure, and so on. A number of photomicrographs illustrate the text. *Aluminum Company of America, Pittsburgh, Pennsylvania.—Gratis.*

PUNCHING & NOTCHING EQUIPMENT is an eight-page illustrated folder describing the design features of extremely flexible equipment for a number of industrial applications. *Wales-Strippit Corporation, 345 Payne Avenue, North Tonawanda, New York.—Gratis.*

EBERBACH MICRO HARDNESS TESTER is a 10-page illustrated pamphlet which describes a precision instrument for the purpose, as well as accessories, and gives directions for accomplishing this type of work. *Eberbach and Son Company, Ann Arbor, Michigan.—Gratis.*

SUCCESSFUL RADIO REPAIRING WITH AVAILABLE SUBSTITUTE PARTS is a pocket-size booklet designed for radio technicians who must cope with the changes which the war has forced upon their operations. *Supreme Publications, 328 South Jefferson Street, Chicago, Illinois.—25 cents.*

LINDBERG FURNACES is an eight-page illustrated bulletin describing units for heat treating the non-ferrous metals such as aluminum and magnesium. These units feature temperature uniformity and control accuracy. *Lindberg Engineering Company, 2450 West Hubbard Street, Chicago, Illinois.—Gratis.*

SAFETY TREADS is an eight-page illustrated pamphlet which describes various types of treads for use on ship ladders and decks, as floor plates, on thresholds, and so on. All are designed toward promoting safety in industry. *Wooster Products Inc., Wooster, Ohio.—Gratis.*

FLAT SPRAY NOZZLES is a six-page folder describing a new spray nozzle which has various uses ranging from cooling fruit in packing plants or cleaning trolley busses to washing logs in lumber mills or descaling sheets and plates in steel mills. The nozzle itself is a non-clogging device which projects a high velocity spray. *Chain Belt Company, 1600 West Bruce Street, Milwaukee, Wisconsin.—Gratis.*

HARD-FACING WITH COAST METALS is a 12-page illustrated pamphlet which presents a description of this effective maintenance method, together with a tabulation of hard-facing welding rods, typical applications, and specific examples. *Coast Metals, Inc., 1232 Camden Avenue, S.W., Canton, Ohio.—Gratis.*

Previews of the Industrial Horizon

(*Continued from page* 195)

electricity, Mr. Hibben points out that such developments will call for more adequate home and industrial wiring, a field in which little progress has been made in the past 30 years. Here, then, is food for thought for those directly interested in the electrical industry.

PRESSED METALS

SOME of the present industrial uses of the science of pressing metals into various shapes are dealt with in the article starting on page 208. From these will be gained a comprehensive view of the possibilities of replacing expensive and time-consuming forging and casting operations in many fields. A survey of such operations in any plant will undoubtedly reveal applications of pressing techniques that will speed up production, result in materials savings, make a better product, or produce a combination of some of these desirable ends.

COTTON

KING COTTON has ruled the South for generations, alternately reigning with arrogance from on high and crying for help from the depths. Now, it appears, something more than sporadic attempts to solve cotton's problems is going to be done. Rayon and other fibers are cutting deeply into cotton's tire-cord monopoly and are threatening other strongholds.

Science, however, is starting to alter the situation on a continuing basis. Designs for cotton goods are being developed in a variety of forms; chemical treatments are being worked out to change the feel, the appearance, and the quality of cotton fabrics; cotton is being made water-proof, rot-proof, fire-proof, and spot-proof; agricultural experts are developing plants which will produce better grades of the fiber in larger quantities. Things are being done that may go far to restore the King to his throne.

ONLY EYES CAN SEE

ONE of the crying needs of industry is for increased safety in plants, and in no one phase of safety is this need greater than in the protection of eyesight. Some plants, of course, according to surveys reported by the Better Vision Institute, are carrying on educational programs in respect to vision, but in many factories there is a wanton disregard of the importance of vision.

There is no satisfactory substitute for human eyesight (phototubes to the contrary, notwithstanding). Production speed is reduced, materials are wasted, health is impaired when vision is neglected. These factors will be just as important in the future as they are today and certainly merit intelligent and continuing attention. An industrial eyesight program should not stop with such elementary safety precautions as compulsory use of goggles but should include measures to prevent premature dimming of vision from causes from within as well as from outside the body.

COMBINED SCIENCES

"OPTI-ONICS" is a word coined by Bell and Howell to designate some of the as-yet secret work which they are doing and which involves a combination of the science of electronics and optics. Understanding of the basics can be had from television, where the electronics engineer provides the image on the face of a cathode-ray tube and the optical engineer devises means of enlarging the image to usable size.

Stressing war-imposed secrecy, the company says: "Some of the things we have learned in Opti-onics are almost startling in their implications and in the future developments made possible.

BETTER CONCRETE

OUTSTANDING point of the article on concrete ships (page 205), although perhaps somewhat subdued in the overall discussion of the subject, is the fact that new knowledge is being obtained about an old structural material.

No longer is concrete merely cement, sand, and aggregate mixed with water and used. Studies of the combination have revealed new materials, new mixing techniques, new methods of putting improved concrete into place. The concrete ships described are going to be more than means of water transportation; they represent accumulated research which will make itself felt in other engineering fields where concrete is used. Nor is this all: The newer materials, proved at sea, will undoubtedly suggest applications for concrete where none existed before.

BETTER WATCHES LATER

MASS production of chronometers through the exercise of Yankee ingenuity is turning out large numbers of fine instruments which meet the high standards and severe tests imposed by the Navy. From this mechanization of a former manual art will come finer time-pieces in post-war days.

NON-REFLECTING GLASS

DEVELOPMENT for military uses of glass with non-reflecting surfaces, by American Optical and RCA, can be applied, with desirable results, to post-war manufacture of windshields sans dangerous reflections, less conspicuous spectacle lenses, more easily read instruments, faster camera lenses, shop windows free from reflections, more efficient microscopes and other light-transmitting instruments, and so on.

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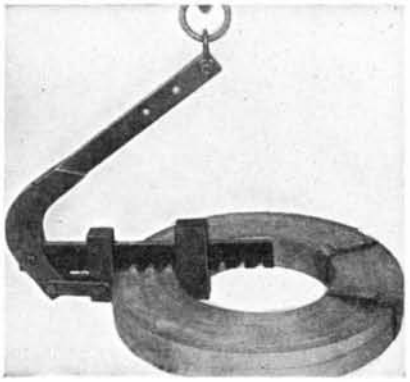
New Products

COIL LIFTER

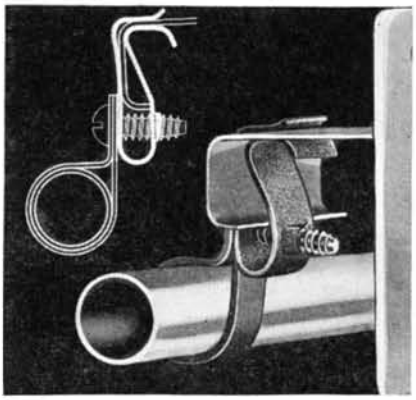
For safe handling of coils of strip a new lifter is readily adjustable for a wide range of coil sizes. It is particularly designed for handling coils in a horizontal position without first raising the coil, as no part of the lifter is underneath the coil. This lifter, made by the Never-Slip Safety Clamp Company, can be used on any crane or hoist and requires little head room.



Adjustable for various coil sizes

SPEED NUT

With the present trend toward more widespread use of rolled metal sections, an entirely new speed nut has been developed for more rapid assembly of conduit, piping, and wire harnesses in aircraft. This nut is made of special aircraft spring steel with a zinc metal spray finish. It is designed to quickly snap around rolled sections or stringers and eliminates the need of drilling holes. As the screw in the speed nut, manufactured by Tinnerman Products Inc., is tightened, the two legs are forced inward to give a firm spring tension grip.



Rolled-section speed nut

MOLDING POWDER

Although available for war purposes only at the present time, a new form of Lucite has been developed for injection molding processes. It is claimed that the parts molded of this material, available in crystal clear or dyed form, will not soften appreciably or distort in temperatures up to 212 degrees, Fahrenheit.

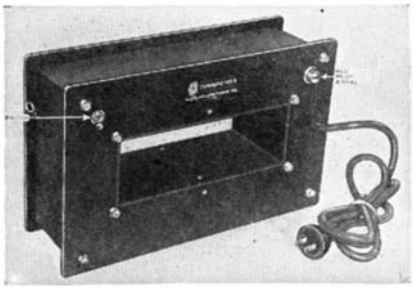
The material will also be available in granular form for compression molding.

CONCRETE IMPROVER

A liquid material designed to be added in small quantities to a concrete mix is claimed to act to disperse cement particles more universally and to improve the workability of the mix. Known as Santorized Trimix Liquid, this material reduces by 20 percent the amount of water required and is said to produce an increase in compressive strength in the resulting concrete.

DEMAGNETIZER

Tools and other metal parts may be either demagnetized or magnetized in the new unit illustrated in these columns, made by the Alofs Manufacturing Company. Drills and tools which would otherwise become dull through magnetization are simply passed through the core of the demagnetizer.



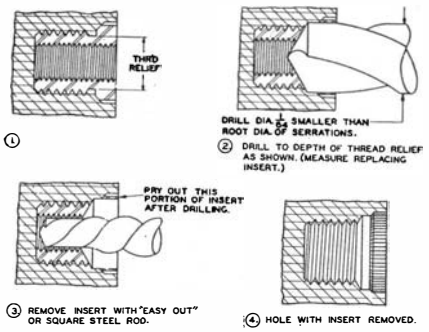
For magnetizing or demagnetizing

Metal parts to be plated may be demagnetized in the same manner, thus preventing the adherence of metal particles which may be detrimental to the finish.

The same unit may be employed to magnetize tools such as screw drivers and wrenches, for use in difficult assembly jobs.

REPLACEABLE INSERTS

A new application of the Rosán Locking System for threaded inserts and studs is designed for use in plastics or other molded materials which require fastening points. Like the standard Rosán threaded inserts and studs, it is locked in, but can be removed without injury to the material and replaced by



Steps in using replaceable inserts

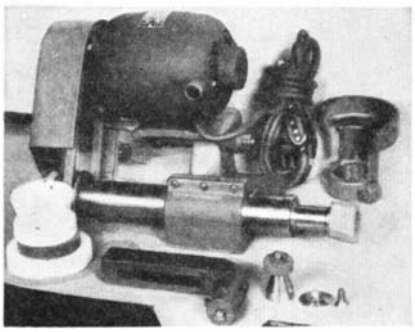
a standard locked-in threaded insert.

On the standard insert or stud, there is a serrated collar. The Rosán locking ring, which is serrated both inside and out, engages its inner teeth with the serrations on the collar while its outer teeth or splines broach their way into the parent material at the sides of the counterbore. The pressure of the surrounding material causes the ring to close in upon the collar enough to eliminate all tolerance and make a solid installation which is permanent.

To remove the one-piece molded-in insert for replacement with the Rosán standard unit, the serrated locking head at the top of the insert is drilled until the drill passes into the thread relief. (See drawings.) This leaves the outer portion of the head in the form of a serrated ring. An "easy out" tool inserted in the drill hole backs out the threaded portion of the insert. The remainder of the ring may be lifted out by hand. The procedure for removing the one-piece molded-in stud is the same except a hollow mill is used for drilling out the serrated locking flange of the stud. The threads and serrations are left molded in the material so that standard units may be installed without further operations.

TOOL POST GRINDER

FOR INTERNAL, external, face, and taper grinding on lathe, shaper, planer, miller, or bench, a new small heavy-duty grinder grinds holes 8½ inches

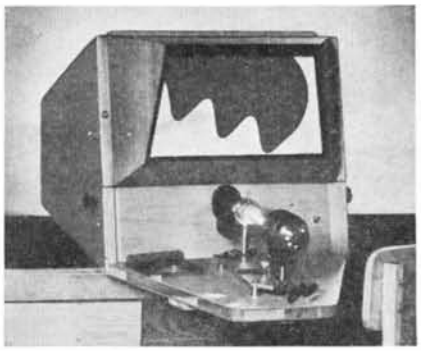


Heavy-duty grinder parts

deep and produces commercially perfect finishes. The quill adjustment of the unit provides the equivalent of two different length quills without the necessity for an extra quill because the motor may be shifted two inches on a slide bracket. The grinding quill is likewise adjustable. This feature also saves considerable set-up time on jobs that require different length quills. This tool-post grinder is made by Lempco Products, Inc.

CONTOUR COMPARATOR

THE F. S. Optical Comparator is an instrument for quickly, simply, and accurately measuring and comparing intricate shapes for purposes of inspection. It is particularly adapted for inspection of parts from mass production, which are not easily checked with customary gages. The instrument employs optical projection of the contour of the part to be measured or compared.



Parts comparison

The aspheric condenser system of the contour comparator—which operates in conjunction with a projection lens of special design—produces a sharp, magnified, undistorted image of the contour of the part being examined—free from disturbing color fringes, on a ground-glass screen, 9 by 15 inches. On the same screen is placed a sketch of the "standard" which has been drawn in the same scale of magnification on a transparent sheet. A slight adjustment of the centering device will align this drawing with the contour of the projected object and permit a detailed comparative examination.

RESISTANT PAINT

DEVELOPED to protect the surfaces of metal, wood, and concrete against the action of acids, alkalies, gasoline, and so on, a new paint has a resin base and is applied by brushing, spraying, or dipping.

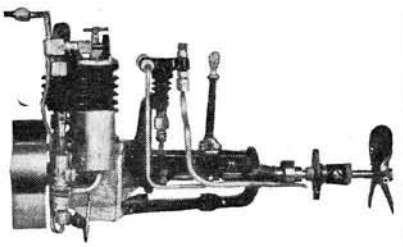
While this new paint, known as Ucilon, air dries to permit application of succeeding coats, it requires forced drying at a temperature of about 250 degrees, Fahrenheit, to develop maximum adherence and permanence.

PHOTOELECTRIC SMOKE METER

SMOKE IN engine exhausts and flues can be readily detected and measured percentage-wise with a portable photoelectric meter recently developed by the Photovolt Corporation. This new equipment consists of an 18 inch-tube and the meter itself with the necessary controls.

In operation, clean air is first drawn

MODEL STEAM MARINE ENGINE



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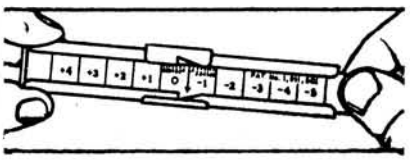
The Morse Decimalizer



The DECIMALIZER shows in a few simple manipulations just where to place the decimal point in the result of any computation involving several elements, part or all of which may be decimals— for example, in such a problem as (9 x .0432 x 74.1 x 3.8) (245 x .0093 x 36) the DECIMALIZER removes that "decimal point hazard" inherent in computations made with the slide rule or otherwise.
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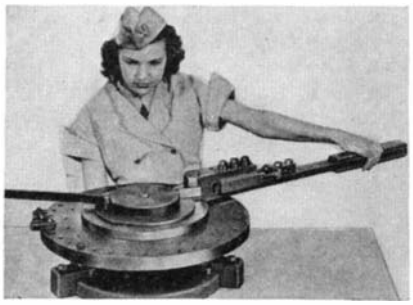
into the tube by means of a built-in fan, and the circuit is adjusted so that the meter reads 100 percent. Then the suspected air from the engine exhaust or boiler flue is drawn into the tube and another reading taken. The difference in the two readings indicates smoke density. Operation of this unit may be from a 50 or 60 cycle 110 volt A.C. line or from a six-volt storage battery.

BENDER

ACCURACY to a tolerance of .001 of an inch in all duplicating work is guaranteed in a new heavy-duty bending device recently announced by O'Neil-Irwin Manufacturing Company, makers of Di-Acro die-less duplicating equipment. This new model bender, Number Three, incorporates all the features of



Duplicated bending accuracy guaranteed to a tolerance of .001 inch

the smaller models which have been used successfully for the past several years. It has, however, a considerably greater radius-forming capacity, handling up to one-half inch round cold rolled steel bar, formed cold to a one inch radius or larger. For more ductible materials the capacity is proportionately greater.

WEAR INDICATION

THE COLORING processes for metals known as Black Magic and reported previously in these columns, is finding new application on plug, ring, and other types of gages as a means of indicating surface wear. Since the coloring penetrates to a depth of .0001 inch, it does not change the dimensions of the gage, yet it shows up the bare metal in sharp contrast when the gage wears beyond this amount. Scratches or nicks also show up vividly. The color is applied to gages by boiling in a special salt solution, followed by rinsing in cold water. The treatment is claimed to retard corrosion and stain of parts to which it is applied.

ELECTRO-ANALYSIS

THE NECESSITY for chemical analysis of an unknown alloy steel is eliminated by a new thermal-electric unit which checks the unknown material against known samples for identification purposes. The basis of this test equipment, developed by the Dravo Corporation, is the phenomenon of thermo-electricity, and depends upon the fact that a minute voltage is set up when two dissimilar conductors are in contact and have temperature differentials between the other conductor junctions.

In the Identometer test equipment, contact is set up by connecting the known and unknown steels to clamping terminals. A potentiometer reading may be taken. Lack of current flow indicates that the steels are of the same analysis while an indication of current shows that they are dissimilar.

The test can be applied also to large quantities of unknown materials by means of extension conductors reaching from the instrument housing. The unit is designed for operation on a 110 volt, 60 cycle A.C. power source.

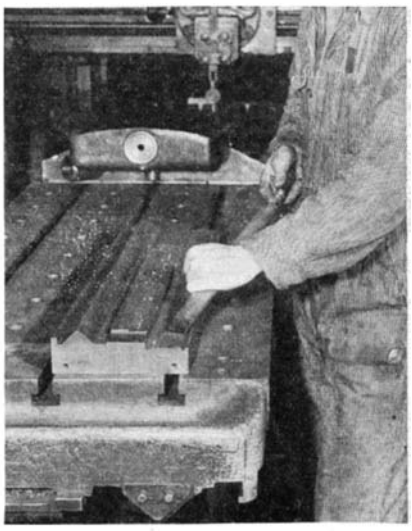
CARBOLOY SCRAPERS

THE WORN-OUT file, once the stand-by of scraping departments in tool rooms of machine shops, seems to be becoming a war casualty. With the advent of the war and the stress of getting production out fast, commercial scrapers tipped with cemented carbide are taking its place for finishing both iron and steel castings.

Prime reason for the development of this new tool was the need for accelerating production of machine tools. One of the bottle-necks in machine tool production was the necessity for carefully hand-scraping the ways and slides to high degree of finish and accuracy. Steel scrapers — mostly converted files — proved too slow. A few scrapes and they had to be sharpened again. The introduction of flame-hardening aggravated the problem since the hardened surface further decreased the life per grind of the steel scraper. Some steel surfaces with weld spots could not be scraped at all.

Independent tests carried out at the Batelle Institute at the instigation of one of the leading machine tool builders revealed that by tipping scrapers with Carboloy cemented carbide, the formerly unscrapeable surfaces could be scraped with a longer life per grind than the previously most easily scraped materials.

The new scrapers are being made with special steel handles, strong enough to withstand pressure without deflecting or bending.



Replacing the worn-out file

A New Industrial Frontier

By FRANKLIN P. HUDDLE

(*Continued from page* 213)

through spontaneous acknowledgements made by the engineers they assist."

The anomaly presented by the most productive country in the world of manufactured goods, in the position of having ignored a significant and efficient aid to production, inspired investigation. The resulting report clearly indicated the need for intensive work by this country to expand its available personnel of applied mathematicians.

In response to this need Brown University, in the summer of 1941, initiated what has become, for this country, a unique program of "Advanced Instruction and Research in Mechanics and Allied Branches." The work was approved as a part of the Engineering, Science, and Management Defense Training program of the United States Office of Education.

The program at Brown began with courses in elasticity, fluid dynamics, and partial differential equations. Even before Pearl Harbor the demand for mathematical technicians had sharpened so much that the emphasis of the school shifted from a long-range to a short-range point of view. Advanced students attacked problems relating specifically to war production and students completing course work were encouraged to enter immediately into various centers of war activity. Although the war has become the vital and immediate concern, at its conclusion the project must be returned to its original, long-range aim of developing applied mathematicians to serve this country's industry.

The objective of the course, defined by an Evaluating Committee[4] in a report, is "To increase the application of the analytical techniques of mathematics to practical problems, and in particular to problems of engineering and industry."

The course is designed first to adopt competent mathematicians to the war program, second to prepare able men for teaching mathematics to prospective scientists and engineers, and third to initiate competent students into research in these fields. This program answers the particular recommendation of the Evaluating Committee "that a long-range but solid and sure attack can be made on the problem through an essentially educational effort, aimed at recruiting very high grade men and giving them thorough and deep training for careers as teachers of applied mathematics."

For advanced students actual research problems are submitted by aeronautical and marine production authorities. By this means the student body is taught the technique of answering such problems of production, and at the same time the problems are solved. In addition, the student body is expected, after receiving the training, to apply it as soon as possible. A partial list of the students indicates that they are meeting this obligation creditably.

Seven students who have taken courses hold research posts at the David Taylor Model Basin; three have gone to the National Advisory Committee on Aeronautics at Langley Field; four are at the National Defense Research Committee Radiation Laboratory at M.I.T.; one is doing N.D.R.C. work at the Cruft Electrical Engineering Laboratories at Harvard, and another at Rockefeller Center; two more are attached to the Signal Corps Laboratories at Fort Monmouth, N. J.; two men are doing research in meteorology for the Army; four men are giving instruction in the Navy; two are doing sonics research and one ballistics research for the Navy; one is at the National Bureau of Standards; one is teaching mathematics at the Air Corps School at Chanute Field; three are doing work for the government in ballistics and ordnance; another nine hold industrial posts, three with Pratt and Whitney, two with Curtiss Wright, and one each with the U. S. Rubber Company, the American Can Company, and the Chrysler Corporation. This is only a partial list but the number is more significant when one remembers that only about 150 applied mathematicians were employed in American Industry in 1939.

Many of the faculty members at Brown were doing research or teaching in German technical schools when Hitler rose to power. For different reasons they found the Nazi regime unacceptable. Several went to Turkey because the Turkish government was making an effort to stock its technical schools with German political refugee scholars.

In a sense the cosmopolitan quality of the organization at Brown is a fine thing and illustrative of a development in contemporary history that most people would like to see pursued. However, in another aspect the scant contributions made by our own citizens indicate a weakness that should be overcome. As a matter of pride we should increase our proficiency in this field so that American contributions will rank with European in the application of mathematical science to industry. And finally, if we are to do our part in the production of world-wide scientific knowledge we would be foolish to neglect a field in which relatively slight efforts are so disproportionately rewarded.

[4]The Evaluating Committee appointed to weigh the merits and recommend direction of the Brown School of Applied Mathematics, consisted of Marston Morse of the Institute for Advanced Study and at that time President of the American Mathematical Society; Mervin J. Kelly, Research Director, Bell Laboratories; George B. Pegram, physicist and Dean of Columbia Graduate School; Theodore von Karman, Director of Aeronautical Laboratories, California Institute of Technology; and Warren Weaver, Director for Natural Science, Rockefeller Foundation.

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Telescoptics

A Monthly Department for the Amateur Telescope Maker

Conducted by ALBERT G. INGALLS
Editor of the Scientific American books "Amateur Telescope Making" and "Amateur Telescope Making—Advanced"

IN LETTERS, and orally for years and years, readers of this department have been saying, sometimes strenuously, that they doubted greatly that Ellison's claim to be the originator of the auto-collimation test for objective lenses could be justified. His claim appears in Chapter XI of his part of "Amateur Telescope Making," where he says he "believes he was the first to devise, and he certainly was the first to publish," a simple means for testing objective lenses—the familiar auto-collimation test.

Your scribe did not, however, pursue the question to a finish before Ellison died. A letter from a reader who questioned the claim was once sent to him and in his reply, now lost or misplaced, he said he now claimed only independent discovery. He was asked whether the text of "A.T.M." should not therefore be altered (he was always most jealous of alterations to that text) but did not allude to this question when he next wrote; hence nothing was done at the time.

In 1928, when it was first decided to include his chapters on the objective lens in "A.T.M." (second edition), and he was asked if this was satisfactory to him, he sent us a full typescript of these chapters, with a few small alterations. But he did not, while so doing, alter his claim to the discovery and original publication of the auto-collimation test.

In December, 1936, he died.

Some time later, while browsing through old files of *English Mechanics*, a communication from Ellison was found (April 4, 1924, page 166) in which he had even then, in Britain, altered his claim to "independent discovery." Had he changed his mind in the meantime?

Figure 2: The famous Clarks

In September, 1937, after Ellison had died, W. H. Newman, Ditchling, Sussex, England, provided the governing data. While browsing through old files of *Engineering* (London) for 1888 he had come across an abstract of an article about the celebrated Clarks of Cambridge, Massachusetts, in which the auto-collimation test was described, and that abstract was from an article in Scientific American! No date was given, and for some reason Newman's letter found its way into your scribe's archives without the article being hunted up in Scientific American back files.

Recently, the Newman letter was encountered, a search was made and the article found in Scientific American

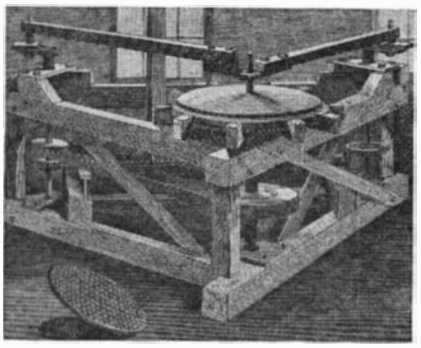


Figure 3: Clark machine

Sept. 24, 1887. (Why, you ask, didn't your scribe remember it? Because, while he was then on the way, he was not yet born.) A part of that article is reproduced in Figure 1. Matter pertaining to tests begins in column 3 of that figure, which should be read before proceeding.

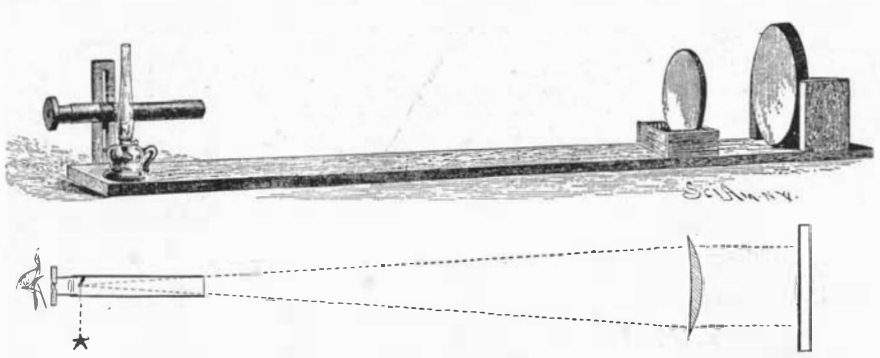
198 Scientific American. [SEPTEMBER 24, 1887.

THE ALVAN CLARK ESTABLISHMENT.

The home and workshop of the sons of the world-famous Alvan Clark is situated in Cambridgeport, just in the environs of Boston, Mass. Leaving the city by the Cambridge road, crossing the waters of the Charles River and turning to the left before the University of Harvard appears, the place is soon reached. It is easily recognized by a telescope tube raised on a high pier that towers above the surrounding objects. A piece of ground of about an acre in extent contains the buildings. In front are three dwelling houses, the homes of George B. Clark, of his brother Alvan G., and of the widow of Alvan Clark, the father. The grounds are very prettily kept as a luxuriant lawn with flower beds and paths. In the rear of the residences is a lofty and now disused observatory, the great rusty telescope tube already alluded to, and a low brick building. The latter, as unpretentious as a structure well can be, is the factory. In it the great Pultowa, Washington, and Lick objectives were made. The least imaginative visitor cannot but feel a sense of inspiration as he treads the truly classic spot that has furnished astronomy with its most efficient weapons. The story of the foundation of the business has already been briefly told in the sketch of the life of Alvan Clark * with water and with a cast iron sand. The latter is made by flowing air into melted iron. This blast drives out a cloud of minute vesicles of metal, that are chilled instantly by the air. This material is very fine and is rust colored. On treatment with hydrochloric acid, hydrogen is evolved, thus proving the presence of the metal. It is used principally by granite polishers, and has been adopted by the Clarks for their work.

The lens is pressed upon the rapidly rotating lap, being held to one side of the center and slowly moved about to insure regular grinding. Were it held motionless, the part over the center of the lap would not be cut, and a prominence would soon be created there. The iron sand is the only cutting agent. It possesses a great advantage over emery, in not "breaking down." The grains, owing to their metallic nature, are very tough, and possess great cutting power. In this way the faces of the lens are [illegible] tool follows an endless variety of paths, never repeating its course over the face of the lens. The driving gear is seen under the bench, and the face of the pitch-faced lap divided by grooves into squares is also shown. Rouge and water is the polishing agent.

The lens thus shaped and polished has next to be tested. Two methods are used for this work. In one a prism is mounted in a tube attached to a lamp chimney of metal. A flame is maintained within the chimney. This prism is so screened as to furnish a minute source of light reflected outward. The lens to be tested is held in a generally vertical plane. Directly back of it a plane mirror, silvered on its anterior face, is placed. The lamp and prism are so placed that the beam of rays from the prism falls upon the face of the lens, passing through it, and returning again after reflection from the mirror, the prism occupying about the focal position. The eye of the observer is held as near the back of the prism as possible. The lens then appears brightly illuminated, because the eye so nearly coincides in position with the focus. The work is done in a dark room. If the lens is perfect, the field is of uniform brightness, presenting, however, the prismatic colors of the zones and areas. If the smallest irregularity



TESTING VISUAL OBJECTIVES.

Figure 1: The original publication of the auto-collimation test

The following is the continuation of the text reproduced in Figure 1: "If the smallest irregularity exists, it appears as a spot or ring or other area on the glass.

"In the other method, which is shown in the illustration, the source of light is a minute bead or convex surface of glass, carried in the center of a sighting tube, about six inches long. The light from a lamp is received on this and dispersed. All is arranged otherwise as before. The pencil of light from this source, representing almost a mathematical point, is received and transmitted by the lens as before, is reflected from the mirror, and again transmitted.

"In these methods the rays of light pass twice through the lens, so that a doubling of the effect due to a misshape is obtained. The Clark process, therefore, is of twice the delicacy of the older methods."

So this is where you end when you start tracing the auto-collimation test —at the Clarks, who obviously made it public as long ago as 1887, through Scientific American.

It seems probable that Ellison himself never was certain about the matter. He lived far from any large library where he could have run the question down, and probably had to depend largely on oral advices and loose suppositions put forth by others.

The same article, written obviously by some visiting member of Scientific American's staff but anonymously, as was the editorial custom of the time, indicates that the 36" objective lens for Lick has just been finished by the Clarks and it contains a wood-cut (Figure 2) which is also reproduced because, while the name of the famous Clarks is everywhere mentioned in optical literature, the men themselves have become vague and shadowy—their pictures seldom seen. Alvan Clark, the father (central figure), had died only a month before, in August, 1887. Alvan G. and George B. Clark were the sons.

To an amateur telescope maker, an outline of the elder Alvan's career, from Scientific American, September 3, 1887, should be much to the point. Son of a farmer, he was artistic and for nine years worked as an engraver for calico printers, and then as a portrait painter for 11 more years. At this time, Alvan G. Clark, his son, was studying engineering at Andover and became absorbed in telescopes. The father began studying astronomy and mechanics, in order to instruct the son. Together they made a reflecting telescope. Encouraged by a Harvard professor, they next tried objective lenses and made out so well that they devoted themselves thereafter to making telescopes. Their reputation grew, reached England, and Dawes—the Dawes of "Dawes limit"—ordered a telescope in 1853. It did such fine work that many foreign orders for similar 5¼" objectives were soon received. By 1860 the Clarks had tackled an 18", then the largest objective in the world.

Larger and larger objectives were made in later years as the firm became more and more famous—leading up to the Lick and Yerkes lenses.

The story of the Clarks is told in much greater detail in G. Edward Pendray's "Men, Mirrors, and Stars." George B. Clark died in 1891, and the other son, Alvan G. Clark, in 1897. The Clark tradition then passed on to the Lundins.

Figure 3 is from a wood cut in the Scientific American article referred to above, where it was published with the following caption: "Machine used in polishing the Lick objective."

This mention of Lick makes your scribe's face blush to a deep long-winter-underwear red, for in the September number he stated that the donor Yerkes was buried in a crypt under the pedestal of the 40" refractor at Yerkes. It turns out that it was Lick who was thus buried, and at Lick Observatory beneath the 36" refractor. There, darn it, goes a good story.

⊕ ⊕ ⊕

TYROS are urged in "A.T.M." to make their first mirror about $f/8$, this being a sort of compromise between a number of partly conflicting considerations, but when making a second mirror it is not inadvisable to depart from this, either as a venture or for a specific purpose. For planetary work many prefer something like $f/10$ or $f/12$, which gives a larger image. E. White, Box 1, Ymir, B.C., Canada, has just made an 8½" $f/12$ (Figure 4) and says that "its performance is very good, both optically and physically. I designed it," he continues, "for observing lunar and planetary detail but it performs admirably on stars as well.

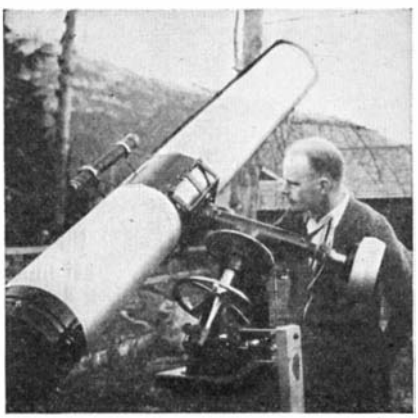


Figure 4: White of "Wymer"

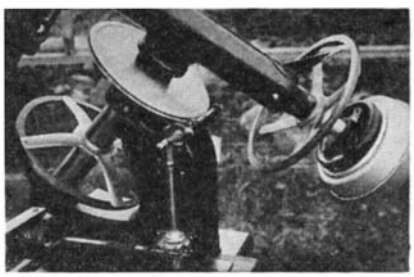


Figure 5: White's motor drive

"The equatorial mounting (Figure 5) is motor driven by a train of gears made as per the instructions on hobbing ('A.T.M.A.' page 365) with a tap."

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RADIONICS*

"the impossible we do immediately the miraculous takes a little longer"

ARMY SERVICE FORCES—

The Army is . . . men . . . trained men . . . equipped and maintained. On the home front . . . in factories and on farms . . . civilians produce the armament and food and supplies. The bridge between civilians who furnish and soldiers who use . . . is . . . the Army Service Forces. Wherever the soldier is . . . whatever he does . . . the Army Service Forces are charged with seeing that he lacks no essential thing. To fulfill the task outlined in the twenty-one words above . . . literally . . . the "impossible" and the "miraculous" become daily routine with the Army Service Forces.

"AYE, AYE, SIR"

In old English, "Aye" meant "yes."

It means far more in the Navy.

"Aye, Aye, Sir," means that the order is understood and will be obeyed.

The Navy has given Zenith many "orders" since this war began.

Our prompt "Aye, Aye, Sir," has, we believe, been justified by the "intelligence and initiative" (as the Navy says) with which these orders have been executed.

—in days of civilian radio, Zenith was proud of its long series of "firsts"—improvements which made radio history and established leadership in the industry.

—today our viewpoint has changed—materially.

—engaged exclusively in war production, the things we have been called upon to do—the tasks we have succeeded in accomplishing, make past improvements in civilian radio literally look like "child's play."

—the work of our engineers in radionics has made the "impossible" possible and accomplished the "miraculous."

*—mark that word "RADIONICS" (with its subdivisions of Electronics, Radio, etc.) — it has brought into reality and being, devices which only a year or so ago came in the "impossible" and "miraculous" categories.

—today Zenith works in the science of radionics for our armed forces alone.

—in that bright "tomorrow" when peace returns—

—we can only say—the post-war radios that Zenith will produce will contain many interesting new developments.

—that statement is based upon experience which we can not now reveal—but you may take our word that it is a fact.

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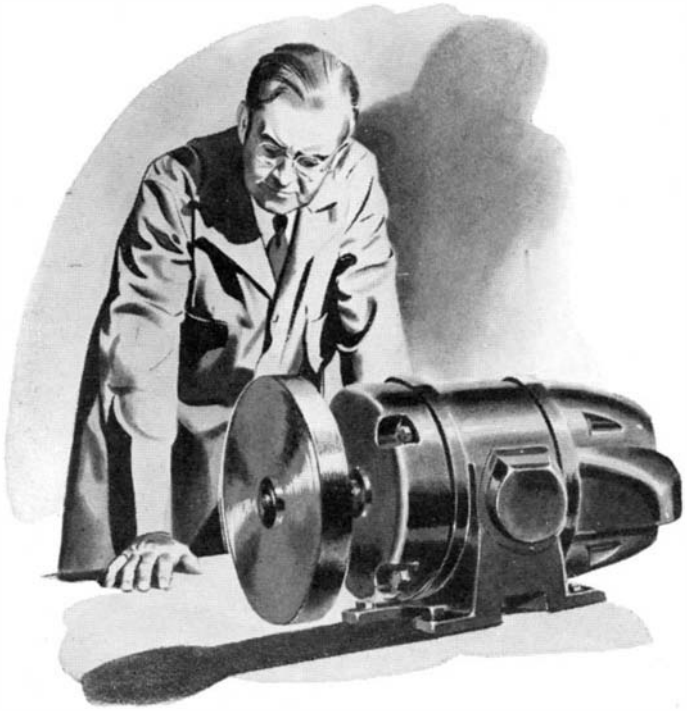
RADIONIC PRODUCTS EXCLUSIVELY—WORLD'S LEADING MANUFACTURER

You can't see it . . . but it's there



THE MOST ACCURATELY machined rotating part ever built—although apparently in balance to the naked eye—may be *out of balance.*

You can't see the unbalance . . . even if it's there.

With the rapid development of high-speed machines, the need for *locating and correcting* unbalance in rotating parts has become vitally important—if you want smooth, vibration-free operation and long life.

In 1933, scientists in the Westinghouse Research Laboratories tackled this problem of quickly and accurately measuring the *static* and *dynamic unbalance* in rapidly whirling masses—both symmetric and asymmetric.

Through painstaking study and experiment, these Westinghouse research engineers discovered a totally new principle for balancing rotating parts of every shape and form . . . the "Dynetric Balancer."

Today, the Gisholt Dynetric Balancer . . . using Westinghouse *electronic equipment* . . . is solving the most difficult balancing problems in many war plants.

With this machine, vibrations as small as *twenty five millionths* of an inch in crankshafts, armatures, turbine rotors, propellers, and countless other whirling parts are located and measured in a matter of minutes, or even seconds!

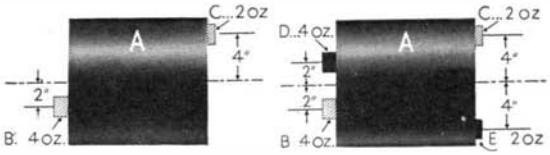
Westinghouse Electric & Manufacturing Co., Pittsburgh, Pennsylvania.

THE PROBLEM OF UNBALANCE

Static unbalance

(*Left*) Disc A is *statically unbalanced* by the 4 ounce weight, B, placed 2 inches from the axis.

(*Right*) This *static unbalance* can be corrected by placing a 2 ounce weight, C, 4 inches from the axis.

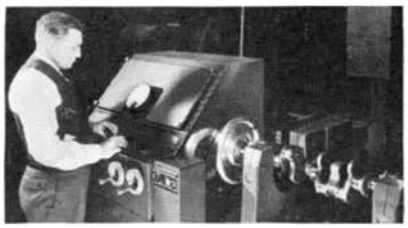


Dynamic unbalance

(*Left*) Cylinder A is *statically balanced*—by the weights B and C—but *dynamically unbalanced* by the twisting effect of these weights when the cylinder is rotated.

(*Right*) This *dynamic unbalance* can be corrected by placing weights D and E, as shown.

. . . AND ITS SOLUTION



On this Dynetric Balancer, *combined* static and dynamic unbalance in engine crankshafts is accurately and quickly measured by instrument readings. Corrections are then made by drilling holes in the crank arms.

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