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OCTOBER
1955

The Wisconsin engineer

25c

Richard S. Crowell, class of '48,
speaks from experience when he says . . .

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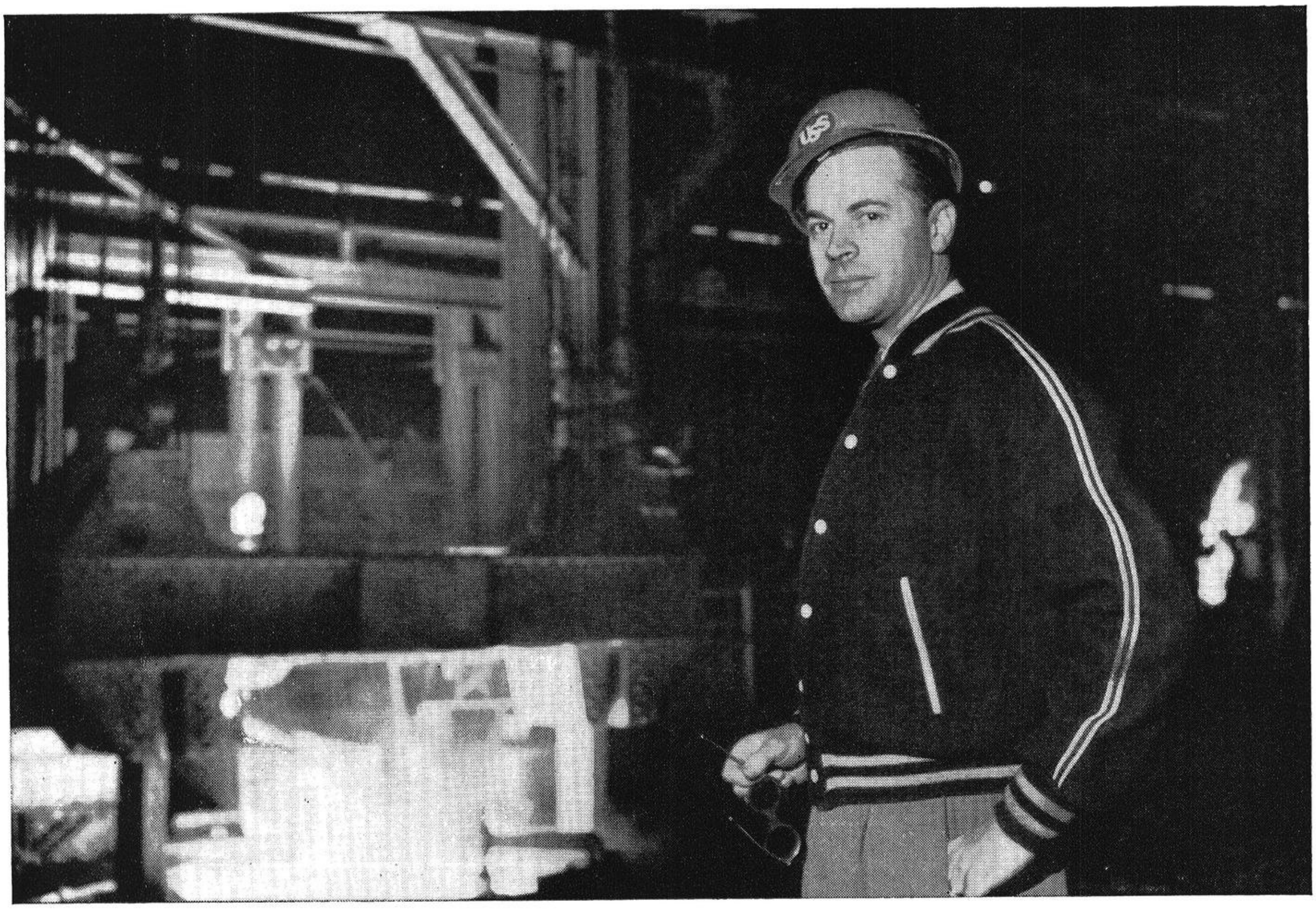

Immediately following his graduation as a B. S. in Metallurgical Engineering, Richard Crowell was recruited by the chief metallurgist of U.S. Steel's Clairton works. By 1951 he received his third promotion to Engineer-Operating Practices in the Open Hearth Division at Clairton. Recently he had his fifth promotion to his current position as Assistant Superintendent of Clairton's Open Hearth Department.

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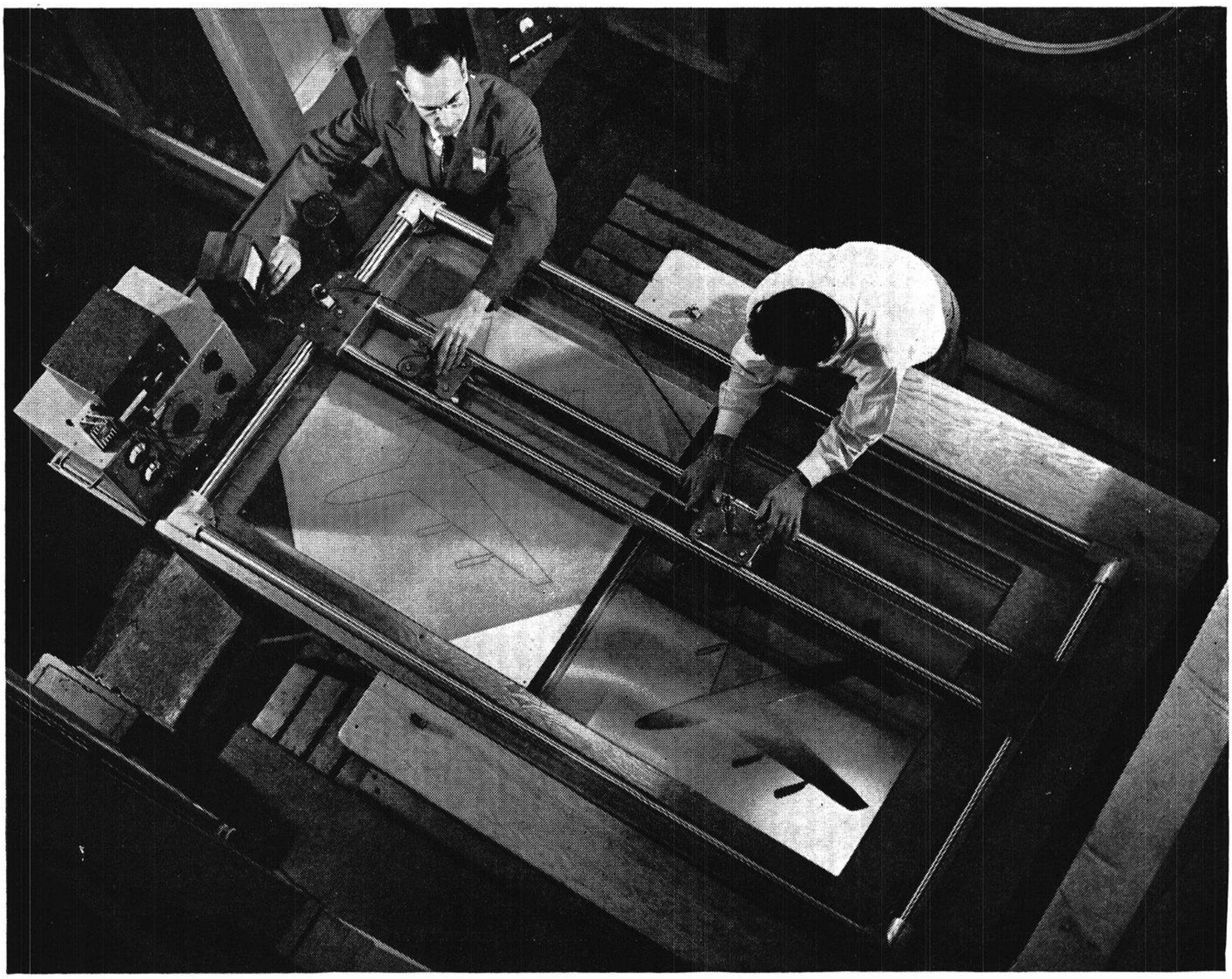

Boeing engineers are kept free for creative assignments

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The Student Engineer's Magazine

FOUNDED 1896

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Cover

The shell of the University of Wisconsin Athletic Practice Building stands as a tribute to the accomplishments of engineers and architects working with concrete and steel. The huge arch, made of reinforced concrete, and supported by no auxiliary framework, has been completed and work has begun on closing up the two ends. Photography Editor Jim Richards caught the transit, symbol of the civil engineer, framed by the movable steel form in this unusual picture. The crane in the background is being used to dismantle the steel framework.

IN THIS ISSUE . . .

by Alan Black, e'58

JOHN BOLLINGER

Are you a frustrated driver? Do you ever feel a hopeless sense of defeat when caught in the familiar morass of weekend traffic? Cheer up—the day may yet come when you will be able to fly your heap right over the snarl. All of which leads us subtly (despite what the editor says) to John Bollinger's article, "Whirling Wings". Frankly, the article is weak on such vague gadgetry, as 'copter cars, but it will give you some rather surprising facts on the theory of helicopter flight, plus the interest on engineering developments in the field.

John is a junior in Mechanical Engineering and has come all the way from Manhasset, New York to get his education here. His activities include A.S.M.E., and the general chairmanship of the 1956 Engineering Exposition. In his spare time John somehow holds down a job on the story staff of the Wisconsin Engineer and is issue editor of this month's magazine.

RICHARD PETERSEN

It's becoming increasingly apparent that the immediate future of aviation is going to depend in large measure upon the jet engine—turbo jets in particular. Conclusion: if you don't want every A.F.R.O.T.C. man to think you're a washout as an engineer take a quick look at Dick Petersen's fine bit on "Turbo Jet Engines". Dick takes the engines apart and shows you how they work. You'll find special emphasis on heat power and thermodynamics.

Dick hails from Sturgeon Bay where he works during the summer for the Green Bay Power and Light Co. His position on the editorial staff of the Wisconsin Engineer is evidence enough of his sterling quality. In addition, Dick is feature editor of the Air Badger, a member of A.S.M.E., and active in preparations for the 1956 Engineering Exposition.

Now a junior in Mechanical Engineering, Dick hopes to enter the field of heat power and thermodynamics when graduation and the Air Force have been completed.

FRITZ CALLIES

You just can't keep a good man down. At least you can't keep them away from the *Wisconsin Engineer*. As evidence we offer an article by Fritz Callies on ultrasonic machine tools.

Fritz graduated from the college of Mechanical Engineering last spring and is now a second lieutenant in the Army Corps of Engineers at Fort Monmouth, New Jersey. While at Wisconsin Fritz was active in many fields. He was captain of the University rifle team, a member and leader in the student branch of A.S.M.E., and publicity editor of the Engineer—just to name a few of Fritz's interests.

We think you'll like his article on ultra sonic machine tools. It's a new and fascinating field with almost unlimited applications to precision tool making and engineering.

ALLIN SCHUBRING

In this month's issue we think we've got the answer for anyone who has ever had any trouble getting the proper lighting setup for a picture. Allin Schubring has written a comprehensive article on the topic of lighting for portrait photography in which he outlines and explains some of the most useful and practical methods of lighting.

A look at some of Allin's activities gives a good indication that he knows his subject. He has been a camera addict for several years and is currently building his own workshop and darkroom. Here on campus he is a **Badger** photographer and a member of the camera club. And he studies too. A senior in Mechanical Engineering, Al has been elected to Tau Beta Pi and to Pi Tau Sigma.

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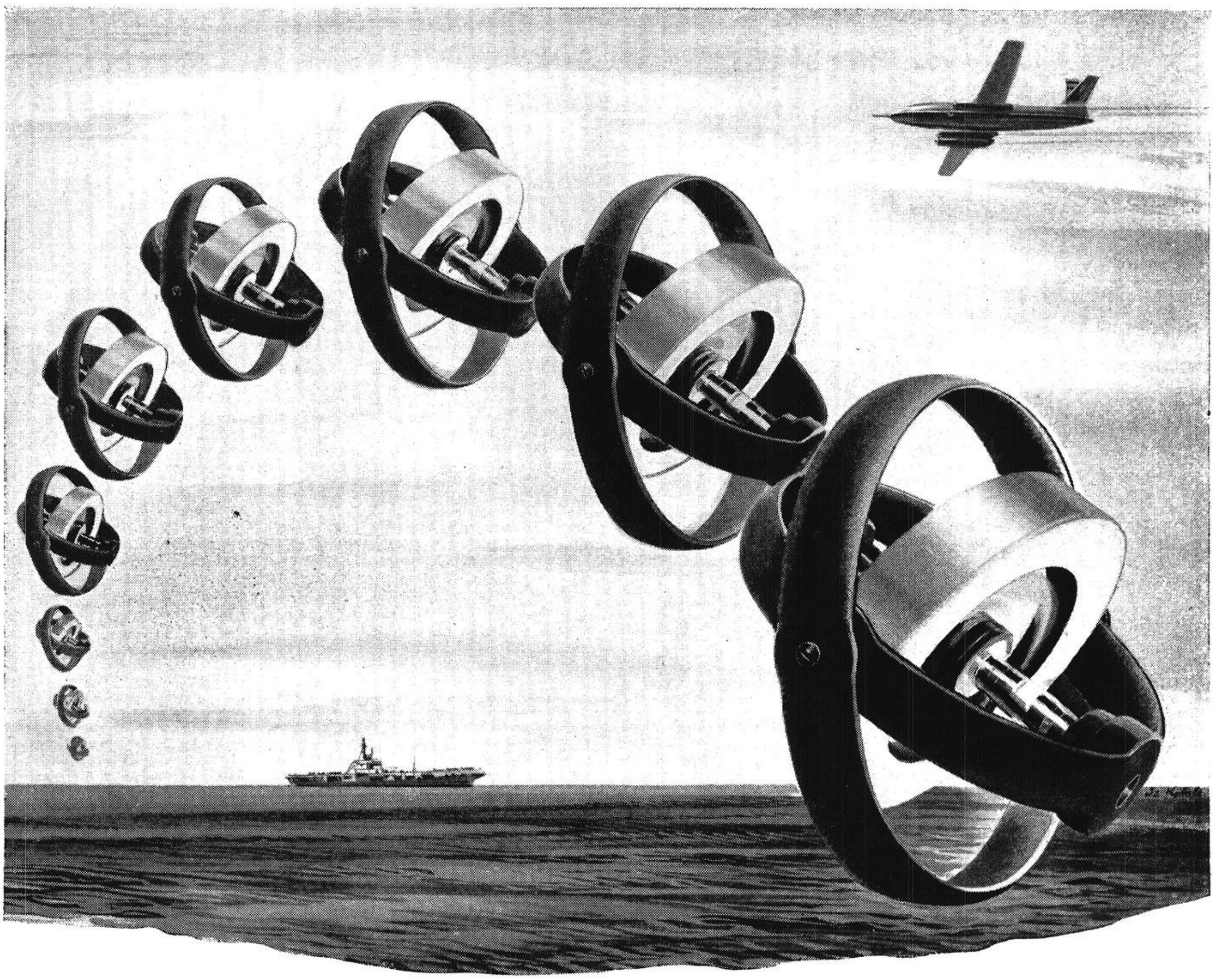
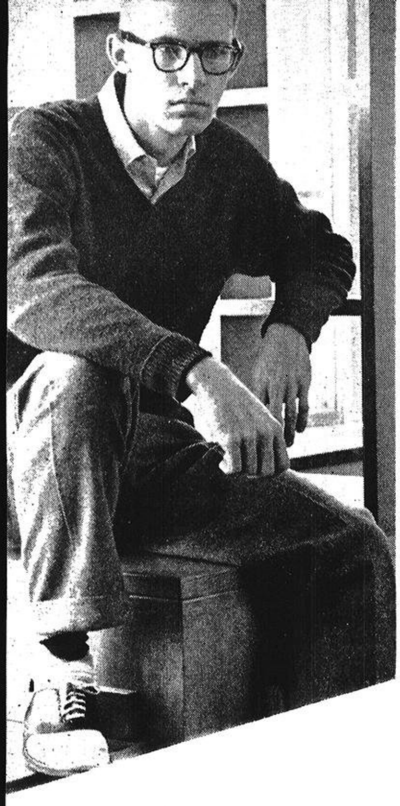




ONE MAN'S OPINION, BUT . . .

THAT DOESN'T MAKE A MAGAZINE

You have before you the first issue of this year's *Wisconsin Engineer.* I might have said this year's bigger and better *Wisconsin Engineer,* but I hesitate at being quite that trite. Offhand we can say one thing about this issue, it actually *is* bigger; to go so far as to say it is better, however, is another thing. Those of us who put this magazine together are not always in the best position to determine that. We, like many other people, are susceptible to mistaking change for progress. To say there have been changes since the last issue would be expressing a not too optimistic, though truthful, observation.

Yes, there have been changes, and, we hope, there has been progress. But after all, that is not for us to determine here and now. You will notice in paging through the magazine that a new feature called "The Camera Eye" has been introduced; Alan Black is now previewing our articles as well as reviewing their authors in his page "In This Issue . . ."; Jim Richards, with his camera, is always looking for candid shots of you and your engineering classmates—as a result, you may someday find your face peering back from our pages. Not to forget a rather important point, there have also been some changes in staff positions since last year. Changes are usually born of new ideas from new minds, so that with changes in personnel, we cannot help but do things differently.

Not everything has changed. Sneedly is back, seemingly whether you like it or not; our joke page, alas the most popular feature, is back with new and repilfered jokes, if they may be called that; the Dean's column is back under a different name, and we could name more such features.

The distinction between change and progress, so far as the staff of this magazine is concerned, must be made largely by you, the reader. It is very easy for us to make changes, but it does no one any good unless we know how these changes are being received. As you may have learned in your speech course, a good and effective speaker depends upon a circular response to keep his audience interested. So too with any magazine. Circular response is analogous to feed-back in a servomechanism. If what we print is unacceptable or uninteresting, that fact should be relayed back automatically so that adjustments in the system can be made. If, on the other hand, something else is very popular, we should know about that too, so that we can concentrate on giving you more like it.

Unfortunately, this circular response for our purposes has not yet become mechanized, and is probably doomed to hand labor for years to come. Our links with you readers are not on the order of automatic controllers, but only spoken or written words. More unfortunately, such replies from our readers are almost nonexistent. Oh, occasionally, when we inadvertently slip in an off-color joke, many engineers ask for more of the same, and our faculty advisor calls for less. That seems to be the only time we get any response from our readers.

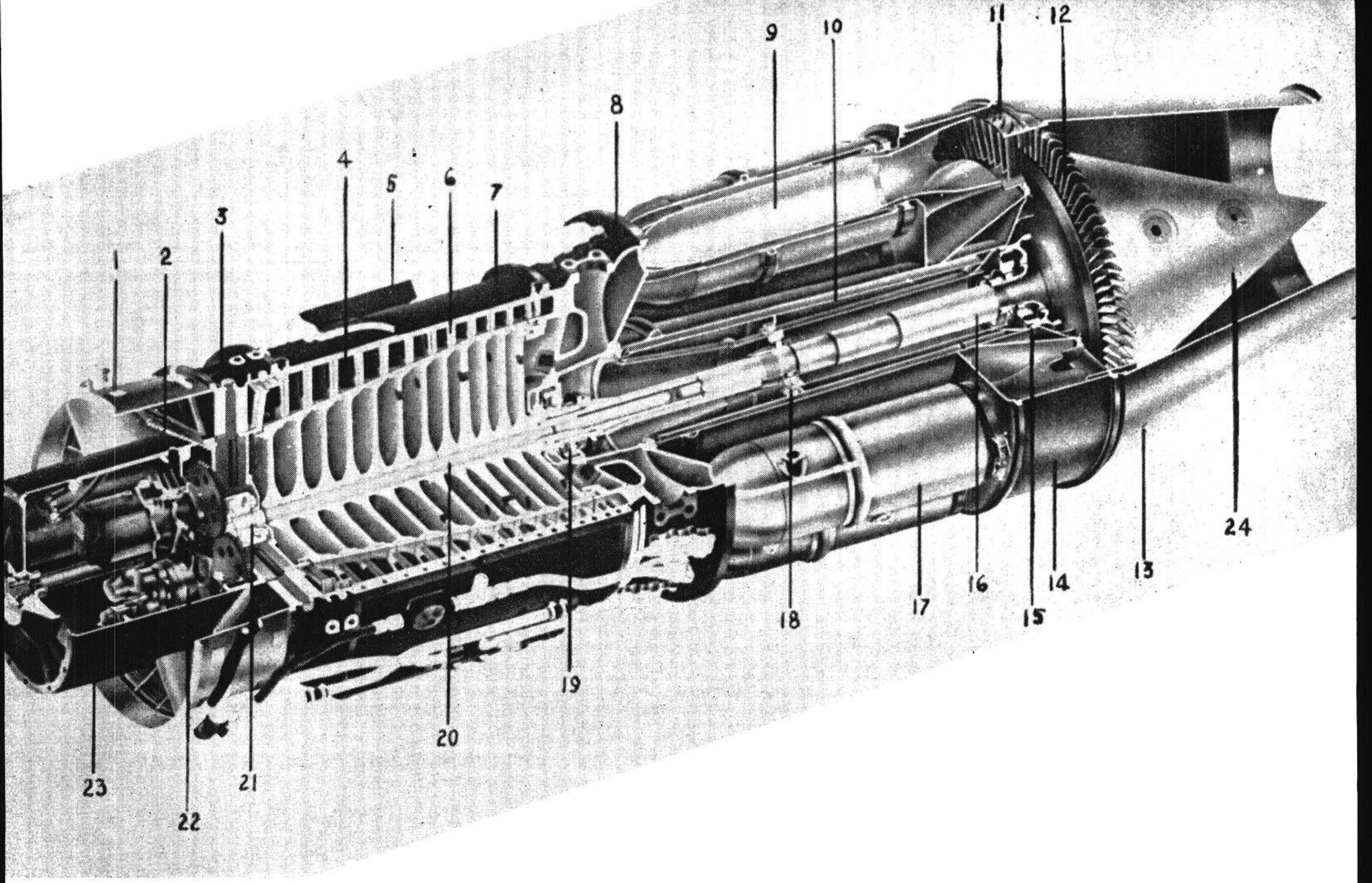
The primary principle upon which all successful journalism must operate is giving the reader what he wants to read. If we know what you like, not only in the way of features, but articles too, we will do our best to give you what you want.

In other words, the *Wisconsin Engineer*—the Student Engineers' Magazine—as it is labelled in the masthead, means just what it says. The magazine doesn't merely belong to those few who write it and put it together, but to all of you engineers on campus. It is you who should determine what goes into the pages. If you don't like the magazine, let us know about it—but tell us, please, why you don't like it. Remember, however, that there is no magazine published which, from cover to cover, appeals to every reader. If you have constructive criticism to offer, write a letter or postcard to the editor and we'll publish your criticism in hope of getting more ideas on your opinion. We can't bring you the kind of magazine you like, if you don't tell anyone what you do like.

Of course, if you think that this magazine is completely fouled up, then we welcome your efforts in helping to unfoul it. In a few weeks there will be interviews for positions on the Engineer, and that is your time to step forward to lend us a hand. We never think that we have a corner on the idea market, so if you think you can be of help, please don't deprive all of your fellow engineers of that help.

We are constantly looking for progress in this magazine—probably because we're caught up in an engineering world. It depends upon you whether we keep changing on a hit-or-miss basis or finally take a step in the right direction. Don't be afraid to speak up, we can't move forward if we all stand back.

—R. A. H.



THE BIG PUSH

Bring yourself up to date on the principles and operation of the turbojet engines.

by Richard Peterson, m'57

Jet propulsion has been known to man as far back as 100 AD when Hero of Alexandria invented the first steam turbine called the Aeolipile. Fireworks such as skyrockets and pin wheels, and weapons, like the bazooka and the German buzzbomb are more recent innovations to the jet propulsion field. Devices such as the bazooka and buzzbomb, though destructive in their use, expedited the development of modern jet propulsion in general, and turbojet engines in particular.

Until immediately after World War I, many ideas were advanced on the possibilities of jet propulsion in aircraft. While most of the work was discarded as impractical, much of the ground work which helped to direct later activity in the field was laid during this time. Research and experimentation from the early thirties until the end of World War II, led to the independent development of the turbojet, in Germany and England during approximately the same time.

Dynamic Principles

The dynamic principles attributed to jet propulsion can be expressed only through a clear understanding of Newton's Second and Third Laws of Motion. The Second Law is stated as follows: The resultant force acting on a body is equal to the product of the mass times the acceleration of the body. Expressed as a formula the law becomes the familiar $F = ma$ or in a form common to engineering practices $F = \frac{W}{G} \frac{v_2 - v_1}{t}$

Where:

F = resultant force (lbs.)

$\frac{W}{G}$ = mass of the body (slugs)

v_2 = final velocity (ft/sec)

v_1 = initial velocity (ft/sec)

t = time of action (sec)

(Continued on page 12)

As an example of this law consider a block weighing 100 lbs. being acted upon by two forces, the applied force of 20# and a total resisting force of 10#. Say the block is accelerated at a rate of 3.22 ft/sec each second.

Then the resultant force $R = \frac{100 \text{ lbs.}}{32.2 \text{ ft/sec}^2} \times 3.22 \text{ ft/sec}$ or 10 lbs.

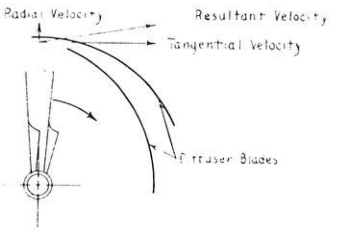
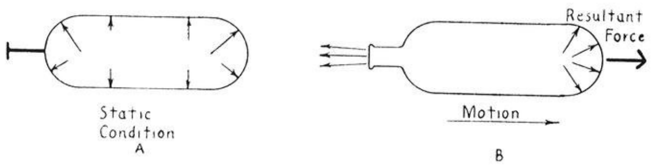


Figure 6

Newton's Third Law can be expressed as follows. For every action (or force) there is an equal and opposite reaction. This law states that forces never exist singly but always in pairs. When a gas is confined in a container under pressure (such as the ignited fuel mixture in the combustion chamber of a turbojet engine) the total force exerted by the gas is equal to the unit pressure (lbs/in^2) times the inside area of the container (in^2). The container exerts an equal and opposite force on the gas. At this point the deflation of a balloon would illustrate the dynamic result when a hole is opened in the container. In Figure 2, part B the neck of the balloon has just been opened.



The balloon exerts a force on the air which accelerates the air through the constricted opening. The resultant force, which is equal and opposite to the accelerating force, causes the balloon to move in the direction shown. It should be impressed that the resultant force is not the reaction to the "push" on the outside air by the escaping air. The reaction to the air accelerating force provides the thrust.

Engine Operation

The fundamental feature of the turbojet engine, which is common to all air stream jet engines, is the mechanism by which thrust is produced. Air is taken from the atmosphere by some device, and heat is added at elevated pressure. The air is then ejected rearward at a velocity greater than the intake velocity.

Essential parts of the aircraft torbojet are shown in Figure 3. They are: 1. accessory assembly, 2. compressor unit, 3. combustion chamber(s) and turbine assembly, 4. the exhaust cone. Air is drawn into the compressor, which raises the pressure several atmospheres. In an average turbojet engine, the amount of air drawn in in a minute would empty a building 100 feet square and 8 feet high. At high air speeds the ramming effect of the air may raise the pressure another atmosphere or so. The result is a pressure ratio (the ratio of the air pressure after the air has passed completely through the compressor, to the pressure of the air as it enters the compressor) ranging from 4–6. A higher ratio may be desired but very little increase in the thermal efficiency of the engine results.

From the compressor the air enters the combustion chamber(s) where a portion of it is mixed with fuel. Ignition of the fuel-air mixture is accomplished. After combustion is completed the ignition system is cut off and the burning process is maintained by the flame in the combustion chamber. Fuel under a high degree of atomization is sprayed into the combustion chamber in a continuous stream. The mixing ratio at the time of combustion is about 14 parts of air to 1 part of fuel. Combustion temperatures range up to about 3500° F. A large part of the air from the compressor is used to cool the gases to a temperature at which the turbine can function safely. This temperature is approximately 1200–2500°F. Substantial gains in thrust can be made in turbojets by increasing both the air flow through the engine and turbine-inlet gas temperature.

The release of tremendous heat energy of the fuel causes the air to expand. However, since the turbine end of the combustion chamber is open, no compression occurs as in the closed cylinder of an automobile engine.

Combustion chambers are divided into two classifications: the through-flow type and the counter-flow type. These classifications are derived from the way in which the air flows through the chamber. In the through-flow type, as the name implies, the gases flow straight through the combustion chambers to the turbine. Most late model engines, such as the J–47 in Figure 3, incorporate this type. In the through-flow chamber, the direction of the gases is completely reversed twice before the gases enter the turbine.

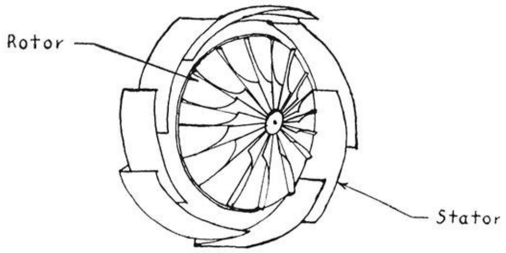
Because of their rapid expansion, the heated gases are accelerated rapidly and enter the guide vanes in the stator (stationary) ring of the turbine at high velocity. The guide vanes direct the flow of gases so that they strike the blades of the turbine rotor at the proper angle. Here the kinetic energy of the gases is transformed into mechanical energy to rotate the main shaft. Turbine speeds vary from 8000 rpm to 16000 rpm at full speed depending upon the design of the unit.

Approximately 100 hp must be generated at the turbine for each pound of air delivered per second by the compressor. On the average, one pound of air per second will give 50 lbs. of thrust. Thus, when you hear of a turbojet engine capable of delivering 2000 lbs. of thrust, the turbine must deliver approximately 4000 hp to the compressor. The J–47 in the F–86 Sabre jet produces slightly less than 6000 lbs. of thrust!!

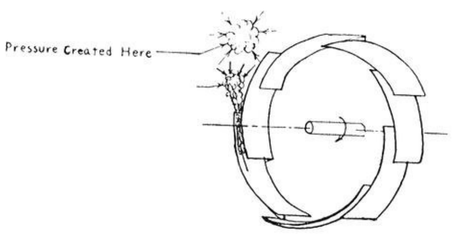
From the turbine the gases are exhausted through the cone at tremendously high speeds. The velocity of the jet stream in a turbojet depends largely upon the turbine inlet temperature, the jet velocity increasing with temperature. In modern engines, jet velocities range up to 1200 mph. The exhaust assembly functions to reduce turbulence set up by the turbine due to rotation of the turbine wheel. Figure 3 is a diagram illustrating engine operation.

Turbojet Components

There are two types of compressors used in turbojet engines. They are similar in that both consist of a stator, a rotor and a casing. The first practical jet engine had a centrifigal type compressor. (See Figure 4) In this type, as the rotor revolves air is "grasped" into the blades near the hub where the blades curve. Centrifugal action forces the air out to the rim of the stator. The tangential velocity at the rim is much greater than at the hub, thus the air is greatly accelerated before it finally enters the diffuser blades at high velocities. Here you have the single entry rotor. The whole process, however, could be duplicated on the other side of the rotor with an additional set of blades in which case you would have the double entry rotor.



The stator consists of diffuser blades overlapping in a circumferential pattern as shown in Figure 4. Air leaving the rotor rim with a high resultant velocity enters the diffuser blades. (See Figure 5) By the process of diffusion into a larger space, the air velocity decreases but pressure increases and the compressed air flows through the casing to the combustion chamber.

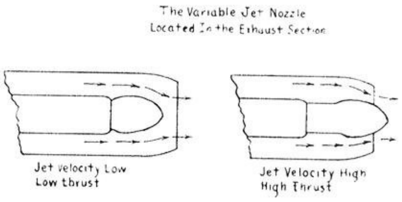


It is evident that to generate high linear velocities in the rotor type compressor requires a large rotor radius, consequently a large compressor. Because modern aircraft design required a compact propulsion system the centrifugal compressor was replaced by the axial-flow type compressor which is used in the greater percentage of jet aircraft today.

As the name axial-flow implies, the air is forced along the axis of rotation similar to the way a fan forces air across a room. Like the propellor of the fan, the rotor has airfoil shaped blades, pitched at a definite angle, and extending radially from a central axis. (See Figure 3, no. 4) As the rotor is turned the blades impart energy of motion to the air between them, the direction of motion being the resultant of an axial component and a tangential component both imparted by the rotor blade. This force resolution is shown in Figure 6. The pressure developed by a single stage, such as the one described above, is approximately 5–7 psi with a pressure ratio of 1.5 : 1.

In practice the desired final ratio is obtained by increasing the number of stages and so forming a multistage compressor. Most modern turbojet engines employ from 6–14 stages and are designed so that a row of fixed stator blades alternate with the rotor blades. The function of the stator blades is to redirect the air leaving one stage so that it might enter the next stage at the proper angle of attack. (See Figure 3, no. 6)

Engines using axial-flow compressors must have stability of flow from the time of air intake until the final exhaust. Therefore, to reduce some of the turbulence and assist in maintaining stability, a variable jet nozzle is used. One such arrangement is shown in Figure 7. At slow speeds the "bullet" is in the full forward position and low thrust results. As the engine speed increases the bullet moves slowly to the rear decreasing the area but increasing the jet velocity. Such would be the situation at take-off.



Combustion chambers in jet engines are of two types, the "individual" and the "annular" combustion chambers.

The individual system is so arranged that air enters each individual chamber (the chambers are usually in a ring) through air-adapters. These adapters carry fuel nozzles, domes of the combustion chambers and in certain chambers, spark plugs. Each chamber has an outer casing and a flame tube usually made of stabilized stainless steel. Air is "bled" from the casing into the flame tube through holes which supply air for combustion and for dilution to a lower temperature at the tube outlet. (See Figure 3, no. 9)

The annular type combustion chamber is used in many engines designed to use axial-flow compressors. Its use permits building an engine of very small diameters. Instead of individual combustion chambers, the compressed air is introduced into an annular space formed by an inner, cylindrical sleeve around the turbine shaft and an outer sleeve concentric to the inner sleeve.

Turbines in jet engines are classified (as far as description is concerned) the same as compressors. For

(Continued on page 62)

Illumination Engineering—Hobby Scale

by Allin W. Schubring, m'56

At one time or another, each of you has purchased portraits of yourself or members of your family from a commercial studio. Invariably, when buying a portrait you marvel at what a good photographer can do with a portrait, or else you complain about the high prices a commercial studio charges. In any good commercial portrait studio, the emphasis is placed on quality—the good and flattering appearance of the subject and background. Thus the photographer must demand payments in line with the quality of the work.

One of the most important phases of portrait photography is lighting. Even the camera itself can take a back seat to the lighting arrangement. With the proper lighting portraits taken with an old type box camera can be produced that rival those taken with the most expensive studio camera.

Anyone with a little experience can take portraits. At first you will probably sacrifice both quality and quantity for the sake of economy, but after experimenting with different lighting schemes, you should be able to develop interesting portraits.

Every photographer is capable of taking portraits at any time of the day or night, and practically in any location regardless of existing light conditions, by the use of any or several combinations of aids such as floodlights, electronic speedlights (strobe units), flashbulbs, spotlights, very sensitive films, and high speed lenses.

The secret of good lighting is to understand the basic facts of lighting. They are *direction, quality,* and

Fig. 4.—Combination Lighting.

contrast. No matter what lighting scheme is used, the basic problem of lighting remains the same.

In figures 1–4, the four lighting arrangements illustrate the basic methods of directional lighting. Each

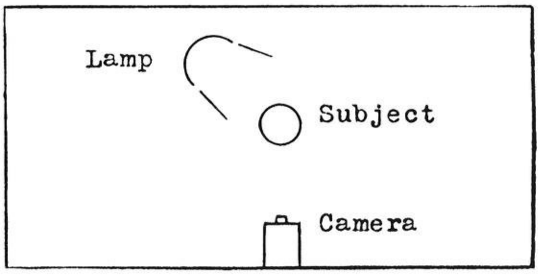


Fig. 5.—Back Lighting.

arrangement has a different effect upon the model Isabel Ericksen, a Wisconsin co-ed. In figure 1 the front light produces an even illumination and few shadows on her face, this effect is called "flat" lighting. In figure 2 the 45-degree side-light eliminates the "flat" effect and creates shadows which add depth to the picture. The 90-degree side-lighting in figure 3 skims the surface of the model and emphasizes texture as well as depth. In lighting schemes this light is usually moved back as in figure 4 to combine the effects of the 90-degree side-light and the back-light. The back-lighting in figure 5 is much different than the others because it produces a silhouette. This type of lighting is only used to create a dramatic effect. Every floodlight except the front light is elevated above the model's head.

The quality of lighting is the degree of concentration or diffusion of the light cast

Fig. 1.

Fig. 2.

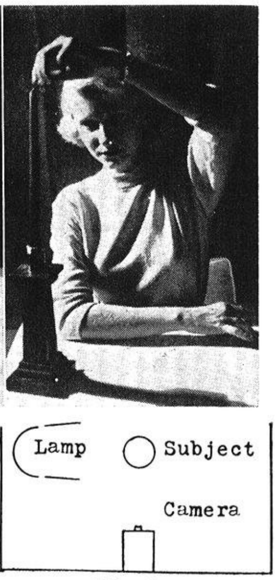


Fig. 3.

on the subject. Flashbulbs and electronic speedlights used as single lights produce concentrated black shadows as in figure 6. Hard directional lighting produces strong-black shadows that are undesirable in portrait work. Soft lighting (shades of gray) is more desirable and is obtained by using a flood light. Softer lighting as shown in figure 7 is produced by scattering the light from the source by a diffuser; the light is still somewhat

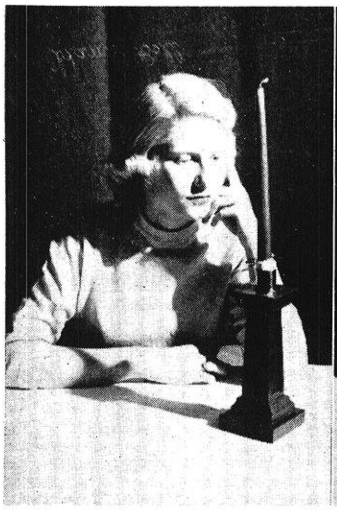


Fig. 6.—Hard Lighting.

Fig. 7.—Soft Lighting.

directional. Highly diffused bounce light (light reflected from the ceiling) is illustrated in figure 8. It is very soft and creates few shadows.

The contrast in portraits is the scale of tones ranging from dark shadows to bright highlights. In figure 9 the shadows are very dark and the detail in them is lost; the result is high contrast. If an auxiliary or fill-in light is used to brighten the shadows as in figure 10, the contrast is reduced, but the shadows still remain on the subject expressing depth.

Although the photographer can use one floodlight, it is not recommended. However, if only one light is

Fig. 8.—Bounce Light.

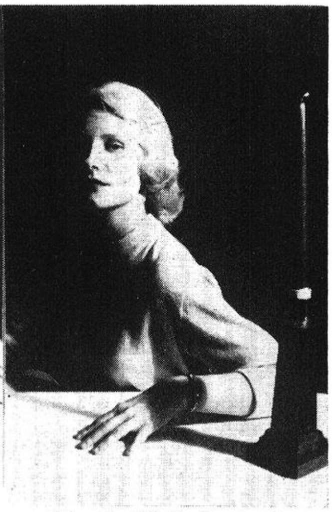


Fig. 9.—High Contrast.

available, these three types of lighting can be used; 1) the "flat" lighting of figure 1; 2) the soft-diffused lighting of figure 7; 3) an elevated 90-degree side-light. The third method is used in figure 11 and it

Fig. 10.—Low Contrast.

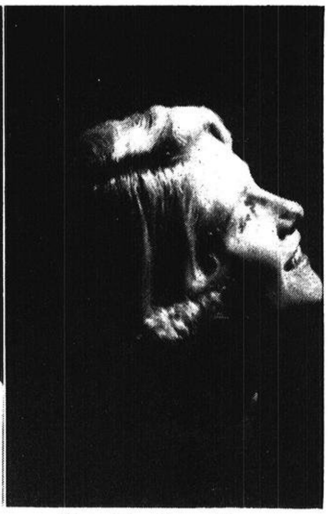


Fig. 11.—Low Key.

creates a low key portrait (picture filled with blacks and dark grays). This type of portrait illustrates the dramatic quality of low-key photographs.

Often fill-in floods are used to produce better portraits. There are many combinations of floods which produce different effects. In figure 12 the combination of the two floods produces the effect of the two-main directional lights as shown in figures 1 and 2 (hereafter the floodlights from figures 1 and 2 are designated as lights 1 and 2). The full illumination from the front in figure 1 decreases the deep and dark shadows in figure 2 so that the shadows become lighter and more transparent. There is an even distribution of light over the model's face. However, there are just enough shadows to create depth in the portrait.

Figure 13 shows the result of using light 1 and a 45-degree back-light together. Again the face of the model is fully illuminated by light 1. The addition of the 45-degree side-light emphasizes the characteristic highlights of the hair. There is a distinct difference between the lighting effects of figures 12 and 13. It is quite apparent that the latter is the better portrait because there is less texture to the face and sweater, therefore softening the facial features. The lights of

(Continued on page 54)

Fig. 12.—Two Floodlights.

Fig. 13.—Two Floodlights.

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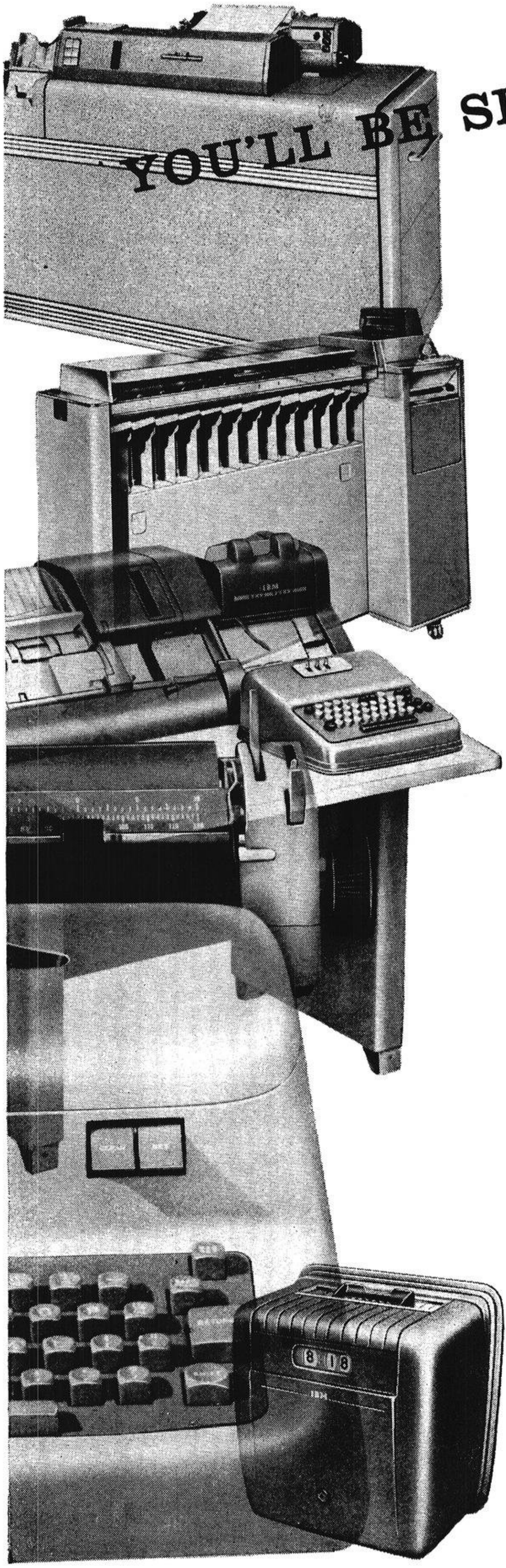

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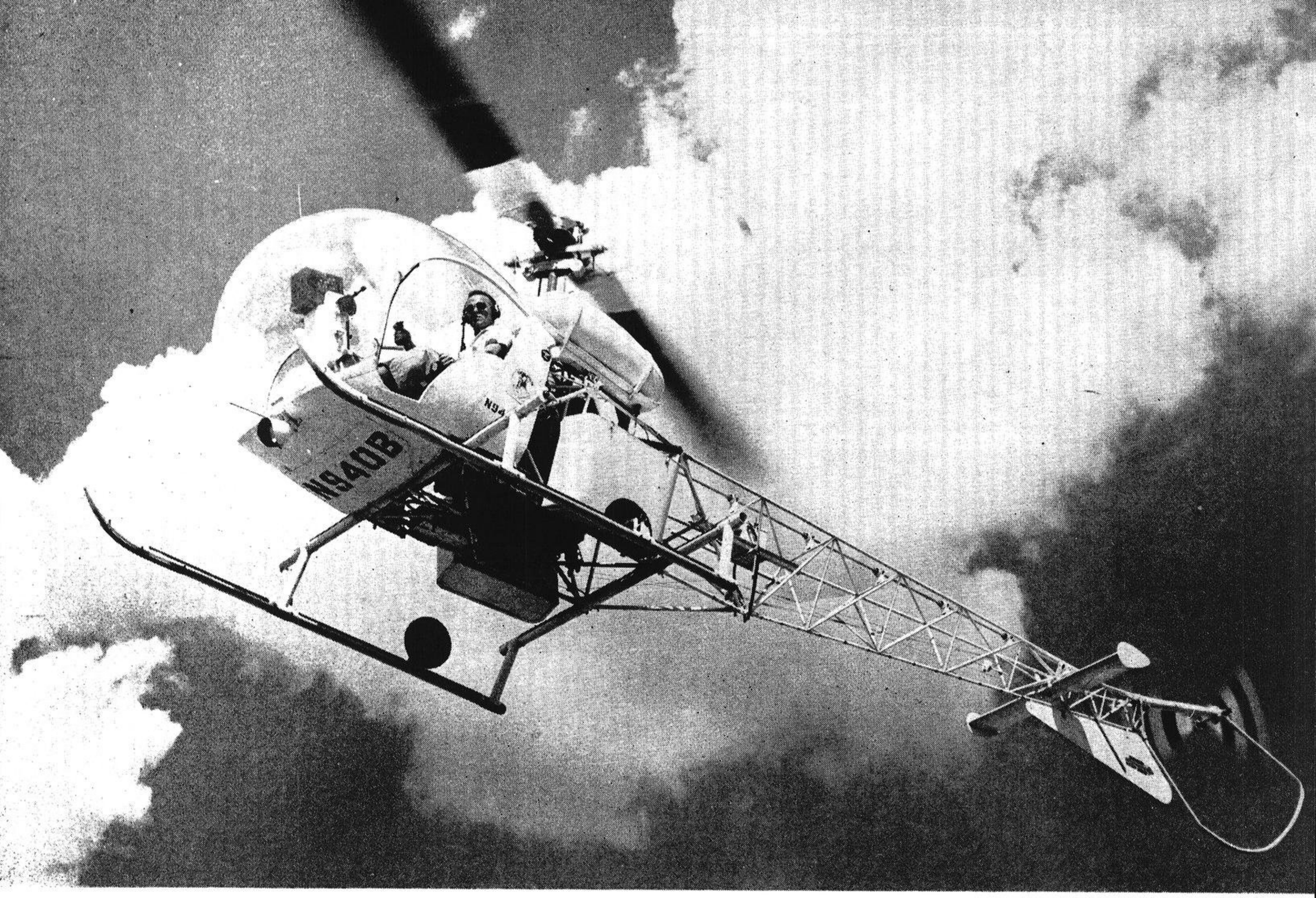


Bell Model 47 G.—Courtesy of Bell Aircraft Corporation

WHIRLING WINGS

by J. G. Bollinger, m'57

The helicopter, old in conception, yet new in accomplishment is one of the most interesting developments in the history of aircraft. The idea of vertical flight was present in the creative genius of Archimedes during the second century. Later in the fifteenth century, the Master Leonardo DaVinci conceived of a machine that could ascend vertically into the atmosphere. Da Vinci's inventiveness produced a model helicopter driven by a spring mechanism operating in the manner of modern clockwork. But, it was Igor Sikorsky who in the twentieth century, demonstrated the first "really modern helicopter."

The fascination of helicopter operation and the realization of the commercial potential which the helicopter possesses in our present economy has lead aircraft corporations to put emphasis on helicopter research and production. From an engineering standpoint, the helicopter can be adapted to an endless number of operations with almost no theoretical limitation on weight or size.

To understand the operation of the helicopter, it is essential first to review a few of the fundamental principles of flight. Although the helicopter is capable of many maneuvers impossible to perform in conventional aircraft, basically it flies for the same reason, the rapid passing of an air foil or wing through the air produces lift to overcome the gravitational forces of the earth.

The four major forces acting on any aircraft are lift, drag, thrust, and gravity. Lift, as has already been mentioned, is that upward force produced by a stream of air moving past an airfoil. It is created by the differential in air pressure above and below the wing. The air passing across the top surface of the wing, which has the greater curvature, travels a greater distance than the air on the lower side of the wing. However, it must reach the trailing edge at the same time. Consequently, the air on the top surface travels faster. In accordance with Bernoulli's Theorem the fast moving air creates an area of reduced pressure and the resultant force acts upward. Associated with the lifting action of an airfoil, the tilted lower surface of the wing forces air downward creating an equal and opposite force in an upward direction on the wing.

The total retarding force acting on an airfoil is known as drag. It is the resistance offered to forward motion of the body through the air. Thrust is the propelling force which overcomes drag and moves the body forward through the air.

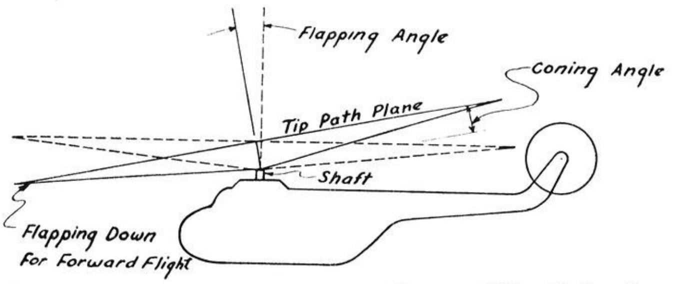
These basic factors which contribute to the flight of conventional aircraft apply equally well to a rotary winged aircraft. Rather than pulling or pushing the aircraft through the air to create lift, the helicopter accomplishes the very same thing by rotating its airfoils through the air about a central shaft, the power being derived from an engine. Such motion produces lift without any horizontal movement of the aircraft.

The airfoil adopted at present by many helicopter designers incorporates a double convex airfoil having equal and symmetrical curves or cambers above and below the chord or center line passing from the center of the leading edge to the center of the trailing edge. Even though the airfoil is symmetrical, when it is inclined to the airstream the path of air travel over the top of the airfoil is longer than the path under the airfoil. The adoption of this type of airfoil was brought about by three contributing factors. Firstly, this design was found to deliver the best lift-drag ratio for the full range of velocities from root to tip. Secondly, there is no change in the position of the aerodynamic center with change in angle of attack. Thirdly, a symmetrical airfoil is the easiest to construct and most economical to produce.

In addition to lift, centrifugal force is another major factor influencing the action of the rotor blades. The centrifugal force acting on a typical blade may build up to as high as 21,000 pounds at 190 rotor rpm. Centrifugal force is a limiting factor in the "flapping action" or vertical action of the blade about its horizontal hinge, and in the "hunting action" or movement of the blade about its vertical hinge. Torque created by the engine and profile drag are also forces which act on the rotor blades. Another very important factor affecting lift and directional change is that of pitch variation. Collective pitch change refers to changing all the blades simultaneously and to the same degree. Cyclic pitch change means that the pitch of each blade is changed individually during each cycle of rotation.

The control of a helicopter rests in the movement of the rotorblades themselves. "Coning" is the average angle made by the blades in their flapping motion and is relatively constant, increasing slightly with lower rotor speeds, higher gross weight and maneuvering position load factors. The "Flapping angle" is the departure of the cone-tip from its relatively horizontal hovering position (along the tip path plane).

Actually there are only two types of flight in the helicopter. In hovering flight where airspeed is zero, lift exactly equals gravity. The tip path plane is



—Courtesy of Sikorski Aircraft

parallel to the earth's surface and all three blades carry the same collective pitch and have the same angle of attack. There is no movement of either the vertical or horizontal hinges. In directional flight the tip path plane tilts in the direction of desired flight. The lift component, which always acts perpendicular to the tip path plane, tilts with it, adding a forward thrust component.

Thus, to create forward or backward motion the pilot moves the cyclic control stick in the direction he wishes to go, obtaining a forward or rearward thrust with the tipping of the rotor disc. Lateral control or tipping of the rotor to either side provides a means of banking the helicopter in a turn, flying sideways, hovering in a cross wind, or simply trimming the helicopter.

The torque necessary to overcome the moments of drag on the rotating blades is balanced by a single shaft-driven rotor on the tail of the ship. The tail rotor, driven by means of a geared take-off, connecting drive shaft and gear box, also offers precise directional control in flight.

Collective pitch controls the altitude of the helicopter, vertical ascent, descent, and trim. As the collective pitch is changed, the power requirement to maintain a constant rotor rpm is also changed. To facilitate a simultaneous change of power supplied and pitch, a motor-cycle type throttle is normally incorporated in, and connected with the collective pitch control.

Transitional lift is the changing relationship between power required and power available, developed upon the introduction of forward speed. As the helicopter moves through the air with forward speed, more air moves past the airfoil to produce lift, thereby requiring less power from the engine. At a substantial value of forward speed the power required is considerably less than power available, thus there is an excess of power for ascent. This excess power makes possible take-off and climb in a heavily loaded or underpowered helicopter.

An additional factor which aids take-off is the cushioning action of the ground on a mass of air as it is moved downward by the rotor to produce lift. Such ground reaction reduces power required to hover. Correspondingly, there is more power available for lifting, climbing, and maneuvering. This "ground cushion" effect is noticeable up to a height equal to one diameter of the rotor.

(Continued on page 50)

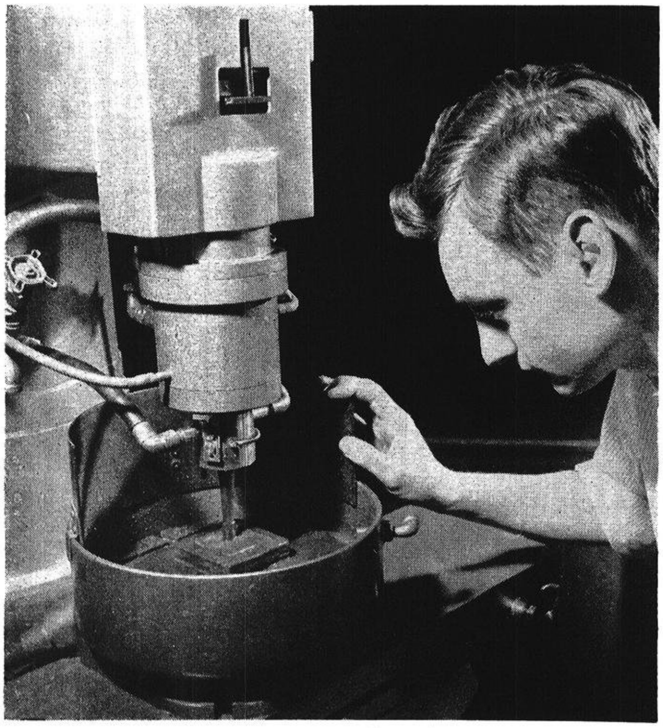
MAGNETOSTRICTION....
OR ULTRASONIC MACHINING

by 2d Lt. Fritz Callies, m'55

As modern technology develops new products, new manufacturing methods to make these products must be conceived. What process could be used to chisel an intricate design .025 in. deep in a carbide stamp? How can you cut a .004 in. slot in a stainless steel hydraulic valve, or drill holes one mil in diameter at two mil spacing in glass? How do you go about sinking a blanking die in tungsten carbide to an accuracy of .0003 in.? The limitations of conventional methods of casting, forging, milling, or drilling severely restrict operations such as these.

But these and other problems have now been solved by the application of a new process known as "ultrasonics" [1], which makes formerly impossible tasks look ridiculously easy. For instance, that carbide stamp is being produced by the new ultrasonic machine tool in thirty seconds. Where production of one good hydraulic-valve slot had been considered a fortunate day's work with milling cutter and jeweler's saw, one is now cut in ten minutes using a piece of .004 in. shim stock as the cutting tool. And accurate dies of all kinds are made quickly and cheaply, with a ten micro-inch surface finish.

[1] Worscheck, G. A., "Industrial Use of Ultransonics," *The Wisconsin Engineer*, January 1954, p. 20.



—Photo Courtesy Curtiss–Wright

Fig. 1.

The basis of this amazing new tool is a property known as "magnetostriction" [2]. This means simply the expansion and contraction which ferromagnetic substances undergo when placed in an alternating magnetic field. It is very similar to the reaction of the non-metallic "pizoelectric" materials such as quartz crystals and certain ceramics like barium titanate, Changing size with the rapidly alternating magnetic field, the magnetostrictive metal vibrates at a frequency beyond the range of human ears—thus it is termed an "ultrasonic" process.

Nickel, which exhibits the strongest magnetostrictive effects, is usually used in the ultrasonic tool. Its vibrations are conducted into a resonating, conically shaped tool holder. The end of this cone can be given a displacement of as much as ± .002 in. While this is not a large elongation, the fact that it is occurring about 25,000 cps produces terrific accelerations, often exceeding 150,000 times the force of gravity. Power output at the cutting tool may range from 500 to 3000 watts of sonic energy.

You can put your finger on the tip of this tool and feel nothing, but it will cut through the hardest materials known to man like a hot knife through golden Wisconsin butter. It doesn't hurt your finger because flesh is resilient enough to absorb the vibration, but the repeated blows quickly carve an impression in hard substances.

In use, a punch of mild steel or even copper, shaped in the image of the desired cut, is attached to the end of the vibrating tool holder. An abrasive suspended in water flows between the tool and the workpiece, and the tool imparts its acceleration to the abrasive particles. As these particles are driven against the work, eah chips off a small piece of material, producing a hole the exact shape of the tool.

No finishing or polishing is required after machining, for the ultrasonic tool leaves an exceptionally smooth

[2] Traeder, H. F., "Magnetostriction," *The Wisconsin Engineer*, May 1949, p. 7.

surface. Furthermore, the physical, chemical, electrical, and metallurgical properties of the piece are unchanged, for there is no heat involved. A small downward thrust is the only stress on the work, and the piece usually does not even have to be clamped in place. Small pieces which might be washed away by the flow of the abrasive are often cemented onto a piece of glass in order to have more mass. Glass has the advantage of having good parallel surfaces for locating the work. Furthermore, since glass is cut very rapidly by the ultrasonic tool, the change in cutting rate gives a good indication of when the workpiece is cut through.

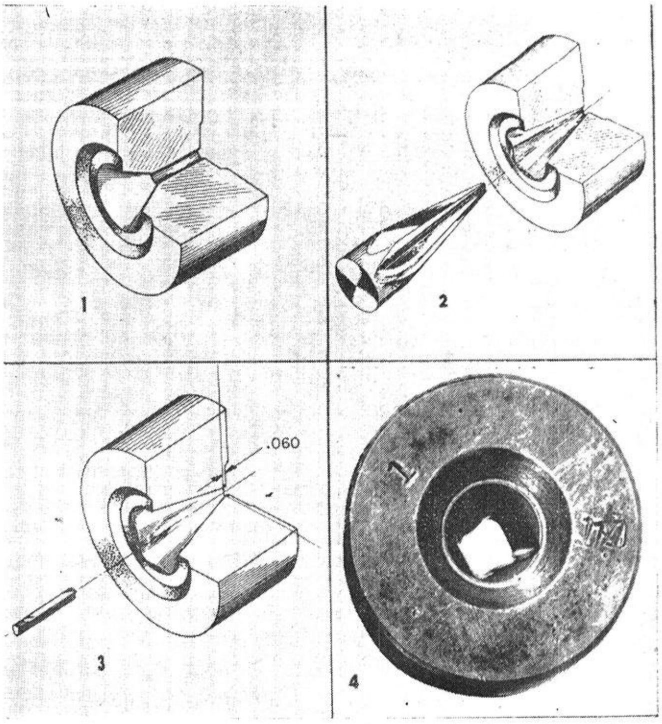
Because of the high accelerations involved at the tool tip of this "sound-propelled cookie-cutter", one of the most important considerations is the proper design of the cones which hold the tools. The combination of cone and tool should be of such a length that it will resonate within the frequency range of the electronic driver, and of such a mass that it will not overload the transducer and reduce displacement at the bottom of the cone to less than .0006 in. There must be good metal to metal contact between the cone and the tool tip in order to insure a smooth flow of energy between the two pieces. Silver soldering is usually the method used to attach the tools to the cone, since the stresses tending to force the tool cone apart from the tool may reach over 40,000 psi. The tool tip should be as short as possible—never longer than 1¼ in., for the longer the tool the higher the stresses between it and the cone. If cuts deeper than 1¼ in. are required, the tool should overhang the cone by about .010 in. to provide an undercut.

The tool itself can be of cold rolled steel, or other material which can easily be shaped to the male (or female) counterpart of the desired cavity (or boss). It should not be tapered, or it will change size as it wears. Tool wear occurs only on the face, and varies from one part in two hundred when cutting glass, to nearly equal wear on tool and on work when cutting tungsten carbide.

The amplitude of the tool's vertical motions depends on the job to be done, but must be at least great enough to allow the abrasive to flow between the tool and the work.

A wide range of abrasive sizes is available for different requirements, ranging from 180 grit (.002 in.) to 800 grit (.00014 in.) in boron carbide, silicon carbide, or aluminum oxide. The larger sizes give a faster cutting rate, but poorer accuracy. Concentration of the abrasive and water mixture is important: a thick "slurry" will not distribute itself well under a large tool, but with a small tool it will cut faster than a thin mixture. A continuous supply of abrasive must be maintained at the work surface; this is accomplished by a pump which recirculates the slurry.

The cutting rate is proportional not only to the grit size, but also to the hardness and brittleness of the material being cut. For instance, glass can be cut at a rate of .250 in. per minute, tool steel at only .015 in. per minute.



—Courtesy Raytheon Corporation

Fig. 2.

Ultrasonic cutting, boring, and shaping is not meant for heavy stock-removal, and every opportunity should be taken to keep the stock-removal factor to a minimum. When working on carbide this can best be accomplished by starting with a workpiece that has been cored approximately .015 in. below the finished size, while tool steel should be roughed out a like amount undersize by conventional methods before hardening.

There are currently three manufacturers of ultrasonic machines in the United States: Raytheon Manufacturing Co. of Waltham, Mass., Curtiss-Wright Corp. at Caldwell, N. J., and the Cavitron Equipment Corp. of Long Island.

Let us illustrate the procedure for planning and doing a job on the Raytheon Ultrasonic Machine Tool by outlining the steps necessary from start to finish. Assume that we wish to cut a ½ in. diameter hole through a 3/16 in. piece of solid carbide. Since carbide cuts at a comparatively slow rate (.015 in. per minute), it is desirable to operate at maximum power. In order to operate at full power the tool tip must be kept as short as possible: a length of ⅝ in. is a good compromise between economy and the ability of the soldered joint to stand up.

If only one tool is to be used for the complete job, it must have two diameters, one for roughing and one for finishing. In order to remove as little stock as possible, we would use a trepanning, or hollow, tool. The dimensions of this tool would be as follows: overall length ⅝ in. with a 7/16 in. diameter, ½ in. deep hole drilled in the center; bottom "roughing" diameter ¼

(Continued on page 22)

Magnetostriction

(Continued from page 21)

in. long; upper "finishing" diameter ⅜ in. long. The diameters themselves will depend on the size of abrasive used.

Because we want the maximum cutting rate, we would use a cone which will give the greatest amplitude. In this case, an exponentially tapered cone with 2½ in. diameter at the top and ½ in. diameter at the bottom would fulfill the requirements.

We are now ready to determine the frequency at which the transducer with tool cone and tip resonates. The transducer with no cone attached will resonate at 25,000 cps, but with cone and tool attached it will seldom resonate at this exact frequency. Consequently, the electronic driver is designed to cover a frequency range from approximately 23,500 cps up to 26,500 cps.

There are two methods of determining the frequency at which the transducer and tool cone resonate: tuning to a peak reading of the indicator on the electronic driver, or tuning to the maximum agitation noise obtained when the tool tip is immersed in water. This latter method is based on the fact that maximum agitation of the water occurs at maximum amplitude of the cone, which in turn occurs only when the cone is at resonance. (Immersing the tool cone in water serves the additional purpose of subjecting the brazed joint to the same stresses it will be exposed to in actual operation.) The tuning should be very sharp; if it is not sharp or seems to occur at several positions on the dial it is a positive indication that either the soldered joint is faulty or that the tool or cone is cracked.

We now place the workpiece into position in the slurry tray. There are no forces which tend to shift the position of the work during the cutting operation, except the flow of abrasive. Since in this case the piece is relatively large, clamping will not be necessary. With the abrasive flowing and directed onto the tool tip, the force mechanism is set to produce a pressure of approximately ten psi between the tool tip and the workpiece. This pressure has been found to work well for most conditions but can easily be varied to test different settings while the machine is running.

For the roughing operation a 320 grit Norbide will be used, mixed in the ratio of one part abrasive to 1¼ parts water by weight. The size of the particles of 320 grit abrasive is .0012 in. If the roughing tool is .490 in. in diameter, it will produce a hole of .489 in. diameter at the bottom and .493. in. at the top. The taper is the result of oversizing at the top because of the particle size of the abrasive, and undersizing at the bottom because of wear on the tool. This is the reason that more than one tool is used to obtain straight holes.

We are now ready for the finishing operation. The slurry is changed to a 600 grit Norbide, which has a particle size of .0004 in. When used with a .4992 in. diameter finishing tool, it will produce a hole .5000 in. in diameter, ± .0002 in. The time required to complete the job is approximately 20 minutes, and we have produced a hole .5000 in. in diameter, ± .0002 in. The taper is also within this tolerance, and the surface finish is between 10 and 15 micro-inches.

The procedure for cutting through carbide thicker than 3/16 in. is different only in that a two-diameter tool is no longer used. Instead, different tools for roughing and finishing must be used. In order to cut a ½ in. diameter hole through a ½ in. thickness in carbide, two tool tips an inch long are required. This length is necessary because the tool wear encountered when cutting carbide approaches a one to one ratio—approximately 7/16 in. will be worn from the end of the tool while cutting through ½ in. of carbide.

Costs can in many cases be cut drastically through the use of ultrasonic machining. The first application for which the Raytheon machine was used was reworking molds for the ceramic buttons which go into mercury switches. Originally these intricate molds, (Fig. 2), were made from a hobbing steel and required maintenance of extremely close tolerances. These dies cost $345.00 per set and produced approximately 125,000 pieces before they had to be discarded. Using the Raytheon Ultrasonic Machine Tool, it was possible to recut the worn dies at a cost of $75.00 per set and bring them back to their original accuracy.This recutting resulted in a saving of $13,500.00 in the first year of operation. The success in reworking these dies led the company to use the ultrasonic machine for making the die of tungsten carbide. These dies cost $345.00 per set—the same as those made of hobbing steel by conventional method. But the carbide dies can produce two million pieces without reworking, and can be reworked when necessary for only $75.00.

Transistors, which are rapidly replacing vacuum tubes in consumer as well as military electronic applications, have created unusual production problems. Cutting the tiny germanium wafers with diamond saws was a severe production bottleneck, but the slicing, dicing, or multiple sawing of germanium, silicon, and other materials used in transistor applications is readily accomplished with the ultrasonic tool. One firm using the new machine reports it is about sixty times faster than their previous method, resulting in appreciable savings.

Another good illustration of the economy of the ultrasonic machine tool is in the manufacture of shaped-carbide wire-drawing dies. The shaped wire that goes into trolley cables is an example of this. It has been found that wires of this special shape, when stranded together into a cable, have the maximum obtainable surface contact with each other—essential not only for strength, but also for electrical conductivity.

Formerly there had been only one method of producing carbide wire-drawing dies: ripping and polishing. In this method a standard cored nib is opened up on a ripping machine which uses boron carbide as an abrasive. The rough shape is then finished and polished by

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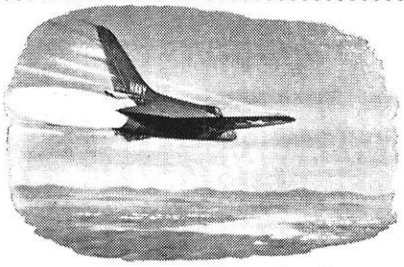
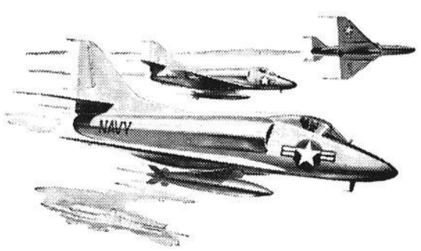
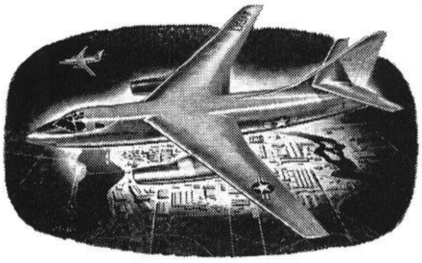


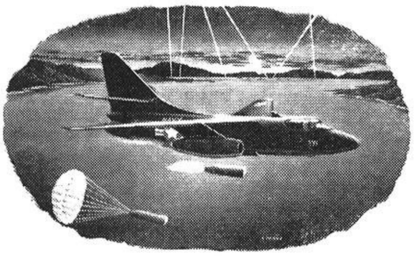
F4D, "SKYRAY"— only carrier plane to hold official world's speed record



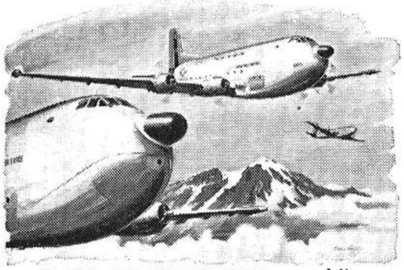
A4D, "SKYHAWK"— smallest, lightest atom-bomb carrier



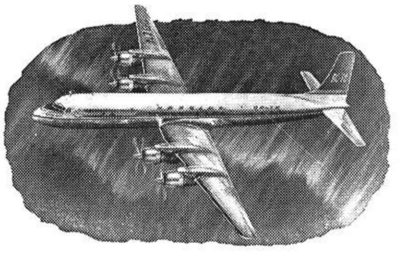
RB-66 — speedy, versatile jet bomber



A3D, "SKYWARRIOR"— largest carrier-based bomber



C-124, "GLOBEMASTER"— world's largest production transport



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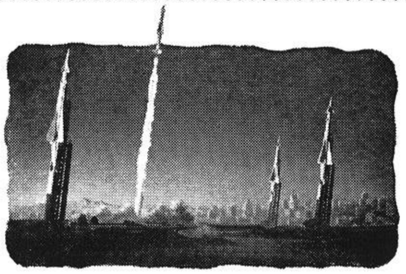
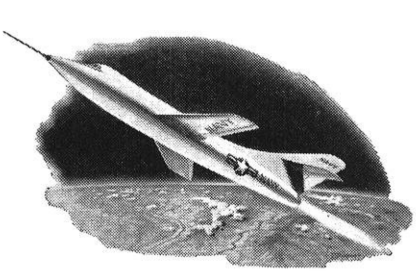


"NIKE"— supersonic missile selected to protect our cities



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SCIENCE HIGHLIGHTS

edited by Dick Tomlin, Ch'56

BATTERY UNIT CONVERTS ATOMIC OR LIGHT RADIATION TO ELECTRICITY

A tiny semiconductor device that converts either light or atomic radiation directly to usable electrical energy has been announced recently by RCA scientists.

The device, a silicon junction similar to those used in transistors has been employed in experimental solar and atomic batteries. Using light and radioactive material interchangeably as sources of radiation, these batteries have powered a specially designed low-power transistorized radio receiver.

Batteries capable of such conversion promise to find important application in the near future as sources of electricity for low-power electronic equipment, especially in the field of transistorized devices.

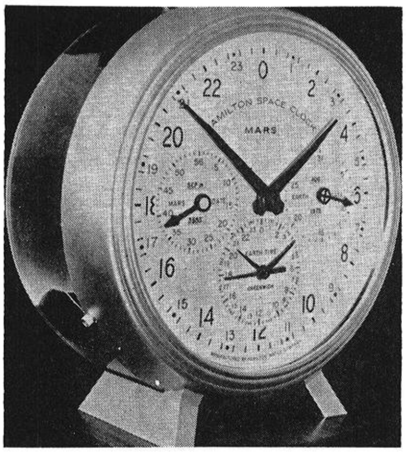
The unit, in which radiation is converted to electricity, is a wafer of silicon into which an impurity is alloyed to form a junction. When the wafer is exposed to bombardment either by beta particles from a radioactive source or by photons of light, electrons are released within the silicon. These electrons, flowing across the junction, produce a voltage that can be applied to a circuit and cause a current to flow.

LOW-COST, PHOTOSENSITIVE PAPER DEVELOPED BY SCIENTISTS FOR NEW DRY PHOTO PROCESS

A low-cost, coated paper that is so photosensitive that it can make contact prints at exposure of a fraction of a second has been developed by scientists for use in a new, simplified dry photographic process known as Electrofax.

Although the paper is as sensitive as standard photographic contact printing papers, it compares in cost with the low-sensitivity papers in common use for reproduction of diagrams and plans. Created for obtaining rapid and permanent prints from photo negatives, microfilm enlargements or projected images, the new paper has proven its sensitivity in numerous tests, including experimental use in a camera. At exposures of one-half a second in outdoor light, it has produced positive prints in a few seconds, with no chemical processing.

The speed with which images can be photographed and printed with the new paper and the Electrofax technique has permitted experimental development of a mechanized system of continuous-strip reproduction that may be adopted for use with electronic computers or other devices which produce a flow of visual information. It is also regarded as a practical and inexpensive method of producing master copies of letters, diagrams, microfilm records and other documents.



SPACE CLOCK

A preview of products which the instrument industry will be called on to create in the age of interplanetary travel is provided by a space clock.

The space clock was conceived to demonstrate interplanetary time differentials which future space travel pilots must consider in planning trips to Mars. It indicates simultaneously (on two separate dials) both Mars time (outer dial) and Earth time (bottom dial). Two other dials give the calendar dates on Earth (right center dial) and on Mars (left center dial). The "calendar" dial for Mars is based on a year of twelve months, but the Mars month has up to 56 days, and the days on Mars are 24 hours, 37 minutes, and 12 seconds long.

SAFETY FIRST

Maywood, Illinois, became the first town in the world to protect the lives of its firemen and policemen with complete installation of a new radio emergency traffic control signal system which permits emergency vehicles to clear a path for themselves through traffic.

All of the fire apparatus and police cars in Maywood have had mobile radio transmitters installed permitting each of the vehicles to turn traffic lights red in all four directions when the vehicle approaches an intersection. Special radio receivers have been connected with the traffic lights.

By stopping all traffic at each intersection along the route of the emergency vehicle, drivers will be able to maneuver properly at necessary speeds in responding to emergency calls.

The system was perfected as a result of the fatal automobile accidents involving emergency vehicles. According to the National Safety Council, one out of every one hundred fatal automobile accidents involves an emergency vehicle.

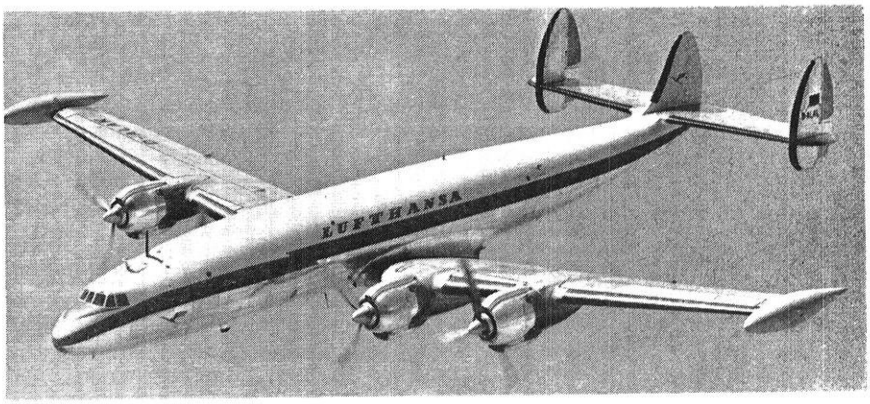
A special feature of the system, is that it warns emergency vehicle drivers of other emergency vehicles approaching the same intersection. While the traffic lights for four blocks in advance of each emergency vehicle remain red in all four directions, the signals along one route also flash yellow at the same time, giving the driver on that route unrestricted right-of-way. Drivers of other emergency vehicles proceeding to the same scene see a rapid flashing yellow light in addition to a red light at one or more intersections along their route, alerting them to an oncoming vehicle crossing their route at that corner.

"PERFECT" IRON

Pure and perfect slivers of iron, having breaking strengths approaching a million pounds per square inch—far greater than any other known metal—have been produced. The slivers of iron, or "whiskers" as they are called, are each a pure iron crystal so perfect that no defects can be detected in its structure. The crystals are as much as two inches long and a thousandth of an inch thick. Previous attempts to produce these "whiskers" have given crystals which could be observed only with the aid of a microscope.

Perfect iron is another forward step in an attempt to gain a broader understanding of the fundamental properties of metals. Because of their strength, hardness, ductility and other useful properties, metals have always been the backbone of civilization. But it is interesting to note that all these desirable properties of metals, as we know and use them today, are actually determined not by the metal itself but by the impurities and imperfections it may contain.

Theoretically, however, it is known that pure metals should exhibit fantastic properties which could make them extremely valuable to man. For example, pure iron has an ultimate tensile strength of more than a million pounds per square inch. This is at least 10 times the strength of ordinary iron which has been hard drawn into wire and at least three times the strength of the kind of steel used in making piano wire.



GERMANY SPREADS HER NEW WINGS

Here is the first four-engine transport for Germany's newly reborn Lufthansa world airline. This Lockheed Super Constellation, is one of a fleet of eight for Lufthansa. It will be the first German four-engine transport to cross the Atlantic in 17 years. These turbo-compound-engine transports, 113½ feet long, will carry up to 76 passengers, providing both tourist and first-class accommodations on the same plane. They cruise at 335 m.p.h.

SKINDIVERS IN SEWAGE CONSTRUCTION HELP ACCOMPLISH "IMPOSSIBLE" JOB

"Skindiving" equipment, normally used by swimming sportsmen, has taken its place in the building contractor's utility kit. The equipment recently was used with outstanding success to complete an apparently hopeless sewer installation.

Six-to-ten feet of water in trenches had defeated three previous contractors in their efforts to lay the final 7,000 feet of sewer pipe for a 400-home housing development near Coral Gables, Fla. The fourth and successful contractor, however, accomplished the job by abandoning the idea of pumping water from the trenches, since porousness of the sand-and-coral soil made such conventional methods impractical.

Using long-length sewer segments of clay pipe that would hold the number of underwater joints to a minimum, the workers wore underwater breathing apparatus, face masks and fins to install the pipe in the flooded trenches. Underwater joining of the 21-foot segments was accomplished with inflatable rubber gaskets.

STRONGER PAPER FROM SYNTHETIC FIBERS

Paper has been successfully produced for the first time from synthetic fibers, the Du Pont Company has announced. It is three to ten times stronger than paper made from the conventional pulp or rags.

The unusual properties of synthetic fibers are carried over into the papers made from them. They are highly resistant to chemical attack, absorb very little moisture, and resist the action of molds, bacteria, and light.

The high strength of the synthetic fiber papers suggests use in such applications as heavy duty bags and their resistance to chemical attack would be useful in filtration of corrosive liquids and packaging chemicals. The stability of the papers to moisture indicates possible use in map and tracing papers and for important records and documents where permanence is necessary.

LOW-POWER TRANSISTORIZED AUTOMOBILE RADIO

An experimental transistorized automobile radio that operates directly from a 6-volt car battery and requires only about one-tenth of the power used by a conventional

(Continued on page 56)

Long-Range Development Program Provides for New Engineering Test and Research Facilities

● Allison's $75 million expansion program in ENGINEERING, RESEARCH and DEVELOPMENT facilities creates the need for a 40 per cent increase in our enneering staff.

Completion of the five-year program—financed by General Motors—will give Allison, and Indianapolis, one of the world's most complete, best equipped, centers for the development of new, high performance turbo-prop and turbo-jet aircraft engines for both military and commercial use.

As General Motors President Harlow H. Curtice said in the announcement, "Engines in production today cannot meet the requirements of the aircraft of tomorrow where ability to operate at supersonic speeds, and very high altitudes, will continue to be demanded from engine builders . . . To design and build engines with such advanced performance, test facilities are required which go far beyond the capabilities of equipment in existence today. In recognition of this need, General Motors will add extensive high performance test facilities to those already established and in operation at the Allison Division."

Already a recognized leader in the design, development and production of turbo-jet and turbo-prop engines, Allison NOW is in a position to offer even greater opportunities to the technically-trained, well-qualified, young graduate who is interested in building his engineering career with a pace setter in the field.

Whether you're still in school, or graduating this year, we'd like to tell you more about your engineering future at Allison. Write to:

R. G. GREENWOOD, Engineering College Contact
ALLISON DIVISION, General Motors Corporation
Indianapolis 6, Indiana.

To the man who intends to do creative engineering...

AIRESEARCH AIR DATA COMPUTER SYSTEM *integrates electronic, pneumatic and electrical components to automatically sense, measure and correct for all air conditions affecting flight.*

AiResearch is looking for your kind of engineer.

We have always been a pioneering company, constantly developing new products and searching out new and better ways of meeting the demands of modern civilization.

A sample of this ingenuity is our development of transducer-computer systems which simplify the job of flying. AiResearch also leads in the aircraft air-conditioning and pressurization fields. We are blazing the trail in overcoming the heat problem in jet flight. In the new, rapidly growing field of small turbomachinery we have more experience than all other companies combined. We produce more than 1000 different products, from unique air-valves that can operate under unprecedented temperature conditions to the most complicated complete systems. We work on the very frontier of present scientific knowledge.

That's why we need creative engineers . . . and appreciate them. You who qualify for an AiResearch position will receive stimulating assignments, utilize some of the finest research facilities in the country and be well rewarded financially.

Premium positions are now open for mechanical engineers ...electrical engineers...physicists...specialists in engineering mechanics...specialists in aerodynamics...electronics engineers ...aeronautical engineers.

Write to Mr. Wayne Clifford, AiResearch Manufacturing Company, 9851 S. Sepulveda Blvd., Los Angeles 45, California. Indicate your preference as to location either in Los Angeles or Phoenix.

THE GARRETT CORPORATION

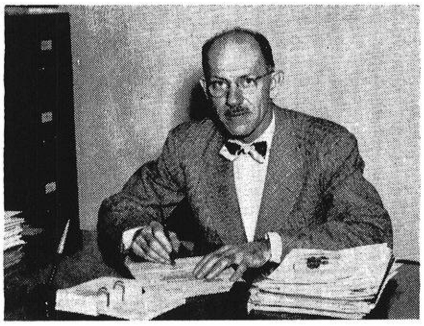
AiResearch Manufacturing Divisions

Los Angeles 45, California • Phoenix, Arizona

Designers and manufacturers of aircraft components: REFRIGERATION SYSTEMS • PNEUMATIC VALVES AND CONTROLS • TEMPERATURE CONTROLS CABIN AIR COMPRESSORS • TURBINE MOTORS • GAS TURBINE ENGINES • CABIN PRESSURE CONTROLS • HEAT TRANSFER EQUIPMENT • ELECTRO-MECHANICAL EQUIPMENT • ELECTRONIC COMPUTERS AND CONTROLS

ACCORDING TO THE DEAN . . .

The Engineering Exposition offers you many opportunities



Kurt F. Wendt

As we begin another year I take this opportunity to extend to all of you a warm welcome to the campus. I have already had the pleasure of saying a personal word of greeting to the freshmen, and I trust that by this time they are beginning to feel themselves a part of the entire engineering college and university family. Opportunities to greet the sophomores, juniors, seniors, and graduates in class groups are rare, unfortunately, but my welcome to them via the printed word is no less hearty or sincere.

Now that the summer with its jobs, its summer schools, its military camps and cruises is over I hope that everyone is ready to reassume the duties and responsibilities of carrying a full program of studies. Fully realizing that a technical engineering program demands a large amount of time and hard work, let me assure you that the effort expended pays large dividends in satisfaction, not to mention the final monetary return. At the same time it is of first importance to recognize that college offers much more than studies alone. With a carefully planned time budget, all need not be work by any means! Many worthwhile activities will compete for a portion of your time, and I hope that each one of you will find time to participate in several. The trick is planning—a good engineering trait to cultivate and develop.

This year Polygon is again sponsoring an Engineering Exposition to be held in the spring. The seniors, who were freshmen at the time of the last exposition, will remember some of the fun, the crowds, the fine exhibits, and alas, the work. All the rest have a great, new experience ahead. To be a success a venture like this requires the solid support of the entire student body. Your ideas, your ingenuity, your brains, and your brawn are needed. Chairmen of the many committees have their work plans developed and some have already recruited their aides and begun on their tasks. In past years the Engineering Expos have set high standards, and earned well merited praise. I am sure that this year's show will again delight the campus and the community. If you have not yet had a chance to offer your services, check with your Polygon representative or drop your name, address, and phone number in the Engineering Exposition mailbox in the lobby of the Mechanical Engineering Building. Your help will be appreciated.

An exposition is one of the few activities which draws all divisions of engineering, all classes, and the faculty as well, together working towards one common goal. I wish we could promote more activities which would accomplish the same purpose. Getting to know the fellow in another branch of engineering or in another college, meeting the faculty on an informal basis, and planning and working together can be both satisfying and rewarding. One way to increase this type of contact is to take part in your professional society activities and to promote many more joint programs than we commonly enjoy.

Let's all resolve to work together, play together, and make this a banner year for the entire college.

—KURT F. WENDT

CAMPUS NEWS

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

ENGINEERING INSTITUTE

INDUSTRIAL PRODUCTS DESIGN

October 25, 26

Good product design can cut production costs and increase sales. This program will be devoted to the total problem of product design and will be of interest to chief engineers, product design and development engineers, and production supervisors.

Fee: $20. Robert A. Ratner, Institute Coordinator.

PLASTIC PROCESSING

October 27, 28

It is the intent of this institute to present the latest information on the application of plastics. Items to be covered include injection molding, compression, and transfer molding, extrusion, casting, metallizing, tooling, and rigid plastics. This meeting will be of interest to persons engaged in any of the above plastic processes.

Fee: $20. Ralph D. Smith, Institute Coordinator.

INDUSTRIAL NOISE CONTROL

November 3, 4

The problem of noise reduction in industrial plants has become increasingly important because of recent court decisions concerning worker's claims for partial loss of hearing. Architects and engineers are eargerly seeking information on building materials, and techniques resulting in quieter working conditions. This two-day program will attempt to show what can be done both to reduce noise in present structures and to obtain good acoustics in proposed buildings.

Fee: $20. Raymond C. Tegtmeyer, Institute Coordinator.

AIR CONDITIONING

November 7, 8, 9

Topics to be covered at this institute include theory of air conditioning and refrigeration, instrumentation, air distribution, refrigeration, coil design, duct design, fans, heat load calculations, and new developments. This program will be of interest to architects, designers, contractors, mechanical engineers, and engineering personnel representing manufacturers of air conditioning equipment and accessories.

Fee: $25. Ralph D. Smith, Institute Coordinator.

INSPECTION METHODS AND ADMINISTRATION

November 15, 16, 17

Problems of current interest to the chief inspector and inspection supervisor will be discussed so that they can more effectively administer the inspection function. New inspection techniques and devices, gage control, and supervision of the inspection force are some of the topics to be presented.

Fee: $25. Robert A. Ratner, Institute Coordinator.

ELECTRICAL CONTRACTORS INSTITUTE

November 28, 29

This is the first of two such meetings for electrical contractors. Twenty-five per cent of the time will be spent on fundamentals of electricity and problems of everyday practice. One full day will be spent studying the Code. The final half-day will cover business ethics and selling the job. The spring meeting will stress residence, farm, and industrial wiring, and there will be a full day on estimating.

Fee: $15. Ralph D. Smith, Institute Coordinator.

HONORARY DEGREES AWARDED

The University of Wisconsin awarded honorary degrees to three Americans noted in the fields of labor, engineering, and architecture at Commencement ceremonies in Camp Randall Stadium June 17.

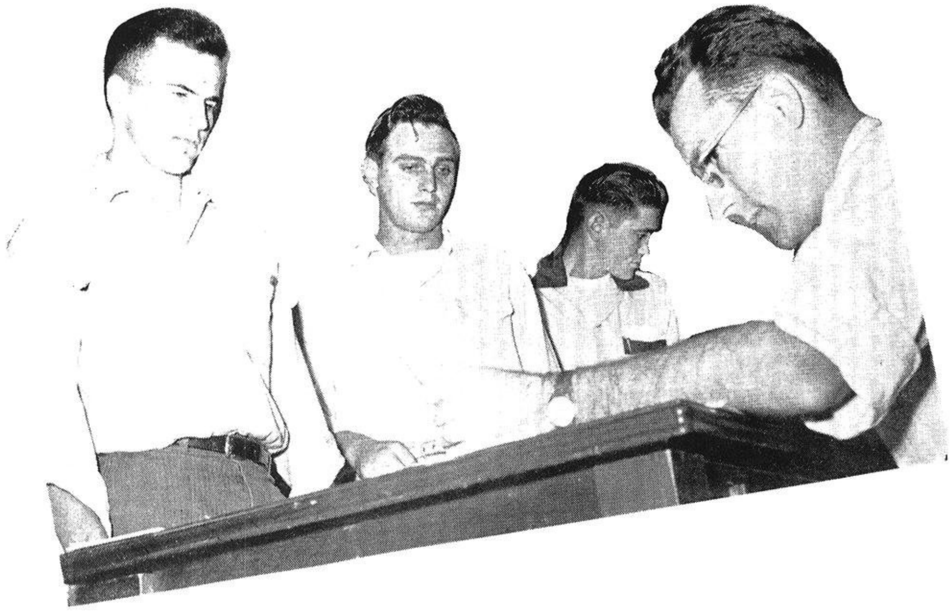
University regents confirmed degrees for the following:

Jacob F. Friedrick, Milwaukee, Wis., Wisconsin labor leader who has been for almost 40 years one of the foremost champions of cooperative labor-management relations and of worker's education, top officer of the AFL Milwaukee Federated Trades Council, member of many industrial, labor, and educational advisory committees—the doctor of laws degree;

Lillian Moller Gilbreth, Montclair, N. J., president of Gilbreth, Inc., construction engineers in management, educator, author, consultant to industries across the globe, mother of 12 children immortalized in "Cheaper by the Dozen" and "Bells on their Toes," and Knapp Visiting Professor of Mechanical Engineering at the University—the doctor of science degree;

Frank Lloyd Wright, Spring Green, Wis., native son and University alumnus known around the world for his pioneering work in "organic" architecture, creator of structures as unique as the Imperial Hotel in Tokyo and the Guggenheim Memorial Museum in New York City, member of national and royal academics around

(Continued on page 34)



"This is just the beginning . . ." Robert J. Bosben, ME'1 (left), receives his packet from Mr. Leidel (right) as Joseph Zauner, ME'1 (center), and Gary Broezman, CE'1 (right rear), wait in line.

THE CAMERA EYE...

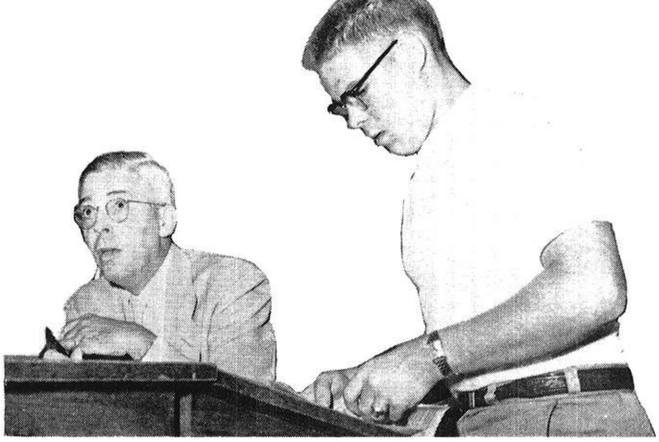
WATCHES FRESHMEN REGISTRATION

"Fill out the cards and come back here". Merton Barry, drawing instructor, explains the procedure to Warren Bowers, MetE'1, (2nd from left) as Don Alloy, EE'1 (left), and Ron Beatty, CE'1 (right) wait patiently.

"You'll have to take Drawing 12." Miss O'Keefe fills out the program of Thomas Bullock, EE'1.

"I have to work during the noon hour . . ."
Eugene Klinsing, BS'1, and Glenn Belsley, CE'1, (left to right) look on hopefully at the assignment committee.

Photos by Jim Richards, Met.'57



"Whose next?"
Prof. Worsencroft finishes with Thomas Bartol, ChE'1, and looks for another frosh.

"What are assignment committees?"
Jim Kaphengst, ME'1, wonders what comes next.

"You can't go wrong with the WISCONSIN ENGINEER!"
Bob Hentges, editor (extreme right), gives four freshmen a subscription pep talk, as John Albrecht (foreground) prepares a subscription form. The eager buyers (left to right) are Lowell Watkins, Tom Underwood, Arthur Wilke, and Ken Viken.

Campus News

(Continued from page 31)

the world, author of innumerable definite works in his field, founder of the "Taliesin Fellowship"—the doctor of fine arts degree.

PROF. SKILES WINS KIEKHOFER AWARD

Assistant professor James J. Skiles of electrical engineering was named winner of the 1955 Kiekhofer Memorial Teaching Awards in ceremonies at a meeting of the University of Wisconsin faculty late last semester.

A check for $1,000 was presented to him by University Regent Wilbur Renk, Sun Prairie.

The award, which is one of two given annually to outstanding young Wisconsin faculty members for "excellency in teaching," is a "living memorial" honoring the beloved UW economics teacher, Prof. William H. Kiekhofer, whose classes in elementary economics enrolled more than 7,000 students during the long years of his teaching prior to his death in 1951.

Prof. Skiles, 26, has taught in the University of Wisconsin College of Engineering since 1951—as instructor in electrical engineering until 1954 when he was awarded a Wisconsin Ph.D., and since that time as assistant professor.

PROF. HOUGEN RECEIVES REYNOLDS AWARD

Olaf A. Hougen, professor of chemical engineering in the University of Wisconsin's College of Engineering, was awarded last May 6, the first annual Benjamin Smith Reynolds Award of $1,000 for "excellence in teaching of future engineers".

Native of Manitowoc, Wis., and a graduate of its University, Prof. Hougen has combined teaching and research in the UW College of Engineering for 34 years. He has long been recognized nationally for his discoveries and publications in chemical engineering. Among the national awards he has won is the William H. Walker Award of the American Institute of Chemical Engineers (1944) for his outstanding contributions to chemical engineering literature. END

ON MAKING ANNOUNCEMENTS IN "THE WISCONSIN ENGINEER"

I. The "Wisconsin Engineer" magazine wishes to print more campus activities each month—Engine Ears (Engineering Society News), Announcements, Awards, Scholarships, Contests, Engineering Institutes, Banquets, and job opportunities, which are of interest to the student engineer at Wisconsin. We will be glad to consider any material you believe to be newsworthy.

II. News Reaches:

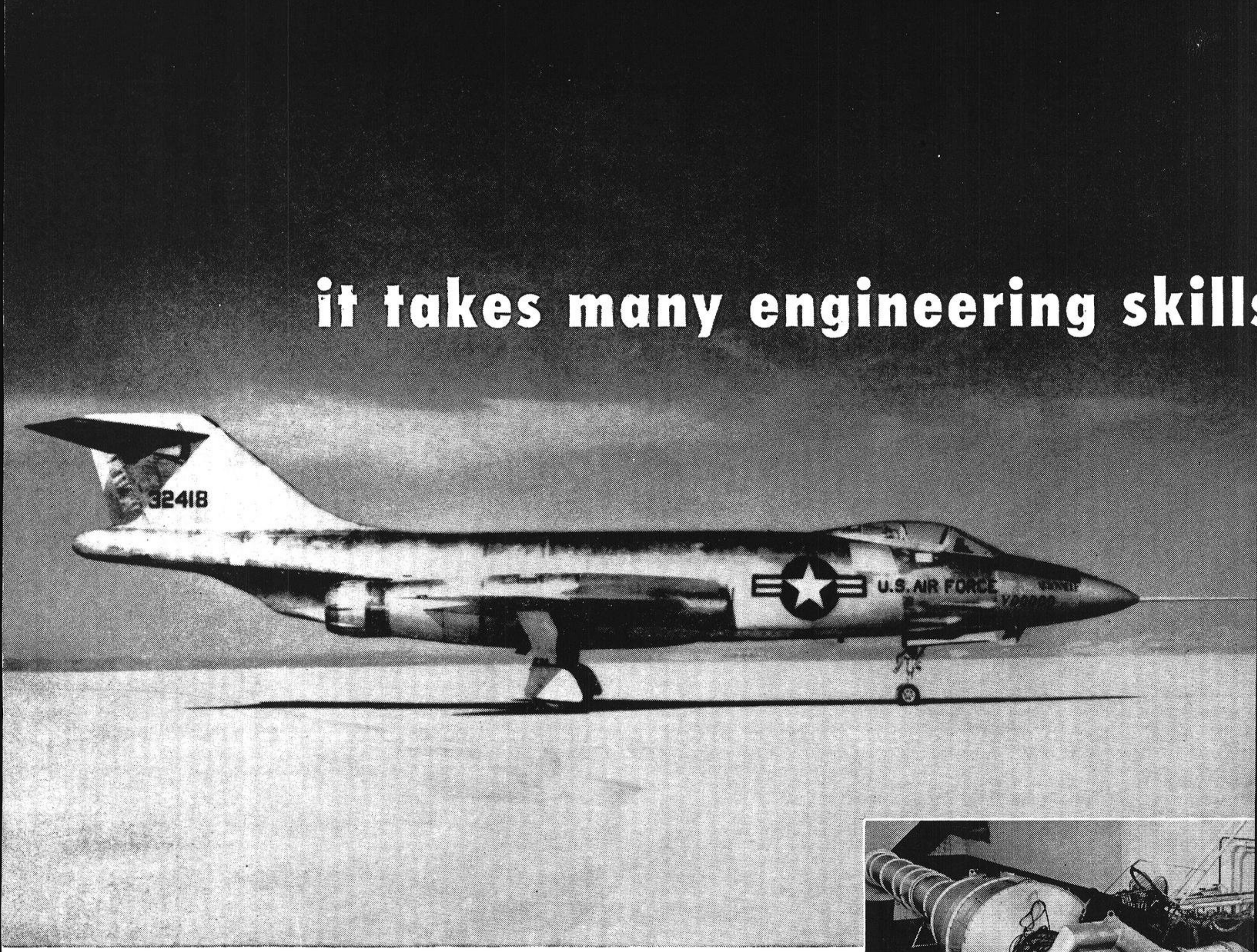
1. A cross-section of the student body.
2. All members of the faculty.
3. The 1,100 members of The Wisconsin Society of Professional Engineers.
4. 450 high schools throughout Wisconsin.

III. Requirements for submitted material:

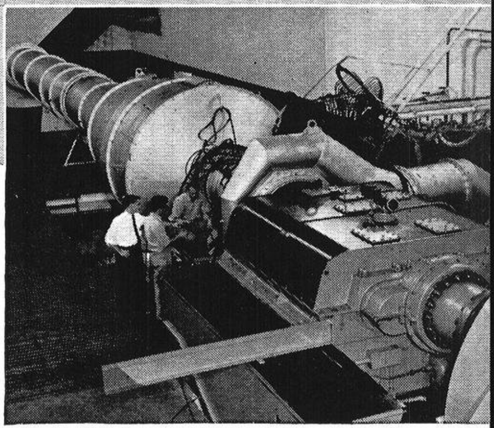
1. Neatly typewritten—Double-spaced.
2. Submitted in advance of deadline.
3. Check the following deadlines to insure material and announcements are printed in correct issue.

Issue	*Deadline for Submitted Material*	*Mailing Date*
December	Nov. 7	Dec. 12
January	Dec. 5	Jan. 13
February	Jan. 6	Feb. 15

it takes many engineering skills



McDonnell "Voodoo", *the most powerful jet fighter ever built in America.*



MECHANICAL ENGINEERS are concerned with many phases including experimental testing and development, mechanical design, stress and vibration analysis, combustion research, heat transfer and nuclear reactor development.

J-57 POWERED AIRCRAFT

MILITARY

F-100	F8U
F-101	A3D
F-102	B-52
F4D	KC-135

COMMERCIAL

Boeing 707

Douglas DC-8

AERONAUTICAL ENGINEERS work on innumerable internal and external airflow problems concerned with design, development and testing of aircraft powerplants. Some who specialize in analytical engineering forecast engine-airplane combinations a decade in advance of design.

ELECTRICAL ENGINEERS directly contribute their specialized skills to the analysis and development of controls, systems and special instrumentation. An example is the "Plottomat" which automatically integrates and plots pressures, temperatures and air angles in performance testing.

o create the top aircraft engines

An aircraft powerplant is such a complex machine that its design and development require the greatest variety of engineering skills. Pratt & Whitney Aircraft's engineering team has consistently produced the world's best aircraft engines.

The best planes are always designed around the best engines. Eight of the most important new military planes are powered by Pratt & Whitney Aircraft J-57 turbojets. The first two jet transports in the United States will use J-57s. Further, no less than 76 percent of the world's commercial air transports are powered by other Pratt & Whitney Aircraft powerplants.

Such an enviable record can only be built on a policy which encourages, recognizes and rewards individual engineering achievement.

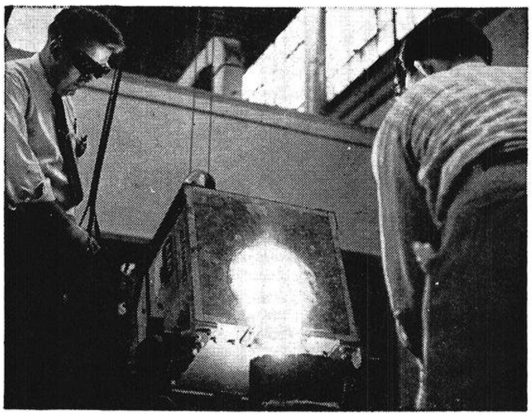
PRATT & WHITNEY AIRCRAFT

Division of United Aircraft Corporation

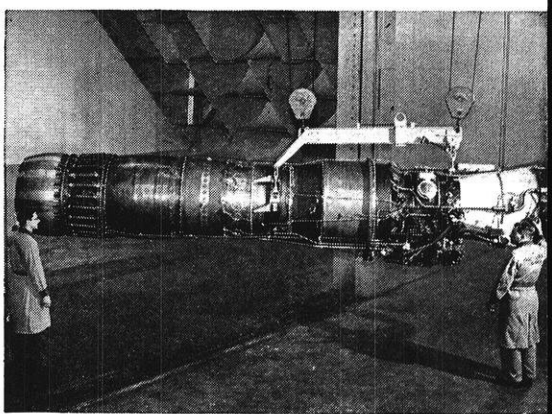
EAST HARTFORD 8, CONNECTICUT

World's foremost designer and builder of aircraft engines

HEMICAL ENGINEERS, too, play an important ole. They investigate the chemical aspects of eat-producing and heat-transferring mateials. This includes the determination of hase and equilibrium diagrams and extenive analytical studies.



METALLURGISTS investigate and develop high temperature materials to provide greater strength at elevated temperatures and higher strength-weight ratios. Development of superior materials with greater corrosion resistance is of major importance, especially in nuclear reactors.



WORLD'S MOST POWERFUL production aircraft engine. This J-57 turbojet is in the 10,000-pound thrust class with considerably more power with afterburner.

ALUMNI NOTES

by John M. Albrecht, c'56

Five leading engineers and industrialists, all of them graduates of the University of Wisconsin College of Engineering, were cited for outstanding accomplishments in their field at the annual Wisconsin Engineers Day celebration which was held on the UW campus May 6, 1955. The five who received citations were Gordon Fox, Henry J. Hunt, Ralph J. Kraut, Irving L. Wade, and Kenneth M. Watson.

Gordon Fox, vice president of the Freyn Engineering Co., Chicago, Illinois, is serving this year as president of the Wisconsin Alumni Association. A native of Milwaukee, Wisconsin, Fox received his bachelor of science degree from the University of Wisconsin in 1908, and has won wide acclaim as a distinguished electrical engineer with world wide experience in the development of the steel industry, especially in the application of electric motors in that field.

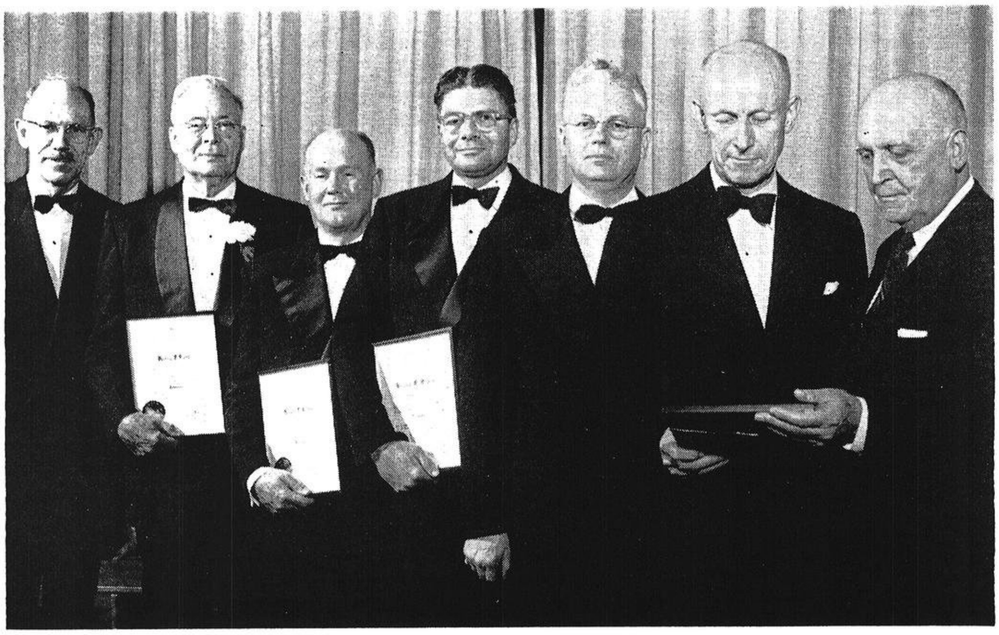
Henry J. Hunt is vice president of Mead and Hunt, Inc., Madison, consulting engineers. Born in Stoughton, Wisconsin, Hunt received his BS degree in civil engineering in 1906, and his professional degree in that field in 1912. The author of a large number of technical papers, he has designed and constructed many water power and steam power plants, transmission lines, water supply systems, and sewerage works.

Ralph J. Kraut, president and general manager of the Giddings and Lewis Machine Tool Co., Fond du Lac, Wisconsin, was born in Chicago, Illinois, and graduated from the University of Wisconsin College of Engineering in 1908, the top man in his class of mechanical engineers. A successful engineer and one of Wisconsin's foremost industrialists, Kraut is widely known for his continual effort to advance the interests of the engineering profession.

Irving Wade was born in Wauwatosa, Wisconsin, and presently is general superintendent of the generating stations for the Commonwealth Edison Co., Chicago, Ill. Wade received his bachelor of science degree in mechanical engineering in 1923 and has been a loyal member of the Wisconsin Alumni Association for 30 years. Engaged in the public utility field since his graduation, he has become a nationally known authority in the field of steam generators and steam turbines.

Kenneth M. Watson, vice president and director of research for the Pure Oil Co., Crystal Lake, Ill., was born in Herman, Minnesota, and received his bachelor of science degree in chemical engineering in 1923, his master's de-

(Continued on page 40)



Left to right, Dean Wendt, Henry J. Hunt, Ralph J. Kraut, Kenneth M. Watson, Irving L. Wade, Gordon Fox, President Fred.

Alumni Notes

(Continued from page 38)

gree in 1924, and his Ph.D. in 1929, all from the University of Wisconsin. He has made an outstanding record in research and development in connection with the petroleum industry and holds numerous patents in his field.

Co-author of four basic standard textbooks in chemical engineering, Watson was the winner of one of the most prized awards in American chemical engineering, the William H. Walker award of the American Institute of Chemical Engineers, in 1948. He served as professor of chemical engineering at the University of Wisconsin on a part-time basis from 1942 to 1950.

In June, the sad news was announced that **Patrick Henry Hyland,** the philosophizing engineer had passed away. Professor Hyland was concluding 43 years of service to Wisconsin engineering education.

Although an engineer with a mind as precise as the machines he designed, "Pat" Highland was a very human sort. Blessed with a wonderful sense of humor and wit, a razor-sharp mind, and a quick tongue that could jump from one subject to another with speed and smoothness, he was a homespun philosopher based on plain down-to-earth common sense.

Born in Grand Rapids, Michigan, on July 10, 1884, he started his schooling there. At the age of fourteen, machines became his education—big machines of the Pennsylvania Railroad. Young Hyland became a machine apprentice and later a journeyman.

Machines held a strong power over Hyland. He worked with them by day, studied their design by night, and soon became a machine designer with the Erie Railroad at Meadville, Pa., where he designed locomotives and rail cars. Later he joined the staff of a Mishawaka, Indiana, firm that specialized in transmission engineering.

All this time, Hyland felt the need for more professional training in his field. Undaunted by the lack of a high school diploma, he passed the entrance examination to attend Purdue University and study mechanical engineering. He received his bachelor of science degree in 1919, and earned his higher degree in 1921.

Immediately upon receiving his degree from Purdue University, Hyland joined the UW College of Engineering staff as an instructor. In 1938 he gained a full professorship. Busy as he always was with his teaching, research, and student advising, Professor Hyland still found time to take an active part in national and state engineering, and to establish a reputation as a family man.

Looking backward, Professor Hyland had a sort of engineering formula which he aptly applied to life. The four component parts of successful living, he said, are ability, energy, good health, and luck. "You just take these four ingredients, mix them very thoroughly, and you just can't help but get the most of life."

Yes, Professor Hyland applied his formula, and indeed, he got the most out of life.

Returned with their families to Wisconsin now are **Profs. Vincent C. Rideout,** electrical engineering, and **James R. Villemonte,** civil engineering. Staying for a second year are **Profs. R. R. Benedict,** electrical engineering, and **Gerald Pickett,** mechanics.

JAMES R. VILLEMONTE

VINCENT C. RIDEOUT

During the past year, Villemonte has served in hydraulic engineering at the Bengal Engineering College, while Rideout served in communications engineering at the Indian Institute of Science at Bangalore, Mysore, India. Besides teaching at the Indian schools, both Rideout and Villemonte worked on India's engineering and engineering-education problems during their year's stay.

Colonel Aldro Lingard, a 1938 graduate of the University of Wisconsin, was named chief of the Aeronautical Research Laboratory at the Wright Air Development Center, Wright–Patterson AFB, Ohio. Colonel Lingard will head 300 scientists and engineers in studies of basic aeronautics and research.

The colonel was graduated from the University of Wisconsin in 1938 with a bachelor of science degree in electrical engineering. He received master and doctor of science degrees from Massachusetts Institute of Technology in 1951.

Bainbridge, Douglas W., M&Me. '43, (Phd. Calif. '54), was recently appointed Assistant Professor of Metallurgy at Colorado School of Mines, Golden, Colorado. **END**

WISCONSIN SOCIETY OF PROFESSIONAL ENGINEERS

W. S. P. E.

SECRETARY'S OFFICE

575 Toepfer Avenue
Madison 5, Wisconsin
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EDWIN J. KALLEVANG
HAROLD TRESTER

ENGINEERS' CREED

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.

ANNUAL MEETING

The WSPE Annual Meeting is scheduled to be held at the Shroeder Hotel in Milwaukee on January 26, 27 and 28. The social get-together will be Thursday evening Jan. 26, 1956. Business and Committee meetings will be held on Friday and Saturday. Make your plans now to attend this important event.

ENGINEERING EXAMINATIONS

The Wisconsin Registration Board of Architects and Professional Engineers have announced the dates of their next Engineering Examinations as January 30 and 31, 1956. To be eligible for those examinations, application must be on file in the Board's office on or before December 1, 1955. Application forms and information may be obtained at or by writing to the Board's office, 1140 State Office Building, Madison, Wisconsin.

Examinations will be conducted January 30, 1956 at Madison and Milwaukee, Wisconsin for those desiring Certification as an Engineer-in-Training. To qualify for certification as an Engineer-in-Training the applicant must in addition to passing the one-day, 8 hour, examination on the fundamentals of engineering have a record of 4 years of satisfactory engineering experience. All of the required 4 years of experience may have been gained by formal education.

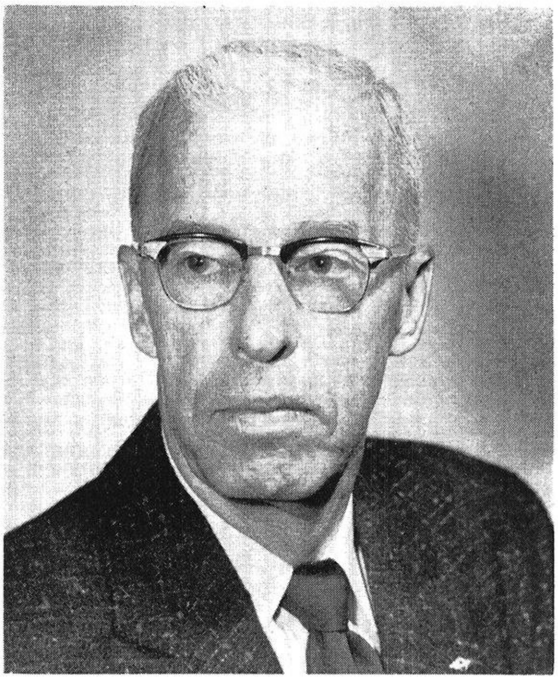
Examinations will be conducted January 30 and 31, 1956 at Madison, Wisconsin for those desiring registration as a Professional Engineer. Holders of certification as an Engineer-in-Training in Wisconsin will be required to appear for examination only on January 31, 1956, while those who are not holders of such certification will be required to appear on both January 30 and 31, 1956. The examination on January 30, 1956 will be on the fundamentals of engineering. The examination on January 31, 1956 covers in the forenoon a field of engineering and in the afternoon a sub-field of the field selected by the applicant for the forenoon's examination. The applicant must choose a field and sub-field which has been established or approved by the Board. Fields and subfields for each have been established by the Board as follows:

1. Chemical with the established sub-field of Sanitary and others to be approved by the Board.
2. Civil with the established subfields of Highway, Hydraulics, Municipal, Sanitary, Structural.
3. Electrical with the established sub-fields of Electrical Machinery, Electric Power–Generation and Distribution, Illumination, Industrial Electronics, Communications.
4. Mechanical with the established sub-fields of Air Conditioning–Heating–Refrigeration, Heat Power and Heat Engines, Industrial, Machine and Tool Design.
5. Metallurgical with the sub-fields to be approved by the Board.
6. Mining with the sub-fields to be approved by the Board.

To qualify for registration as a Professional Engineer the applicant must in addition to passing the 2-day examination have a record of 8 years of satisfactory engineering experience 4 of which may have been gained by formal education.

(Continued on page 44)

Meet the President



A. OWEN AYRES
State Society President

A. Owen Ayres, President of the Wisconsin Society of Professional Engineers, is a man of many interests. His position of service to the Society, in the office of president, is but one of many in business and community enterprises.

Mr. Ayres' principle affiliation is with the Eau Claire Sand and Gravel Company; he has risen to the position of president and principle stockholder since he first became affiliated with the company in 1923. Following his graduation from the University of Wisconsin, where he received his B.S. in Civil Engineering, Mr. Ayres served in the 107th Engineers of the famed 32nd Division during World War I, and then worked for the Wisconsin Highway Commission from 1918 until 1922. He was also engaged in municipal and consulting work.

Since joining W.S.P.E., he has served as Director of the Northwest Chapter, Director of the State Society, 2nd Vice President, 1st Vice President, and now President. He also is credited with the founding of the Eau Claire Technical Society. As a resident of Eau Claire, Mr. Ayres has contributed much time and effort to a host of civic activities and enterprises. He is a member of the Boards of Directors of Wisconsin Mineral Aggregate, the Eau Claire Y.M.C.A., Eau Claire Development, the Eau Claire Chamber of Commerce, and the Eau Claire Builders Exchange. He is also the president of the Y.M.C.A., Vice-President of the Builders' Exchange, and a member of the Finance Committee of the Wisconsin Public Expenditure Survey. He is affiliated with other civic organizations in his home city.

Mr. Ayres also finds time to participate in many social and religious activities. He is President and Director of the Eau Claire Country Club, a member of all Masonic Bodies and the Shrine, a member and trustee of the First Congregational Church, and a member of the American Legion and Veterans of Foreign Wars. In addition, he enjoys golf and bowling in his leisure time.

Mr. Ayres was married to Florence M. Schutte in 1920, and is the father of three children, Natalie, Owen, Jr., and Frederick.

W. S. P. E.

(Continued from page 42)

The next engineering examination after the January 30–31, 1956 examination will be conducted by the Board about the middle of June 1956 with April 15, 1956 as the closing date for filing application to enter it.

MEMBERSHIP COMMITTEE

W. F. Baumgartner, *Chairman*

Our Membership Committee is off to good start. Give them your help and cooperation. Our Society must continue to grow. With the help of every member,, we can change the "Prospects" to "Members".

MEMBERSHIP REPORT SEPTEMBER 16, 1955

Total Members and Affiliate Members as of August 20, 1955

Members	1143
Affiliate Members	119
Total	1262

Losses from August 20, to September 16, 1955

Deceased (R. G. Pitz, Oshkosh) (W. F. Eichfeld, Milwaukee)	2
Dropped (Nonpayment of 1954 dues)	1
Total	3

Additions from August 20, to September 16, 1955

Applications for Members	7
Applications for Affiliate Members	0
Total	7

Total Members and Affiliate Members as of September 16, 1955

Members	1147
Affiliate Members	119
Total	1266
Increase since August 20, 1955	4

Secretary-Treasurer Kingsbury presented the membership report. Accepted.

	Prospects		Membership 7-9 55			September 1, 1955 Sponsors For New Members		Percent of Quota
Chapter	PEs	EITs	PEs	EITs	Quota	7/9 PEs	8/20 55 EITs	
Wis. Valley	60	-	44	3	15	1	-	6.6
Northwest	40	-	62	8	20	1	-	5.0
Milwaukee	1300		450	42	175	2	5	4.0
Fox River Valley	225	-	170	19	50	1	-	2.0
Southeast	255	-	63	11	30	-	-	0.0
Southwest	300	-	239	12	60	-	-	0.0
Western	20	-	63	5	10	-	-	0.0
Out of State	800	100	32	10	5	-	-	0.0
	3000	**970	*1133	*110	365	5	5	2.5

(*)These figures received from State Secretary on August 20, 1955.
(**)Estimated 870 in all chapter areas.

COMPARISON BY YEARS

	1953-54 New Members	1954-55 New Members	1955-56 New Members
July	---	---	---
August	---	2	10
September	11	24	---
October	---	38	---
November	---	---	---
December	22	71	---
January	44	123	---
February	92	---	---
March	128	187	---
April	208	---	---
May	---	227	---
June	214	252	---

By the action of the Board of Directors on September 16, 1955, the following engineers became members and affiliate members of WSPE. We welcome you into our Society.

Name and Position	Address	Reg. No.	Sponsors
Milwaukee Chapter			
Gustav Waidhas Staff Engineer Jackson Brewing Co. of New Orleans, La.	620 Decatur St. New Orleans, La.	E-4901	G. Sievers
George E. Sonntag Design Eng. Vapor Blast Mfg. Co.	10555 W. Spencer Pl. Milwaukee 16, Wis.	E-5736	A. P. Neumann
Wilbur E. Watts Transmission Eng. Wis. Telephone Co.	740 N. Broadway Milwaukee 2, Wis.	E-5948	W. C. Lallier
Palmer T. Severson Dev. Eng. Cutler Hammer Inc.	2118 N. 67th St. Wauwatosa 13, Wis.	E-5444	P. M. Fischer
Fox River Valley Chapter			
Roy Lee Spaulding Engineer, Paper Dept. Kimberly Clark Corp.	123 Edna St. Neenah, Wis.	E-5912	W. Bryan
Wisconsin Valley Chapter			
Arlie Raymond Dent Chief Structural Eng. Consolidated Water Power & Paper Co.	531-11th St. S. Wisconsin Rapids, Wis.	E-4321	Frank Henry
Out of State			
Giorgio Gaspare Muller Consultant	1, Eyfeldweg Burgdorf, Be. Switzerland	E-5442	W. A. Piper

EIGHTH SUMMER CONFERENCE

The beautiful Dell View Hotel at Lake Delton was both the headquarters and playground for the 8th Summer Conference of the Wisconsin Society of Professional Engineers during the sunny weekend of Sept. 16–18.

About 175 engineers and their ladies frolicked through what was generally considered to be one of the most successful summer meetings in the history of the organization. The weatherman certainly must be an engineer, because he provided perfect weather for the occasion. Golf, duck and boat rides, airplane rides, and swimming in the crystal clear Dell View pool were popular activities in between the meetings, dinners, and dances in the air-conditioned main lodge of the hotel.

Even as the registration desk was being rolled out Friday noon, some early golf engineers were already teeing off on the first hole of one of the sportiest 18-hole courses in the Middle West. By the time the early evening Smorgasbord was in full swing, the crowd of engineers and their ladies had grown to a considerable size. It was a sight to behold the engineers and their partners rock and roll almost without letup until the midnight hour, when again food was rolled out and diets were again forgotten for a pleasurable hour.

During the course of Friday evening, the Board of Directors held their meeting. Reports of the various state committees were submitted to the Board including Budget, Ethics and Practice, University Cooperating, Publications, Membership, Education, Interprofessional, Legislation and Program.

Despite the lure of the summery out-of-doors, the serious business meetings were held and very well attended both Saturday and Sunday mornings. State committee meetings pertaining to Education, Ethics and Practice, Membership, Program, Public Relations, Legislative, and Interprofessional were held in such inviting settings as the

(Continued on page 46)

Welcoming Committee for President Ayres as He Arrives in His "Cadillac."

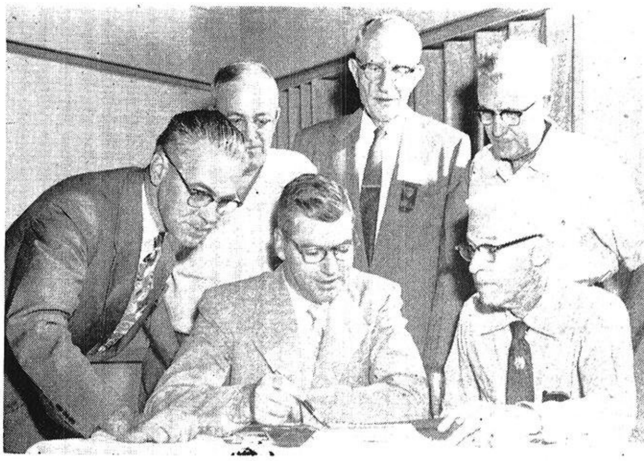
Left to Right—Page A. Johnson, Host Committee; Mrs. Page A. Johnson; Mrs. Jack H. Maxfield, Host Committee; Mrs. Harold L. Lautz, Host Committee; Mrs. A. Owen Ayres, First Lady; Karl O. Werwath, State Program Chairman; President A. Owen Ayres; Ed Kallevang, Past National Representative; Harold L. Lautz, Chairman, Host Committee; Paul J. Crogan, Host Committee.

Sunday Morning Breakfast.
Interprofessional Committee with Engineering Members of Registration Board.

Left to Right—Harold C. Trester, National Representative; Arthur G. Behling, First Vice President; Herman T. Hagestad; W. A. Piper, Secretary Wis. Registration Board of Architects and Prof. Engineers; William E. Crawford, Member, Registration Board; A. L. Genisot, Second Vice President; Charles A. Nagel, Chairman, Interprofessional Committee.

Chapter Presidents and Their Wives with President and Mrs. Ayres.

Standing: Left to Right—Wesley C. Lallier, Robert W. Stieg, Mrs. Robert W. Stieg, Mrs. Donald C. Bengs, Donald C. Bengs.
Seated: Left to Right—Mrs. Willard W. Warzyn, Mrs. A. Owen Ayres, Willard W. Warzyn.

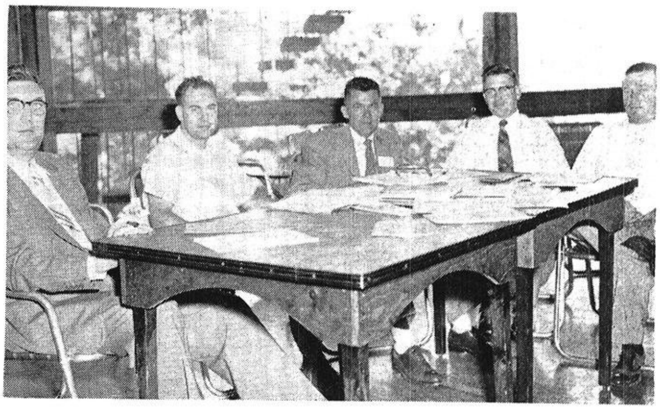


Officers Confer with Senator on 688, A.

Standing: Left to Right—Arthur G. Behling, First Vice Pres., WSPE; A. L. Genisot, Second Vice Pres., WSPE; George P. Steinmetz, Past Pres.; Charles A. Nagel, Chairman, Interprofessional Committee.
Seated: Left to Right—Senator Arthur L. Padrutt, A. Owen Ayres, President.

Sunday Morning Breakfast.
Chairmen of Functional Groups Planning Theme for the State Convention—Engineers and Civic Affairs.

Left to Right—John Gammell, Education Committee; Carl A. Cajanus, Public Employment Committee; Karl O. Werwath, Program Chairman; Louis J. Larson, Industrial Commission.



Public Relations.
State Publicity Committee Prepares Engineers Week Project.

Left to Right—Donald C. Bengs, R. M. Lyall, Victor A. Kneevers, Arthur H. Graettinger, Leo F. Kosak.

W. S. P. E.

(*Continued from page 44*)

Fireplace Lounge, the Small Cocktail Lounge and the Sun Deck.

And during these early morning male goings-on the ladies were relaxing (1) In bed, (2) At late breakfast, (3) Walking around the spacious hotel grounds, or (4) Just chit-chatting!

But the ladies had an unusual program all their own. At their Saturday noon luncheon they were presented with an outstanding circus program by Atty. and Mrs. Sverre Braathen of Madison.

Our main speaker at the Saturday luncheon hour was Senator Arthur A. Padrutt, chairman of the Legislative Committee. He expressed the opinion that our Senators and Assemblyman appreciate receiving our views on bills which are up before the Legislature.

An afternoon solely for recreation was saved for Saturday when everyone took part in some form of planned fun activity. The Saturday evening banquet and professional entertainment were followed by another informal dancing and mixing hour.

As the Sunday afternoon 3 o'clock checkout time approached, new friends said farewell to new friends, old friends said again: "We'll see you in Milwaukee in January", the little wife's three or four suitcases were hauled out to the car, and the Local Arrangements Committee sighed to one another: "Well, that's over; but wasn't it a lot of fun!"

PROPOSED REVISIONS OF 1944 BOILER CODE

Industrial Commission—State of Wisconsin

There have been important changes in the field of boiler and unfired pressure vessel design and fabrication since the adoption of the 1944 Boiler Code.

The demand for greater economy of operation has resulted in higher temperatures and pressures. To maintain standards for reasonable safety under heavier operating conditions it has become necessary to employ alloy steels of greater tensile strength than heretofore required. It has become necessary to fusion weld entire vessels to secure the desired strength and tightness.

The primary objective of this new code is safety. The interest to users of boiler and pressure vessels is of paramount importance. This code has been proposed to afford a reasonable degree of protection to life and property, to provide a margin for deterioration in service, and to obtain a reasonably long and safe period of usefulness.

The interest of manufacturers has been recognized by considering recent improvements in design and materials and the benefits of manufacturing expense. Special consideration has been given to the repair and maintenance of boilers and pressure vessels. A new section referring to the repair of all types of pressure vessels, fired and unfired, which have deteriorated from corrosion or from overheating, has been added to the code. Welding procedures and rules for repair specify that manufacturers, owners, or contractors undertaking repairs, shall have available for inspection a written welding procedure specification that shall be followed in making the necessary repairs and also a record of procedure qualification tests.

Under new construction all boilers and unfired pressure vessels hereafter installed shall be constructed and installed in accordance with the American Society of Mechanical Engineers Boiler and Pressure Vessel Code.

Public hearings concerning the proposed revisions were held in various cities throughout the state. Our secretary has previously notified the chapters of the hearings in their areas.

The revised code is scheduled to become effective January 1, 1956. Complete information regarding the proposed revisions can be obtained from the Industrial Commission, Madison, Wisconsin.

This is a project which should be of vital concern to all engineers. Our membership is urged to participate in the revisions of our state codes. Your participation will no doubt be of value in the building of codes which are in the interest of economy, workability, and safety.

Chapter News

WESTERN CHAPTER

M. L. HOGLUND
Reporter

The first meeting of the Western Chapter was held Thursday, September 22, at the Stoddard Hotel in La Crosse. The meeting was arranged as a joint meeting with the local A.S.M.E. group, because of the outstanding speaker of the program—Dr. George H. Brown, Director of R.C.A. Research Laboratories in Princton, New Jersey. Dr. Brown reviewed the theory behind and the progress of both color and black-and-white television.

One of our chapter members, John R. Mangan, has been promoted from Assistant Plant Superintendent of The Trane Company, La Crosse, Wisconsin, to Plant Superintendent of Plant No. 2, La Crosse, Wisconsin. Mangan is a native of Chicago and obtained his Mechanical Engineering Degree from the Illinois Institute of Technology. Prior to joining Trane in 1948 he had five years of production engineering experience with Goodyear Aircraft Corporation, and a year as Consulting Engineer with the Airdraulics Engineering Company, during which he did design and development work. Mangan is also a member of the American Society of Refrigeration Engineers.

Another of our members, Arthur M. G. Moody, who was Program Chairman of the Western Chapter last year, was elected President of the La Crosse Rotary Club during the summer and is now directing the activities of that club. Moody has been with The Trane Company since 1952. Prior to that time he was Chief Research Engineer for Delaval Steam Turbine Company

(*Continued on page 48*)

RCA's New Orthophonic High Fidelity Sound Opens a New World of Music

From Ceylon to Chile, people of the world can now enjoy a wonderful new kind of recorded music.

This is made possible by RCA's development of New Orthophonic Sound that weds the beautiful tone of RCA Victor records with the superb performance of new high fidelity "Victrola" phonographs. Born of RCA's acoustical and electronic research, New Orthophonic Sound reproduces a noticeably wider range of sound frequencies, perfectly balanced for musical realism.

The experience and skill behind this achievement are inherent in all RCA products and services. And continually, RCA scientists at the David Sarnoff Research Center in Princeton, N. J., are working toward new thresholds of "Electronics for Living" — electronics that make life easier, safer, happier.

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.

NEW ORTHOPHONIC HIGH FIDELITY "VICTROLA" PHONOGRAPH, $129.95
With Panoramic Speaker System — 3 speakers scientifically angled to diffuse sound throughout room. Mahogany or modern oak finish. Legs optional, extra. Model 6HF5. Other high fidelity instruments to $1600.

RADIO CORPORATION OF AMERICA
ELECTRONICS FOR LIVING

W. S. P. E.

(Continued from page 46)

and he later was Chief Engineer for the Blower Division of the Elliott Company. Moody is a graduate of Princeton University, receiving both his Bachelor's and Master's Degree from that school.

Author of numerous technical papers which have appeared in trade publications, Moody is listed in Who's Who in Engineering and Who's Who in the Midwest. He has also received two certificates of merit from the American Society of Mechanical Engineers of which he is a member.

MILWAUKEE CHAPTER

R. M. LYALL
Reporter

No chapter news received.

SOUTHEAST CHAPTER

E. F. SPITZER
Reporter

The regular fall meeting was held at the Burlington Hotel, Burlington, Wisconsin on September 14, 1955. Edwin J. Kallevang, P.E. was principal speaker for the evening, which was devoted entirely to a discussion of Bill 688A now pending before the State Legislature. The following action was taken:

1. A resolution was passed unanimously that the Southeast Chapter of WSPE is satisfied with Bill 688A and recommends its passage. A copy of this resolution is to be sent to every state senator and all state chapters of WSPE requesting them to do likewise.
2. It was agreed that all members present should write personally to their respective assemblyman and senator.
3. Arrangements were made whereby groups of members would actually visit their senator to stress the importance of Bill 688A and its passage.

Lester O. Hoganson, P.E. was Program Chairman for the evening.

FOX RIVER VALLEY CHAPTER

V. W. KNEEVERS
Reporter

No chapter news received.

WISCONSIN VALLEY CHAPTER

J. M. HOLDERBY
Reporter

No chapter news received.

NORTHWEST CHAPTER

W. A. ROSENKRANZE
Reporter

The Northwest Chapter held its September meeting at the Glen Park Lodge in River Falls. About 50 members, wives and guests were present.

Dr. E. H. Klienpell, President of River Falls State College gave an interesting talk entitled "My Friend Jim", an account of the environmental factors facing the children of today. Psychological effects of the "Cold War" on today's youth, the inadequacies of our public school system and the need to "look forward" and not dwell on the past. All members were greatly impressed with the wealth of information presented by Dr. Klienpell.

Guests of honor at the meeting included Lt. Governor Warren Knowles and Mrs. Knowles, and State Senator and Mrs. Robert Knowles.

Following Dr. Klienpell's talk a business meeting was held and the major item on the agenda was Assembly Bill 688A. All of the various facets of the problem were considered by the Chapter.

OBITUARIES

Ray E. Behrens, 8141 Stickney Ave., Wauwatosa, Planning Director, Milwaukee County, died in March 1955. He was born March 11, 1897. Registration No. E 47.

William F. Eichfeld, 2549 N. 30th St., Milwaukee, died in Aug. 1955. He was President and Chief Engineer of Wm. F. Eichfeld & Sons Co. Mr. Eichfeld was born April 26, 1880. Reg. No. E 163.

Harry S. Fullwood, 2347 N. 101 St., Wauwatosa General Engineer, Resident Inspector, U. S. Bureau of Reclamation died in June 1955. Reg. No. E 2723.

Charles B. Hayden, 83, 509 N. Carroll St., Madison, former WSPE member, Retired Assistant Chief Engineer of the Wisconsin State Public Service Commission died Sept. 8, 1955.

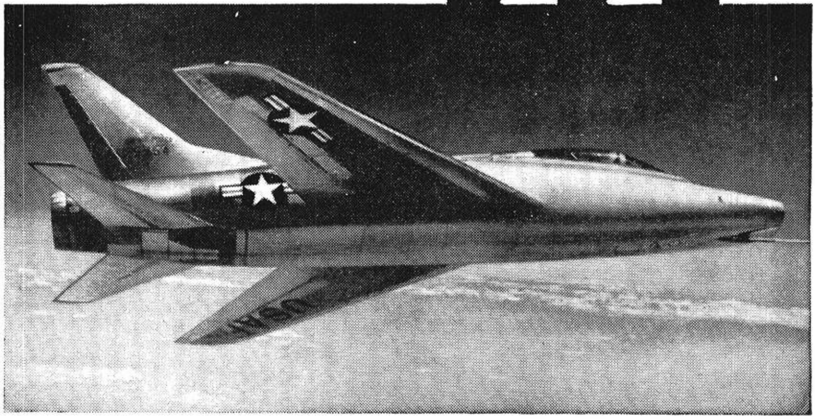
Raymond G. Pitz, 215 Church St., Oshkosh, Engineer in Training, died in Aug. 1955.

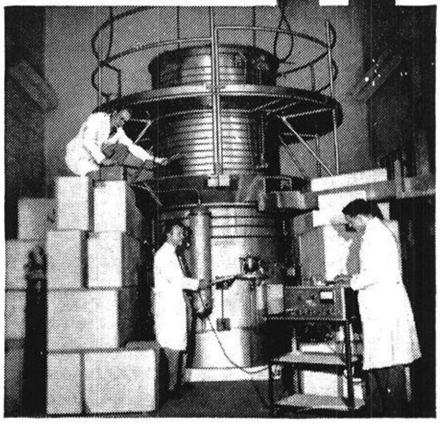
Edwin W. Seeger, 9702 Harding Blvd., Milwaukee, Vice President and Assistant Secretary, Cutler Hammer Inc., died in Aug. 1955. He was State President of WSPE in 1946 and National Representative in 1949 and 1950. He was born May 22, 1892. Reg. No. 1 144.

Joseph H. Volk, 1906 W. St. Paul Ave., Milwaukee, President of Thomas E. Hoye Heating Co., died in June, 1955. He was born June 14, 1892. Reg. No. E 1535.

Our Secretary, Harold N. Kingsbury, will appreciate your help in keeping him informed of the passing away of members in your chapter area. **END**

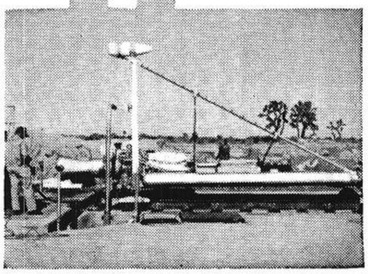
NORTH AMERICAN HAS BUILT MORE AIRPLANES THAN ANY OTHER COMPANY IN THE WORLD

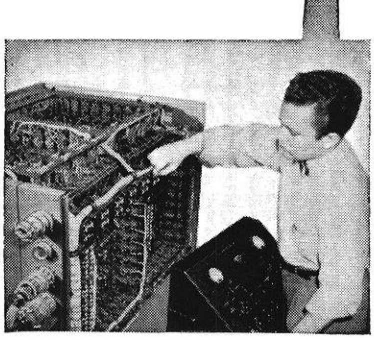




At North American—

DIVERSITY CREATES OPPORTUNITY





Graduates, undergraduates – A North American representative will be on your campus soon. He will give you complete details on the hundreds of openings these expanding fields create: AIRCRAFT: the Korea-famed F-86 SABRE JET, the record-smashing F-100 SUPER SABRE, and Airborne Vehicles of the Future. GUIDED MISSILES: the SM-64 NAVAHO Intercontinental Guided Missile. ELECTRO-MECHANICAL CONTROLS: fire controls, automatic navigation systems, flight control computers – for aircraft and missiles. ENGINES: lightweight, high-thrust rocket engines for the NAVAHO and for other missile programs. ATOMIC ENERGY: the development of nuclear reactors for research, medicine and power.

North American engineers work in top-level teams, share in a liberal Patent Award Program, a highly successful Suggestion Award Plan and many other unexcelled job benefits.

See the North American Representative at your school . . . or write:

Mr. Stevenson, Dept. 56-CM
Engineer Personnel Office
North American Aviation
Los Angeles 45, California

Mr. Kimbark, Dept. 9120-CM
Engineer Personnel Office
North American's Missile &
Control Departments
Downey, California

Mr. Pappin, Dept. 56-CM
Engineer Personnel Office
North American's
Columbus Division
Columbus 16, Ohio

ENGINEERING AHEAD FOR A BETTER TOMORROW

NORTH AMERICAN AVIATION, INC.

Whirling Wings

(Continued from page 19)

One of the most interesting phenomena of helicopter flight, and probably the most astonishing aspect to those who are not familiar with the operation of rotary-winged aircraft, is the principle of "autorotation". Autorotation is the ability of the rotor to continue turning in the direction of normal rotation after the power is shut off. Therefore, engine failure under normal flight conditions presents no problem. The instant the power is shut off the free-wheeling coupling of the transmission takes over allowing the rotor blades to autorotate. In this condition, with a low pitch setting and the relative wind coming up through the blades producing a high angle of attack, the blades can produce enough lift to insure a controlled rate of descent, and normal or near normal landing in a space slightly larger than the total diameter of the rotor.

Engineering Developments in Rotary Wing Aircraft

Research programs in rotary wing aircraft have been, for the most part, a product of the World War II years. McDonnel Aircraft's Whirlaway, the world's first twin engine, twin rotor helicopter received a Navy contract for development in May 1944. Desiganted the (XHJD-1), the Whirlaway was designed to carry ten passengers. It is fitted with tandem rotors mounted on short airfoil pylons which house the power plants and two 450 horsepower Pratt–Whitney Wasp Jr. engines.

The counter rotating rotors which are mounted well above head level elminate the need for compensating tail rotors, and add an additional safety factor for ground personnel. The flight control system in the cockpit is a dual arrangement of conventional control stick

—Courtesy McDonnel Aircraft Company

XHJD–1 Whirlaway.

—Courtesy McDonnel Aircraft Corporation

XV–1 Convertiplane.

and rudder pedals as well as the pitch controls characteristic of helicopters. Each rotor is fitted with three 50 foot blades covering a span of 91 feet. They receive power through transmissions and gear boxes incorporating centrifugal and over-running clutches which permit emergency power transmission from either engine automatically. Level flight under normal conditions can be maintained with either of the two engines at full gross weight of 5-½ tons.

Though this aircraft has never become a production model it has provided valuable data on helicopter operation, performance, balance, stability, and vibration characteristics under many possible flight conditions. After years of research, the X–HJD–1 was flown for the last time in June 1951 and has since been turned over to the Smithsonian Institute's National Air Museum.

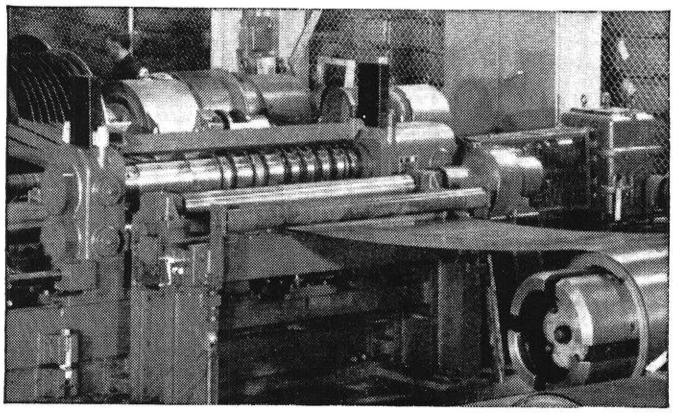
In contrast to the now obsolete Whirlaway is the McDonnel XV–1 Convertiplane. Announced in February 1954 the XV–1 is the first military aircraft of this type ever developed in the United States. It possesses the unique distinction of utilizing the principle of pressure jets and high disc loading—a machine equipped with a rotor for vertical flight and wings and propeller for forward flight.

During vertical flight or hovering, the rotor provides all the lift. In forward flight the wings provide essentially all the lift, allowing the rotor to autorotate at its lowest drag configuration. This avoids the speed limitations encountered by conventional helicopters due to stalling of blades when they must carry lift at high speeds. The rotor blades are powered by individual McDonnell–developed pressure-jet units located at the tip of the blades. Fuel is fed into the three pressure-jet tip burners through a rotor fuel governor driven from the rotor hub accessory drive. The application of power directly to the blade tips eliminates the torque which in conventionally driven helicopters must be balanced by the use of a second rotor or propellor. A conventional reciprocating engine is located on the aft fuselage to supply air to the pressure jet units during vertical flight and power to the propeller during forward flight.

(Continued on page 52)

Another page for **YOUR BEARING NOTEBOOK**

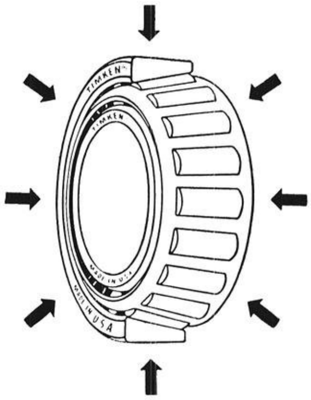
How to keep cutters aligned on high-speed coil slitter



Company engineers had the problem of keeping the cutters on this Stamco Coil Slitter operating accurately at high speeds. It meant keeping them in rigid, positive alignment. To take the heavy combination of radial and thrust loads required, they specified mounting the cutter arbors on Timken® tapered roller bearings.

Tapered design lets Timken® bearings take both radial and thrust loads

Because of their tapered design, Timken bearings can take radial or thrust loads or any combination. And because the load is carried along a full line of contact between rollers and races, Timken bearings have extra load-carrying capacity.



Want to learn more about bearings or job opportunities?

Some of the engineering problems you'll face after graduation will involve bearing applications. For help in learning more about bearings, write for the 270-page General Information Manual on Timken bearings. And for information about the excellent job opportunities at the Timken Company, write for a copy of "This is Timken". The Timken Roller Bearing Company, Canton 6, O.

TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS

NOT JUST A BALL ○ NOT JUST A ROLLER ⊂⊃ THE TIMKEN TAPERED ROLLER ⊂⊃

BEARING TAKES RADIAL AND THRUST LOADS OR ANY COMBINATION

Whirling Wings

(Continued from page 50)

Bell Aircraft Corporation, pioneering in helicopter development, developed one of the most versatile lines of rotary winged aircraft in their latest model, 47G. Within the bubble-type cabin of free-blown Plexiglas, the Bell Model 47G accommodates three persons in a side-by-side seating arrangement. The cabin enclosure houses pilot controls, engine instruments, safety belts, map-case, removable cushions, and the required VFR flight instruments.

By utilizing welded aircraft steel tubing for the fuselage, optimum structural requirements with a minimum of weight have been met. A skid-type landing gear with no moving parts has been adapted to facilitate ease of landing on extremely rough terrain.

The model 47G helicopter is powered by a six-cylinder Aircooled Motor's engine having a rated brake horsepower of 200 at 3100 rpm. The main rotor, tail rotor, generator, and cooling fan are driven by a two-stage planetary transmission. Safe, controllable power-off landings are insured by a free wheeling unit in the transmissions which allows the main rotor to autorotate and drives the tail rotor at the same time.

The rotor system consists of a two-bladed, semi-rigid main rotor with laminated wooden rotor blades, a steel hub and a stabilizer bar. A newly developed control feature is a synchronized elevator which is tied directly into the control system, providing more stability and allowing a greatly increased center of gravity travel.

The extensive use of Bell helicopters (more than 1000, logging a total greater than one million flying hours) throughout the world can be attributed to the manner in which Bell has developed their machines for many applications. Examples of the auxiliary equipment available for the Model 47G are: extended cargo carriers for transporting machines and materials, spraying equipment for erosol fog and crop dusting, rescue litters for emergency rescue work, and float type landing gear for amphibious operations at sea or in marsh and swamp areas.

Commercial Helicopter Operation

The helicopter is today, and will be even more in the future, an important consideration in the commercial handling of strategic traffic. In July of 1953, New York Airways inaugurated the first regularly scheduled helicopter passenger service in the world. Previously they had been certified to carry only cargo. At present "skybus" Passenger service provides flights between LaGuardia, New York International (Idlewild) and Newark airports, Trenton and New Brunswick in New Jersey, White Plains in Westchester County and Stanford in Connecticut. The helicopter now used by New York Airways is the Sikorsky S–55 the largest helicopter certified for commercial use in the world. The helicopter transport service can do in 18 minutes what a truck takes 2-½ to 4 hours to perform lifting freight over the surface traffic rivers and harbors. Service for airmail is performed at night, commonly carrying as much as 1000 lbs. of airmail out of Newark airport; this results in the faster delivering of about 50,000 letters. A wide variety of commodities is carried by helicopters. Whenever rush delivery is essential, such as production orders or needed pharmaceuticals, helicopters air lift answers the call. Freight limitation in the S–55 are those generally applied to the D.C. 3's: in size 20"x24"x40", in weight, 200 lbs. per piece and a floor loading no greater than 100 lbs. per square foot.

Sikorski S–55.

—Courtesy New York Airways

In addition to New York Airways, Los Angeles Airlines and Helicopter Air Service, Inc. in Chicago are also engaged in similar transportation operations. Helicopter air mail service on the European Continent was initiated in 1950 by the Sabena Belgian Airlines. During the first year of operation their helicopters delivered more than four million letters over a 268 mile route in Belgium.

Cost, at present, is the largest deterrent to the commercial application of helicopters, the initial cost of a helicopter being higher than that of a conventional airplane. Maintenance costs, too, in some respects are higher than those of most aircraft. For example, the rotor head assembly on the helicopter, an intricate machine, is high priced with a relatively short life of about 100 flying hours. The basic passenger rate set by New York Airways is set on a sliding scale of 50 cents per mile for short runs, to 16 cents per mile over long distances (60–70 miles). The standard passenger rate from La Guardia Airport to International Airport of $4.09 is cheaper than taxi service and two to four times faster than taxi, train or bus.

The helicopter has met with universal acceptance and is at present, operating in more than thirty foreign countries. The scope of helicopter use is unlimited ranging from governmental surveys, construction, agriculture, airmail, power line patrol, fire fighting, traffic control, and ranching to freight and passenger transportation. The military has found the helicopter an indispensible item as it serves in the capacity of search plane, liaison, reconnaissance, cargo transporter, wire layer, and rescue plane. On the Korean Peninsula alone, approximately 25,000 wounded United Nation's troops and Korean civilians were evacuated by helicopter. The helicopter is a truly dynamic aspect of the aircraft industry with a relatively short, but full past, and prospects for an even greater future. **END**

Illumination Engineering

(Continued from page 15)

figure 13 are particularly flattering for subjects with dominant features or coarse complexions.

The arrangement in figure 13 may be altered slightly to create a different effect. The model and the subject remain in the same position, but the back-light is directly behind the model and elevated three ft. above her head. In this portrait the model's hair is highlighted on the top and partly on each side. The facial features are also altered slightly.

Another simple plan using two lights is illustrated in figure 14. Again light 1 is used with a back-light pointed toward the background. The results are the same except the shadows cast on the background by the model are eliminated and the background is also brightened.

A much better method of portrait lighting than any of the ones previously described, is obtained by using three floodlights as shown in figure 15. This portrait is the combination of lights 1 and 2, and a 45-degree back-light. The combination of these three lights produce excellent characteristics: 1) the full lighting of the model and the background by light 1, 2) the texture of light 2; 3) the depth of the 45-degree back-light. Although the position of the three floodlights can be changed slightly, this is the basic scheme. If it is used properly, it will produce a portrait creating the illusion of three dimensions.

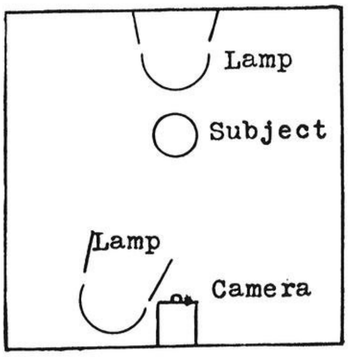


Fig. 14.—Two Floodlights.

Fig. 15.—Three Floodlights.

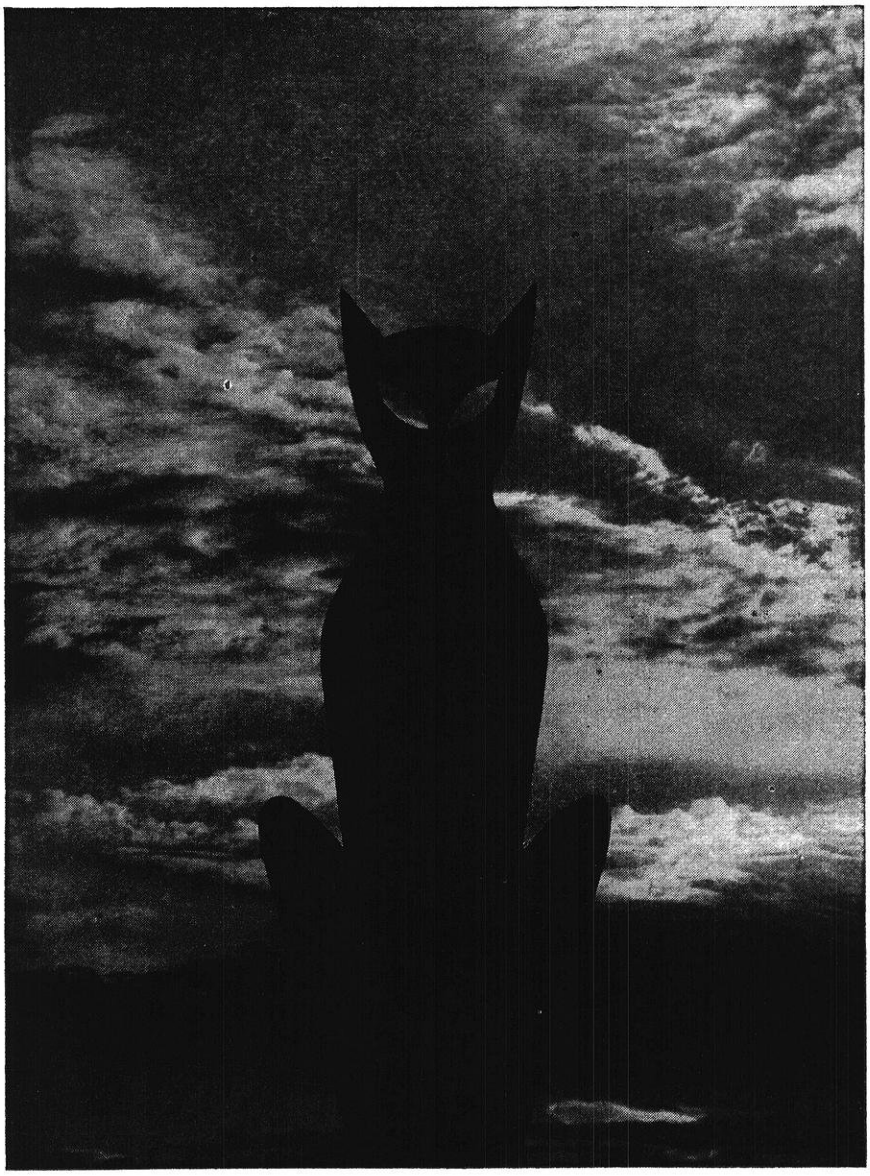
Another entirely different method of lighting is by electronic speedlight. If the flash is bounced off a light-colored ceiling or any light-colored surface, the subject is evenly illuminated and it is similiar to figure 8. This type of lighting is general and produces a soft effect. Furthermore the duration of the flash is so brief (1/1000 sec.), that any movement by the model will not cause a blurry negative. Other advantages of an electronic flash are: 1) the electronic flash units are small, portable, and light-weight; 2) the units can be handled with minimum care and still give long periods of service; 3) the light is on only during the exposure of the negative and does not fatigue the model. There are two rules for electronic bounce lighting: 1) the light should be above the subject's head to avoid direct lighting from the reflector; 2) the light should be as far away from the ceiling as possible to produce even lighting on the subject.

In most cases the electronic flash unit is too expensive to buy, and therefore, you will undoubtedly work with floodlights. A very economical reflector can be made by using a 16 x 20 in. cardboard; one side is painted white and for more reflection, the other side is covered with inexpensive aluminum foil. The cardboard is only used with a main light and is placed near the model. The reflection from the cardboard will remove any deep shadows on the subject's face.

As you can see, it is unnecessary to own expensive equipment to take good portraits. Floodlights with spring-clamps eliminate the need for lightstands, because the lamps can be clamped on chairs, or floor lamps. Plain backgrounds should be used to avoid attractions of the eye toward the background objects. A solid dark-colored blanket can be used for most portraits. An inexpensive tripod is almost a necessity because hand-held cameras are not very steady for long exposures.

After experimenting with different lighting schemes, you as an amateur photographer probably will modify them to suit your own taste. However, if you understand the purpose of each basic lighting scheme, you will be able to take your portraits without any difficulty.

END



Science Highlights

(*Continued from page 27*)

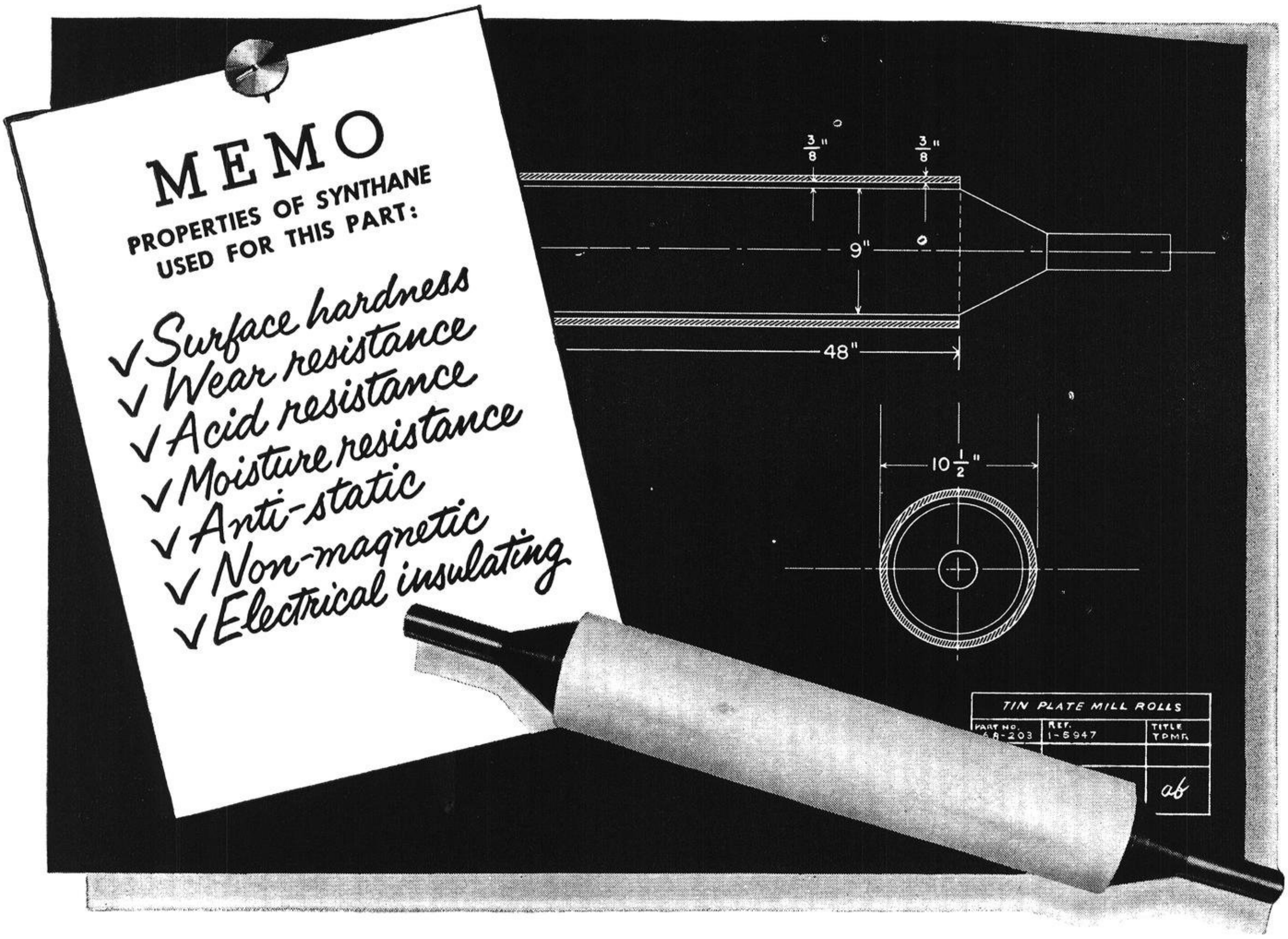
car radio has been described recently by scientists.

The new radio, employing nine transistors in place of electron tubes, is equal in performance to standard car radios. Emphasizing its low power consumption, it was pointed out that more than half the small amount of current required by the radio is used to light the two small pilot lights that illuminate its dial. A radio of this type would create so little drain on a car battery that it could eliminate many cases of battery failure that now occur when a driver forgets to turn off the radio when he parks his car.

The radio has been tested with a 6-volt battery as its power source. It is also adaptable to installation in automobiles with 12-volt batteries.

While the experimental radio resembles present car radios in its external appearance it requires no vibrator, END

YOU FURNISH THE PRINT, WE'LL FURNISH THE PART



TIN PLATE MILL ROLLS, COVERED WITH SYNTHANE LAMINATED PLASTICS, LAST 3 TO 5 TIMES LONGER, CUT DOWN TIME, IMPROVE PRODUCTION

The hundreds of rolls guiding steel plate through pickling, tin-plating and polishing operations at speeds up to 4100 feet per minute take a terrific beating from moisture, acid, sharp edges. Rubber-coated rolls sometimes last but a week. And tiny bits of abraded rubber prevent the deposition of the tin plate, mar the surface. Then Synthane laminated plastic covers were applied directly to the rolls.

SYNTHANE CORPORATION, *13 River Road, Oaks, Pa.*

Please send me more information about the combination of Synthane properties.

Name______________________________

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Company__________________________

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City______________Zone______State______

What a difference! The hard Synthane surface does not become imbedded with foreign particles. Synthane is anti-static and non-magnetic, doesn't attract metal chips which could scratch the surface.

Synthane is also chemical-resistant; plating acids have little effect upon it, and being an electrical insulator, Synthane does not short the electroplating currents.

The net result is a 3 to 5 times longer life for Synthane-covered rolls, far less downtime; less maintenance and higher production rates. Look into Synthane's combination of properties for your product or application. Write for booklet of Synthane sheets, rods, tubes and fabricating service.

SYNTHANE

LAMINATED PLASTICS

SYNTHANE CORPORATION • OAKS, PENNSYLVANIA

Magnetostriction

(Continued from page 22)

this method cost between $250.00 and $300.00.

The ultrasonic machine tool was able to produce the die, (Fig. 2), at a cost of less than $60.00, including $30.00 for tools. These tools, incidentally, were the same ones that would have been used on the ripping machine for opening up the die shape, so no special tools were necessary. The entering angle was produced in 60 minutes, using two tools. The bearing section was established with one tool in 30 minutes. Finish and accuracy were such that the die could be immediately put into use.

This die was made at the request of a leading manufacturer of shaped wire, who was so impressed with the job that he promptly purchased an ultrasonic tool and has since worked it into a position in his plant where it is even more dramatically economical.

Although it appears that this ultrasonic machining process fills a real gap in our present machining methods, it does have limitations. It is not well adapted to working softer materials, nor is it suitable for heavy stock removal. Its principal field is in machining hard materials such as carbides or ceramics, and in jobs requiring detail and accuracy impossible to obtain by other machining methods. No elaborate set-ups or skilled operators are required, and this helps to lower production costs.

The science of ultrasonics has already been put to work in the fields of food processing and brewing; inspection and quality control; altering and mixing applications in the chemical industry; military uses such as Sonar and fog control; medical therapy, exploration, and surgery; and even the lowly task of industrial cleaning and degreasing, the ultrasonic machine tool is another successful application of this new science of silent sound, and seems certain to take its place alongside conventional machining methods as an important tool in industry. END

A Joke That Didn't Get Printed . . .
After enjoying a Hoffman House meal, the after-dinner jokesters took over. The banquet was attended by staff members, faculty advisers and board members, former officers, and guests.

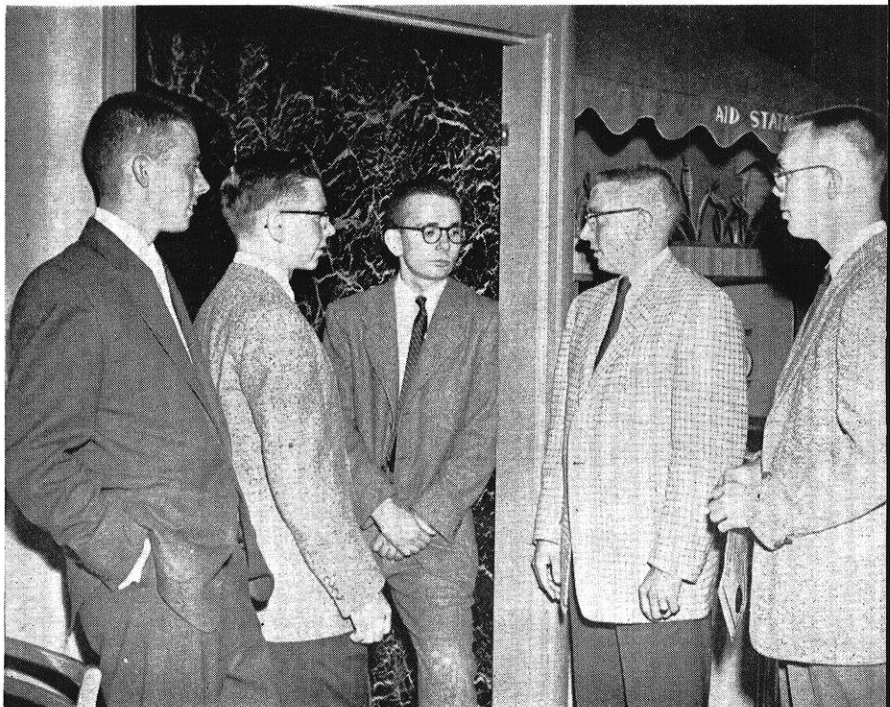
". . . and Best of Luck for the Next Year."
John R. Frederick, last year's publication committee chairman for W.S.P.E., spoke of the need for co-operation between professional and undergraduate engineers.

1954-55 WISCONSIN ENGINEER BANQUET

photos by Jim Richards, Met.'57

In the Money . . .
Dick White (left) and Fritz Callies (right) pose briefly for the photographer before rushing out to cash their award checks.

"What A Meal!"
Some of the staff pause to comment on the night before leaving. They are (left to right) Tom Collins, Dick White, Ned Godfrey, Jim Collins, and Fritz Callies.

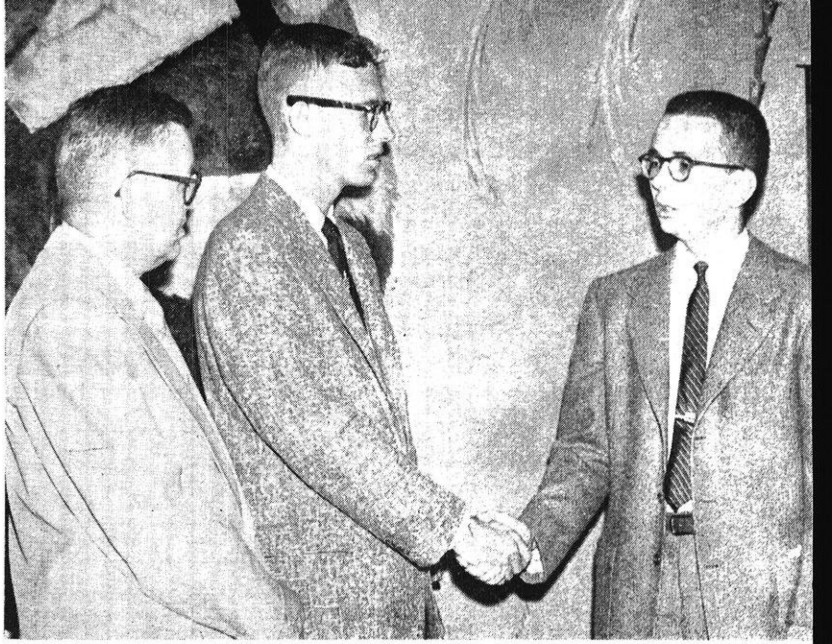


The *Wisconsin Engineer* held its annual banquet last May 25th, at the Hoffman House, for the purpose of congratulating and thanking last years staff and wishing good luck to this year's team. Dean Wendt served as toastmaster and the main speaker was Mr. John R. Frederick, chairman of the Publications Committee for WSPE. Mr. Frederick spoke of the growing need for better communications between undergraduates and practicing engineers. He felt that the *Wisconsin Engineer* was helping to fill that need and expressed hope for more links of that type.

Awards were given to Richard White for his story, "Putting Old Sol to Work", and to Fritz Callies for his several good stories last year. "*Wisconsin Engineer*" keys and Certificates of Merit were awarded to qualifying members of last year's staff. *Wisconsin Engineer* Keys and Certificate winners are:

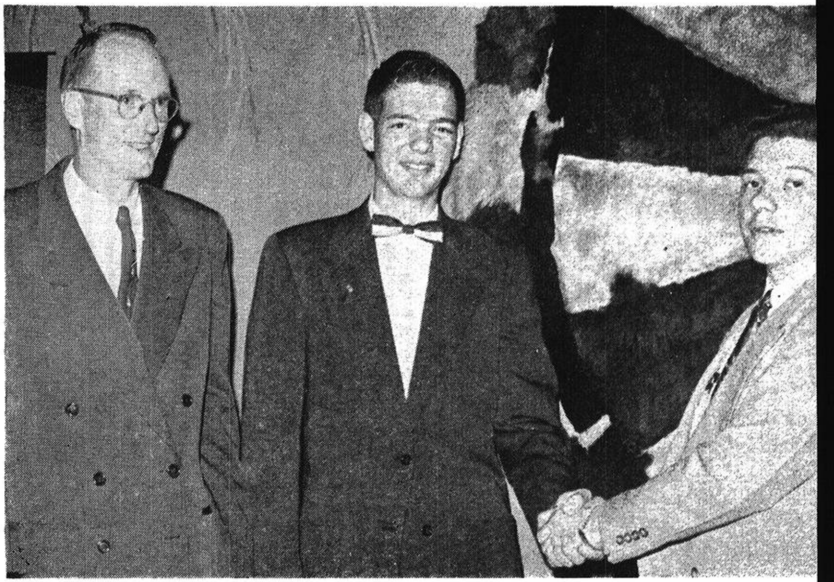
Keys—Bob Hentges, Jon Baumgartner, Don Edwards, Dick White, Dave Dauterman, Robert Kohn, Clarence Reider, C. Barclay Gilpin.

Certificates—Ron Parkinson, William Gresenz, James Richards, Robert Kaseguma, Fritz Callies, Carl Burnard, Ron Schroeder, Larry McCormick, George Knudson, Jule Bergauer.



"Hate to Rush, but My Job Is Done . . ."

Ned Godfrey, retiring editor (right) leaves his work for Bob Hentges (center) to continue. Prof. Gage, faculty adviser (left) promises to watch over Bob during the next year.

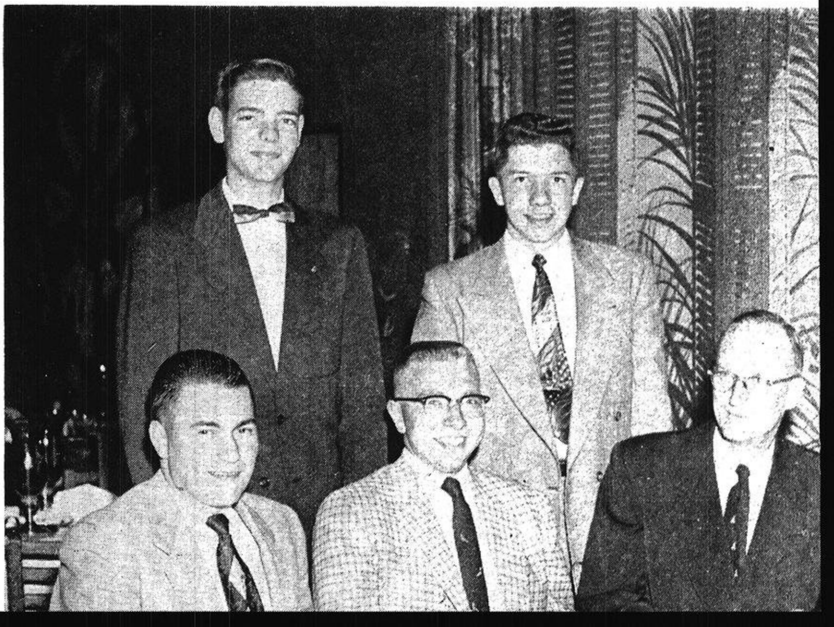


"Keep Your Eye on the Editorial Staff . . ."

Carroll Rands, retiring business manager (right) warns Barclay Gilpin (center) of the spendthriftness of the editorial staff. Prof. W. K. Neill, chairman of the Board of Directors (left) smiles knowingly.

Five Generations

Five generations of Business Managers attended the banquet last spring. They were (left to right) Preston Koento, Jim Collins, Prof. Neil in the first row; Barclay Gilpin and Carroll Rands, in the back.



Turbojets

(Continued from page 13)

example we speak of a single stage turbine and a single stage compressor.

The single stage turbine (See Figure 3, no. 12) consists of a stator and a rotor. The stator delivers hot gases from the combustion chamber to the rotor at the proper angle of attack. To compensate for high thermal expansion, the stator blades are allowed to slide freely in the outer ring of the stator assembly. In some turbine assemblies the stator blades are hollow and are water cooled.

The rotor parts are the disc, shaft and blades. The disc and shaft are usually machined from a single alloy steel forging; however, the shaft may be flash-butt welded to the disc. The shaft and disc are usually balanced before the blades are inserted, then balanced again after insertion of the blades.

In the operation of the single stage turbine, gases from the combustion chamber pass through the nozzles in the stator which direct them at high velocity into the turbine blades. The direction of the gases reverse as they strike the blades and as a result, a force is developed which tends to move the blades. Since velocity is a vector it can be resolved into components: an axial component parallel to the rotor shaft, and a tangential component. The axial velocity can be thought of as moving the gases through the turbine rotor while the tangential velocity acts to move the blades. Multi-stage gas turbines are used principally in engines equipped with axial-flow compressors.

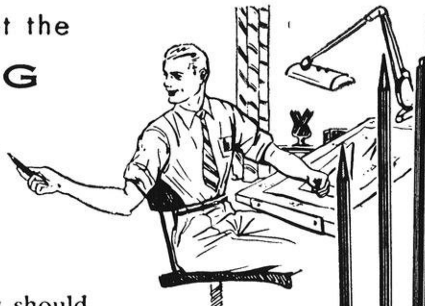
When gases leave the turbine they have much turbulence. The main function of the exhaust assembly is to straighten out the flow of gases so that they leave the engine in a smooth stream. The exhaust assembly is shown in Figure 3 as consisting of an inner cone, an outer cone and a jet orifice, the tailpipe not being attached. The inner exhaust cone, in jet engines incorporating a centrifugal compressor, is a fixed member supported by streamlined struts usually made of stainless steel.

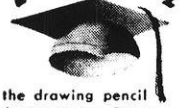
All turbojet engines have an accessory assembly which generally consists of an accessory gear casing, a train of reduction drive gears, an oil reservoir and other miscellaneous accessories. The accessory assembly is usually mounted either directly on the front, or on the forward sides of the turbojet engine.

Lubrication System

In comparison to piston engines, turbojets are comparatively easy to lubricate due to the absence of many moving parts and because none of the moving parts are exposed to the heat of combustion. The oil reservoir has a capacity of approximately 14 qts. A baffle is included in the reservoir to prevent suring of oil during flight operations. Modern turbojet aircraft are designed to operate from sea level to 45,000 ft. Over this range of altitudes, atmospheric pressure will vary

(Continued on page 64)





Microwave Systems
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Aviation Instruments
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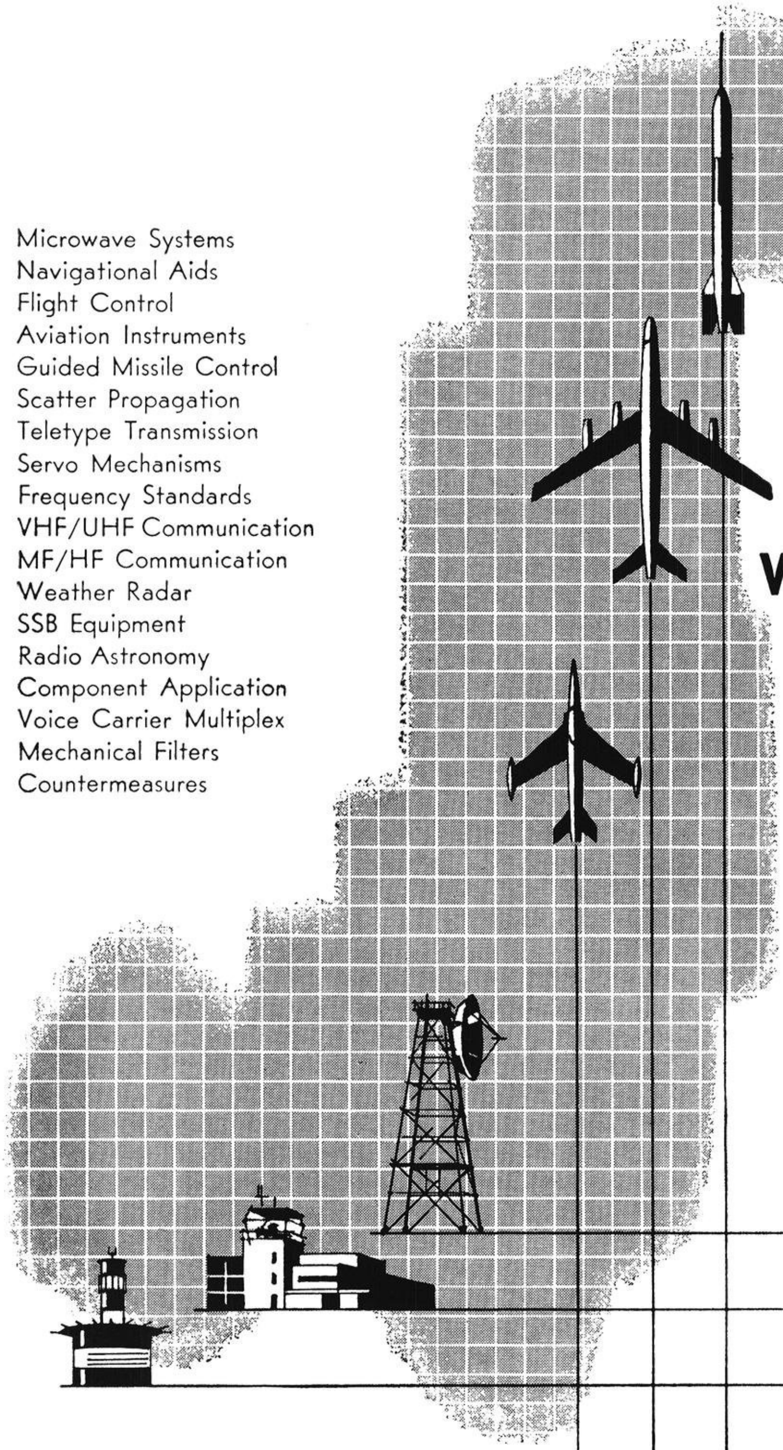

VISION, VERSATILITY

In Electronic Engineering

Collins Radio Company's engineering research and development facilities are as complete and advanced as the Company's leadership in the electronic field. New thoroughly-equipped labs and highly-experienced manufacturing operations promote the creative efforts of the 1,500-man engineering division. Total employment is 7,500. Plants and labs are located at Cedar Rapids, Dallas, Burbank and Toronto.

If you are graduating in mechanical or electrical engineering, contact the engineering placement office and request an interview. A Collins representative will outline the many opportunities in advancement, salary and security, and employee benefits.

Interviews will be held on the campus, Friday, November 4.

For additional information, write L. R. Nuss, Collins Radio Company, Cedar Rapids, Iowa for a copy of "Career With Collins."

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CREATIVE LEADERSHIP IN ELECTRONICS

COLLINS

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Turbojets

(Continued from page 62)

from 14 psi to 2 psi and atmospheric temperature from 140°F to-80°F. With these extremes, correct choice of lubricant becomes a cardinal factor in the operation of the engine.

Turbojets require a free flowing, fast burning fuel which will librate a maximum amount of heat in a given time without leaving gum, carbon deposits or excess ash. Kerosene meets these requirements as well as free flow at low temperatures, relatively low cost and a margin of safety as compared to gasoline.

One of the main disadvantages of the turbojet engine is its high fuel combustion. The sleek design used in modern aircraft (thin wings, slender fuselage, etc.) limit the fuel storage space adding to the problem.

The thrust produced by turbojet engines usually is adequate at high altitudes but some means of thrust augmentation must be employed to permit reasonably short take-off runs. There are now two practical methods of thrust augmentation which are: water alcohol injection and exhaust reheat (afterburner).

In the water-alcohol method, a mixture of water and methyl alcohol is sprayed into either the combustion chambers or the air before it enters the compressor. The result is an increase in turbine discharge pressure, higher jet velocity and finally an increase in thrust. Thrust is increased from 18% to 30% with the water-alcohol injection method.

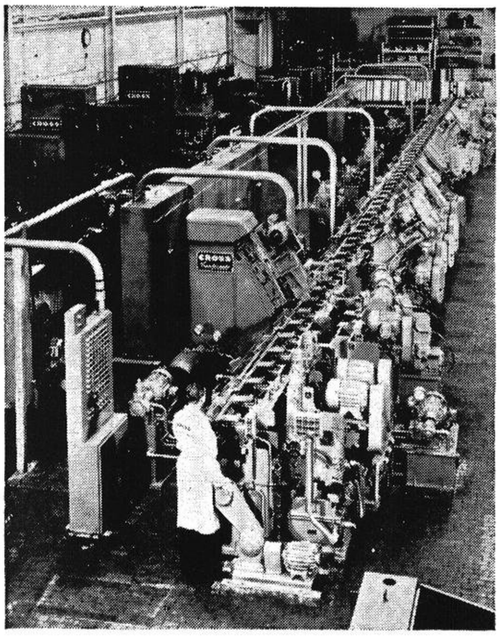
Other factors remaining constant, the thrust of a turbojet engine is increased with a rise in exhaust temperatures. The turbine will only withstand temperatures up to a certain limit, but if the exhaust gases are reheated *after* passing through the turbine, increased thrust will result with no damage to turbine parts. This is the principle of the afterburner in which a fuel mixture is sprayed into the exhaust system and ignited with the escaping air. Because a turbojet consumes only 25% of the air taken in, there will always be an adequate supply of air to the afterburner to combine with the fuel before ignition.

When using the afterburner a much larger exhaust nozzle must be used than for a non-augmented engine. A variable nozzle or "eyelid" is provided for this purpose. The nozzle is constricted during normal operation and fully open when the afterburner is in effect.

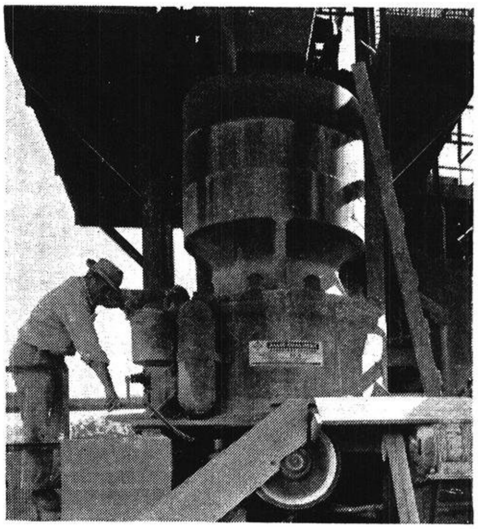
The turbojet engine is certainly a highly specialized and exact piece of machinery. Tolerances of some engine parts run to one-tenth the thickness of a human hair. Requirements for high rates of production of this engine have resulted in many newly specialized and competitive industries in the United States. This fact should be taken into account when considering our country's high Air Force budget. Yes, the turbojet is a great engine, whose principles developed primarily for fighting purposes will some day set the pace for peace time use of jet energy.

END

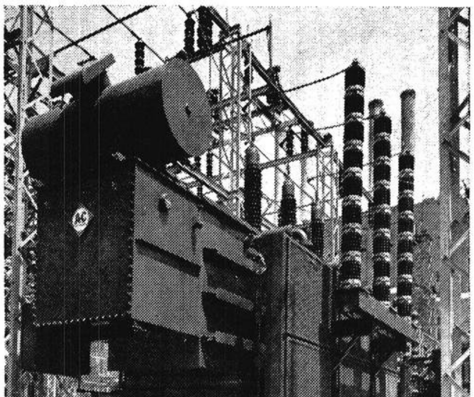
Build your future on these 3 Growth Industries . . .



MANUFACTURING — There are 51 Allis-Chalmers motors in this lineup of machine tools designed for high automobile production.



CONSTRUCTION—Crushers like these from Allis-Chalmers process the enormous quantities of aggregate for the booming construction industry.



POWER GENERATION—Allis-Chalmers is helping meet growing power demand with equipment such as this 150,000 kva transformer.

THERE IS much talk today about growth companies. Allis-Chalmers is one of them, supplying machinery for three basic industries—manufacturing, construction and power.

Therein lies an opportunity for you, since Allis-Chalmers builds many types of equipment.

. . . for a manufacturing industry that must increase output $3.5 billions by this time next year.

. . . for the construction industry that is destined to spend many billions of dollars on highways in the next ten years.

. . . for the electric power industry that will double its capacity by 1956.

Here's what Allis-Chalmers offers to Young Engineers:

A graduate training course that has been a model for industry since 1904. You have access to many fields of engineering: Electric power, hydraulics, atomic energy, ore processing.

There are many *kinds* of work to try: Design engineering, application, research, manufacturing, sales. Over 90 training stations are available with expert guidance when you want it. Your future is as big as your ability can make it.

Or, if you have decided your field of interest and are well qualified, opportunities exist for direct assignments on our engineering staff.

In any case—learn more about Allis-Chalmers. Ask the A-C manager in your territory, or write direct to Allis-Chalmers, Graduate Training Section, Milwaukee 1, Wisconsin.

A-4684 **ALLIS-CHALMERS**

Plants and Sales Offices all over the World

So You Think You're SMART!

by Sneedly, bs'60

They tried to get rid of good old Sneedly last year, but they didn't quite make it. As a result, Sneedly spent the summer thinking up problems to have a few of you campus geniuses figure out.

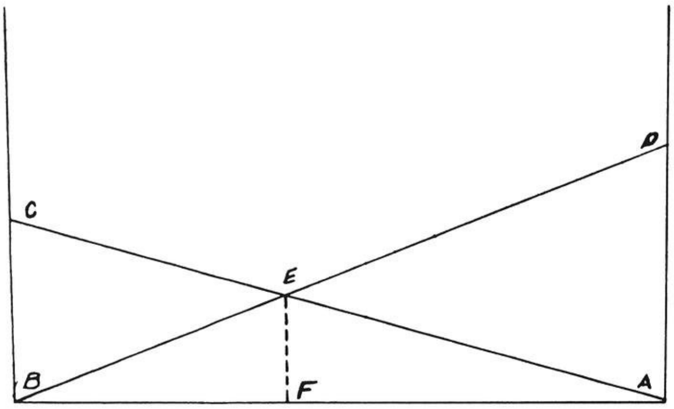
The first problem which Sneedly wants the answer to is one which certain persons on campus who tried to find Sneedly's identity last year, and didn't, can use as a hint this year. Sneedly is twice the age that you were when Sneedly was your age. When you get to be Sneedly's age, your ages will total 63 years. How old am I? Along with this hint on Sneedly's age you can be assured that he is an engineer. This should make his identity no secret.

* * *

Here is another little "quickie" to get you warmed up to the hard problems now on the way. Sneedly found this one at an indoor track meet last winter. Three speedsters, Jim, John, and Joe, evenly spaced on a circular track in that order, start walking around the track in the same direction. If Jim overtakes John in 15 minutes and requires an additional 5 minutes to overtake Joe, how long does it take John to overtake Joe?

* * *

Sneedly didn't tell you but he had a construction job last summer and since he is known far and wide for his mathematical abilities, he was given this problem by his foreman:



In an alley of width AB, two beams are resting against two vertical walls as shown in figure one. AC is fourteen feet long, BD is sixteen feet long and EF is two feet. Sneedly's problem was this; how wide is the alley? Good old Sneedly figured it out, can you?

* * *

Another easy twister that Sneedly found and liked the looks of is one about a wholesaler. A certain wholesaler receives his slide-rules in boxes of two sizes, each containing a definite number of slide-rules. With these boxes he receives, he can make out any order to the retailer without opening a box with the exception of six orders. The head economist for the box manufacturer decides that the demand for one of these sized boxes has declined and it would be to the manufacturer's advantage to make a different sized box. He readily does so and he makes a box which contains a different number of slide-rules. After the change, the wholesaler can fill any order except ten orders. How many clocks are there in each of the three boxes?

* * *

This next problem Sneedly is dedicating to all Junior Ch.E's struggling through their fluid flow problems in Unit Operations this semester. A tank has three drains in it. If the number one drain is opened, the tank will drain in fifteen minutes. When the number two drain is opened the tank drains in thirty minutes, while if the number three drain is used, it takes forty-five minutes to empty the tank. How long will it take to drain the tank if all three drains are opened at the same time. (*Hint*—Bernoulli's fluid flow equation may or may not apply.

Sneedly feels that these problems should keep you occupied for an hour or two. Send any of these problems' solutions to "Sneedly" in care of the Wisconsin Engineer, 333 Mechanical Engineering Building. For those of you who cannot figure out these problems frontwards, the answers to the problems will appear in next month's issue and you can work them backwards. **END**

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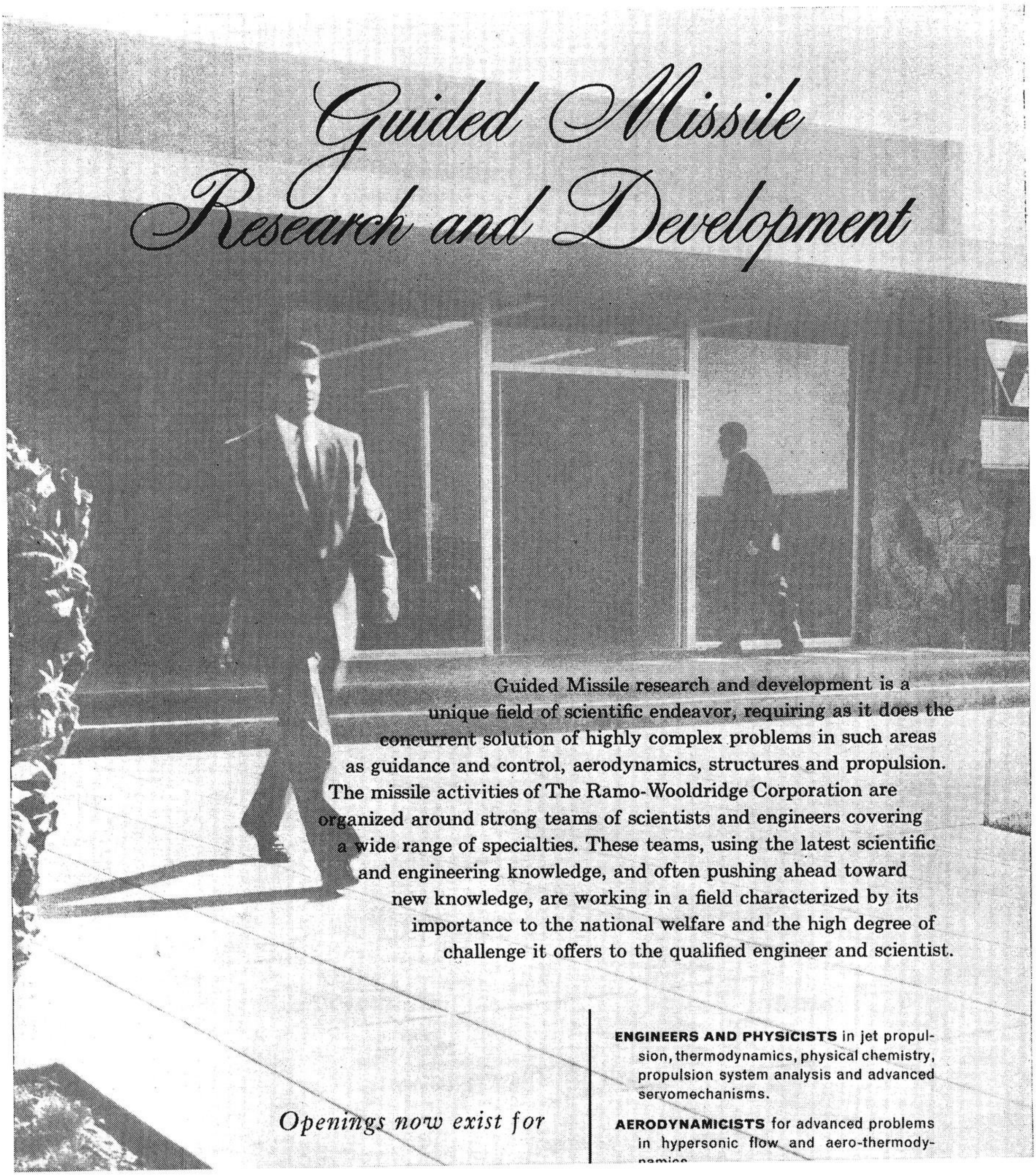
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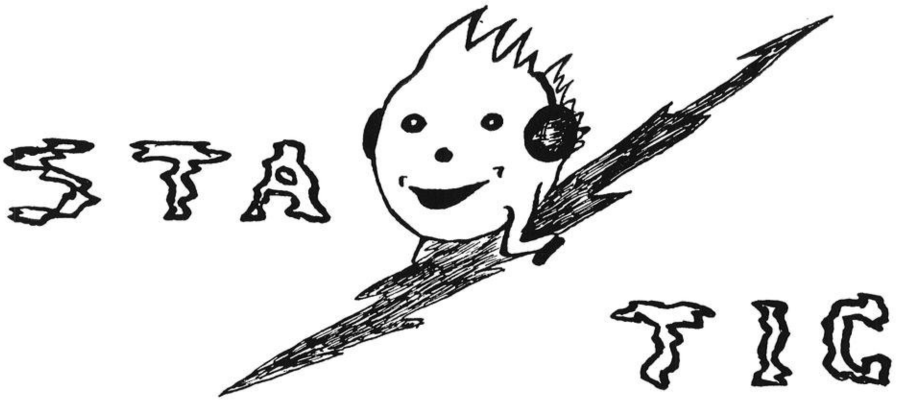
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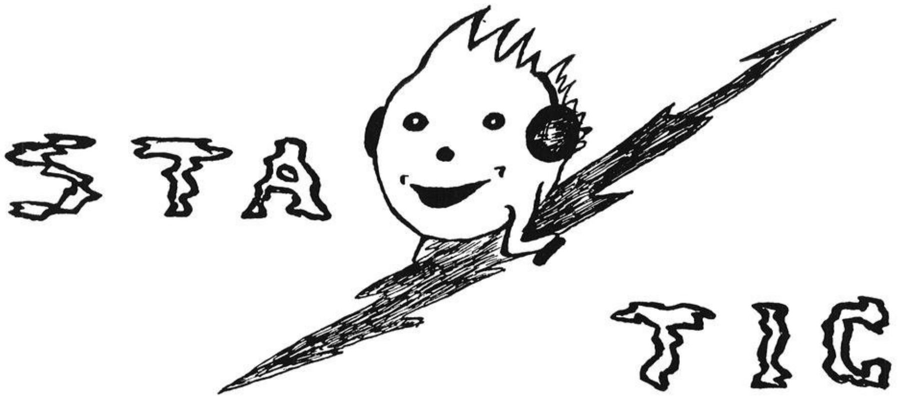


by I. R. Drops

What Is a College Boy?

From the *Tower Times*, Univ. of Rochester

"Between the senility of second childhood and the light-hearted lechery of the teens, we find a loathsome creature called a college boy. College boys come in assorted sizes, weights, and states of sobriety, but all college boys have the same creed: To do nothing every second of every minute of every day and to protest with whining noises when their last minute of inertia is finished and the adult males pack them off to the Employment Office or the Draft Board.

"College boys are found everywhere—breaking train windows, tearing down goal posts, inciting riots or jumping bail. . . . A college boy is Laziness with peach fuzz on its face, Idiocy with lanoline in its hair and the Hope of the Future with an overdrawn bank book in its pocket. . . . When he wants something it's usually money. He likes good liquor, bad liquor, cancelled classes, double features, Playtex ads, girls, and football weekends. . . .

"Nobody else can cram into one pocket a slide rule, a Marilyn Monroe calendar, Kant's 'Critique of Practical Reason', a collapsible pool cue, a Hawaiian ukelele, 39 cents in Italian lire, Muggsy Spanier record, and a YMCA towel. A college boy is a magical creature—you can lock him out of your heart but you can't lock him out of your liquor cabinet. You can lock him out of your mind but you can't get him off your expense account. . . . But when you come home at night with only the shattered pieces of your hopes and dreams, he can make them mighty insignificant with four magic words: 'I flunked out, Dad'."

* * *

Mike: "You look broken up. What's the matter?"
Norm: "I wrote home for money for a study lamp."
Mike: "So what?"
Norm: "They sent the lamp."

* * *

Television: An improvement over radio. Now you cannot only hear static, but you can see it too.

Caterpillar: An upholstered worm.

G. I. Haircut: A patch of hair with white sidewalls.

Evening Dress: A dress that's more gone than gown.

Love: A lot of dame foolishness.

* * *

A faith healer ran into his old friend Max and asked how things were going.

"Not so good," was the pained reply. "My brother is very sick."

"Your brother isn't sick," contradicted the faith healer, "he only thinks he's sick. Remember that he only thinks he's sick."

Two months later they met again and the faith healer asked Max, "How's your brother now?"

"Worse," groaned Max, "he thinks he's dead."

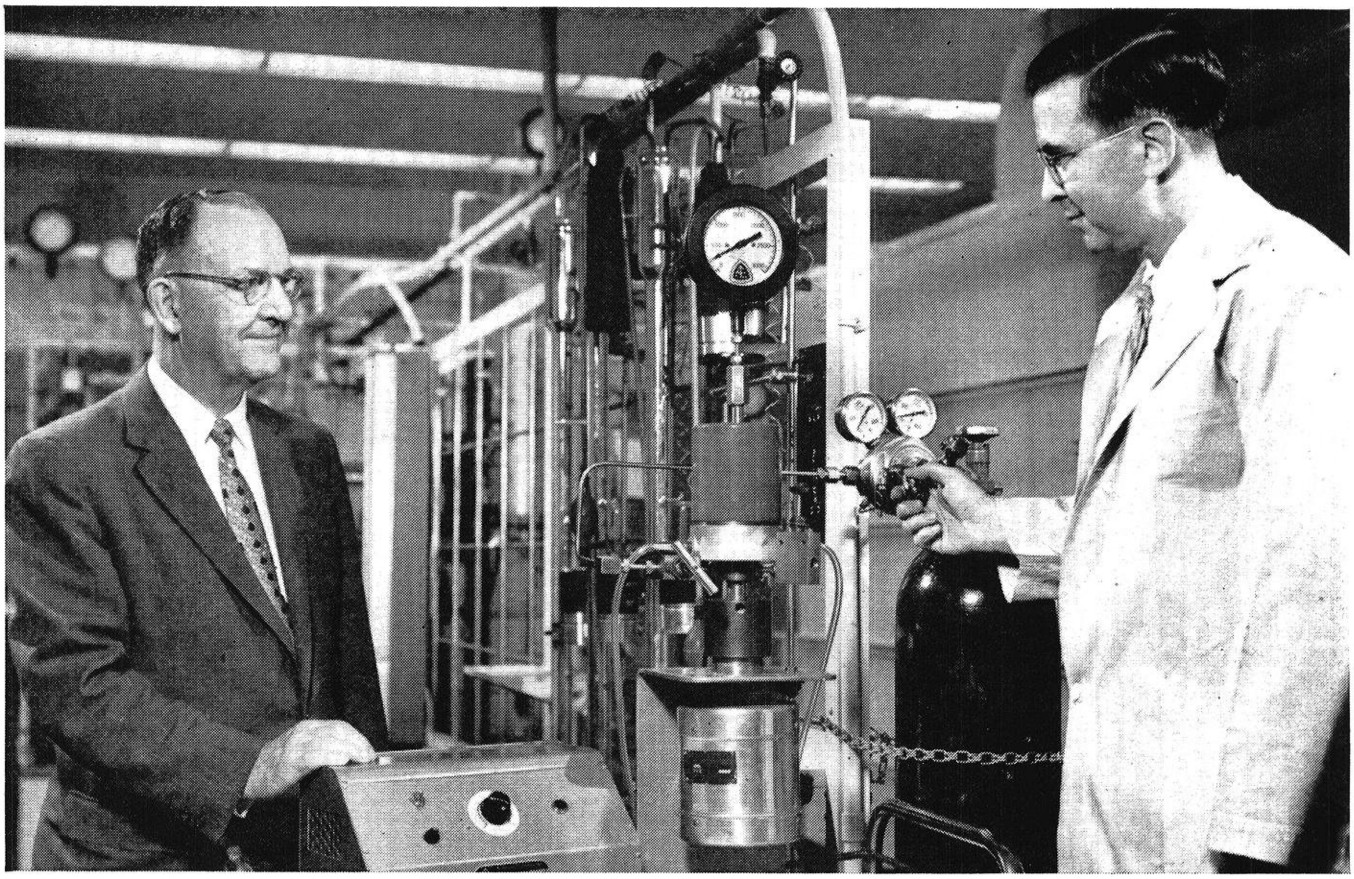
* * *

Engineer's Lament

Keep on studying, get no sleep,
Soon you're looking like a creep;
Coffee flows, aspirin too,
Seems your eyes are full of glue;
Stress and strain, calculus,
Find the unknown, must not fuss,
Temper short, work with droop,
Keep on feeling like a stupe.
Paper spread upon the floor,
"Quiet Please" pinned on the door.
Books are stacked in towering pile,
Wonder if it's worth the while,
Toss a coin, decide the crams,
Heads, the army; tails exams.

* * *

Three engineers got to boasting about the earning capacities of their respective fathers. The M.E., a doctor's son said, "My father operated on a movie star last month and sent him a bill for a nice eight thousand." The E.E., a lawyer's son broke in with the remark, "My father was the mouthpiece for a big racketeer a week ago and he pulled in a cool twenty grand for one day's work." The C.E., a minister's son said quietly, "On Sunday, my father preached a sermon in church, and it took eight men to bring in the money."



Dr. Ward Kuentzel and Dr. Edmund Field, co-inventors, observe operation of the new Magne-Dash autoclave in Standard Oil's Whiting research laboratory.

Orders for inventions taken here

Modern research creates a need for brand-new types of equipment. In petroleum laboratories, mixing up some stuff in a beaker usually isn't the answer. The research pioneer may have to use high temperatures and high pressures. If he must stir his mixture, he has a tough job. How can he prevent leakage past the shaft of the stirrer?

To meet this and other difficult situations, Standard Oil has set up a "Special Devices Program". A group of scientists creates the apparatus needed to solve today's problems.

An example is the Magne-Dash* autoclave. It has a magnetically operated agitator, and no external moving parts. Leaks cannot occur. Research men now use freely the high pressures that lead to new plastics and other new products.

Like many other inventions made by Standard Oil scientists to solve our own problems, the Magne-Dash is licensed for production and sale by a maker of scientific equipment.

The Special Devices Program is just one of the creative activities at Standard Oil. Young scientists find it stimulating to work in such an atmosphere.

*Manufactured under Standard Oil license by Autoclave Engineers, Inc., Erie, Pa.

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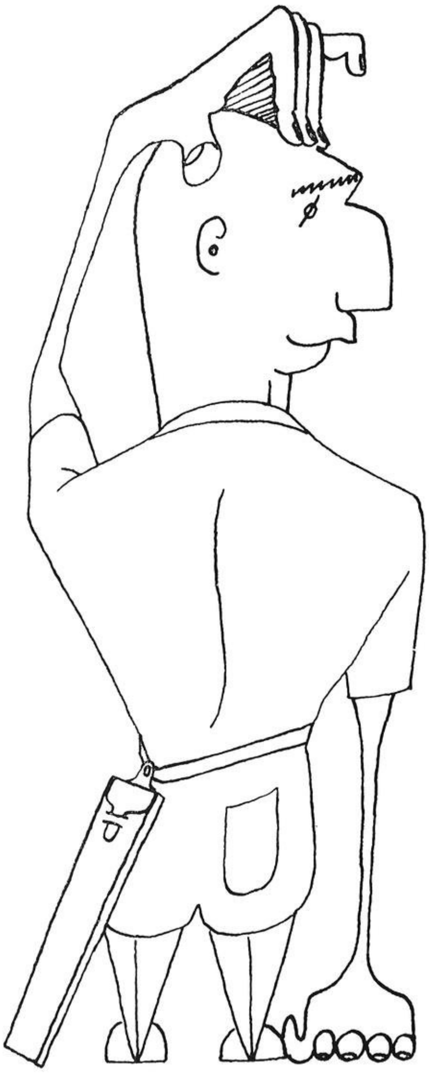

Haven't we met Somewhere Before?

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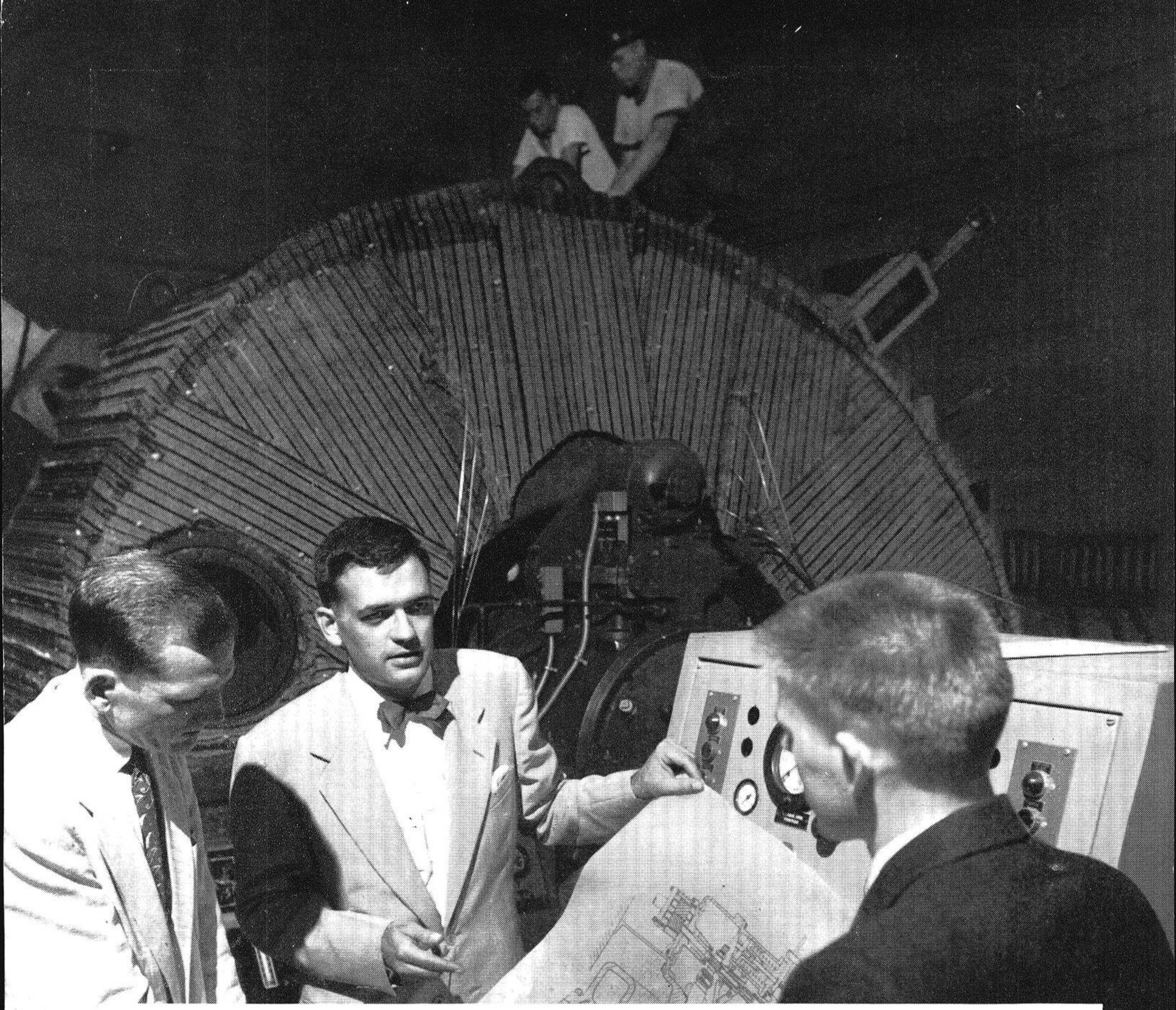

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