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OCTOBER
1957
The Wisconsin
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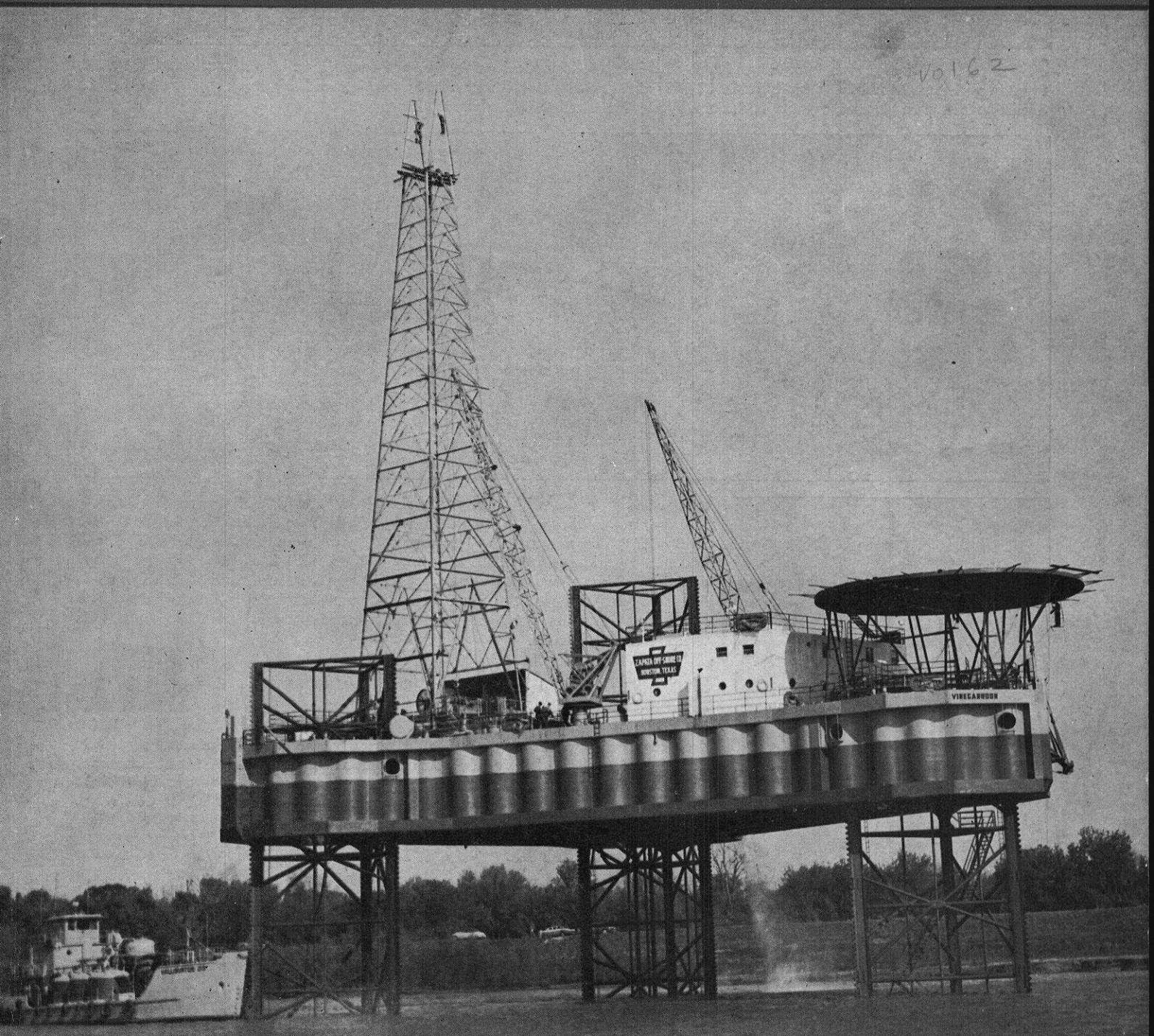
engineer



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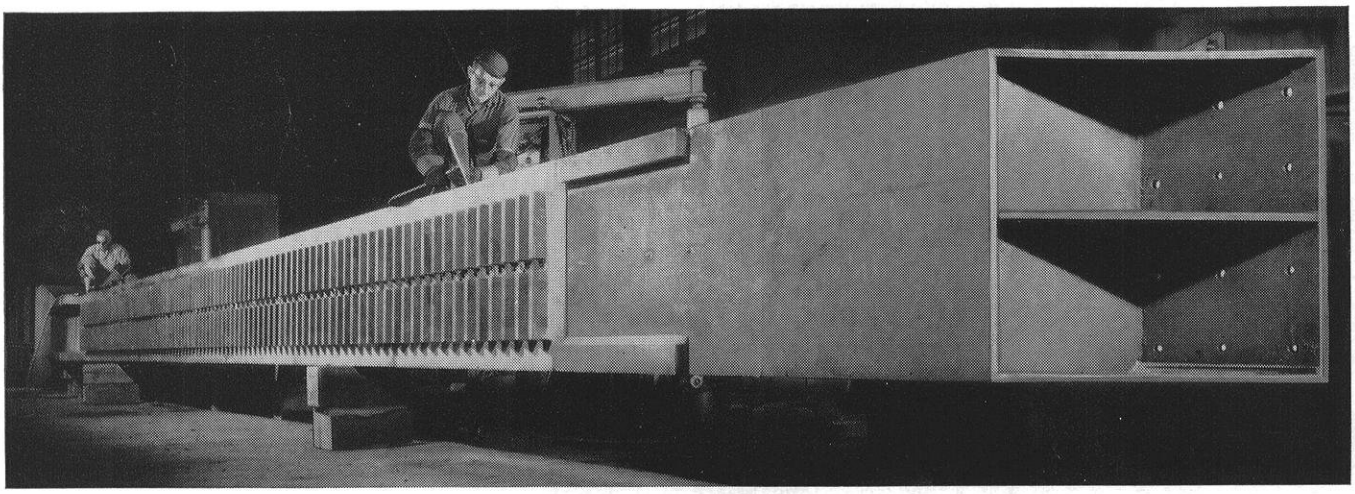

World's Biggest Crowd. On power shovels, a "crowd" is the arm which moves the dipper and dipper-stick forward and back. It coordinates closely with the lift motion of the dipper, and is a key part in the operation of the shovel which must withstand extremes of stress at any temperature. This is a picture of the biggest crowd ever built, now installed on the biggest power shovel in the world. It's made from USS "T-1" Steel, the remarkable new constructional alloy steel developed by United States Steel. An exceptionally strong and tough steel, it is noted for its welding characteristics. *"USS" and "T-1" are registered trademarks.*

Slap That Bermudavarius! The Talbot Brothers of Bermuda, famous for their colorful calypso music, recently retired their homemade packing-case "bass viol," and proudly premiered in its place the world's first Stainless Steel bass viol (or dog house or Bermudavarius, as it's customarily referred to). An exact replica in USS Stainless Steel of their original homemade design, it was built for them under U. S. Steel's supervision by a well-known manufacturer of Stainless Steel sinks who commented that the fabricating job wasn't difficult—but certainly was *different.*

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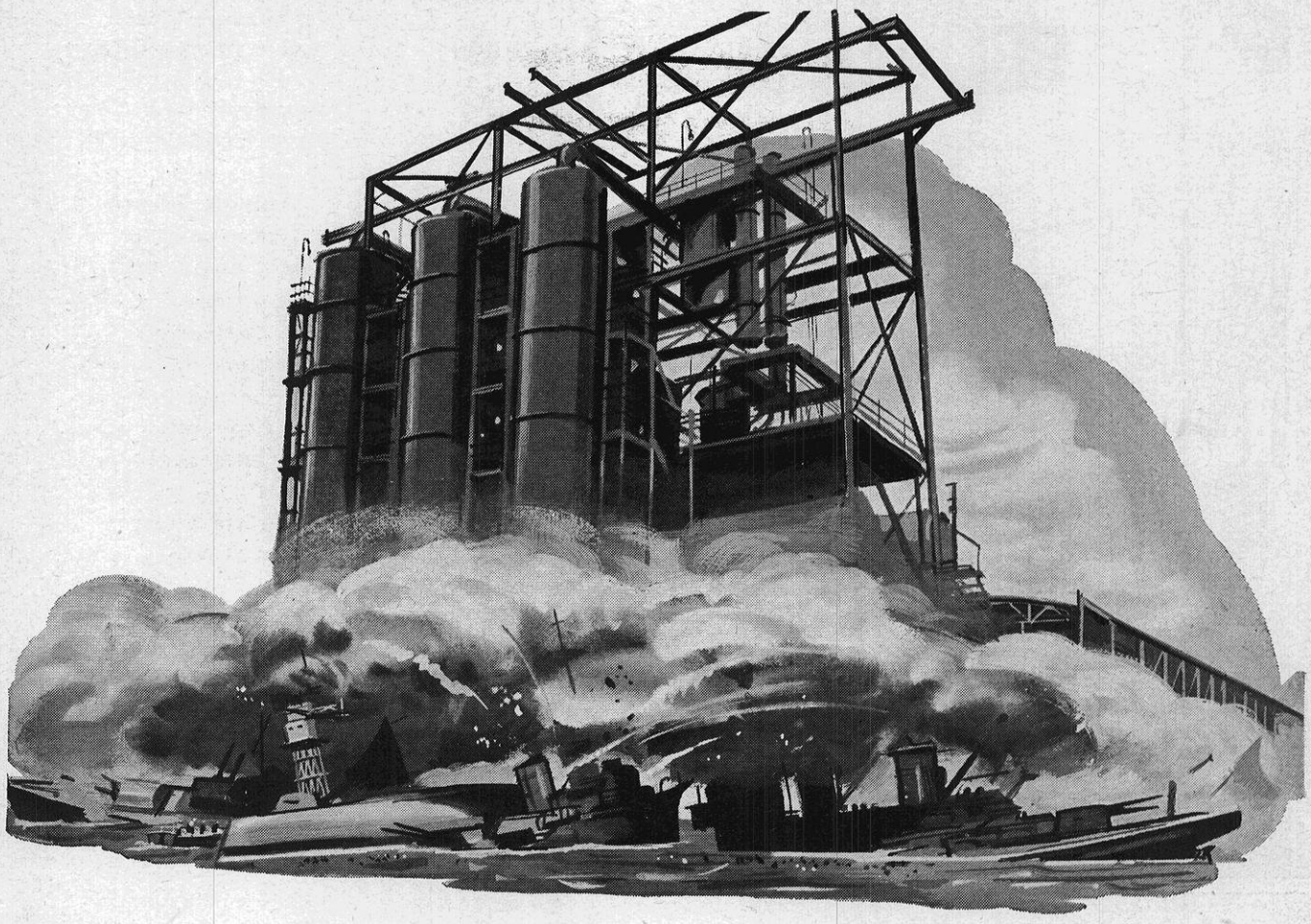

From War Baby to Peacetime Giant

Here's why the synthetic rubber field is a natural for young engineers

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Volume 62 OCTOBER 1957 Number 1

WISCONSIN ENGINEER

The Student Engineer's Magazine

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Departments

Cover

On the day preceding its christening, the mobile off-shore drilling barge "Vinegarroon," undergoes final outfitting of its heliport and 140 ft. derrick. Only the second tripod self-elevating drilling barge to be placed into tideland drilling service, the rig was christened at New Orleans, La., on March 29, and immediately began initial operations approximately 15 miles off Cameron, Louisiana.

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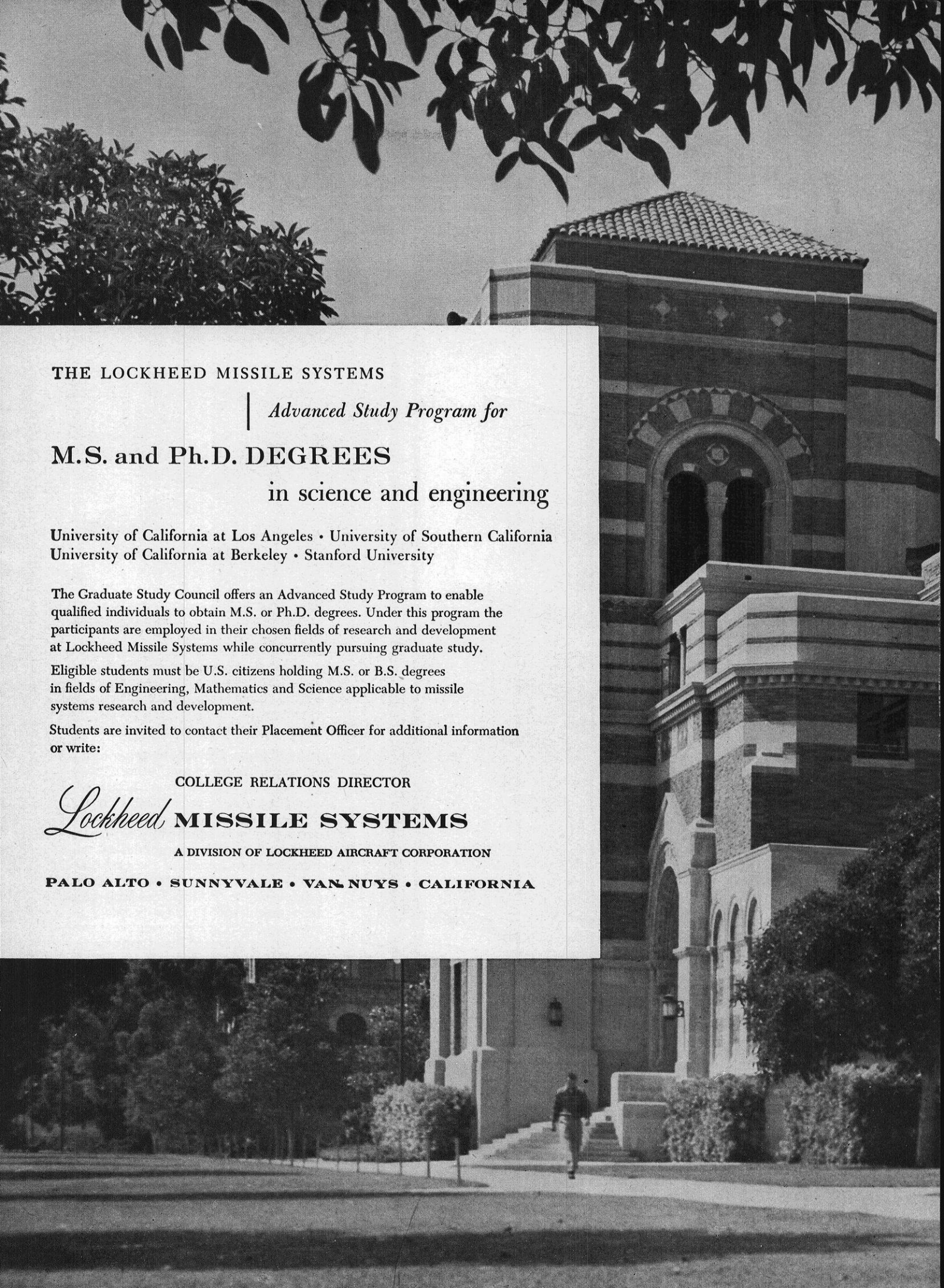

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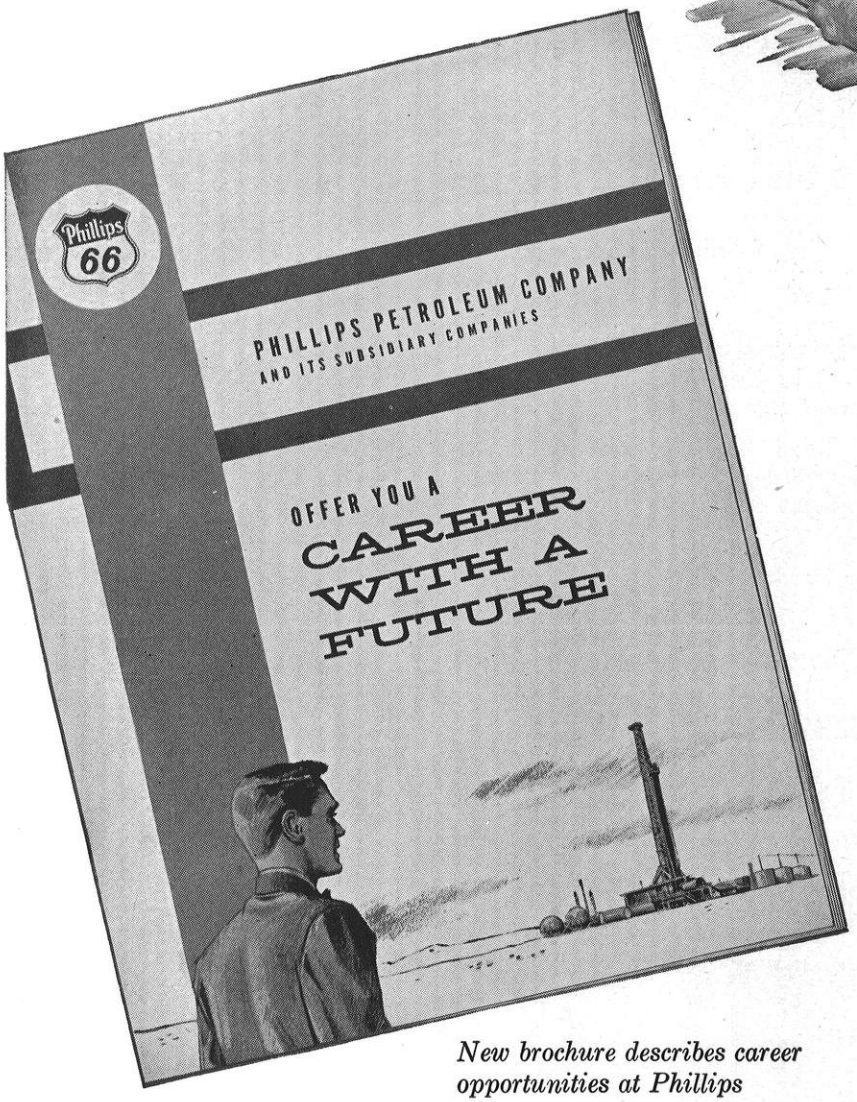

New brochure describes career opportunities at Phillips

This new booklet describes in detail the unusually fine career opportunities at Phillips Petroleum Company—the growth leader among America's integrated oil companies. New projects and expansion programs at Phillips have created many attractive openings for young men in practically every company operation.

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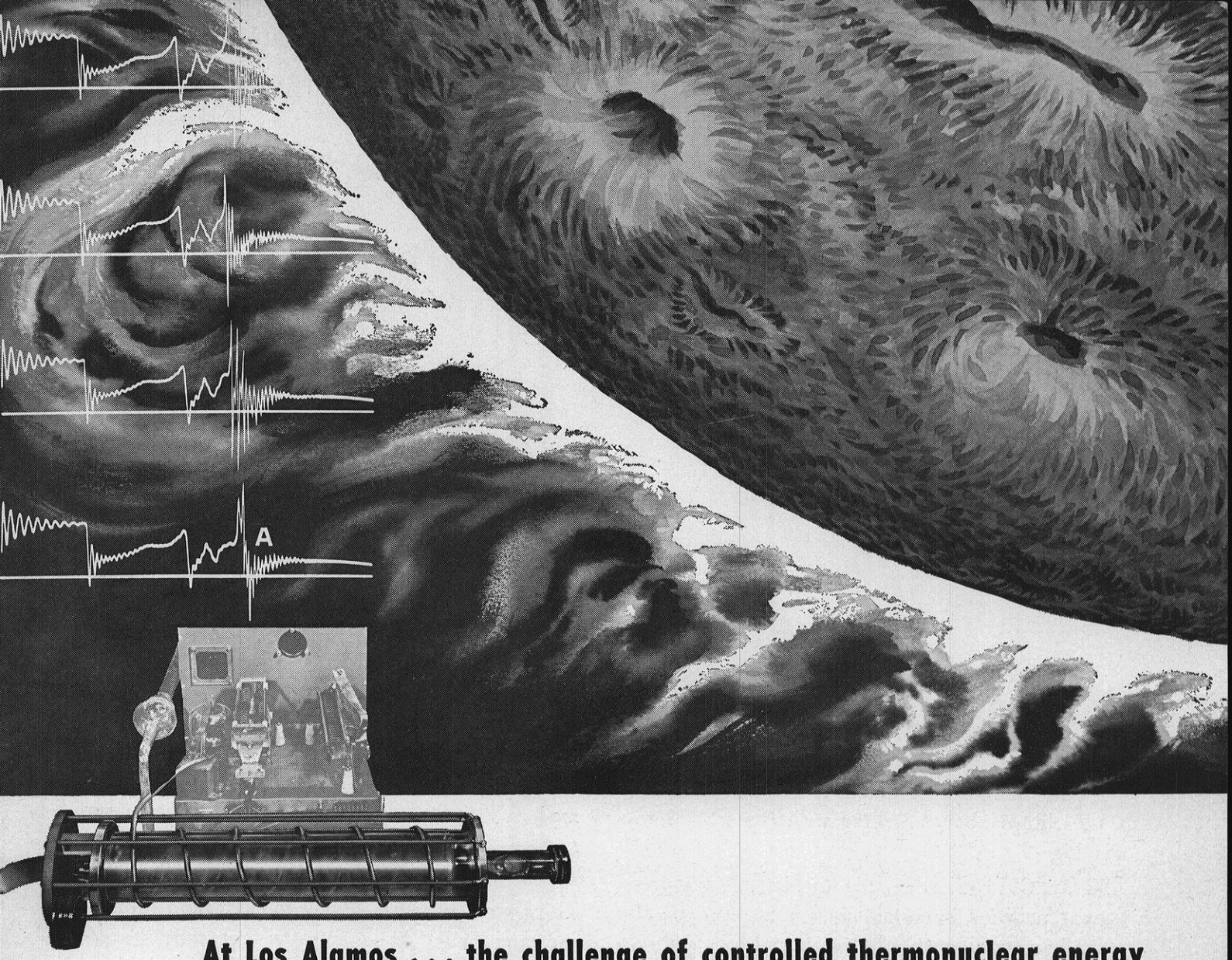

At Los Alamos . . . the challenge of controlled thermonuclear energy

The controlled release of fusion energy in a practical thermonuclear reactor will be an important milestone in the nuclear age. This scientific achievement is the object of PROJECT SHERWOOD . . . one of the interesting scientific investigations now under way at Los Alamos Scientific Laboratory.

Pictured above is "Columbus 1," an early experimental device developed by Los Alamos scientists to further this study. The bright line along the axis of the tube was produced by a discharge in heated and highly conducting argon gas. This discharge was "pinched" down to a small fraction of the tube diameter by the mutual attraction of its own currents. The temperature was roughly equal to that of the sun's photosphere. When deuterium was substituted for argon, intense bursts of neutrons appeared at time A on the voltage time signatures of the pinch (above, left), providing an interesting puzzle as to their origin. The similar signatures of successive discharges indicate the degree of reproducibility that has been achieved. Detailed studies of such reproducible behavior have led to considerable advances in understanding both the dynamics and the means for stable containment of heated plasmas.

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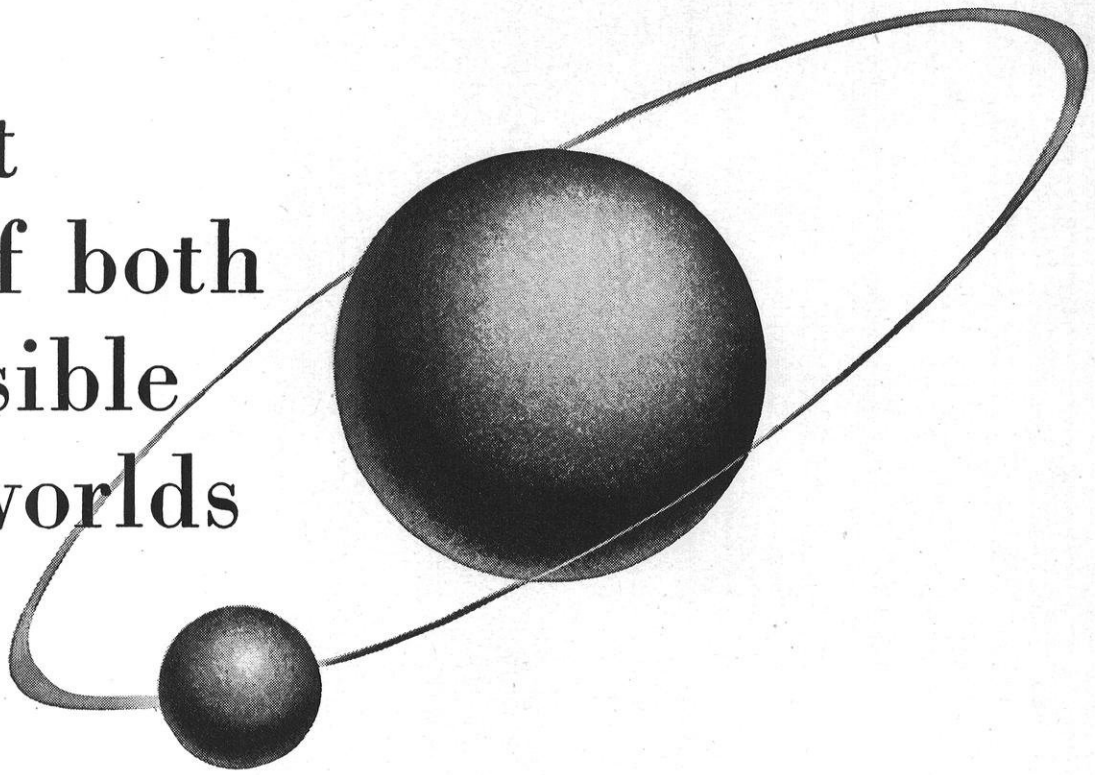

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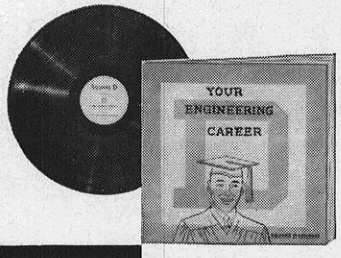

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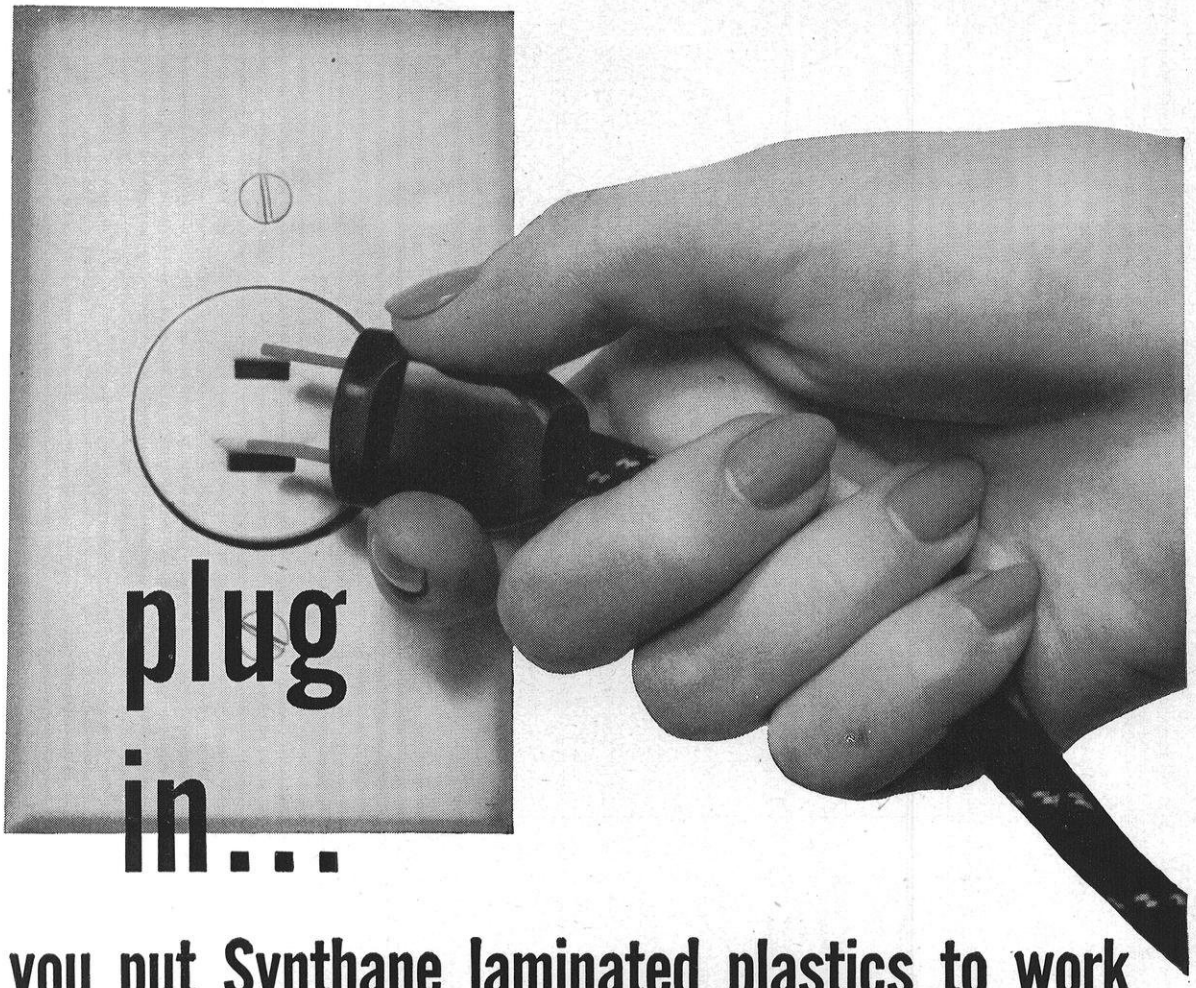

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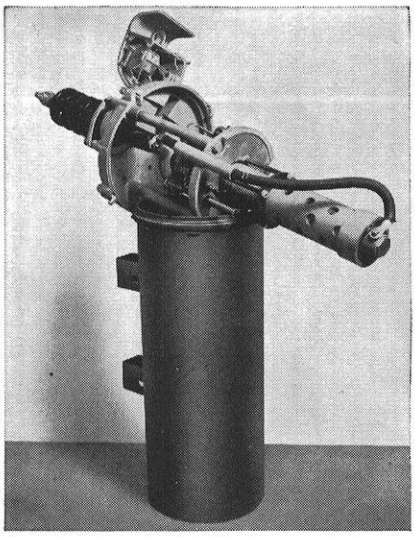

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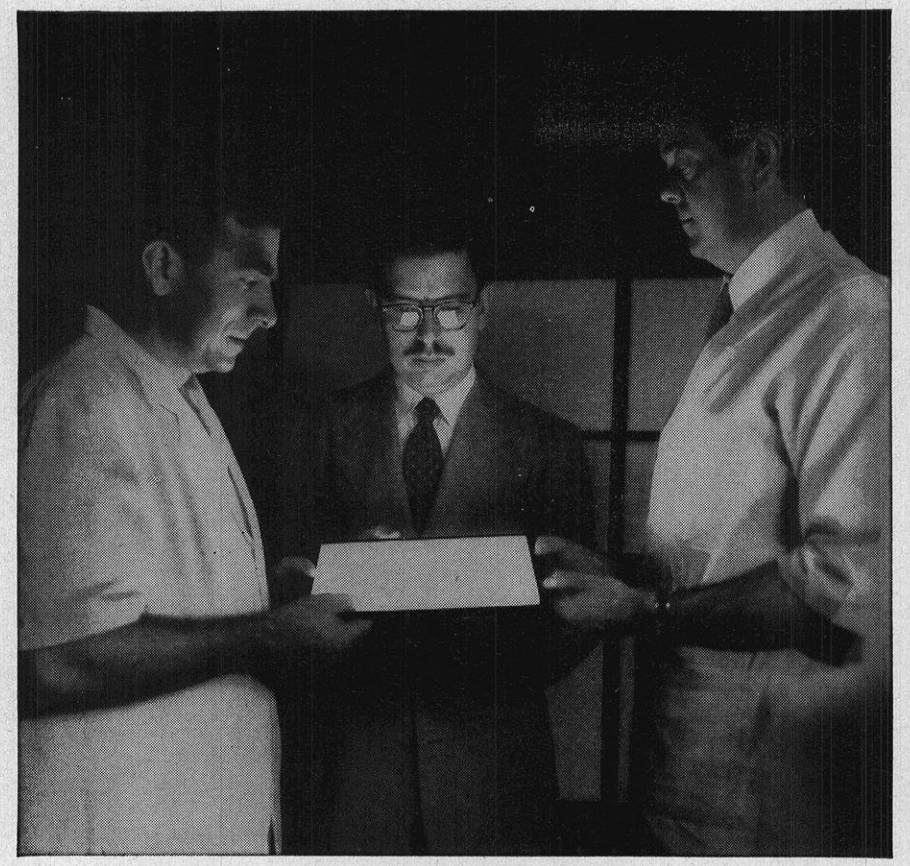


"Glowing wafer" of light (electroluminescence) sheds illumination on the faces of three Westinghouse scientists who helped to develop it. Left to right: Dr. Willi Lehmann (University of Brunswick, Germany); Dr. Henry F. Ivey (University of Georgia, Massachusetts Institute of Technology); and R. W. Wollentin (Rutgers University).

The Light With no Third Dimension

A new source of light is nearing practicality. Called electroluminescence, it comes from a flat surface. By the twist of a knob, you can change the brightness, or even the color, of a room.

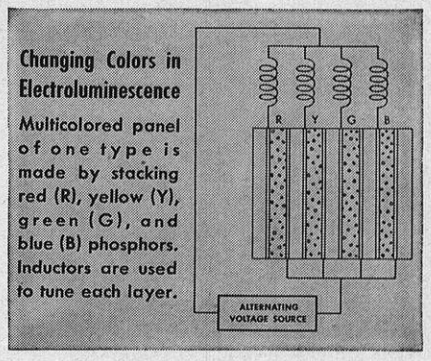
Since electric lighting first became practical, only three basically different light sources have achieved widespread use—incandescent, fluorescent, and gas-discharge lamps. Now a fourth basic type—electroluminescence—is nearing practicality. With fewer theoretical limitations than any of its predecessors, it promises to revolutionize lighting and become a practical light source of the future.

In an incandescent lamp, light comes from a single point. In a fluorescent lamp (form of gas-discharge), light comes from a straight line. In electroluminescence, light comes from an area or flat surface. Electroluminescence is light emission from phosphor powders embedded in an insulator, excited by an a-c field.

Westinghouse engineers gave the first practical demonstration of this new light source. They lighted an entire room with flat electroluminescent panels on the ceiling and three walls. These panels were one-foot-square flat glass plates about as thick as a window pane and coated with a plastic containing the phosphor. They were topped off by an aluminum conducting coating. Hooked up to a source of power, these plates had a brightness of 100 foot lamberts in their present stage of development.

Since some phosphors have more than one emission band, the color and brightness of electroluminescent lighting can be changed by varying the frequency. It is possible to control the color of a room, and brightness too, simply by twisting a knob. Besides supplying ordinary light, this new light source has other fascinating possibilities. Just one is "picture framing" television. An electroluminescent cell might replace the conventional cathode-ray tube in such a set.

Westinghouse engineers, under the supervision of E. G. F. Arnott (Princeton '28), developed electroluminescent lighting under the name of "Rayescent" lighting. Westinghouse approached the problem, not as a commercial venture, but as a pure research project. Much work remains to be done in this field. It is typical of the pioneering developments undertaken by Westinghouse.



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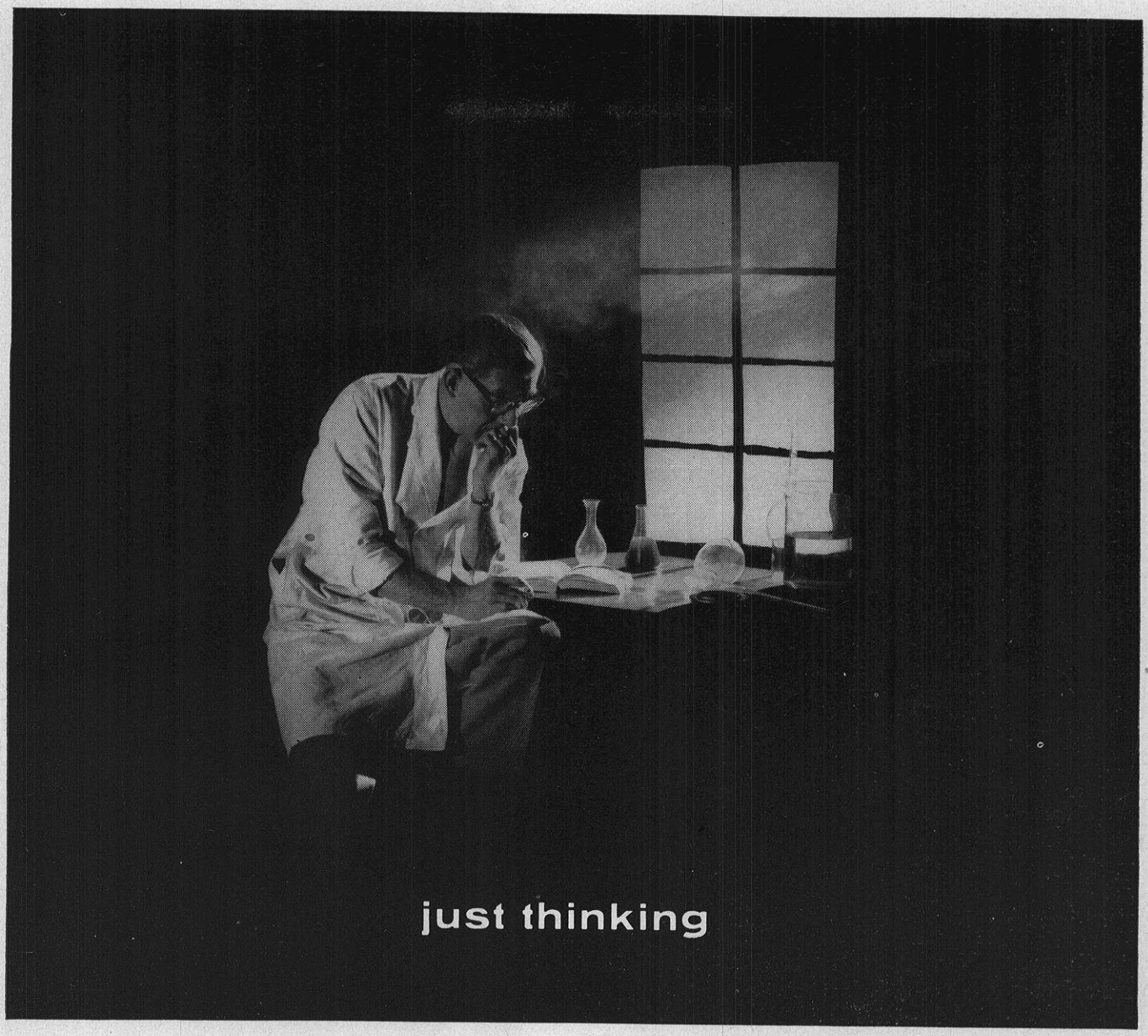

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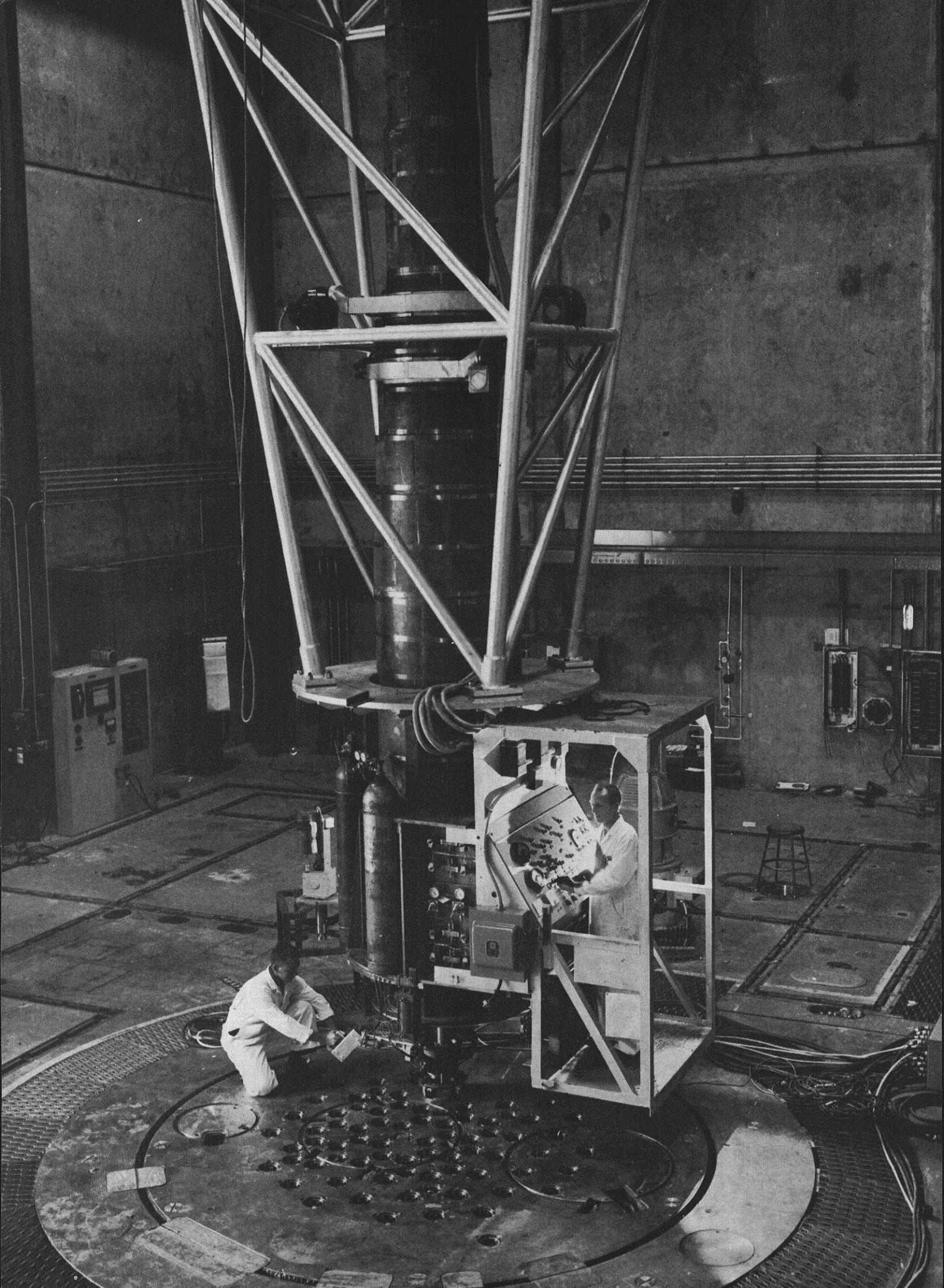
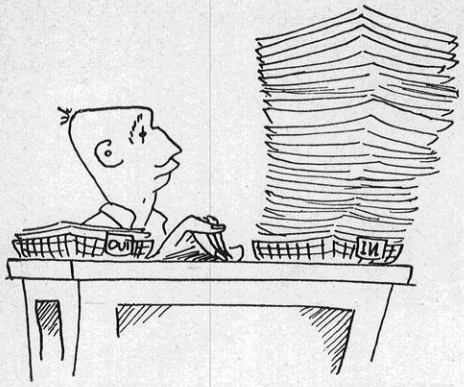




Rambling WITH THE EDITOR

Congratulations to last year's staff ended the series of issues for the 56–57 school year, and they're also in order for the beginning of this series. At the annual Engineering College Magazines Associated Convention held at Northwestern University, several awards were given out for the eight issues published last school year. A first was received for the best technical article, "Horizons Unlimited" by John Hilgers, which concerned, strangely enough, an accounting of the yet-to-be-launched earth satellite. Evidently the ECMA judges weren't the only ones who liked Mr. Hilger's story, since he also won the Wisconsin Engineer $50 prize for the best article, awarded last spring at our annual banquet. A second prize was won for the best editorial, written by Ron Schroeder, last year's editor, in the March '57 issue of the Engineer. A third prize was received for the best layout of any single issue, and finally, honorable mention was given to the Engineer in the best single issue category. Last year's staff, many of whom are still working on the magazine this year, have a right to be proud of themselves. Congratulations for a job well done.

Next year's ECMA conference to be held at Colorado University, Boulder, Colorado, in the heart of the Rocky Mountain range, will reveal the success of this year's staff as compared to that of last. We, of course, hope to turn out a good series of issues and welcome comments on improvements that you would like to see. As a start, a new monthly feature will begin with November concerning the now humorous statements and articles that appeared in the Engineer of yesteryear. Dick Soref, EE senior, has been poring over back issues for the past month and will be telling us of the trials and tribulations of the Wisconsin engineering student of fifty and sixty years ago. Be sure and look for it.

Getting back to the ECMA convention at Northwestern University, one of the more general complaints about college engineering magazines was the lack of humor so evident on all of the joke pages. One delegate announced that many of the jokes now circulated among humor editors were also present in pre-World War I issues of his magazine. Although the Engineer has never heard this particular complaint about its joke page, mainly because the Engineer of pre-World War I days had no jokes, we do realize that our offerings do not always cause students to cavort madly in the halls. What this is all leading up to is the lack of a humor editor for this year. We need someone who is good at wielding the paste pot and scissors and maybe even has a few jokes of his own that can brighten up the Static page. Anyone interested is welcome to call me or else to drop a note in the Engineer mailbox in the ME lobby. If anyone has some good personal anecdotes about life and trials at the UW, this would be a good opportunity to put them to use.

Looking over the above and having convinced myself that I've lived up to the "rambling" caption on my page, I'll say goodbye for now. Don't forget to let the Engineer know about any ideas or complaints that you may have, and we'll see that they get aired in the magazine. See you next month.

J. E. S.

Electricity from atomic energy—A huge, lead-shielded chamber for loading uranium fuel into an atomic energy reactor, near Los Angeles, hovers over the "core" or heart of the reactor sunk deep beneath ground.
—Photo Courtesy Atomic International

TRANSISTORS— A PROGRESS REPORT

by William J. Cattoi

This article gives an insight to the numerous applications of transistors to electronic equipment that are being found by engineers every day. Mr. Cattoi graduated from the college of electrical engineering in June of this year.

ONE of the latest devices to give great impetus to new development in the electronics field is the transistor. This relatively new and fascinating device was developed in the Bell Telephone Laboratories by two prominent solid-state physicists, John Bardeen and Walter H. Brattain. They announced their discovery of the first practical transistor in June of 1948.

Just what is the transistor and what electronic magic can it performs? The term "transistor", as it applies today, refers to a semiconductor device capable of power gain. A semiconductor is a material, such as germanium, through which electrons do not readily flow. Semiconductors lie in the class of materials located electrically between conductors and insulators. The electro-physical theory of transistors is complex, but basically the operation of transistors depends upon the formation of electron "barriers" between different types of germanium alloys.

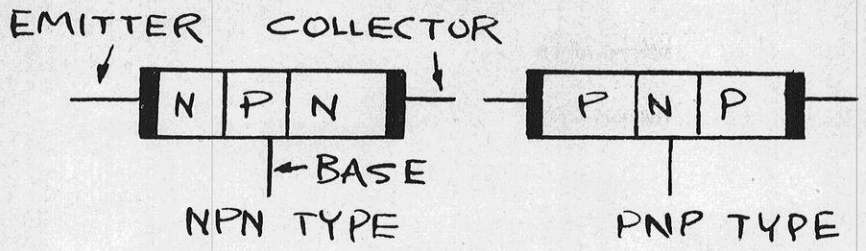
In a typical transistor triode, for example, a thin slab of germanium alloy having a deficiency of electrons (hence, a net positive charge) called "P" type germaniym is sandwiched between two small blocks of another type of germanium alloy having an excess of electrons which is called "N" type germanium. Such an assemblage is called an NPN junction triode transistor. A PNP junction triode resembles the NPN type in that it has a thin slab of "N" type germanium sandwiched between two blocks of "P" type germanium. Both types form electron barriers between materials which allow for amplification or power gain within the transistor.

Reversed current directions and voltages form the basic difference between the two types. The NPN might be thought of as an electron tube with ordinary electrons as charge carriers, whereas the PNP type would then correspond to a tube with positive charge carriers. The availability of both NPN and PNP types is a unique feature of transistors.

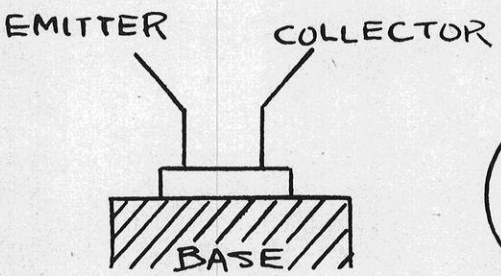
Along with the junction type there exists a second class of transistors called "point-contact" transistors. This type of transistor resembles the "cat whisker" crystal used in early radio receivers. Point-contact transistor triodes consist of two tiny (0.005″ dia.) phosphor-bronze wires welded to a rectangular block of germanium. Barriers are formed between these elements, as in the junction type, allowing for amplification and power gain.

The various types of transistor triodes and their electron tube counterparts are shown in the diagrams on page 17.

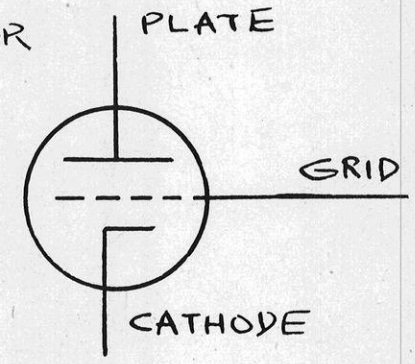
As seen in the diagrams, the names given to the transistor electrodes are not the same as those used for electron tube elements. The emitter of the transistor corresponds to the cathode of the electron tube. The base of the transistor corresponds to the grid



Junction transistors.



Point-contact transistor.



Vacuum tube counter part.

of the tube and the collector to the plate. The emitter, base, and collector perform essentially the same function as their electron tube counterparts.

Both the junction type and the point-contact type of transistor can be used interchangeably in some electronic operations, but basically the junction type transistors are used where power requirements are high and the point-contact types are used where high frequency requirements must be met.

Point-contact transistors have been used at frequencies as high as 300 megacycles, but the output power and stability at such frequencies are limited. Point-contact transistors are used extensively in high-speed switching circuits in electronic computers. Junction type transistors, on the other hand, have been developed to handle several watts of power at low frequencies and at voltages from 12 to 28 volts.

Since transistors perform essentially the same function as vacuum tubes, it is apparent that they have a potential application wherever vacuum tubes are used. There are, however, several limitations. One of the important limitations of transistors is their sensitivity to temperature.

Transistor parameters change with temperature variations and, although the transistors may not become inoperative, the instability due to these temperature changes may be highly undesirable. This is especially true in aircraft equipment, for example, where temperature variations are appreciable. Uniform operation over a temperature range of 0° to 100° C. has already been realized in some transistor equipment. Special silicon transistors, now in the development stage, appear to satisfy the need for transistors to operate at even greater temperature extremes.

Along with temperature variation problems, another serious drawback to early transistors was the generation of a large amount of undesirable noise. Transistors on the market at the present time have reduced the noise problem considerably. Noise figures for the point-contact triodes have been reduced from 60db to about 48 db, while commercially available junction triodes have been reduced to an average of 20 db. Experimental junction triodes with noise figures as low as 3 db have been built and junction triodes with noise figures of 5 db will soon be available commercially. The above noise figures are given for a frequency of 1 kilocycle; at higher frequencies they may be substantially lower.

The third serious limitation of early transistors was their relatively poor high frequency response. Since electrons move at comparatively low velocities in crystals, the transit time, or time for the electrons to travel from one electrode to the other, becomes an important criterion for high frequency operation. When the transit time of the electrons becomes greater than the period of oscillation, the output of the oscillator drops drastically. One method used to minimize transit time effects is to use extremely thin slices of crystal material. Slices of 0.005 inches and smaller are used in some transistors. Much improvement has been made in obtaining a reliable high frequency response from transistor circuits. Although a reduction in power gain is evident at 455 KC (broadcast intermediate frequency) for most of the present junction transistors (the present point-contact type are much better), oscillator frequencies as high as 300 megacycles (FM radio and VHF television frequencies) have been obtained in the laboratory for both the junction and point-contact types.

One obstacle preventing a widespread use of transistors is their relatively high cost. This fact is probably evident when comparing the cost of transistor portable radios to equivalent tube-type sets: transistor sets cost about twice as much. Prices of transistors, however, have already shown a marked decrease and will undoubtedly continue to decrease as better methods of mass producing transistors become available.

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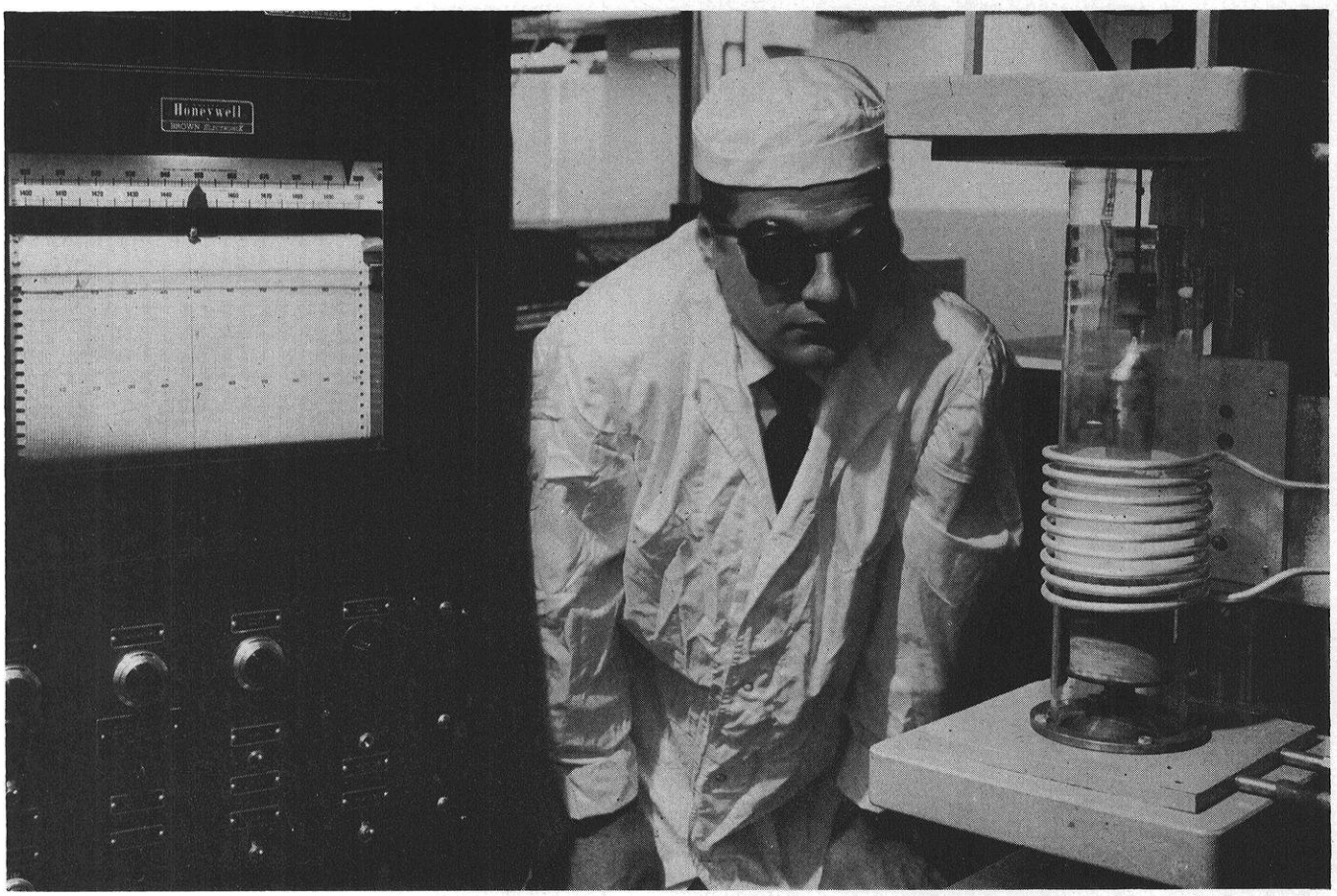
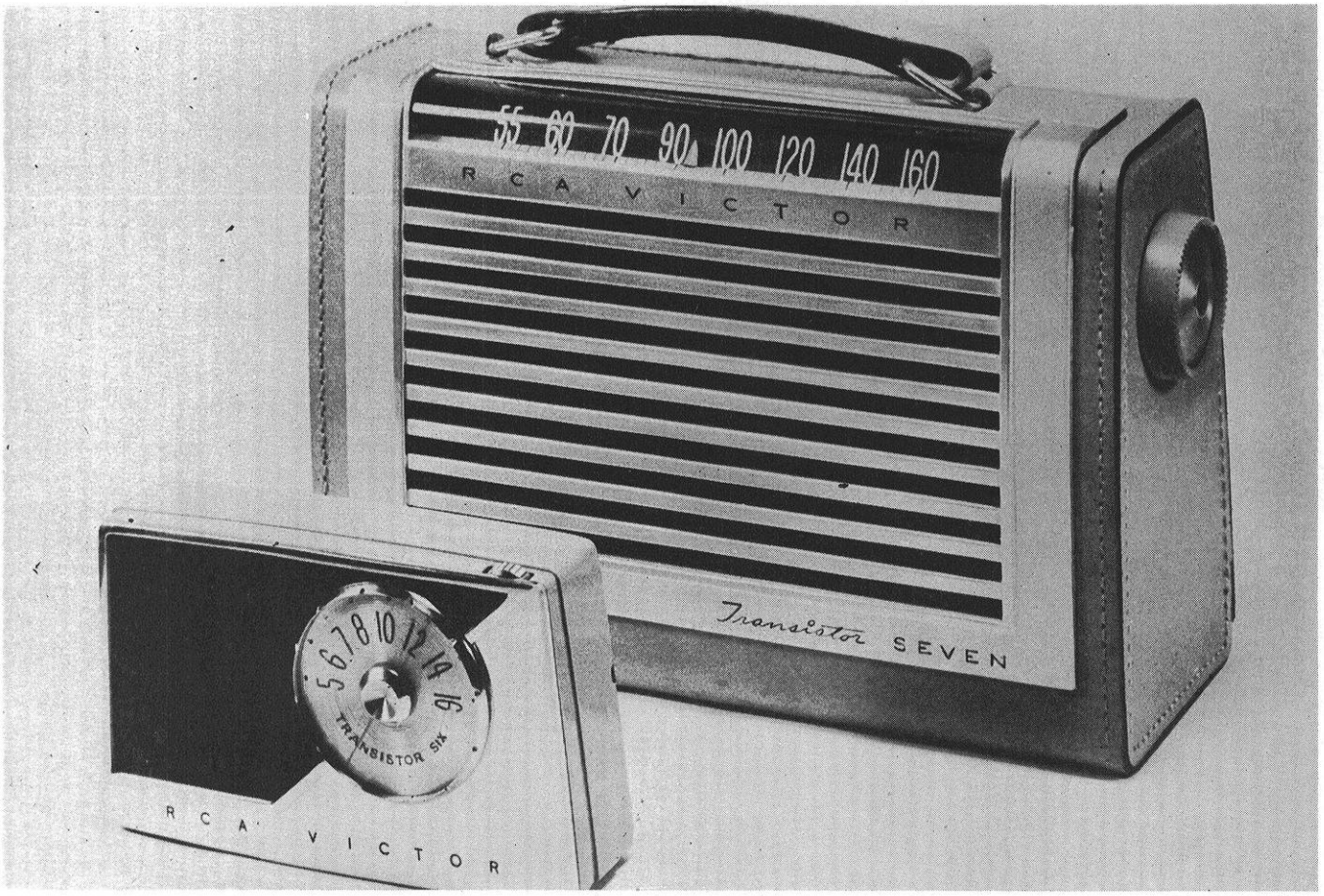


—Courtesy Minneapolis-Honeywell

Transistors are "grown" in electric induction furnaces under watchful eye of physicist. Process is charted on recording instrument at left.



—Courtesy RCA

Two of the small really "portable" radios that the transistor has made possible.

Despite the limitations discussed, the many advantages of the transistor make it one of the most valuable components in the design and development of new and improved electronic equipment. Probably the most obvious advantage of the transistor is its small size. Transistors used in some radio sets are so small that ten of them could fit on one dime. Some special subminiature PNP type transistors have been developed which are so minute that 20 of them can be placed on one dime. An experimental amplifier, the size of a pencil eraser, has been developed which used this type of transistor and could realize a 70 db gain.

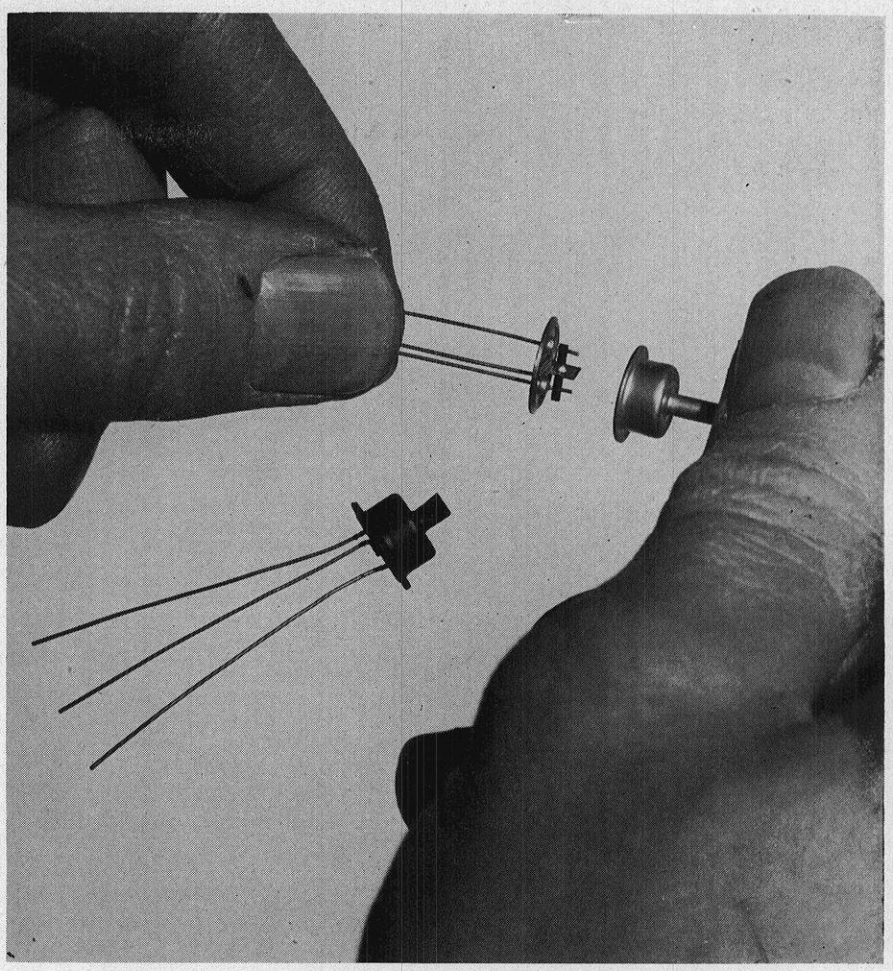
The minute size of the transistor makes it a highly desired component in the design of aircraft equipment where size and weight are of utmost importance. Miniaturization of much of the existing electronic equipment is now underway and will proceed at an increasing rate as newer type transistors are developed.

A second important advantage of the transistor is its relatively small power requirement. Transistors used in portable radio equipment, for example, use between 6 and 9 volts, and can operate at power levels of a fraction of a milliwatt. This is but a small fraction of the power required for electron tube equivalents.

Transistors are also available which can work at voltages as low as one volt. Since the transistor requires no filament power, a second substantial power saving is obtained. This tremendous saving in power makes the transistor a valuable element in the design of lightweight, long life portable electronic equipment.

The reliability and long life of the transistor are also included in its list of advantages. On the reliability of transistors, Mr. C. H. Zierdt, an engineering consultant in General Electric's Semiconductor Products Department, recently stated:

> "Replacement of transistors in portable radios and other electronic equipment may never be necessary if they are used within limits set by the manufacturer.
>
> Life tests on transistors picked at random (1954) showed no failures after 18,000 working hours at full power. This is equivalent to maximum load, eight hours a day for six years.
>
> Only one-fourth of one percent could not be operated at peak ratings after 1000 hours at full power."



Small size of the transistor can be readily seen, as compared to the bulk of glass envelope vacuum tubes.

Because of their solid construction in a single compact unit with no moving or floating parts, transistors are extremely rugged. Most transistors are hermetically sealed, not only to increase their life, but also to help stabilize their operation.

Other less obvious advantages give the transistor great potential. Since the filament is eliminated, negligible heating effects result. This allows for smaller packaging without danger of overheating. The "warm-up" period required for most vacuum tubes is also eliminated. Filament transformers, heater hum, and the undesirable feedback through the filament circuit are nonexistant.

As stated previously, both NPN and PNP junction type transistors are available in which the currents and voltages are reversed. This double action in transistors allows new versatility in electronic design. For example, an NPN and a PNP transistor in parallel can operate as a push-pull amplifier without an input or output transformer.

One of the greatest commercial outlets for present day transistors is in the portable radio industry. Since transistors are well adapted to the audio frequency range and because of their low voltage and power requirements, long life, and minute size, the use of transistors in portable radio receivers was a natural consequence. In a portable radio about two-thirds of the power is consumed in the output power stage and therefore the first attempts to use transistors in portable radios centered around transistorization of this stage.

Most transistorized output stages

(Continued on page 63)

BLOODHOUNDS OF THE DEEP— THE STORY OF THE SONOBUOY

by James E. Kirchstein

The Sonobully—A heart warming sea story about a buoy and his sea-dog who, inspired by the tales of his Great-Grandfather (who was a sea Pirate) as told to him by his father (who sells peanuts and popcorn at the Brooklyn Navy Yard), developed a great interest in the destruction of submarines. The story begins in 1771 when the buoy was just a boy, that is, when the boy was just a bully, er—the blubby ws jst a blp, wod frm unkx qw sdfg, and ends 10 years later in 1953 when the buoys were mass producing people for submarine destruction of aerials.

AS FAR back as 1771 when Bushnell, an American inventor, produced the first successful submarine men have been thinking of the possibilities of the submarine. But not even in their wildest dreams could they imagine the destruction accomplished by the German submarines in the early part of World War II. Very effective submarine warfare developed, in a Jules Verne fashion, at the beginning of the twentieth century, and the great need for anti-submarine warfare became very evident.

The first successful submarine detection device was the hydrophone, an underwater microphone lowered from a surface vessel with the purpose of listening for submarines. So sensitive were these hydrophones that under favorable conditions the sounds made by a submarine's gyroscopic compass could be heard. The hydrophone's main disadvantage was that it could not tune out interfering noises from the vessel on which it was mounted.

On July 16, 1916, the motor boat "Salmond" used hydrophones to hunt down the Submarine minelayer UC-7 and then dropped a depth-charge that detonated the mines in the submarine. Besides its results in actual destruction, the hydrophone and depth charge combination proved so nerve wracking to those submarine crews that survived its attack that it impaired their morale.

As submarine warfare improved, anti-submarine warfare was always a short step behind until the beginning of 1946 when the development of the Sonobuoy placed the odds against the submarine.

The first Sonobuoy, designated by Navy code SSQ-1, was a long thin cylinder inclosing a hydrophone, and a transmitter. It was dropped from an aircraft, usually a patrol aircraft, descended on a parachute, and upon impact with the water released its hydrophone which sank to a depth of approximately twenty feet.

The main part of the buoy floated, thereby keeping the antenna clear of the water. The hydrophone picked up underwater sounds and transmission of this information was accomplished by an FM transmitter. Airborne receivers picked up the transmitted signal and gave the radio operator information of the U-boat's speed and course.

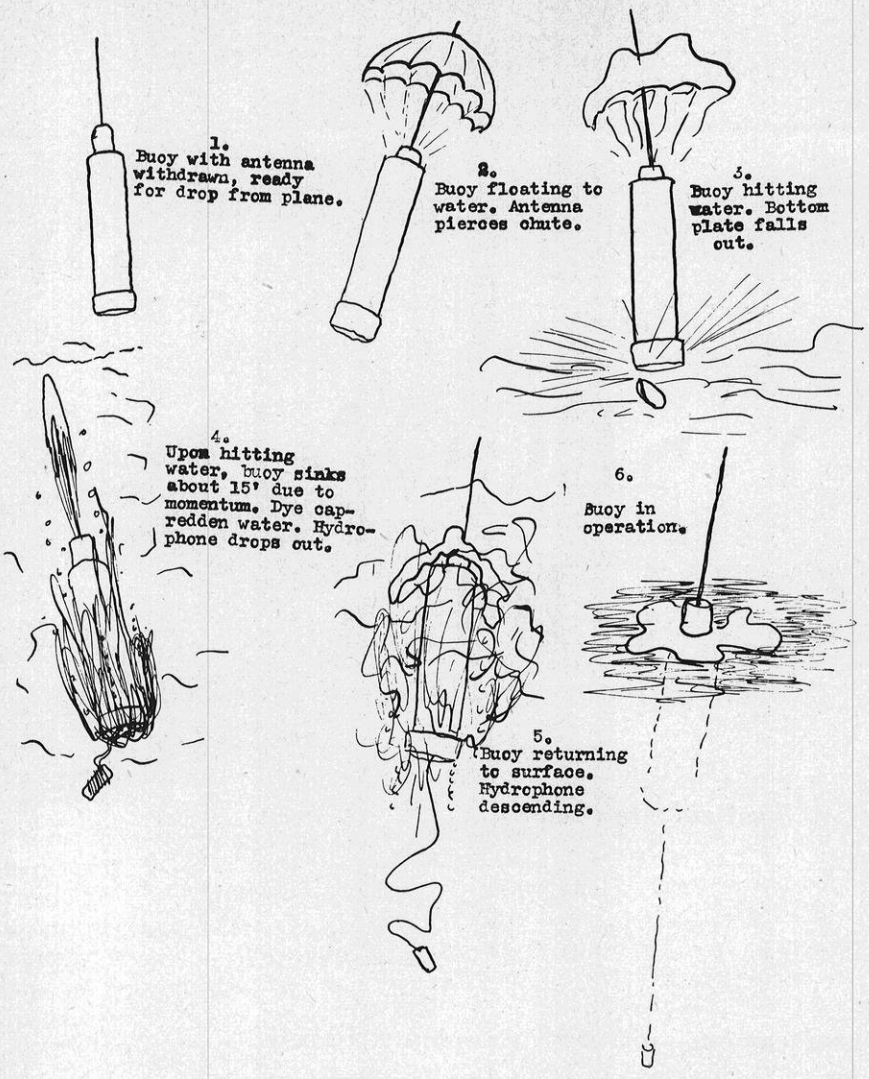
The big advantage of this type of submarine detection over the surface vessel method of detection is the absence of interfering noises from the vessel on which the detection equipment is mounted. The pick up range of the hydrophone depends upon the state of the sea, and the speed, depth, and type of submarine being hunted.

Upon indication of a submarine's presence, such as the picking up of the periscope on radar, a Sonobuoy is dropped in the near vicinity of the periscopes' last known position. A pattern is then set up and charted by the Navigator. There are two types of patterns used in Sonobuoy operation, the diamond pattern, and the seven buoy pattern. Both patterns were used with the SSQ-1, but the seven buoy pattern was preferred with the modified Sonobuoy, SSQ-2B.

As the pattern is being layed, the radio operator tunes in each buoy. Color coding on the receiver's dial corresponding to the individual Sonobuoys allows the operator to report the "nearer" buoys, that is, the buoys closest to the submarine. The pattern is easily seen from the air due to dye released from each buoy when it hits the water.

Usually one pattern is sufficient to obtain the necessary information to make a bombing run, but if the submarine should happen to escape the pattern, three more buoys are dropped in the area adjacent to the part of the first pattern where the submarine escaped. Knowing the location of the submarine, a bombing run is made and a magnetic mine is dropped.

The mines used in anti-submar-



Sketches showing dropping of the SSQ-1 sonobuoy.

ine warfare look something like a torpedo. They hover in a circular path, increasing the radius of the path with each complete turn. Upon coming sufficiently close to a metallic object, the mine closes in due to magnetic attraction and explodes.

Submarines that try to outrun the patterns are almost always a sure thing for Davy's locker since the noise they make in their flight affords an easy target for sonobuoys to follow. Most submarines found that their best chance to survive the attack was to shut down all motors possible, maintain complete silence, and wait. It is little wonder that many of the submariners were ready for the "psycho ward."

We shall now study the Sonobuoys in greater detail, the SSQ-1 first and then its modified version, the SSQ-2B. The circuitry of the two buoys is very similar although they work in different frequency bands. The SSQ-1 works in a band of 70 mcs to 80 mcs, while the SSQ-2B works in a band of 162 mcs to 173 mcs.

The SSQ-1 Sonobuoy measures 4¾ feet long with a 4 inch diameter. Its weight: 13½ pounds. Upon being manually dropped from the aircraft, it descends at a rate of 30 knots as controlled by a 24 inch muslin parachute. Upon striking the water an impact switch releases the lower plate of the buoy and the hydrophone descends to a depth of 20 feet. Capsules containing water-soluble powered dye are broken upon striking the water releasing the dye as previously mentioned.

The hydrophone consists of waterproof wire windings on a magnetized nickel cylinder. Sound waves are transformed by magnetostriction into electrical impulses of approximately 3 microvolts which are fed through a high ratio step up transformer to a two stage amplifier. The amplifiers, a pair of 1L4's, are flat 200–10,000 cps, and down about 12 db at 50 cps. The input transformer and two stage Resistance-Capacitor coupled amplifiers provide high voltage gain.

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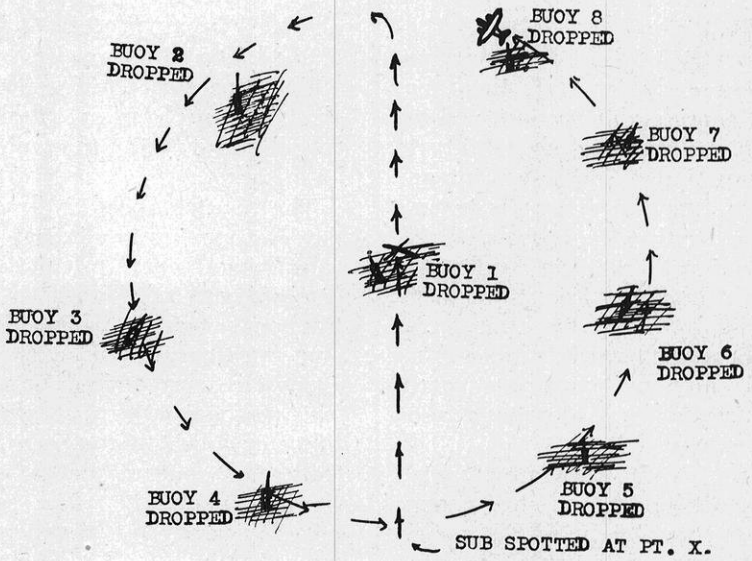


The seven buoy pattern.

SIXTY SECOND PICTURES

by Paul Marshall

The Polaroid land camera—pictures in a minute. Here is a report on the Polaroid Land process of film development.

EVER since the Polaroid Corporation released its new camera early in 1947, there has been considerable curiosity about its unique features, the ability to produce a dry, finished print one minute after the picture is taken.

In order that the process be carried out with uniform results, the camera frame must be strong, rigid and light. The main structural members such as the frame, front panel and lens board are accordingly made from aluminum alloy die castings.

In the camera body are mounted two precision ground steel rollers, each approximately 3-5/16 inch in length and 7/16 inch diameter. These rollers are a vital part of the film developing process to be explained later in the report.

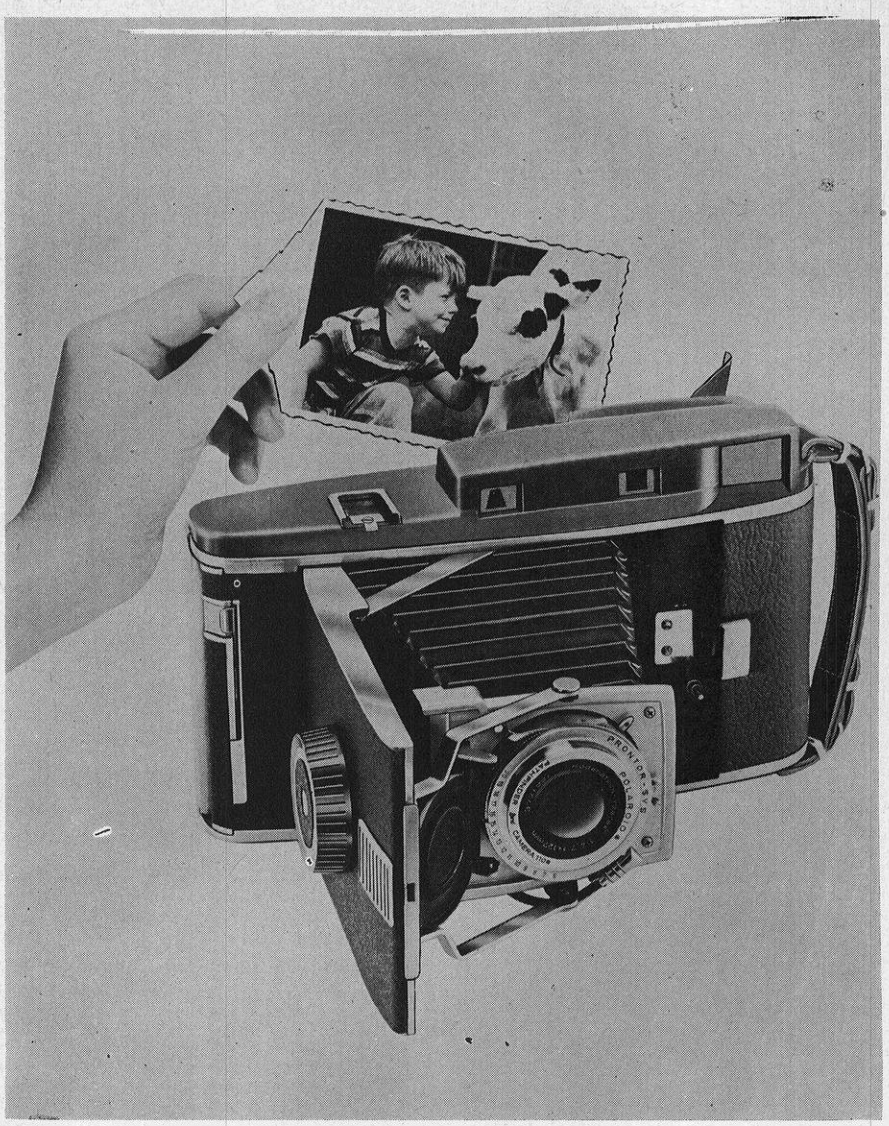
The lensboard carries the lens, shutter mechanism, flash and speedlight outlets, and cable release socket.

The shutter speed is keyed to the lens opening to eliminate time-consuming mental calculations of combinations of f-numbers and fractional seconds which is common practice when using the more expensive conventional cameras. This mechanism provides the flexibility of adjustable exposure controls and shutter speeds, yet is simple to operate. The settings are indicated by numbers 1–8 appearing in a small window in the lensboard.

However, because of the developing process, compensation for a poor negative cannot be made through the choice of a suitable positive print paper as in conventional processes. Because the exposure is somewhat critical, it is difficult to guess the correct exposure for given light conditions.

This deficiency can be overcome by the use of a Polaroid light meter which reads in exposure numbers. It remains only to obtain a reading from the object to be photographed and to set the exposure number on the camera to the corresponding number on the meter.

The amount of light entering the camera is controlled by rotating a metal disc with holes of various



—All photos courtesy of Polaroid Corporation

sizes spaced around its rim into the path of the light from the lens.

The shutter speeds are coupled to these lens openings by the cam surface on the disc. When the shutter lever is depressed, the shutter is kicked away from its closed position and rotates about its central pivot under the torsion of a hairspring until it comes into contact with a spring that has been dropped into the arc by the cam on the exposure control disc.

The shutter rebounds against the spring and comes to rest in its original position. For longer exposures, the exposure disc is rotated to a lower number raising the near spring and allowing the shutter to travel a longer path before rebounding against the next spring.

As the exposure control wheel is turned from a higher number to a lower number, such as from eight to seven, the exposure is doubled, and conversely, as the wheel is turned from a smaller to a larger number, the exposure is cut in half. The exposure on the lowest setting (number I) is 128 times as great as that for the highest number (number 8).

Camera lenses are usually described in terms of their characteristics, which include number of elements, local length, and relative aperture.

Number of elements means the actual number of simple lenses in the optical system. The model 95A system contains three elements made of rare earth optical glass capable of producing very sharp images.

The focal length or distance from a central point in the lens system to the film is 130mm, or about 5¼ inches.

The relative aperature is a measure of the amount of light the lens will pass in a given instant and is indicated by an "f-number". The f-number is the ratio of the size of the widest lens opening to the focal length. "Fast" lenses of f/2 or f/2.8 pass a greater amount of light per second than a "slow" lens of f/22 or f/32.

The 95A lens has a relative aperture of f/8.8, which is modest speed. However, the lens was designed for use with Polaroid Land films which are of very high speed (extremely sensitive to light) so that pictures may be taken successfully even under poor lighting conditions.

The 95A is focused manually by estimating the subject distance in feet and setting a lever on the camera to the correct position. The focusing lever moves the lensboard in and out to bring the picture to sharp focus. The focusing range is from 3.5 feet to infinity.

If the camera is focused at 10 feet, and the exposure set at number eight, objects between the distances of 6.9 and 19 feet will be in sharp focus. As the exposure is increased (exposure numbers lowered) the zone of sharp focus narrows until objects between 9 and 11.3 feet are in sharp focus at exposure numbers one through four.

High speed lenses with very wide aperature, such as f/2, have a very shallow zone of sharp focus while the Land camera with maximum aperture of f/8.8 has a relatively deep zone.

The land process system consists of a composite film containing all the materials necessary to make a positive print. These materials consist of a light-sensitive negative, print paper, and the necessary chemical reagents.

The design of the camera and film makes possible the production of a picture by means of an essentially dry process. A separate pod of reagent for each picture insures the proper amount of fresh reagent for each shot. Because each charge of reagent is used only once, there is no problem of exhaustion and replenishment of reagent as in conventional processes.

Processing the print begins automatically when the film is ad-

(Continued next page)

vanced for the next shot and proceeds to completion within the camera. Uniform processing is thus assured by eliminating variations occurring in hand-controlled separate operations.

A roll of light-sensitive negative material on a spool and a roll of light-insensitive positive material not on a spool are attached to a strong paper leader.

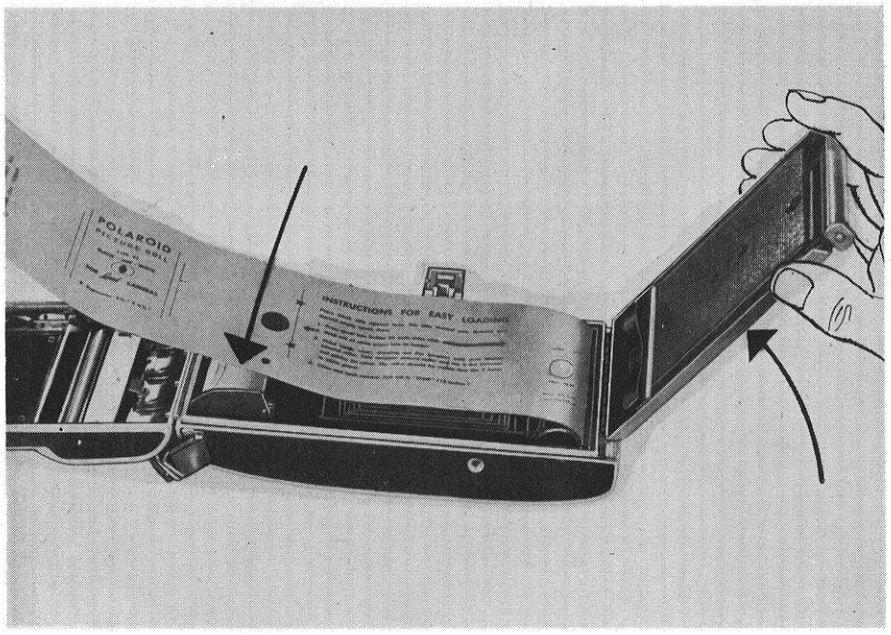
Attached lengthwise to the positive paper are small metal-foil pods of jelly-like reagent.

The negative material consists of a coating of silver halide crystals in a gelatin suspension on a paper-base backing.

By pulling the paper leader out until it stops automatically, the first negative is positioned within the camera.

After the picture has been snapped, automatic development takes place as the film is advanced for the next shot. The film is advanced by pressing a small button and pulling the leader out until it clicks to a stop. As the film is advanced, the leader carrying the negative and section of positive paper is pulled between the steel rollers.

At the beginning of each section of positive paper is its own metal-foil reagent pod which is considerably thicker than the space between the rollers. So the rollers squeeze the pod open and spread a very thin (0.0003 inch) layer of viscous reagent between the positive and negative sheets, forming a sort of "sandwich" which is held together by the gelatin through the development process.



A photograph of the same camera mechanism shown in drawing below.

As the reagent diffuses into the negative layer, it develops the exposed halide grains and simultaneously dissolves the unexposed grains which diffuse across the reagent layer and precipitate as metallic silver on the surface of the positive sheet.

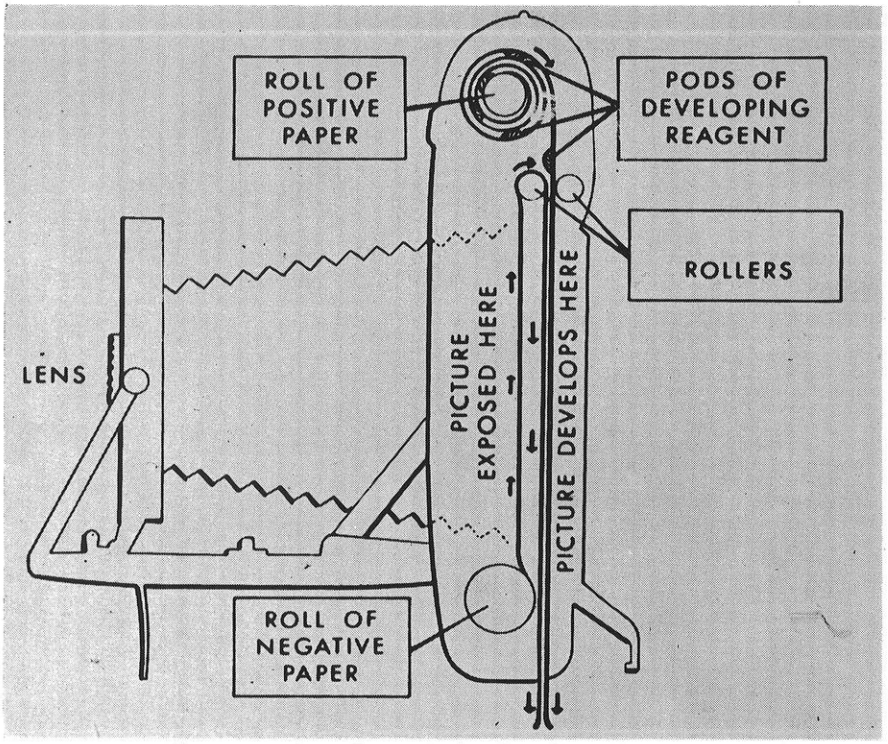
After a minute has elapsed, the positive sheet is removed, leaving the reagent clinging to its negative counterpart, producing a nearly dry, finished print.

The highlights are regions where no silver has precipitated and shadows are regions where varied amounts of silver have precipitated.

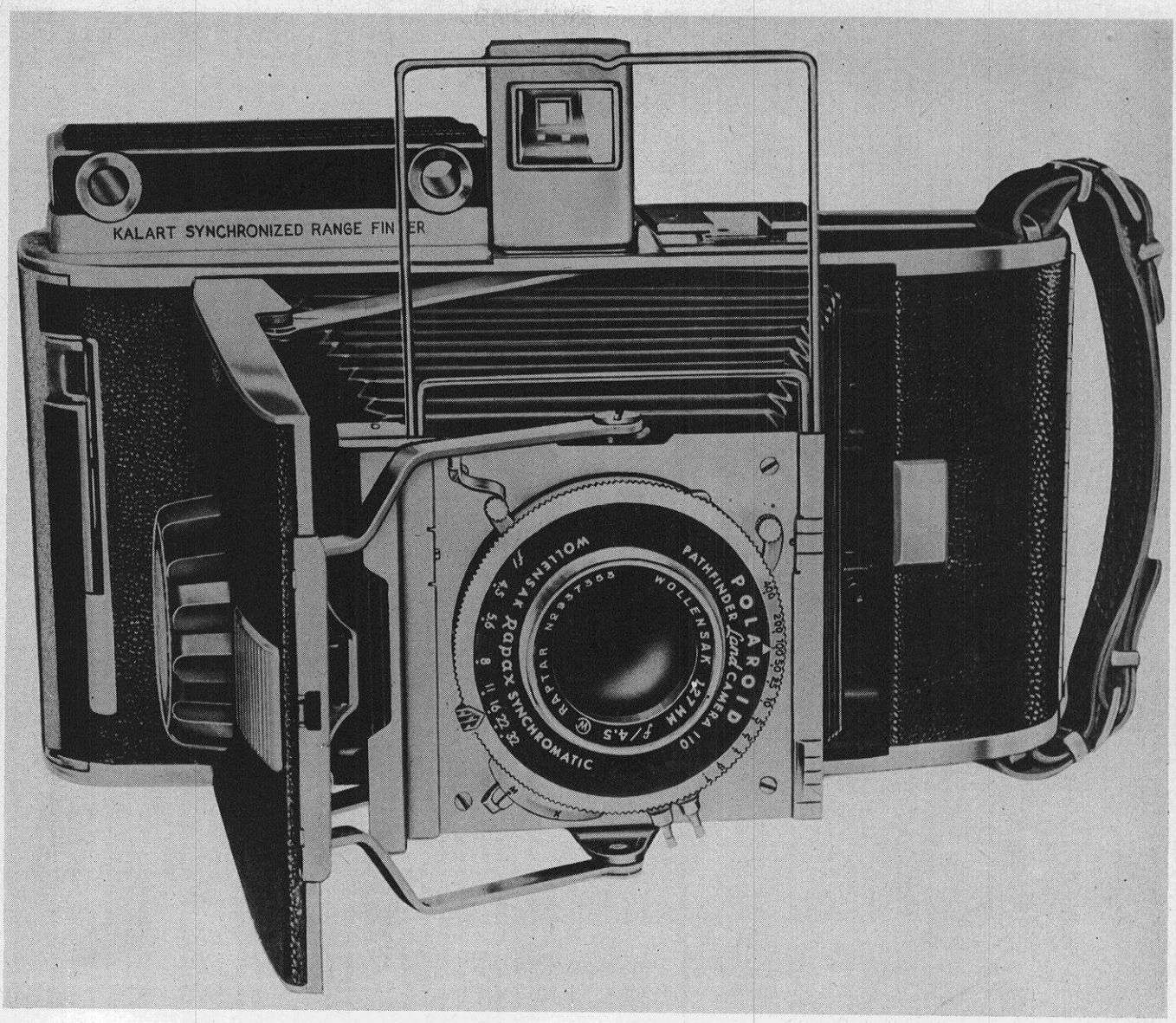
One of the requirements of the process is that the print require no washing. Since incompleted reactions are likely to go to completion and reagents subject to oxidation in air are likely to oxidize, as much of the reagent as possible must remain on the negative sheet which is discarded. The reagent that does remain on the positive sheet must not discolor it. Therefore precautions are taken to eliminate reagents that might react to bleach the image-forming materials.

Materials are added to the positive sheet to decrease the reduction potential of the reagent layer by automatic neutralization (acidification) after the image is formed. Anti-oxidants are added to the positive sheet to inhibit reagent oxidation after the print is removed.

The reagent must act as a reducing agent which will develop the exposed grains rapidly while simultaneously dissolving the less exposed grains. It must not readily precipitate silver ions in solution as silver in the negative, in spite of the rapidly growing concentration



Cut-a-way view of a typical Polaroid Land camera.



This photo shows the lens and shutter adjustments on a typical Polaroid Land camera.

of silver grains in the gelatin derived from the more exposed silver halide crystals. It must ultimately reduce these ions to silver on the surface of the positive sheet.

A combination of five substances satisfy the chemical requirements:

1. & 2. Hydroquinone in presence of sodium hydroxide acts as the reducing agent.
3. Sodium thiosulfate is the silver solvent.
4. Sodium sulfite is added as the anti-oxidant.
5. These chemicals dissolved in a solution of high molecular weight such as carboxymethyl or hydroxyethyl provides the high viscosity.

In addition to creating the mechanical system, Dr. Land, president of the Polaroid Corporation, was the first to overcome these technical obstacles.

He not only developed a process that could be performed with fast negative-type emulsions, but worked out the physics and chemistry of the silver precipitation to control the color and produce full-tone graduations yet give high maximum and low minimum densities.

The Land "Diffusion Transfer Reversal" process just described achieves a high degree of control over the chemistry and physics of the development, dissolution, and precipitation processes.

In conventional processes, the negative must be exposed, developed, fixed, washed and then dried. The positive print is obtained in a similar fashion. The whole series of operations are very time-consuming. If the picture does not come out as desired, all this time is wasted. Frequently the operation or object to be photographed must be set up once more and the whole process repeated.

With the Polaroid camera, however, a picture can be taken and viewed in one minute. If the shot did not turn out it is a simple matter to readjust the camera and retake the picture with little waste time or effort.

There need be no great outlay of money to employ a trained technician to process the film, or to build and maintain an elaborately equipped darkroom. In industry, where the dollar counts, there can

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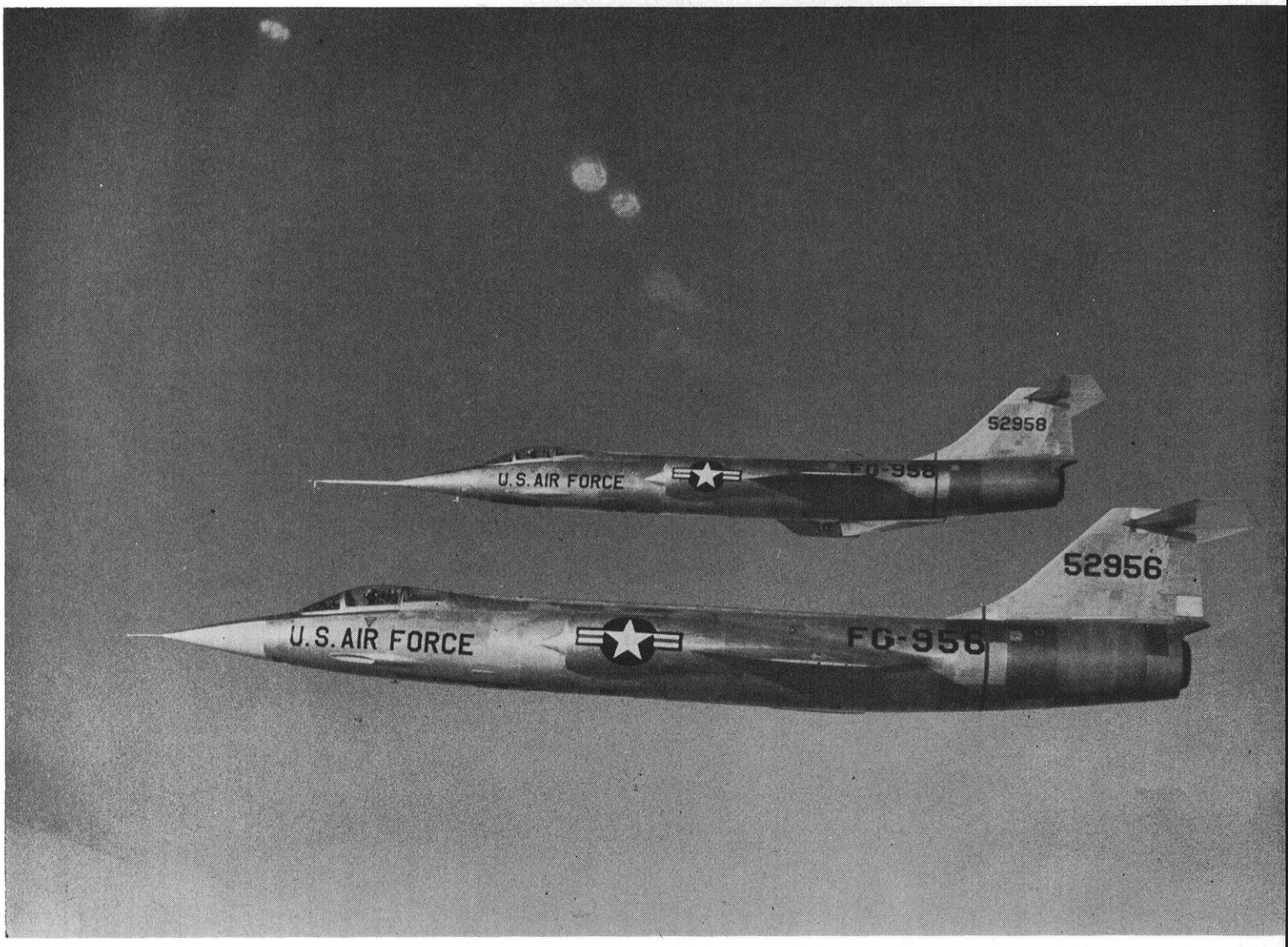


THE AREA RULE—A NEW DIMENSION IN FLIGHT

by Dayle D. Winnie

UNTIL recently, flights at supersonic speeds had been accomplished by a few research aircraft for brief periods only. On December 21, 1954, the first production aircraft to break the sound barrier in level flight was also the first aircraft which conformed to the National Advisory Committee for Aeronautics' *AREA RULE*. As a result of this success, numerous other aircraft have been built around the Area Rule.

The Area Rule has been confirmed in supersonic flight testing of the following new jet aircraft:

1. Convair F-102A, delta winged all-weather interceptor now in production for the United States Air Force at San Diego.

2. Grumman F11F-1, carrier-based interceptor now in production for the Navy at Bethpage and Peconic River, Long Island.

3. Chance Vought F8U-1, carrier-based interceptor scheduled to go into production soon at Dallas, Texas.

4. Convair B-58, delta winged bomber. The worlds first supersonic long range bomber now under tests.

At relatively slow speeds (200 miles per hour) an airplane in flight has little effect on the air particles in its path. They are smoothly displaced as the aircraft passes. Flights at these speeds do not involve any unusually large amounts of drag (air resistance).

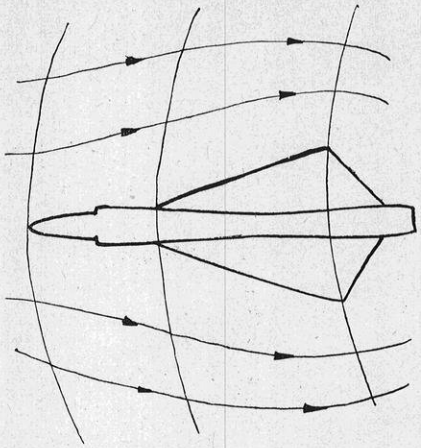


Fig. 3.—Shockwave and airflow patterns with area rule.

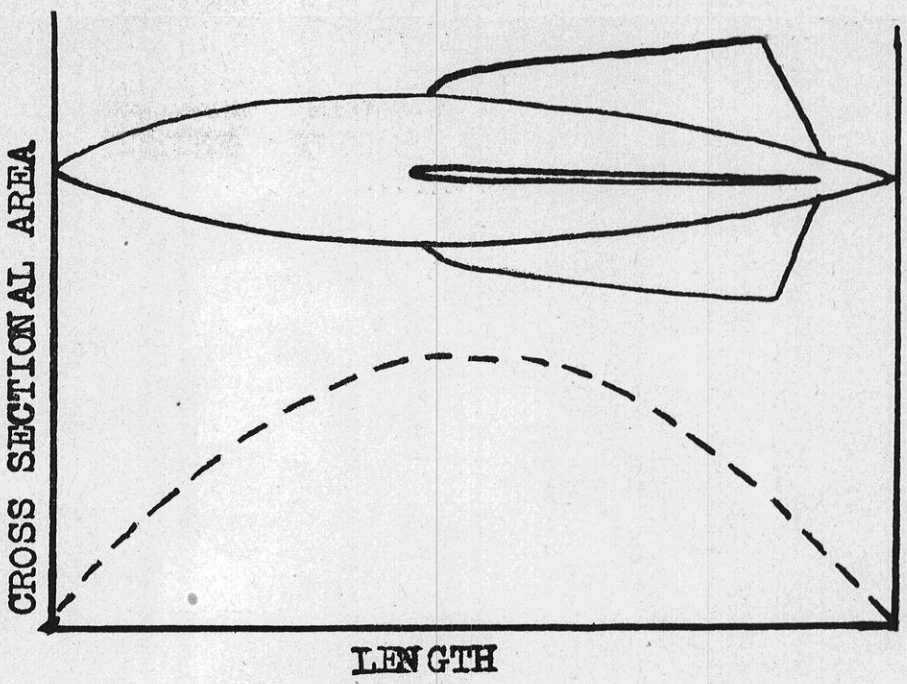


Fig. 5.—Graph of ideal cross-sectional area versus length.

As an aircraft approaches the speed of sound (760 miles per hour at sea level), however, the airplane is moving so fast that the air particles can not get smoothly out of its way. They are shoved violently aside by the passing of the airplane and form a wall of compressed air known as a shock wave. In the case of the Convair B-58, there are three of these major shock waves, each occurring where the air is suddenly forced aside.

The first occurs where the mass of the aircraft first encounters the air, or at the "nose". This is the first place where there is an increase in cross-sectional area.

The second appears at the wing beginning, as there is another abrupt increase in cross-sectional area at this point. At the end of the wings, where this is a sudden reduction of cross-sectional area, there is a third shockwave.

The interference drag of these shockwaves (the major drag component at transonic speeds) depends almost entirely on the distribution of the airplane's total cross-sectional area along the direction of flight. Interference drag is caused by the intersection of wings, fuselage, tail and other airplane components.

The speed of any airplane which must carry along three large shockwaves will be greatly reduced.

The Area Rule was nicknamed the "Coke-bottle effect" because it was to leave some airplanes with fuselages that looked strangely like Coca-Cola bottles. Simply, the effect of the cinched Coke-bottle design was to give "breathing" space to the shock waves of highly compressed air encountered at the speed of sound.

As the body of the plane noses into the heavy shock wave, its cinched waist gives the wall of compressed air a momentary space in which to lose some of its compression or density. Then, like a thin hipped boy scuttling through a hole in a fence, the plane slips through this barrier.

Another important result of the Area Rule is the elimination of buffeting in the transonic region. The first few aircraft to fly into the transonic region experienced a violent shaking or buffeting. This buffeting could result in serious damage to the aircraft, and even be the cause of a crash.

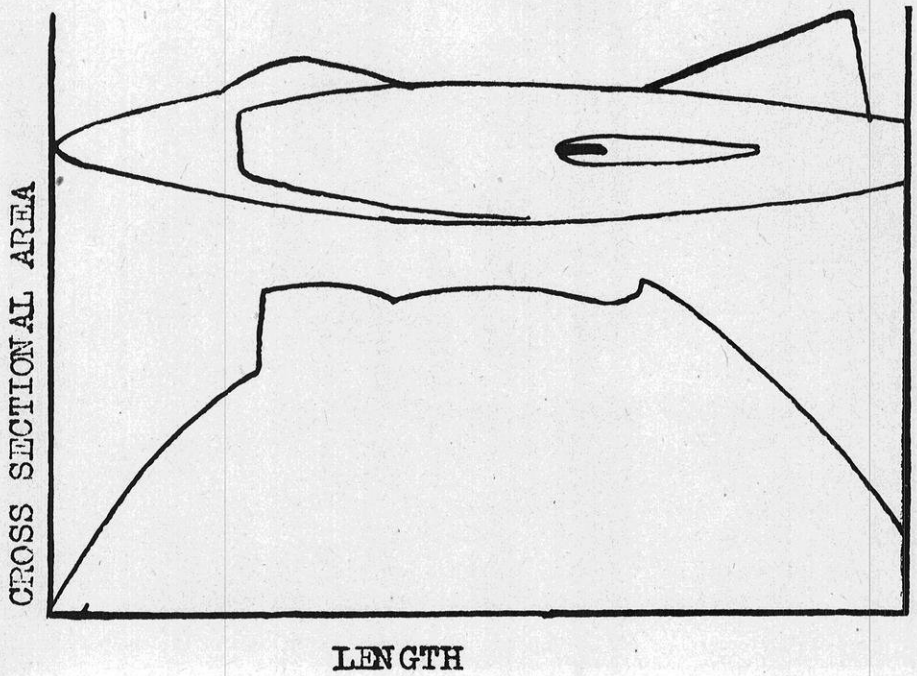
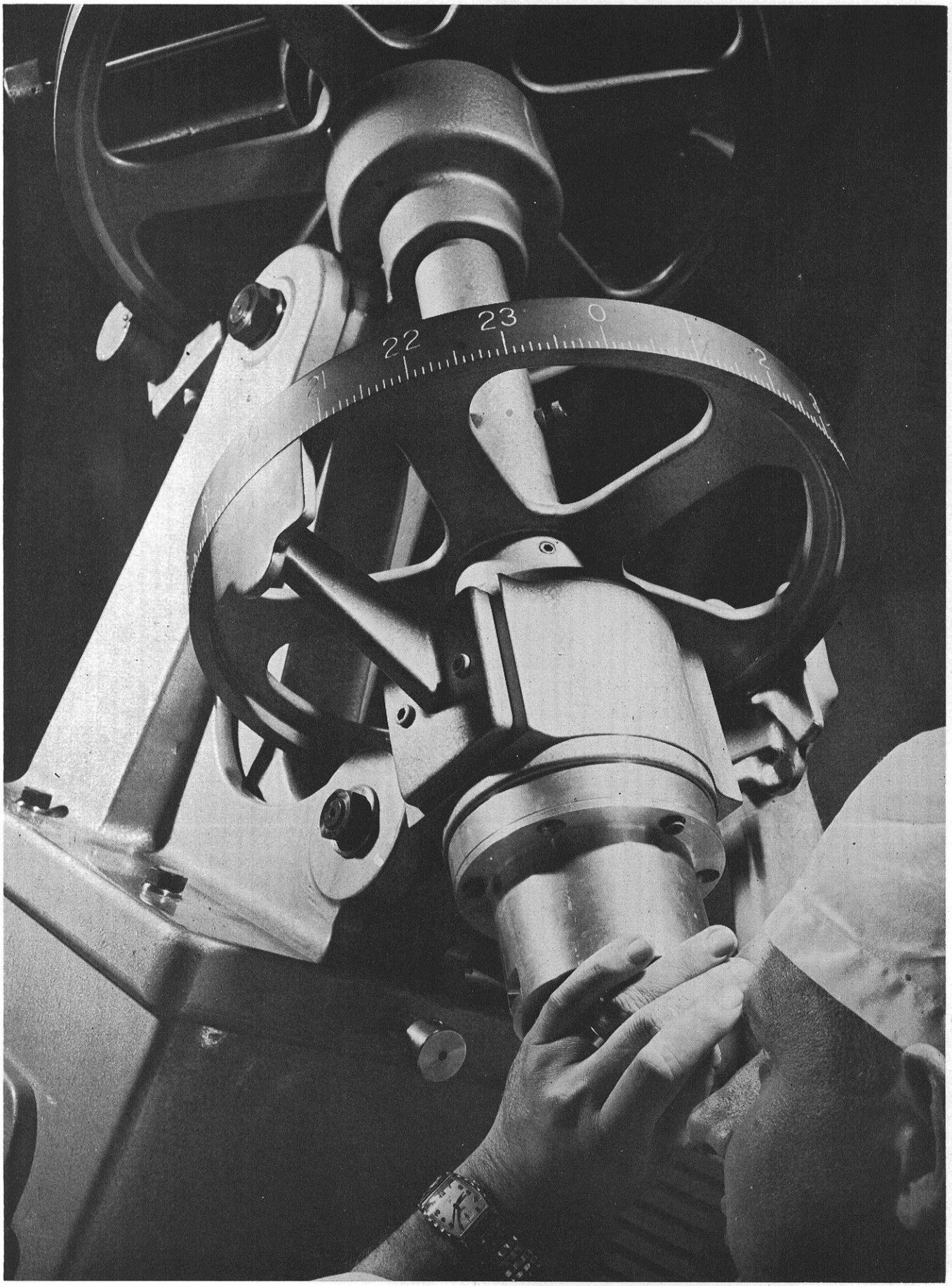


Fig. 4.—Graph of typical aircraft cross-sectional area versus length.

(Continued on page 72)



Engineer aligns equatorial mount on a fixed star reference so axis of the mount is parallel to the axis of the earth. Sidereal drive rotates the mount at the same relative speed but in the opposite direction as the earth's rotation.

THE AUTOMATIC PILOT

by Jim Naze

The author discusses the automatic steering devices that take over the routine of flying for the human pilot and its basis, the gyroscope. He predicts a future for this type of control that will eventually extend even to space craft.

THE history of the automatic pilot dates back to the discovery of the gyroscope by the French physicist J. B. Foucault in 1852 when he demonstrated the earth's rotation by means of a rapidly spinning wheel. The distinguishing characteristic of the gyroscope is that it provides a stable reference direction and it possesses "inertial stability." By its nature the gyroscope tends to maintain its spin axis in a fixed direction similar to the way in which the earth is stabilized with its spin axis pointed toward the North Star.

Developments advanced the use of the gyroscope and soon it was introduced to the aircraft industry when the aircraft gyroscope was developed. It is surprising to learn that an aircraft was flown by an automatic pilot before the First World War when aircraft themselves were in a primitive state of development. It was 1909 when the first gyroscopic stabilizer was built and successfully installed in an airplane by the Sperry Gyroscope Company of New York. This was the beginning of an outstanding application of the gyroscope.

Other gyroscopic devices were soon invented such as the directional gyro, the vertical gyro, and the rote gyro. They gave the pilot visual information for proper flight. This visual information method of flying was quite satisfactory in the days of relatively slow and stable aircrafts, but for use with unstable high speed modern aircraft, the human reaction time proved too slow for the mechanics of modern flight. The pilot was unable to properly control the aircraft's flight even with the information available. Also the more modern aircraft had longer flights. Thus the need for relieving the pilot's fatigue became greater than in the past. Some form of automatic flight control was needed.

Such a control system did come in the form of an automatic pilot which employs gyroscopes as the sensing elements. "The object of the automatic pilot is to take over for the human pilot the monotonous routine of flying the aircraft straight and level and with extremely greater accuracy.

The human pilot can control an aircraft with an accuracy which depends on his experience and skill as a pilot and his ability to interpret correctly the various instruments during an aircraft's disturbance. Today's automatic pilot systems maintain straight and level flight at all times and are also capable of controlling aircraft on takeoffs and landings with increased safety, comfort, and economy.

This automatic control of lateral, longitudinal, and directional movements of the aircraft is all a part of the instrument board. The human pilot on the other hand has a visual indication of the angular movements of the aircraft for use in either automatic or manual control.

Two gyroscopes are used in the automatic pilot system, the directional, and the bank and climb gyroscopes. Although the gyroscopes can either be air driven or electrically driven, today the greater majority of the gyroscopes used in automatic pilot systems are air driven; this is the type to be considered in this discussion.

It is important to realize that the automatic pilot does not stabilize the aircraft by means of any gyroscopic torque because this would require a gyroscope too large for practical use on aircraft. The gyroscopes are used to supply flight information by two or more reference lines or axes to detect any angular movement of the aircraft. This can be compared to the human pilot who uses his brain (through his eyes) to detect the angular movement.

The human pilot through his nervous system and muscles applies corrective power to the aircraft's controls while the automatic pilot system, in duplicating the functions

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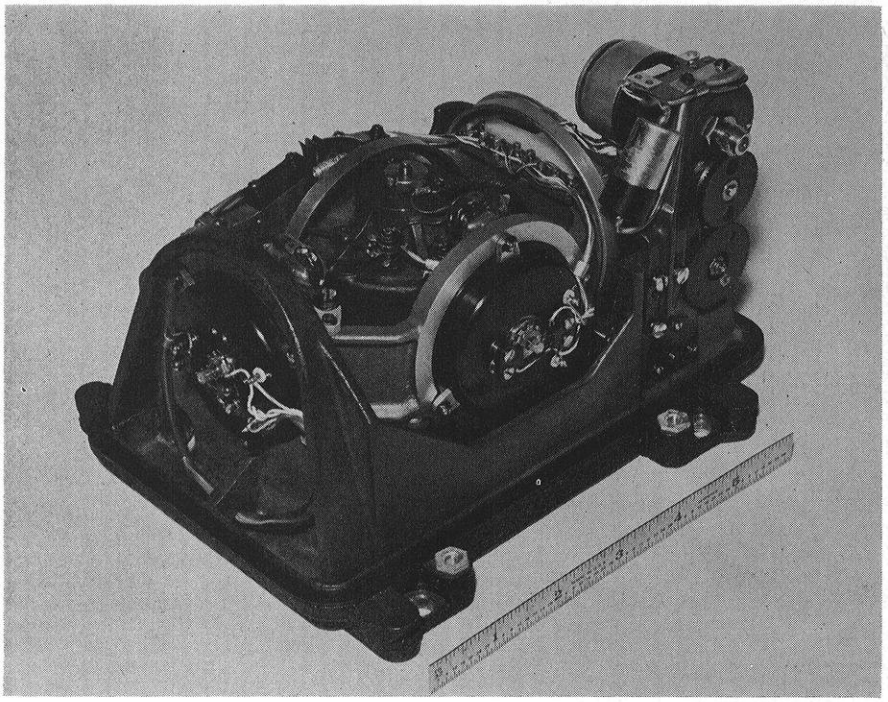
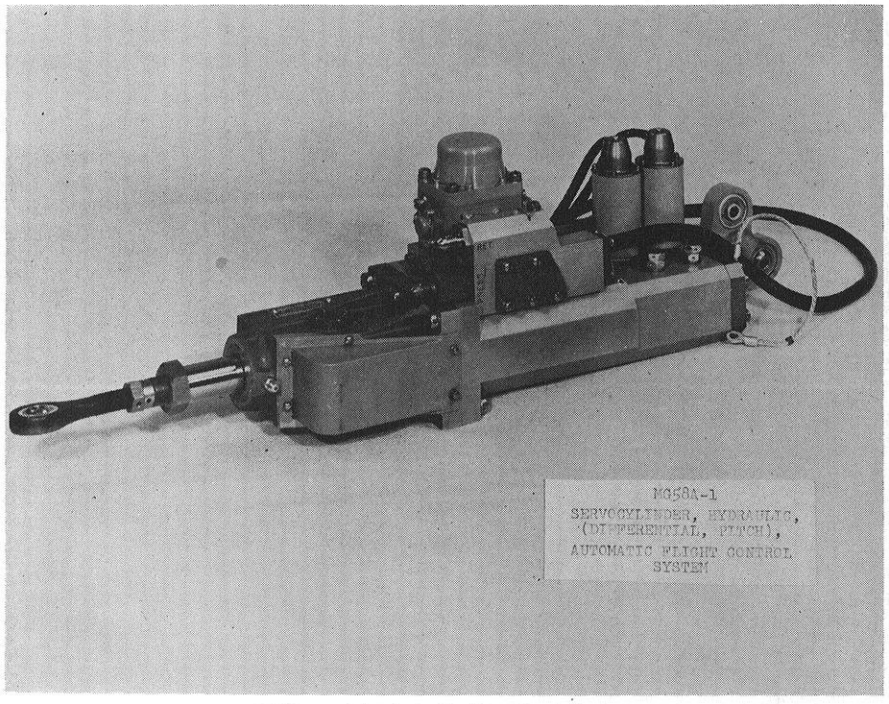


New cageable vertical gyro which features a new synchro design allows for extremely high accuracy.



Differential pitch hydraulic cylinder.

of the brain, nerves, and muscles, employs a device known as a "pick-off" for detecting the displacement information from the gyroscopes. This "pick-off" is the "brain" and may be pneumatic, hydraulic, or electric, depending on the particular system. In present day automatic pilot systems the electric signal system is the most prominent.

To minimize the reaction on the gyroscopes the impulse or signal from the "pick-off" is very small so a form of relay, or amplifier "nerve system," is used to magnify it into a force capable of operating the servos which act as "muscles." These move the aircraft controls to correct for the disturbances.

To better understand the operation of the automatic pilot system a brief description of the operation and function of the two gyroscopes will be given.

The directional gyroscope with two degrees of freedom, besides rotation about the spin axis, gives the pilot a direct indication of the aircraft's heading. This gyroscope consists essentially of a rotor supported by two gimbals each pivoting about an axis perpendicular to the other. By mechanically coupling the outer gimbal to a dial the aircraft's heading angle can be indicated on the instrument panel or relayed to the automatic pilot.

This dial mounted upon the gyro is a circular cord graduated in five degree intervals through three hundred and sixty degrees of azimuth. Due to the gyroscopic principle of rigidity, this cord will maintain a constant heading.

The directional gyroscope indicator has no directive force like that of a magnetic compass. It must therefore be checked periodically, every hour or less, with the magnetic compass and reset if necessary. This is because, due to friction in the bearings, the gyroscope has a tendency to "drift" or wander off the set heading in one direction or the other.

This gyroscope drift is not to be confused with wind drift. The directional gyroscope knows nothing about wind direction or velocity; the pilot must make his allowance for wind drift in the usual manner when he determines the course to be flown.

When the aircraft is in level flight, the indicator dial remains stationary, but when the aircraft turns the gyroscope rotor retains its direction in space while the aircraft and the instrument case turn about the gyroscope. Thus an indication is presented to the human pilot or relayed to the automatic pilot proportional to the amount of the turn. Because the gyroscope remains fixed wih its axis horizontal at all times while it rotates, these indications can also be used for making precision turns.

The directional gyroscope control unit, together with the bank and climb gyro control unit, is carried in the mounting unit and the whole is installed as a part of the instrument panel. The two indicators are usually close together but their position may vary in different types of aircraft.

The knob below the directional

gyroscope indicator is the rudder knob which is used for setting the gyro pilot to steer at any selected heading. At any desired time during the flight the knob can be reset to another heading or the automatic control system can be taken over by human control.

The bank and climb control unit contains the bank and climb gyroscope, also known as the vertical gyro. This gyroscope is used for lateral and longitudinal indications and control. It also is free to rotate about two axes. The major difference between the directional and vertical gyroscopes is that the vertical gyro's spin axis is vertical instead of horizontal. While maintaining this vertical position it indicates whether the aircraft is diving, climbing, banking, or maintaining level flight.

The horizontal bar is attached to the gyroscope and remains in a horizontal position at all times. The gyro horizon shows bank, either side, climb, glide, and level flight, just as it occurs without any delayed action or lag in the instrument. This instrument is called the flight indicator.

Using this instrument is so similar to using the natural horizon that it is a very simple task to learn how to use it for instrument flight. To maintain level flight the miniature aircraft is lined up with the horizon bar in the prescribed manner. When the aircraft is banked the pointer at the top of the dial indicates the amount of bank, thirty degrees, sixty degrees, and ninety degrees on each side.

A complete automatic pilot system consists of several separate units each with a specific purpose. Aside from the directional and vertical gyroscope control units the system consists of the mounting unit, the servo unit, the oil pump and sump, and the vacuum control unit.

The two gyroscope control units are attached to the mounting unit and supported on shock absorbers behind the instrument panel, to which the necessary relays, valves, and other controls of the system are also attached.

The servo unit moves the control surfaces of the aircraft as the automatic pilot supplies it with signal instructions. The servos for rudder, aileron, and elevator control consist of three hydraulic cylinders with pistons under oil pressure. The servo piston rods are connected directly to the main control cables and to the control units so proper control can be applied to the aircraft.

An "on and off" lever on the control panel operates a by-pass valve which when turned on closes the valve. This causes oil under pressure to pass to the piston which can then operate a control surface when signals are received. When the lever is in the "off" position the by-pass valve is opened and the pressure on each side of the piston is neutralized.

The oil pump provides the necessary oil pressure for the flow of oil for operating the servo systems.

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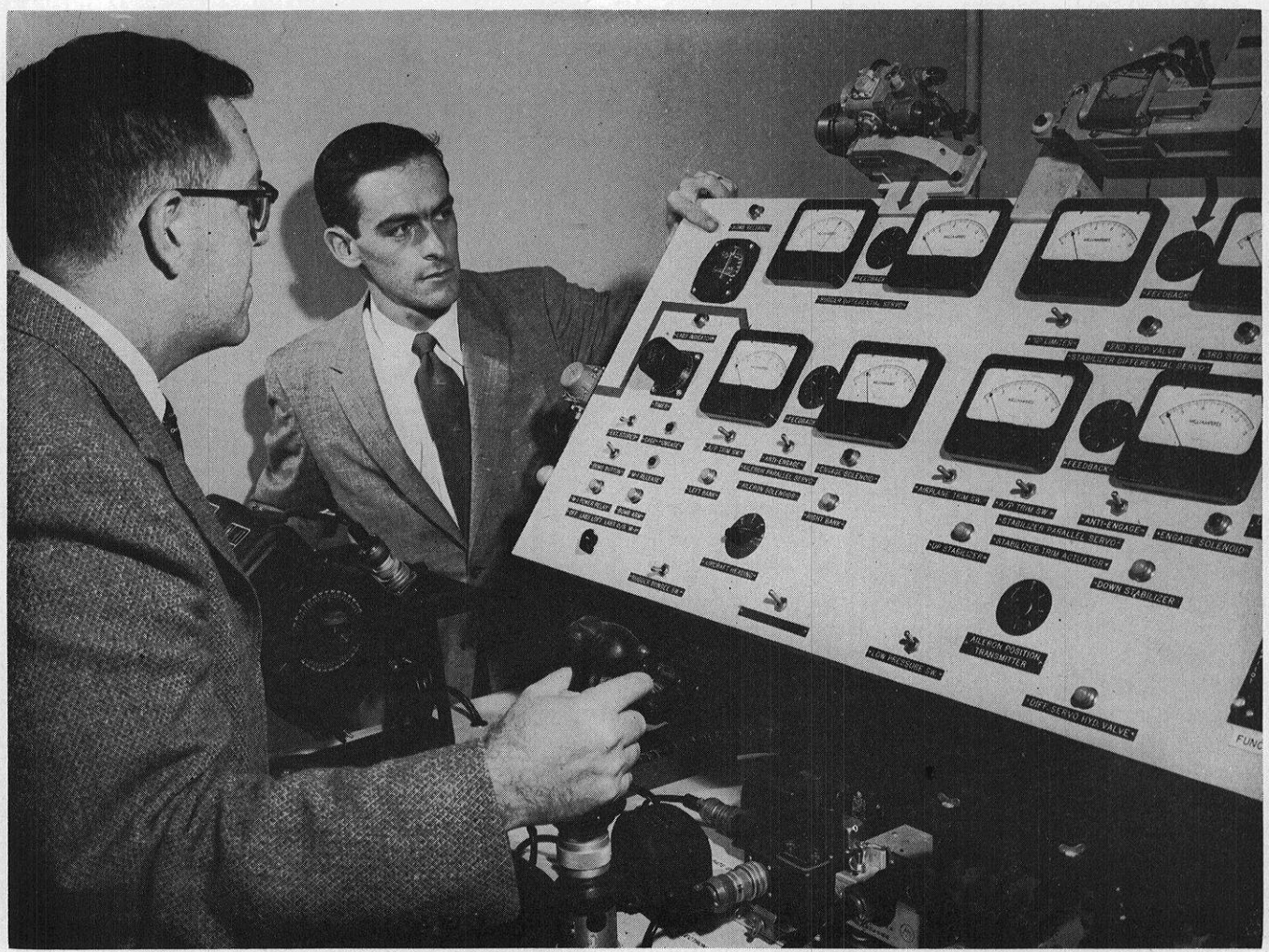
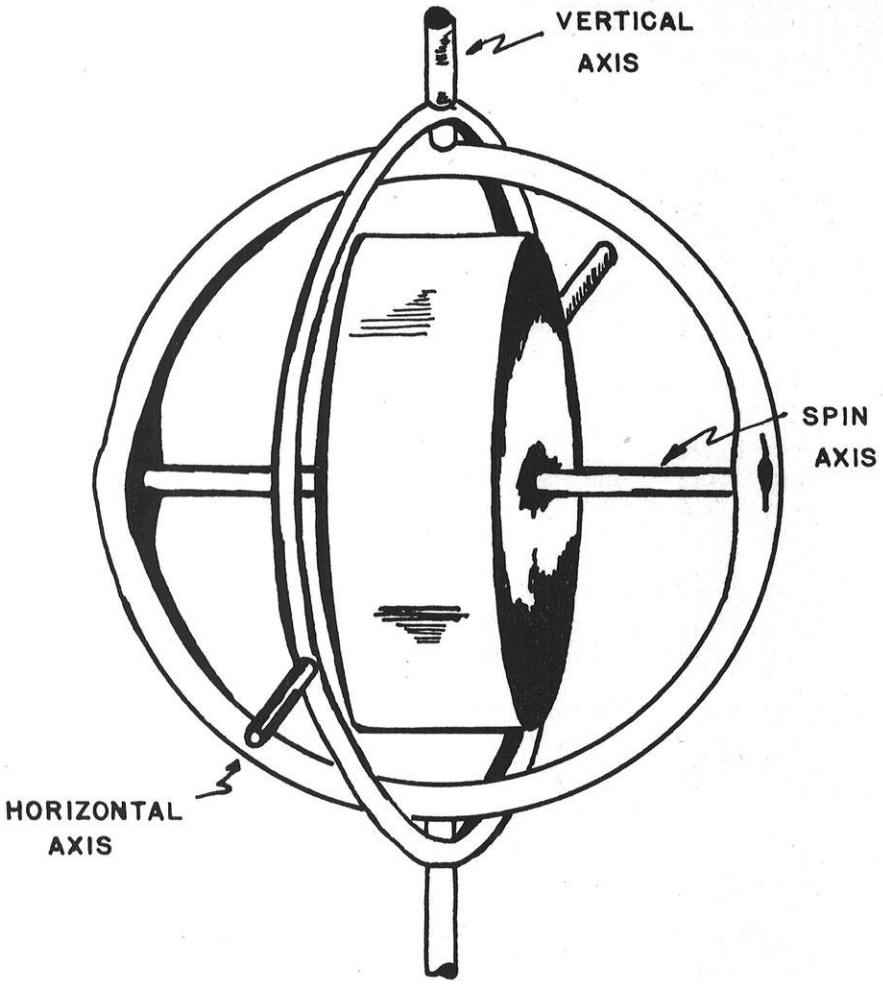


Simulator used to test auto-pilot equipment.



Gyroscope.

The sump is the reservoir for the oil and contains the oil pressure regulator which maintains the desired pressure and by-passes oil, which is not being used to operate the servo unit, back into the sump.

The vacuum control unit furnishes a flow of air which turns the gyroscope rotors in the two gyro units. This air flows through the instrument case and is directed at buckets attached to the rotors of the gyroscopes by means of a small jet. A suction valve regulates the proper flow of air through the main system to maintain a constant speed of the gyroscope rotor. Although vacuum systems on different aircraft vary slightly, they all have the same basic principles.

As do other systems of control, the automatic pilot has operational limitations which must be considered when using the system. The vertical gyroscope is affected by turns of the aircraft which cause a temporary mis-indication commonly referred to as Horizon Turn Error. This error has been reduced to a minimum in modern systems, but is by no means negligible.

A turn may cause the bank and climb gyroscope unit to process slightly producing a slight "lowering" of the horizontal bar. The automatic pilot corrects for this apparent climb resulting in a loss of altitude. When the horizontal bar tilts slightly, because of this turning movement, the automatic pilot applies a small amount of correction for this apparent bank. These errors are small, lasting for only a short duration, and in a normal flight are not usually considered. However, when flying at low altitudes (less than one thousand feet) with the automatic pilot in use for flight reference, the small corrections endanger the safety of the aircraft.

The directional gyroscope has no such limitations because it is not affected when turning and there is no limit to the amount of turn that can be made.

The requirements of the automatic flight control system have greatly increased over the past ten years in both commercial and military uses. This increase of requirements has been one of increased function to match aircraft development as well as increasingly severe environment accompanying greater speed and higher altitude of flight, and a growing need for a "fail-safe" automatic flight control system.

At the present time no automatic flight system is completely failure free, however tremendous strides have been made over the past years with the result that the actuality of a failure free automatic flight control system is now much closer.

In today's modern fighter aircraft the autmatic pilot, in addition to stabilizing, must allow the human pilot to maneuver the aircraft while under automatic control. Because of the maneuverability required, work on jet fighter automatic pilots has resulted in the development of an automatic pilot with full freedom attitude control. Instead of an earth axis reference system, an aircraft axis reference is used, giving prime control which is correct for all aircraft attitudes. This eliminates the requirement for highly precise data transformation. This fighter automatic pilot is also designed for operation with fighter fire control systems.

In the same development period the A-12 gyropilot which is used in many types of aircraft was introduced. Its development was based upon the philosophy that tightness of aircraft control was extremely important, not only from the standpoint of furnishing a stable bombing platform, but for all aircraft control. The A-12 automatic pilot design has been extremely valuable in the military use and has been installed in all of the latest jet bombers.

Controlling aircraft on takeoffs and landings has given more effective and safe operation than could be performed by the human pilot. It has solved the problem of landing under "zero-zero" weather conditions which is one of the

L to R, rear, are stablizing gyro, and tranceiver units; front, radar screen and synchronizer unit, and master control panel for many different uses.

requirements of the Air Force's all-weather interceptors.

The automatic pilot landing system supplies the pilot with readily observable, accurate, and completely reliable information concerning the location of the aircraft with respect to the ground and its direction of motion. Reliability of such a system in presenting this information is essential in order to justify pilot confidence when he must make the critical decision to land or go around.

The control of pilotless aircraft and guided missiles has been the next step beyond the control of piloted aircraft. Aircraft, including high speed modern jets, have been converted to drones which are flown and landed completely by automatic flight control systems. Reliability and automation are essential to the success of these systems.

In the guided missile application, the automatic pilot's guidance system must determine the missile's position geographically and deliver it to the preselected target. The problems of control are severe for missiles because of the impracticability of manual preflight check outs. If a missile is to be controlled in flight it must be able to change course and speed on command from the guidance system. Obviously the heart of the guidance system is a navigation system capable of performing the commands of the guidance system satisfactorily. Such are the requirements for the automatic pilot system used in the missile field where perfect control also makes possible their recovery after flight.

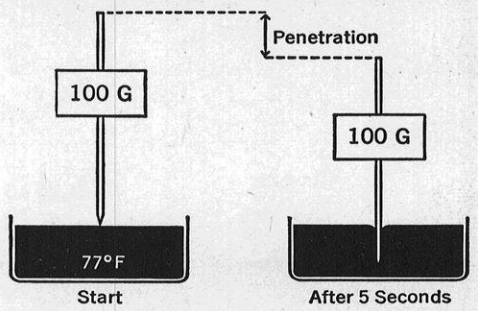
The wider application of the automatic pilot in the more accurate and more useful defense and commercial systems dictated by technological progress promises a bright future for the automatic pilot systems. This future is to a large extent tied up with the missiles and ultimately space craft programs.

The greater portion of the programs presently being carried out are to develop weapons to show strength which it is claimed will help in the preservation of peace. If nations can ever exist peaceably without this show of military preparedness, the automatic control systems developed for the guided missiles and space craft programs can have applications usefulness in fields far beyond that of defense.

THE END

ASPHALT ENGINEERING BULLETIN #3

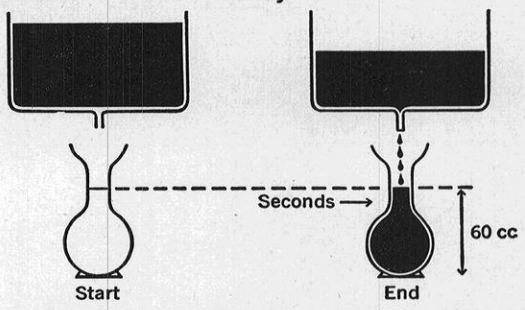
PENETRATION indicates consistency



Consistency is determined by measuring the **penetration** made in 5 seconds by a standard needle loaded with 100 grams. The test is normally run at 77°F and penetration is measured in units of 0.1 mm.

FIG. 1

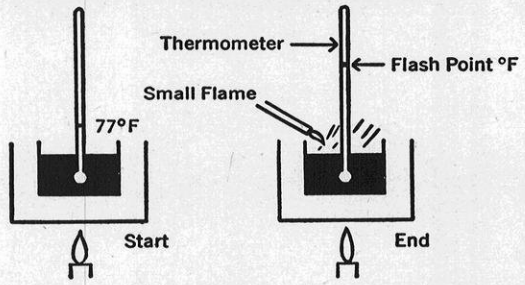
VISCOSITY indicates fluidity



Fluidity is determined at specified temperatures with a Saybolt-Furol Viscosimeter. Results are expressed as Saybolt-Furol Viscosity . . . the time in seconds for 60 cc of the product to flow into measuring flask through a precisely dimensioned orifice. The slower the flow, the higher the viscosity.

FIG. 2

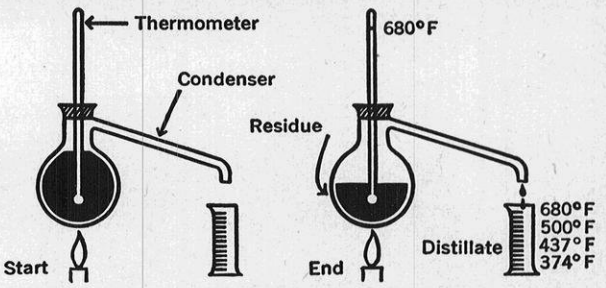
FLASH POINT indicates safe heating temperature



Volatile constituents evolve when the temperature of an Asphaltic product rises sufficiently. The temperature at which they "flash" or temporarily ignite when a small flame is passed through them, during heating of the product, is its **flash point.** This temperature is usually well below the **fire point** or the temperature which will support burning.

FIG. 3

DISTILLATION indicates volatile content...residue



Volatile Content is determined by gradually heating to 680°F, a measured volume of material in a distillation flask connected to a condenser. Relative amounts of volatile materials evaporating at different temperatures and of residual Asphalt are thus determined. Further tests are usually run on Asphalt residue to determine its characteristics.

FIG. 4

Tests on Asphaltic Materials

The suitability of an Asphaltic material for highway or other use depends upon characteristics which can be determined by a series of tests. Four of the principal tests are:

PENETRATION TEST (Fig. 1)
indicates the *consistency* or hardness of Asphalt cements (which are semi-solids) used in hot-mix Asphalt pavements. The softer the product, the greater its number of penetration units. On the basis of consistency . . . denoted by penetration ranges . . . Asphalt cements are classified into grades. Those paving grades now recommended by The Asphalt Institute are:

PENETRATION GRADES

60-70 85-100 120-150 200-300

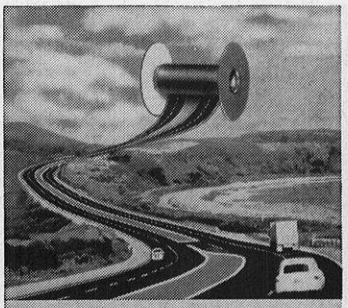
(a 40-50 penetration grade is recommended for special and industrial uses.)

VISCOSITY TEST (Fig. 2)
indicates the fluidity of liquid Asphalts. Viscosity measures the consistency of these products just as the penetration test measures the consistency of semi-solid products. Those liquids flowing too slowly for accurate measurements by the viscosimeter at 77°F are tested at higher temperatures—usually at 122°F, 140°F, or 180°F.

FLASH POINT (Fig. 3)
indicates the temperature at which vapor ignition may occur when heating and manipulating Asphaltic materials.

DISTILLATION TEST (Fig. 4)
indicates the amount of Asphaltic residue to expect in liquid Asphalts after lighter constituents volatilize under manipulation and use. It indicates, too, the relative rapidity at which these lighter constituents "cure" out of the Asphalt.

Be sure to cut out and file this data sheet, as well as future sheets and those previously inserted in this publication. Make them your professional reference material.



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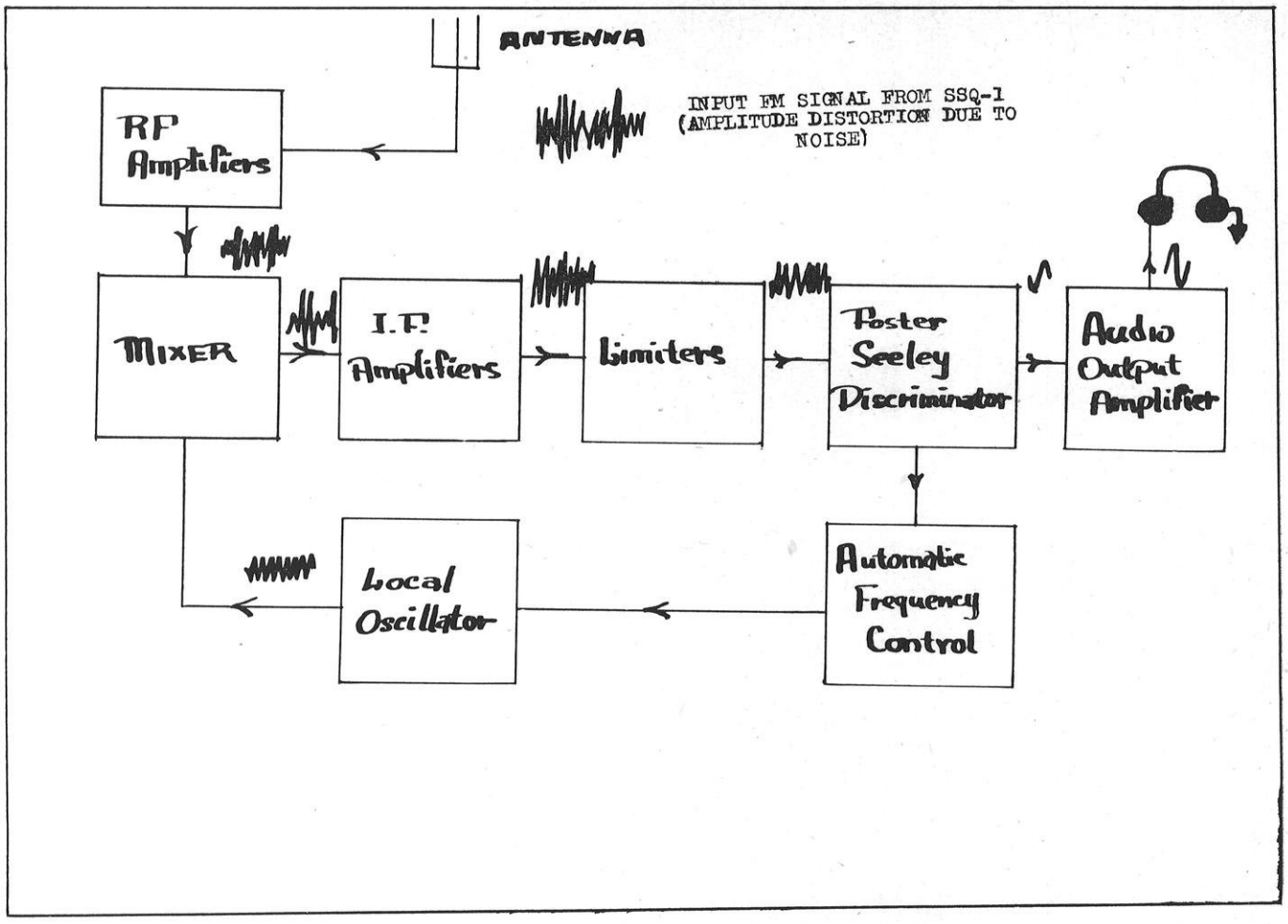


Block Diagram of the SSQ-1 sonobuoy.

Sonobuoy

(Continued from page 21)

Between the two amplifiers is a potentiometer called the "Random-Sea-Noise Adjust". This control is carefully adjusted in the laboratory to eliminate interferences from sea noise. It is important that each Sonobuoy be adjusted to the same degree of sensitivity so that accurate comparison of the audio signals can be made by the radio operator.

The output of the second audio amplifier is R-C coupled to the grid of the reactance modulator tube, a 1L4. The reactance modulator frequency modulates the tank of an electron coupled Hartley oscillator in the grid circuit of the 3Q4 oscillator tube. By using reactance tube frequency modulation, neglible power is needed for modulation.

The oscillator works in the vicinity of 17 mcs with its plate circuit tuned to the second harmonic. In the following stage, a power amplifier doubler, the frequency is again doubled. Thus the transmitter is in the 70 mc range and has a 75 kc maximum deviation.

The antenna system consists of a vertical quarter-wave whip, cut to 39 inches. Insulators hold the antenna base just above the surface of the water. The radiated power is approximately 1/10 watt which is sufficient for line of sight transmission. A surface vessel can receive the Sonobuoy transmissions from a distance of up to 6 nautical miles, while an aircraft at 5,000 feet can receive Sonobuoy signals up to 50 nautical miles.

Research and development engineering on the SSQ-1 was carried out at the Underwater Sound Laboratory of Columbia University at New London, Conn. under a National Defense Reserve Commission contract. Production Engineering and manufacturing was by Emerson Radio and Phonograph Company and Freed Radio Corporation.

Many hundreds of the SSQ-1 were used in both the Atlantic and Pacific waters. They saw most of their action in 1943 when the German submarines were taking a tremendous toll of our shipping. It was during this period when the buoy was described as the "Expendable Radio Sono Buoy."

In 1951 modifications of the Sonobuoy rapidly took place until the development of the SSQ-2B produced highly effective results in submarine detection. In studying the SSQ-2B Sonobuoy, we shall only consider the additional features.

The audio amplifier stages and transmitter section were only slightly modified by using subminiature tubes in lieu of some of the miniature tubes to obtain better stability in the transmitter, and better frequency characteristics in the audio amplifiers.

Whereby the SSQ-1 required the pulling out of the antenna by hand to put it into position, (this action also connected the batteries into the circuit), the SSQ-2B requires no handling prior to its release from the aircraft. Sonobuoy racks were installed in the midsection of

the Patrol and Anti-Submarine aircraft. Release from the racks and projection of the buoys out of the aircraft was put at the disposal of the pilot or navigator.

The SSQ-2B utilizes a rotor assembly to control its rate of descent. As with the SSQ-1, the rate of descent is 30 knots. Upon striking the water, the bottom plate just below the hydrophone is released by an impact switch and the rotor assembly is released via a coupling rod running the entire length of the buoy. The momentum of the blades is sufficient to carry the rotor assembly upwards and completely clear of the antenna deck.

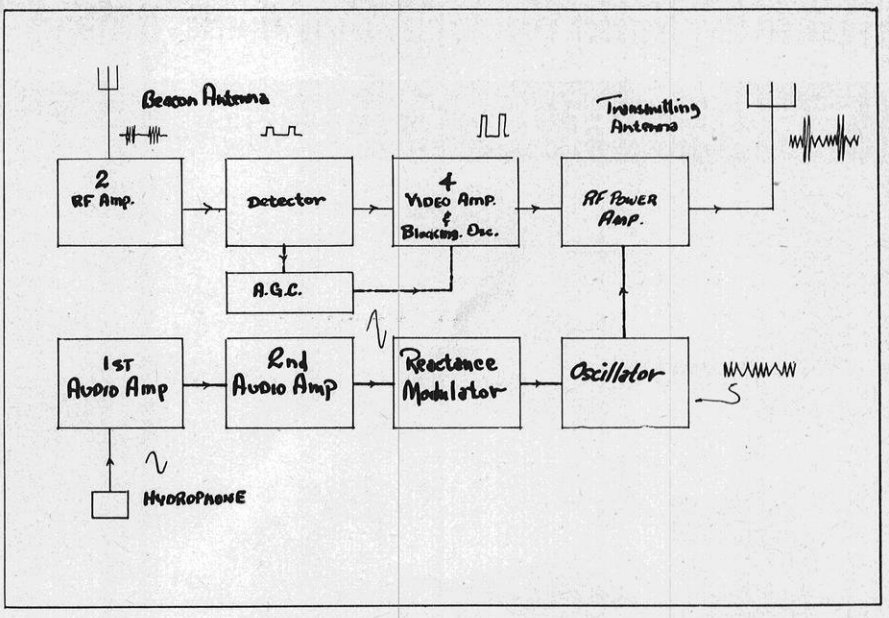
The antenna is electrically the same as that of the SSQ-1 but is physically different in that it is just a long springy strip of metal coiled up and held in place by a loop of paper which has the property of being strong when dry and very weak when wet. Therefore upon hitting the water, the paper tears apart and the antenna springs into place.

The B batteries of the SSQ-2B are connected at all times but draw no current until the filament voltage is applied. Application of the filament A supply is accomplished by water-activated batteries. The A supply consists of four such batteries connected in series. Upon being saturated with sea water sufficient filament voltage is produced to start the entire buoy into operation. Within 15 seconds, operating voltage is built up.

Upon release of the bottom plate, the hydrophone sinks to a depth of 40 feet (Note the change in the length of the cable). Because the hydrophone is twisting and turning as it descends, there is danger of the cable snarling. This snarling is prevented by winding the hydrophone cable around the hydrophone and having each layer of winding separated by a sheet of waxed paper.

The hydrophone is a prepolarized ceramic cylinder which works on a piezoelectric principle. It is much more rugged than the hydrophone of the SSQ-1 and much easier to manufacturer.

As previously mentioned, the transmitter of the SSQ-2B is almost identical to that of the SSQ-1 with the exception of use of some sub-



Block diagram of the SSQ-2B sonobuoy.

miniature tubes. The main addition on the newer Sonobuoy was the Beacon stage. In some cases it would be desirable to observe the buoy pattern on radar (such as in heavy overcast or at night), and as the buoy is too small to return a good radar signal to the airship, a Beacon stage was added which transmitted back pulses upon being triggered by the aircraft's radar.

Beneath a plastic dome on the antenna deck of the buoy is located the Beacon antenna. As the radar beam sweeps by the buoy, radar pulses are picked up by the beacon antenna, fed through a stage of RF amplification, detected, and then fed through four stages of amplification. A blocking oscillator, triggered by the pulses coming from the fourth video amplifier, applies high plate voltage to the plate of the final RF amplifier in the transmitter. The buoy's output carrier is thus both frequency modulated and pulse modulated. An Automatic Gain Control circuit biases the fourth video amplifier to such a level that only the strongest pulses cause tube conduction. As the strongest pulses would be received only when the center of the radar beam is on the buoy, the buoy's target on the radar screen is seen to be a sharp, distinct image.

As a security measure, both the SSQ-1 and SSQ-2B Sonobuoys contain a water soluble carbowax plug which completely dissolves after two hours, thus sinking the buoy. There is, therefore, very little chance of the enemy retrieving the Sonobuoy.

The receiver used with the SSQ-1 is designated as the ARR-31 Airborne Receiver. It is a standard FM receiver. It utilizes a Foster–Seeley discriminator with a well designed Automatic Frequency Control circuit. Any unbalance in the discriminator's output due to random drift of the Sonobuoy would be corrected by the AFC circuit in controlling the frequency of the local oscillator.

Corresponding to each of the 16 Sonobuoy channels, is a color section on the dial of the continuous tuning receiver. Thus the radio operator could be listening to several buoys at the same time, reporting the "nearer" buoys to the navigator by their colors.

The sensitivity of the receiver is very important as the direction of the submarine's motion is determined by a change in the hydrophone signal. It has been reported that under favorable conditions, men could be heard talking in the submarine.

With the development of the SSQ-2B Sonobuoy came the need for a new receiver, the ARR-26. Its main feature is that of the video section used in conjunction with the Beacon feature of the buoy. The Beacon pulses are detected, amplified, and fed to the radar. Also the ARR-26 uses two receivers thus permitting the instantaneous comparison between

(Continued on page 52)

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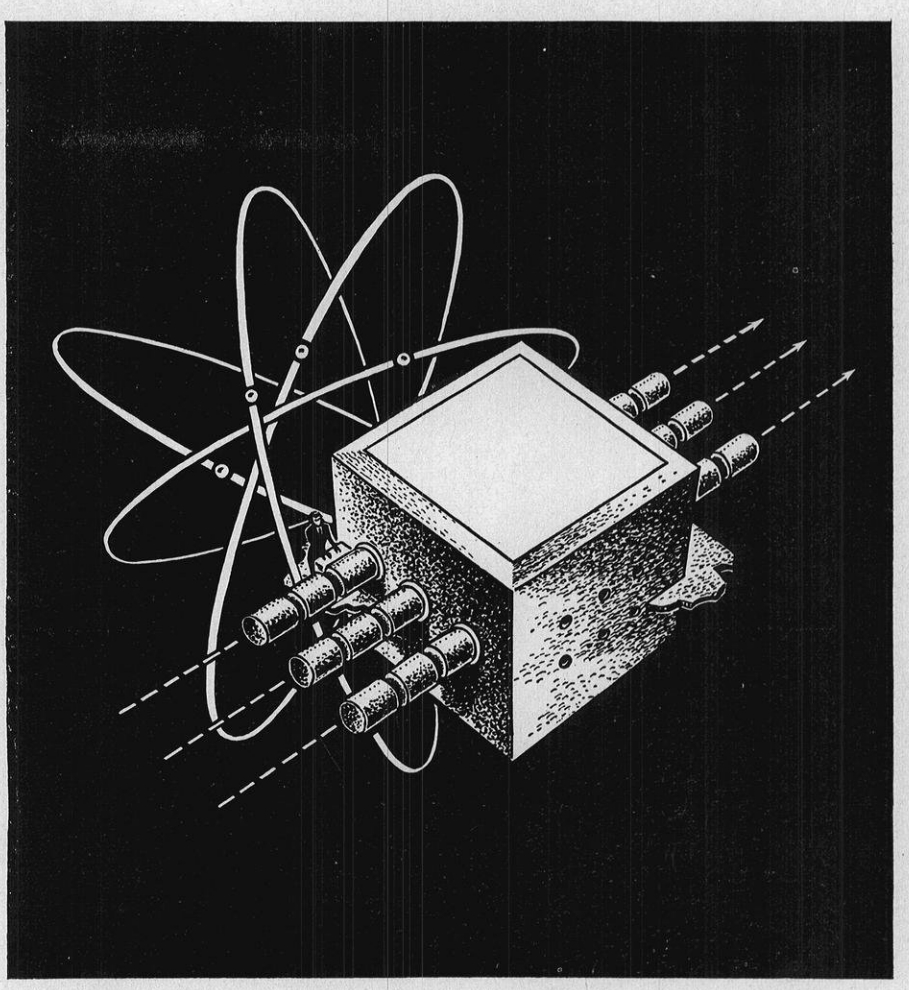

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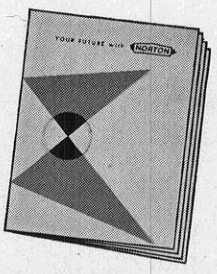

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Arne Steivang and Charles Baumann of Federal Bakery Co., Winona, Minnesota, receive engineering service and product data from Stan Nelson (left), of Standard Oil, to help keep maintenance costs low on Federal's truck fleet.

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He likes people. He especially likes to get into business problems with them where he and his company can help. Truck maintenance, lubrication, and fuel consumption are big items to fleet operators, large and small, who have found that help from Stan pays off—for them.

And he likes selling. He functions frequently as a key man for the sales department. His intelligent analysis of a problem in his field may either improve our service to a valued customer or help us to secure a new one.

He likes to keep moving, too, and he's done that. He held several sales positions in Minnesota and attended Standard's intensive Sales Engineering School in Chicago before being promoted to his present position in which he works out of the Mason City, Iowa, division office.

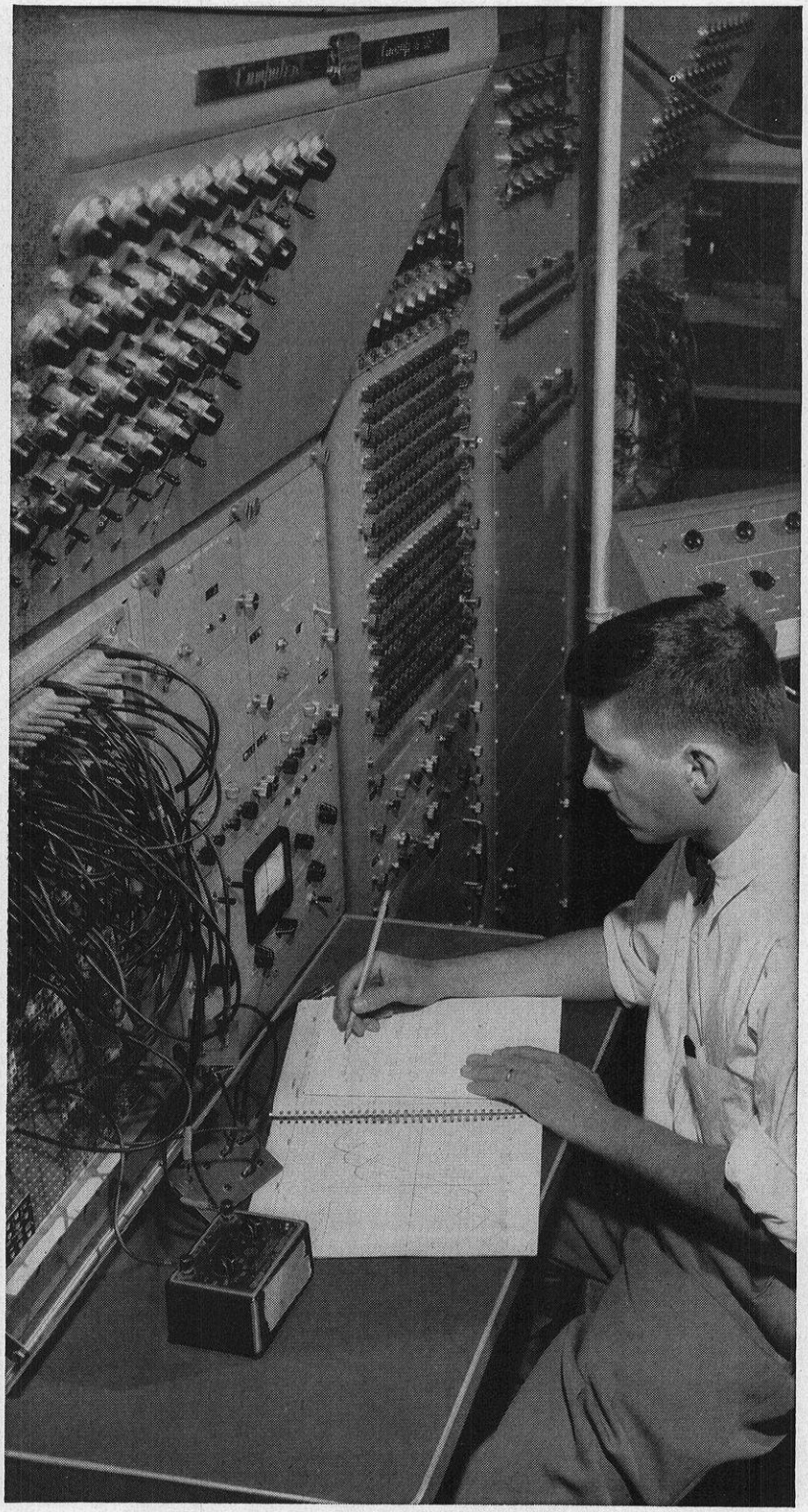
As men like Stanley Nelson earn their way upward in our organization we have frequent openings for ambitious college men to follow them. You might find a career in engineering, research or sales with this stable and progressive company rewarding, too.

Standard Oil Company

910 South Michigan Avenue, Chicago 80, Illinois

STANDARD

How keen is your **IMAGINEERING?**



Can your imagination identify the problems being solved by this young Sperry engineer? Whether your guess is right or wrong, there's no question that at Sperry "imagineering" is the order of the day.

And working with men rated tops in their fields you'll *earn* while you *learn* and start right in on specific assignments in the field of your choice. You will be given important work from the beginning for there is no ceiling on ideas in fields like guided missiles, inertial navigation, advanced radars, microwave technology and many more where Sperry is blueprinting the future *now*.

Sperry is interested in *your* future, too—giving you the chance to study for advanced degrees. And Sperry plants are conveniently located near leading engineering colleges — whether you'd rather work in California, Florida, New York, Utah or Virginia.

When Sperry representatives call at your school, be sure to talk to them. Check your Placement Office for the dates. Meanwhile, write for more facts to J. W. Dwyer, Sperry Gyroscope Company, Section 1B5.

ANSWER: *This Sperry engineer is simulating a ship roll problem on an electronic computer. Solution was incorporated in the new Sperry Gyrofin* Ship Stabilizer which reduces ship roll as much as 90%.* *T.M.

SPERRY GYROSCOPE COMPANY
Great Neck, New York

DIVISION OF SPERRY RAND CORPORATION

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W. S. P. E.

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.

SOUTHWEST CHAPTER

Officers elected for 1957–58 include:

President: JACK H. MAXFIELD
Vice President: A. F. AHEARN
Secretary–Treasurer: DONALD JOHNSON
Past-President: THOMAS HIGGINS
Directors: THOMAS K. JORDAN, ROGER KREMPEL and DAVID K. EVANS

A dinner meeting of all committee members was held at the Cuba Club on October 1 to formulate organizational functions and activities for the year.

LAKE SUPERIOR CHAPTER

Officers for 1957–58 are as follows:

President: WILLIAM H. FORSYTH
Vice President: HARVEY C. SARGENT
Secretary–Treasurer: KEITH H. JENSEN
Directors: E. W. BERG, L. L. MCGAVLEY and R. C. BUCK

A. L. Genisot, state president, held a meeting of all chapter presidents and secretaries at Wisconsin Rapids on Sept. 7, to formulate organizational functions and duties. At the same time State Secretary Harold Kingsbury, outlined the mechanics of operations to the chapter secretaries.

MILWAUKEE CHAPTER

E. C. Koerper, chapter president, reports that Milwaukee seems to have been unusually successful in their Thursday noon luncheons. Attendance for the last two meetings averaged 50 members. The slogan of the Milwaukee Professional Engineering Circles is "See You Thursday".

The forthcoming meetings include a professional news summary, discussion and talk by Mr. Martinson, Chief Engineer of the Koehring Company on "Construction Machinery and Federal Highway Program". Mr. Carl W. Muhlenbruch, President of Educational and Technical Consultants, covered "Scientific Sleuthing-Lawyers and Engineers Join Hands", in which he told of the technical and scientific sleuthing for court cases. The number of lawyers attending included the Federal District Judge and the President of the Bar Association.

NORTHWEST CHAPTER

Details of the $1,500,000 "Nike" air defense rocket installation to be built in the Hudson–New Richmond–River Falls area were outlined to the Northwest Chapter, at River Falls on September 5, 1957.

Col. J. H. Farren and Major Charles H. Pillsbury, from headquarters of the Four Region Air Defense Command at Kansas City, Mo., explained the project, which is the first of four to be constructed around the Twin Cities population center.

Walter D. Hestekin, Eau Claire, president of the Northwest Chapter, announced committee appointments for the coming year, and said meetings will be held on alternating first Wednesdays and Thursdays of the month.

Activities of W.S.P.E. during the summer months were generally at a standstill for most of the Chapters. Statewise, several board meetings were held. A full year of activities is planned starting with the summer conference which was held at the Gateway Hotel and Inn, Land o' Lakes. The Wisconsin Valley Committee in charge was headed by Carl Dvorak and Jess Holderby. Registration began on Friday, Sept. 20 and concluded on Saturday morning.

The Consulting, Industrial, Education and Public Employment groups met Saturday. The business meeting was conducted Saturday at 3:00 P.M. An informal banquet and dance concluded the day's activities.

On Sunday morning the program was completed with State Committee meetings.

THE END

Meet the President

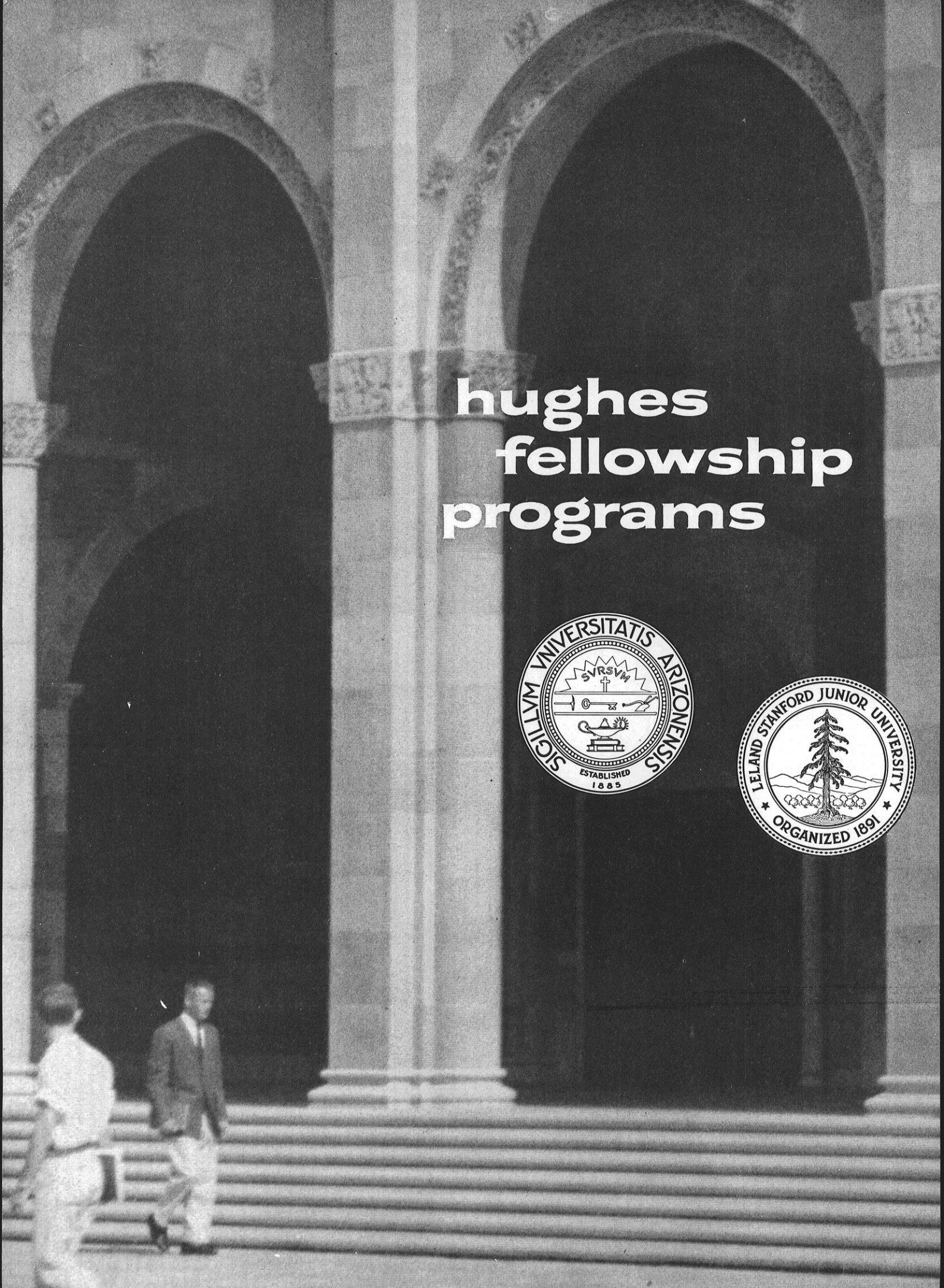
JOSEPH KURANZ

Waukesha Chapter

The president of the Waukesha Chapter, Joseph Kuranz, was born March 15, 1920, in Waukesha, Wisconsin. He studied mechanical engineering at Tri-State College, Angola, Indiana. He is now the Assistant Manager and Engineer of the Waukesha Water Utility Company. He was Junior Engineer with Federal Shipbuilding Co. of New Jersey from the date of his graduation in 1941 until entrance into the U. S. Navy in 1943. Mr. Kuranz served as Lieutenant Commander in the U. S. Navy in active duty during World War II. He was an Engineering Officer and later was promoted to Flotilla Engineer. He joined Remington Rand, Inc., as a Design Engineer in 1946. In 1947, Mr. Kuranz took his present position as Engineer and Assistant Manager of the Waukesha Water Utility.

After joining the WSPE, he became affiliated with the S. E. Chapter. He held several co-chairmanship appointments before being appointed Chairman of Public Relations in 1954.

He was married to Jennie Holub of New York City on January 9, 1943. They are parents of three children, Joseph, Janice and James.


hughes
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programs
SIGILLVM VNIVERSITATIS ARIZONENSIS
SVRSVM
ESTABLISHED
1885
LELAND STANFORD JUNIOR UNIVERSITY
ORGANIZED 1891

howard hughes fellowships

Ten awards are open to candidates interested in studies leading to a Doctor of Philosophy or Doctor of Engineering degree or in conducting post-doctoral research.

Each Fellowship provides a cash award of not less than $2000 . . . a minimum salary of $2500 for summer or part-time work . . . up to $1500 for tuition, books, and research expenses . . . and moving and transportation costs. Eligibility is based on the completion of one year of graduate work in physics or engineering, and qualification for graduate standing at California Institute of Technology, University of California (Berkeley), or Stanford University. Application closing date: January 15, 1958.

master of science fellowships

One hundred awards are open to participants who will complete courses leading to the Master of Science degree within 2 academic years. Tuition, admission fee, and books will be provided. During the summer they will have the opportunity to work with experienced Hughes scientists and engineers, while receiving salaries based upon their ability and technical experience.

Applicant must receive his B.S. degree during the coming year in Aeronautical Engineering, Electrical Engineering, Mechanical Engineering, or Physics. Participant may request his graduate school from the following six institutions: University of Southern California, UCLA, Stanford University, University of Arizona, Purdue University, or West Virginia University.

Write, specifying appropriate fellowship, to:
Office of Advanced Studies

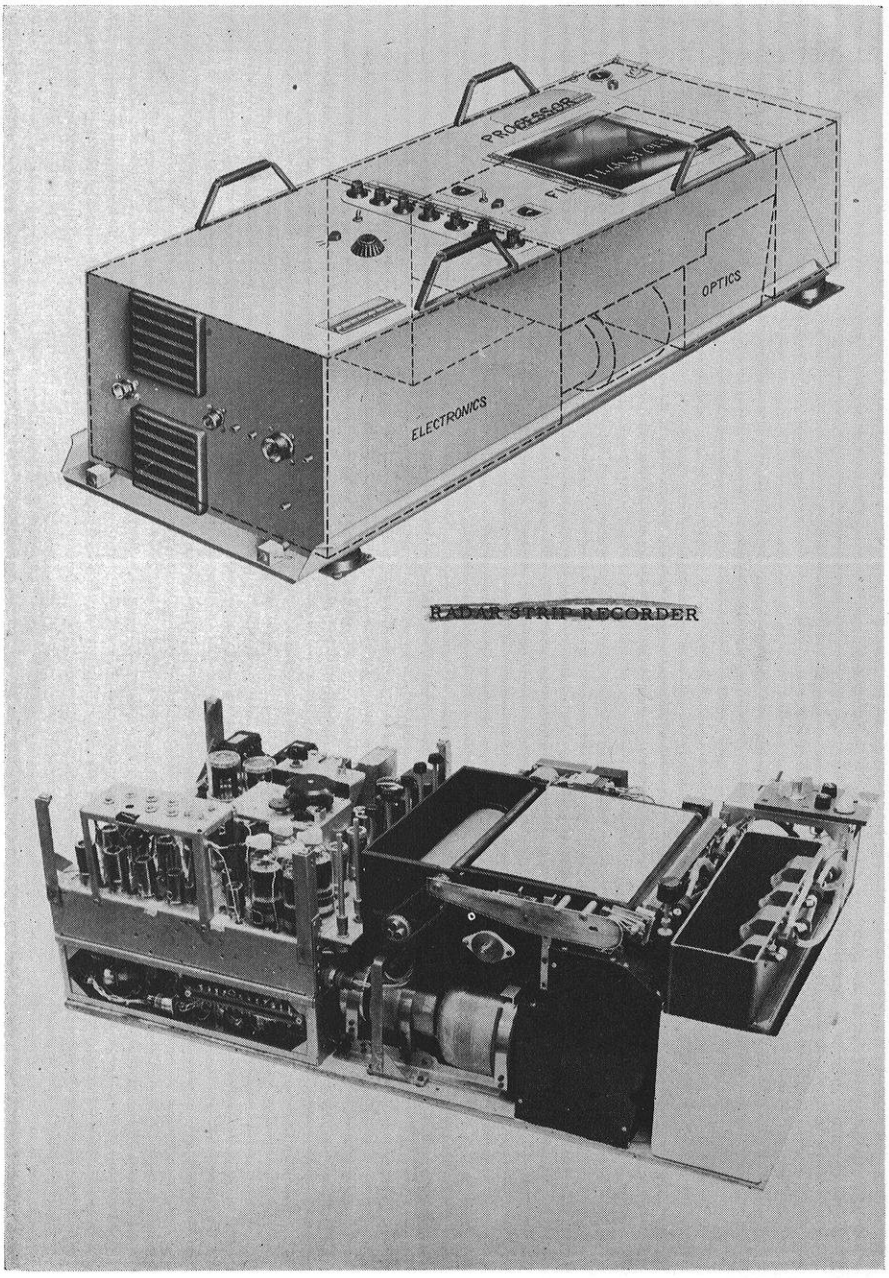
HUGHES

RESEARCH AND DEVELOPMENT LABORATORIES

Hughes Aircraft Co., Culver City, Calif.

SCIENCE HIGHLIGHTS

by Ed Allen m'60



Radar strip recorder makes instant maps possible.

INSTANT RADAR MAPS MADE IN FLIGHT

Airplane pilots and navigators can now consult a map that is only twenty seconds old made night or day in flight by radar. With a device called a radar strip recorder which presents a photograph of the ground beneath the airplane as seen by airborne radar eyes, navigation to pin point accuracy is now possible. The airborne system is equally useful in peace or war.

Previously navigators and pilots have had to rely on memory or hasty notes and calculations taken from radar presentations in the air. The new automatic device requires no operator; it combines electronics and photography to make it easy to determine the airplane's exact position and true flight path at any time desired in flight without relying upon memory or radio equipment on the ground.

Initially designed for use with an airborne radar system, the strip recorder with its associated fast film processor is adaptable to practically all types of airborne radar. In addition, the device is useful as a ground recorder of radar or telemeter information relayed from flying radar sets. In such uses, the strip recorder makes it a simple matter for ground controllers and observers to monitor the flight path of a missile or drone aircraft.

Instrumental in making the rapid strip recorder feasible is a unique process for developing high sensitivity film in only ten seconds. The

(Continued on page 58)

Yes, we want engineers,

BUT

. . . we don't want just any engineer. We want engineers with ideas, engineers with drive, engineers who can stick with a job and work with other people to get it done. Scientists, business and liberal arts graduates, too.

Union Carbide has a marvelous potential. It's a top producer of many things, from petrochemicals to titanium, from molecular sieves to flashlight batteries. Its sales have soared from a half a billion in '47 to one and a third billion in '56.

And we plan to keep on growing. That's where you come in.

We need creative people. We spend a good portion of sales profit on research, but it takes creative people to make research effective.

We need people with initiative. They are the key to opening up new markets and to get production rolling. We introduce new products at the rate of two a month, and the rate is accelerating.

Representatives of Divisions of Union Carbide Corporation, listed below, will be interviewing on many campuses. Check your placement director, or write to the Division representative. For general information, write to V. O. Davis, 30 East 42nd Street, New York 17, New York.

BAKELITE COMPANY Plastics, including polyethylene, epoxy, fluorothene, vinyl, phenolic, and polystyrene. J. C. Older, River Road, Bound Brook, N. J.

ELECTRO METALLURGICAL COMPANY Over 100 ferro-alloys and alloying metals; titanium, calcium carbide, acetylene. C. R. Keeney, 137—47th St., Niagara Falls, N. Y.

HAYNES STELLITE COMPANY Special alloys to resist heat, abrasion, and corrosion; cast and wrought. L. E. Denny, 725 South Lindsay Street, Kokomo, Ind.

LINDE COMPANY Industrial gases, metal-working and treating equipment, synthetic gems, molecular sieve adsorbents. P. I. Emch, 30 East 42nd Street, New York 17, N. Y.

NATIONAL CARBON COMPANY Industrial carbon and graphite products. PRESTONE anti-freeze, EVEREADY flashlights and batteries. S. W. Orne, P. O. Box 6087, Cleveland, Ohio.

SILICONES DIVISION Silicones for electrical insulation, release agents, water repellents, etc.; silicone rubber. P. I. Emch, 30 East 42nd Street, New York 17, N. Y.

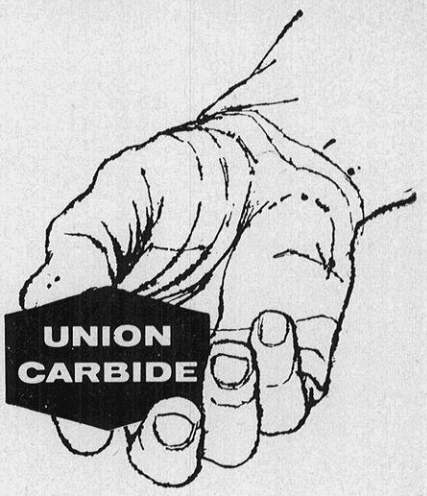
UNION CARBIDE CHEMICALS COMPANY Synthetic organic chemicals, resins, and fibers from natural gas, petroleum, and coal. W. C. Heidenreich, 295 Madison Ave., New York 17, N. Y.

UNION CARBIDE INTERNATIONAL COMPANY Markets UNION CARBIDE products and operates plants overseas. C. C. Scharf, 30 East 42nd Street, New York 17, N. Y.

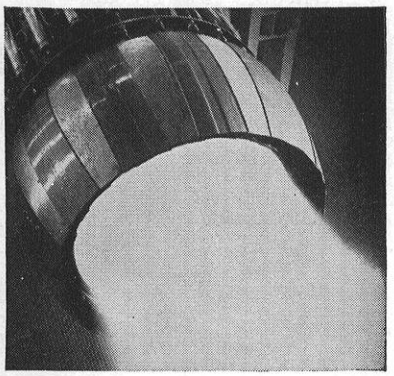
UNION CARBIDE NUCLEAR COMPANY Operates Atomic Energy Commission facilities at Oak Ridge, Tenn., and Paducah, Ky. W. V. Hamilton, P. O. Box "P", Oak Ridge, Tenn.

VISKING COMPANY A pioneer in packaging—producer of synthetic food casings and polyethylene film. Dr. A. L. Strand, 6733 West 65th Street, Chicago, Ill.

GENERAL OFFICES—NEW YORK Accounting, Electronic Data Processing, Operations Research, Industrial Engineering, Purchasing. E. R. Brown, 30 East 42nd Street, New York 17, N. Y.



What's doing...



One indication of accomplishment in the combustion field: the J-57 engine, augmented by afterburner, provided the thrust which made supersonic flight practical for the first time.

This special periscope gives Pratt & Whitney Aircraft engineer a close-up view of combustion process actually taking place within the afterburner of an advanced jet engine on test. What the engineer observes is simultaneously recorded by a high-speed motion picture camera.

at Pratt & Whitney Aircraft in the field of Combustion

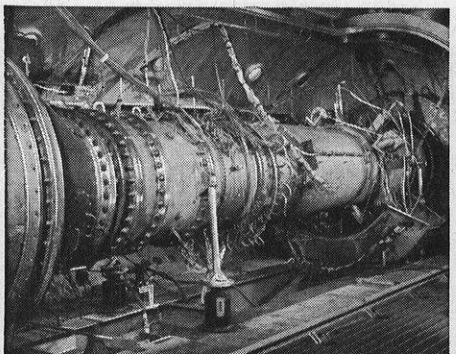
Historically, the process of combustion has excited man's insatiable hunger for knowledge. Since his most primitive attempts to make use of this phenomenon, he has found tremendous fascination in its potentials.

Perhaps at no time in history has that fascination been greater than it is today with respect to the use of combustion principles in the modern aircraft engine.

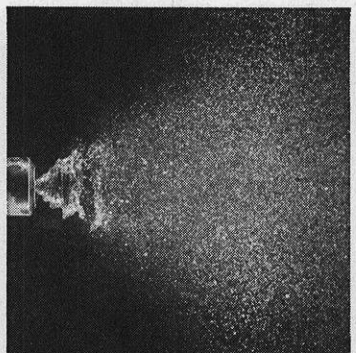
At Pratt & Whitney Aircraft, theorems of many sciences are being applied to the design and development of high heat release rate devices. In spite of the apparent simplicity of a combustion system, the bringing together of fuel and air in proper proportions, the ignition of the mixture, and the rapid mixing of burned and unburned gases involves a most complex series of interrelated events — events ocurring simultaneously in time and space.

Although the combustion engineer draws on many fields of science (including thermodynamics, aerodynamics, fluid mechanics, heat transfer, applied mechanics, metallurgy and chemistry), the design of combustion systems has not yet been reduced to really scientific principles. Therefore, the highly successful performance of engines like the J-57, J-75 and others stands as a tribute to the vision, imagination and pioneering efforts of those at Pratt & Whitney Aircraft engaged in combustion work.

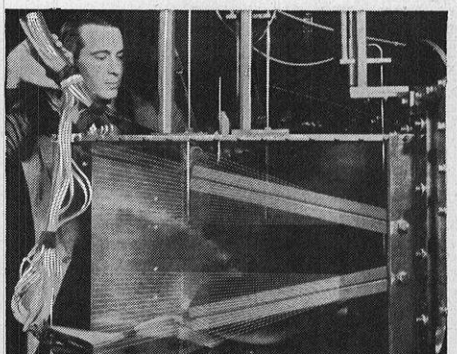
While combustion assignments, themselves, involve a diversity of engineering talent, the field is only one of a broadly diversified engineering program at Pratt & Whitney Aircraft. That program—with other far-reaching activities in the fields of instrumentation, materials problems, mechanical design and aerodynamics — spells out a gratifying future for many of today's engineering students.



Mounting an afterburner in a special high-altitude test chamber in P&WA's Willgoos Turbine Laboratory permits study of a variety of combustion problems which may be encountered during later development stages.



Microflash photo illustrates one continuing problem: design and development of fuel injection systems which properly atomize and distribute under all flight conditions.



Pratt & Whitney Aircraft engineer manipulates probe in exit of two-dimensional research diffuser. Diffuser design for advanced power plants is one of many air flow problems that exist in combustion work.

World's foremost designer and builder of aircraft engines

PRATT & WHITNEY AIRCRAFT

Division of United Aircraft Corporation

EAST HARTFORD 8, CONNECTICUT

Highlights of your future with Honeywell

Glenn Seidel, Vice President in Charge of Engineering, BME, Minnesota, '36

The many

People, Places, Projects

"The story of Honeywell, as I know it, is a story of growth—from a thermostat to over 12,000 products; from a handful of employees to more than 30,000; from a basement in Minneapolis to a world-wide organization. For Honeywell, world leader in automatic controls, has expanded as rapidly as this exciting field. And employment, sales and income have increased steadily year after year.

"The future is even more challenging. Planned diversification puts Honeywell in such new fields as office and factory automation, process control, plastics, atomic energy, electronics, missiles and satellites. Whole new areas of opportunity are waiting for today's engineering graduates in each of Honeywell's divisions. Here are some division representatives to tell you about them."

CORPORATE RESEARCH
HOPKINS, MINNESOTA

Dr. Finn Larsen, PhD,
Iowa State, 1948
Director of Corporate Research

"Our Research Center is a focal point for Honeywell's over-all research program. Here, Honeywell scientists and engineers conduct basic research into areas such as Heat Transfer, Metallurgy, Thermodynamics, Solar Energy, Radioactivity, Electronics, etc. This research supplements other research carried on by Honeywell's separate divisions, plays an important part in the company's development program. There's certainly plenty of opportunity for the imaginative scientist or engineer here."

AERONAUTICAL DIVISION
MINNEAPOLIS; LOS ANGELES;
ST. PETERSBURG

E. H. Olson, BA,
U. of Minnesota, 1937
Director of Aero Engineering

"In the past six years our engineering force has trebled through our expansion into such advanced fields as inertial guidance, jet engine control, computers, fire control and bombing systems, fuel management, and precision gyros. We have developed and produced more autopilots than any other manufacturer, and built the reference system for the Earth Satellite Rocket. The diversity and wide acceptance of our products indicates the boundless opportunities we have for engineers and scientists."

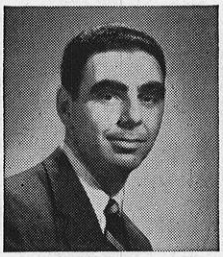
ORDNANCE DIVISION
MINNEAPOLIS; SEATTLE;
MONROVIA, CALIF.

Clyde A. Parton, BSEE,
U. of Alabama, 1940
Director of Ordnance

"Here at Honeywell Ordnance we're putting all our experience and imagination into maintaining America's technological lead. We work in such new fields as infrared sensors, missiles, servo mechanisms, new types of turret control systems. We've developed proximity and mechanical fuzes, antiaircraft fire control systems, underwater warfare equipment and other products in widely diversified fields. Our more advanced products, naturally, are still classified, but they offer outstanding challenges and opportunities."

sides of Honeywell

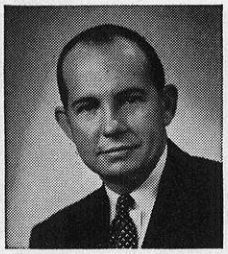
BOSTON DIVISION
BOSTON, MASSACHUSETTS



George J. Schwartz, MIT, '42
Vice President
and General Manager

"Our Honeywell division is making the brains of automation. We turn out such small, but complex and important components as gyros, flight controls, servos, synchros, electronic amplifiers and magnetic controls. Engineering projects now in progress point to many new products and applications from our division, including development of new transistor applications. Opportunities? They're here by the score."

MICRO SWITCH DIVISION
FREEPORT, ILLINOIS



R. W. Pashby, BSEE,
U. of Illinois, 1932
Director of Product Research

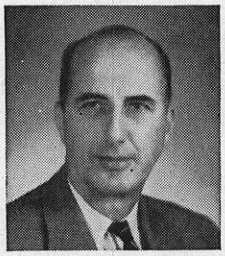
"Products of our Micro Switch Division help giant aircraft land safely, interlock machine tool operations, feed instructions into electronic computers. These are just a few of their applications—applications which are growing year after year. The development of these precision switches requires high engineering skill, puts a premium on your imagination, offers you tremendous opportunities for advancement and recognition."

RESIDENTIAL, RETAIL AND COMMERCIAL DIVISION
MINNEAPOLIS, MINNESOTA

H. T. Sparrow, BSEE,
U. of Minnesota, 1930
Director of Product Research

"We specialize almost entirely in comfort control. Typical of the advances our division has made recently is the Supervisory Data Center* which enables one man in one location to read and control the temperature of every room in a large building. Our other new products include Air Blenders, Zone Control Systems, Electronic Air Cleaners and many more. Our business is a rewarding one for engineers!"

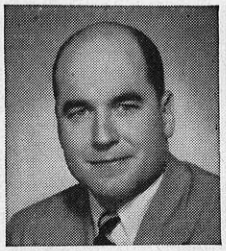
INDUSTRIAL INSTRUMENTS DIVISION
PHILADELPHIA, PENNSYLVANIA



C. L. Peterson, BSEE,
U. of California, 1924
Vice President and Gen. Mgr.

"No company in the fast growing instrumentation field is growing faster than Honeywell's Industrial Instruments Division. There's practically no physical quantity under the sun that Honeywell instruments cannot measure, and, in most cases, control, from open hearth furnaces to complex processes still on the designer's boards. Finding new applications and designing the instruments, computers and read-out devices of tomorrow, offer you a fascinating present and an unlimited future."

HEILAND DIVISION
DENVER, COLORADO



S. A. Keller, BS,
U. of Pennsylvania, 1941
General Manager

"This division of Honeywell manufactures two different classes of products: Instruments and Photographic Equipment. Our recording oscillographs—typified by the radically new 'Visicorder'—are used in a wide range of industrial, scientific, and military applications. Our famous 'Strobonar' electronic flash equipment is used by 5 out of 6 newspapers and all important press services. The variety of products and markets of the Heiland Division promises an ever-expanding field that challenges young engineers."

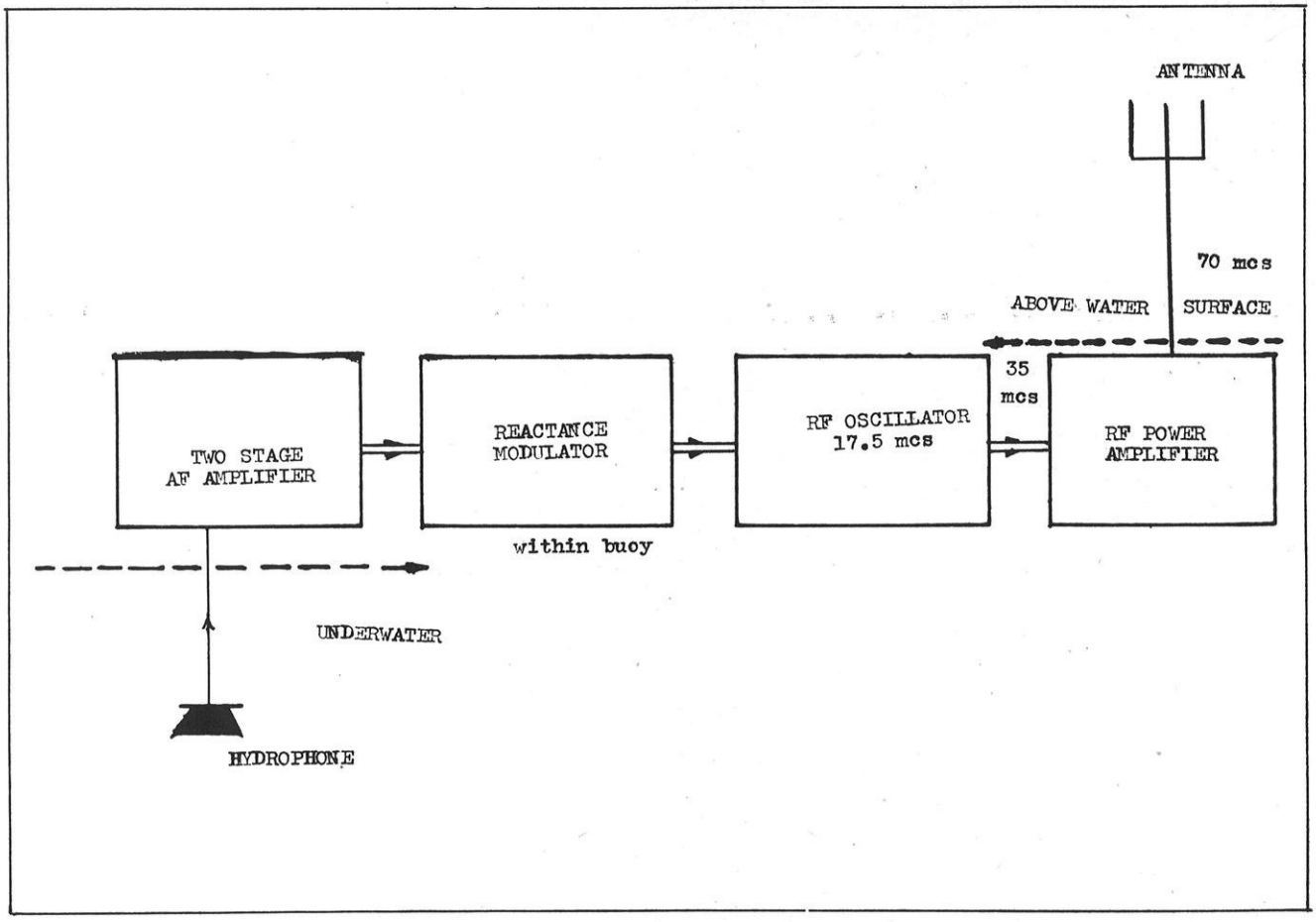
This is Honeywell: more than 12,000 highly engineered products, 14 separate divisions, locations sprinkled throughout this country and abroad, projects by the hundreds on the outposts of every major technological advance. It's a land of opportunity for the engineering graduate. Want to learn more about it? Send for our free booklet, "Your Curve of Opportunity." Write to:

R. L. Michelson, Dept. TC29C
Personnel Administrator
Minneapolis-Honeywell Reg. Co.
Minneapolis 8, Minnesota

Honeywell

First in Controls

*Trademark



Block diagram of the An/Arr-31 airborne receiver.

Sonobuoy

(Continued from page 37)

any two buoy signals. A rotary switch is utilized for tuning, again speeding up the operation over that of the ARR-31. The circuitry of the ARR-31 is still classified and therefore cannot be included in this report.

Up until 1953, the cost of the Sonobuoy was relatively high. An unofficial estimate was $160 each. In 1953 a system for automatic production of electronic equipment was developed by the National Bureau of Standards. The development program, code-named Project Tinkertoy, resulted in the simultaneous development of two systems: a production system utilizing automatic fabrication and assembly equipment, and a compatible general system of electronic equipment using a modular concept. The two systems exploit printed circuit techniques, the use of conducting paints for wires, thin ceramic capacitors, adhesive-tape resistors, and automatic dip soldering.

From June, 1950, through June, 1953, approximately $4,700,000 was allocated by the Navy to the National Bureau of Standards for project Tinkertoy. Almost 85% of the entire amount was expended in procurement of equipment from industry, largely through subcontracts.

The Sonobuoy was the first electronic unit to go into pilot-plant production using the modular wafer design and automatic silver-painting, tinning, dip-soldering, and testing machines developed by the National Bureau of Standards. Begun in 1950, mechanizing the construction of electronic equipment has resulted in the development of a machine line capable of building practically any type of electronic equipment with complete versatility in converting from one equipment to another.

The input to the mechanized line consists largely of raw or semi-processed materials, which alleviates the necessity of obtaining complete components from many sources.

To facilitate mechanical handling of all components with minimum machinery, a steatite wafer 7/8 inch square by 1/16 inch thick is employed as the basic modular unit on which components are machine-printed or mounted over printed circuitry.

Six of these wafers are automatically selected, stacked, and then joined mechanically and electrically by machine-soldered riser wires to form a standard module. Generally a tube socket is mounted on the top wafer. Any number of these modules can be mounted manually on plates having etched wiring, to provide the desired plate assembly for any specific application.

Ceramic capacitors, NBS tape resistors, tube sockets, and terminals are compatible with this system of construction and can be produced by automation from bulk materials.

Capacitor values are varied by changing the dielectric constant and/or the electrode area.

Tube socket bodies are molded from the same stealite material as the wafers, and tube pin connectors for the socket body are formed from beryllium copper strips.

Precision resistors are made by evaporating and trimming a nickel chrome alloy on a specially

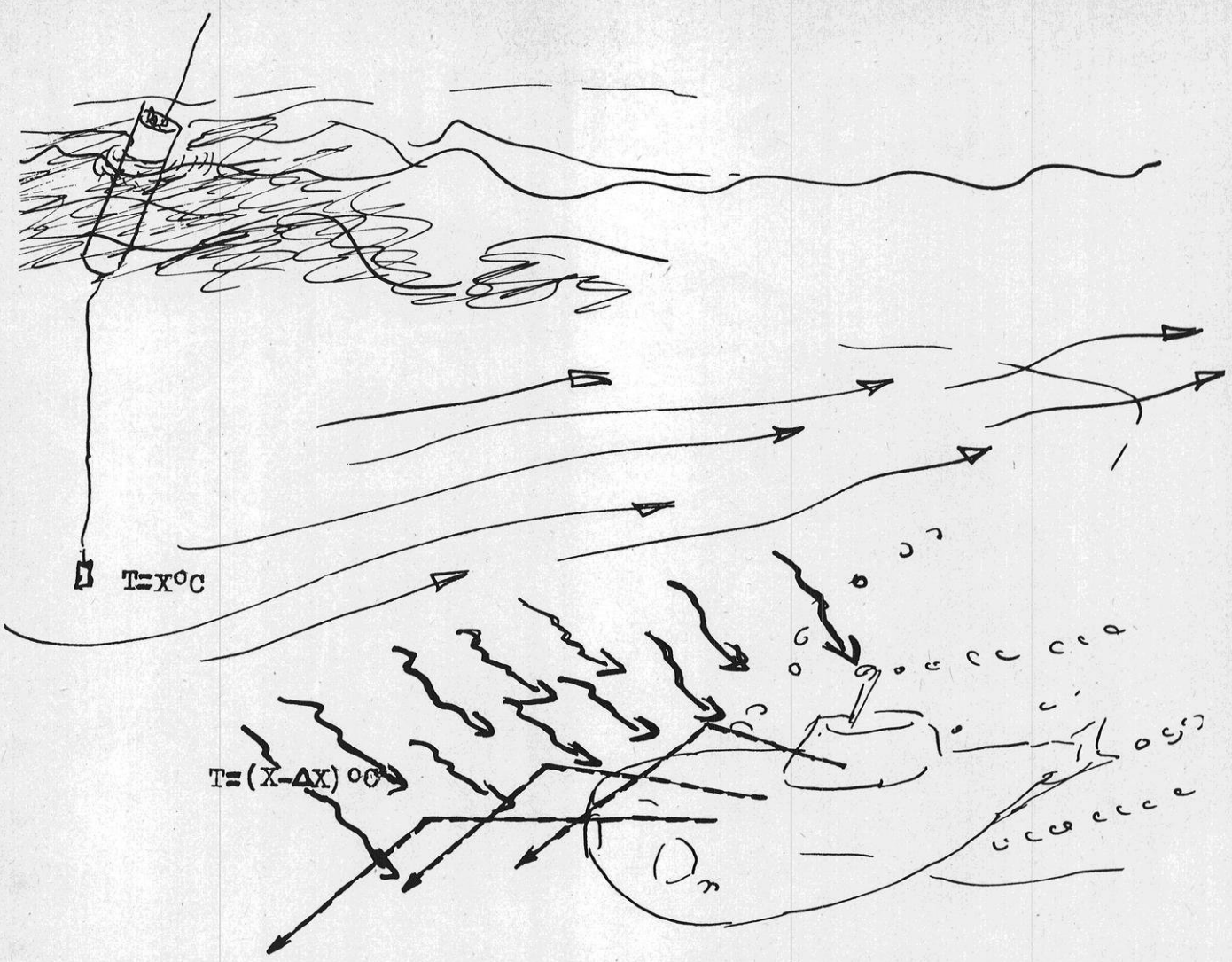


Fig. 6.—Sketch showing the effect of underwater currents and the temperature gradient on the transmission of sound. The straight arrows represent the direction of the current at the depth of the Sonobuoy, while the wiggly arrows represent the direction of the current at the submarine's depth. Although the buoy is fairly close to the submarine, it may fail to detect sounds from it due to the reflection of the sound as shown by the angled arrows.

prepared wafer surface. Spiral and toroidal inductors are mounted on the wafers. A dielectric film and associated strips of foil are folded in a square configuration to form a high value capacitor compatible with the modular construction system.

A standard punched control card is prepared beforehand for each wafer. The cards contain production information such as initiating time, identification of parts, setup information, etc.

The wafers upon entering the production machine are cleverly lined up by indexing segments. The first process is to paint the notches so that the wafers may be connected together by a riser wire as mentioned previously. The pattern of the printed circuit is silk-screen printed first on one side of the wafer and then on the other by a squeegee driven across the screen surface, forcing silver paint onto the wafer surface. After drying and heating, a second printing follows.

Several wafers assembled together form a Module. The Modules are fastened to the Sonobuoy's decks forming a more compact buoy as well as one that is more rugged, more stable, and of considerably lower cost.

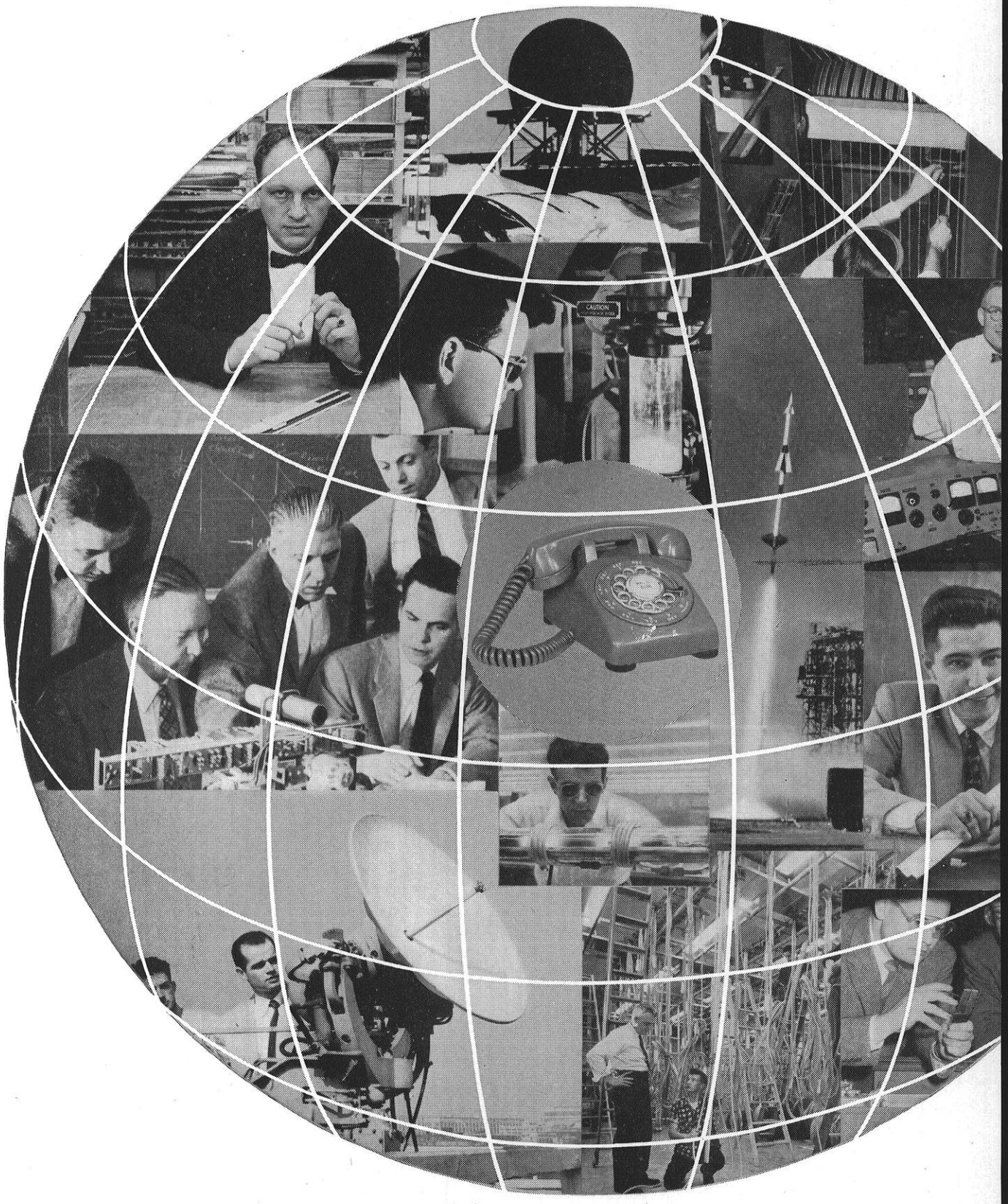
When considering the factors which affect the effectiveness of the Sonobuoy one can imagine other types of Sonobuoys that might supersede present buoys. Due to underwater currents and temperature gradients, reflection of sound waves occur. This phenomena could prevent the hydrophone from picking up sound waves from a submarine even though the buoy was close to the submarine. Thus, a Sonobuoy of the future might contain small remotely controlled motors which could vary the depth of the hydrophone by reeling in or letting out the hydrophone cable. Additional circuitry could be added so that the hydrophone could self-seek the depth of maximum sound.

In the present system of operation, from 7 to 14 buoys are used per run. By utilizing a rotating hydrophone, and having video circuits synchronized with the rotation in the aircraft receiver, only two or three Sonobuoys would be required to plot the course of the submarine.

With the development of atomic powered submarines, more effective Sonobuoys will have to be developed. The development of such Sonobuoys, by modern electronic knowhow, will seriously hamper the submarine as being an effective weapon of war.

THE END

There's an engineer's



● Western Electric has major manufacturing plants located at Chicago and Decatur, Ill., Kearny, N. J., Baltimore, Md., Indianapolis, Ind., Allentown, Pa., Winston-Salem, N. C., Buffalo, N. Y., North Andover, Mass. Distribution Centers in 30 cities. Installation headquarters in 16 cities. General headquarters: 195 Broadway, New York, N. Y. Also Teletype Corporation, Chicago 14, Illinois.

world at Western Electric

As THE world's largest manufacturer of communications equipment our continued progress depends greatly on our engineers. They have a key role in the production of some 50,000 types of apparatus and component parts that Western Electric makes in a given year.

● To our engineers falls the monumental task of developing manufacturing operations and of planning the installation of telephone central office equipment across the nation. They devise the new machines, tools and methods needed to do our job. They also shoulder the major responsibilities in carrying out the defense contracts the government has asked us to take over — major projects like the Nike guided missile system and SAGE, the continental defense system.

● In the course of their technical work, engineers participate in such broad managerial functions as production, merchandising, installation, and many others. What's more, we have a record of promotions from within. It's not surprising, therefore, that fifty-five percent of the college graduates in our upper levels of management have engineering degrees.

● Naturally we do everything possible to encourage and speed the professional development of our engineers. Just recently, for example, we inaugurated a full-time off-the-job Graduate Engineering Training Program at special training centers, a program with few parallels in American industry.

● The new engineer moves into the first phase of this program, **Introduction to Western Electric Engineering,** four to six months after he joins us and devotes nine weeks of study to such technical subjects as communications systems, military electronic systems, product design principles. He takes part in the second phase, **General Development,** after the first year on the job. In this phase he devotes nine weeks to courses in human relations, semantics, engineering statistics, electronics, measurements and instrumentation, systems circuit analysis. The third phase, **Advanced Development** (4 weeks per year), is available to selected engineers and is geared to the individual to help develop his creative engineering abilities; goes deeply into such subjects as magnetics, computer applications, electronic switching, radar fundamentals, feedback control systems and technical paper writing.

● Besides this company-wide program, a number of our divisions offer individual engineering courses in their own specialties. We also sponsor a Tuition Refund Plan for out-of-hours study at nearby colleges. Open to all employees, this plan helps our engineers study for advanced degrees at Company expense.

● Truly there's an engineer's world here at Western Electric . . . one in which engineers in every field of specialization can expect to grow.

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Planning telephone central offices:
Equipment requirements — E.E.; Power and cable requirements—E.E.

Development and design:
New machines and tools—M.E., E.E.; Material handling methods—M.E., I.E.; New equipment and processes—M.E., E.E.; Repair shop methods—M.E.; Testing facilities—E.E.; Testing methods—E.E.; Job evaluation studies—I.E.; Wage incentive studies—I.E.; Production control studies—I.E.; Improved chemical processes—Chem. E., Met. E., Phy. Sc.; New application for metals and alloys—Chem. E., Met. E., Phy. Sc.; Raw material test procedures—Chem. E., Met. E., Phy. Sc.; Service to military on electronic devices—E.E.

For further information write: Engineering Personnel, Room 1030, 195 Broadway, New York 7, N. Y.

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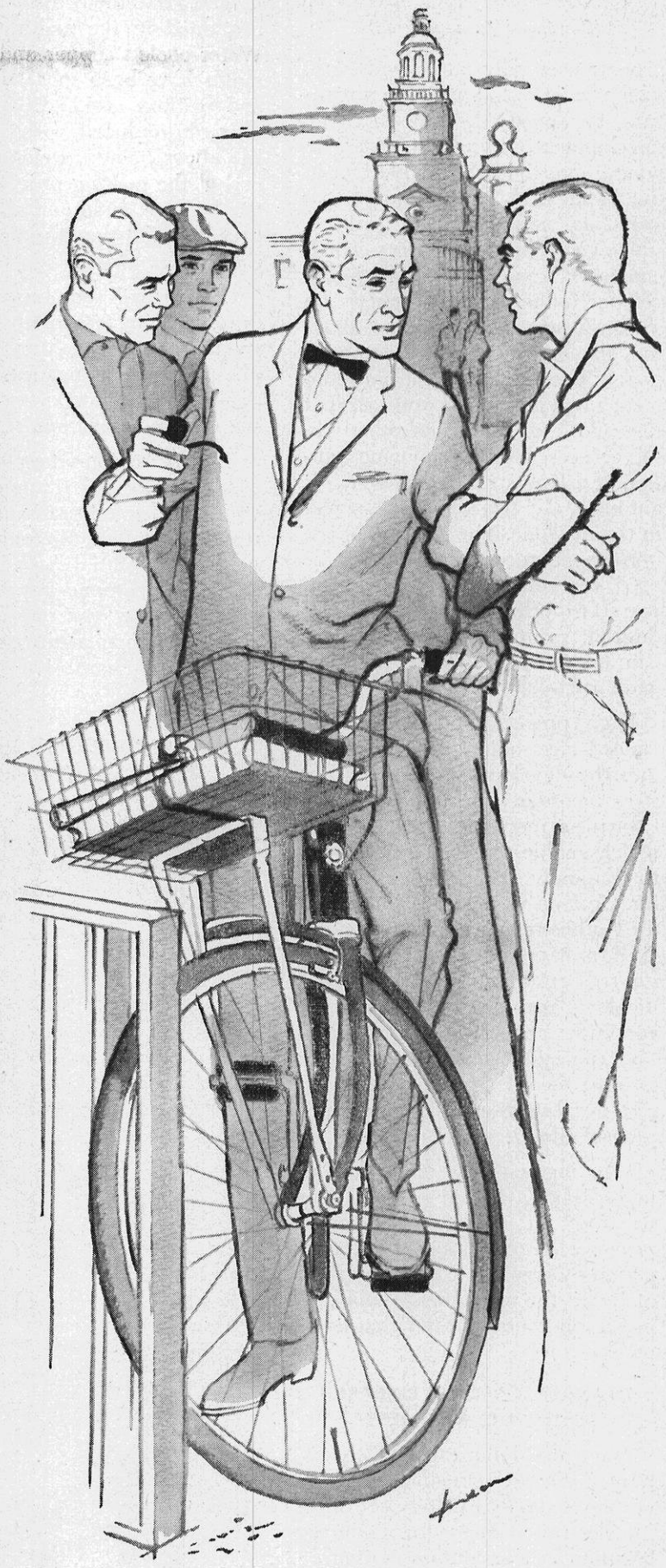
"So, my advice is that you start thinking about the aircraft industry. It offers the greatest opportunities... opportunity to use your training, to advance, to make a comfortable living. It's still a young industry and it thrives on and encourages young ideas."

Scenes like this are taking place on campuses all over the country. Engineering professors must keep up with scientific advances. They realize that these advances mean added opportunity for soon-to-graduate students. Research in the aircraft industry has uncovered so many areas for further study that young men are urgently needed to solve these problems. Long a pioneer in new facets of aviation, Northrop is one of the companies that wants such aggressive young men.

At Northrop you can put your training to work on the Snark SM-62, the world's first intercontinental guided missile. And new projects like the twin jet, supersonic trainer, the USAF-Northrop T-38, and others of top priority are moving ahead steadily.

Products are only as good as the engineers behind them and good engineers require good surroundings. In line with this thinking, Northrop has built a multi-million-dollar Engineering and Science Center in Hawthorne, California, that is as modern as any in the industry. Here, you will be working with leading engineers who respect your individuality, initiative and engineering abilities. In addition, at Northrop you will receive added benefits that are among the finest in the industry.

Why not write us now... regardless of your class at college. Ask us questions about how you might best gain a career with Northrop. Write to Manager of Engineering Industrial Relations, Northrop Division, Northrop Aircraft, Inc., 1031 East Broadway, Hawthorne, California.



NORTHROP

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BUILDERS OF THE FIRST INTERCONTINENTAL GUIDED MISSILE

5-A-144

Science Hi-Lights

(Continued from page 46)

process uses only one liquid bath, which functions at a high temperature to speed the photographic development. Liquid is literally wiped onto the 9-inch wide film in the radar strip recorder much the same as painting walls with a squee-gee. The transparency which emanates from the monobath developer is then viewed directly on a translucent lighted screen about the size of a sheet of notebook paper. The recording and development process is continuous, so that the pilot, navigator, or other observer sees a slowly moving portion of a long strip of film which is automatically wound up on a roller in the machine. The roll of film is a permanent record which can be used for reference or later compared to other flight records. If desired, prints or other negatives can be made from the transparency roll.

High precision optics and advanced electronic techniques went into the development of the radar strip recorder. The optical system includes mechanical adjustments which enable the pilot or observer to manually correct the machine for airplane wind drift. This wind drift adjustment results in a rectilinear record which maps the ground accurately along perpendicular axes, regardless of wind conditions at high altitude. In addition, special electronic circuits built into the recorder automatically correct for distortions due to the altitude of the aircraft.

Working equally well day or night, above clouds or in clear weather, the radar strip recorder promises to revolutionize air navigation by combining the accuracies of radar, the convenience and utility of photography and the speed of electronics.

TITANIUM CASTING RESEARCH SHOWING PROGRESS

Oregon Metallurigcal Corporation of Albany, Oregon has in operation a 100 lb. capacity consumable electrode furnace for producing titanium and zirconium castings.

Since titanium and zirconium in the liquid state react with every known element except argon and helium, the mold itself must be contained in the melting furnace. Water cooled copper and graphite molds have been successfully used and castings of 125,000 psi tensile strength produced, with higher tensile alloys being developed. At the end of the melting process, the entire furnace, mold and all, is rolled over, pouring the liquid metal into the mold.

Castings will soon be available as pure titanium, zirconium or alloyed with aluminum, vanadium, tin, chromium, manganese, molybdenum or in almost every conceivable alloy combination.

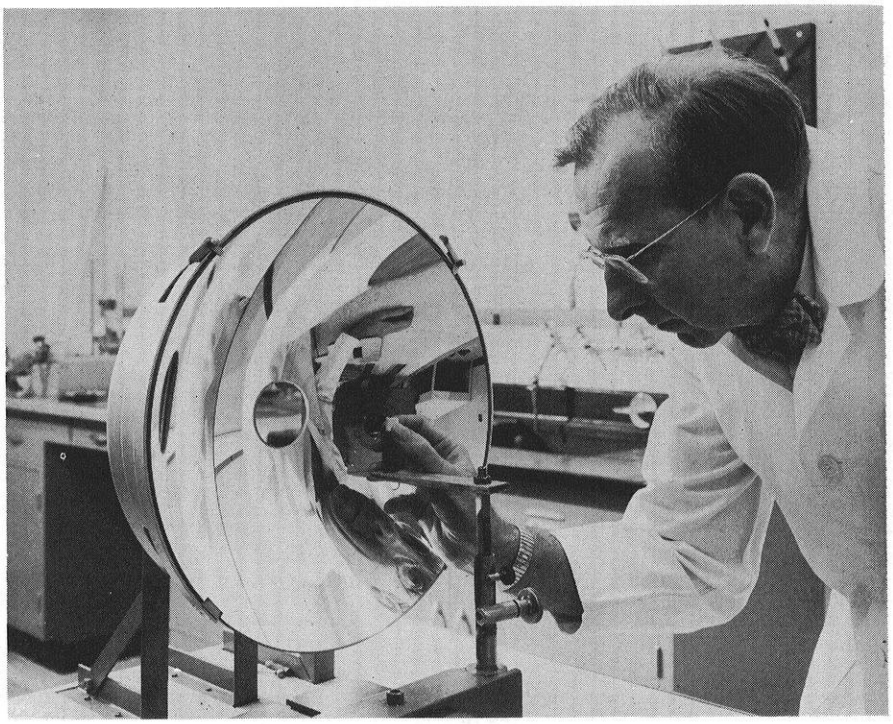
The most important physical characteristics of titanium are its strength-to-weight ratio and its corrosion resistance. Zirconium has a growing potential as a structural material in atomic power reactors because of its low rate of absorption of termal neutrons and its resistance to corrosion at reactor temperatures.

SCIENTISTS DUPLICATE SUN'S HEAT WITH MOVIE MIRRORS

Scientists probing the mysteries of intense heat have produced temperatures approaching that of the sun's surface with ordinary motion picture projection equipment. Highly-polished curved mirrors concentrate rays from a carbon arc into a small but extremely high-energy beam that can produce temperatures above 7,000 degrees Fahrenheit. The technique is actually a scientific version of the use of a magnifying glass to set fire to a piece of paper, and was developed in connection with high-temperature studies at the research laboratories of National Carbon Company.

Previous furnaces have used specially-designed parabolic mirrors to focus the arc's energy onto the substance to be heated. The new design uses two elliptical mirrors of the standard type found in motion picture projection equipment. One mirror directs the energy of the arc at the other, which in turn concentrates the radiation on the specimen being heated, forming a life-size image of the actual arc.

The new equipment is highly compact and portable and can be operated practically anywhere, at any time. It is said to produce results comparable to that of a solar furnace with a 60-inch diameter reflector, which depends on the sun's rays for its energy and can be operated only under favorable climatic conditions.



Crucible heated to incandescence by movie mirror.

The arc image furnace now in use uses arc carbons less than one-half inch in diameter, focused by mirrors approximately 18 inches in diameter and placed about 6 feet apart. The arc draws a current of 200 amperes, which is approximately twice the electrical requirement of a modern home. Normal operating voltage is 80 volts. There is no reason why the arc image furnace cannot be extended to larger arcs with higher power to heat larger samples, and work along these lines is already underway.

In addition to its use of standard equipment, the new system has the advantages of providing a narrow beam midway between the two mirrors where a shutter can be placed to turn the energy on and off very quickly without disturbing the arc. A tilted mirror can be placed at the same point to tip the beam at any desired angle if it is to be used in melting a specimen.

As an extremely 'clean' source of high temperatures, the arc image furnace is ideally suited to metallurgical research where purity is particularly important. The beam can be projected through a transparent window into an enclosed vessel in which the atmosphere can be controlled, and which can even be raised to high pressures if a combination of high temperature and pressure is desired. Because of these features, it is a very valuable research tool, and might well become a useful production tool in the future as high temperature operations become more common in industry.

"BIG SCOOP" EMPTIES BARGES

The "big scoop," world's fastest barge unloader, is now feeding the world's largest coke and coal chemicals operation at U. S. Steel's Clairton (Pa.) Works on the Monongahela River southeast of Pittsburgh.

Emptying a 900-ton river coal barge in less than half an hour, the coal-eating monster is push-button operated and replaces two clamshell bucket hoists to help keep the plant's 23 coke batteries (1,567 ovens), in operation. The mammoth continuous barge unloader was designed, fabricated and erected by Link-Belt Company, and consists of three endless lines of bathtub-size buckets, each of half-ton capacity.

In operation, a boom over which the buckets travel, is lowered to a loaded barge. As the barge is pulled slowly between the river wall and the piers which support the unloading unit, the rotating buckets eat their way through the coal and strip it out in barge-width layers. Two passes by the big scoop empty a barge and raise the coal for conveyance to the steel company's various operations where it is converted into metallurgical coke, coke oven gas and a variety of coal chemicals.

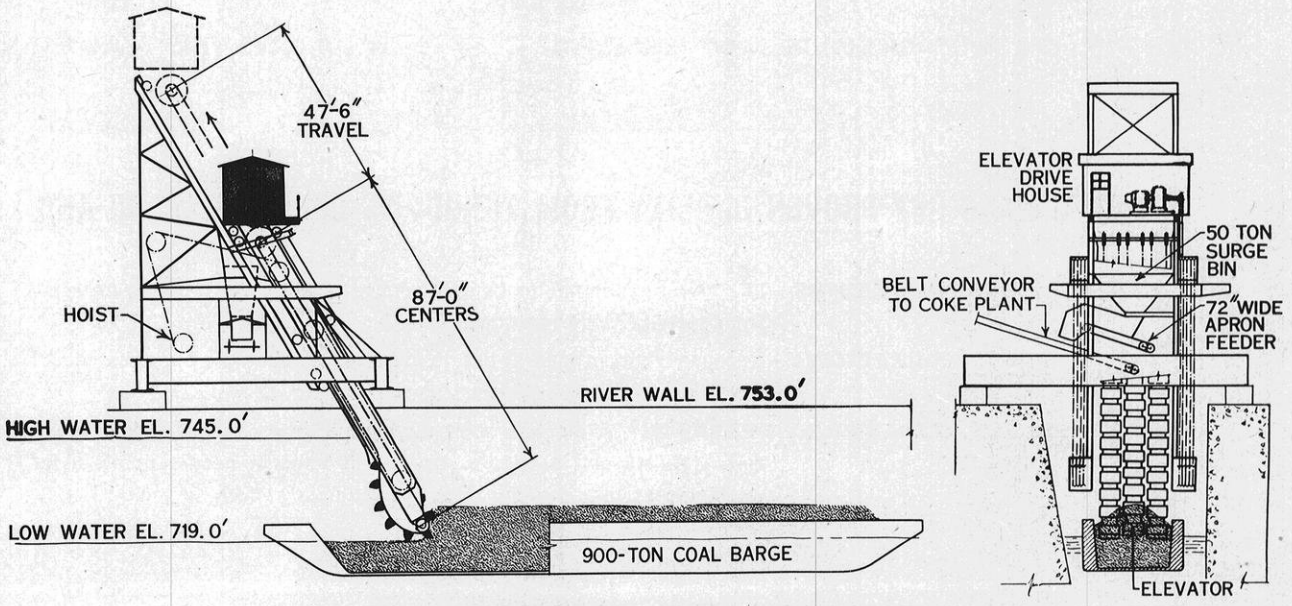
ELECTRICITY FROM GASES NOW PRACTICAL

The direct conversion of the chemical energy of gases into electricity—long a dream of scientists and for years a laboratory curiosity—has been accomplished with the development of the first fuel cell capable of economically producing thousands of watts of power. Using hydrogen and oxygen as fuel, the new silent source of power has been developed by scientists at the Research Laboratories of National Carbon Company, Division of Union Carbide Corporation.

First significant application of the new fuel cells is in providing silent electrical power for the U. S. Army Signal Corp's new "Silent Sentry," now under test in Arizona. The world's smallest known radar set, the lightweight, portable unit provides movile Army forces with local combat surveillance of enemy movements despite smoke, darkness, or fog. A battery of fuel cells provides power to operate the radar set at the U. S. Army Electronic Proving Ground at Fort Huachuca, Arizona.

The secret of the new fuel cell's success is the chemically treated, hollow, porous carbon electrodes through which the gases enter the

(Continued on page 66)



"Big Scoop" continuous barge unloader.

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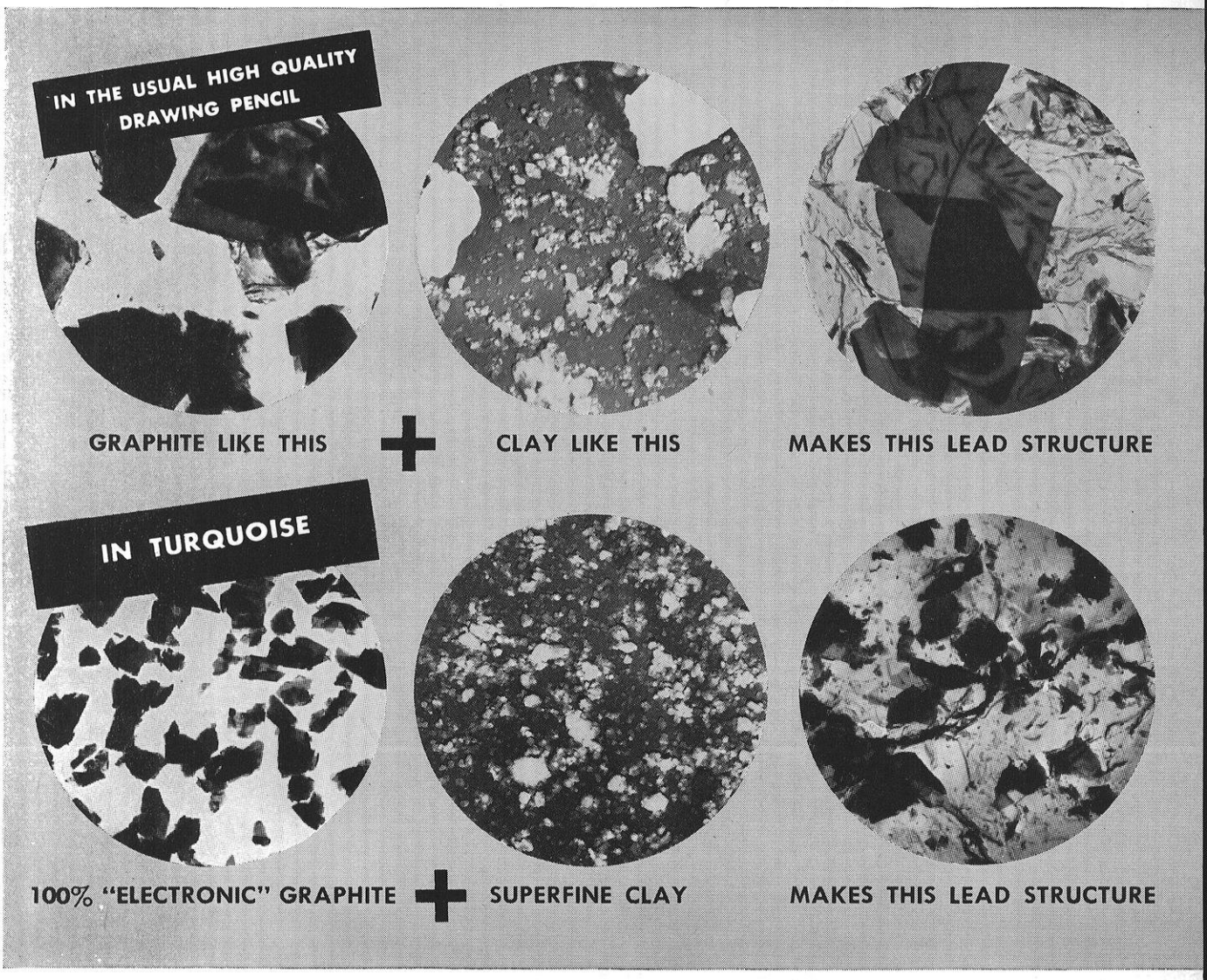

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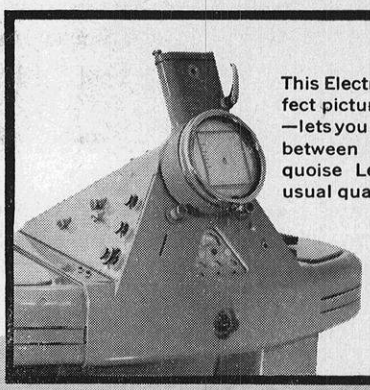
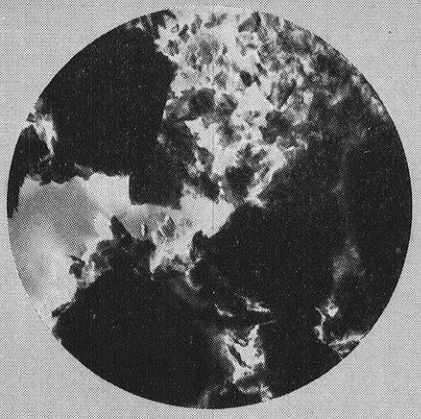


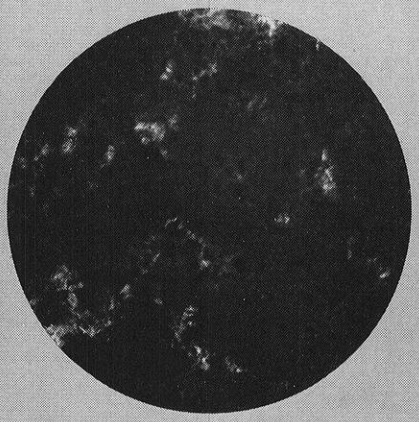
This Electron Microscope takes perfect pictures 7,500 times actual size—lets you see the startling difference between Eagle's "Electronic" Turquoise Lead and the lead in the usual quality drafting pencil.

Photographs courtesy of Ladd Research Industries, Inc.



...AND MARKS LIKE THIS

Relatively large, irregular particles of graphite make a rough-edged line. Drawings will be inferior.



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Tiny, more uniform particles deposit as a clean-edged, solid line. Drawings will be perfectly sharp, clearly defined.

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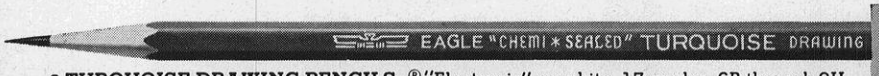

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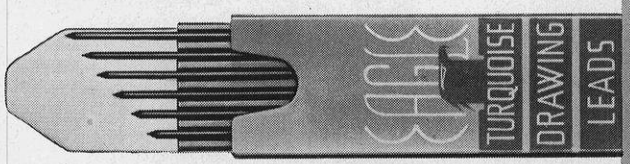

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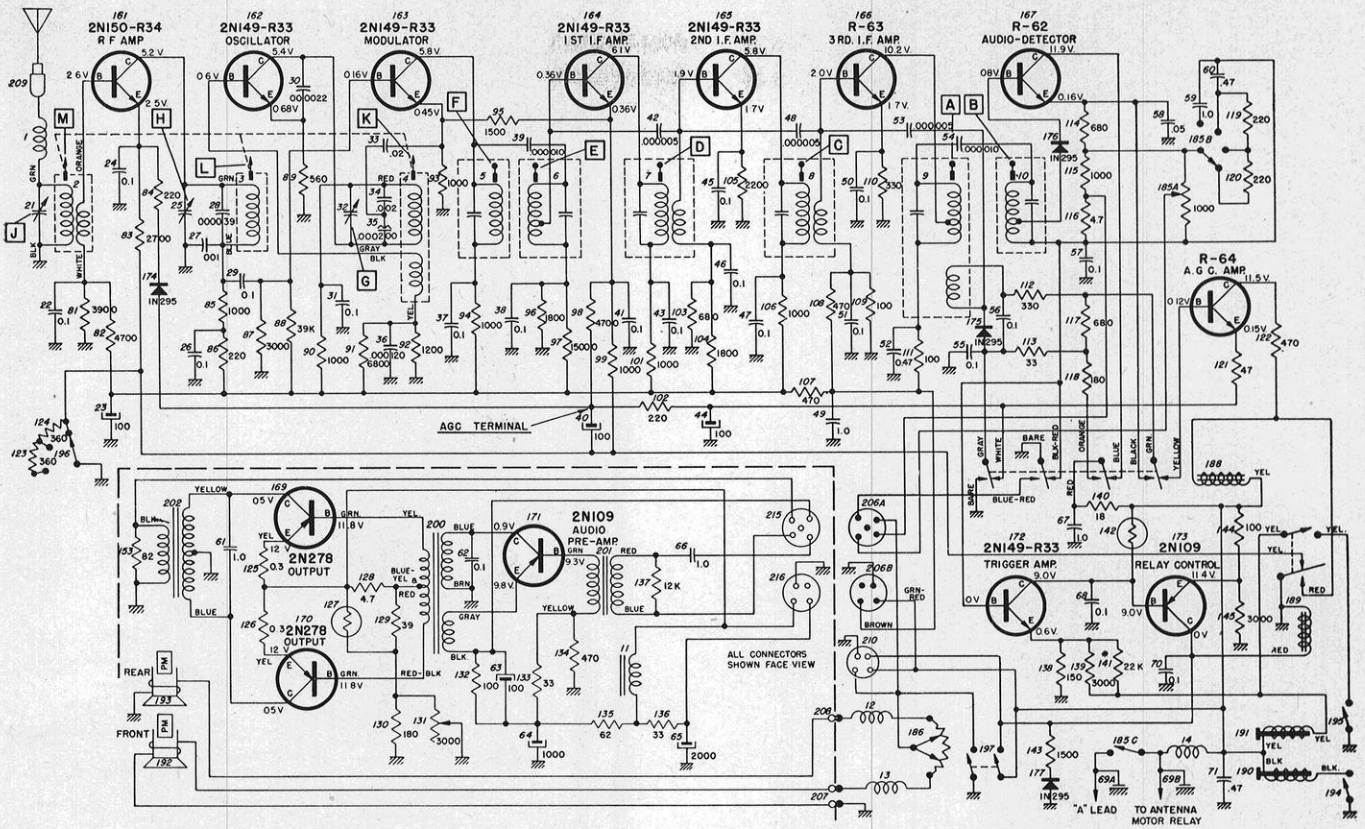


Circuit diagram of all transistor radio developed for Cadillac El Dorado Brougham. It uses 13 transistors and 90 percent less current than non-transistorized version.

Transistors

(Continued from page 19)

contained a class B push-pull arrangement using two transistors as described previously. The increased efficiency of class B operation, the low distortion of the transistor push-pull network, the elimination of the very high filament power required for this stage, as well as the elimination of the power transformer, were among the chief advantages that could be realized from a transistorized power output stage. Such a receiver, utilizing both tubes and transistors, was called a "hybrid" receiver. One of the radio companies that manufactured a successful "hybrid" receiver was the Crosley Radio Corporation.

Another successful type of hybrid superheterodyne radio is presently being built by several radio companies for automobile use. In this set tubes are used in all but the output power stage, but the operation of the tubes differs from the conventional use since the plate voltage on the tubes is only 12 volts. Amplification can be obtained at this low voltage but the power output is small.

This set obtains the necessary power from a push-pull transistorized output power stage. Because both the tubes and the transistors operate at only 12 volts, the 12 volt electrical system of the automobile can supply the necessary power directly. This has eliminated the need for the troublesome vibrator which has been the one big factor in automobile radio failure, as well as being a source of undesirable noise.

Power requirements for this type of set are lower than for the conventional set for reasons already discussed. The elimination of the power transformer saves space as well as weight. Automobile receivers of this type are presently being installed in several of the automobile lines.

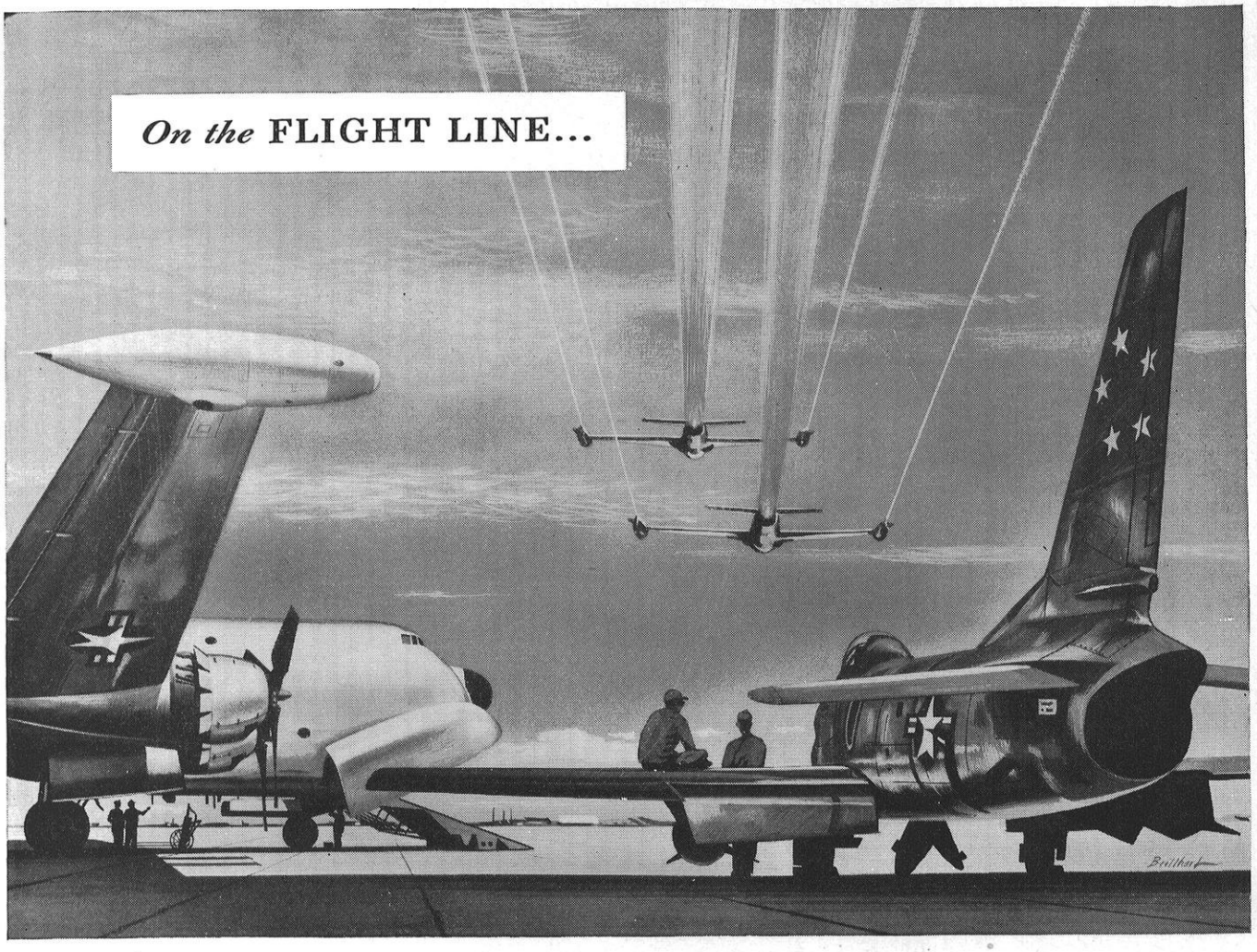
Below is a picture of the all transistor automobile radio recently developed by the Delco Radio Division of General Motors for the Cadillac El Dorado Brougham. As seen in the circuit diagram, it used 13 transistors. Delco Radio engineers claim the set requires 90 percent less current to operate than the non-transistorized version.

Almost every major radio company has a fully transistorized portable radio on the market today. Transistors have been developed to perform efficiently each tube function as required in a typical superhetrodyne receiver. Compared to the hybrid set, the fully transistorized set has the added advantage of reduced power requirements and a smaller, more compact chasses. Printed circuitry is used in both types of sets to reduce size still further.

Most transistor radio sets fall into two size groups: the miniature pocket-sized model and a larger model which is about the same size as the present tube-type portable radio. The RCA set No. 7-BT-9J set is typical of the miniature personal transistor radio, while the RCA set No. 7-BT-10K is typical of the larger size sets that are presently available.

One of the principal disadvantages of the miniature personal sized portable radio is the very poor output quality of the speaker. Speakers used in these sets are not much larger in diameter than a silver dollar, and the majority of sets have a great deal of intolerable

(Continued on page 90)



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Science Hi-Lights

(Continued from page 59)

cell, and which also conduct the electricity produced by the electrochemical reaction.

Designed to work at ambient temperatures, and at approximately atmospheric pressure, the new fuel cell is the first that does not depend on high temperatures or pressures for efficient operation.

The production of electricity directly from hydrogen and oxygen in a fuel cell is inherently more efficient than its production in a conventional steam system in which the heat is supplied by burning these same gases. Practical limitations in utilizing all of the heat produced reduce the overall efficiency of a steam system to approximately 30 or 35 percent, while a fuel cell, which eliminates the intermediate heat step and converts directly from chemical to electrical energy, has a top efficiency of about twice that figure.

The new fuel cell is merely a sealed jar into which are fed hydrogen and oxygen through the special hollow electrodes. The electrochemical reaction of the gases at these electrodes produces an electric current, with only water as a by-product. With the water disposed of by evaporation, the life of the fuel cell is theoretically unlimited. Cells have been operating 8 hours a day, 5 days a week for the past year, with no signs of deterioration. This type of operation was purposely chosen for testing because the repeated starts and stops are much harder on the cell than would be continuous, around-the-clock operation.

Ability of the new fuel cell to operate at approximately atmospheric pressure has the obvious advantage of eliminating heavy, costly pressure vessels. If increased output is desired, however, it can be obtained by increasing the pressure. For a given cell, higher outputs vary directly with pressure.

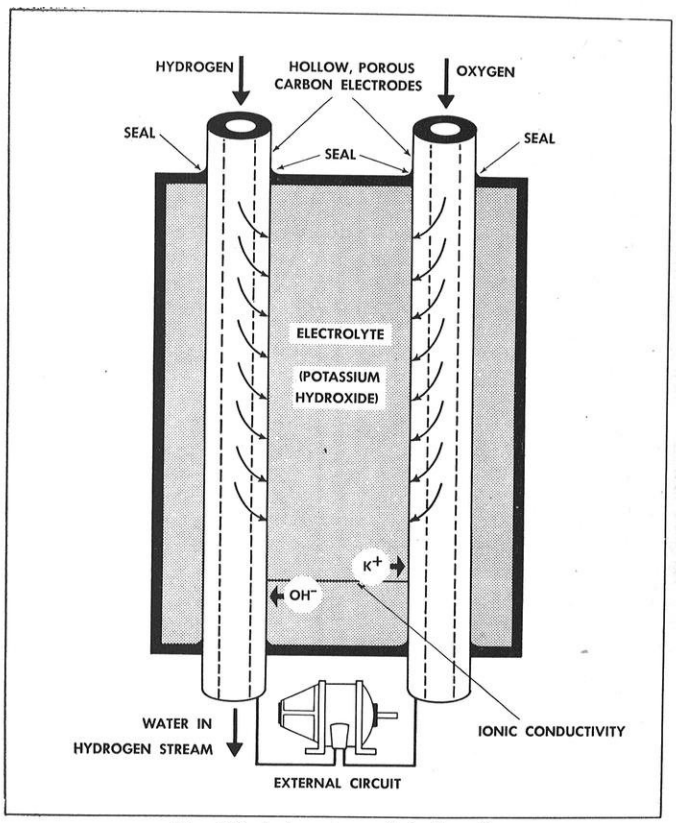
The efficiency of operation of the new fuel cell depends on how it is used, but the general efficiency range is from 65 to 80 percent when operated at normal temperatures and pressures. Efficiency is affected by power density—that is, at lower currents, a greater percentage of the chemical energy is converted to electrical energy. Research and development to date indicate that the optimum fuel cell design will be one which will produce approximately one kilowatt of power from a packaged unit one cubic foot in volume.

The voltage across the electrodes of the new fuel cell is approximately one volt, and it is simply a matter of connecting a number of cells in a circuit to get any voltage desired. The amount of electrical current produced by the cell depends on its physical size, so by varying the number and size of the cells, many combinations of voltages and currents can be obtained. Basically, the fuel cell is most desirable for high current, low voltage use.

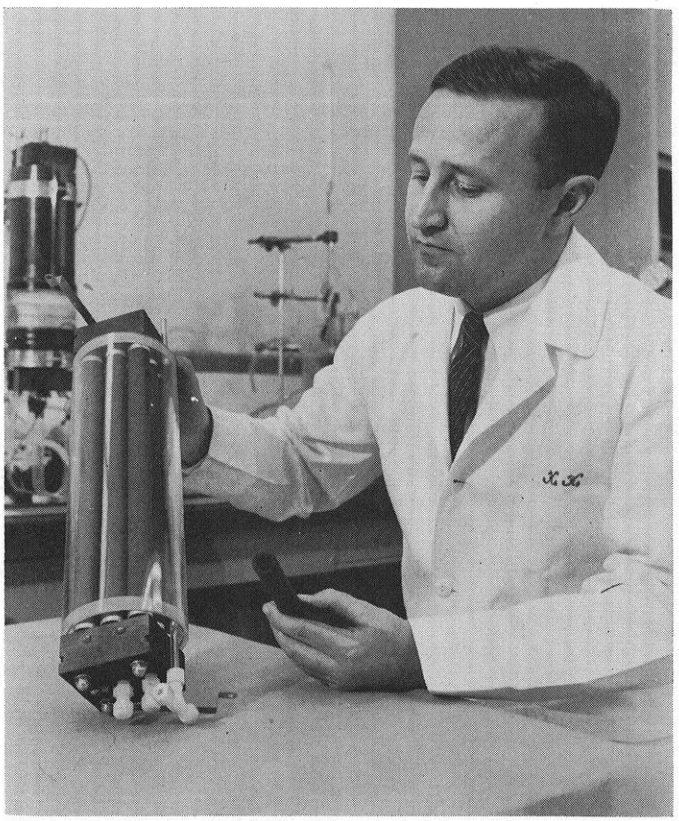
NEW EXPOSURE VALUE SYSTEM FOR INDUSTRIAL PHOTOGRAPHY

A new easy-to-use series of 35mm cameras can increase the scope of photography as practiced by business and industry. This is the promise that four new miniature cameras just announced by Eastman Kodak Company now hold forth. According to the company's top camera designers the cameras are so simple to use anyone can obtain the color slides and black-and-white prints that industry increasingly relies on to meet all sorts of needs from personnel

(Continued on page 82)



Simplified drawing of fuel cell.



Scientist holding actual cell.

DU PONT SIZE, GROWTH PRESENT VARIED CHOICE OF JOB LOCATIONS TO QUALIFIED TECHNICAL MEN

BENEFIT PROGRAM MEANS ADDED INCOME

by
C. M. Forbes
Du Pont
Representative

Don't forget the "extras" of an employee benefit program when you compare the job offers and salaries of different companies. At Du Pont, these extras mean added income that doesn't always meet the eye. They include life insurance, group hospitalization and surgical coverage, accident and health insurance, pension plan and paid vacation.

In addition, the Company sponsors a thrift plan. For every dollar you invest in U. S. Savings Bonds, the Company sets aside 25 cents for the purchase of common stock in your name. Roughly 65 per cent of our 90,000 employees are now participating in this plan.

If you have specific questions on Du Pont benefits, just send them to me. I'll be happy to try to answer them. E. I. du Pont de Nemours & Co., Inc., Room 2504-A Nemours Bldg., Wilmington 98, Del.

Building Program, Expansion Create Many Opportunities at Company Plants and Labs

Engineers and scientists of all kinds work in 75 Du Pont plants and 98 laboratories scattered over 26 states. Where you're assigned depends on your qualifications and the openings in the kind of work you want.

Geographical Spread

Right now, most of the Du Pont units are located east of the Mississippi, but there are plants in Texas, Colorado and on the Pacific Coast, too. And new building is under way in Kansas, Tennessee, Virginia and North Carolina.

Du Pont headquarters and many of the Company's labs and some of its plants are situated in and around Wilmington, Del., an attractive residential area within convenient traveling range of Philadelphia, New York and Washington.

Community Life

Wherever you're assigned, you'll find that the Du Pont Company and its people are interesting, companionable and active in the life of the community.

As you move ahead, as you grow in your job, you may move to another plant or laboratory—a possibility that adds to the variety and interest of your job.

METALLURGISTS PLAY VITAL ROLE AT DU PONT

Opportunities in metallurgy at Du Pont include research into the nature and properties of elements; development and supervision of pilot plant work; and the actual production of titanium metal and high-purity elemental silicon.

Other Du Pont metallurgists study problems relating to plant processing equipment. Some, for example, carry out research on intergranular corrosion or investigate failure relationships encountered in high-pressure operations.

These projects offer an interesting career to graduating metallurgists.

SEND FOR FREE BOOKLET

Booklets packed with information about Du Pont are yours for the asking. Subjects: mechanical, civil, metallurgical, chemical, electrical, instrumentation engineers at Du Pont; technical sales, research and development. Just name the subject that interests you and send your name, school and address to E. I. du Pont de Nemours & Co., Inc., Room 2504-A Nemours Building, Wilmington 98, Del.

ENGINE EARS

by Pete DeWitt che'60

ENGINEERING INSTITUTES

EFFECTIVE DRAFTING OPERATIONS

October 24–25

Effective drafting operations are generally dependent on the leadership skills of the supervisor and the controls and procedures established in the department. With this in mind, the institute advisory committee selected the following topics for this program: Personnel Problems—The Psychology of Supervision, Panel Discussion on Drafting Department Problems, Controlling the Drafting Effort, and Improving the Efficiency of the Drafting Operation with Proper Reproduction Methods. Attendance at this institute will be beneficial to supervisory draftsmen from almost all types of organizations.

Fee: $20.00. Robert A. Ratner, Institute Coordinator.

FUNDAMENTALS OF MATERIALS HANDLING

November 6–8

The purpose of this institute is to quickly acquaint beginners in materials handling work and persons indirectly concerned with materials handling work, such as production foremen and supervisors, with the fundamentals that will enable them to decrease the materials handling costs in their departments. Some of the topics to be presented are: Characteristics and Applications of Different Types of Equipment, How Do You Recognize a Handling Problem?, What Are the Steps in Solving a Handling Problem?, Methods of Analyzing Materials Handling Problems, Effective Presentation of Proposals, and panel presentation of typical problems and their solutions. Nationally recognized speakers will present these topics. Companies with beginners in materials handling work should consider sending these men to this program.

Fee: $35.00. Robert A. Ratner, Institute Coordinator.

RIGHT OF WAY PROBLEMS

November 14–15

The acquiring of right of way for utilities and roads has always been a source of problems and some irritation. Now, with the tremendous increase in the amount of land needed for highways, the tremendous highway program, the increased density of population and cost of land, it is more important than ever that it be handled efficiently and tactfully. This will be the theme of this institute.

Fee: $20.00. Leonard F. Hillis, Institute Coordinator.

AIR CONDITIONING

November 19–20

More and more companies are finding it necessary to install air conditioning, both for the comfort of their employees and for the control of precision equipment. To help the users cope with some of the problems arising when this equipment is installed, current information on the selection, installation, and operation of air-conditioning systems will be presented. Mechanical engineers, operating engineers, architects, contractors, and heating and ventilating engineers in particular, will benefit by attendance at this institute.

Fee $20.00. L. E. Johnston, Institute Coordinator.

INSPECTION ORGANIZATION

November 21–22

The primary purpose of this meeting is to help the inspection supervisor to mold a more effective inspection organization. With this in mind talks in these general areas will be presented: training and development of inspectors, application of statistical techniques, and management problems with inspection departments. Companies interested in reducing their inspection costs will find much useful information in this program.

Fee: $20.00. Robert A. Ratner, Institute Coordinator.

ALUMNI NEWS

PROF. RATNER NAMED DIRECTOR

Prof. Robert A. Ratner, University of Wisconsin Extension Division department of engineering, has been named director of Engineering Institutes.

The engineering institute program is part of the extension division's department of engineering, headed by Prof. Paul J. Grogan. The department is also responsible for correspondence study courses, special classes, and other adult education services.

Ratner holds mechanical engineering degrees from Iowa State College, and also attended Coe College in Cedar Rapids, Ia.

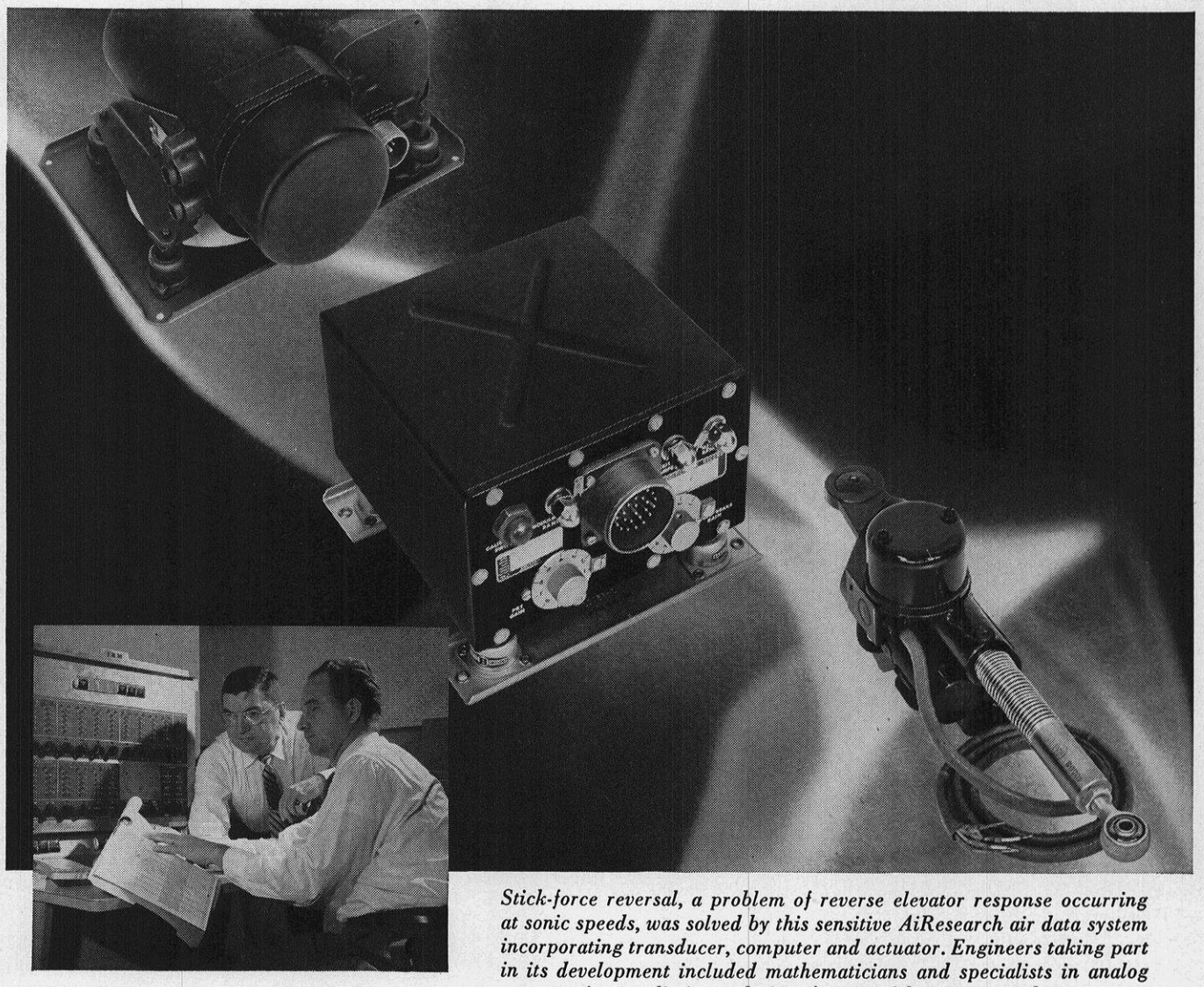
A specialist in work simplification and statistical quality control, Ratner held time-study posts with several industrial firms, taught for two years at the University of Nebraska and for three years at Iowa State before coming to Wisconsin.

KAISER AT NEW YORK UNIVERSITY

Elmer R. Kaiser has been appointed senior engineering scientist in the Research Division of New York University's College of Engi-

(Continued on page 70)

IF college has sharpened your urge to know more...



Stick-force reversal, a problem of reverse elevator response occurring at sonic speeds, was solved by this sensitive AiResearch air data system incorporating transducer, computer and actuator. Engineers taking part in its development included mathematicians and specialists in analog computation, preliminary design, fractional hp motors and gears.

Your formula for advancement in present day technological industry is growth in knowledge and ability.

Applying this principle at Garrett, engineers are achieving outstanding reputations for excellence in the following aircraft, missile and industrial fields: air conditioning and pressurization; heat transfer; cryogenic and nuclear systems; pneumatic valves; controls and air motors; system electronics; computers and flight instruments; gas turbine engines and turbine motors; prime engine development and industrial turbochargers.

Upon employment, you may choose either a direct assignment or enter a 9 month orientation program which permits you to survey Garrett engineering activities to aid you in selecting your field of interest. With company financial assistance you can continue your education at neighboring universities.

Typical project work is done in small groups where opportunities for learning, added responsibility and advancement are enhanced. To receive full information write to Mr. G. D. Bradley

THE GARRETT CORPORATION

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DIVISIONS: AIRESEARCH MANUFACTURING, LOS ANGELES • AIRESEARCH MANUFACTURING, PHOENIX • AIRSUPPLY
AIRESEARCH INDUSTRIAL • REX • AERO ENGINEERING • AIR CRUISERS • AIRESEARCH AVIATION SERVICE

Campus News

(Continued from page 68)

neering. The announcement was made Friday, May 24 by Dr. Harold K. Work, director of the Research Division.

He will be engaged in research on air pollution and allied problems, working on a project sponsored by the U. S. Public Health Service to improve flue-fed incinerators, as well as on projects dealing with the ecological conditions aboard space ships.

A native of New Holstein, Wisconsin, Mr. Kaiser received both a bachelor's and a master's degree from the University of Wisconsin in 1934. He is active in a number of engineering societies.

WISCONSIN ALUMNI PROMOTED

John R. Hulten has been appointed Manager of Fluorocarbon Sales, Union Carbide Chemicals Company, Division of Union Carbide Corporation, it was announced today by John A. Field, Vice-President of the Company. Mr. Hulten will be responsible for establishing an organization capable of serving both the refrigerant and aerosol propellant industries.

Mr. Hulten is a native of Washburn, Wisconsin. He received the degree of Bachelor of Science in Chemical Engineering at the University of Wisconsin in 1941. In July, 1941, he joined Union Carbide's fellowship at Mellon Institute of Industrial Research, and has been with the Company continuously since then, except for three years' service in the U. S. Navy. Mr. Hulten has been employed in the Sales Department of Union Carbide Chemicals Company as technical representative, District Manager of the Albany district, District Manager of the Philadelphia district, and since February, 1956, as Central Division Manager. In his new capacity, Mr. Hulten will make his headquarters at the Company's main office in New York.

Dr. William A. Bain, Jr. of Sandy Hill Road, Chatham, N. J., director of Vitro's West Orange Laboratory, N. J., has been elected vice president of Vitro Laboratories, a division of Vitro Corporation of America.

(Continued on page 88)

A Vought Vignette
ONE OF A SERIES

The propulsion engineer who was allergic to switches

During the Vought Crusader's N.A.A. record-breaking flight across the continent, fuel management was a vital factor. But it wasn't the constant worry it might have been. Fred Alvis had seen to that, beginning four years ago.

When the Crusader project was formed, Fred was just a few years out of Alabama Poly. His was still a new face. Mighty new, Fred would have agreed when he was tapped to develop the functional design of the Crusader fuel system.

Navy specs told Fred his system should be reliable and very lightweight. Pilots, too, gave him a special request. In the ready room near the flight line they described the constant in-flight attention required by complex fuel systems. "Can you fix it so we can forget fuel for a minute?" they asked the young designer. "Can you cut down on those switches?"

Fred went all-out for simplicity, plunging into a three-month whirl of schematics. He was encouraged by close design group assistance in studies and layouts. Soon he was making procurement selections and writing functional reports. Then, with the fuel system mockup, Fred unveiled what he'd done.

It was a showpiece of simplicity. Absent was the usual complex CG control system. Fred had bypassed the problem entirely by canny choosing of fuel cell locations and fuel line sizings. Absent, too, was an emergency system — together with the need for it! There was a unique air transfer system for moving fuel from the Crusader wing tank to the main sump, plus some freshly conceived lesser features.

As mockup and flight tests proved, Fred's ideas more than met weight and reliability requirements. And, as pilots were shown, all simplification features led directly to the cockpit. There Fred had won his war against switches.

Only one had survived.

At Vought, the invitation to find a fresh approach is extended to every engineer. Here, in groups that coordinate for mutual progress, and in test facilities that can evaluate the most advanced proposals, ideas receive the attention they deserve.

BUILDERS OF MILITARY AIRCRAFT
40th ANNIVERSARY
1917 TO 1957

CHANCE VOUGHT AIRCRAFT
INCORPORATED · DALLAS, TEXAS

Area Rule

(Continued from page 27)

To apply the Area Rule to an aircraft, the designer has four steps confronting him.

1. First he calculates the cross-sectional areas perpendicular to the axis of the airplane at a number of sections and makes a graph of these results versus length. He does the same with a theoretically streamlined body, such as a bomb or rocket.

2. He then superimposes the "ideal" area distribution on top of the actual. Now he can see what area corrections are going to be needed to make the actual airplane conform to the ideally shaped body.

3. On the superimposed graph he reworks the actual airplane area distribution until it agrees as closely as practicable with the ideal shape. This is done in the following manner:

Because the area for the ideal is greater than the area of the actual airplane, from 1 to 2 and from 3 to 4, the designer knows he must add area at these points to his airplane in order to conform with the ideal area distribution. From 2 to 3 the cross-sectional area of the actual aircraft is greater than the corresponding ideal area. Here the designer must reduce the area of his aircraft. Compromises may be forced by such factors as visibility

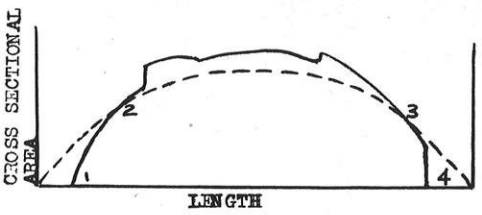

Fig. 6.—The typical and ideal area distribution graphs superimposed.

requirements from the cockpit, or for addition of an afterburner at some later date.

4. He then converts the new area distribution plot back to airplane cross-sections, subtracting wing, tail and other component areas from the fuselage cross-section at each station.

That area reduction may be made by a uniform change in fuselage radius, or it may be made by changes on the fuselage sides. In the case of the Convair B-58, additional areas are seen by a longer nose, and a tail which is moved farther back on the fuselage. Reduced areas are made by removing a uniform amount from the fuselage radius.

The slimness, or fineness ratio, is limited by design considerations. Grumman's Tiger, for example, was length-limited by carrier elevator dimensions; its diameter was determined by the size of the Wright-built J-65 turbojet engine it used.

The final shape shows the curious indentation of the fuselage at the wing which has been called the Coke-bottle wasp, or Marilyn Monroe shape. (Fig. 7 & 8), familiar now because of the Tiger F11F-1 and the F-102A. In both designs, fuselage cross-sections have been reduced locally in the region of the wing by the amount of the wing cross-sections.

But it isn't always necessary to take away area and therefore usable volume from the space-limited designer. Sometimes it is necessary to add area, as has been stated earlier. Another example of this is the tail blister, (slight bulges on the rear of the fuselage), on the F-102A. These additions usually result in gains of valuable volume around the nose and tail sections, a space used to great advantage by the designer.

The Area Rule is given much of the credit for the outstanding performance of the B-58. Without it, it is very unlikely that the B-58, or Hustler as it is called, would even surpass the speed of sound. With the area rule applied, the Hustler will outfly most of our jet interceptors. It is easy to forsee the B-58 as our most important strategic threat to Russia.

The original F11F-1 Tiger, required a 12,500 pound thrust Pratt and Whitney J-57 with afterburner. With the Area Rule, the F11F-1 gets the same performance using a 7500 pound thrust J–65, a 40 per cent decrease in the thrust required.

Before the Rule was applied to the F-102A its top speed was less than that of sound. With the Area Rule applied its speed jumped to well over the speed of sound. Today the F-102A is one of the first line fighters of the United States Air Force.

On the basis of these results, it is evident that near the speed of sound the drag-rise of a thin wing-body combination is mainly dependent on the axial distribution of the cross-sectional areas perpendicular to the air stream.

With the development of this rule, flying through the sound barrier can be done more efficiently by using a smaller thrust engine. This in itself is a considerable savings in cost.

By eliminating buffeting, flight at supersonic speeds have been made safer for the pilot. **THE END**

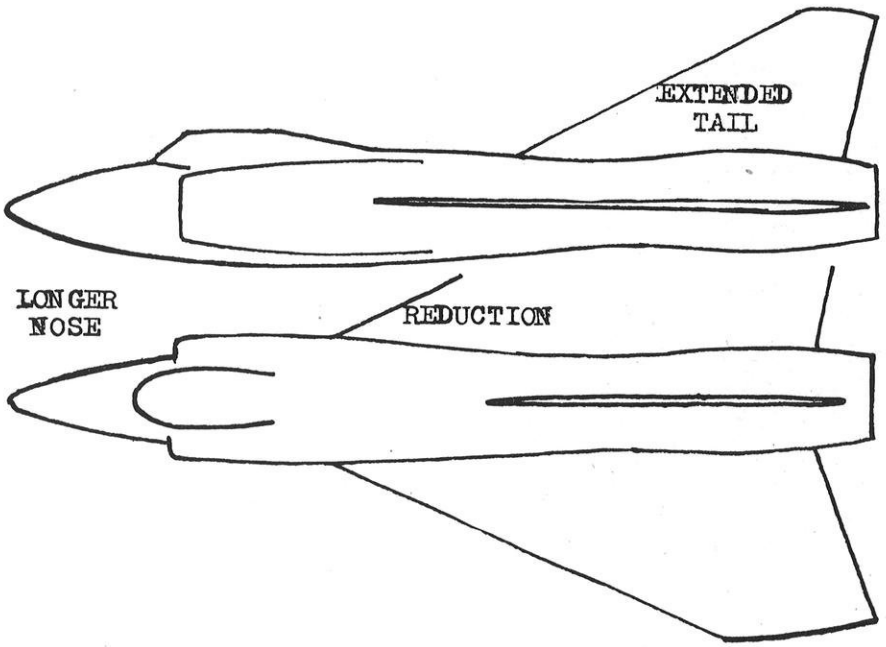

Fig. 7.—Top: Side View of B-58 Converted to Conform with the Area Rule.
Fig. 8.—Bottom: Top View of B-58 Converted to Conform with the Area Rule.

FYI

FOR YOUR INFORMATION

Allied Chemical

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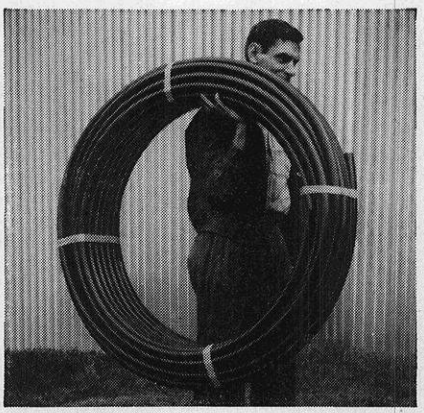
- *new polyethylene pipe compound*
- *ammonia data book*

Polyethylene pipe

Flexible plastic pipe for water service and industrial applications. Chemical-resistant plastic pipe for transmission of solvents and hydrocarbons in the oil and gas fields. Pipe that is resistant to impact, heat and other stresses.

These are some of the advances made possible by a unique new polyethylene pipe compound developed by Allied Chemical. A very high molecular weight polyethylene, it is the successful culmination of 10 years of basic research at our Central Research Laboratories. It is now in commercial production.

Development work is now underway to find other uses for the resin's exceptional physical properties, for the time when the production rate permits sale beyond pipe manufacture. Likely candidates for new uses are tubings, films, sheets, tiles, moldings and fibers.



New plastic pipe made by Orangeburg Mfg. Co.

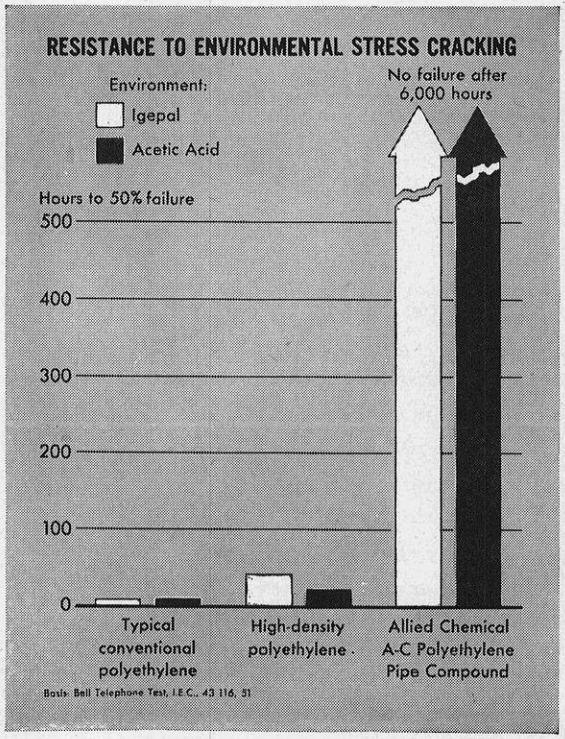
This distinctly different polyethylene resin made at low pressure is the best thing yet for extruding a superior polyethylene pipe. Pipe being made from the new A-C polyethylene pipe compound has high bursting strength, resistance to impact, shows no stress cracking, has superior heat resistance and resistance to chemicals, organic solvent and hydrocarbon liquids.

These properties are due to the high molecular weight — on the order of 750,000 — and structure of the polyethylene molecule, not present in any other known polyethylene. These new qualities will greatly expand the acceptance of plastic pipe for water service and industrial applications. A common fault of some polyethylene pipe has been environmental stress cracking; this is entirely overcome in pipe made of this new resin.

Also, tests indicate the pipe will be suitable for carrying solvents and hydrocarbons for oil and gas pipe lines, a use denied to conventional polyethylene pipe. There is a growing need in this field for a flexible, tough pipe, resistant to the corrosive conditions which attack steel pipe.

A-C polyethylene pipe compound has an unusually high melt viscosity, reflecting its great molecular weight, and requires special techniques for manufacture of pipe.

The new resin is a companion product to a line of low molecular weight polyethylene products introduced on a commercial scale in 1954 by Allied. These are used in the injection molding of many household items, and as additives in paper coatings, polishes and printing inks.



A-C is an Allied Chemical trademark

Ammonia data book

A new 68-page technical book on ammonia has been prepared by the largest ammonia producer, Allied's Nitrogen Division.

The comprehensive manual is actually a two-in-one piece: the first section on ammonia, and the second on ammonia liquor. Its contents include major uses, physical and chemical properties, specifications, shipping and storage procedures, physical tables, graphs and analytical procedures.

Major ammonia consumers — industries such as explosives, textiles, petroleum refining, refrigeration, pulp and paper, metallurgy and synthetic resin — will be interested in this up-to-date information.

Creative Research

These examples of product development work are illustrative of some of Allied Chemical's research activities and opportunities. Allied divisions offer rewarding careers in many different areas of chemical research and development.

ALLIED CHEMICAL
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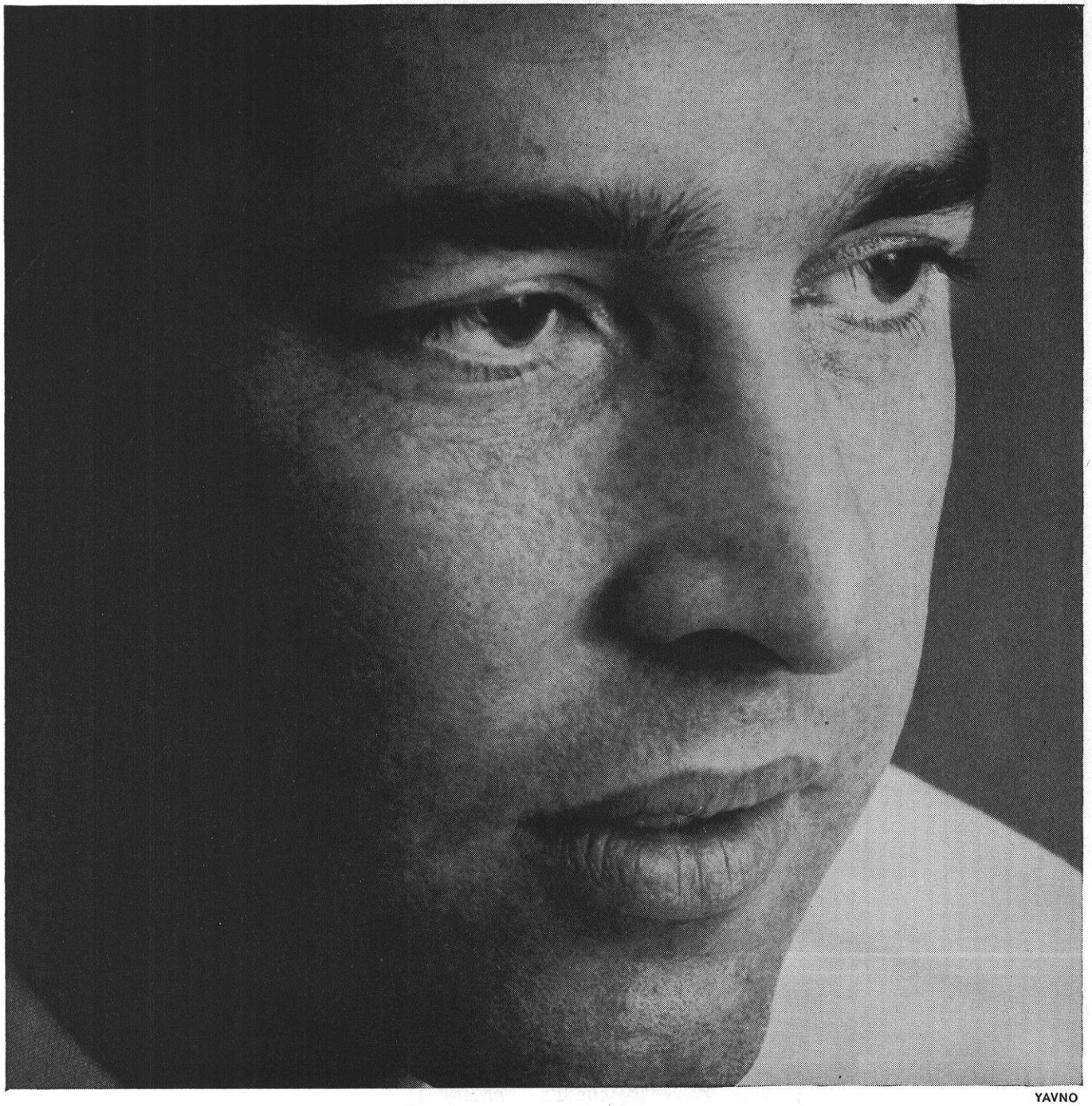

YAVNO

...on science and impossibility

"Scientific knowledge is derived from observations of the world. Our imaginations, however, are not bounded by this constraint—we can easily imagine physical nonsense. Not everything is possible. We sometimes get the opposite impression because new scientific discoveries force us to modify an old theory, and give rise to new and unexpected possibilities. But the point is that the old theory was verified for some class of physical phenomena, and a domain of validity was established. The new theory, however radically it may differ from the old one in its conceptual basis, must always agree with the old theory in the predictions it makes for that class of phenomena. Despite the greater generality of quantum mechanics, Newton's laws still apply to macroscopic objects. Parity is still conserved for the strong interactions. The old impossibilities still remain. Within the limits defined by the impossibilities, there is plenty of room for man's inventiveness to operate. In fact, the game is even more challenging that way."

—*Richard Latter, Head of the Physics Division*

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A nonprofit organization engaged in research on problems related to national security and the public interest

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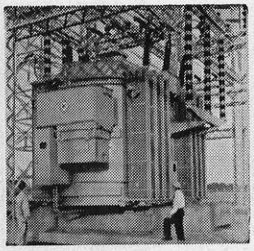
...where you can design, build, research or sell products like these

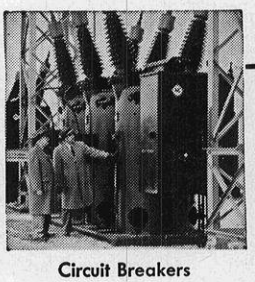
...and grow with 3 growth industries

POWER EQUIPMENT

Steam Turbines

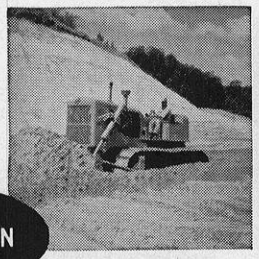


Transformers of all Types

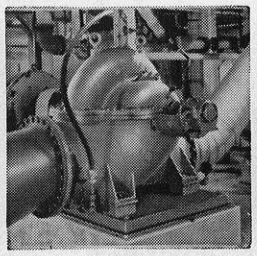


Circuit Breakers

CONSTRUCTION



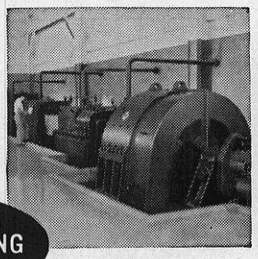
Road Building Equipment



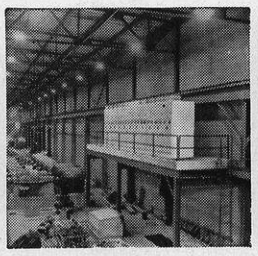
Pumps, Blowers

Cement-Making Equipment

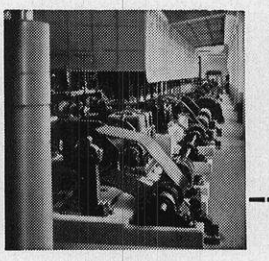
MANUFACTURING



Motors



Control



V-Belt Drives

Opportunities in these fields

- Thermodynamics
- Acoustics
- System Analysis (Electrical and Mechanical)
- Stress Analysis
- Hydraulics
- Electronics
- Process Engineering
- Mechanical Design
- Structural Design
- Metallurgy
- Nucleonics
- High Voltage Phenomenon
- Analog and Digital Computers
- Fluid Dynamics
- Basic Research

You can grow faster in a company that supplies the basic needs of growth! Power, construction and manufacturing *must* grow to supply the needs of our population which is increasing at the rate of 50,000 per week. Allis-Chalmers is a major supplier of equipment in these basic industries.

But there's another factor of equal importance: Allis-Chalmers Graduate Training Course offers unusual opportunities for the young engineer to:

- Find the type of work he likes best
- Develop engineering skill
- Choose from a wide range of career possibilities

Allis-Chalmers graduate training course 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 Allis-Chalmers, Graduate Training Section, Milwaukee 1, Wisconsin.

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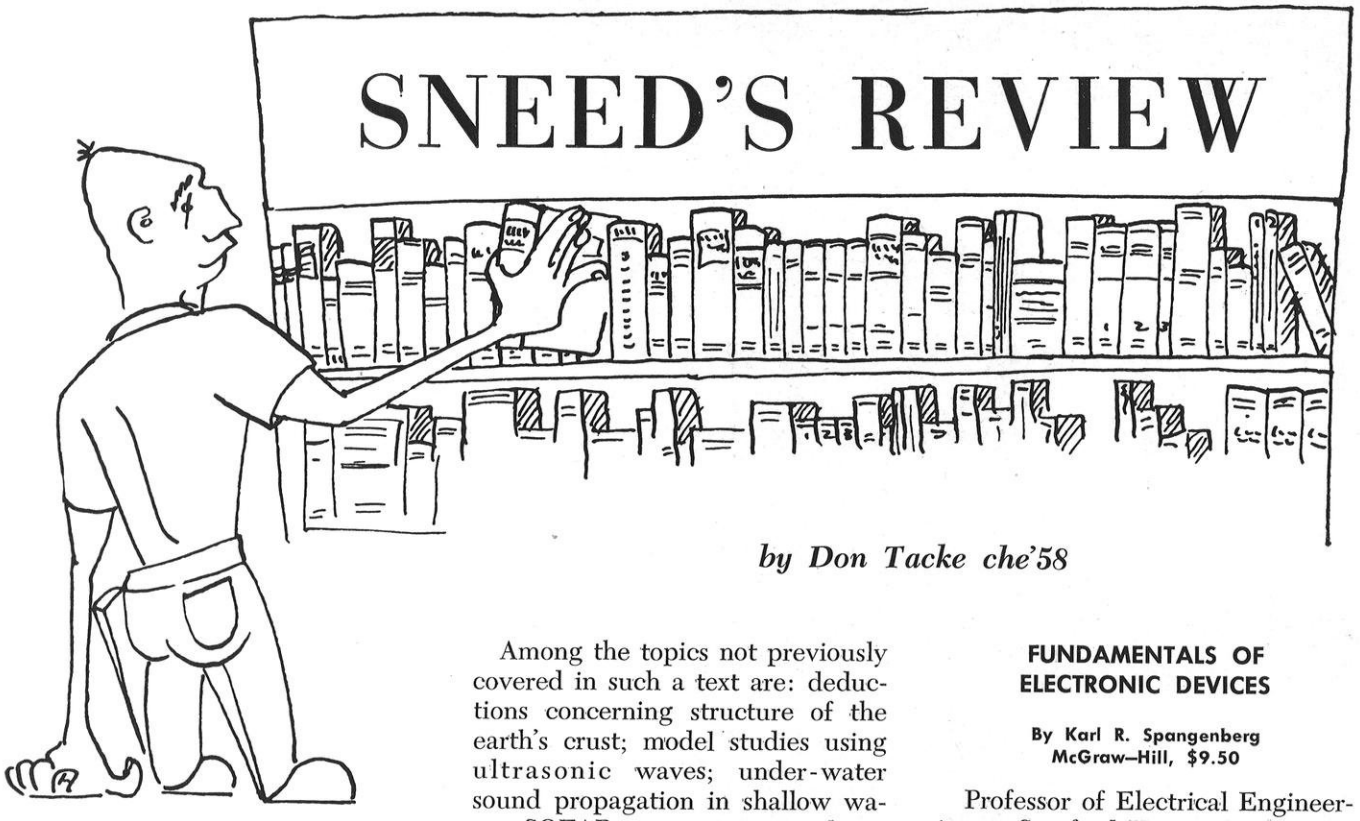
SNEED'S REVIEW



by Don Tacke che'58

ELASTIC WAVES IN LAYERED MEDIA

By W. Maurice Ewing, Wenceslas S. Jardetzky, and Frank Press
McGraw–Hill, $10.00

This work is the outgrowth of a plan to make a uniform presentation of the investigations on earthquake seismology, under water sound, and model seismology. The scope was subsequently enlarged to cover a particular section of related problems.

Both the experimental and theoretical aspects of the subject are fully covered. Observations of surface waves from explosions and earthquakes, flexural waves in ice, and SOFAR sound propagation are a few examples of topics in which the theoretical and practical investigations benefited each other.

Each subject begins with elementary discussion and culminates with advanced treatment; emphasis is placed on topics for which at least some experimental data are available. Where possible, physical interpretations are made of mathematical results, and pertinent experimental data are presented and interpreted in the light of theory. The most comprehensive bibliography ever compiled before in one place is included in the book.

Among the topics not previously covered in such a text are: deductions concerning structure of the earth's crust; model studies using ultrasonic waves; under-water sound propagation in shallow water, SOFAR propagation in plates, rods, holes, spheres, and propagation in heterogeneous media. In connection with geophysical prospecting the groundroll problem, refraction, and reflection in layered media, offshore prospecting applications and waves in boreholes are discussed.

* * *

MATHEMATICS AND COMPUTERS

By George R. Stibitz and Jules A. Larrivee
McGraw–Hill, $5.00

Surveys the work of the applied mathematician, the problems he studies, the methods he uses, especially computational methods, and the computing devices that help him in the application of mathematics to problems in science, engineering and business. Computing devices and their components are described, especially the automatic digital computer, the way it works, and its capabilities and limitations, also the non-digital computing devices, use of randomness in computation, and typical applications of computing devices in technology and business.

Mr. Stibitz is a consultant in applied mathematics and Mr. Larrivee is the Associate Professor of Mathematics at Worchester Polytechnic Institute.

FUNDAMENTALS OF ELECTRONIC DEVICES

By Karl R. Spangenberg
McGraw–Hill, $9.50

Professor of Electrical Engineering at Stanford University, Karl R. Spangenberg, has written this book in which emphasis is placed on physics of electron devices, presenting a unified fundamental treatment of electron devices including vacuum tubes and transistors. It is valuable to practicing engineers and others who wish information on new devices particularly semiconductor devices. Emphasis is on the similar features of tubes and transistors using semi conductor theory. Internal physics of the devices is stressed, and the book discusses the role physics plays in determining the external characteristics. A fundamental treatment of commonest circuit applications is also included.

* * *

NUCLEAR ENGINEERING

By Charles F. Bonilla
McGraw–Hill, $9.50

Twelve experts in various fields of engineering and science have prepared this complete reference on the basic principles of the main engineering disciplines involved in the design of nuclear reactor cores and power plants. Fundamentals in each field are given clearly and briefly with enough illustrations and advanced specific analyses to make the book of practical value to the working design engineer.

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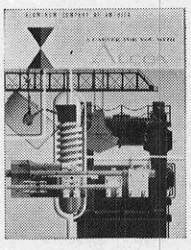

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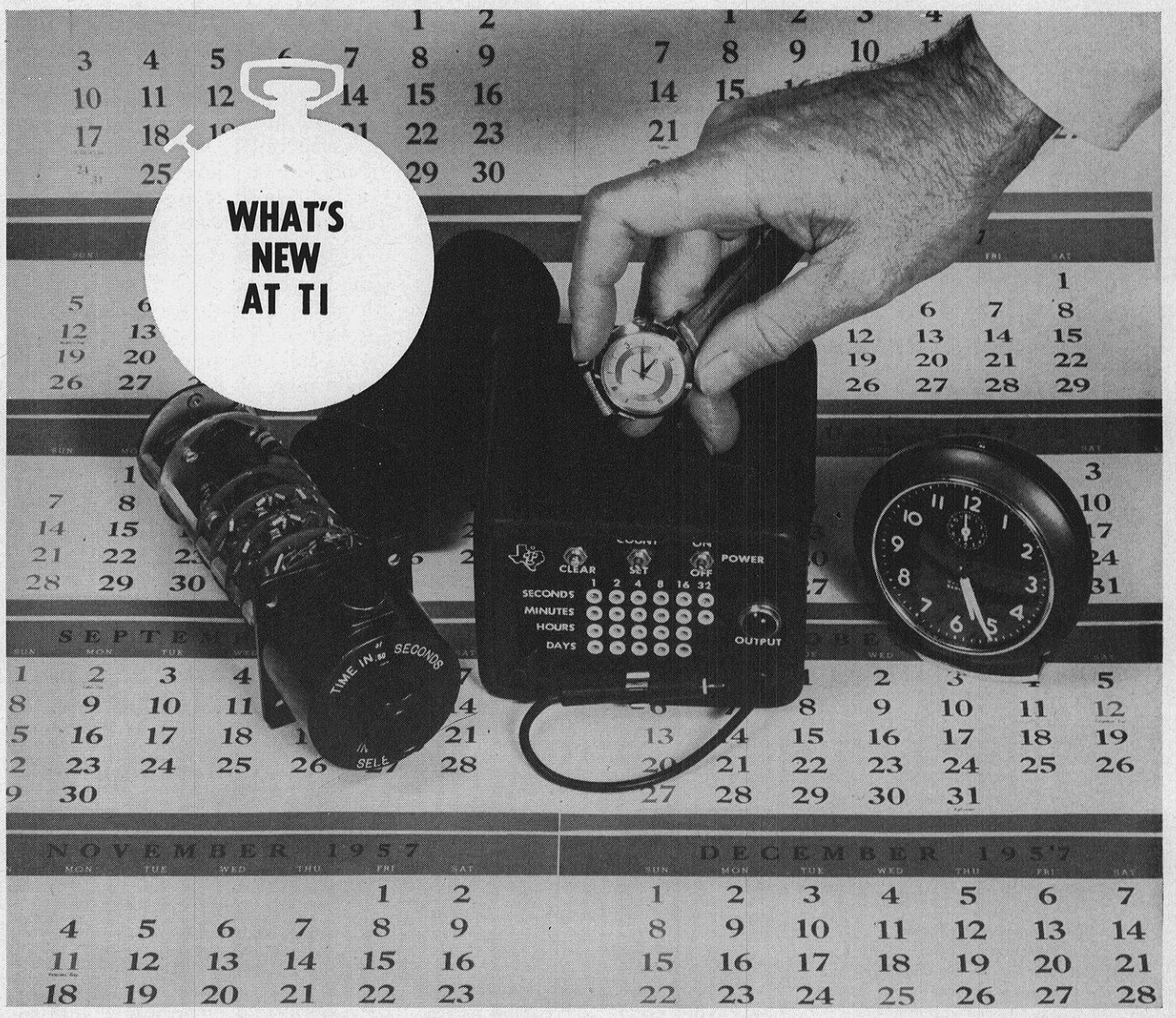


TRANSISTOR 'STOP-WATCHES' FOR INDUSTRY

accuracies to a 50 millionth / intervals from microseconds to months

Texas Instruments engineers are building portable electronic timing devices to uncanny accuracies with interval variations to infinity. They allow applications never before practical because of previous size, weight, power drain, and maintenance limitations . . . particularly in airborne installations. Essentially binary counting and storage devices, these TI timers present an entirely new concept in time measurement . . . a result of the new design freedom allowed by transistors . . . of which TI is also the world's largest commercial manufacturer.

At engineer-managed Texas Instruments, recognition of individual achievement has contributed to TI's twentyfold growth in the last ten years — to a current $70 million volume. Advanced personnel policies include company-sponsored educational assistance, profit sharing, insurance, and retirement programs.

Texas Instruments plants are within Dallas, yet away from downtown traffic . . . within 5 minutes of fine residential areas, churches, and public and private schools. Your home will be within 15 minutes of year-around recreational, amusement and cultural activities.

Here are the major products and programs you can work with at TI:

SEMICONDUCTORS & OTHER COMPONENTS—Transistors, diodes, rectifiers, resistors, and panel meters. ELECTRONIC & ELECTROMECHANICAL APPARATUS—Radar, sonar, infrared, navigation, magnetics, telemetering, communications, computers, transformers, and instruments. RESEARCH—Semiconductor materials and devices, ferromagnetics, infrared, optics, high speed data reduction, etc. ADMINISTRATION—Production, planning, purchasing, cost analysis, etc.

TEXAS INSTRUMENTS
INCORPORATED
6000 LEMMON AVENUE DALLAS 9, TEXAS

Science Hi-Lights

(Continued from page 66)

pictures to new-product-in-use snapshots.

Three letters in the alphabet of photography spell out the assurance that regardless of who takes the picture with these inexpensive cameras the results will be clear and sharp. The letters, EVS, stand for "Exposure Value System," the new internationally accepted system of determining the right camera setting under varying light conditions and film loads. With EVS any employee can take well-exposed identification photographs, record pictures, production, sales promotion and employee activity photographs and slides.

The cameras come equipped with a set of seven EVS cards, each designating best settings to be used with a particular type of film under varying light conditions or with flash. The cards slip on the back of the camera for easy reference. A glance at the card tells the setting to be used. This number is translated to the EVS setting on the camera. Technically, the EVS number is a combination of the two elements that determine how much light falls on the film: the shutter speed and opening of the lens diaphragm.

In the simplest of the new cameras, the Kodak Pony II Camera, there's a fixed speed shutter and the EVS setting changes only the lens opening. The other three offer several combinations of lens opening and shutter speeds that add up to the same EVS number. This lets you work for one of two goals: fast shutter speed or increased depth of field.

EVS, incidentally, is a term everyone who uses a camera will hear more about. Formerly a feature on only high-price imported cameras, it's been adopted as standard by the world's photographic industry.

RUBBER BRIDGE BEARINGS SOLVE LONG STANDING PROBLEM

Until the advent of a new natural rubber bearing that has just been introduced in England, bridge engineers were restricted to the traditional nests of rollers or sliding plates for bridge expansion bearings. The problem with these was maintenance. Rollers tend to wear flat after a period of time. Both rollers and plates are subject to rust. Now a new natural rubber bearing fulfills all requirements of longitudinal movement, with the added benefit of long life with no maintenance whatsoever.

This bearing was introduced in the construction of London's Pelham Bridge, a quarter of a mile in length with dual vehicular roadways and pedestrian pavement. The end spans of the bridge are reinforced concrete. The center spans, which total 288 ft. and cross the railway, are constructed with welded steel girders, composite with concrete deck slab. Wellesley Road Bridge, a smaller London project is also making use of the natural rubber bearing innovation.

Bearings are now available with nominal capacities of 50 and 100 tons. In appearance, the bearings are merely large blocks of rubber—the 100-ton unit measuring 24″ x 16″ x 7⅛″ deep, and the smaller unit 11″ x 16″ x 7⅛″ deep. Actually, however, the rubber is interlayered with steel plates. These plates have a minimum cover of ¼″ of natural rubber about their edges and are therefore unaffected by the elements.

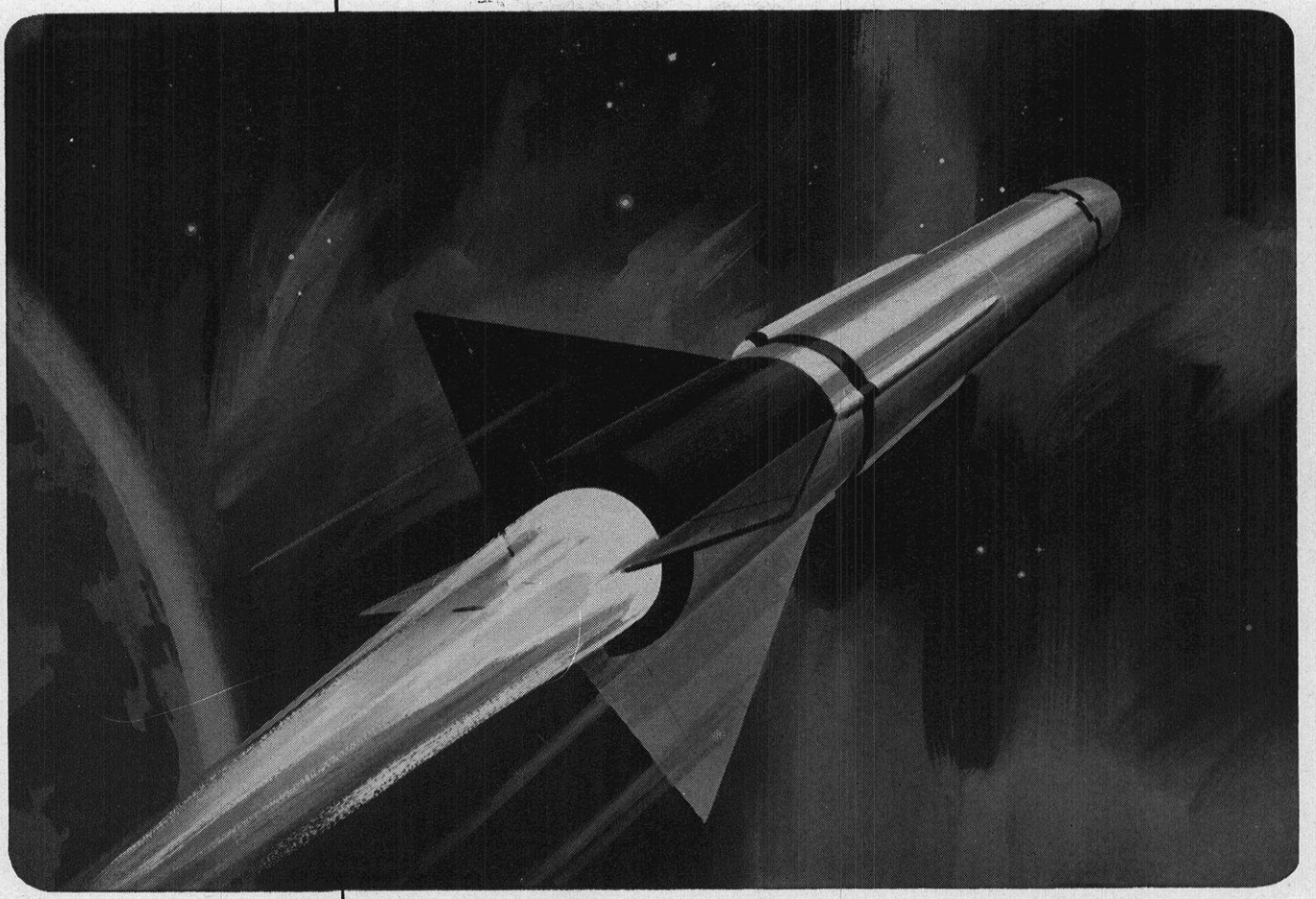
The shear ratings of the bearings are the same in any direction in the horizontal plane. The compression rating of the two bearings is such that for most bridge work the bearing can be regarded as a pinned support, the actual rotational stiffness for the longer bearing being 1,800 tons ft. per radian.

Bearings with greater capacity and different properties are now being developed. Work is being particularly concentrated on bearings with vee'd plates which provide lateral stiffness with the same longitudinal rating and also with domed bearings which have high lateral stiffness in all directions but low rotational stiffness.

The current issue of RUBBER DEVELOPMENTS contains a complete description of these revolutionary bearings together with illustrations and diagrams. For a free copy write, Natural Rubber Bureau, 1631 K St., N.W. Washington 6, D.C.

THE END

IMPORTANT DEVELOPMENTS AT JPL



The Jet Propulsion Laboratory is a stable research and development center located north of Pasadena in the foothills of the San Gabriel mountains. Covering an 80 acre area and employing 2000 people, it is close to attractive residential areas.

The Laboratory is staffed by the California Institute of Technology and develops its many projects in basic research under contract with the U.S. Government.

Opportunities open to qualified engineers of U.S. citizenship. Inquiries now invited.

Weapons Systems Responsibility

In the development of guided missile systems, the Jet Propulsion Laboratory maintains a complete and broad responsibility. From the earliest conception to production engineering—from research and development in electronics, guidance, aerodynamics, structures and propulsion, through field testing problems and actual troop use, full technical responsibility rests with JPL engineers and scientists.

The Laboratory is not only responsible for the missile system itself, including guidance, propulsion and airframe, but for all ground handling equipment necessary to insure a complete tactical weapons system.

One outstanding product of this type of systems responsibility is the "Corporal," a highly accurate surface-to-surface ballistic missile. This weapon, developed by JPL, and now in production elsewhere, can be found "on active service" wherever needed in the American defense pattern.

A prime attraction for scientists and engineers at JPL is the exceptional opportunity provided for original research afforded by close integration with vital and forward-looking programs. The Laboratory now has important positions open for qualified applicants for such interesting and challenging activities.

JOB OPPORTUNITIES IN THESE FIELDS NOW

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JET PROPULSION LABORATORY

A DIVISION OF CALIFORNIA INSTITUTE OF TECHNOLOGY

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So You Think You're SMART!

by Sneedly bs'61

SNEEDLY had a rough vacation this summer! He worked for the world's largest sports equipment manufacturer testing their products; everything from skis to sports cars, golf clubs to tennis rackets. One week he would be skiing in Sun Valley and the next he would be fishing in the Gulf of Mexico.

What a grind! Sneed finally had to give up this dream job—someone mistook him for a hill student and rather than lose his good name, reputation, and self respect, he quit.

Have you figured out how Charlie the Knight found the honest engineer? Well, he knew that the second man was lying because the first man couldn't have said that he wasn't an EE. If he was an EE he couldn't have lied and if he wasn't he couldn't have told the truth. In either case he couldn't have said that he wasn't an EE. The third man must have been telling the truth when he said that the second man was lying, therefore he was an EE.

Sneedly found the counterfeit coin by first weighing four coins on each side of the balance. If it balanced, then the bad coin could easily be found from the four held back. If the first weighing didn't balance, one coin was removed from each side, one coin moved from the left hand pan to the right, two from the right to left hand pan and two of the four from the third group of four that were known to be good were used to balance the right hand pan.

If this second weighing balances, the bad coin is one of the two removed. If the second weighing results in the same pan going down, then the bad coin is one of the three not changed. If the pans reverse their rise (or drop) then the bad coin is one of the three that was changed.

In either of the last two cases, one of two coins that were in the same group during the first two weighing were weighed against each other to determine which of the three was the bad coin. In this solution, it is important to notice which pan rises and which drops.

Five men are playing cards. They are Turner, Brown, Perkins, Reilly, and Jones. Each had a pack of smokes, Camels, Luckies, Old Golds, Chesterfields, and Raleighs, containing 20, 15, 8, 6, and 3 cigarettes, not in that order.

At the beginning of a hand, Perkins asked for three cards. Reilly had smoked half of his supply, one less than Turner. The Chesterfield smoker originally had two and a half times the number of weeds he had at the end of the game. One of the men drew an inside straight and in the excitement, lit the tipped end of the tenth cigarette. The Lucky smoker had smoked two more than anyone else, including Perkins.

Brown drew as many aces as he originally had cigarettes. The Camel smoker asked Reilly to pass Brown's matches. At the end of the game no man had finished all of his cigarettes, except the Old Gold smoker, who smoked the same number as Reilly. Which man had which brand of cigarettes, and how many?

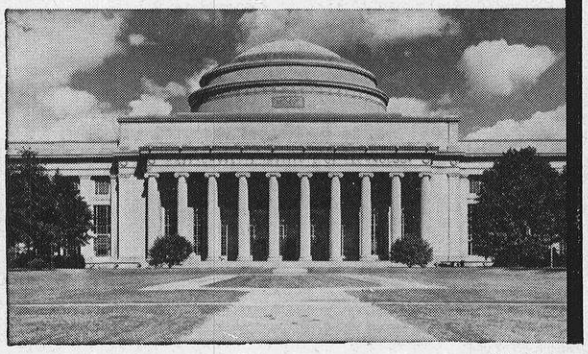
Bob Mayer and Curtis Druckrey of Green Bay sent in perfect solutions to problems. Dean Schultz of Brooklyn sent in solutions that were almost perfect and Allen Kofal, a Drummond High school student, supplied Sneedly with a perfect solution to the division problem in February's issue. Nice work Allen!

Green Bay still leads in the number of perfect solutions. Sneed thinks that G B is the only town in the state that has engineers in it. All the other towns must be full of hill students. Sneedly is still laughing at Milwaukee—the only letter he got from that town was a plea for help, and from a girl, at that!

announcing . . . RAYTHEON GRADUATE PROGRAM

CALTECH

HARVARD



M. I. T.

FOR STUDY AT CALTECH, HARVARD AND M.I.T. IN 1958-59

The Raytheon Graduate Program has been established to contribute to the technical development of scientists and engineers at Raytheon. It provides the opportunity to selected persons employed by Raytheon, who are accepted as graduate students by Harvard, M.I.T. or California Institute of Technology to pursue, at Raytheon's expense, regular courses of study leading to a master's degree in science or engineering in the institution of their choice.

The Program requires, in general, two or three semesters of study, depending on circumstances, with the summer months spent in the Company's research, engineering, or manufacturing divisions. It includes full tuition, fees, book allowances and a salary while at school. Students also receive health, accident, retirement and life insurance benefits, annual vacation and other privileges of full-time Raytheon employees.

To be considered for the Program, applicants must have a bachelor's degree in science or engineering, and should have outstanding student records, show technical promise, and possess mature personal characteristics. They must be under 30 years of age on September 15 of the year admitted to the Program. They may apply for admission to the Program in anticipation of becoming employees of Raytheon.

YOU ARE INVITED TO ADDRESS YOUR INQUIRY to Dr. Ivan A. Getting, Vice President, Engineering and Research, outlining your technical background, academic record, school preference, and field of interest, prior to December 1, 1957.

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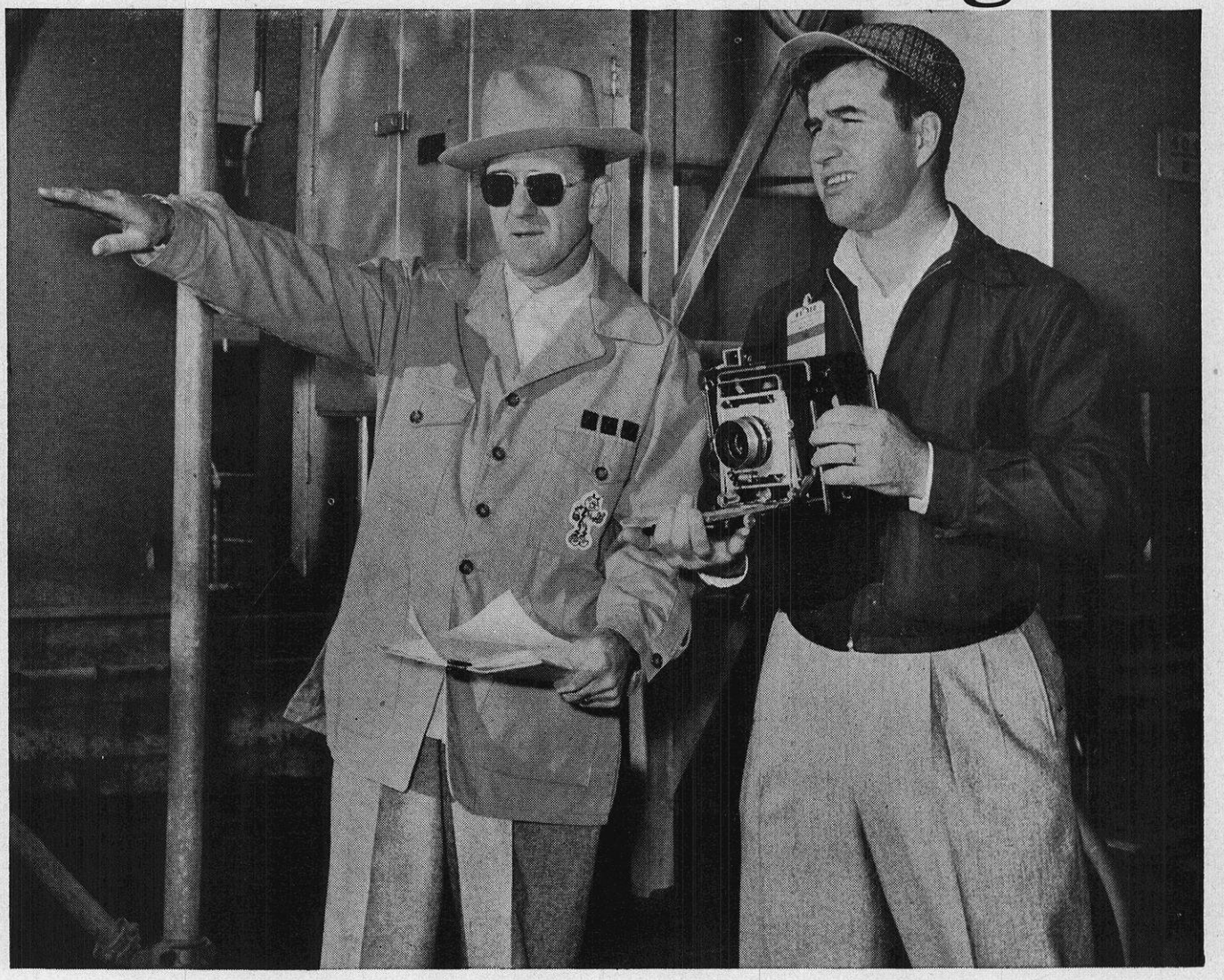
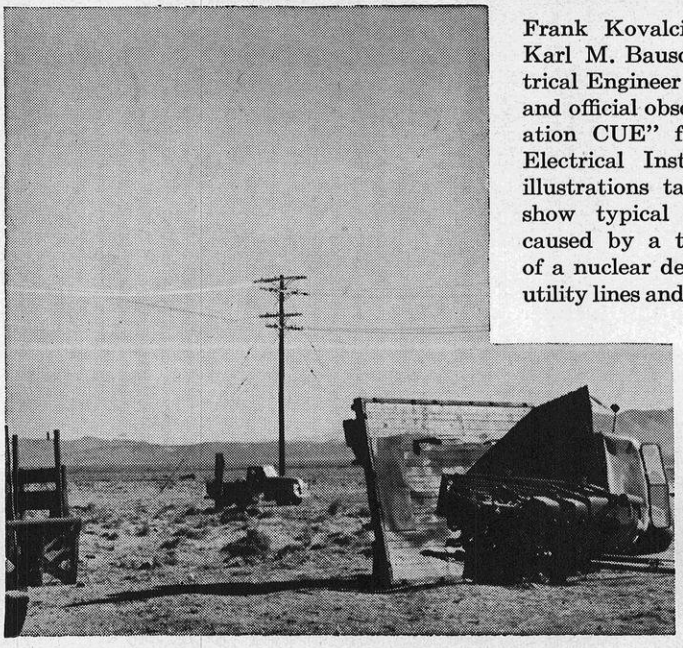
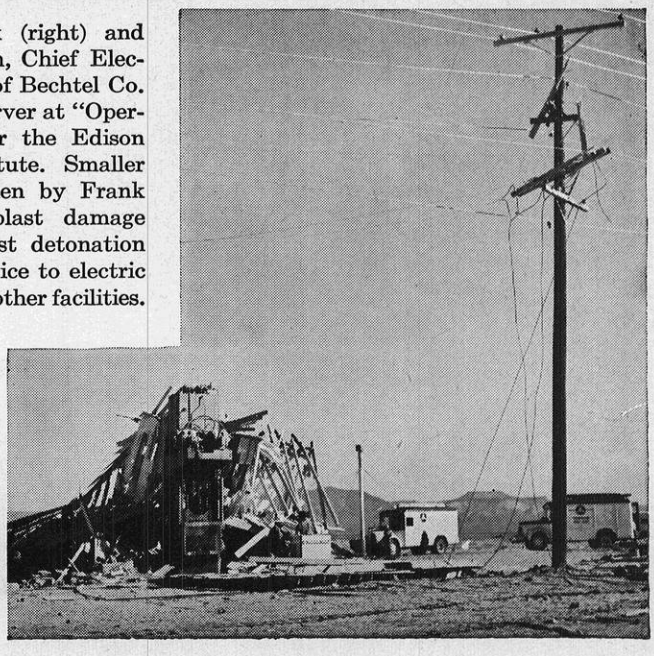
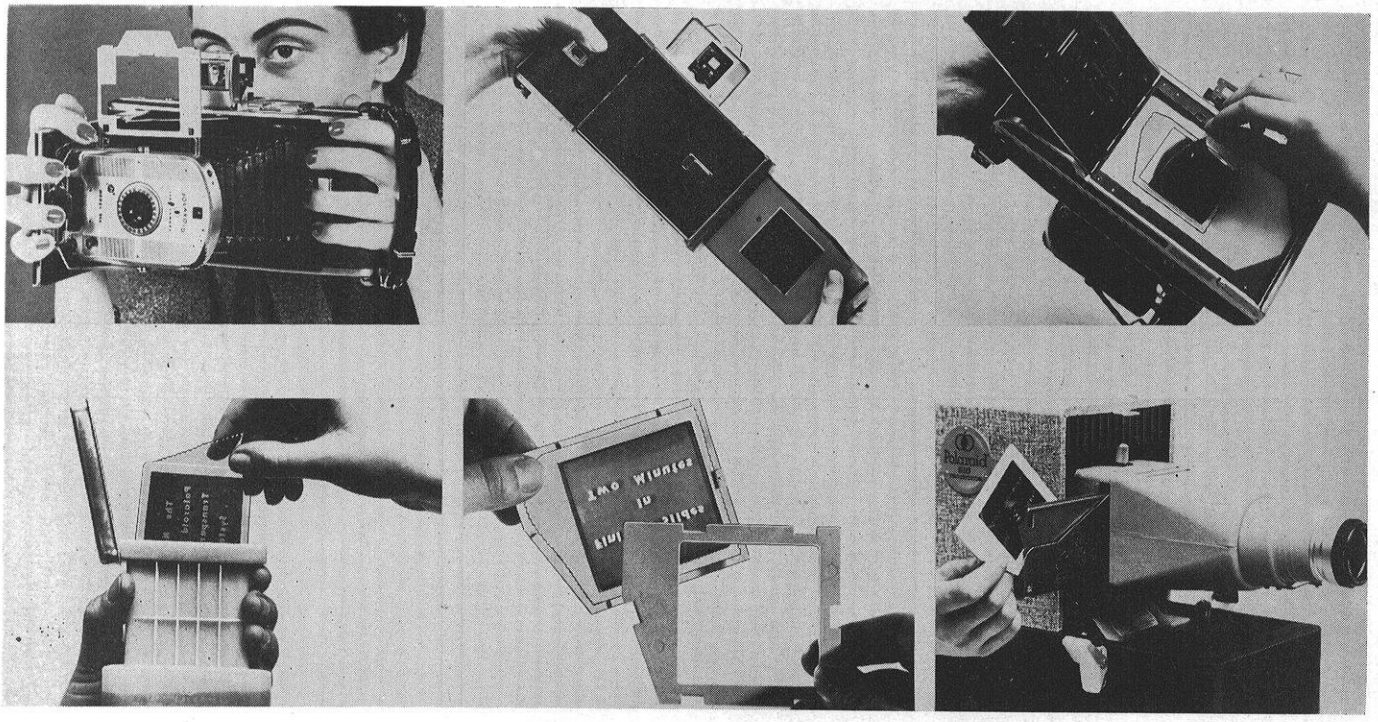




Frank Kovalcik (right) and Karl M. Bausch, Chief Electrical Engineer of Bechtel Co. and official observer at "Operation CUE" for the Edison Electrical Institute. Smaller illustrations taken by Frank show typical blast damage caused by a test detonation of a nuclear device to electric utility lines and other facilities.





A revolutionary photographic system makes it possible to snap a picture and project it on a screen a couple of minutes later.

Basis of the system is the new 1000-speed Polaroid Land Projection Film. Panchromatic, it produces virtually grainless black-and-white transparencies which can be projected as big as a 12-foot square without loss of sharpness and brilliance.

All the user does is snap the shutter, pull a tab and in two minutes lifts out a transparency that can be mounted and projected at once.

One size (Type 46) of the film produces 2¼x2¼" slides which, in special Polaroid snap-together plastic mounts, cannot be projected upside down or backwards in the new 500-watt Polaroid Projector. Another size (Type 46L) makes 3¼x4" slides for existing lantern slide projectors.

Polaroid Camera

(Continued from page 25)

be a substantial saving through the use of the Polaroid camera.

In electrical engineering, where records must be made of transient waveforms as observed on an oscilloscope the Polaroid camera with special attachments has been found extremely useful.

Fairchild Camera and Instrument Company produces an oscilloscope camera for this purpose which utilizes a light-tight hood with a built-in viewing port that attaches a modified Polaroid camera to a five inch oscilloscope. A position-shift device enables two pictures per print to be taken with an image reduction of one half the scope size.

Progress reports may be made more vivid with the inclusion of pictures showing the work currently being done on a project. Setups and installations can be quickly photographed and filed for future reference. Should a similar installation be required in the future, the photo permits the job to be accurately visualized and cuts down setup time.

When used with special photomicrographic equipment, the camera has filled a great need. Pictures of textiles, crystals, and other specimens are ready in minutes and can be retaken immediately if not satisfactory.

In quality control, pictures of defective materials can be quickly taken and forwarded to the specialists for analysis. Shots of rejects and discards can be given to the workmen so they will show what to look for

Patent attorneys use the camera to decrease the time needed for search purposes. The ability to obtain graphical records quickly is a great help in building evidence in lawsuits.

In the personnel department, the camera furnishes photographs for the identification of new employees.

New applications are being found each day, those mentioned above are only a few related to the field of engineering. **THE END**

Campus News

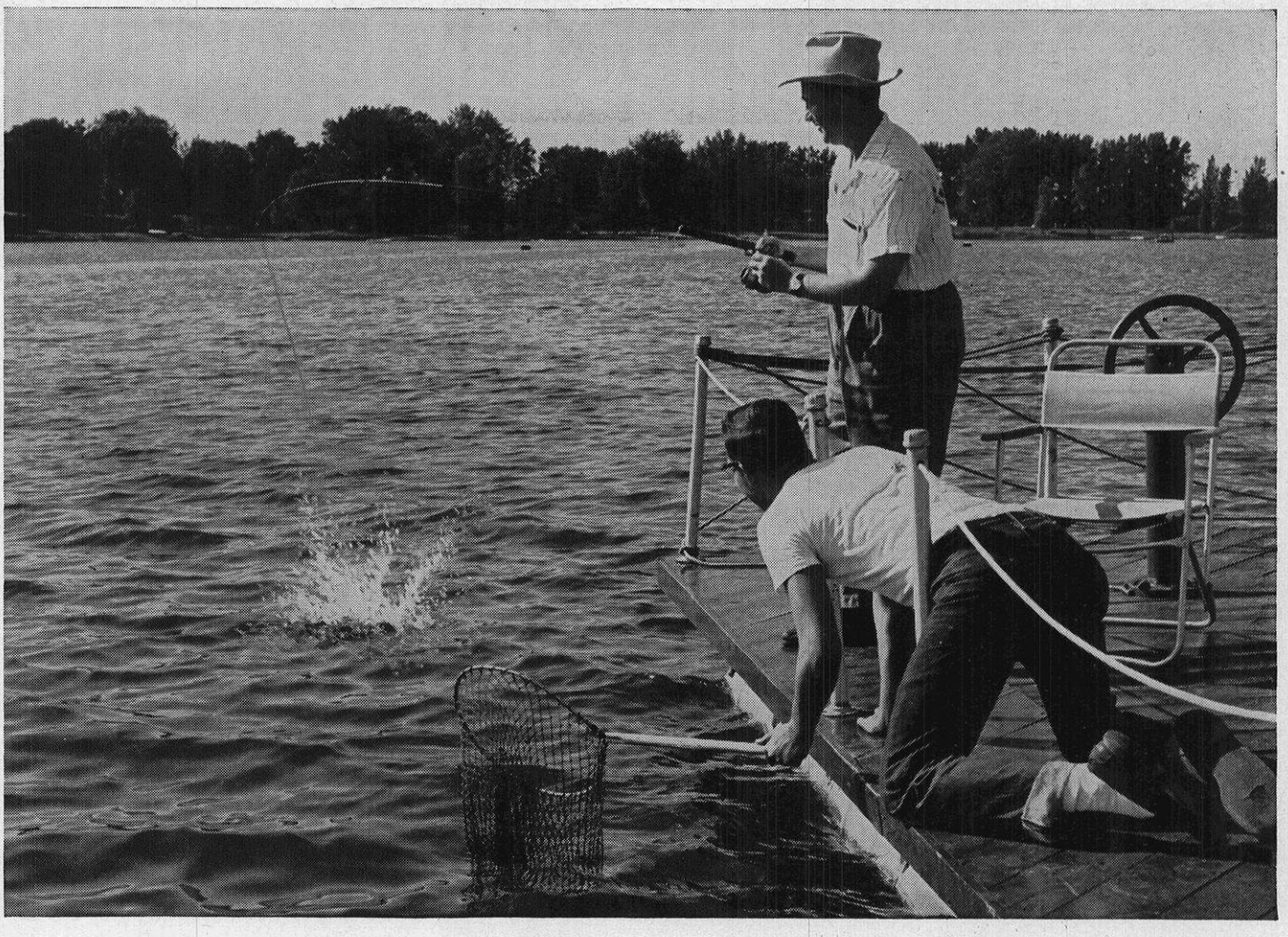
(Continued from page 70)

Dr. Bain, who will continue as director of the West Orange Lab, received a B. S. degree from North Carolina State College in 1936. He was awarded an M. S. degree in 1938 and a Ph. D. in chemical engineering in 1943, both from the University of Wisconsin.

George R. Wernisch, Eastern regional manager who is being reassigned to the general office staff, was elected a director of Ceco Steel Products Corporation.

Wernisch is a graduate of the University of Wisconsin and Lehigh University. He worked in the firm's Milwaukee and Kansas City offices as an engineer, and in 1940 became assistant manager of the steel joist and roof deck department. He served as lieutenant-commander in the United States Navy bureau of yards and docks during World War II. He went to Washington as eastern regional manager in 1954.

THE END



There's fission and then there's fishin'...

just five minutes apart for 3M'er Jim Johnson

From the lab to the lake in only five minutes—that's 3M-land! It's a place where young men like Jim Johnson, with a talent for both engineering and happiness, find life good . . . to them and their families.

There's some kind of outdoor fun going on year 'round—golf, fishing, swimming, boating, hunting, skiing, skating. And never more than five miles from job or home.

There's work, too—vital, exciting, creative work geared to the future. For 3M is a research-minded company. Its scientific plant, including the new multi-million dollar Central Research Laboratory, is one of the finest. In this young, fast-growing company there's always been plenty of opportunity for young men to get ahead, and for new ideas to get a hearing. Witness such original products as "SCOTCH" Brand Cellophane Tape, and the "SCOTCHLITE" reflective signs that guide you safely on highways day and night. More than 22% of the products 3M sells were developed in the last five years.

And as for compensation, 3M engineers and executives are substantially above the average in take-home pay, home ownership, car ownership, and stock ownership! So, if you're interested write 3M, St. Paul 6, Minnesota.

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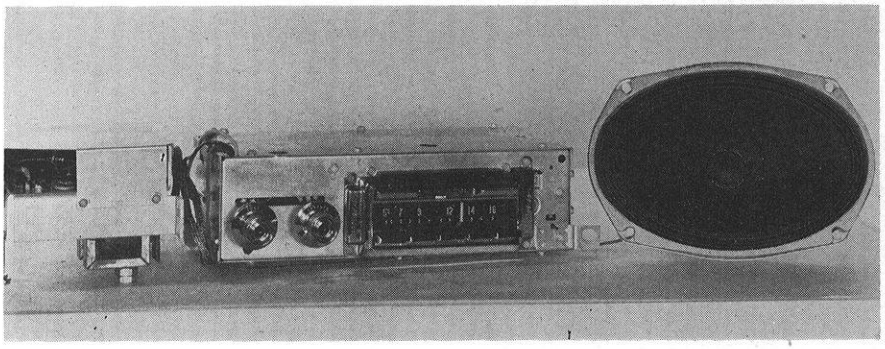
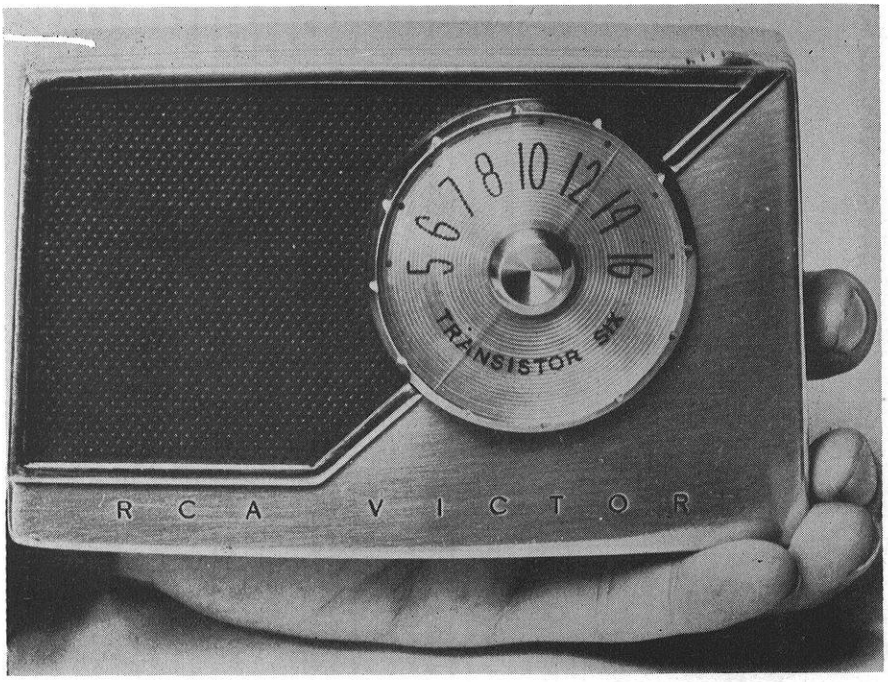
WHERE RESEARCH IS THE KEY TO TOMORROW

3M COMPANY



The all-transistor Cadillac Brougham auto radio.



Compact size is one big advantage of the transistor portable.

Transistors

(Continued from page 63)

distortion over the output power range. The larger sets have much better output quality since speaker size is not as critical as it is in the miniature models. The output quality of the larger sets is comparable to equivalent vacuum tube sets. Some of the early transistor sets had a detectable background hiss but this has largely been eliminated by improved transistors and circuitry.

Many articles have been written on the pros and cons of available transistor radios, so a brief summary is probably in order:

In comparing transistor sets to comparable tube models, the manufacturer quickly points out the power supply advantages. A tube type portable radio may have a battery life of approximately 25 to 50 hours of intermittent duty. Both a filament power supply (the A battery) and a high voltage plate power supply (the B battery) must be available, adding bulk and weight as well as cost to this type of set. In comparison, a comparable transistor set will operate on four standard flashlight batteries for as many as 500 hours of intermittent duty. This is indeed a good selling point! Since power requirements are so small, the development of a sun-powered transistor radio is already underway.

The reliability and long life of the transistor, as discussed previously, is another of the advantages of the transistor radio.

The high cost of the transistor radio has restricted sales somewhat. Prices range from about $30 to $100. When the price of transistors is comparable to vacuum tubes the price range will be about the same as the vacuum tube sets. Better manufacturing methods should bring about this equality.

The output quality of the two types of sets has already been compared, but results of most tests tend to show the quality of the tube type sets to be slightly superior to present transistor sets. Selectivity appear to be about equal.

With new development and improvement of transistors, the field of transistor applications has been mushrooming. One of the big consumers of transistors is the hearing-aid industry. The miniature size and low power requirements of the transistor make it ideally suited for hearing-aid use. Operating costs for hearing-aids have been reduced by a factor of 60.

The television industry is also becoming a big consumer of transistors. Because television utilizes the UHF and VHF bands, not all tubes can be replaced by transistors, but the audio section and parts of the lower frequency video sections will soon be fully transistorized.

Digital computers can utilize the high-speed switching property of the point-contact type of transistor. Here again, decreased power, reliability, and long life, are important criteria. Motor controls, servomechanisms, and other control units are utilizing a vast number of the junction type transistors. Portable telephone units have already been successfully transistorized.

The non-portable home radios have not as yet been converted to transistor circuits since 60 cycle AC power costs for such sets are negligible. One tendency, however, might be to replace the AC type home radio with a long life transistor portable model which could be conveniently moved to any place in the home where AC outlets are not available. Portable military equipment as well as lightweight airborn communication and navigation equipment are also included in the realm of transistor applications.

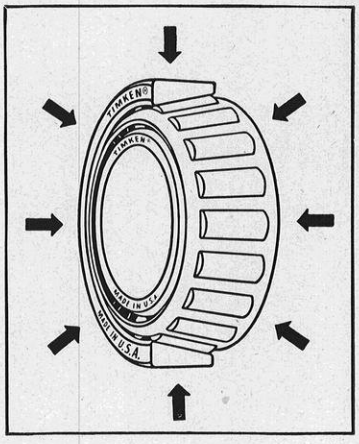
These are but a few of the many transistor applications. The small size and equally small power requirements of the transistor present a fascinating challenge to the creative imagination of the application engineer.

THE END

Tear out this page for **YOUR BEARING NOTEBOOK...**

How to lick a mixing problem

IN designing the bearing mounting for the drum axle of this heavy-duty mixer, the engineers had to consider the punishing radial and thrust loads as the drum rotates at an angle. And heavy shock loads from the impact of driving on rough roads had to be considered, too. To handle these loads simultaneously, keep the drum shaft aligned, the engineers specified Timken® tapered roller bearings. Result —free rolling, longer life, less maintenance.



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

The taper enables Timken bearings to take radial and thrust loads in any combination. And full line contact between their rollers and races gives Timken bearings extra capacity for the toughest loads.

Want to learn more about bearings or job opportunities?

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NOT JUST A BALL ○ NOT JUST A ROLLER ▭ THE TIMKEN TAPERED ROLLER ▭ BEARING TAKES RADIAL ↓○↓ AND THRUST →○← LOADS OR ANY COMBINATION →✳←

MINIATURE or massive

Maico engineers and fabricates Recording Heads for home, industry and the military.

. . . Bringing musical pleasure to millions of homes.

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There's a real opportunity for you right near your home with Maico!

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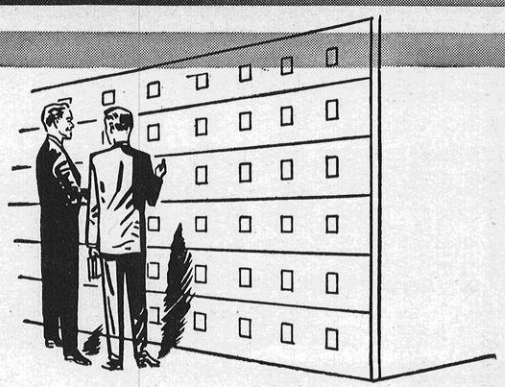


STA  TIC

During mock maneuvers an army commander ordered a notice to be displayed on a bridge stating: "This bridge has been destroyed by air attack." But to his chagrin, he noticed through his field glasses that a foot regiment was crossing the bridge despite his orders. He sent his adjutant to the officer in charge post-haste to find out how he dared to defy his orders. An hour later the adjutant was back. "It's all right, sir," he reported. "The troops are wearing signs saying 'We are swimming'."

* * *

The elephant looked down at a mouse and exclaimed, "You're just about the puniest, most insignificant object I ever laid eyes on."

"I'm not always this little," the mouse squeaked angrily. "I've been sick."

* * *

I eat my peas with honey—I've done it all my life. It does make the peas taste funny—but it keeps them on my knife.

* * *

A musician was practicing on his saxophone late at night when the landlord came in: "Do you know there's a little old lady sick upstairs?" asked the landlord.

"No," replied the musician, "hum a little of it."

* * *

Clerk: "Yes sir, that medicine is sure powerful. Best stuff we have for the liver: Makes you peppy."

Customer: "Can you give me any references of people who have taken it with good results?"

Clerk: "Well, there was a man living next door who took this liver medicine three years."

Customer: "Well, did it help him?"

Clerk: "He died last week."

Customer: "Oh?"

Clerk: "But they had to beat his liver with a stick for three days before they could bury him."

* * *

Salesman: Is your mother home, Sonny?

Three year old: No, but my sister is.

Salesman, happily: "Would you please send her to the door." The salesman waited impatiently, then after a long delay, the voice of the small child was heard, "I can't lift her out of the play pen."

* * *

Three men were sitting on a park bench. The man in the middle was sitting quietly as though asleep. But the two men on either side were going through the motions of fishing. With deadly seriousness they would cast, jerk the lines gently, then swiftly wind their imaginary reels. This had gone on for some time when a policeman sauntered over, shook the man in the middle and demanded, "Are these two nuts friends of yours?"

"Yes, officer," replied the man.

"Well, get them out of here then."

"Right away, officer," said the man as he began to row vigorously.

A man named Joe Hogsbristle appeared in court to have his name legally changed. The judge nodded, "What name do you want to take?"

"Frank Hogsbristle. I'm sick and tired of hearing people say, "Hi Joe, whattya know'."

* * *

The efficiency expert died after many years of faithful service and his company had arranged an elaborate funeral. The pallbearers were carrying the casket out of the church, when suddenly the coffin lid popped open and the expert sat up and said, "If you put this thing on rollers, you can lay off four men."

* * *

They told him it couldn't be done
With a smile he went right to it.
He tackled the thing that couldn't be done.
And found that he couldn't do it.

* * *

Young man transferring from Engineering to B.A. would like to trade one good study lamp for comfortable bed.

* * *

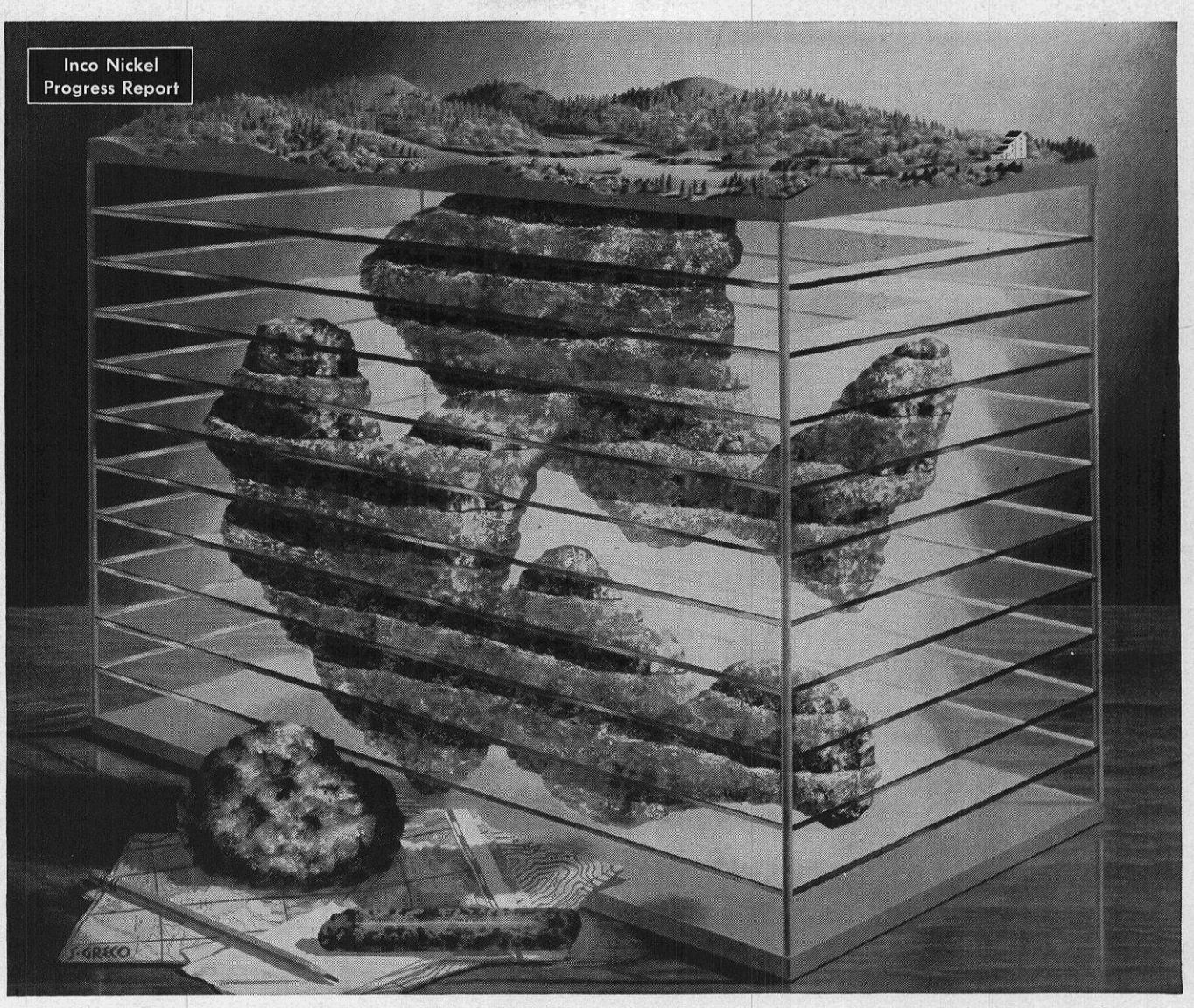
Newton's sixty-ninth law: The dimmer the porch light the greater the scandal power.

* * *

The guy was walking down the street dressed only in a barrel when a cop stopped him.

"Are you a poker player?" asked the law.

"Not me," replied the character, "but I just left a couple of guys who are."



Inco mine engineers construct a 3-dimensional "picture" that shows where new, untapped ore bodies lie.

This 3-D model of an ore body shows where future supplies of Inco Nickel will be mined

How do Inco engineers keep a mine "alive"? For one thing, they try to learn as much as possible about the location of ore for the future.

New levels—new exploring

As soon as they open up *new* levels, the engineers start up exploratory drilling, to probe and "feel" in many directions.

Their hollow-shafted drills bring out specimen cores that show where there is worthwhile ore and where only worthless rock.

Hundreds and hundreds of ore samples

These ore samples enable International Nickel engineers to build small models of their mines' ore bodies. So they know where each ore body lies, how large it is, and of what grade.

They know, as well, how to get that ore out of the ground in the safest, most sensible, most economical way possible—know what shafts may have to be sunk, what tunnels and drifts to drive. Know, in a word, how to reach and mine every possible ton of usable ore. And, having mined it, how to extract every possible pound of useful metal.

Reserves—at new highs

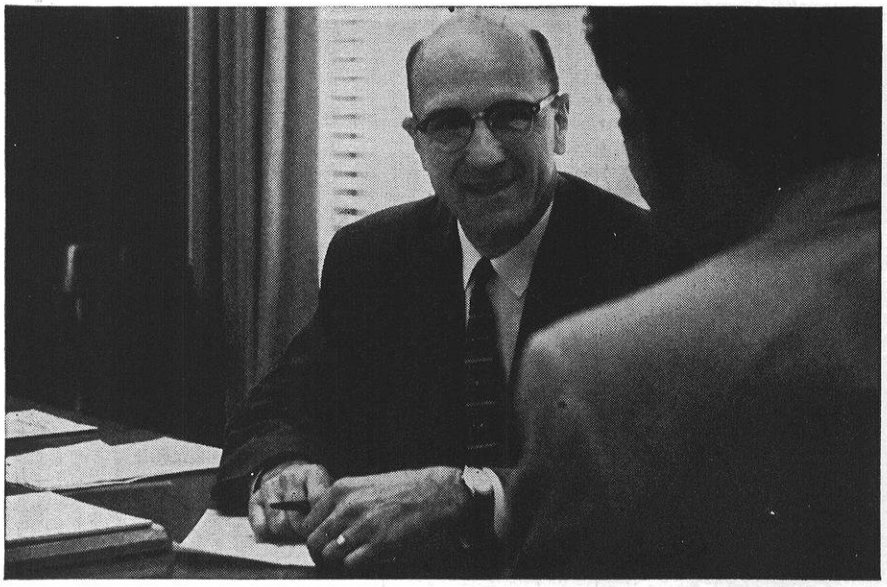
Today Inco has larger reserves than ever before – although some of this ore lies a mile or deeper underground. And the Company also reports another fact: its multi-million dollar "mine-more" program makes possible today's high output of Inco Nickel. And looking to the future—in 1961, Inco Canada's Nickel output should be 385 million pounds a year. A hundred million more than in 1956!

"Mining for Nickel," color film, is loaned to technical societies, universities, industry. The International Nickel Company, Inc., Dept. 143f, New York 5, N. Y.

INCO TRADE MARK **International Nickel**

The International Nickel Company, Inc., is the U. S. affiliate of The International Nickel Company of Canada, Limited (Inco-Canada)—producer of Inco Nickel, Copper, Cobalt, Iron Ore, Tellurium, Selenium and Platinum, Palladium and Other Precious Metals

CAREERS WITH BECHTEL



KARL BAUSCH, *Chief Electrical Engineer, Power Division of the Bechtel Corporation.*

ELECTRICAL ENGINEERING

One of a series of interviews in which Bechtel Corporation executives discuss career opportunities for college men.

QUESTION: *Mr. Bausch, in considering a position with Bechtel, or any other firm, isn't it true that what most college men want to know first of all is "What will I be doing?"*

BAUSCH: That's true, and it isn't an easy question to answer. So much depends on individual preferences and abilities and the way a man develops. On joining us, he would be asked if he'd like to work on the drafting board doing layout work. As an alternate, he might prefer a starting assignment involving helping out on calculations, requisitioning materials, writing specifications, etc.

QUESTION: *In other words you try to give the new man some freedom of choice?*

BAUSCH: As far as possible. We know that the beginning period is a difficult one. It takes some time for him to get his feet on the ground and we try to "expose" him to many different activities. In that way he gets needed experience and familiarity that help him decide the work for which he feels best qualified. It also gives us the opportunity to evaluate his potential.

QUESTION: *Assuming a man shows the necessary ability and begins to produce, how does he branch out?*

BAUSCH: Generally, in either of two ways. He may work on the electrical portion of power plants, designing circuits, control and relaying systems, unit protection, etc. The other way is on the physical layout of power plants —that is, location of equipment, conduit and raceway systems, etc. In either case he would be put in charge of one section of the project.

QUESTION: *And his next advance would be...?*

BAUSCH: Assuming he progresses satisfactorily, he would ultimately move into a lead job as a group supervisor in charge of the design of the electrical system of the complete plant.

QUESTION: *Could you give an estimate of the time involved in the various steps?*

BAUSCH: That's impossible. We have no hard and fast schedule. In general, we have found that it takes a man about a year to get his feet on the ground and become a real producer. From that point on, it's up to him.

QUESTION: *In other words, he can advance in keeping with his individual ability?*

BAUSCH: That's right. Of course, there are many other factors involved, including the vitally important one of the great advancements being made in every phase of the electrical industry. These create new jobs and new types of jobs involving new skills. And for every opportunity existing today, it is safe to predict there will be at least two tomorrow.

Bechtel Corporation (and its Bechtel foreign subsidiaries) designs, engineers and constructs petroleum refineries, petrochemical and chemical plants; thermal, hydro and nuclear electric generating plants; pipelines for oil and natural gas transmission. Its large and diversified engineering organization offers opportunities for careers in many branches and specialties of engineering —Mechanical...Electrical...Structural ...Chemical...Hydraulic.

Write for new brochures showing the wide variety of projects Bechtel builds throughout the world.

Address: John F. O'Connell, Vice President, Industrial Relations 220 Bush Street, San Francisco 4, Calif.

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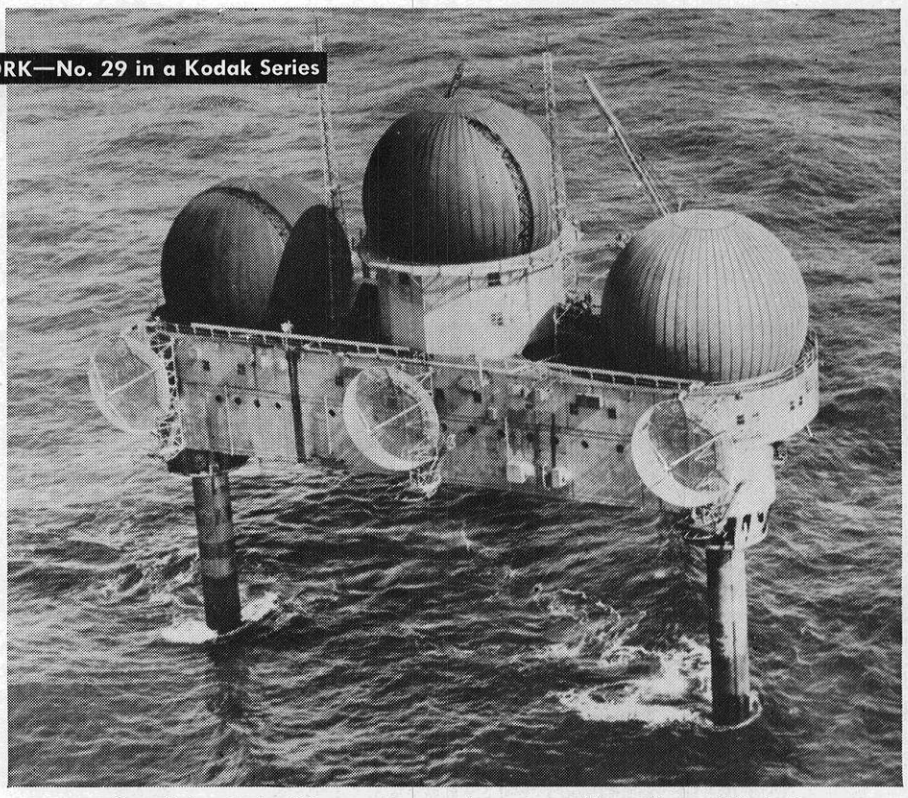
PHOTOGRAPHY AT WORK—No. 29 in a Kodak Series

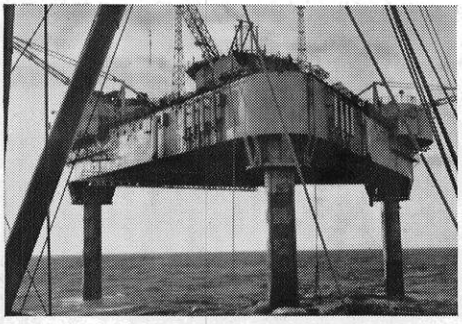
Sturdy sea legs for Radar eyes



One of America's offshore radar warning towers—Texas Tower III—built by Walsh Holyoke Division, Continental Copper and Steel Industries, Inc.

—*with every seam proved sound on X-ray film*

In record time, Continental Copper and Steel Industries, Inc. built and launched "Texas Tower III" and every weld was checked by radiography.



Here is a steel island 110 miles at sea—2700 tons of 2-deck platform setting on staunch and stalwart caisson legs 272 feet long. It is destined to stand against the hammering of giant seas and howling hurricane gales.

No place here for the tiniest flaw in a single weld! So the magic of radiography was called on to make sure. Two and a half miles of x-ray film hold positive proof that every seam has showed itself flaw-free and secure.

Everyday radiography is working like this for welders, large and small—for foundries interested in making sound castings—for any manufacturer who must know internal conditions of a product without destroying it. It is one example of the many ways photographic processes work for business and industry—how it helps make better products and improve manufacturing procedures.

CAREERS WITH KODAK

With photography and photographic processes becoming increasingly important in the business and industry of tomorrow, there are new and challenging opportunities at Kodak in research, engineering, electronics, design and production. If you are looking for such an interesting opportunity, write for information about careers with Kodak. Address: Business and Technical Personnel Department, Eastman Kodak Company, Rochester 4, N. Y.

EASTMAN KODAK COMPANY
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Kodak
TRADE MARK

One of a series

Interview with General Electric's Frank T. Lewis Mgr., Manufacturing Personnel Development

The Next Four Years: Your Most Important

The United States is now doubling its use of electrical energy every eight years. In order to maintain its position as the leading manufacturer in this fast-growing electrical industry, General Electric is vitally interested in the development of young engineers. Here, Mr. Lewis answers some questions concerning your personal development.

Q. Mr. Lewis, do you think, on entering industry, it's best to specialize immediately, or get broad experience first?

A. Let me give you somewhat of a double-barreled answer. We at General Electric think it's best to get broad experience in a specialized field. By that, I mean our training programs allow you to select the special kind of work which meets your interests—manufacturing, engineering, or technical marketing—and then rotate assignments to give you broad experience within that area.

Q. Are training assignments of a predetermined length and type or does the individual have some influence in determining them?

A. Training programs, by virtue of being programs, have outlined assignments but still provide real opportunities for self-development. We try our best to tailor assignments to the individual's desires and demonstrated abilities.

Q. Do you mean, then, that I could just stay on a job if I like it?

A. That's right. Our programs are both to train you and help you find your place. If you find it somewhere along the way, to your satisfaction and ours, fine.

Q. What types of study courses are included in the training programs and when are the courses taken?

A. Each of our programs has graduate-level courses conducted by experienced G-E engineers. These courses supplement your college training and tie it in with required industrial techniques. Some are taken on Company time, some on your own.

Q. What kind of help do you offer employees in getting graduate schooling?

A. G.E.'s two principal programs of graduate study aid are the Honors Program and the Tuition Refund Program. If accepted on the Honors Program you can obtain a master's degree, tuition free, in 18 months while earning up to 75% of full-time salary. The Tuition Refund Program offers you up to 100% refund of tuition and related fees when you complete graduate courses approved by your department manager. These courses are taken outside normal working hours and must be related to your field of work.

Q. What are the benefits of joining a company first, then going into military service if necessary.

A. We work it this way. If you are hired and are only with the Company a week before reporting to military service, you are considered to be performing continuous service while you are away and you will have your job when you return. In determining your starting salary again, due consideration is given experience you've gained and changes in salary structure made in your absence. In addition, you accrue pension and paid-vacation rights.

Q. Do you advise getting a professional engineer's license? What's it worth to me?

A. There are only a few cases where a license is required at G.E., but we certainly encourage all engineers to strive for one. At present, nearly a quarter of our engineers are licensed and the percentage is constantly increasing. What's it worth? A license gives you professional status and the recognition and prestige that go with it. You may find, in years to come, that a license will be required in more and more instances. Now, while your studies are fresh in your mind, is the best time to undertake the requirements.

Your next four years are most important. During that period you'll undoubtedly make your important career decisions, select and complete training programs to supplement your academic training, and pursue graduate schooling, if you choose. These are the years for personal development — for shaping yourself to the needs of the future. If you have questions still unanswered, write to me at Section 959-6, General Electric Co., Schenectady 5, N. Y.

LOOK FOR other interviews discussing: • Salary • Advancement in Large Companies • Qualities We Look for in Young Engineers.

GENERAL ELECTRIC