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Dean Kurt F. Wendt
203 Mechanical Engineering Bldg.
University of Wisconsin
Madison 6, Wis.

MAY
1956

The Wisconsin engineer

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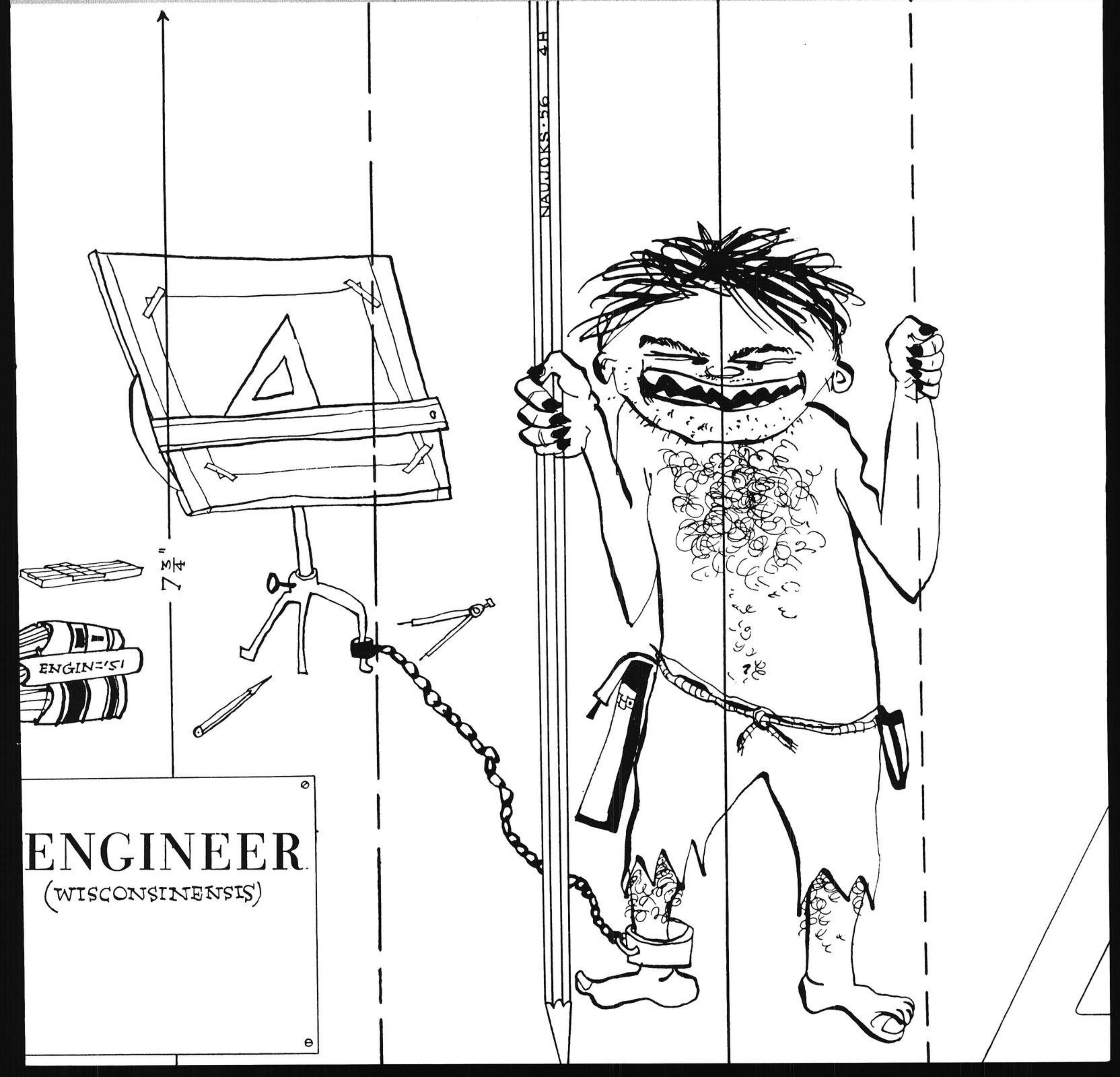
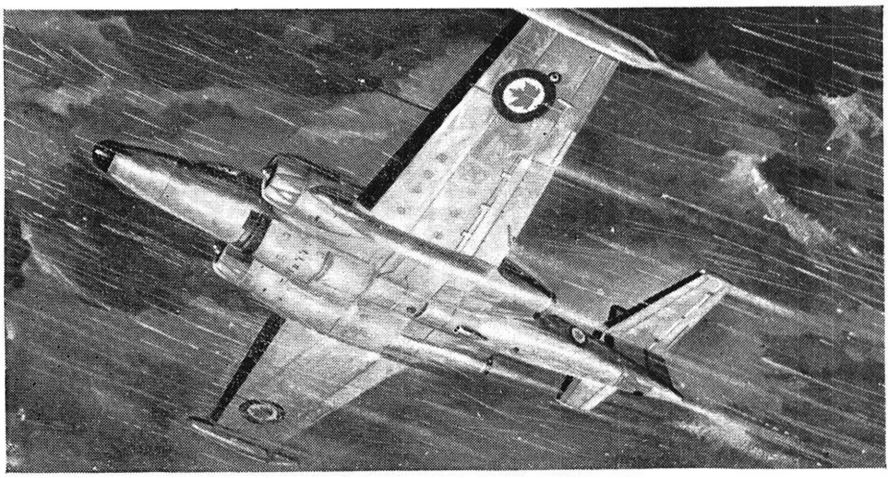


"ELECTRIC BLANKET" DEICES ARCTIC AIRCRAFT



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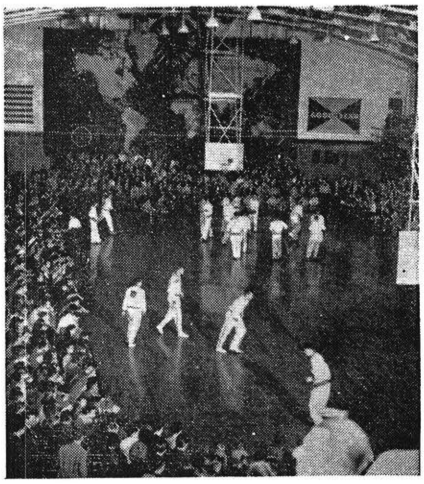

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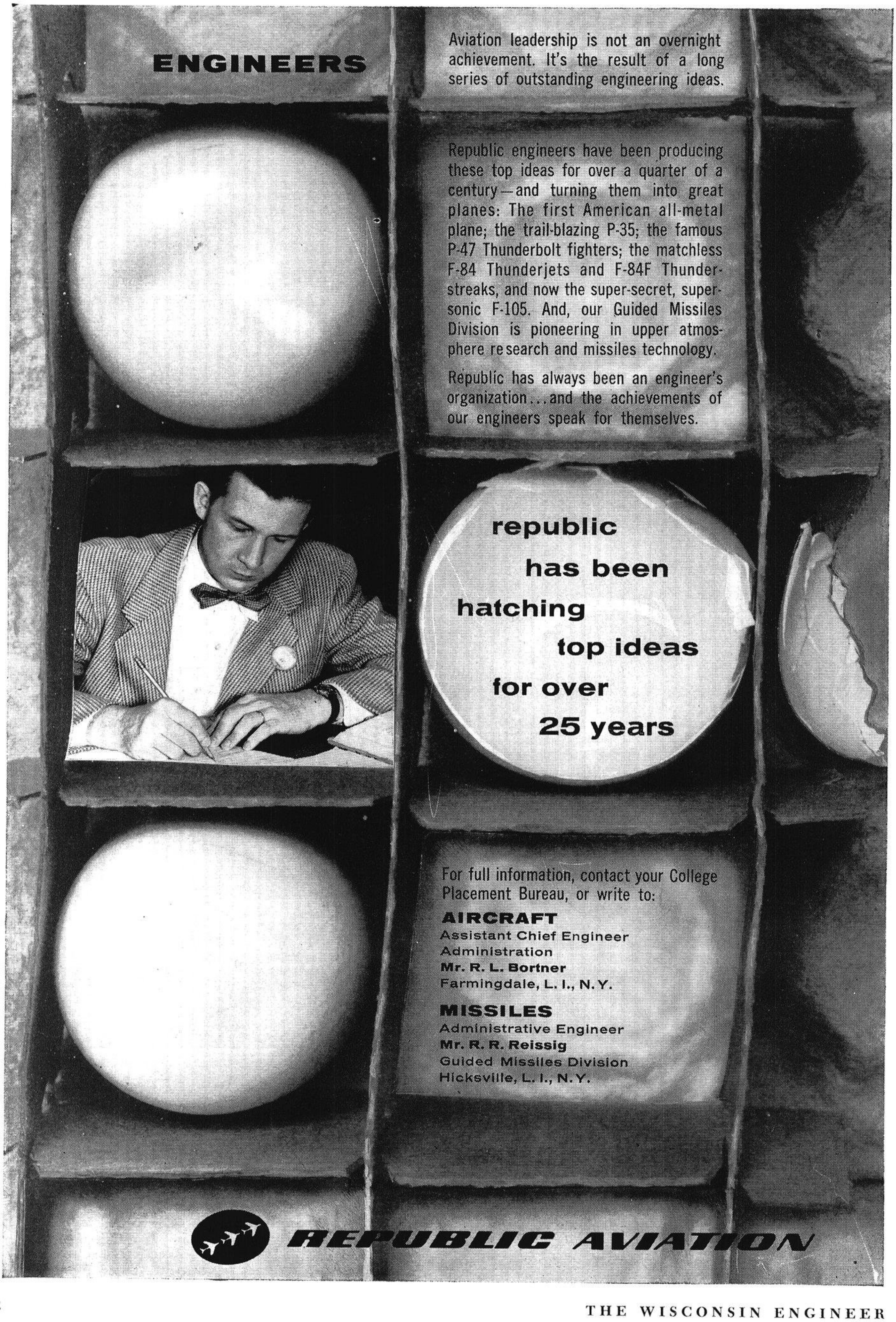
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The Student Engineer's Magazine

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Volume 60 | **MAY, 1956** | **Number 8**

Features

Departments

Cover

The engineer on June 1, 1956.

Frontispiece

IFR—The jet fuel being guzzled by this B-47 is being accurately measured by a new in-flight refueling transmitter, which can measure 600,000 pounds of fuel an hour. Previous models could handle only 12,000 pounds an hour. The transmitter is located in the flying tanker's line that leads to the fuel boom (foreground).—Courtesy General Electric.

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Rambling WITH THE EDITOR

This being the first issue put out by the new staff I would like to take this opportunity to meet all our readers. In doing so I have two requests that I would like to have you fulfill.

First, the only way that I can find out what you want in this magazine is for you to tell me.

Please criticize this magazine at any time whether it be what students of speech call constructive criticism or just plain old fashioned gripes. The staff will welcome all comments and give due consideration to any new ideas you would like us to incorporate in the magazine.

Second, if any of you would like to put some of your wasted spare time to good use, the staff would very much like to have you join us. A simple telephone call to anyone on the present staff will give you all the information you want. Whether it be just the desire to see your name in print or the chance of providing a service for your department we would be glad to have you with us. Remember, the best way to use your ideas for this magazine is for you to put them in effect yourself.

* * *

We of the *Engineer* would like to tip our hats to the Wisconsin Engineering Exposition Committee and especially to John Bollinger the chairman for the top notch job they did in handling the exposition. With the help of the weather man this was by far one of the most successful expositions in their history. The University can certainly be proud of The College of Engineering. —R.F.S.

P. S. Do you have any comments on the new registration procedures? Let's hear them!

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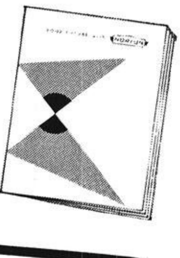

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MOTION WITHOUT MOTORS

by Peter J. Barrett, m'57

Theory of Sailing

Most people find it easy enough to understand why a sailboat can move with the wind pushing it, but often have difficulty seeing how a yacht can move upwind against the force which is giving it motion. A boat moves downwind because the wind is pushing it, just as a chip of wood will be blown across a puddle on a windy day. See Fig. 1, where the sail is arranged perpendicular to the wind to present the greatest area and consequently the greatest driving force.

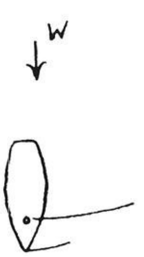


Fig. 1

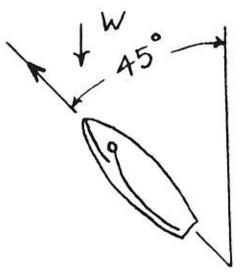


Fig. 2.

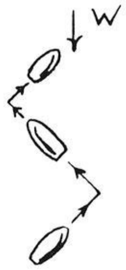


Fig. 3.

In Fig. 2 the boat is moving upwind, against the wind, at an angle of 45°. This is as close as any sailboat can sail to the direction the wind is blowing from. Thus, to reach a point directly upwind, a sailboat is forced to sail a series of zig-zags, each 45° from the wind direction, and with each corner a 90° turn. See Fig. 3.

The force that is driving the boat upwind is the same force that keeps an airplane in the air. Picture an airplane wing with the air flowing over it (Fig. 4). Particle A, moving over the top of the wing, has further

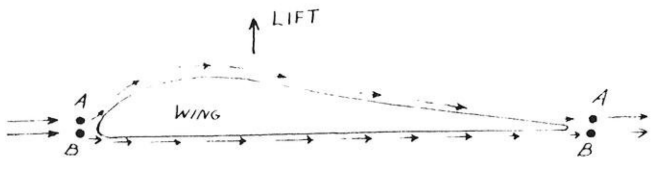


Fig. 4.

to go than particle B which moves underneath the wing. If both particles start across the wing at the same instant, they must both arrive at the trailing edge of the wing at the same instant. Since A had farther to go, we may assume that it traveled faster than B, which had a shorter distance to cover. This means a current of air traveling over the wing with a higher velocity than the current passing under the wing. Bernouli's Theorem, from high school physics, states that fluid pressure is inversely proportional to velocity. Translated, this means that the higher velocity air stream above the wing exerts less pressure on the wing than the air beneath . . . and the wing will rise.

Fig. 5.

All this can be directly translated to a sailboat. Instead of the wing, we have a sail with an air stream flowing over it, and a low pressure area on the side away from the wind. Thus a force is exerted which tends to move the boat sideways and ahead, and because a boat is long and narrow it moves ahead much more easily than sideways. See Fig. 5. It is this low pressure area, or vacuum, which pulls the boat forward against the wind.

How Sails Are Made

Most landlubbers, after seeing white sails flitting about on a lake, would assume that all that is necessary to make a sail is to know the three dimensions of the triangle, make a big piece of cloth and cut it to the correct size, and put it on the boat and sail. This is far from the truth, in that sailmaking is one of the oldest, most secret, and most highly skilled trades (or perhaps it should be called an art) in the world. Going back to the analogy of an airplane wing, it is easy to see that a flat piece of cloth could hardly be expected to assume the shape of an aerodynamic surface automatically when hoisted on the mast and pulled out along

(Continued on next page)

the boom. The art of the sailmaker is to cut a piece of cloth so that when two of its edges are securely fastened to straight, rigid spars the cloth will take the shape of an aerodynamic surface. In order for this to happen, the edges of the sail must be curved in their natural form, so a sail laid out on a flat surface, say the floor of a sail loft, will look like a straight-sided triangle but like a spherical triangle. See Fig. 6.

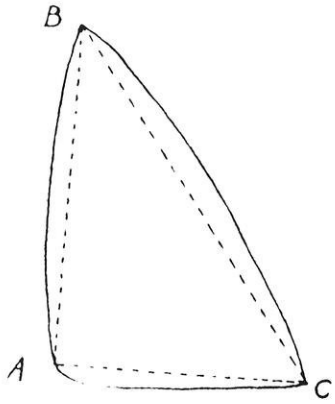
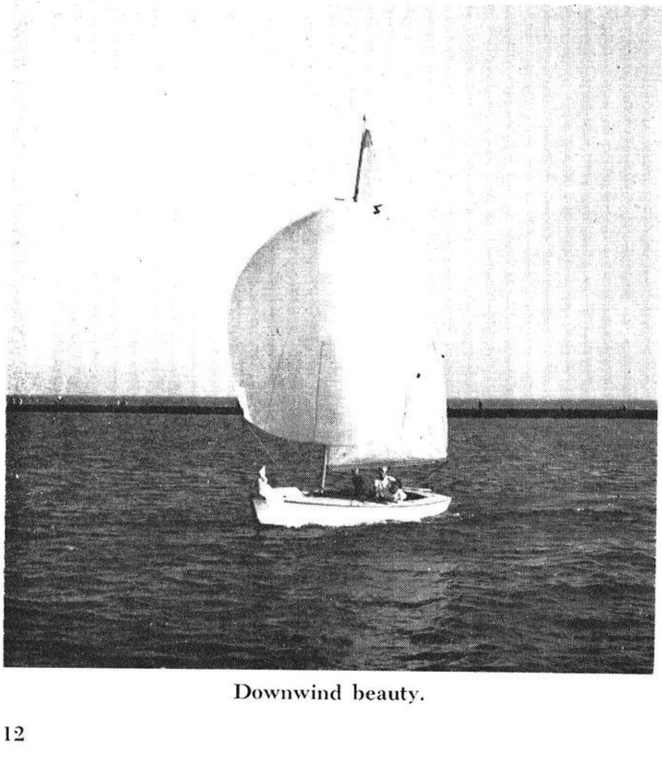


Fig. 6.

Watch out for that puff coming across the lake.

A great deal of effort is spent in making sails in order to arrive at the correct curves for sides AB and AC (Fig. 6), so that the sail will assume the proper shape when AB is fastened to the mast and AC to the boom. What makes it even more of a challenge is the fact that nobody knows exactly what is the best shape. The draft of a sail is the depth of the belly in it, the extent to which it curves away from the plane of the mast and boom. The amount of this draft and the location of the point of maximum draft are two important variables which even the most experienced sailmakers and yacht racers cannot control perfectly. Not only because the means of control are imperfect (no two sailcloths will react the same, no length of rope which is sewn on the edge of the sail will stretch or shrink exactly evenly, no two spars will bend the same), but more important because the correct solution is itself an unknown.

However, there are some generalities that are pretty well agreed upon. A flat sail (little draft) is better in a strong wind, and as the wind decreases, the amount of draft should increase proportionally so that a light wind requires a rather full sail (one with a large amount of draft). Since the number of sails which a yachtsman may own is limited by the size of his budget (and at $1 plus per square foot may find their budget quite limited), it becomes important to be able to control the draft of a sail by means which enable the same sail to be utilized over a variety of wind conditions.



Downwind beauty.

Spars

Before going into the actual methods of sail control, a brief description of spars might be useful. We are only concerned with two for the present; the mast, or vertical spar, along which the sail is hoisted; and the boom, or horizontal spar, which holds the bottom of the sail taut and provides a means for adjusting the angle between the sail and the centerline of the boat.

There are two popular ways of fastening the sails to the spars. The most widely used today is the channel, or boltrope, method where a small channel in the mast (or boom) is connected with the outside by a smaller opening, and a rope sewn on the edge of the sail runs in this channel while the sail extends through the smaller opening. See Fig. 8.

The other method is track and slides, where slides are sewn onto the sail and slide freely on a track which is screwed to the spar. See Fig. 9.

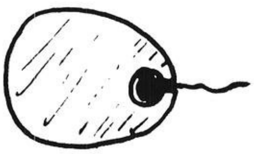


Fig. 7.

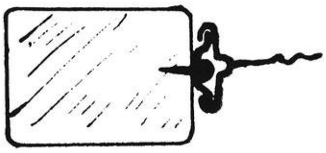


Fig. 8.

The shape of the mast is quite important, because it is the leading edge of the sail and very important in establishing smooth, non-turbulent flow over the surface of the sail. Masts may either be rigidly fastened at their base or may be mounted upon a swiveling device, so they can turn freely. In the first case a round mast is superior, because at no angle will there be any eddies caused by the flow of fluids around a corner. In the second case, that of a pivoting mast, it is possible to design a teardrop cross-section for the mast, because, while the boat is going against the wind and streamlining is important, the mast will always be pointing into the wind. In fact, some designers have gone to extremes and designed a long tapering teardrop which faces into the wind during upwind sailing and doesn't act as a resistance, and which turns perpendicular to the wind while sailing downwind and greatly increases the effective sail area of the boat.

The shape of booms is not as important as that of masts. However, one can design a high, narrow boom which will also add to the effective sail area, or a perfectly round boom which will reduce turbulent flow around the lower edge of the sail.

In the next section the bending of masts and booms is going to become important, and this is also an important factor in designing the cross-section of a mast or boom. Naturally the spar will bend easier in the direction of least cross-sectional width, and the designer should decide whether he is going to want fore and aft bending or lateral bending, or rigidity, and should keep this in mind as well as the other factors mentioned.

Controlling Sail Draft

Something that few inexperienced and intermediate yacht racers realize is that just because they have only one sail, or perhaps two, they are not limited in the number of different wind conditions they can rig their boat for. The draft and shape of a sail can be greatly controlled by the proper adjustment of the mast and rigging of the boom.

Let us suppose that we have a sail which is cut for moderate winds (that is, with a medium amount of draft and the point of maximum draft approximately one third of the distance back along the boom). Suppose we come down to the shore on Saturday, eager for the big race, only to find it blowing a gale with whitecaps racing across the gray water. Before we turn homeward in disgust because our sail simply isn't flat enough to drive us to windward under these conditions, let's try a few adjustments.

Normally our mast is straight. What we want to accomplish is to pull out some of the bag or belly in our sail. Now if we can get the mast to bend concave backwards, with the top going back and the middle moving forward, we can in effect pull out that belly in the center of the sail and have a flatter setting sail. This we can do by slacking off on any stays running to the top of the mast, leaving the top limber and free to bend backwards when the sail is trimmed in flat. And of course, when the conditions are opposite (light wind) we want the mast to bend concave frontwards, with the top forward; so we tighten up on any stays running to the top of the mast and pull the top forward. This has the effect of moving the center of the mast backward, thus adding to the looseness of the sail and the draft or belly. Thus the mast may be caused to curve in either direction and the amount of this curvature closely controlled. There are numerous staying variations possible, depending upon the length and rigidity of the mast and the amount of control desired. Some scow sailors prefer such a limber mast that they can actually see it bend as a wave hits the hull or a guest of wind strike the sail—this is probably going to extremes.

Once we have seen how one can control the amount of curvature, it is easy to imagine how one can control the shape of the curvature by causing the mast to curve

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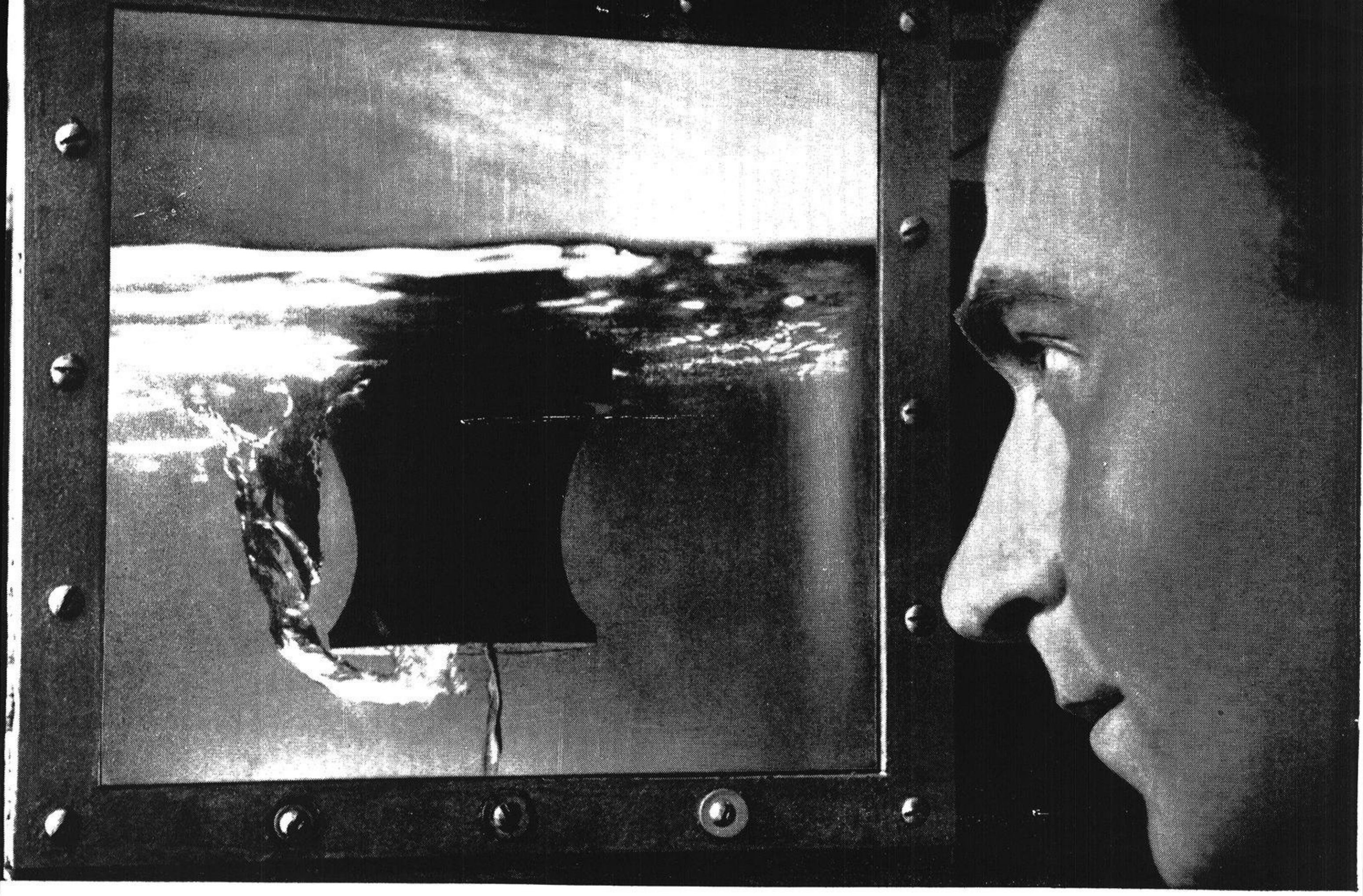

A WHIRLPOOL SPIRALS into the inlet of a model pump. This unique picture shows how air, a common cause of pumping trouble, was carried into the pump in . . .

The Case of the Baffled Whirlpool

Some time ago, the report reached us that two Worthington vertical turbine pumps installed by one of our customers weren't working right. They delivered plenty of water, but vibrated badly and burned out bearings.

The customer asked us to find the trouble fast. After checking we knew the pumps were okay, so Worthington Research had to answer him.

First thing we did was build a one-tenth scale model of the customer's installation. The photo shows what happened when we started pumping.

A whirlpool immediately formed between the water surface and the pump inlet. Air, trapped in the whirlpool and carried into the pump, was the villain in the case.

The solution came with experimentation. A simple baffle arrangement in a side channel eliminated the whirlpool—and the trouble-making air.

Chasing the gremlins from pump installations like this, boosting the efficiency of heat transfer in air conditioners, developing better seals for pumps and compressors — these are all in the day's work for Worthington's busy research engineers. At Worthington, research ranks right alongside engineering, production, and sales to develop better products for all industry.

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DIE CASTING

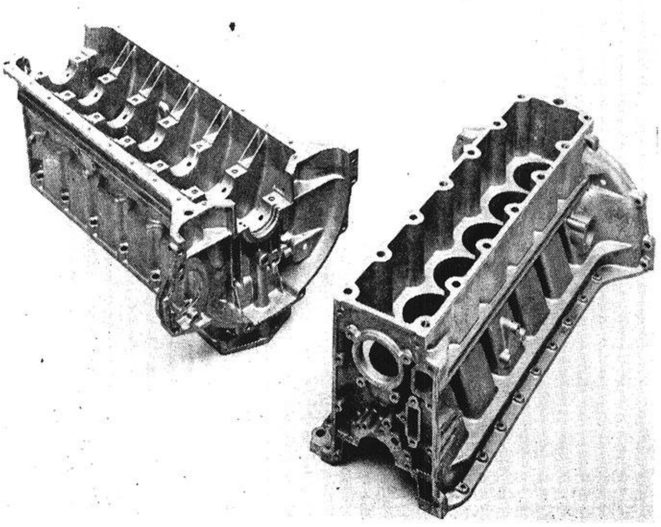
by Robert Wesolowski, m'57

The process of die casting has come to be recognized as one of the leading modern high speed production methods for converting raw materials into finished products. No one other fabricating technique has contributed more to the economic and quantity production of metal parts.

Wherever one may look, in the office, store, factory, on the street, or in the home, he is confronted with numerous products in which die castings are an integral part. Aircraft, precision instruments, hardware, industrial machinery, internal combustion engines, and thousands of other items depend on die casting for their component parts. From an obscure beginning, die casting has grown into a mighty industry.

One of the oldest methods of casting molten metal is by gravity pouring it into sand molds. That method, with some refinements, is still practiced in our sand foundries today. In the course of time, the jewelry trade by its requirements for sharper outlines and smoother castings developed a process utilizing plaster or gypsum molds.

This method resulted in parts having a finer surface than sand castings. The disadvantage was that, as in sand casting, the mold had to be destroyed to remove the cast part.



—Courtesy Doehler-Jarvis Corporation

Aluminum engine blocks such as these are typical of the wide range in both materials and products possible with die casting.

The search for a permanent mold or form which could be used to produce parts in quantity from the same mold seemed to be a natural development. In the Middle Ages the pewterware manufacturers perfected a casting process using iron molds to produce plates, cups, pitchers and other household utensils.

The next step was the production of toy soldiers, or "tin soldiers" which appeared in the 1800's. They were made by gravity pouring molten metal into iron molds constructed in two halves which were hinged together and mechanically opened and closed. The mold was filled with molten metal, and after a suitable interval of time had elapsed, the bulk of still liquid metal was poured out. A thin walled casting was produced with a minimum metal consumption. This technique is termed "slush" casting and is still used today.

In the light of those established practices of using iron molds for quantity production to produce sharper, better, and smoother cast parts, in contrast to the centuries-old method of using sand forms, the next logical step was to improve accuracy and appearance of cast parts. This was accomplished by applying pressure to force the molten metal into strong steel molds, instead of merely relying on gravity pressure.

The casting of type about a century ago is believed to have been the first article cast by applying pressure to force the molten metal into the mold. A machine for die casting type was patented in 1849, but it was not until some twenty years later that a machine for making miscellaneous castings appeared.

By 1904 bearings for automobile connecting rods were die cast. This was the beginning of the rapid progress of die casting which has more or less paralleled that of the automobile industry.

Today some die casting machines are almost, if not quite, completely automatic and nearly all have the major parts actuated by power.

The production of castings by die casting is one of the more notable developments in modern manufacturing practice. Die casting provides a means of producing unlimited quantities of castings of such uniformity and accuracy that machining costs are either reduced greatly or eliminated entirely. Die casting is generally considered a "one step" process because the molten metal is converted in a matter of seconds from a fluid formless mass, into a finished or semi-finished product.

The actual production of a die casting involves three basic requirements: a properly designed die, a smooth working casting mechanism properly designed to hold and operate a die under pressure, and a suitable alloy.

The die casting die, which consists of two steel blocks into which an impression of the casting is cut, must be split in two sections so that the casting can be removed after it is formed. The two sections are called the cover die and the ejector die. The cover die is fastened to the casting machine and does not move during the casting cycle.

The ejector half is mounted on the movable table of the machine. The die halves are fastened to opposing plates which are operated as the machine opens and closes. When the machine is closed, the two halves of the die are locked tightly together, after which the molten metal is injected at high pressures, which may vary from 100 to 100,000 pounds per square inch, into the die cavity.

Within a fraction of a second, the fluid alloy fills each minute detail and section of the die. Because of the low temperature of the die, the casting cools quickly permitting the die halves to be separated and the casting ejected from the cavity in a few seconds.

The function of the die casting machine is to hold the two halves of the die tightly together, to inject molten metal under pressure into the die cavity, and to close and open the die halves to permit removal of the finished castings.

Essentially any die casting machine consists of a frame on which the die is mounted, an actuating device which opens and closes the die, and the injection part of the machine which forces the molten metal into the die under pressure. The injection part of the machine is basically a plunger which when moved forward, propels the molten metal into the die cavity. The plunger for metal injection is arranged for operation either by hand, compressed air, or hydraulic pressure.

The sharpest restriction on the use of die casting comes about through the limited range of die castable metals. However, through research and close quality control during production of castings, maximum physical properties are being secured. Furthermore, current work is being done to increase the life of die casting dies for high temperature die casting alloys, which may permit more extensive use of brass and bronze.

The usual non-ferrous metals for die casting in approximate order of commercial use are: zinc, aluminum, copper, magnesium, lead and tin.

Zinc alloys account for about three-fourths of the total tonnage of die castings produced, because they present the most favorable combination of low cost per casting, good physical properties, and ease of casting and finishing. The average melting point of zinc

—Courtesy Doehler-Jarvis Corporation

This die casting machine contains a 30 ton die that stamps out 6-cylinder engine blocks under 4,000,000 pounds of pressure.

alloys is 716°F. Casting is commonly done at temperatures of 750 to 800° F. at which temperature the metal is quite fluid and is easily injected into the die.

At this comparatively low casting temperature, dies will last almost indefinitely because they will not be subject to attack by the alloy. For short runs, the steel dies can even be used without hardening, although for long runs at least surface hardening is recommended. There is little tendency for the zinc alloy to solder to the die, hence little or no die lubrication is needed. In many instances speeds up to 500 die casting cycles per hour can be obtained.

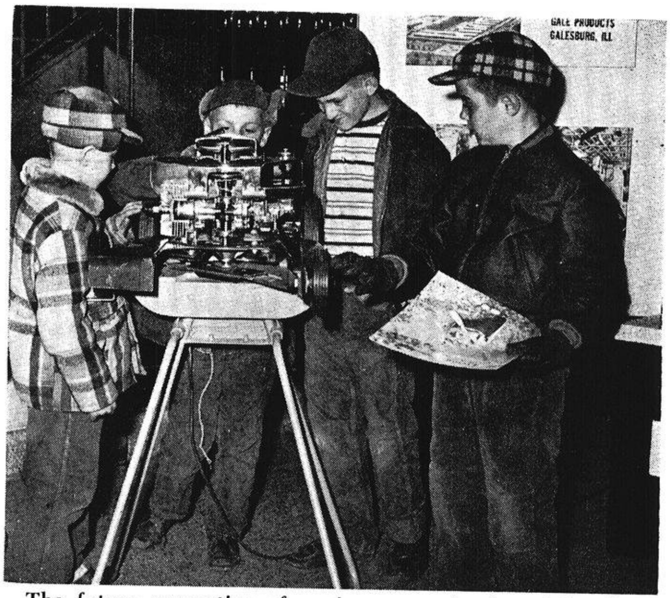
Castings of extreme smoothness are produced with zinc alloys and if the die cavities are properly polished, castings can be plated with little or no polishing. This fact, together with the ease and speed in the plating of brass, nickel or chromium, is the primary reason for using zinc die castings for hardware and decorative applications, especially in automobiles and other consumer merchandise.

Aluminum alloys rank second in die casting use. In some cases they cost no more or even slightly less per casting, than zinc castings of the same dimensions. About 20% of all die castings are of aluminum alloys. The primary advantage is light weight. Dimensional stability is rated as high. Where low weight and the savings therefrom are desired, aluminum is favored unless magnesium alloys can be used. Die casting rates for aluminum are lower than for zinc but commonly range from 80 to 200 die fillings per hour.

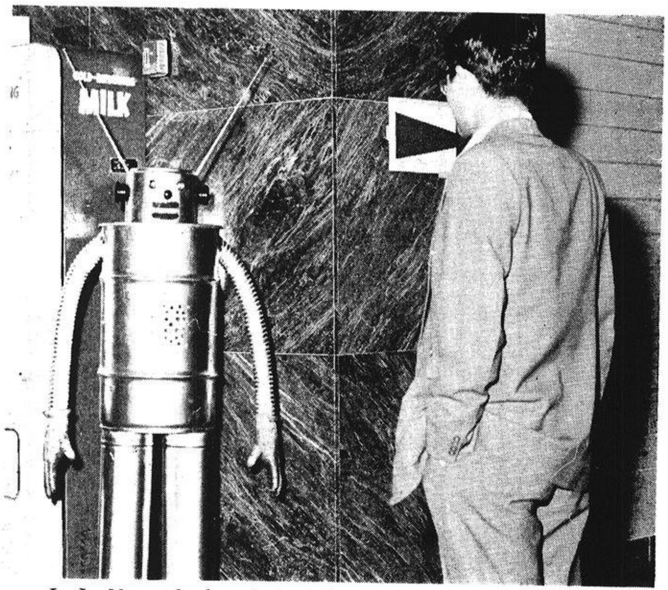
Copper alloys, usually referred to as "brass", have the highest physical properties of any die casting alloy. Because of the high melting point of such materials,

(Continued on page 53)

John Duwell's molding process exhibit drew many a watchful eye.

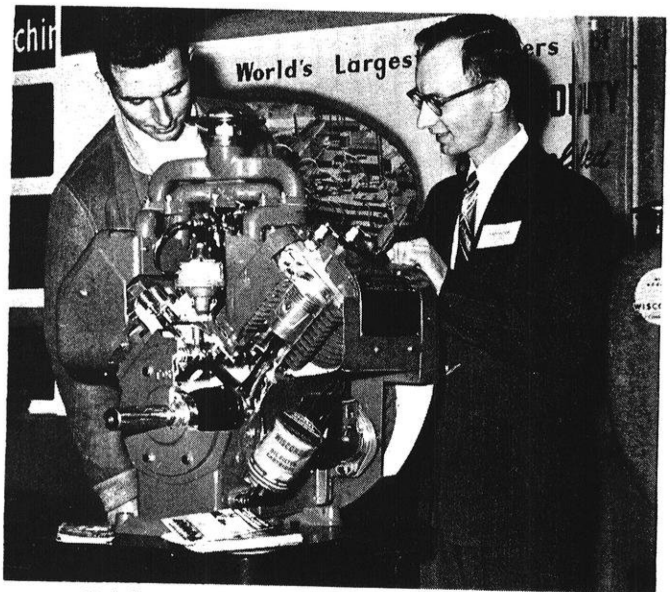


The future generation of engineers are fascinated by the cut-away view, of a power lawn mower.

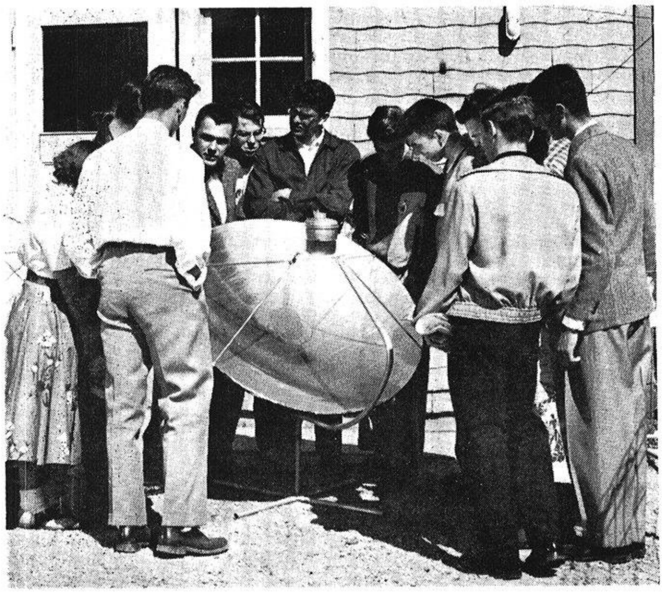


I. J. Nagrath found it difficult to converse with his electronic friend.

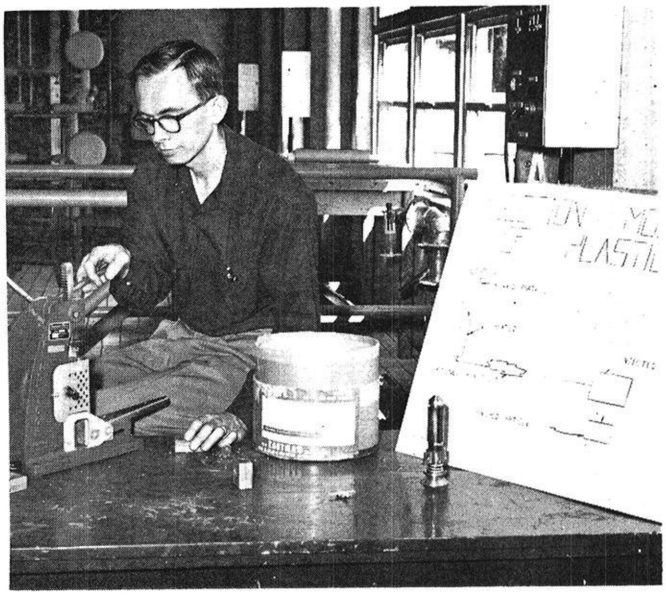
Questions were in Order at the Exposition



Ralph Seifert proved to be a good listener for demonstrator Eric Bunow.



The Solar Energy exhibit interested everybody—
even the fair set.



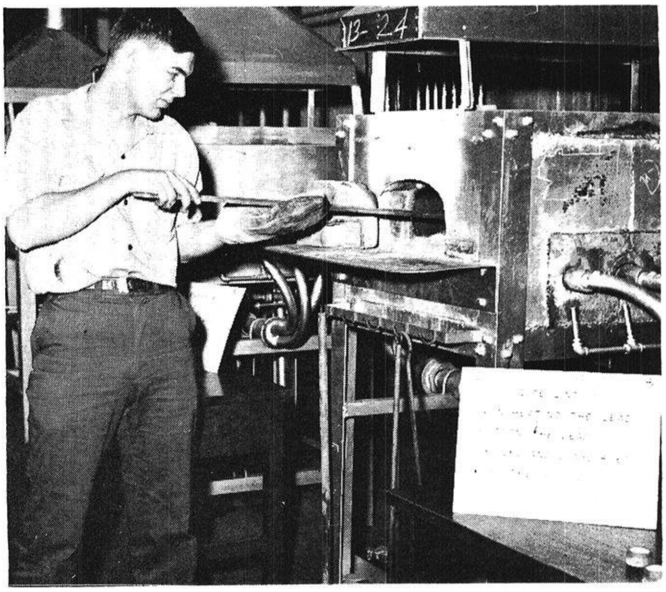
Al Prescott gave an injection molding demonstration.

1956 Engineering Exposition

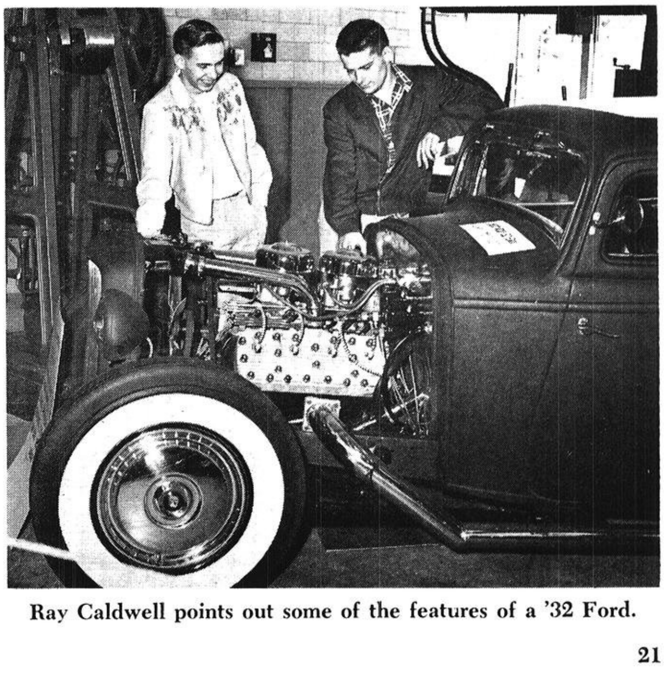
Vastness and versatility were the keynotes of the University of Wisconsin's 1956 Engineering Exposition. The main purpose of the Exposition was to open the doors of engineering to the public and reveal to them the many advancements that have been made in industry. All desires of attendance were fulfilled for along with perfect weekend weather came thousands of people eager to see the many innovations to the fields of engineering.

Escorted tours took viewers through the various engineering buildings. Housed in these buildings were over thirty industrial exhibits representing companies located throughout the United States, and over seventy students exhibits. Much time and effort were put into the student exhibits, the incentive being three trophy awards and $400 in cash awards. The awards were presented to the students near the close of Saturday's activities.

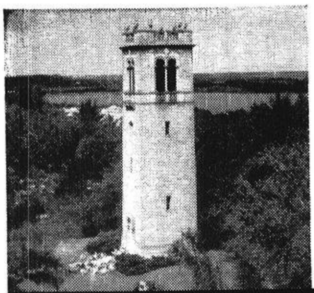
The complete success of the Exposition can be attributed to the students whose combined efforts made it the best exposition this campus has ever seen.

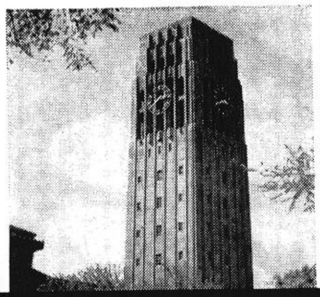


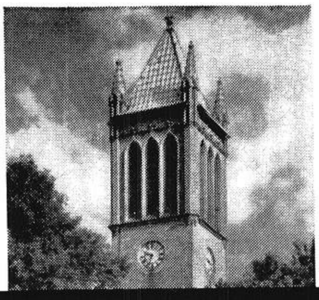
Barclay Gilpin charges a high temperature assaying furnace.

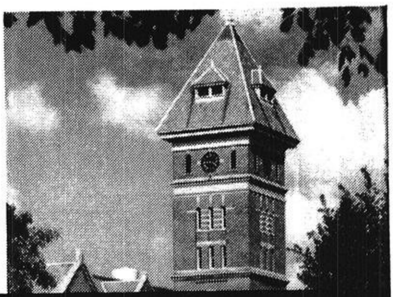


Ray Caldwell points out some of the features of a '32 Ford.


WISCONSIN


MICHIGAN

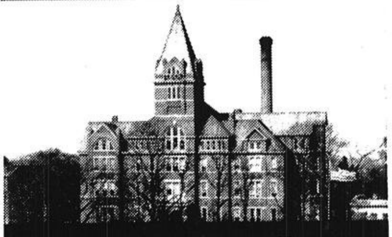

IOWA STATE

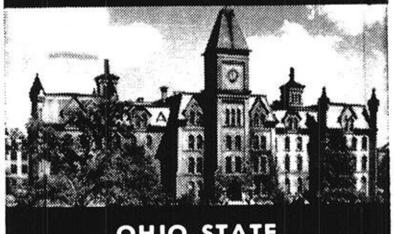

PURDUE


TEXAS A & M


ILLINOIS


PENN STATE


GEORGIA TECH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HERE'S
where we Look
. . . AND
HERE'S
where we Find

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Over a period of many years we've found scores of fine engineers in these nine schools. Most of them are still with us, prospering in the ever-expanding electrical field.

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SQUARE D COMPANY

WESLEY J. HELLEN

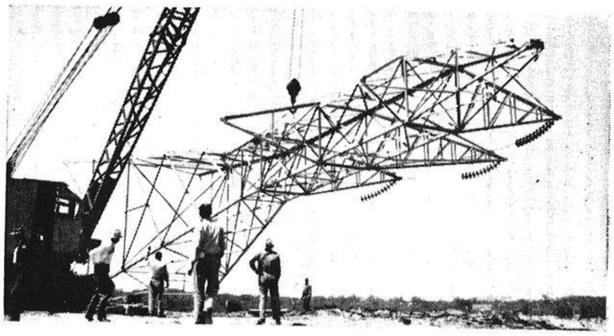
"I'm glad that I chose WISCONSIN ELECTRIC POWER COMPANY"

After receiving a BS degree in mechanical engineering from the University of Wisconsin in 1949, Wesley J. Hellen decided to follow in the footsteps of his father who has been at Wisconsin Electric Power Company for more than 30 years. Starting as a Cadet Engineer in the Testing division, Wesley has advanced through several steps to his present position of Senior Test Engineer in the Company's newest and most modern power plant at Oak Creek.

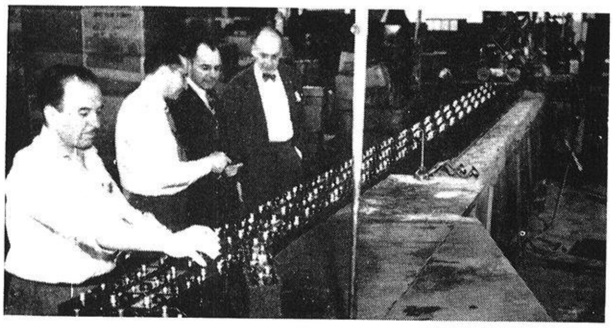
THERE'S A PLACE FOR YOU IN OUR FUTURE!

Many engineering graduates choose Wisconsin Electric Power Company because of its reputation for sound and steady progress . . . for its modern and pioneering policies. For example, our power plants have established world records for efficiency. They were the first to develop and use the process of burning pulverized fuel, the first to introduce radiant superheaters into their furnaces. Engineering talents are needed in the varied fields of our operations. Recognition of ability is assured through an unique "management inventory" system which has received industry-wide attention.

PLANNING — Engineers are needed to help plan and design the generating, transmission and distribution facilities which serve the needs of more than half a million electric customers in Wisconsin and upper Michigan.



CONSTRUCTION — Engineers are needed to supervise the details of a continuing construction program. The 1955 construction budget for the Wisconsin Electric Power Company system amounted to more than 41 million dollars.



SALES — Engineers are needed for many phases of the Company's sales program. Openings are available in the field of industrial sales . . . in the activities of lighting, heating, air conditioning and commercial groups.

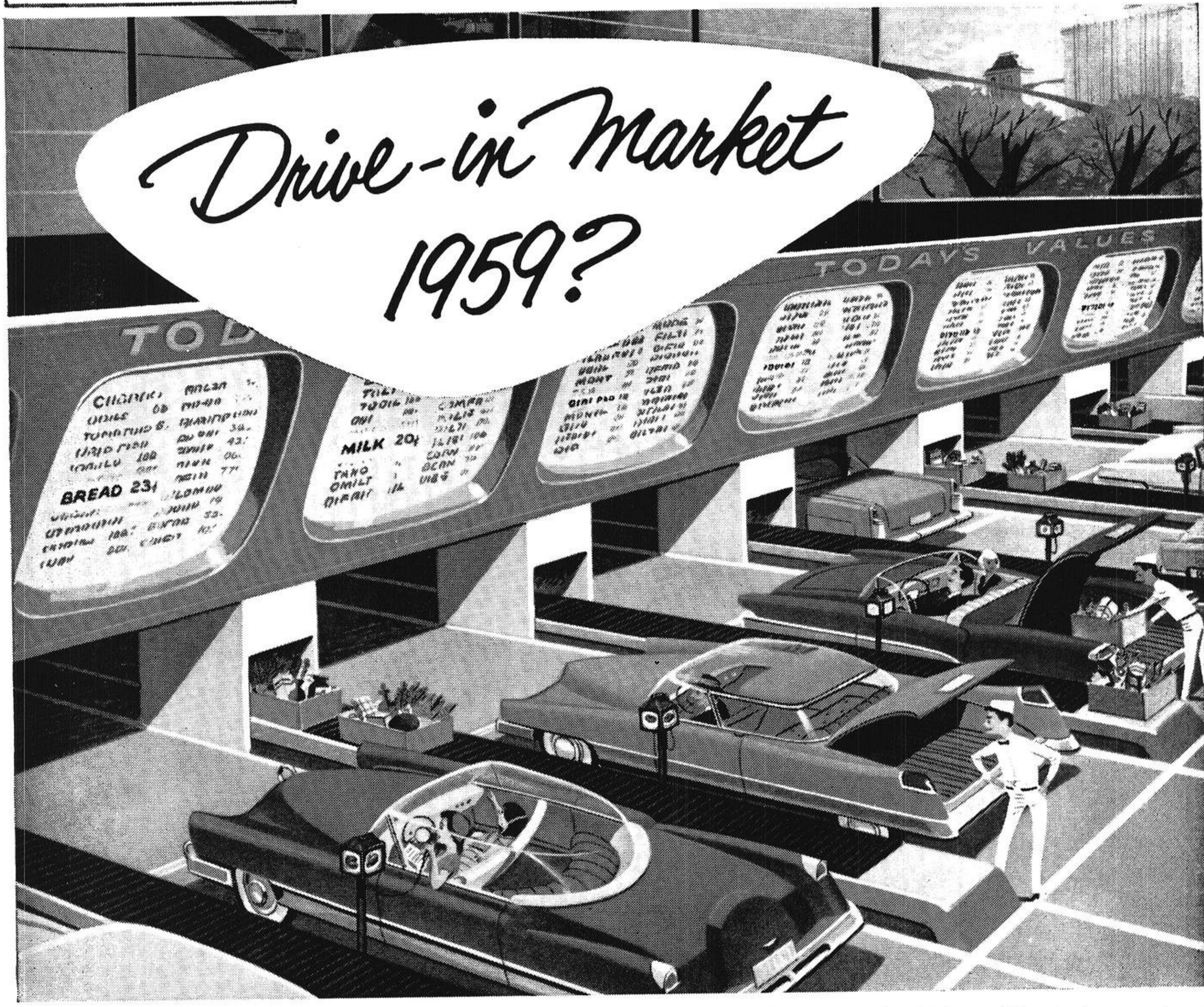
ADMINISTRATION — Engineers are needed for many activities which provide an excellent training for advancement into administrative fields. Many of our executive positions are now held by engineering graduates.

Write to our PERSONNEL SERVICES DEPT. for a copy of our Annual Report and other information

WISCONSIN ELECTRIC POWER COMPANY

231 West Michigan St., Milwaukee 1, Wisconsin

NEW DEPARTURES OF TOMORROW

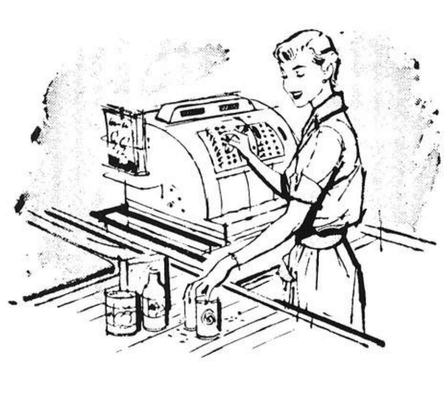


TOMORROW: Choose items from the monitor screen; electronic impulses select, assemble, deliver your order, total your bill and return your change.

A week's shopping in minutes! And you haven't moved from your car. It's that simple at the Drive-In Market of tomorrow. **Just select your items from the monitor screen; electronic impulses select, assemble, deliver your order, total your bill and return your change.**

It's just a dream away! And when it takes shape, look for New Departure to provide the proper bearings to keep all moving parts functioning smoothly. New Departure ball bearings keep parts in perfect alignment, support loads from any angle and require little or no maintenance.

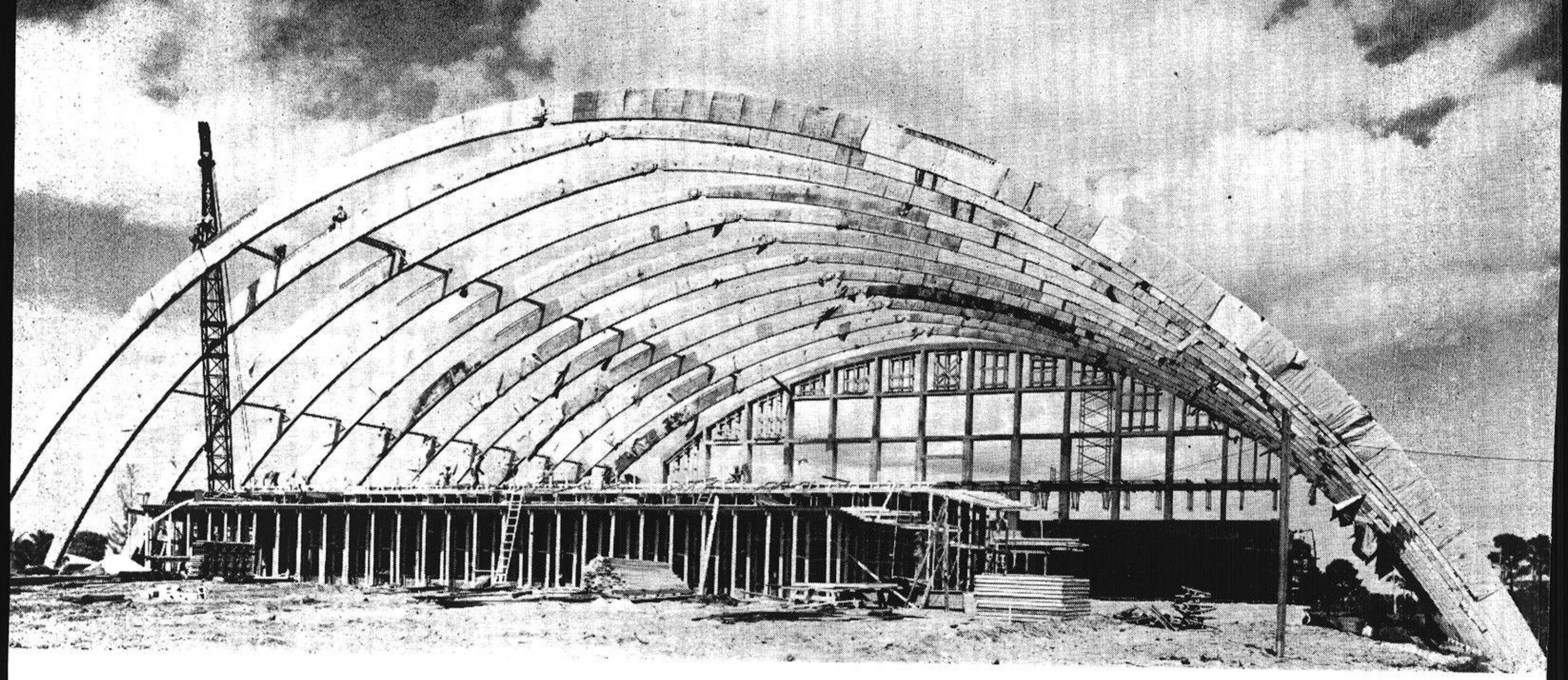
NEW DEPARTURE • DIVISION OF GENERAL MOTORS • BRISTOL, CONNECTICUT



TODAY: New Departure ball bearings in today's business machines keep intricate moving parts functioning smoothly, quietly within precision tolerances. Accuracy is maintained even after long use.

NEW DEPARTURE
BALL BEARINGS

NOTHING ROLLS LIKE A BALL



WOOD ARCHES

by *Jim Schilling, e'58*

West Palm Beach—Florida's fourth Jai Alai fronton, also the fourth in the nation, will open here tonight with a seating capacity of 3,500—*AP release.*

Fronton, the word means court, and this new building will be just that, a mammoth sports center where spectators will be able to watch Jai Alai—the national Spanish game now growing popular in the United States. This game, which originated in the Basque country of Spain in the seventeenth century, requires a large indoor playing area unencumbered by posts. And such an area was provided by the use of the largest glued laminated wood arches ever manufactured.

There are only twelve arches in all, but they are the sole structural support for the entire building. Each arch has an arc measurement of 340 feet, and a clear span of 247 feet. At the crown, they are 80 feet above the ground—the equivalent of an eight-story building. This span is more than 50 feet greater than that of any that have been built before. But it is not only this great span that makes the Jai Alai fronton of significance to architects and builders. These arches also lack the constant cross-section that is so common and they taper from 11 inches by 20 inches at the crown, and 11 inches by 25 inches at the base, to 11 inches by 46 inches at the middle third of the arches, which is the point of maximum stress. These twelve arches, spaced 16 feet apart, give the fronton a length of 195 feet, making it the largest of all the Jai Alai courts in the United States.

These monstrous arches seem to rise from the ground itself on each side of the building and are so large that each arch contains approximately 17,000 board feet of Southern Pine lumber weighing over 15 tons.

No wood structural members of this size could ever have been cut from the largest tree grown, and each arch is of glued laminated lumber, glued and shaped through the use of specially engineered presses. The entire structure is covered with 4 inch by 5 inch solid wood decking that eliminates the need of purlins, joists and other bracing. Only four rows of struts are required for lateral support because of this extensive decking.

With this combination of arch and decking, this new Jai Alai court will afford a stage as dramatic as the game being played in it. Beside being entirely post free and affording an excellent view for all of its 3,500 spectators, the ceiling will be painted a midnight blue and the lighting arrangement is to be installed in such a manner that the ceiling will resemble the open sky.

Because the designers wanted to achieve an impressive appearance for both the interior and exterior of the court, a complete wood construction was chosen for the sports arena. Noise reduction must also be considered in this type of building and wood has a natural sound absorbing quality that keeps the noise at a lesser minimum that is possible with any other exposed material. Coupled with this is the high degree of fire resistance that is inherent in heavy timber construction.

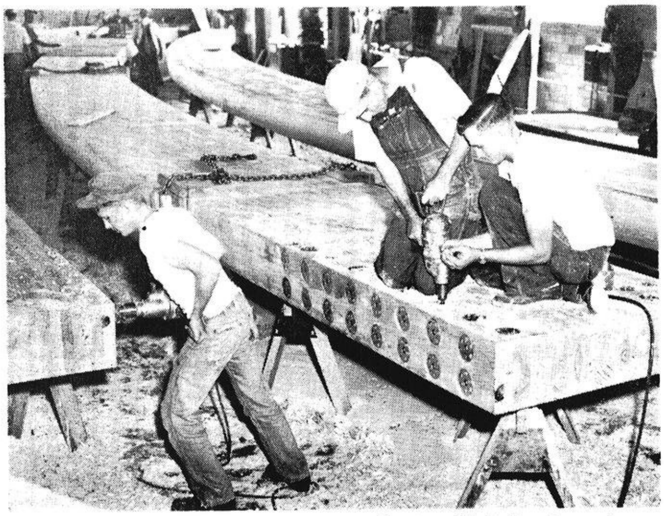
Now completed, this new Jai Alai court possesses a simplicity of design that does not reveal the problem that had to be solved before the structure could be built. While still in the planning stage, it became evident that the large size of the arches requires special study. Theoretically, there is no limit to the size of the glued, laminated wooden arch, but in practice, the handling and shipping of the arches impose certain limitations.

Even before the arches for the court were fabricated, an airport runway was needed to lay out and build the plywood template needed to align the jigs that formed the finished arches. So important were the shipping restrictions on such a large span, that even before bidding for the job a special shipping plan was formulated. This called for specific cars and carriers and it indicated the sufficiency of tunnel and bridge clearances between the fabricator's plant and the job site.

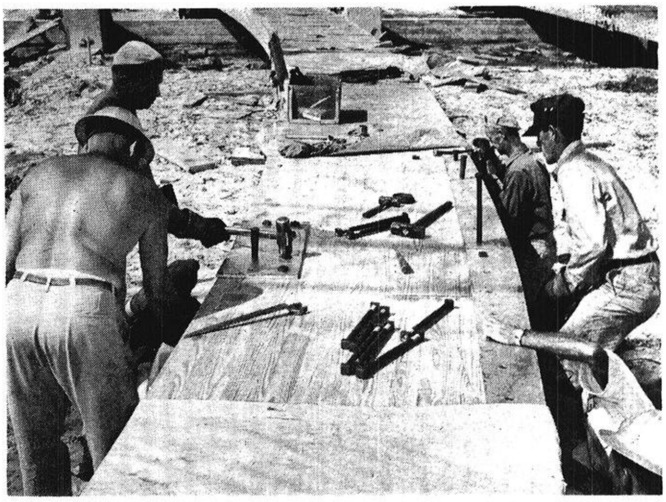
Once the shipping plan was established, the handling restrictions were studied. Because the requirements for quality control in glued laminations are so demanding, lamination at the job site was out.

The laminating process was carried on completely in plants especially controlled and equipped for the process. Because of the huge span of the arches, it was also decided to ship the arches in four sections, the longest having a length of 88 feet. Ordinarily, wood structural members of this type would have only two, or at the most, three sections. This departure from customary procedure, the use of four arch sections, was possible because of a special splice joint used at the quarter joints of the arch.

This splice was accomplished by using one-half inch thick steel plates, 12 feet long on the top of the arch and 6 feet long on the bottom. These plates were joined to the arch by 100 shear plates at each splice. The base and the crown connections of each arch had hinges instead of a splice. At the base, these hinges are fastened to buttresses.



—Courtesy Unit Structures, Inc.
While still in the fabrication stage, the quarter arch sections were prepared for future splicing at the job site.



—Courtesy Unit Structures, Inc.
This special splice joint of 1/2 inch thick steel plate was fastened to the quarter joint of each arch.

In the actual manufacturing of the arches, long laminations were formed using 2 by 12 inch pieces of Southern Pine joined end to end by means of scarf joints. The longest such lamina contained six such scarf joints. Following this, the laminae pieces were planed on each wide face in order to have a smooth surface for the gluing process. After the surfacing was completed, the lamina were run through a mechanical glue spreader and then were placed on the forming jigs in the proper position.

The eleven interior arches were fabricated with casein glue (a mixture of milk curds and alkali), but the single exposed arch was laminated with a waterproof glue. After all the lamina were assembled in the jigs, screw clamps and calibrated impulse wrenches pulled each piece into place, applying a uniform pressure of 150 psi on all glue lines. The entire process of gluing and clamping for each arch section took about 30 minutes, and then the glue was allowed to dry for 24 hours.

Once the gluing process was completed, all clamps were removed and each section was taken to a finishing table where a portable planer surfaced the sides of the arch to its 11 inch width. Then each arch segment was precision trimmed to fit its plywood template, sanded, and equipped with its clear plate connectors.

After two coats of clear sealer were applied, the arches were loaded on rail cars and shipped over 1,000 miles to the job site. When the arch sections reached the job site, concrete piers embedded in the ground were prepared to hold the arch bases. Three 1½ inch diameter steel rods set in each pier carried the horizontal component of each arch.

Each half arch was assembled on the ground at the site of the construction. After installing the splice plates and crown and base hinge connections, each half arch was attached to the buttress connections while still on

(Continued on page 54)

TO SEE OR NOT TO SEE

The Importance of Plant Lighting

by Paul M. Karcher, m'57

Artificial lighting is one of the most necessary and universally employed artificial aids to modern life. During the hours when natural light is not available, or in places where it cannot sufficiently penetrate, it is only with the aid of artificial lighting that one can enjoy the nature of his surroundings or perform the tasks which require vision. However beautiful the design and decoration of a room may be, it can be appreciated best only when there is light to see it; however well laid out a factory may be, it will be idle if there is no light.

But the problem of good lighting is not just a question of light or no light, of seeing or not seeing; it is a question of how much the amount and kind of light we use affect our efficiency and comfort. Sufficient and suitable lighting reveals and enhances beauty of form, line, and detail, creates a pleasing atmosphere, makes one feel cheerful and fit, helps one to work faster without feeling tired, helps to avoid dangers and accident, promotes cleanliness, and in many other ways affects favorably our mental and physical health, our appreciation of our surroundings, and our working efficiency. The wrong type of lighting may have exactly the opposite effects.

Adequate and appropriate plant lighting is important no matter what type of building a company occupies. And although there has been great improvement throughout industry during the past thirty years, so far as the adequacy of lighting is concerned, it would be too optimistic to say that all plants are up to date in this respect. Thus the subject is one that is worthy of attention.

Although this discussion will remain nontechnical, there are several definitions required for an understanding of the subject. *Candlepower* refers to the illuminating capacity or luminous intensity of a standard candle. A *foot-candle* is the amount of direct illumination given by a standard candle when it is placed one foot from the object illuminated. A *luminaire* is the lighting engineer's name for a complete lighting fixture including the reflector, housing, globe or fluorescent tube, and any auxiliary equipment.

However highly technical the subject of plant lighting may be, it is important that everyone in a position of responsibility be aware of the general nature of the problem of lighting so that one can recognize when steps should be taken to improve situations which for one reason or another have become unsatisfactory.

Good lighting is not simply the packing of the maximum number of foot-candles into the smallest area at the lowest possible cost. On the contrary, it is a matter of providing adequate intensity with proper diffusion.

Intensity refers to the amount of light supplied at the workplace measured in foot-candles. The intensity required for the various jobs around a plant varies according to the nature of the work. It is noteworthy that over the years there has been a considerable upward revision of the intensity considered desirable for certain types of work. For example, in cases where 35 to 40 foot-candles were adequate a few years ago, lighting engineers are now recommending 50 to 60-foot candles.

Lighting intensities of over 100 foot-candles are recommended only for the most exacting factory jobs. As little as 5 to 10 foot-candles is sufficient for aisles, service areas, and the like. General area lighting is usually the best way to produce low intensities, but it is uneconomical to produce high intensities. It is cheaper and just as effective to use to moderate amount of general lighting supplemented by additional lighting at points where more is needed. It is rarely economical to produce intensities as high as 50 foot-candles by general lighting alone. Many companies maintain a general intensity of 25 foot-candles and use supplementary lighting wherever greater intensities are needed.

Proper diffusion means that there is a more or less even spread of the light over the working area with freedom from sharp contrasts of light and shade. Differences in brightness up to ten to one are generally regarded as satisfactory for industry, but much higher ratios are often found. If such contrasts are eliminated, there will be a reduction in the amount of eye-strain and eye-fatigue caused by the necessity of the eye to adjust itself to varying intensities of light. Proper diffusion, however, does not call for complete elimination of shadows since seeing can actually be aided in the right places and at the right angles.

In the case of artificial lighting, proper diffusion is largely a matter of selecting the right type of luminaire and placing it correctly in relation to the working area. A luminaire serves to direct the light to the area where it is desired and to reduce the brightness which causes glare. Thus in selecting a luminaire one should consider such things as the efficiency with which it directs the light, the amount of glare which it causes, the ease with which it can be maintained, and its general appearance.

Closely related to the question of proper diffusion is

—Courtesy Pittsburgh Reflector Co.

An air products plant artificially lit with both mercury and incandescent lighting.

that of glare. *Glare* itself is any brightness within the field of vision which causes discomfort, fatigue of the eyes, annoyance, or interference with vision. Excessive glare in the field of vision can cut visual acuity by as much as 90%. It is harmful to the nervous system, it decreases the efficiency of the worker, and it may be a cause of accidents.

A well-conceived system of artificial illumination will have one other feature in addition to adequate intensity and proper diffusion, namely flexibility. It is important always to provide for future changes of plant design. Certainly it would be naive to assume that lighting problems would be exempt from this consideration. Inevitably, changes in product or process will call for a lighting system using different intensities, different light patterns or concentrations, or special types of ceiling diffusions. Such changes can be achieved but they will be more expensive if the fixtures are semi-permanent, the number of outlets inadequate, and the ceiling unadaptable to change.

Achieving good lighting is complicated by the type of building a company occupies, the physical characteristics of the building, and the nature of the work carried on within it. Most plants have windows admitting light from the outside. As a matter of fact, many industrial buildings are designed to make maximum use of natural illumination. In spite of the vagaries of natural lighting, it is free, and most companies use as much of it as possible, particularly for general lighting.

Supplemental lighting for local areas is used both to produce greater intensities where they are needed and to make always available certain minimum intensities. Diffusing glass or painted glass can be used to reduce a good portion of glare from direct sunlight.

There are many plants which use ordinary filament light bulbs of varying wattages placesd in appropriate reflectors. The reflectors can be simple and inexpensive. In many cases these lights are used for supplementary lighting or in areas which occasionally require lighting. They find their best use in those areas where the air contains smoke, dirt, or chemical fumes. Thus in boiler rooms, foundries, heat treating rooms, steel mills, railroad shops, and the like, it is usually economical to use reflector lamps.

In order to eliminate or minimize glare, some attention must be given to the question of locating these lamps. Generally speaking, the best results have been obtained by using the lamps in pairs or in clusters with each lamp of fairly low wattage rather than a few quite powerful lamps scattered here and there. The larger lamps cost more and require more power; hence it may be wise to avoid their use.

Mercury lamps have many industrial uses, although they are seldom used as a sole source if light. They are efficient, provide a maximum amount of light per out-

(Continued on page 56)

A Campus-to-Career Case History

"One open door after another"

"When I joined the telephone company," says Walter D. Walker, B.E.E., University of Minnesota, '51. "I felt I could go in any direction. And that's the way it has been.

"For the first six months I was given on-the-job training in the fundamentals of the telephone business—how lines are put up and equipment installed. Learning those fundamentals has paid off for me.

"Then I had the opportunity to go to the Bell Laboratories in New Jersey. I worked on memory crystals—ferro-electric crystals—for use in digital computers. I learned how important research is to the telephone business.

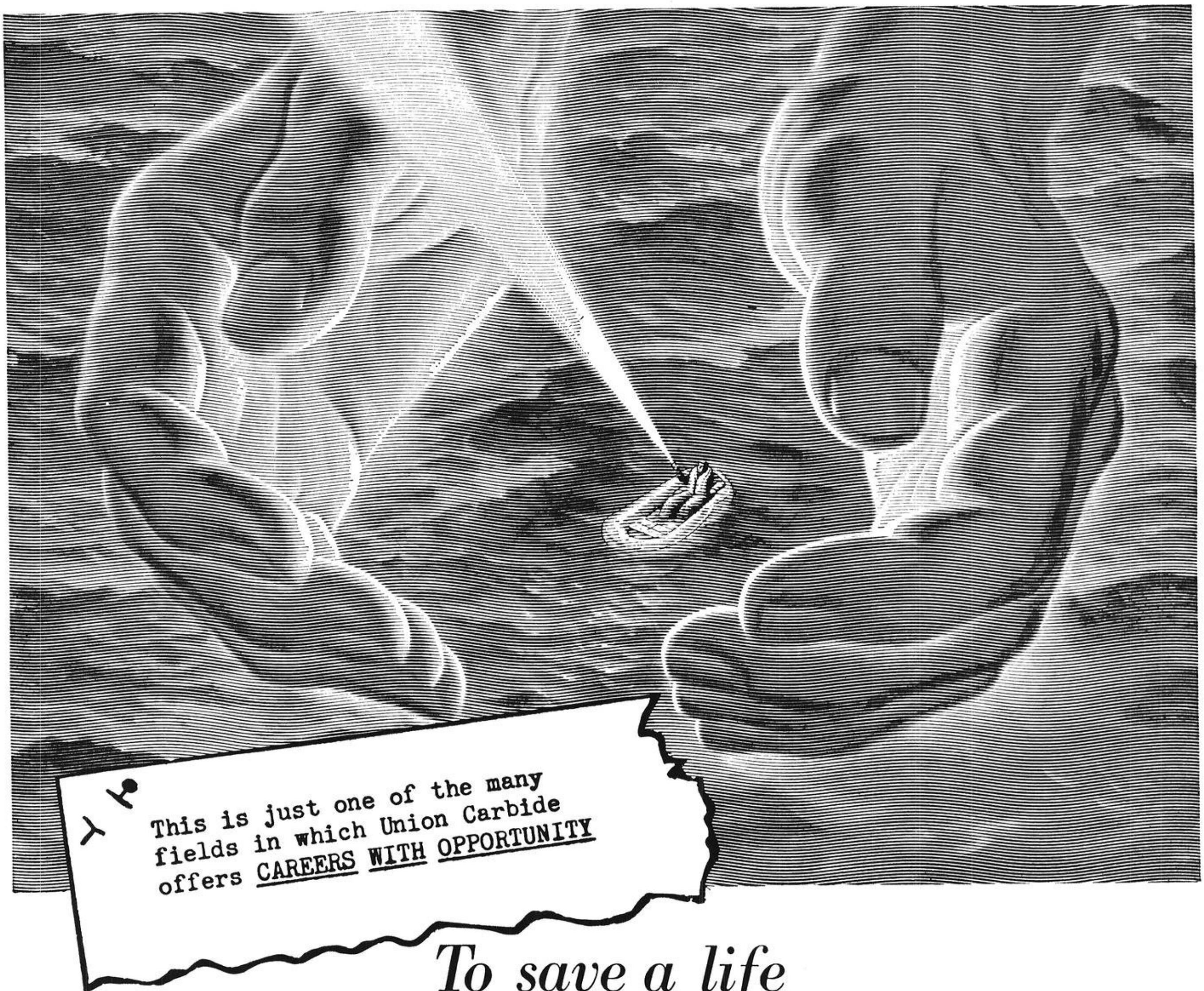
"After two years I came back to Minnesota, to St. Cloud, to work in the District Plant Engineer's Office. There I made field studies of proposed construction projects and drew up plans to guide the construction crews. This combination of inside and outside work gave me invaluable experience.

"In July, 1955, I came to Minneapolis as an Engineer in the Exchange Plant Extension Engineer's Office. We do forecasting—not of the weather, but of future service needs. Using estimates of growth and economic studies, we make our plans for the years ahead. We figure out where and when new facilities will be needed to meet future growth.

"All this has been preparing me for a real future. You see, the telephone company is expanding by leaps and bounds. That's why it offers a young man so many open doors."

Wally Walker's career is with Northwestern Bell Telephone Company. Many interesting career opportunities exist in other Bell Telephone Companies, Bell Telephone Laboratories, Western Electric and Sandia Corporation. Your placement officer has more information regarding Bell System companies.

Bell Telephone System



To save a life

Portable packages of electricity help make our lives safer and more enjoyable

THE BRIGHT BEAM of a flashlight in the hands of an airman down at sea . . . the untold comfort of an almost invisible hearing aid . . . the pleasure of listening to your favorite music over a portable radio.

THESE INGENIOUS DEVICES have one thing in common—they all get their electric power from dry-cell batteries. Each day millions of us depend on these portable packages of power for greater safety, comfort, and pleasure.

LARGE BATTERIES furnish power for signalling and communications systems. Hearing aid batteries are now so tiny that they can hide under a dime. Other dry-cells supply power to everything from toys to Geiger counters.

OVER 60 YEARS AGO, the people of Union Carbide produced the first commercial dry-cell. From this beginning, they developed the great variety of EVEREADY batteries that now serve dependably in so many applications.

SCIENTISTS of Union Carbide are constantly working on new, improved methods of producing packaged power. Their goal is to make dry-cell batteries do even more work for all of us.

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SCIENCE HIGHLIGHTS

edited by Ted Witzel, e'57

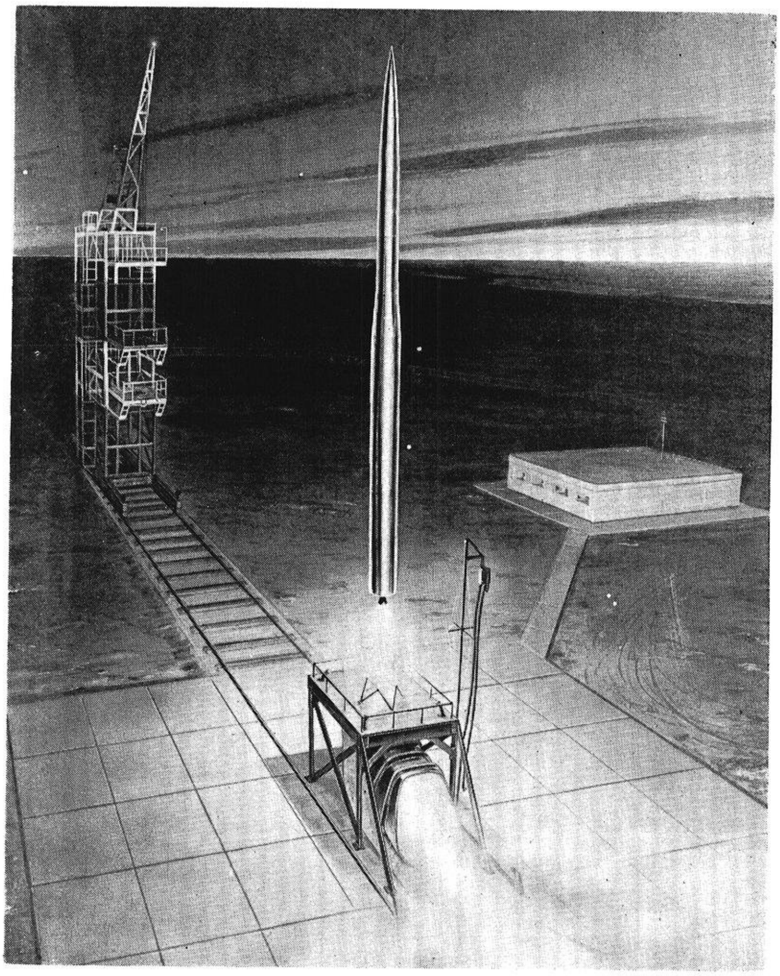
ON TO SPACE

The U. S. Navy released photographs of an artist's conception of the Vanguard three-stage rocket vehicle being designed and built to place the world's first man-made satellite in its orbit. Also released is a drawing depicting the trajectory (flight path) of the vehicle from its launching point to its orbit established some 300 miles above the earth.

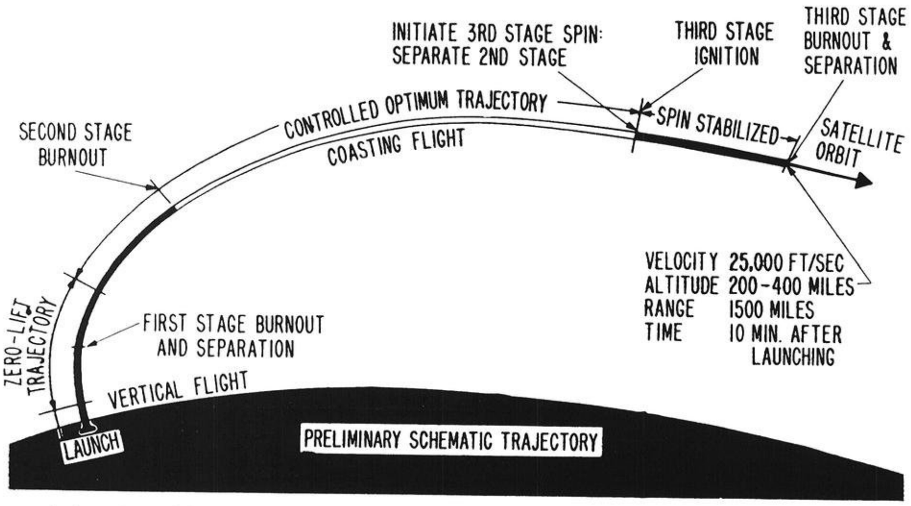
In physical appearance, the satellite launching vehicle will resemble a giant rifle shell complete with bullet. It will be the first liquid fuel rocket designed to be controlled without the use of fins.

The first-stage rocket, approximately 45 feet in length, resembles th Navy Martin Viking research rocket which attained an altitude of 158.4 miles, a world's record for a single stage rocket.

The second stage rocket, mounted above the first stage, has a cone shaped nose section. It also uses liquid propellants. The third stage rocket, with the satellite attached to its nose, will be carried completely enclosed within the second stage rocket. The third stage uses a solid propellant because of its simplicity.



Artist's conception of the Navy Martin Vanguard research vehicle.



A drawing of the trajectory (flight path) of the Navy Vanguard research vehicle.

The first stage, which launches the entire assembly, will burn out its fuel at an altitude of between 30 and 40 miles. Then it will separate and drop off.

The second stage will start firing, and at a certain time during the second stage burning will jettison its nose streamlining, leaving the third stage and the satellite exposed.

The second stage rocket will tilt in the direction of the satellite's pre-determined flight path. After its burnout, the second stage will continue to coast upward until it attains the satellite's intended orbital altitude.

There a spinning movement will be imparted to the third stage rocket to insure directional stability. By that time, the third stage will be set on its course; the second stage will drop off; and the third stage will start firing.

The third stage rocket carrying the sphere has no guidance system, no electronic brain to direct its flight. It's job is to boost the satellite's speed to approximately 18,000 miles per hour. This high speed, necessary to counteract the earth's gravitational pull, will be attained at the rocket's burnout.

At burnout, the satellite may be nudged ahead by means of a releasing device in the nose of the rocket. Therefore its speed will be slightly greater than that of the rocket shell, which will not drop to the earth, but will trail the satellite until atmospheric drag causes both gradually to slow down and spiral toward a lower atmosphere.

Through friction induced by passing into this denser atmosphere, both satellite and rocket will burn briefly and disintegrate after the manner of meteors.

COATING CHECK

A thickness gage, the size of a child's top which operates on a magnetic principle and requires no power, has been developed.

The new Permanent–Magnet (PM) Thickness Gage is designed for quick, accurate, non-destructive measurement of the thickness of non-magnetic materials bonded to smooth iron or steel. The gage will also measure the thickness of nonmagnetic materials which can be placed over a magnetic reference plate.

Typical materials which can be measured are paint coatings, platings, enamels and sheet materials such as plastics, paper and mica.

The small, portable gage consists of a double range scale (high scale from 0.001 to 0.060 inch and low scale from 0.000 to 0.007 inch), range changing slider, calibration adjuster, adjustable limit pointers, and reference thickness standards.

The instrument uses an internal alnico magnet which provides flux to the contact feet. A variable air gap in the magnetic circuit—introduced by the variable thickness of the film on the backing material—causes flux changes in the circuit. The thicker the film the more flux will leak between two iron legs located between the magnet and the contact feet. A gaussmeter-type movement measures this internal leakage flux.

Accuracy of the PM Thickness Gage is 5 to 10 per cent within 50 per cent of the calibration point, and is capable of taking readings in any position, making it ideal for spot checks on a production line.

TRANSISTORS IN POWER SYSTEMS

The first application of transistors in protective relays for electric power systems has been made.

A newly developed alarm relay controlled by transistors is three and one-half times more sensitive than previous designs.

In the alarm unit of the negative-phase-sequence overcurrent relay where transistors are now applied, the relay becomes more sensitive in protecting generators. When the relay was first introduced in 1953 with an alarm unit of conventional design, the alarm would function if the negative-phase-sequence current exceeded 25 per cent of full load positive-phase-sequence current. With the transistor, the alarm unit can now detect 7 to 15 per cent of this quantity.

Further application of transistors is expected to result in improved performance, smaller sizes, and reduced maintenance for relays, and wider use of transistors in relays is being studied.

TESTING AT 2,300 MPH

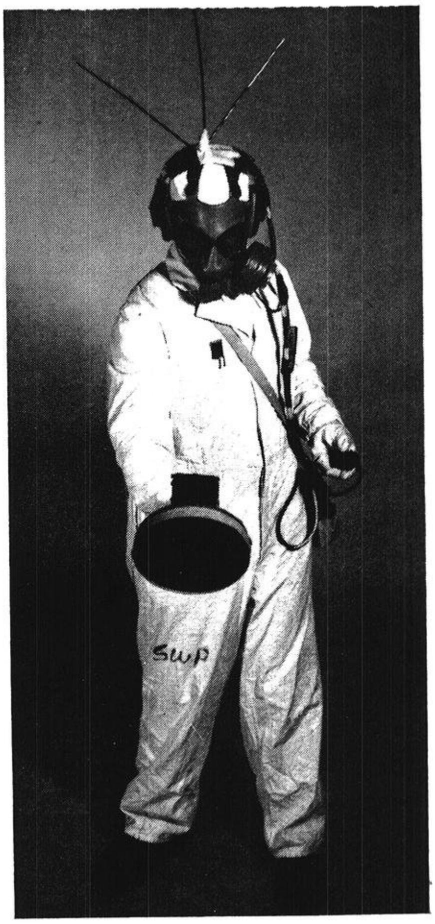
A $20,000,000 test facility capable of simulating supersonic flight conditions for jet engines three times more powerful than any currently in production will be constructed.

The construction plans were announced today at an introduction of the division's present development facilities to top military and aviation officials.

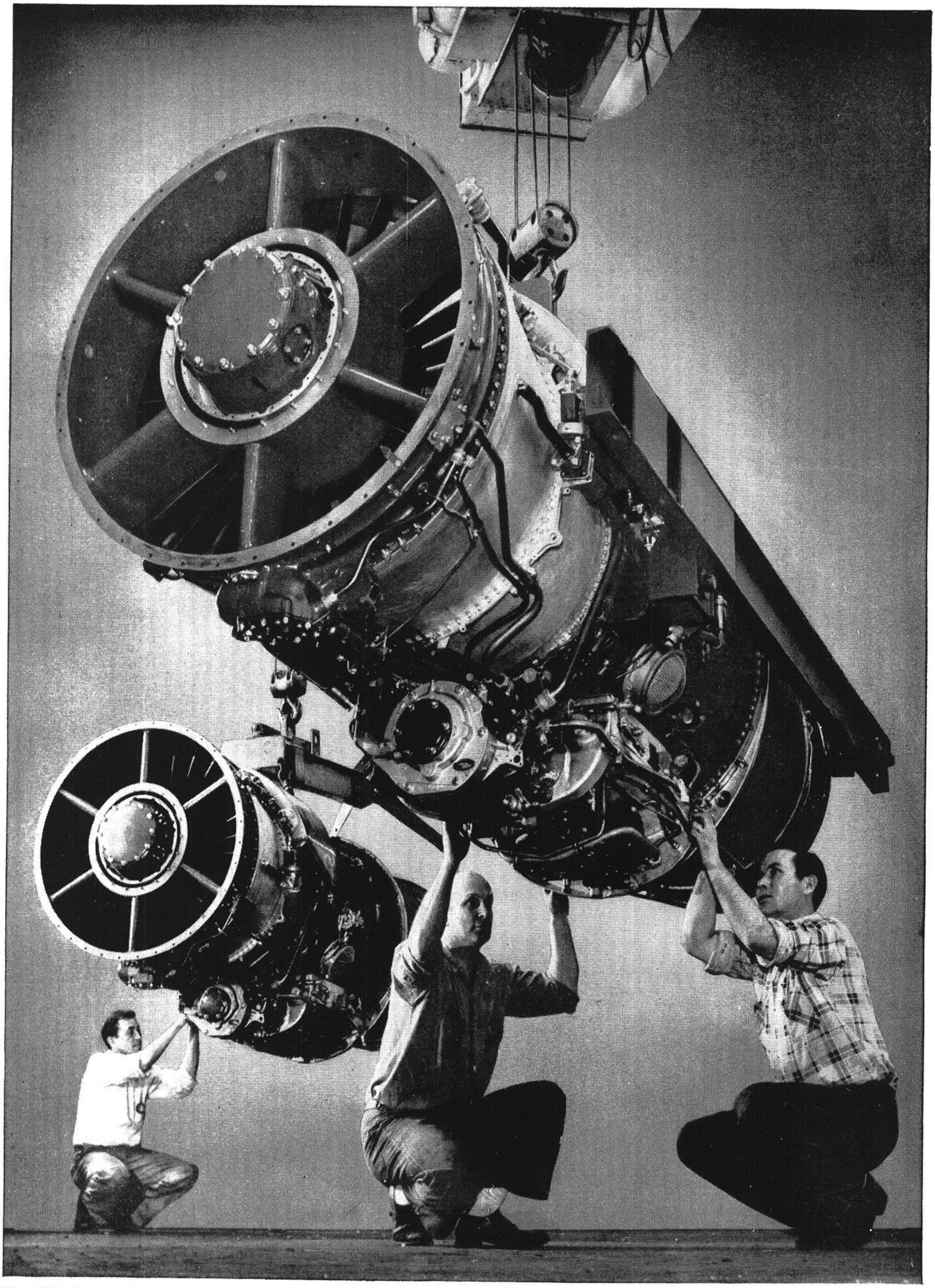
The supersonic test facility will be the most advanced of its type in the world. It will be able to simulate the same conditions a large jet engine would encounter flying at 2300 miles per hour, or three and a half times the speed of sound at 60,000 feet.

Main part of the test facility will be two altitude test cells, each having a diameter of 18 feet in which engines under test will be housed. Vast amounts of air, flowing at supersonic speeds, will be forced through the test cells to simulate engine flight conditions.

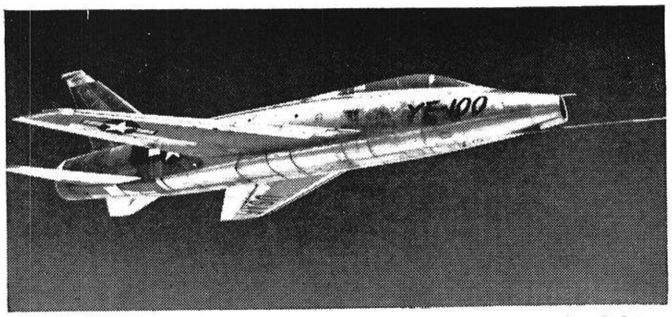
(Continued on page 58)



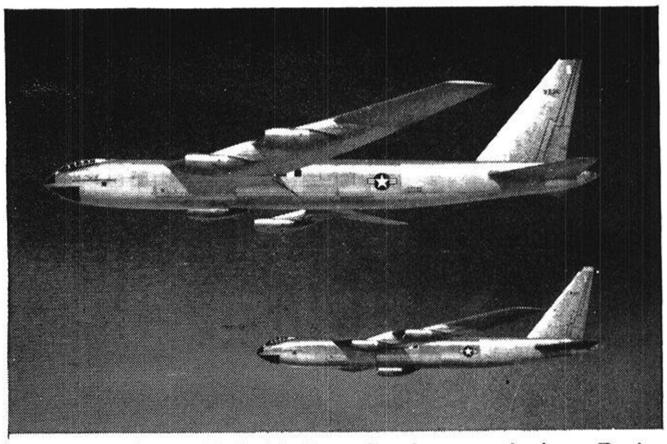
Bug Man—He's not a Martian about to blast through the floor, but a General Electric employee at the Hanford plutonium plant using head antennas and throat microphone to report by radio the radiation intensity in a "hot" zone. Mask and clothing protect from contamination.



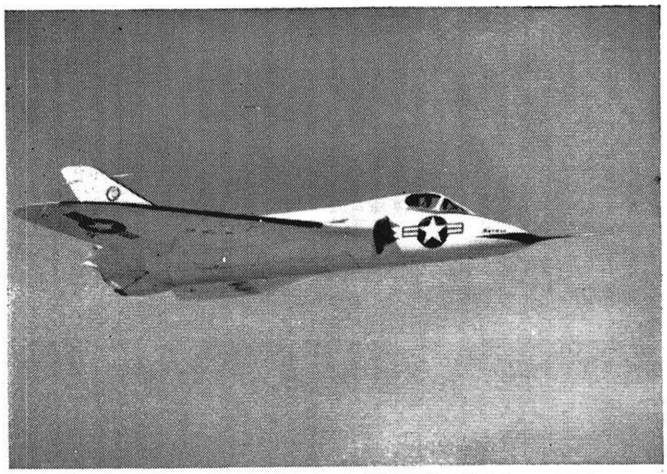
The J-57, in the 10,000-pound thrust class, is the most powerful turbojet engine now in production. A new generation of U.S. air power has been designed around this mighty new Pratt & Whitney Aircraft engine.



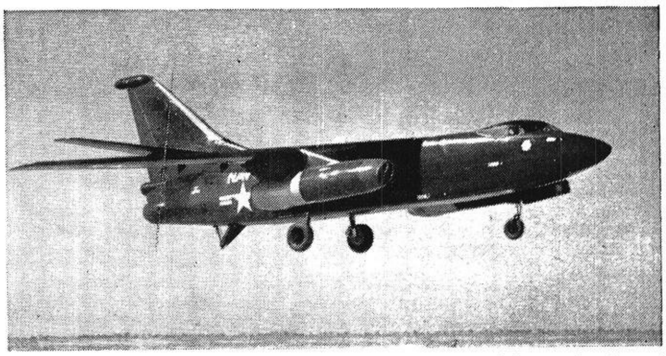
North American's F-100 Super Sabre, fastest Air Force jet fighter, is powered by Pratt & Whitney Aircraft's J-57 engine.



First all-jet heavy U. S. Air Force bombers are the huge Boeing B-52s, powered by eight J-57s mounted in pairs.



The Douglas F4D Skyray, fastest Navy jet fighter, will be powered with the big J-57 engine.



The Douglas A3D, the Navy's most powerful carrier-based attack airplane, has two J-57 engines.

Blazing the Way for a New Generation of Air Power

The most powerful turbojet engine in production is blazing the way for a whole new generation of American aircraft.

That engine is Pratt & Whitney Aircraft's J-57, the first turbojet to achieve an official rating in the 10,000-pound thrust class.

But the J-57 provides far more than extreme high thrust. Its unique Pratt & Whitney Aircraft design, achieved after years of intensive research and engineering, offers as well the low specific fuel consumption so vital to jet-powered bombers and future transports, plus the additional important factor of fast acceleration.

The importance of the J-57 in America's air power program is clearly shown by the fact that it is the power plant for three of the new "century series" fighters for the U. S. Air Force—North American's F-100, McDonnell's F-101 and Convair's F-102—as well as Boeing's B-52 heavy bomber. The Navy, too, has chosen the J-57 for its most powerful attack aircraft, the Douglas A3D, the Douglas F4D fighter and for the Chance Vought F8U day fighter. And the J-57 will power the Boeing 707 jet transport.

The J-57 is fully justifying the long years and intensive effort required for its development, providing pace-setting performance for a new generation of American aircraft.

Engineering graduates who can see the challenge in this new generation, might well consider a career with the world's foremost designer and builder of aircraft engines.

PRATT & WHITNEY AIRCRAFT DEPENDABLE ENGINES

PRATT & WHITNEY AIRCRAFT

DIVISION OF UNITED AIRCRAFT CORPORATION

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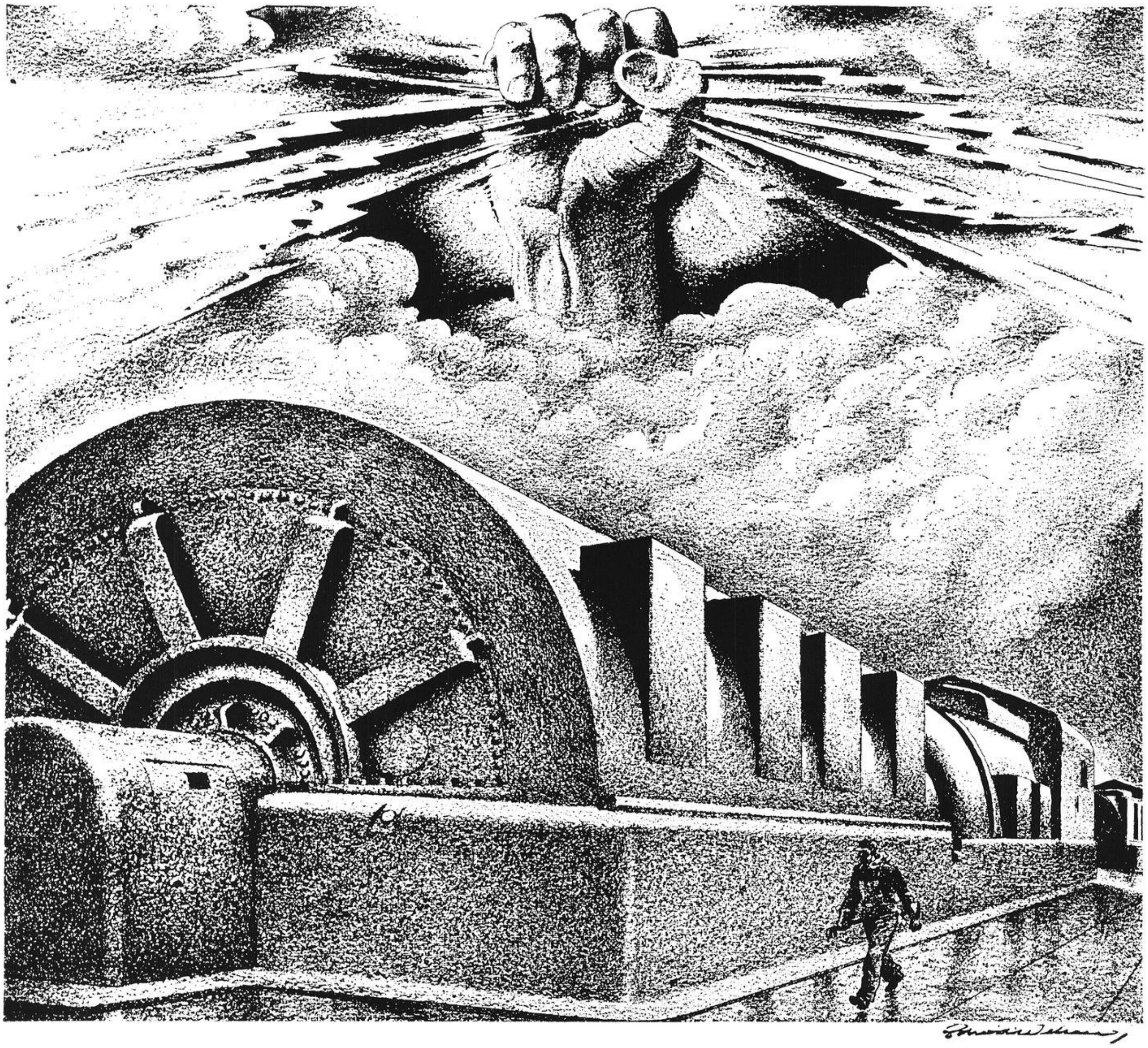

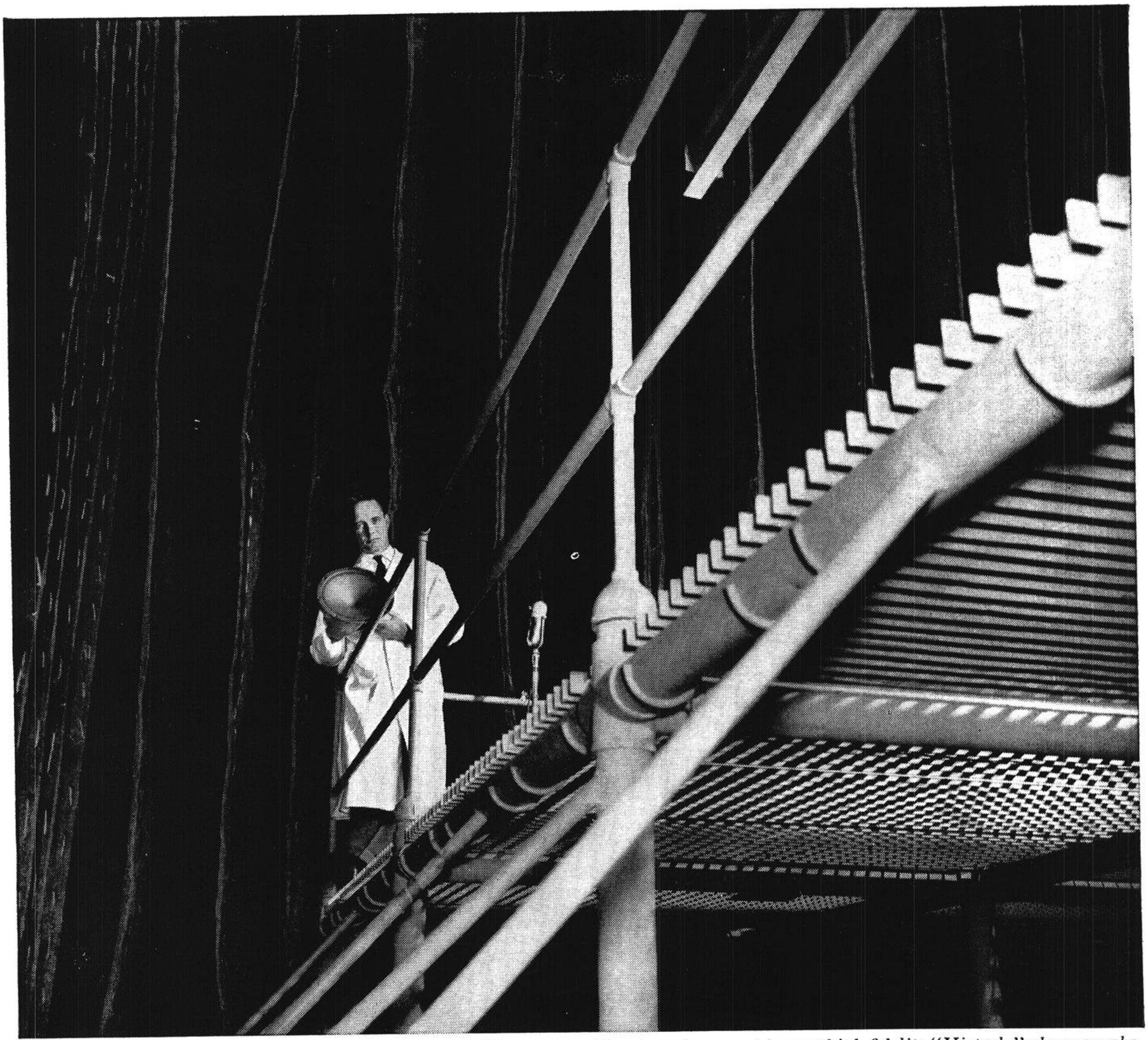

At David Sarnoff Research Center, Princeton, N. J., RCA tests one of loudspeakers used in new high fidelity "Victrola" phonographs.

RCA creates a new kind of high fidelity in the silence of this room

In this room you *can* hear a pin drop. The jagged walls absorb alien noise so that delicate instruments can make sure reproduced sound matches the original as closely as possible.

Thus a new kind of high fidelity is born—and brought to you for the first time in new RCA Victor Orthophonic "Victrola" phonographs. *Listen!* Here is distortion-free performance through the range of audible sound. Here is *more* music than you've ever heard before. Here is the ultimate in high fidelity.

The skill behind new Orthophonic "Victrolas" is inherent in all RCA products and services. And continually, RCA scientists strive to open new frontiers of "Electronics for Living"—electronics that make life happier, easier, safer.

WHERE TO, MR. ENGINEER?

RCA offers careers in research, development, design, and manufacturing for engineers with Bachelor or advanced degrees in E. E., M. E. or Physics. For full information, write to: Mr. Robert Haklisch, Manager, College Relations, Radio Corporation of America, Camden 2, N. J.

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W. S. P. E.

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As a professional engineer, I dedicate my professional knowledge and skill to the advancement and betterment of human welfare.

I PLEDGE

To give the utmost of performance, to participate in none but honest enterprise, to live and work according to the laws of and the highest standards of professional conduct. To place service before profit, the honor and standing of the profession before personal advantage, and the public welfare above all other considerations. In humility and with need for Divine Guidance, I make this pledge.

TECHNICAL INSTITUTE DIVISION, AMERICAN SOCIETY FOR ENGINEERING EDUCATION, REPORT ON GENERAL STUDIES

By KARL O. WERWATH

Among the 18 standing committees of the Technical Institute Division of the American Society for Engineering Education, ten are charged with some phase of curriculum development of the technical institute type of higher education. Some of these standing committees are engaged in broad studies, as applied to curriculum development, such as Student Selection and Guidance, Teacher Training, Completion Credentials, Relations with Industry, Manpower Studies and Enrollment and Graduate Surveys. From the projects accomplished by these groups indirectly comes valuable information for the development of course content. Other committees are engaged in the examination and development of new programs, such as the groups working on Metals Technology and Nucleonics. A third type of committee activity is devoted directly to the study of quantitative and qualitative analyses of courses now being offered. Two major published studies have resulted from such work. One is the five year study "Quantitative Analysis of Subject Matter in Technical Institute Type Curricula as Accredited by the Engineers' Council for Professional Development on November 1, 1949 and Related Qualitative Study of Subject Content in Mathematics, Drawing, Industrial Electricity, Physics, English and Electronics by the Curriculum Development Committee, Technical Institute Division, American Society for Engineering Education, from October, 1951 to June, 1955" and a second is the recent one year study "Report of the Committee on the Place of General Studies in the Technical Institute Program as a Result of the Survey to Discover Techniques Used to Accomplish General Education Objectives Through Both Curricular and Extracurricular Activities."

WISCONSIN SOCIETY OF PROFESSIONAL ENGINEERS 13th ANNUAL MEETING

Schroeder Hotel, Milwaukee, Wisconsin

EDUCATIONAL GROUP

John Gammell, Presiding

Mr. John Gammell, the presiding officer, opened the meeting with a brief statement of the topics to be discussed, namely, "What is being done and what should we do about Nuclear Energy Education in Engineering Colleges?" and "Teaching high school mathematics for college."

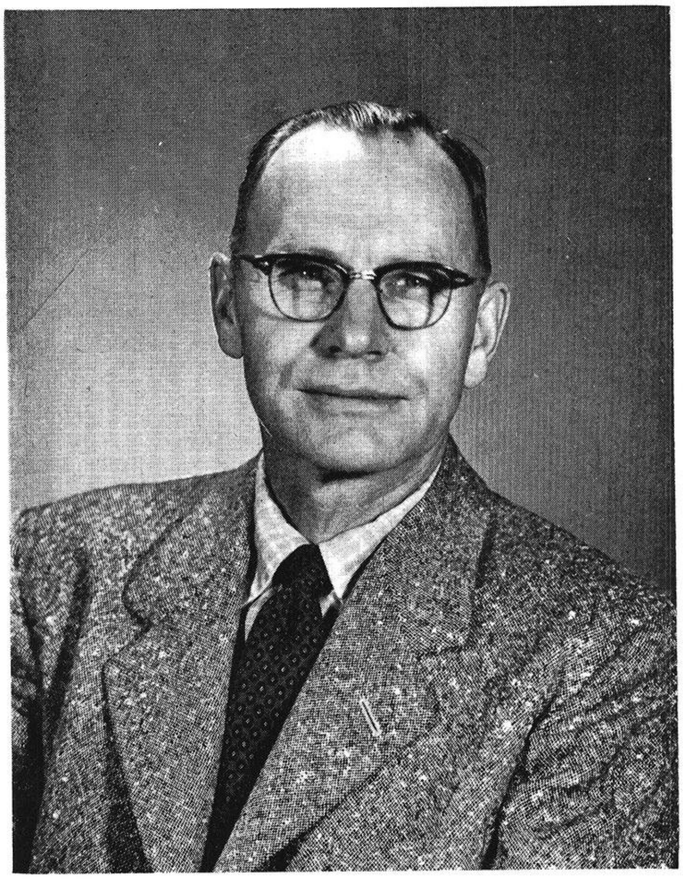
He then introduced Dean K. Wendt, College of Engineering, University of Wisconsin, who led the discussion on "WHAT IS BEING DONE AND WHAT SHOULD WE DO ABOUT NUCLEAR ENERGY EDUCATION IN ENGINEERING?'

Dean Wendt stated that the ASEE appointed a committee in 1950 to study Nuclear Engineering Education. The work of this committee was closely associated with the AEC. The activities of the committee resulted in the establishment of seminars, meetings, and in the publication of reports. In 1955, a survey was made by the deans of the engineering schools and in their report, they pointed out that the engineering schools faced four broad problems, namely:

1. To determine the immediate needs for engineers in the nuclear field and the probable long-term requirements.

(Continued on page 42)

Meet the President



L. W. LEMBCKE
Wisconsin Valley Chapter President

This month the "Meet the President" series features L. W. Lembcke, president of the Wisconsin Valley Chapter. Mr. Lembcke is a graduate of the University of Wisconsin having received his Bachelor of Science degree in Civil Engineering in 1927. Also in 1927 he was married to Lucille Haddy. They now have two daughters, Lois and Florence.

Mr. Lembcke was born on April 22, 1887 in Township Center, Outagamie County, Wisconsin. He is employed by the Wisconsin Conservation Department as Chief Mechanical Engineer.

W.S.P.E.

(Continued from page 40)

2. To present information relative to undergraduate, graduate, and special programs which colleges and universities might be in a position to offer to aid in the over-all education in engineers for this field.
3. To determine the part colleges and universities should play in the education of foreign engineers in the field of nuclear engineering.
4. To study the long-term role of government sponsored training programs.

The best study in answering these questions was made by Professor Myers. This study presents the following alternatives:

1. The minimum offering that could be regarded as significant in an undergraduate engineering program is 6 credits.
2. An undergraduate option in nuclear engineering would increase the offering to 15 credits. The cost of equipment for this program according to Professor Myers would be $13,000.
3. A third alternative is to offer a major in nuclear engineering of 27 credits. In order to equip an engineering school to offer an undergraduate program would cost approximately $430,000.
4. To expand this minimum program of an undergraduate level to a graduate program of 30 credits would increase the cost by another $300,000.
5. For an adequate PH.D program the cost of the facilities and equipment would be approximately $1,000,000.

This indicates that for a school of engineering to set up an engineering program in nuclear energy would entail a considerable outlay of money. Is the need so great for nuclear engineers to warrant this outlay? To clarify the thinking on this problem, Dean Wendt raised two questions:

1. What is the need for trained engineers in nuclear engineering?
2. What kind of training is needed?

Dean Wendt stated that there is no way of getting the information from industry as to the number of nuclear engineers needed today. From studies made, the present need would indicate that we need from 500 to 1000. It perhaps is possible Dean Wendt continued, that

(Continued on page 44)

NEW MEMBERS AND AFFILIATE MEMBERS IN WSPE

MARCH 3, 1956

Name and Position	Address	Reg. No.	Sponsor
Milwaukee			
Francis Joseph Beaudry Self Employed F. J. Beaudry, Consulting Eng.	3103 N. 27th St. Milwaukee 16	E-4715	R. H. Guthrie
James Truman Boyd Tool Eng. Pressed Steel Tank Co.	8621 W. Orchard Milwaukee 14	E-6006	D. A. Francis
John Winfield Boyd Equipment Eng. Pressed Steel Tank Co.	8621 W. Orchard Milwaukee 14	E-6007	D. A. Francis
Northwest			
Norman Wallace Gehlhar Design Eng. U. S. Rubber Co.	338 E. MacArthur Ave. Eau Claire	E-2666	V. M. Dufeck
Louis Henry Gude Relay Dept. Supt. Northern States Power Co.	2-4 S. Barstow St. Eau Claire	E-5567	E. W. Deterling
Southwest			
Daniel Edward Gaffney Engineer Mead and Hunt, Inc.	PO Box 570 Madison 1	E-2637	D. B. Johnson
George Lee Richardson Maintenance Supt. Wis. Power & Light Co.	1320 Emerson St. Beloit	E-5536	L. Stockner
Merle Elwood Timmcke Asst. Eng. Mech. Design Fairbanks Morse & Co.	931 Church St. Beloit	E-4927	P. A. Johnson
Robert L. Anderson Asst. Airport Eng. Wis. St. Aeronautics Com.	232 Locust St. Oak Park Tr. Ct. Madison 4	E-6002	W. W. Warzyn
Cass Frank Hurc Chief Dev. Eng. Fairbanks Morse & Co.	Fairbanks Morse & Co. Beloit	E-5588	P. J. Grogan
Warren Eugene Stenstrom Planning Eng. Wis. Power & Light Co.	2217 Newman St. Janesville	E-5738	W. H. Ferria
Arnold Carl Besserdich St. Power Plant Eng. State of Wisconsin	3437 Edgehill Pky. Madison 5	E-2091	P. J. Grogan
Frank Charles Vibrans, Jr. Marine Eng. Fairbanks Morse & Co.	2661 Riverside Dr. Beloit	E-5753	P. J. Grogan
Robert Turner Fey Engineer Mead and Hunt, Inc.	4325 Bagley Pkwy. Madison 5	E-6018	D. B. Johnson
Theodore Jacob Scheerer Planning Eng. Wis. Power & Light Co.	4010 Mandan Crescent Madison	E-2336	H. L. Gibson
Jervis Daniel Swannack Chief Design Analyst Fairbanks Morse & Co.	1640 Oakwood Beloit	E-4045	P. A. Johnson
Robert J. Maddock Design Analyst Fairbanks Morse & Co.	1841 N. Church St. Beloit	E-4626	B. G. Elliott
Richard H. Prescott Elec. Eng. Fairbanks Morse & Co.	Fairbanks Morse & Co. Beloit	E-5423	E. J. Kallevang
Southeast			
Frederick A. Cape Sec.-Supt. James Cape & Sons Co.	610 Walton Ave. Racine	E-5061	N. C. Johnson
Fox River Valley			
John Eugene Raynoha Sr. Design Eng. Giddings & Lewis Machine Tool Co.	Box 270, Rt. 2 Fond du Lac	E-5841	W. B. Wigton
Wisconsin Valley			
Gene Arthur Rowland Partner Rowland Associates	Mead Witter Bldg. Wisconsin Rapids	E-6054	J. K. Primm
Total—21 members			

W.S.P.E.

(Continued from page 42)

the school of engineering can do a good job in a few basic courses in nuclear engineering on the undergraduate level and then give them the broader training after graduation in a graduate school.

He pointed out that a cooperative program by the schools of engineering has been suggested. Last fall, the deans of the midwest engineering schools met and discussed such a program. They determined that the cost of a cooperative graduate school would be as follows:

1. Facilities and equipment—$3,000,000
2. Ground and buildings—$5,000,000
3. Facilities for staff and students—$4,000,000

The total cost of such a separate nuclear engineering school would be $12,000,000.

In conclusion, Dean Wendt pointed out the biggest problem faced by schools in the field of nuclear engineering is where to get the teachers. Already some steps are taken to help solve this problem. The ASEE, the National Science Foundation, AEC, and Northwestern University are sponsoring an 8 week institute during the summer of 1956 at the Argonne Laboratory. The purpose of the institute is to provide engineering college faculty members with information which will help them to incorporate nuclear engineering material into their courses of instruction.

RECRUITING, RETENTION AND USE OF ENGINEERS BY THE STATE HIGHWAY COMMISSION OF WISCONSIN

By R. F. MILHAUPT
Personnel Officer

Probably the most critical shortage of engineers today is the shortage in government service. There are many reasons for this; governmental agencies are usually thought of as organizations where low pay and limited opportunity abound and graduating seniors, with this distorted picture in mind, do not normally seek employment in government service. Another factor which bears mentioning is the use of engineers in non-engineering work and conversely, the admittance of non-engineers to the engineering classifications. The former is a breach of good management practice for which private enterprise can be found as guilty as government service.

The State Highway Commission pays regular visits to twelve midwestern colleges and universities twice each year. In addition to this, the department sends informational materials to about 140 accredited schools throughout the country. As part of its recruiting program it also gathers and maintains data on current salaries being offered by competing agencies and in this way has succeeded rather well in keeping abreast of competition. Furthermore supplementary data thus obtained have indicated that a high initial salary offer is not the final answer to the problem of devising and maintaining a successful engineer recruiting program. Government agencies have been too prone to wring their hands over salary discrepancies and overlook the fact that the successful recruiting program cannot base its appeal on this factor alone.

In conclusion, it must be stated the previously mentioned innovations in employment of engineers by the State Highway Commission are not expected to solve the engineer shortage, completely. The engineer who places salary above such considerations as public service, job satisfaction and creative opportunity will never be attracted to the State Highway Commission or any other organization with a fixed salary structure. On the other hand salary adjustments are a necessary counterpart of an effective production or service program in any organization. Once an engineer has been employed however, he must be shown that his engineering training will be effectively utilized, that he will not be saddled with tasks which can be satisfactorily performed by less well-trained personnel, that his job will be both creative and professional. If these aims are accomplished demands for more engineers will be tempered by actual needs and supply should eventually meet demand.

NEW NSPE PUBLICATIONS

(Unless otherwise indicated publications listed below are free and may be obtained by writing to the National Society of Professional Engineers, 2029 K Street, N. W., Washington 6, D. C.)

CHAPTER ACTIVITIES

New monographs outlining various chapter functions have been prepared for the use of Chapters: *Promote Ethical Practice, Chapter Publications, Functional Group Activities* and *Meetings, Fellowship* and *Attendance.*

CONSULTING ENGINEERS

So You Want to Open a Consulting office—Series of articles dealing with problems faced in opening a consulting office: By way of qualifications—John B. McGauphy, P. E., Operating Your Practice—Alfred J. Ryan, P. E., Ethical Problems—Francis S. Friel, P. E., Reprints from American Engineer. 20¢ each article—3 for 50¢.

EDUCATION

Needed: A Sure Sense of Values—Bernard Baruch. Discussion of technological advancements. Reprint from American Engineer.

GOVERNMENT

Engineers in the Federal Government—Reprint from American Engineer (NSPE Believes).

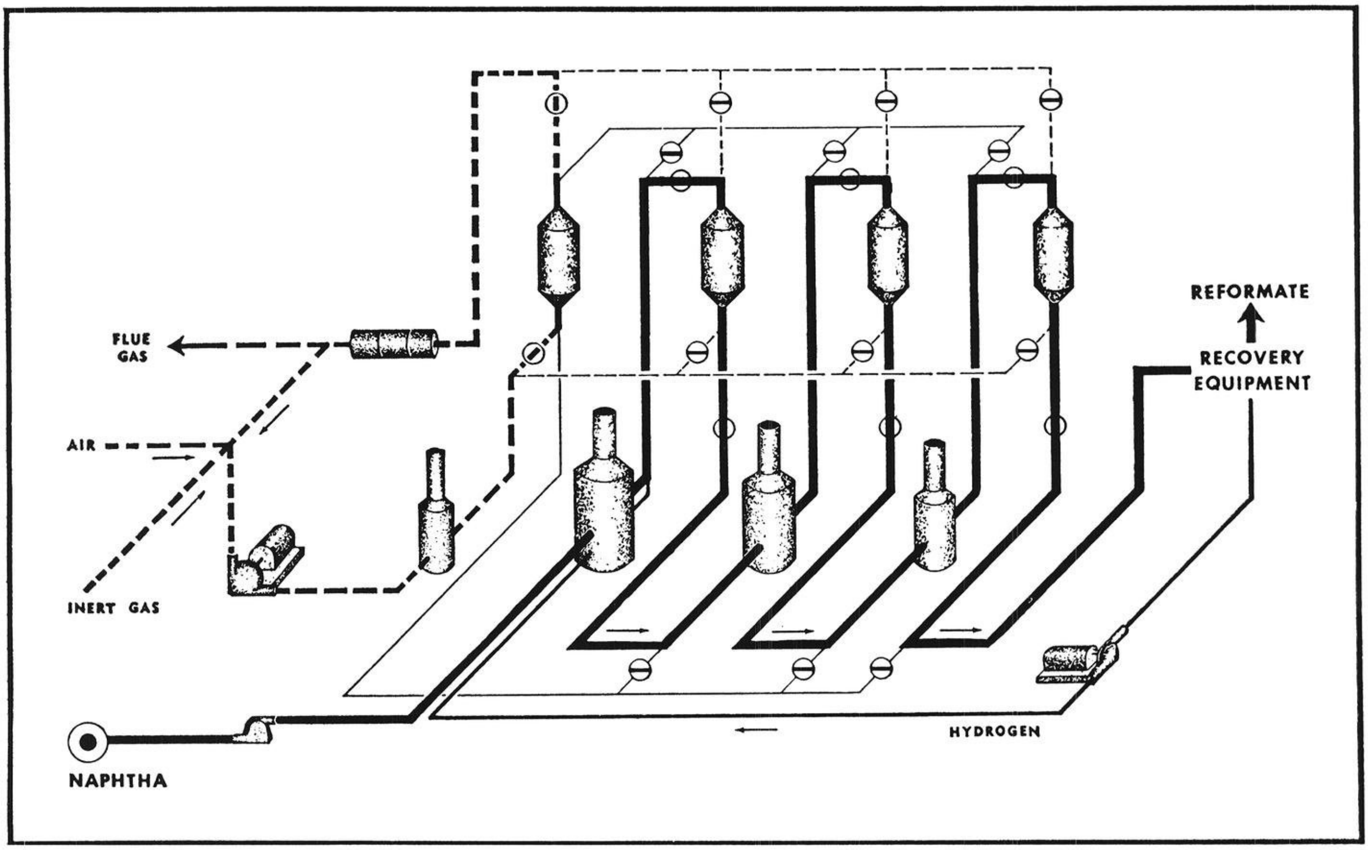
PROFESSIONAL DEVELOPMENT

Professionalism in Industry: The Dow Story—Case history of professionalism in industry. Reprint from American Engineer.

PUBLIC RELATIONS

The National Engineers' Week Story—Review of nation-wide activities of Engineers' Week for 1955.

(Continued on page 46)



The diagram, with a minimum number of reactors, illustrates cyclic regeneration. Piping arrangement permits the swing reactor to substitute for any other reactor in the system. High activity of catalyst is maintained —without interrupting production—in the ULTRAFORMING process.

HOW TO KEEP $1,000,000 WORTH OF CATALYST ON THE JOB

When you have a million dollars' worth of platinum catalyst in a single refinery unit, you hope you can keep it steadily on the job. That's too much money to be standing around idle. Also, you'd like to keep the catalyst working at high efficiency.

Most catalysts lose activity with use. The platinum that "reforms" 40-octane gasoline to 100-octane gasoline is no exception. And the higher the octane number, the faster the catalyst loses activity.

For years activity could be restored only by taking the catalyst out of the unit and sending it away for special treatment. To keep from having too many of these shutdowns, refiners had to operate at relatively low octane numbers.

Standard Oil research scientists came up with a better answer. They developed a new type of platinum catalyst, and they learned how to regenerate it repeatedly—while it is still in the unit. When a swing reactor is provided, the unit need not even be shut down. The new process is called ULTRAFORMING.

During a year of ULTRAFORMING at Texas City, one reactor was regenerated 53 times. The unit is still producing 100-octane gasoline.

ULTRAFORMING also gives high yields of by-product hydrogen. The hydrogen can be used in upgrading other oil products. Or, it can be reacted with nitrogen from the air to make ammonia.

ULTRAFORMING is only one of the many major achievements credited to the scientists who have made careers at Standard Oil.

Standard Oil Company

STANDARD

910 South Michigan Avenue, Chicago 80, Illinois

W.S.P.E.

(Continued from page 44)

REGISTRATION

Professional Engineering Registration Laws—A compendium compiled by Alfred L. McCawley in cooperation with NSPE. Available from A. L. McCawley, Box 474, Jefferson City, Missouri—$8.75.

UNITY

Let's Take Warning From History—President A. C. Neff. Reprint from American Engineer.

VOCATIONAL GUIDANCE

Do We Have Enough Engineers? Reprint from American Engineer (NSPE Believes)

Engineering . . . A Creative Profession Offering a Career of Opportunity—A general vocational guidance pamphlet for parents, and counselors.

Engineers For The Future—Reprint from American Engineer (NSPE Believes).

MEMBERSHIP REPORT

MARCH 3, 1956

Total members and affiliate members as of January 26, 1956:	
Members	1154
Affiliate members	120
Total	1274
Losses:	
Deaths (Shirley, Milwaukee)	1
Resigned (Kotz, NW; ET Jann, SW)	2
Total	3
Change of classification	1
Additions since January 26, 1956:	
Members	21
Affiliate members	0
Total	21
Total membership:	
Members	1174
Affiliate members	118
Total	1292

Chapter News

SOUTHWEST CHAPTER

"How to Attract and Hold Engineering Talent" was the subject of great interest presented by Arthur M. G. Moody, Chief Engineer, Trane Company of La Crosse, to the Southwest Chapter at their dinner meeting held at the Cuba Club on Tuesday, March 20.

About 50 members and guests attended and, although this is considered a normal turnout, T. K. Jordan, program chairman, offered a plan whereby each member present at this meeting will assume responsibility to call three other members assigned to him prior to the next meeting to remind them and urge attendance. It is hoped that a substantial increase will be gained thereby.

Paul J. Grogan of the program committee introduced the speaker who gave an excellent presentation of a subject so vitally important to employers of engineers as well as to engineers themselves.

"The greatest secret in holding engineers is to have a growing company or organization," Mr. Moody said. "The work must be challenging and grow with the man." Some of the more important factors in attracting and holding engineering talent are: a good training program, creative interesting work, a good prospective future, job security, and beneficial retirement program.

He cautioned that employers take greater "interest and acquaint themselves with the problem of holding men in the 4 to 8 years experience category in addition to their interest in recruiting young graduates."

He pointed out that companies and management are becoming aware of professionalism in engineering and should encourage young engineers toward registration and participation in professional societies. All of which will tend to elevate the engineering profession towards universal recognition and with it better compensation.

SOUTHEAST CHAPTER NEWS

DONALD C. BENGS

Wesley Burmeister P.E. district engineer for the Wisconsin Highway Commission spoke on "The Engineer in the Highway Program" at the quarterly dinner meeting in the Hotel Racine on March 7th.

The Chapter voted to extend an invitation to the WSPE to hold

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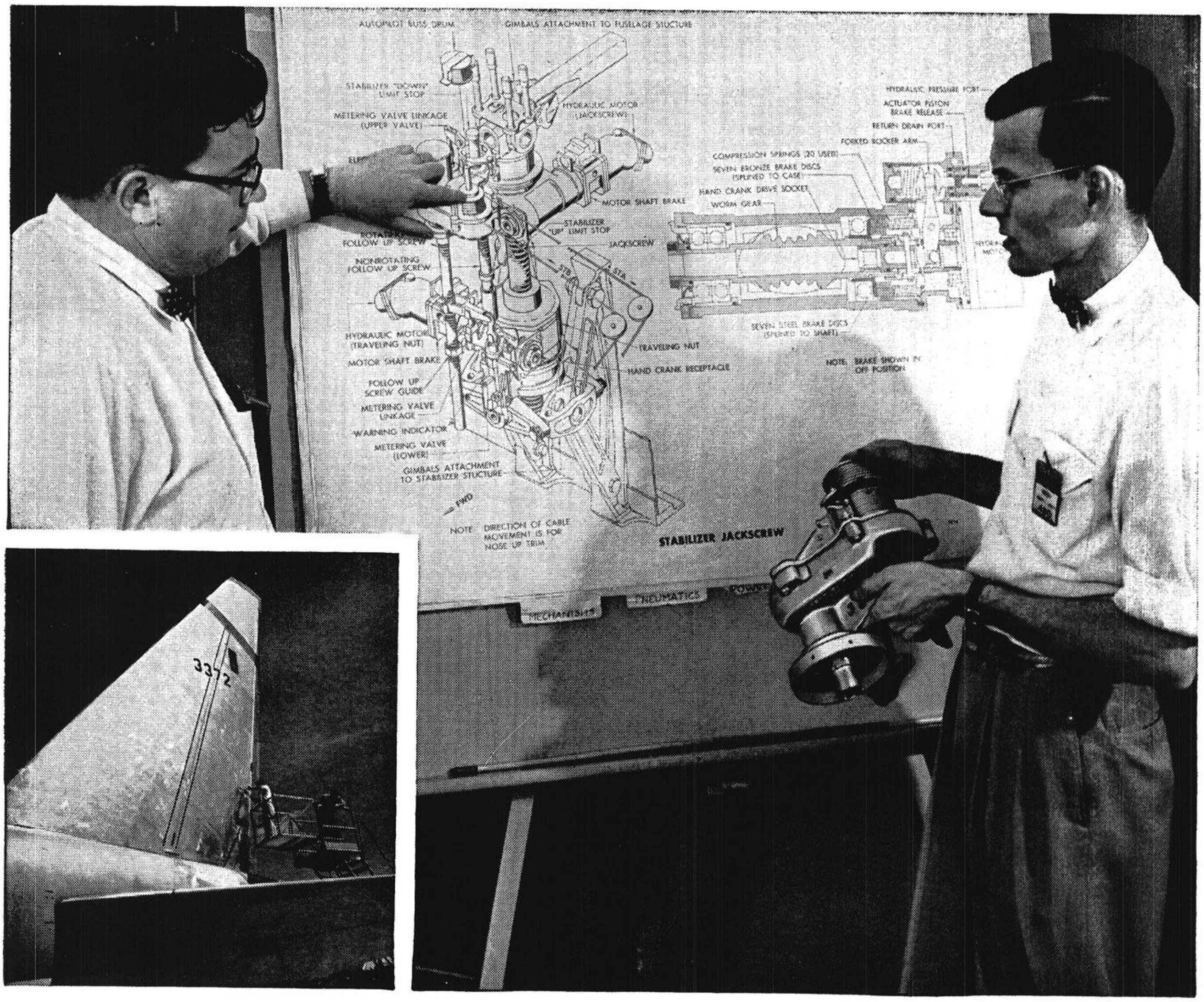
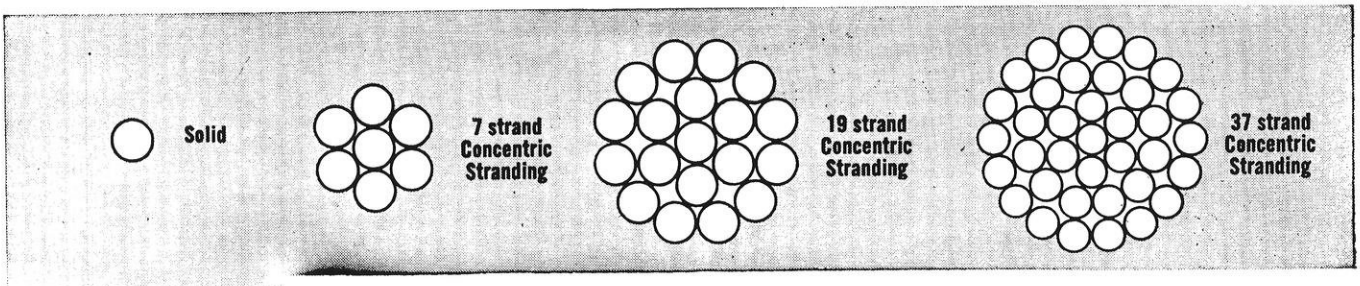
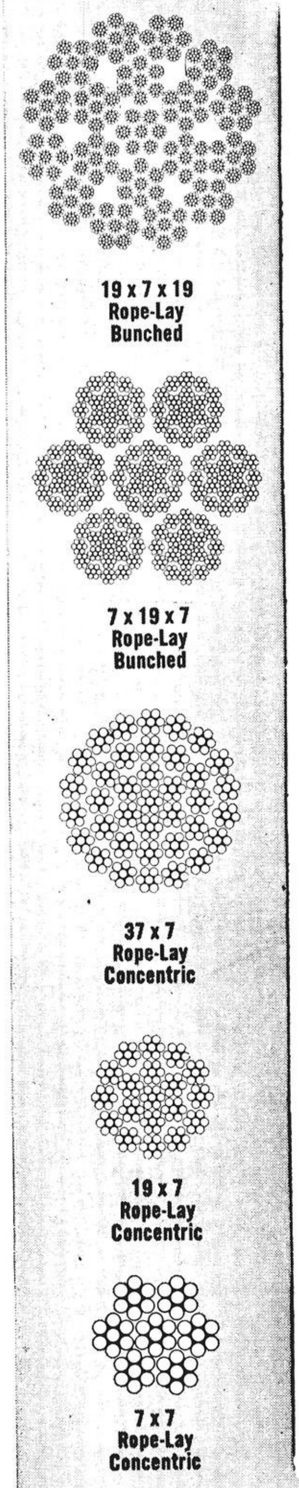

STABILIZER JACKSCREW
HYDRAULIC MOTOR (TRAVELING NUT)
MOTOR SHAFT BRAKE
TRAVELING NUT
HAND CRANK RECEPTACLE
WARNING INDICATOR
JACKSCREW
PNEUMATICS
3372





The Importance of Electrical Conductors

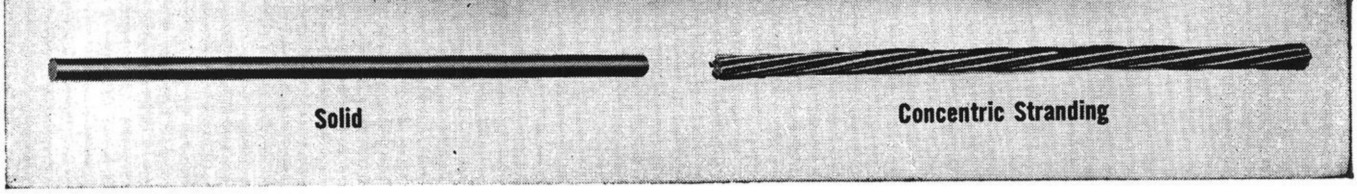
In the ability to transmit electricity, all forms of matter may be divided into two general classes, namely, conductors and insulators. Conductors permit electric current to flow readily; that is, they offer little resistance to its flow, whereas, insulators offer relatively great resistance to the flow of electricity. All substances at normal temperatures offer some resistance to the flow of electric current. In general, the metals are good conductors, while glass, oil and most organic substances are classed as insulators. Although silver offers the lowest resistance to the flow of electricity of the common metals, its cost is such that it is not widely used as a conductor. The conductors most generally used in the cable industry are made of copper or aluminum.

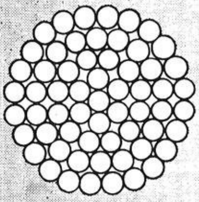
The manner in which electricity flows through elementary material may be readily visualized from the modern concepts of the structure of matter. According to these concepts all elements are made up of minute indivisible particles called atoms. These in turn are composed of a positively charged nucleus around which one or more very small negatively charged particles, called electrons, rotate at high velocity. In conductors, some of these electrons are free to move when only a small difference of potential is applied to the ends of the conductor and, since they are negatively charged, they flow to the positively charged end. This movement of electrons is electric current.

In passing through conductors, *the electrons must pass through the electron fields of many atoms. They thus collide with the atomic nuclei and other electrons. These collisions obstruct the flow of electrons and result in electrical resistance.*

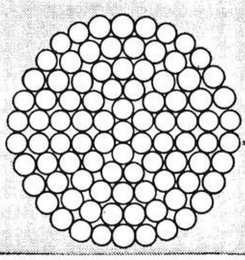
The resistance of a homogeneous conductor of uniform cross-sectional area varies directly as its length and inversely as its cross-section, the length being in the direction of current flow. That is, $R = \rho L/A$ where, R is the resistance in ohms, L is the length in the direction of current flow, A is the area perpendicular to the length and ρ is a constant of the particular material known as its specific resistivity. When the length and area are expressed in the same units such as L = one inch and A = one square inch, $R = \rho \times 1/1$ or $R = \rho$, the specific resistance of the material in ohms per inch cube.

The length and area of a conductor are generally expressed in other units

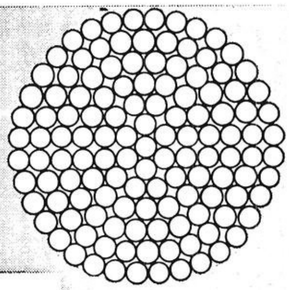




61 strand Concentric Stranding



91 strand Concentric Stranding



127 strand Concentric Stranding

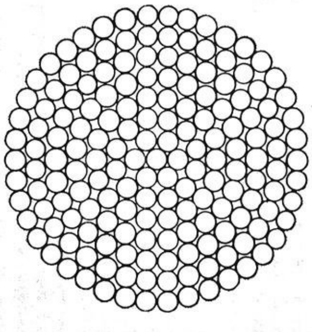
than inches. The most commonly used unit of cross-sectional area in the cable industry is the circular mil, usually designated as cir. mil or CM. This is the area of a circle whose diameter is one mil, 0.001 inch. The area of a circular mil is $\pi/4$ or 0.7854 of a square mil. The unit of length usually associated with this unit is the foot and the resistance becomes ohms per CM-foot. The resistance of annealed copper and aluminum per circular mil-foot at 20C are 10.371 and 17.011 ohms respectively. The resistance of a copper conductor 64 mils in diameter and one foot long thus becomes $10.371 \div 64^2$ or 0.00253 ohms.

The sizes of electrical conductors *are expressed in the United States in terms of the American Wire Gauge. This was originally set up on the basis of a geometrical progression of 39 steps or sizes between a wire 460 mils in diameter (Size 4/0) and a wire 5 mils in diameter (Size 36). The ratio of the diameter of a wire to that of the next larger size in this series is* $\sqrt[39]{460/5} = 1.12293$. *This ratio has since been used to extend the American Wire Gauge (AWG) to sizes smaller than 36 AWG (5 mils). The sizes of conductors larger than 4/0 are expressed in circular mil area. The size of a conductor made up of a number of wires is determined from the sum of the circular mil areas of the individual wires.*

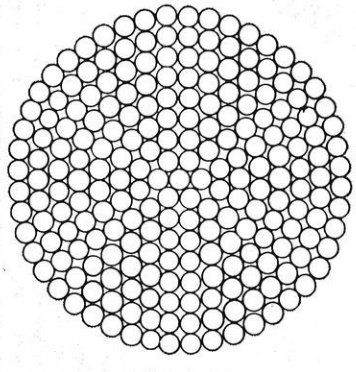
When current flows through a conductor there is, according to Ohm's law, a voltage drop of $E = IR$, where E is in volts, I is in amperes and R is in ohms, and power equal to EI watts is converted to heat. Since $E = IR$, this power converted to heat becomes I^2R watts. These two factors, voltage drop and conductor heating, are of prime importance in the design of conductors. Conductors must be of sufficiently low resistance that the voltage drop does not become excessive. In good design this voltage drop should not exceed 3 per cent for power circuits or 1 per cent for lighting circuits. The conductors should also be large enough that, when carrying their current, their temperature does not exceed that for which their insulation is designed. This rated current is referred to as the current carrying capacity. The current carrying capacities of the various sizes of conductors and installation conditions have been established. It should be noted that the temperature attained by a conductor depends not only on the amount of heat generated but also on the thermal resistance of its surroundings.

In addition to providing satisfactory voltage drop and current carrying capacity, conductors must be designed to provide adequate flexibility during installation and service. This is accomplished by building up the conductor from one or more adequately small wires, depending on the flexibility required. For example, the conductor for heater cord or welding cable, which is subject to repeated flexing in service, is usually made up of copper strands having a diameter of .005" or .0063", while the conductor for overhead weatherproof cable may be a single wire.

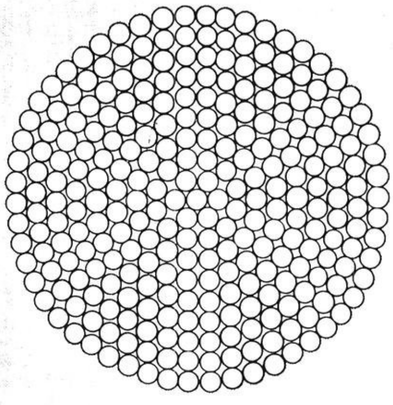
For reprints of these pages write to United States Rubber, Electrical Wire & Cable Department, Rockefeller Center, New York 20, N. Y.



169 strand Concentric Stranding



217 strand Concentric Stranding

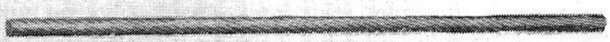


271 strand Concentric Stranding

Electrical Wire & Cable Department

United States Rubber

Rope Stranding



Bunched Stranding

W.S.P.E.

(Continued from page 46)

the summer conference for 1956 in the Southeast area. The location and program will be announced in the News–Letter.

A resolution sponsoring the formation of a Waukesha County Chapter was approved for transmitting to the Board of Directors of the State Society with the petition of the Waukesha members.

The next meeting of the Southeast Chapter will be Ladies Night on Friday, May 25th at the Kenosha Elks Club. The officers to be installed that evening are:

President—Leo Jeselun
Vice–President—Charles B. Lee
Secretary–Treasurer—Walter E. Dick
Directors—Rudy Goecht, John Mielke
Past–President—Donald C. Bengs

Members are requested to have the application blanks of new members approved by the membership chairman or by the President of the Chapter before sending the applications to the State Secretary.

WESTERN CHAPTER

M. L. HOGLUND

The Western Chapter held their April Meeting on Tuesday April 3, 1956. Jose B. Calva, president and technical director of the J. B. Calva & Co., consulting and research engineers, was the principal speaker. The topic of the talk was "Engineering as a Profession." Mr. Calva pointed out that the engineer is not recognized on the same professional level as the medical and legal professions largely because they have not shown a strong degree of unity in their profession. The Minnesota Society of Professional Engineers of which Mr. Calva is president-elect has taken some definite steps to improve this situation. First is the encouragement of all graduating seniors to take the "Engineer in Training" examinations. Second was the formation of an "Engineer in Industry" committee to further the standing of the professional engineer.

E. T. Neubauer reported on activities during Engineer's week and a business meeting was conducted by the chapter president, R. B. Brindley.

R. E. Lucey, Trane Vice President and manager of engineering, has announced the promotion of three senior development engineers in the Company's Products Engineering Department to positions of Chief Engineer.

"The men, R. G. Miner, Jr., E. T. Neubauer and A. M. G. Moody, are all registered professional engineers in the State of Wisconsin and are members of the Western Chapter WSPE. They will assume added responsibilities in their respective fields by heading the Controls and Electrical, Reciprocating Compressor, and Centrifugal Compressor phases of the Trane Company product development program.

FOX RIVER VALLEY CHAPTER

Berry E. Brevik, field engineer for the Portland Cement Association, retires from that position on April 1, 1956, after nearly 30 years of service. (Retirement at age 65 is compulsory).

Mr. Brevik started with the Association July 1, 1926, in the General Office in Chicago, transferring to the Milwaukee office in 1927. Here in Wisconsin he covered the Milwaukee metropolitan area for 16 years, and for the past 13 years whole Fox River Valley as his territory.

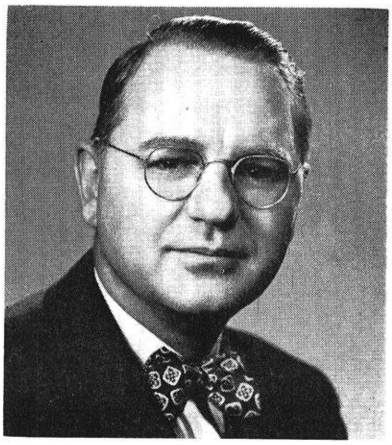
Brevik was graduated from Iowa State College in 1918, was awarded a C.E. degree in 1919, and won his Master's degree in Civil Engineering at the University of Michigan in 1922. After spending a few years with the Michigan and Iowa highway departments, he taught two years at Iowa State and one year at the University of Minnesota before joining the Portland Cement Association staff.

Throughout his career, Brevik has been active in engineering societies, serving as President of the Wisconsin Section of the American Society of Civil Engineers in 1942, and on many committees of the *Fox River Valley Chapter* of the Wisconsin Society of Professional Engineers. He is also active in Masonic circles, and is a member of the Appleton Rotary Club. He and Mrs. Brevik are both active church workers.

The Breviks had two children. The son, Richard, lost his life in the Aleutians during World War II. Their daughter, Jean, is married and living in Chicago.

(Continued on page 52)

R. G. Miner Jr.



E. T. Neubauer

A. M. G. Moody

W.S.P.E.

(*Continued from page 50*)

Brevik will be sorely missed by his many friends throughout the state, by architects and engineers, and by public officials whom he regularly contacted.

His very effective promotional, educational and service activities will also be missed by the Portland Cement Association.

WISCONSIN VALLEY CHAPTER

J. E. HAEFT

The next chapter meeting will be held at the Hotel Tomahawk. Members and wives are invited and dinner will served at the hotel after the business meeting.

E. J. Carrington, W.S.P.E. member from Marshfield spoke at the Medford High School "Career Day" on the Engineering profession.

NORTHWEST CHAPTER

E. J. POLASEK

A special meeting of the Northwest Chapter was held in Superior on April 12, 1956. The purpose of the meeting was the formation of a new chapter, consisting of the present members of the Northwest Chapter who reside in the counties of Ashland, Bayfield, Douglas, Sawyer, and Washburn, and a number of new members (exact number unknown at this time, estimated at 7). The prime purpose of dividing the Northwest Chapter was to reduce the distance which the members of the new chapter had to travel to meetings. At this meeting, the members of the proposed new chapter voted to form such a chapter, and selected the name 'Lake Superior Chapter'. The following officers were selected:

Directors—H. Sargent, W. Berg, M. McGauley
President—Gene Potter
Vice-President—Wm. Forsythe
Secretary-Treasurer—M. Olsen

The formation of the chapter will become official upon approval by the State Board of Directors.

Paul Grogan, Executive Administrator of the Extension Program of the University of Wisconsin, spoke at the meeting on the advantages of Society memberships.

MILWAUKEE CHAPTER

R. M. LYALL

National Engineers Week is set aside each year to give special emphasis to the contributions of engineers in developing a bright future. Your local chapter sponsors many public relations activities during Engineers Week including programs on television and radio. Special displays have been arranged in store windows and the occasion of Engineers Week is used to promote Engineering interest in high school students.

Carl Matheis ably directed our activities for the Engineers Week just past and we tender him a vote of thanks for a job well done.

President Wes Lallier wrote following letter which appeared in the March 17 Milwaukee Journal:

NONPOLITICAL ENGINEERS

"*To The Journal:* From time to time organizations, with political interests and a few registered professional engineers among them, purport to speak for all the professional engineers.

"For the record, the Wisconsin Society of Professional Engineers, which represents only registered professional engineers, is a nonpolitical organization and does not endorse political candidates or political issues. In this regard, the WSPE (with over 500 members in the Milwaukee chapter alone) expresses the same altitude consistently taken by all professional engineering societies.

"In this state, a 'registered professional engineer' is one who is registered by the Wisconsin registration board of architects and engineers. Such registration is based on his proven ability, academic prerequisites, experience and his moral responsibility to professional standards for 'the preservation of health, safety and the general welfare of the public.'

"This is the attitude of service rather than one of more attempted influence.—WESLEY LALLIER, *President*, Milwaukee Chapter, W.S.P.E., 431 N. 49th St., Milwaukee."

The letter had reference to an article in the Journal relative to the Technical Engineers Assn. The article erroneously stated that the Professional Engineers had endorsed Mayor Zeidler for reelection. Lallier's letter put the record straight.

The next general meeting will give us all an opportunity to ask questions and express opinions on matters relating to the profession.

The discussion will be led by a team consisting of Art Behling, Karl Werwath, Kurt Roth and Bob Claypool.

Among the subjects to be discussed are the following:

Legislative Liaison
Professional versus Unions for Engineers
The Large Consulting Office
Questions from the Members Present

The meeting will be preceded by Dinner at 6:30 P. M. END

Die Casting

(Continued from page 19)

ranging up to 1700° F, die life is short depending upon the die steels used and the mass or volume of the casting sections.

Most of the heat from the molten metal, deposited in the die, must be transferred from the casting through the walls of the die cavity before the casting can be ejected. Therefore, castings of relatively thin wall sections can be die cast most economically. Copper alloys have high specific gravity and cost per castings is higher than for aluminum or zinc castings. Brass die casting is commonly done at pressures of 9000 to 25,000 pounds per square inch, and up to 150 die casting cycles per hour can be obtained.

Since cost per casting is the highest of any produced by die casting, copper alloys are employed for die castings only where their strength, high hardness, and good corrosion resistance are essential.

Die casting of magnesium has greatly increased within the past few years primarily because of the extreme lightness of the finished parts. Magnesium is less than one-fourth the weight of steel and about two-thirds the weight of aluminum. Besides ultra lightness, magnesium has relatively high thermal conductivity and good energy absorption qualities. It also has relatively good corrosion resistance. Parts of bare magnesium have been exposed to various outdoor conditions for as long as 15 years, the only effect being the formation of a gray, adherent oxide film.

Commercial production of sound magnesium die castings, free of cracks, has been more difficult than with aluminum. The cost per casting is higher than for aluminum with the result that applications are usually confined to those in which minimum weight is the main consideration. The speed of die casting magnesium is about the same as for aluminum, ranging from 80 to 200 die fillings per hour.

Die casting has many applications, but the biggest single industrial usage of die castings is in the building of automobiles. Die castings go into many parts of the modern car, such as: decorative trim, fuel system, ignition system, functional hardware, chassis, grille, cooling system, window operating mechanisms, trunk hardware, the brake system and so forth.

In home appliances, sewing machines, washing machines, vacuum cleaners, refrigerators, fans, freezers, air-conditioners, driers, and waste disposal units, have many die cast parts in them.

The aircraft industry finds use for a large assortment of die cast parts, principally aluminum and magnesium, because of the weight factor. Electrical fittings, hydraulic housings and components, instrument housings, chair seat hardware, and pilot ejector mechanisms are a small part of the many applications found in this field.

Industrially, die castings find their way into every conceivable type of special machine. Those intended to knit or weave cloth, evacuate radio tubes, blow glass, manufacture shoes, drill holes, roll cigarettes, package foods, produce printing, process chemicals, form pottery, measure gasoline, saw wood, or fill milk bottles are a few examples.

Business and vending machines, likewise, use millions of die cast pieces each year for housings and frames, working parts of type writers, calculating machines, time clocks, music players, drink dispensers, and cigarette machines.

Among other industries, too numerous to list completely, are: radio and electronics, agricultural equipment, builders hardware, textile findings, lighting fixtures, outboard motors and small gasoline engines, photographic and scientific instruments, and toys.

The advantages of die castings are cumulative; that is, the features which favor the use of a die casting will usually give more than one advantage. For example, a die casting is preferred over a rough sand casting because fewer and less expensive machining operations are required. At the same time, the product designer gains lighter weight, better surface finish, and improved detail and accuracy that helps in assembly.

Probably the greatest single advantage of die casting is the cost factor. The end cost of a finished die casting is relatively low because of the high speed of operation and the low amount of labor involved. Initial tooling costs are high because of the intricate dies made of special tool steel and the large amount of skilled labor required to design and build such dies. However, where production runs are long and appreciable degree of complexity or precision are indicated, die casting is the most economical.

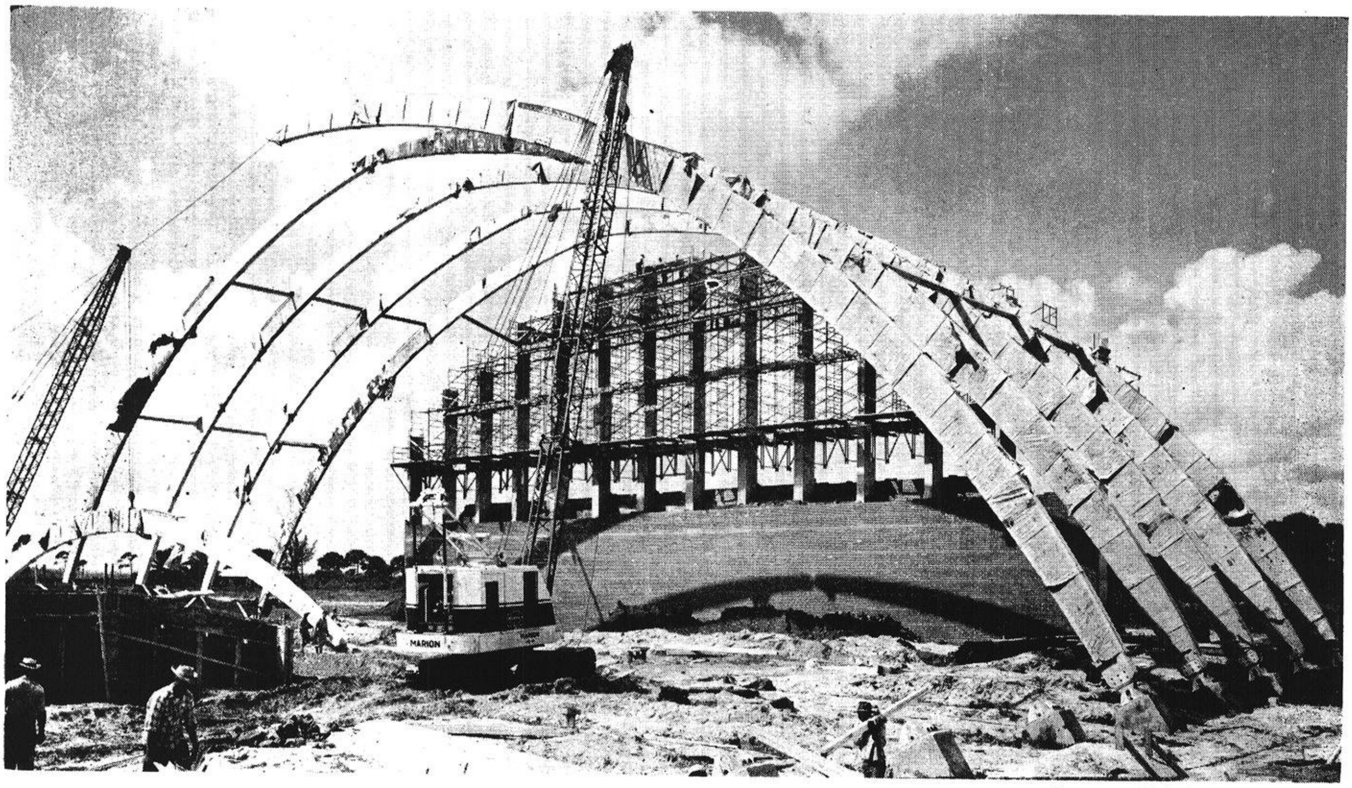
Compared with a completely machined component, the die casting is very often less expensive, consumes very little production time or equipment, results in no scrap loss in chips, is likely to be lighter, and has many other features which would be impractical by conventional machine shop methods.

Die castings are inherently smooth on both internal and external surfaces because they are formed against finished metallic surfaces of the die. In sand castings, sand inclusions commonly occur with the result that tools used for machining die castings have a short life between grinds.

Compared with molded plastics, die castings have the advantage of greater strength and stability, provide more secure anchorage for screws and other fasteners, and are generally superior in durability.

Inserts of other materials can readily be placed in the die cavity and permanently assembled into the casting when the molten metal flows around it. These types of insertions are used to incorporate stiffening materials such as brass, non-metallic materials such as magnets, electrical materials such as core laminations,

(Continued on page 57)



—Courtesy Unit Structures, Inc.

Each half arch is attached to the buttress connections while still on the ground, then truck-mounted cranes rotate them about their base until the two-halves meet at the crown.

Wood Arches

(Continued from page 27)

the ground. Then two truck-mounted cranes lifted the two opposite halves and rotated them about the base hinges until the crown hinges were lined up.

The crown hinge pin was then inserted to complete the erection. As each arch was rotated and aligned, it was tied to the adjacent arch with four 7 by 12 inch struts. Following this, the 4 by 5 inch wood decking was applied to the arches by nailing each piece with a special 7 inch grooved spike. In addition, bolt fasteners were inserted every 4 feet along the roof surface. These fasteners were found to be more than enough to resist any uplift forces which might be caused by wind.

—Courtesy Unit Structures, Inc.

Here the base hinge of a half-arch is pinned to its buttress before being lifted into place.

The ease of this type of erection was a big economy factor in the building of the Jai Alai fronton. It was erected very quickly, and thus provided a covered space in which to carry out the rest of the construction. Furthermore, the arch shell of the building could be built entirely separate from the seating and other interior construction. This allowed work to proceed on various parts of the structure without interference.

A second big economy factor was in the fabrication of the arches. Because of their laminated construction, it was possible to build them to the desired thickness at the point of maximum stress simply by adding a few laminates. If steel had been used, extensive welding would have been required at these points.

When the fronton was opened in January of this year for its first game of Jai Alai, it presented a completed structure that is a study in simplicity. The twelve arches, the struts, and the wood roof deck provide the large indoor playing area, unencumbered by posts, and the high clearance at the center of the building that the game requires.

This $1,250,000 building gives ample room to the old Spanish sport so popular in Cuba and other Latin American countries. As the players use their basket-like "Cestas" to receive and toss the Jai Alai balls against the end walls of the court, and as the spectators watch and bet under a roof that looks like the open sky, they will be playing and watching in a Jai Alai fronton that boasts the largest arch span of any building in the United States.

END

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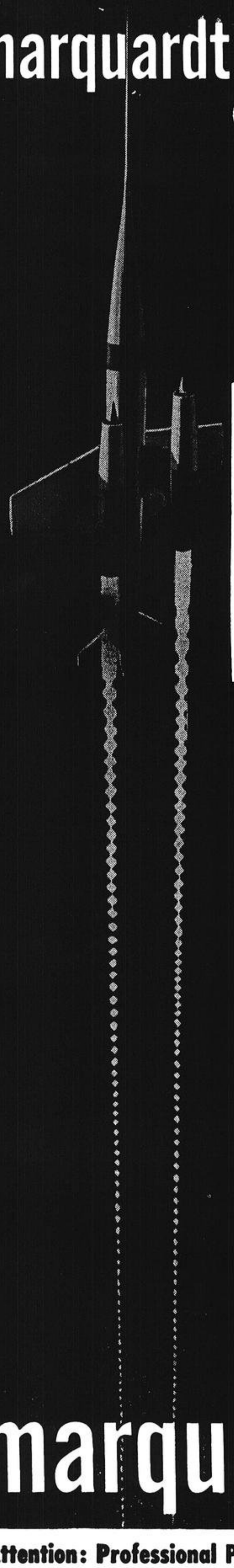

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Plant Lighting

(Continued from page 29)

let, and are long-lived. Their main drawbacks are their need for auxiliary ballast equipment and the greenish-blue light which they emit. The last consideration dictates that they be used with the ordinary filament lamp since the combination of the two gives a cool white light.

A combination of mercury lamps and filament bulbs has the further advantage of insuring that there will be light immediately after a power interruption, since the filament lamps relight at once while the mercury lamps require up to seven minutes to reach full brilliance.

Since the introduction of fluorescent lighting into industrial plants in 1938, it has enjoyed wide acceptance. Fluorescent lamps are about three times as efficient as the usual filament lamp, and although their initial and maintenance costs are high, they give more light per dollar of total cost than the filament bulbs. One characteristic of the fluorescent lamp is the large area giving off light and its low brightness. This results in more uniform lighting, less glare, and fewer harsh shadows. Another important consideration is the fact that they are cool, and this means additional savings where air-conditioning is used and greater comfort when the source of light must be placed near the worker.

Filament lamps and their fixtures cost only two-thirds as much to install as fluorescent or mercury vapor lamps and fixtures. But filament lamps last only about 1,000 hours while fluorescent lamps burn 3,000 to 7,500 hours and mercury vapor lamps from 2,000 to 4,000 hours. Frequent turning off and on has little effect on the life of incandescent lamps, but it reduces materially the life of other types. A 40-watt fluorescent lamp should last 7,500 hours if it burns an average of three hours per start, but its life may be halved when it is turned off and on frequently. Both mercury vapor and fluorescent lamps require auxiliary equipment in the form of starters. The starters may burn out and add to the expense caused by the burning out of the lamp itself. Maintenance and cleaning of reflectors are cheapest when incandescent lamps are used.

Nearly burned-out fluorescent lamps flicker and are annoying to the worker, but incandescent lamps go out suddenly, leaving no light at all. Mercury vapor lamps are deficient in red rays and give off a bluish light which is not suitable for work calling for color discrimination. Workers seen under a mercury vapor lamp sometimes appear to have a sickly pallor, to which female employees in particular may object.

Fluorescent and mercury vapor lamps give a more diffused and softer light than incandescent lamps. Fluorescent lamps give a cool light, and their light output is roughly three times that of incandescent lamps for the same amount of electricity. They also maintain their light output throughout their life, whereas incandescent lamps give progressively less as they age. Fluorescent lamps giving white light the color of daylight are available and are superior to all other types where color discrimination is important. Altogether, if lights are not turned off and on too often, fluorescent lighting will save one-quarter and mercury vapor one-sixth the cost of lighting by incandescents.

If the problems of plant lighting are broadened to include everything that has to do with better vision within the plant, then one phase of the question is that which deals with colors used on floors, walls, ceilings, machines and equipment. It has been proved time and again that seeing can be aided or hindered by the colors used throughout the building.

Generally speaking, ceilings should be painted white in order to reflect light downward on to the workplaces. Walls should not be painted white since they would reflect too much light, causing glare. Thus the preferred colors for the walls are various soft tints. In some cases where is it desirable to reflect light from the floors to the work being done, floors can be painted white.

Various experiments have proved that the passage of time is generally over-estimated in rooms painted red and underestimated in rooms predominantly blue. Moreover, it has been found that it is unwise to use red paint in rooms where the temperature is high or green paint where the temperature is low.

As is the case with a lighting system, whenever a color combination is used in order to aid seeing and to add to the general attractiveness of the plant, it is necessary to maintain it properly if the maximum results are to be achieved. If this is not done, dust and grime will soak much of the light which should be reflected to the workplaces. Thus walls and ceilings should be painted periodically.

It is not enough for a company merely to install a lighting system that achieves the goals of adequate intensity and proper diffusion. It is equally important to see that the system is properly maintained so that these benefits can be enjoyed.

Proper maintenance of all windowed areas is very important. A study made in England revealed that systematic cleaning of 16,000 square feet of skylight increased output by 6%, reduced errors by 5%, and cut accidents by 10%.

The luminaires must also be kept clean so that the amount of light coming from them will not be unduly reduced. One study has shown that the loss of light from dirty lamps and reflectors may run as high as 32%. The frequency of cleaning will be determined by the amount of dust in the atmosphere and by the type of lighting fixture used. Illumination increases are definitely obtained by removing dirt from luminaires.

Many companies have found that it pays to replace lamps periodically on a group basis. Group replacement is the policy whereby all of the lamps in a given area are replaced after they have burned a certain percentage of their rated life, usually around 75 to 80%.

This means that roughly 20 to 25% more lamps will be used than would be the case were bulbs allowed to burn out. However, the savings from group replacement more than offset the additional sum invested in lamps.

In addition to savings on the cost of replacement, there are certain other benefits that come from the use of this plan. Where fluorescent lighting is used, it has been found that old tubes tend to increase costs in that they do not deliver the desired amount of light while continuing to use the same amount of current. Old tubes also cause excessive wear on starters and other auxiliary equipment.

Group replacement has the further advantage, no matter what type of lighting is used, of permitting the installation of new lamps at a time when there is no work going on in the department, thereby eliminating interference with the workers at the machines. Also it is possible to combine ordinary maintenance and cleaning of the fixtures with replacement and thus further reduce costs.

A company should always work out a replacement policy to fit its particular needs. A number of factors should be considered: the net cost of the lamps, the average time required to change them individually compared to the time per lamp to change the group, the percentage of the rated life of the lamps used at the time when the group is replaced, the percentage of failures between the regular replacement periods, the wages paid the maintenance workers who do the job, and so forth. Since these factors vary from plant to plant, it is important that a proper plan be used if the maximum benefits are to be gained. And since improvements are constantly being made in the lamps themselves, it is desirable to examine any given plan from time to time to see if it is still appropriate.

From the above discussion it is clear that plant lighting is a subject of great importance in the successful operation of a plant. But at the same time it is obvious that achieving and maintaining a good system of lighting is neither a simple matter nor inexpensive. Consequently, one is entitled to ask whether the benefits more than offset the effort and expense required to bring the lighting up to modern standards.

Every study of plant lighting indicates that where the proper system is used there has been an increase in the accuracy of the work produced and a reduction in the number of rejects and the amount of spoilage. That this means a great saving is evident when one recalls the enormous cost to industry of material that is spoiled during the process of manufacturing. And although good plant lighting does not eliminate spoilage, it reduces it significantly.

Apart from lowering the amount of rejected work, a good system of lighting increases production. It seems to be a general rule that the more light at the workplace, the more production there will be. To be sure, there is an upper limit beyond which this rule does not apply, for it cannot be assumed that increased production is merely a matter of increased lighting. However, it has been noticed that an improvement in the lighting system is generally followed by an increase in the rate of production.

Employee morale also tends to improve where improvements have been made in the lighting system. There may be many reasons for this. The workers may feel that management is interested in giving them the best possible working conditions, or the cheerfulness of a well-lighted room may make for better feeling on the part of the workers. Or a reduction in the amount of eye-strain and eye-fatigue may result in a better attitude on the part of the workers. In any event there is every reason to believe that where the lighting is good, the morale of the workers will be high. And where this is the case, labor relations will probably be friendly.

It is also a general rule that a well-lighted plant is a clean plant. Where this is true, the task of the maintenance department is made easier. Where all corners of the room are lighted, workers may hesitate to throw refuse and dirty waste away but will place them in the receptacles provided. On the other hand, dark corners seem to invite carelessness in this respect on the part of the workers.

Finally, there can be no doubt of the connection between the accident rate in a plant and lighting. Wherever lighting has been improved, the accident rate has gone down, often by unbelievably large percentages. One company reported a reduction of 60% in its accident frequency rate after a new lighting system was installed. This seems to be a general experience. The savings in terms of higher production and lower insurance rates are, of course, significant. But most significant are the savings in terms of human suffering and misery. These alone would justify the cost and inconvenience of installing and maintaining good systems of plant lighting. **END**

Die Casting

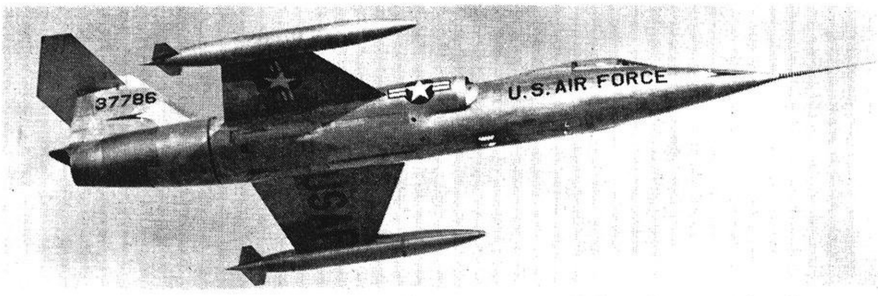
(Continued from page 53)

or conduits such as copper tubing. The metallic parts of zippers are die cast around the cloth that supports them.

Die castings permit very economical fastening methods: self tapping screws, spring type fasteners, screw thread inserts, drive pins, and self-riveting and so forth.

One of the greatest features die casting has to offer, from the view point of the product stylist, is the freedom of shape permissible and the unlimited range of surface ornamentation that can be introduced at a very small increase in tooling or finishing costs.

Ease of surface finish is another factor that favors die casting. The castings are received with smooth surfaces and substantially all flash trimmed off. Following a light sanding at the parting line, the casting is ready for painting.



First of the fastest—The new Lockheed F-104 Starfighter designed for sharp maneuverability at supersonic speeds.

Science High Lights

(Continued from page 35)

Before entering the test cells the air will be cooled or heated, as required. Two air flows of different temperatures will be mixed close to the cells to obtain the required test conditions.

The test facility will have its own power distribution station, water supply system, and steam plant for heating.

A crew of about 100 men will be needed to operate the new facility, which will use more than 80,000 kilowatts of electric power during operation. This is approximately enough electricity to supply the needs of a city with a population of over 100,000.

Included in the plans for the new facility is a means of noise level control.

Already under consideration are future extensions which will allow testing of engines under all possible conditions, even restarting an engine after it has ceased operating at high altitude owing to equipment failure or improper handling. Duplicating this condition and finding the required correction may save many airmen's lives and valuable aircraft.

'COPTERMATIC

An "automatic transmission" similar to the type found in some automobiles will be used on helicopters of the future.

The fluid, in the case of the T58, will be air rather than a liquid as in an automobile's transmission. After the air passes through the turbine wheel connected to the compressor, it comes in contact with a second, unconnected turbine, causing it to spin at a very high speed. It is from the revolving action of this second (or "free") turbine that horsepower is produced to turn the helicopter's rotors.

Rated in the "1000 horsepower class," the T58 is also expected to provide superiority in endurance, range, durability and reliability over a comparable piston engine-powered aircraft.

The T58 is a turboshaft engine. With modifications, it could be converted into a small turboprop (jet engine with propeller) or turbojet.

COLD FABRICATING LAMINATE

A new plastic laminate with properties particularly suited for automatic production of electronic equipment utilizing printed circuits has been introduced recently.

Called Textolite cold punch 11570, the new material is a high insulation-resistance XXXP phenolic, paper-base laminate which permits close registration punching at normal room temperatures.

The cold fabricating quality is reported to eliminate dimensional changes in the material which result from the combination of heat and punching stresses.

It allows precision punching of printed circuits, facilitating the use of automatic assembly equipment in mounting components. The translucency of the laminate permits a visual check for accuracy of circuit registration.

Other significant features include high flexural strength, very low factor, high heat resistance, and optimum uniformity. END

CAMPUS NEWS

compiled by Dick Peterson, m'57 and Larry Barr, m'57

1956 COLLEGE OF ENGINEERING HONOR STUDENTS

John Gordon Akey
John Michael Albrecht
Hilbert Walter Bauman
Jon Henry Baumgartner
Ostap Bender
Donald Benke
Marten Marcus Berndt
Richard Edward Birner
Duane Frederick Bruley
Robert Richmond Carey
Oliver Raymond Clement
Vernon Daniel Coffey
Robert Clark Costen
Ronald Lee Douglas
Ray Durward Dunwell
Erwin Ernst Eberle
Thomas William Ehrmann
Robert Forrest Engel
Henry Goldsmith Goehring, Jr.
Raymond Earl Harrison
James Bernard Hemker
Kenneth Charles Holtz
Thomas William Hurley
Frank Richard Janisch
Paul Merrill Jenkinson
Wayne Howard Jorgenson
R. Frank Kehrberg
Jack Dean Kingsley
Richard George Koegel
Fred Carl Krist
Gene Frank Krcmar
Delbert Leonard Lehto
Norbert Wayne Lenius
Donald Marc Levy
Charles Richard Luebke
Richard Louis Luedtke
Frederick Allen Luhman
William Grant Marshall
Don Walter Martens
Robert Rourke Mills, Jr.
Arthur Lee Morsell III
Kenneth Ellsworth Niebuhr
Thomas Claire O'Sheridan
Vern Donald Overbye
Rodney Gene Pike
Richard Alla Robbins
Danny Eldon Schendel
Allin Walter Schubring
Wilhelm Carl Steffe
Richard Franklin Stieg
Milo Carl Swanson
Robert Allen Thygeson
Dietrich Ekkenhardt Weinauer
Richard Norman White
Duane Alwin Williams
Wallace Allen Yeskie
Charles Elmer Zanzig

A.S.M.E.

The Wisconsin Student Branch of the American Society of Mechanical Engineers concluded an active and commendable year at their final meeting on May 9th. The evening was highlighted by a speaker from E. W. Bliss Co. of Ohio who spoke on the topic of mechanical and hydraulic presses.

Joe Murray, president of the student branch, was the proud winner of first place in the speech contest at the annual regional conference held this year in Fargo, North Dakota. Wisconsin has been chosen to be host to the ASME Student Regional Conference next year.

Elections were held for ASME officers for the coming year and the following slate was chosen: President—John Bollinger, Vice President—Robert Gehr, Treasurer —Robert L. Roberts, Polygon Representatives — Peter Reichelsdorfer and Dave Rex, Secretary—Robert Wesolowski, Corresponding Secretary—Bob Kruse.

POLYGON BOARD

At the May 10th meeting of Polygon unanimous acclamation was given to Milo Swanson for his very fine record as Chairman of the Board. Elections were held and the following people were chosen as officers for the fall semester.

Chairman—Ken Stahl
Secretary—Dave Hartman
Treasurer—Carl Jaeck

Points for Polygon profits distribution were submitted and approved as follows:

ME	4926
EE	4197
CHE	2981
CE	2564
M&ME	2280

The profits distribution for the entire year will be based on a percentage of total points earned by each school.

1956 TAU BETA PI SPRING INITIATES

Seniors — William J. Cattoi, Henry Goehring, Ronald H. Schenck, Duane A. Williams, Wayne H. Jorgenson and Charles C. Zanzig.

Juniors—Robert E. Suelflow, Kenneth L. Stahl, Paul Raab, William J. Salkowsky, Donald E. Tormey, Donald E. Baldouin, Gerald L. Carlson, Charles L. Soukup, Phillip F. Noth, Charles W. Spalding, Thomas A. Kanneman, Ronald G. Fenske, Alfred Hubbel, Donald M. Tacke, William E. Bottcher, Richard G. Kott and James P. Murphy.

ENGINEER'S DAY

Six widely-known engineers and industrialists, all of them graduates of the University of Wisconsin College of Engineering, were cited for outstanding accomplishments in their fields at the annual Wisconsin Engineers Day celebration held on the UW campus May 4.

The outstanding graduates were recommended for distinguished service citations by the UW College of Engineering faculty and Pres. E. B. Fred, and the recommendations were approved by the University Board of Regents.

The six are:

J. Gordon Baker, president of the Baker Manufacturing Co., Evansville, Wis.;

Arthur W. Consoer, consulting engineer, of Chicago and Pittsburgh;

Malvin J. Evans, head of a management engineering consulting firm in Chicago;

Charles A. Halbert, retired Chief State Engineer of Wisconsin, Madison;

T. Delbert Jones, executive of the American Smelting and Refining Co., of Barber, N.J.; and

Keith S. McHugh, president of the New York Telephone Co., New York City.

The citations were presented at the eighth annual Engineers Day dinner held in Great Hall of Wisconsin's Memorial Union at 6:30

p.m. on May 4. More than 400 engineers and industrialists from all parts of the state and nation attended the dinner at which the UW College of Engineering annually honors some of the state's and the nation's leading engineers and industrialists.

The Benjamin Smith Reynolds Award was presented by Mr. Charles D. Gelatt, President of the Board of Regents, to Professor Raymond Jefferson Roark of the Department of Mechanics.

This award is a Living Memorial established in 1954 at the University of Wisconsin in honor of the Wisconsin-born, Wisconsin-educated Benjamin S. Reynolds. It is awarded as a symbol of excellence in teaching of future engineers.

Professor Roark, who has been teaching in the College of Engineering for nearly forty years is a highly respected figure in the engineering world. In addition to his devotion to the education of young engineers, he is recognized as an outstanding consultant for industries throughout the state and nation.

ALUMNI

Anthony J. Woods has been appointed assistant manager of Dow Corning's Cleveland office.

Woods, a technical sales representative with Dow Corning since 1946, received his Bachelor of Science degree in electrical engineering from the University of Wisconsin in 1940. After graduation, he joined the Wisconsin Power and Light Company as customer representative.

From 1941 to 1945, he served as a chief electrical inspector in the U. S. Navy Department. Married to the former Catherine M. Ziebell of Milwaukee, Woods has one son, James and one daughter, Mary.

Woods is a member of the American Institute of Electrical Engineers and the Sales Executive Club of Cleveland. He lives at 3866 Strandhill Road, Cleveland, Ohio.

Fifteen outstanding college students working for their doctor's degrees were named today to receive the 1956 Bell Telephone Laboratories Graduate Fellowships.

The fellowships, awarded for the first time this year, were established to encourage study and research in engineering and science related to communications technology. Each fellowship is for one year and carries a grant of $2,000 for the fellow and another $2,000 for tuition, fees and other costs of the academic institution he selects for his study.

Donald L. Dietmeyer, 23, of 1341 Prospect Ave., Wausau, Wis., received his B. S. degree in electrical engineering in 1954 and his M. S. in 1955, both from the University of Wisconsin. He plans to do his Ph. D. work there on the design and construction of digital computers. He expects to work on the analysis and synthesis of sequential switching circuits.

Harold R. Leland, 24, of 1426 Grand Ave., Wausau, Wis., received his B. S. and M. S. degrees in electrical engineering from the University of Wisconsin in 1954. After his release from the Air Force in September, 1956, Mr. Leland plans to return to that university to begin his Ph. D. work on nonlinear control problems, applying techniques of digital and analog computing.

Lindon E. Saline has been named manager of headquarters recruiting in the General Electric Company's Engineering Services.

Saline will have responsibility for engineering relations with many of the technical colleges in the upstate New York area and supervisory responsibilities in the engineering recruiting headquarters here.

A native of Minneapolis, Minn., Saline served in the Navy from 1942 to 1946. He received a bachelor of electrical engineering degree from Marquette University in 1945 while still in service. He completed his work for his M. S. degree at the University of Wisconsin and obtained his Ph. D. from the same university in 1950.

Joining General Electric in 1948, Saline devoted his efforts until 1953 primarily to the field of power-systems engineering. In 1953 he was assigned to operations research in the analytical-engineering section of the company's Apparatus Sales Division and from November 15, 1954 until September 1, 1955 was analyst with the Project Analysis section of G-E's Research Laboratory.

Charles R. Dunfee was appointed as Manager of the New York office, Jack and Heintz, Inc., one of the nation's leading designers and manufacturers of electric and hydraulic accessories for aircraft.

Mr. Dunfee will be responsible for sales and service functions at all aircraft customers in the Company's Northeastern District. END

A recently patented device for the rescue of downed aviators, or others, at sea consists of a spherical "capsule" which can be dropped from a rescue plane and into which the man in the water can crawl. Provision is made for hooking the capsule from a rescuing plane.

partytime PAPER *and* *lifetime* CHROME

Maybe you can't see the connection between paper and handsome chrome plating—but it's there. Like so many things, both products begin with chemistry—and alkalies are indispensable to both.

Allied Chemical's Solvay Process Division is a leading producer of alkalies—like caustic soda and soda ash used in papermaking. Another Allied Division, Mutual Chemical, uses soda ash in the making of chromium chemicals, such as chromic acid for plating.

Because Allied's seven divisions are foremost producers of chemicals, there are scores of cases where two or more divisions team up to contribute to a finished product or to serve a particular industry.

Allied Chemical altogether turns out more than 3,000 products. Seen or unseen, they're helping everyone who makes, grows or uses things—that is, *you.*

HERE'S HOW THEY'RE ALLIED

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Sailing

(Continued from page 13)

with varying degrees of sharpness at various heights. There are an infinite number of possibilities, and to even begin to discuss them would lengthen this article to an impractical degree. However, we can apply this principle to the boom, where it is even more important to control the shape of the sail (because the curvature is essentially fore and aft, rather than vertical, due to the horizontal nature of the wind flow).

One can still control the draft of the sail at the boom by using the same principles: A curvature concave upwards, with the center of the boom down, results in a flatter sail; and of course reversing the curvature adds to the draft of the sail. This can be accomplished by putting jumper stays on the boom (as is done in some Star boats), but an easier way is to vary the lead of the mainsheet. For normal sailing have a heavy, rigid boom that will remain straight. When the wind is heavy, use a limber boom and lead your sheet from the central part of the spar. The pull of the sail will then cause the outer end to move upwards, resulting in the desired curvature (at the expense of leverage for the sheet.) In light airs, use a very limber boom with a single sheet leading from the extreme outer end. The sail will pull up on the center of the boom and the sheet will pull down on the end, causing it to take the desired concave downward curvature. See Fig. 9.

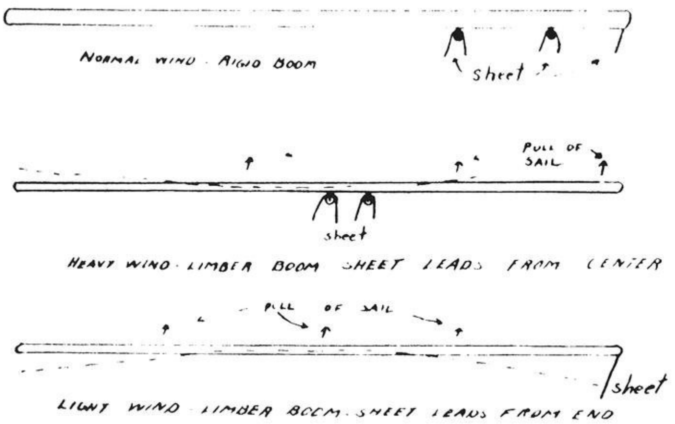
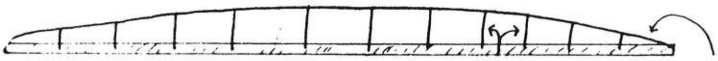
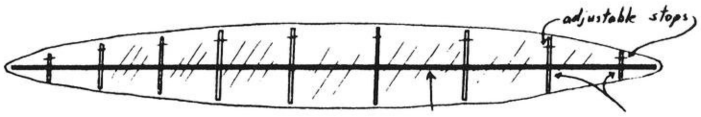


Fig. 9.—All side views.

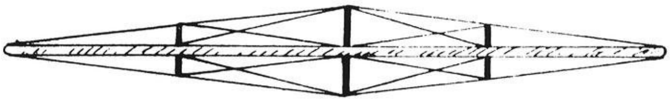
Another and more revolutionary means of controlling draft with the boom is to control the horizontal variance of the bottom of the sail. This was first done with the famous Park Avenue boom, which had a long fore and aft track resting on numerous cross-tracks. By putting stops on the cross-tracks, the bottom of the sail could be made to assume any desired curvature. See Fig. 10. Other means of accomplishing the same thing are to have the sail fastened to a wire running the length of the boom. The wire can be tightened or slackened, flattening or bellying the sail, and small adjustable wires spaced along the boom and attached to the fore and aft wire would give the same control found in the Park Avenue boom. Or a series of diamond stays on the side of the boom could provide a means of causing the boom to assume an infinite number of different curvatures. The only trouble with this system is that it would require all the stays to be re-adjusted each time the boat came about. See Fig. 10 for all methods.



Park Avenue boom-long center track slides on cross-tracks.



Boom with wire—small adjustable wires control long wire.



Series of diamond stays make various curvatures possible.

Fig. 10—All top views.

One of the most useful auxiliary racing lines is a vang. A vang is a line attached to the center of the boom (or slightly forward of center) and used to pull downward and flatten the sail when sailing downwind or on a reach. Another functional but seldom thought of use would be to trim down hard while sailing to windward in a heavy breeze, thus pulling down the center of the boom and preventing the sail from becoming too full.

Another useful line is the topping lift, running from the truck of the mast to the outer end of the boom. It can be used to hoist the boom a little in very light airs, thus taking the weight of the boom off of the sail and letting the sail hang fuller.

Still another method of controlling draft is found on some class C scows. The last 2 feet of sail track are not fastened firmly to the boom, but are mounted on a vertical screw thread which allows them to be cranked up. See Fig. 11. This loosens the after edge of the sail and allows the boom to drop, pulling out the pocket or draft and flattening the sail.

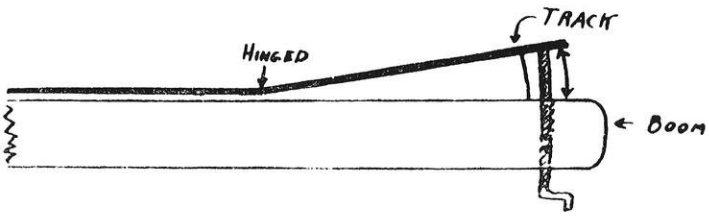
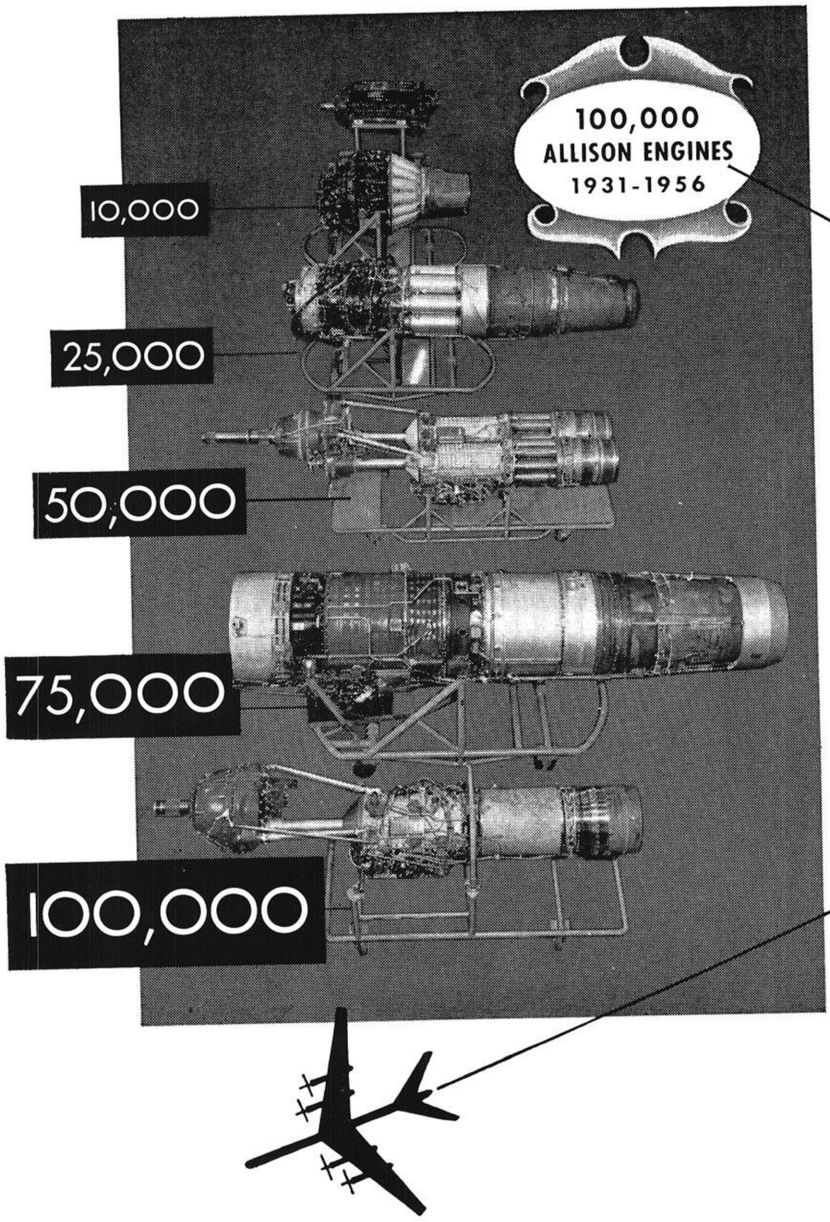


Fig. 11.

There are other, more unconventional ideas on the subject of controlling sail draft, but these are the more widely used methods.

END


100,000
ALLISON ENGINES
1931-1956
10,000
25,000
50,000
75,000
100,000

So You Think You're SMART!

by Sneedly, bs'60

Due to circumstances beyond his control (this sounds like last month), namely, the Engineering Exposition, Sneedly is unable to present the solutions to last months problems. However, the solutions to the following problems will definitely appear in the May issue of the *The Wisconsin Engineer.* (Sneedly swears to this fact with his right hand over his slide rule).

Sneedly's first problem this month was solved by him while he was doing research work on the problem of birth control in house flys at Westnorthern State.

There are a number of house flys lying side by side in straight line long the bottom of a hog trough. There were half as many yesterday. There will be twice as many tomorrow; for, owing to the force of circumstances, the number of house flys doubles every day.

At this rate the entire hog trough will be full of horse flys in just 57 days. But what Sneedly was asked to solve was this: In how many days will the hog trough be just exactly half-full of house flys? Sneedly solved it. Can you?

Ole, Pierre, Juan, and Fred are four engineers that are working part-time as cab drivers to try to earn a living. They are going fare-hunting tomorrow on one of the Madison streets. The street has no traffic lights and they estimate that equal numbers of pedestrians walk in each direction, at an average of four miles an hour.

Ole says: "You boys are crazy to use up gas cruising around all the time. I'm going to park beside the curb until a fare comes along."

Pierre says: "I'm going to cruise up and down at four miles an hour, and I'll have twice your chance of picking up a fare."

Juan says: "Eight miles an hour for me, up and down the street; and I'll have twice the chance of either of you."

Fred says: "I'm going to average twelve miles an hour and I'll have twice as much chance as Juan of getting a fare."

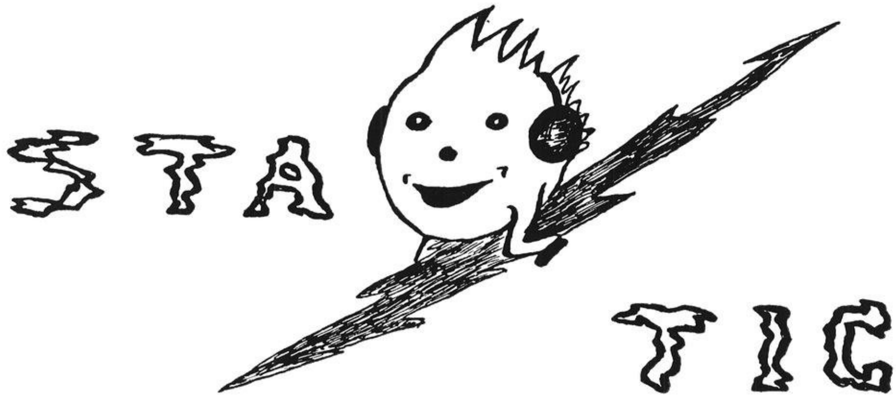
Think about this and figure out the true facts, deciding who was right and who was wrong. What would happen if twice as many people were walking one way as there were walking the other? What would happen if those walking South averaged three miles an hour and the others averaged four miles an hour?

In his physics class the other day Sneedly was asked by his instructor to give four different ways of turning a glass of water upside down without spilling the water. Sneedly mystified his instructor by giving six different ways, each based on a different natural law. How many can you give?

Sneedly's girl friend, Gertrude, has disappeared. Can you help the University police find her? They have nothing to go on except a few torn scraps of paper which they've succeeded in pasting together, and some facts gathered from Sneedly.

The facts: Gertrude never had more than two dresses at a time. Actually, she seldom had more than one, as she was in the habit of selling her old dress shortly after she bought a new one. Her new dress was always a different color from the old.

The notes (in Gertrude's own handwriting). I sold my old dress today before running away. B. The dress I bought before the one I got yesterday was blue. C. The dress I sold before buying the dress I got yesterday was brown. D. The dress I sold before I bought the dress I got before buying the one yesterday was green. E. The dress I bought yesterday is the same color as the one I sold after buying the brown one. What color dress was Gertrude wearing when she ran away? What color dress did she buy yesterday? What color was the oldest dress referred to in the notes that she left? What was the color of the first dress she mentioned buying?



I. R. Drops, II

Getting a joke column is fun, but it's no picnic.

If we don't print jokes, we are too serious.

If we print jokes, we are silly.

If we take from other magazines, we are too lazy to write them ourselves.

If we don't print contributions, we don't appreciate true genius.

If we do print them, the pages are full of junk.

And now, like as not, someone will say we stole these from some other magazine.

We did.

° ° °

A professor sought admission to the pearly gates.

"Who are you?" Saint Peter asked.

"I am a college professor."

"What do you want?"

"I want to get in."

"What have you done that entitles you to admission?"

"Well, I saw a decrepit old senior on campus the other day and I gave him two cents."

"Gabriel, is that on the records?"

"Yes, Saint Peter."

"What else have you done?"

"Well, the other night I gave a starving freshman a penny."

"Gabriel, is that on the records?"

"Yes, Saint Peter."

"Well, Gabriel, what do you think we ought to do with this guy?"

"Give him back his three cents and tell him to go to hell."

Kissing is just so much chemistry, according to Douglas Walkington, a chemist for Canadian Industries. It has to do with a craving for salt.

The cave man found that salt helped him cool off in the summer heat. He found, too, that he could get salt by licking his neighbor's cheek. Also that it was more interesting if the neighbor was of the opposite sex.

Then everybody forgot about salt.

° ° °

The girl was through with her bath and was just stepping onto the scales to weigh herself. Her husband happened to return home at this time and entered through the back door. Seeing what his wife was doing as he passed the bathroom door, he exclaimed, "Well, dear, how many pounds today?" Without turning her head, she replied, "I'll take 50 pounds today, and don't you dare pinch me with those tongs."

° ° °

Life is like that. You usually hear about the man who hits the jackpot, but the fellows who built up the pot are unknown.

° ° °

A farmer had ten employees on his farm, and as none of them were as energetic as the farmer thought they should be, he hit upon a plan which he believed would cure them of their lazy habits.

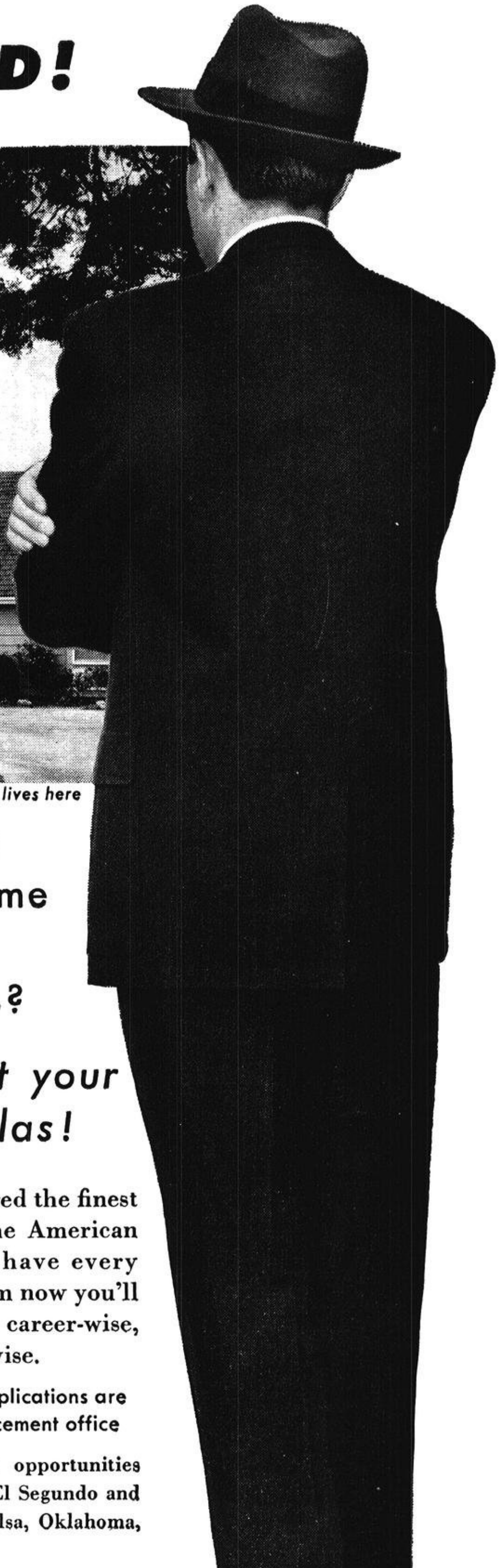
"Men," he said one morning, "I have a nice, easy job for the laziest man on the farm. Will the laziest man step forward?"

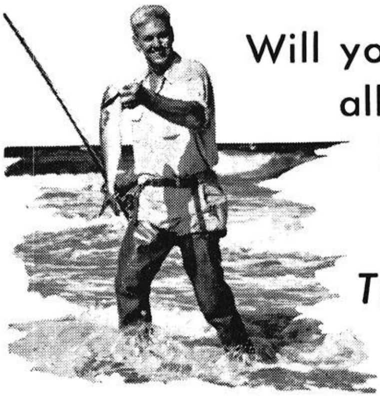
"Why don't you step to the front with the rest," inquired the farmer of the remaining one.

"Too much trouble," came the reply.

ENGINEERS...
LOOK TEN YEARS AHEAD!

A Douglas engineer lives here





Will your income and location allow you to live in a home like this...spend your leisure time like this?

They can...if you start your career now at Douglas!

Take that ten year ahead look. There's a fine career opportunity in the engineering field you like best waiting for you at Douglas.

And what about the Douglas Aircraft Company? It's the biggest, most successful, most stable unit in one of the fastest growing industries in the world. It has giant military contracts involving some of the most exciting projects ever conceived...yet its commercial business is greater than that of any other aviation company.

The Douglas Company's size and variety mean that you'll be in the work you like best—side by side with the men who have engineered the finest aircraft and missiles on the American scene today. And you'll have every prospect that ten years from now you'll be where you want to be career-wise, money-wise and location-wise.

Brochures and employment applications are available at your college placement office

For further information about opportunities with Douglas at Santa Monica, El Segundo and Long Beach, California and Tulsa, Oklahoma, write today to:

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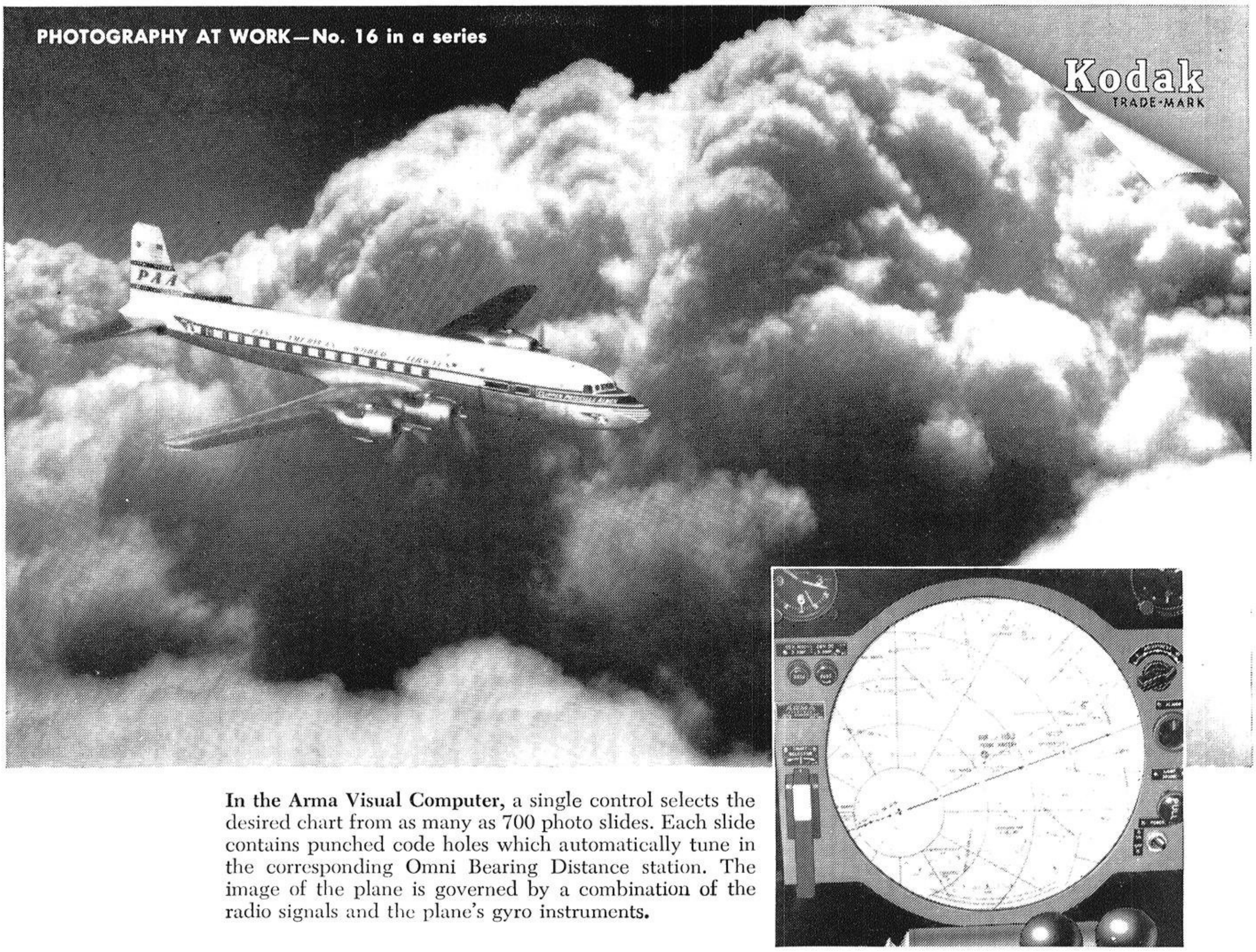
STORY INDEX

VOLUME 60 — OCTOBER 1955 TO MAY 1956



In the Arma Visual Computer, a single control selects the desired chart from as many as 700 photo slides. Each slide contains punched code holes which automatically tune in the corresponding Omni Bearing Distance station. The image of the plane is governed by a combination of the radio signals and the plane's gyro instruments.

Photography teams with electronics and adds new certainty to flight

Now a visual computer pictures a plane's precise position and heading on projected photos of aeronautical maps.

Arma Division, American Bosch Arma Corp., working with the Air Navigation Development Board and C.A.A., has developed a valuable new aid in air navigation using photography.

With it the pilot, high above the weather, flicks a switch and before him appears a map of the area he's over. On the screen a tiny shadow of a plane moves and shows exactly where he is, where he's heading and whether he's on course.

This spells added certainty. Even more! It can mean savings in time and money, too. For the flight can proceed by plan rather than by dog-legs on the beams.

So again we see photography at work helping to improve operations—doing it for commercial aviation just as it does for manufacturing and distribution.

Photography works in many ways for all kinds of business, large and small. It is saving time, saving money, bettering methods.

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Eastman Kodak Company, Rochester 4, N. Y.

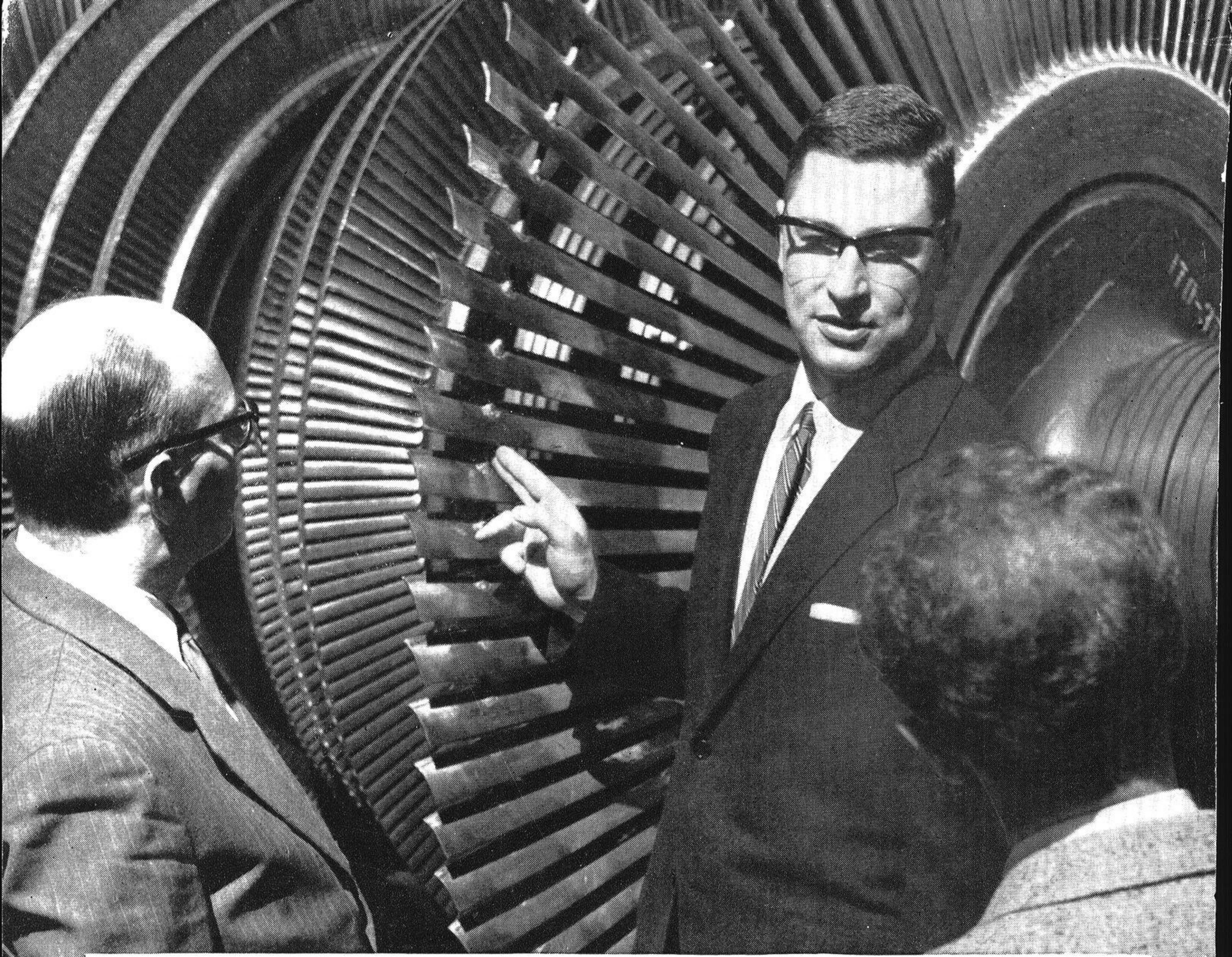

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*ILLUSTRATION: *Sales Engineer and customers discuss turbine rotor construction. Glasses are factory safety measure.*

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