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The Wisconsin

engineer

November, 1953

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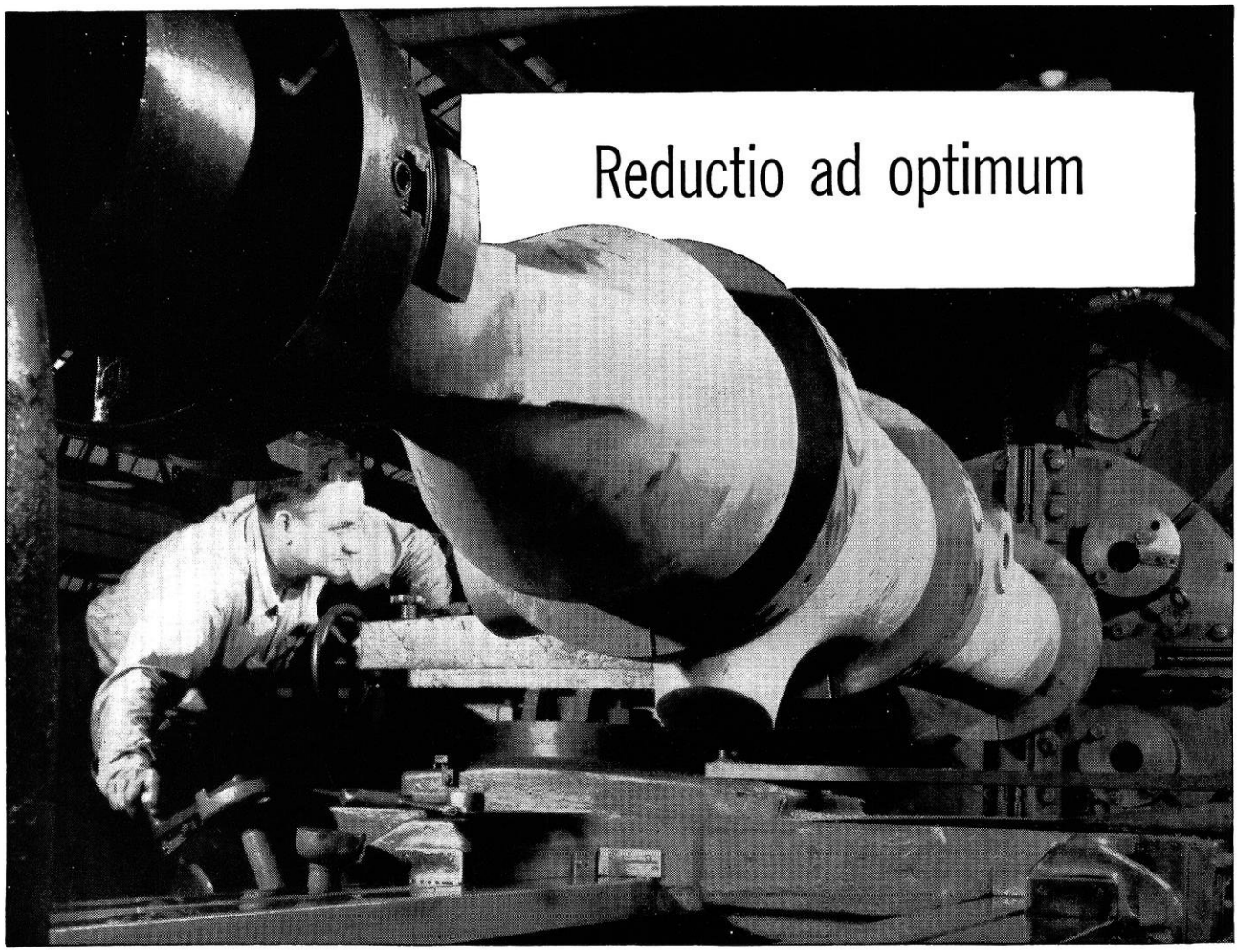

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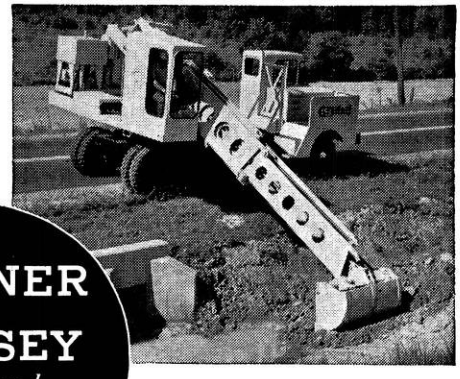

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The prof who put off a trip to Europe

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So, having heard reports on the success of the 1952 conference, he put off his trip and joined in the two-week session of meetings and field trips.

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Why? Because, like his fellow educators, he found GM executives meant what they said when they told their guests:

"One of the principal objectives of this Conference is to make us better acquainted with each other's problems. We hope that you will develop personal contacts during the Conference that will assist you in the future. By developing better mutual understanding and cooperation between education and industry, together, we can do a better job of solving the engineering problems of the future and maintaining our Nation's technical leadership."

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And to you soon-to-graduate engineers, we say, better think seriously about a GM future. It's yours, if you have what it takes.

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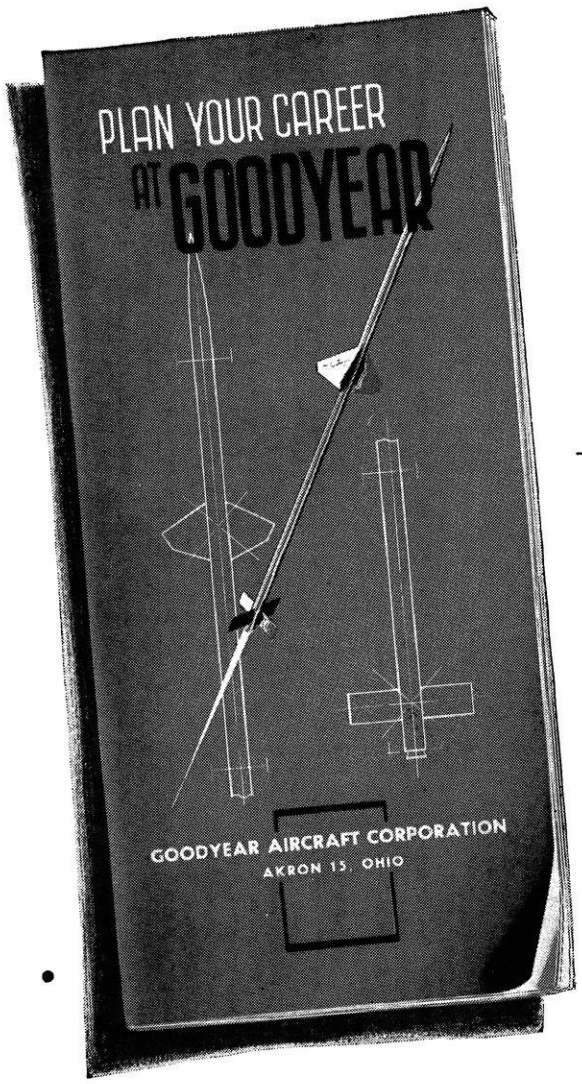

Well worth the reading

(and it's yours for the asking)

The simple step of sending a postal card for the booklet pictured here may well have a tremendous influence upon your future.

Quite frankly, it is written to attract promising young engineers to the opportunities awaiting them at Goodyear Aircraft Corporation.

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It's well worth your reading. We invite you to send for it — and, if you desire, to accompany your request with a brief resumé of your qualifications or experience.

ADDRESS: Dr. K. Arnstein, Vice President of Engineering, Goodyear Aircraft Corporation, Akron 15, Ohio

GOODYEAR
AIRCRAFT

The Student Engineer's Magazine

WISCONSIN ENGINEER

Founded 1896

In This Issue . . .

Cover

AMERICAN ENGINEERED SUPERLINER

The United States Government has recently approved a new transport aircraft driven by a new kind of power for operation by the airlines of the world.

In official ceremonies at Lockheed Aircraft Corporation, the new Super Constellation—world's first turbo-compound-powered passenger airliner—received a Civil Aeronautics Administration certificate qualifying it for immediate public service.

Fastest U. S. transport in service, the Super Constellation earned its CAA ticket during a 48-day test period, probably the fastest certification procedure on record for a four-engine aircraft, Lockheed officials said. This certification beat even the record of the earlier non-compound Super Constellation.

With turbo-compound engines, this super-long-range international airliner can trim more than two hours off trans-Atlantic flying time and shorten schedules wherever it flies.

It is designed with a maximum cruise speed of 335 m.p.h. and a top speed of more than 370 m.p.h.

Super Constellations have been ordered by four times as many airlines as its nearest competitor. Compared with British jets, it has been bought by more than twice as many companies.

The new transport's four 3250-h.p. engines, produced by Curtiss-Wright Corporation, turn up a total of 13,000 h.p., compared with 10,000 h.p. on companion Constellations. The gain comes from three turbines attached to the conventional-type piston engine to harness power usually wasted in exhaust.

Articles

Departments

The Student Engineer's Magazine

WISCONSIN ENGINEER

Founded 1896

Volume 58 NOVEMBER, 1953 *Number 2*

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Richard J. Conway, Lehigh '51, selects Manufacturing Engineering at Worthington

RICHARD CONWAY checks cutting tool with machinist before milling a pump casing.

After completing his general training which brought him in contact with all departments, Richard J. Conway decided that manufacturing engineering was his field. He says, "I chose the Manufacturing Engineering Department after completing my general training at Worthington because as a graduate in Industrial Engineering I can learn the practical aspects of my field while applying theory I learned in college.

"The personnel of this department work together as a team toward the solution of the numerous problems which arise daily. We have the cooperation of all other departments in the corporation in getting the necessary facts pertinent to the solution of these problems. In the course of our day it may be necessary for us to meet the Plant Manager, Chief Engineer, Comptroller, several department heads, clerks, foremen, machinists and many others throughout the company.

"I have contributed to the solution of many problems handled by this department including metal spraying, machining procedures, purchasing new equipment and designating proper dimensions to obtain desired fits between mating parts.

"I enjoy my work because I'm doing the work I want and my formal education is being supplemented with practical knowledge gained from the tremendous wealth of knowledge available to me at Worthington. I know from personal contact with many other departments in the Corporation that Worthington can and will find their young engineers a spot which will give them the same opportunities as have been afforded me."

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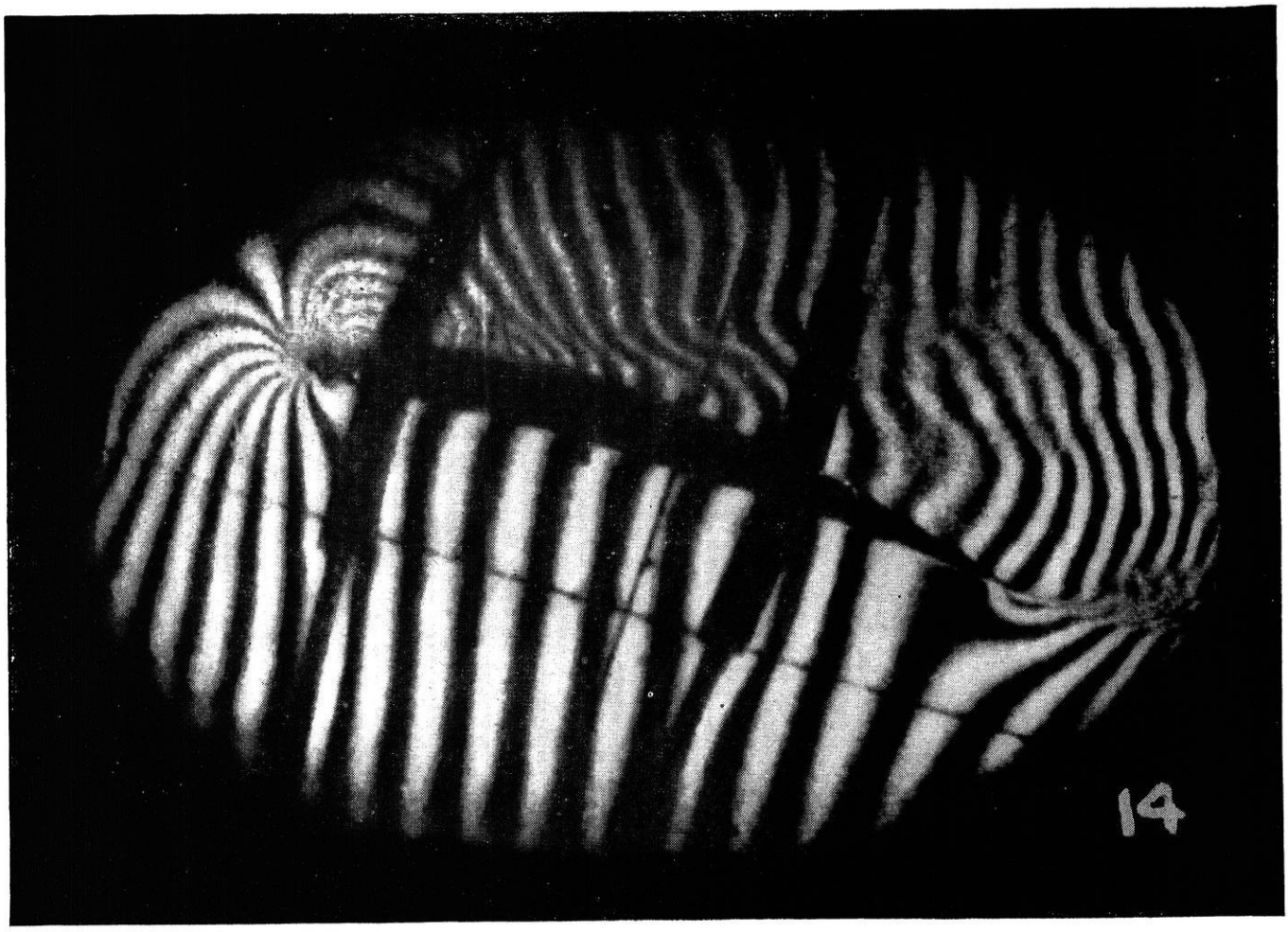

fingerprint of a flutter . . .

A jet engine compressor blade oscillating in a high-velocity air-stream made this fingerprint-like picture. Such interferograms, taken at the rate of 5000 per second, help our engineers to visualize why blades flutter. By analysis, instantaneous vibratory forces can be measured.

Accurate knowledge of blade forces and stresses permits our engineers to design the lightest blades consistent with reliability.

Studies of flow dynamics are important. Yet this is only one small phase of the research that goes into the successful development of high-performance, dependable aircraft engines for supersonic flight.

At Pratt & Whitney Aircraft the use of advanced techniques is encouraged — the most advanced facilities made available because we know that good engineering requires good tools. This partially explains why so many outstanding engineering graduates have been attracted to a career at Pratt & Whitney Aircraft.

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Division of United Aircraft Corporation

East Hartford 8, Connecticut

HONOR ROLL

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Rex, Richard G.	2.666
Palmer, Philip M.	2.675

Civil Engineering

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Electrical Engineering

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Groth, Richard W.	2.941
Sabroff, Albert E.	2.868
Berndt, Martin M.	2.815
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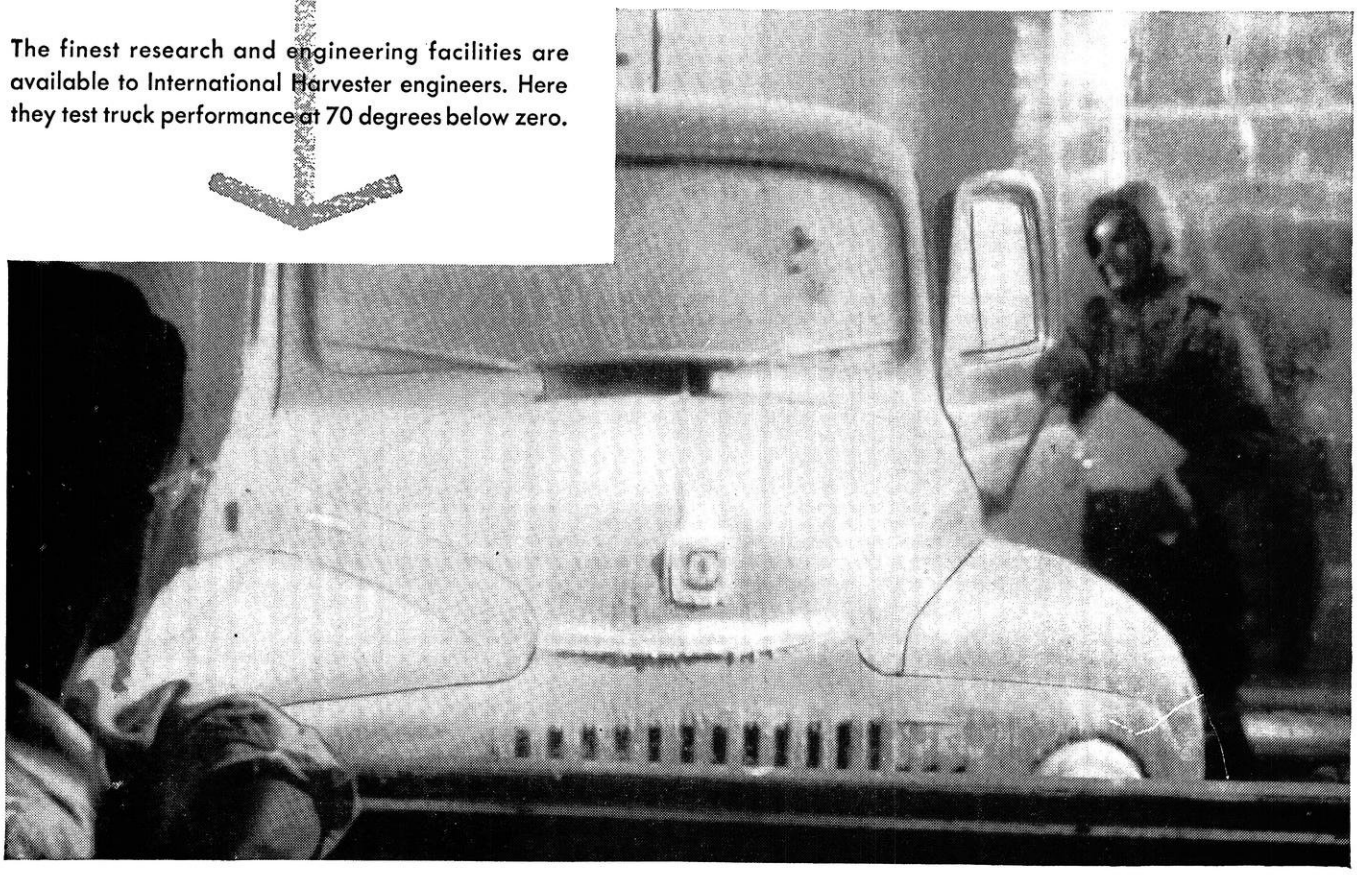
The finest research and engineering facilities are available to International Harvester engineers. Here they test truck performance at 70 degrees below zero.



■ The American transportation system is the most highly developed in the world. And International trucks are part of this picture.

At Fort Wayne, Indiana, International Harvester maintains the biggest truck research, development and testing laboratory in the world. The opportunity such an operation provides for young engineers is obvious.

Throughout the entire International Harvester operation, engineers are needed. Electrical, mechanical, industrial, metallurgical, agricultural, design, research, and testing engineers find that Harvester offers unusual opportunity.

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DEAN?

(See editorial on next page)

editorial

Keep the Figures Straight

Last month, as you will remember, we dedicated that issue to the Dean, and featured his picture on the cover. We contacted the University News Service regarding a picture of the Dean. They complied by telling us to order picture #3213-M from the photographic laboratory. We proceeded to order said picture; but much to our surprise, the picture on the opposite page was the one which arrived. The staff of the ENGINEER was quite elated with the changes which apparently had been taking place in Engine School. Several of the more serious minded staff members, however, concluded that perhaps there had been some mistake.

A quick check into the situation revealed that there was. Somewhere along the line, the #3213-M became confused with #2313-M and we received a picture of Mary Cyliuryk receiving a Knapp scholarship.

Although #2313-M resembles #3213-M, they are not the same figure—as a glance at tne opposite page will reveal.

In engineering, it is especially true that there is no room for inaccuracies and mistakes. A decimal point may cause a boiler to explode, the wrong sign may cause the bridge to fail, and an interchange of digits can even change our dean.

The next time your instructor "takes off too many points" for a mathematical mistake, just remember the case of Mary Cyliuryk and our Dean.

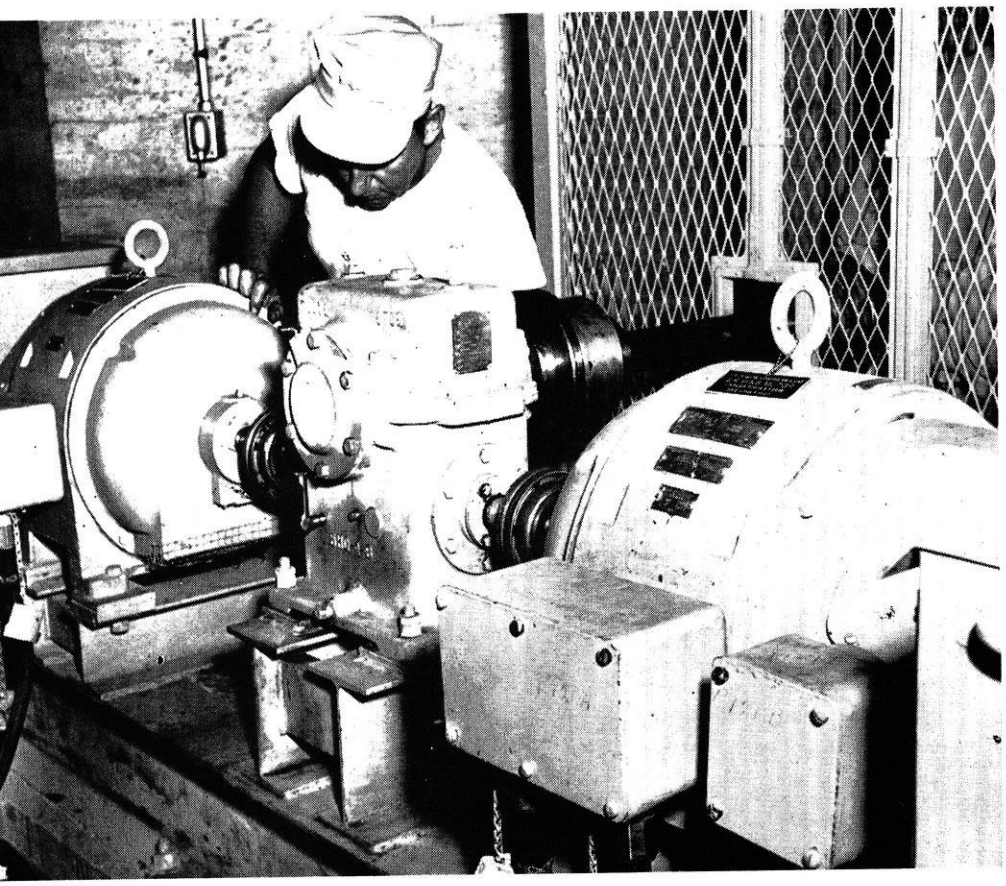
J. E. B.

Synchrotie Systems

By S. J. Campbell, ee'50

Industry Engineering Department, Westinghouse Electric Corporation

This article, also being published simultaneously in the November WESTINGHOUSE ENGINEER. Story courtesy that magazine.



Drive motor and Synchrotie transmitter are duplicates in this vertical lift gate application on Mississippi River Lock 27.

In the Wisconsin town where S. J. Campbell grew up, papermaking and lumbering were the two main industries. Presently, his specialty is application of electrical equipment to paper mills and lumbering operatinos. One might draw the conclusion that his present work was the result of boyhood interest or ambition—but nothing could be further from the truth. Campbell admits that, "In all those years I never even saw the inside of a paper mill."

A bit of advice offered by a high school physics teacher helped steer him toward his profession. Noting Campbell's facility with circuitry, he insisted that he should take nothing but electrical engineering. During the war he served as a radar technician in the Marine Air Corps; this experience, plus an aptitude test given by the Veterans Administration finally decided the matter.

Shortly after his discharge Campbell enrolled at Superior State College; the next year he transferred to the University of Wisconsin, from which he earned his electrical engineering degree in 1950.

Campbell came to Westinghouse via the graduate student course; during the course he spent one of his assignments with the General Mills section of Industry Engineering, and eventually became a permanent member of the group. Other than paper- and lumber-mill applications, another interest has been the Synchrotie, about which he writes in this issue.

POWER FLOW FOR VARIOUS SPEEDS AND ROTATION WITH OR AGAINST THE FIELD

1—*Synchrotie running at low speed in same direction as rotating field, Fig. 2.* This is analogous to induction motors operating at high slip below synchronous speed. Because the slip is high, the frequency in the rotor circuit is high, and the reactance of the rotor circuit is high with respect to the resistance. Thus the rotor circulating current lags behind the resultant voltage and is quite large. A large component of the circulating current is in phase with the receiver rotor voltage. Since the Synchrotie is running below synchronous speed with the field, the product of the receiver rotor voltage and current represents a motoring output analogous to the power that is dissipated in the secondary of an ordinary wound-rotor motor operating at reduced speed. This power is fed into the rotor of the transmitter. Thus when the Synchrotie is running below synchronous speed in the direction of the rotating stator field, the receiver acts like a motor because it takes power from the line, while the transmitter acts like a generator because it takes mechanical power from its shaft and electrical power from its rotor and returns power to the line. The component of the rotor current that is in phase with the receiver rotor voltage is larger than the component that is in phase with the transmitter rotor voltage. Thus, when running with the field, the maximum receiver torque for any given displacement angle is greater than the maximum transmitter torque.

2—*Synchrotie running at close to synchronous speed in same direction as rotating field, Fig. 3.* This is analogous to induction motors operating at low slip below syn-

One or more parts of a machine or system of machines that must run in unison or in a fixed relation to each other can be mechanically connected together. Or they can be conected electrically, using Synchroties. Tnus, small electrical conductors take the place of shafts, belts, or gears which, particularly when the distances are more than a few feet, become extremely cumbersome. The Synchrotie system has a long history of varied and successful application. The principles are here restated.

Basically, a Synchrotie system consists of two or more wound-rotor induction motors that have similar rotor characteristics. If the stator (primary) windings of the motors are excited from a common source, and the rotor (secondary) windings are connected together, the motors maintain a synchronized speed relation within certain limits. If the rotor of one is turned, the other automatically follows it. Speed matching of individually driven machine sections and remote position control or indication (or both) are the two main applications of Synchrotie systems.

Speed-matching Synchroties are used on coater drives for paper machines, vertical-lift bridge drives, and textile range drives in finishing and bleaching plants. Most typical of position matching applications is the use of Synchroties for remote operation of valves. But the number of different applications possible is almost limitless.

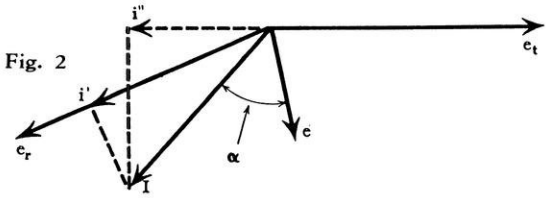
A close analogy exists between an electrical Synchrotie and a lineshaft or mechanical transmission that connects the driven sections of a machine. Both a Synchrotie and a lineshaft will transmit torque or power. Under running conditions in both cases, the receiving end of the transmission will make exactly as many revolutions as the delivery end. In the mechanical transmission, the shaft will twist under application of torque so than an angular difference between the ends of the shaft will result. In the Synchrotie also, application of torque causes an angular difference between the rotors of the transmitting and receiving motors. In the case of the shaft transmission, the amount of angular twist depends upon the torque transmitted, the shaft diameter, and the shaft length. In a Synchrotie drive, the angular difference between the rotors is a function of the size of the motors and the torque transmitted to the receiving end.

In general, where power is transmitted by any combination of shafts, gears, or other mechanical units, the same results can be accomplished by a properly designed Synchrotie. The more complicated the mechanical drive, the more pronounced will be the advantages of the electrical system. The few copper wires that replace heavy shafting and complicated mechanical parts can turn corners, traverse any angle, or travel hundreds of feet. The machines that Synchroties connect will maintain an exactly synchronized relationship at zero speed and at every running speed up to the rated maximum value; however, some angular displacement may exist between the rotors due to friction and load torque.

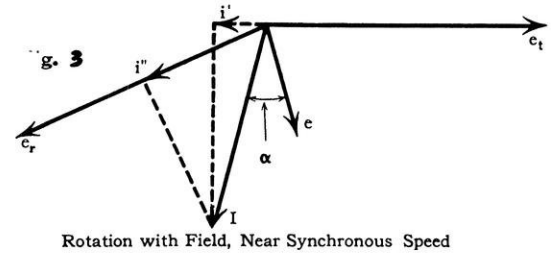
Many of the problems involved in the application of Synchrotie drives are similar to those encountered in the application of ordinary induction motors, such as starting, accelerating, and maximum torques and operating speeds, speed ranges, load torques over the speed range, and motortemperatures. There are, hoyever, additional factors peculiar to the Synchrotie system, which must be carefully considered when making an application.

e_r—Receiver Induced Rotor Voltage
e_t—Transmitter Induced Rotor Voltage
e—Resultant Voltage
I—Rotor Circulating Current
α—Angle between e and I
i'—Power Component of I (Receiver)
i''—Power Component of I (Transmitter)

Fig. 2

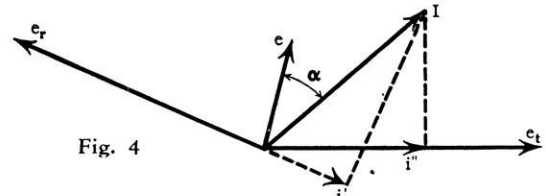


Rotation with Field, Low Speed



Rotation with Field, Near Synchronous Speed

Fig. 4



Rotation against Field, Low Speed

chronous speed. Since the slip is low, the frequency in the rotor circuit is low. Consequently, the rotor reactance is low, and the angle *a* is much smaller than for operation at high slip. The components of the rotor current that are in phase with the receiver rotor voltage are smaller. Thus, the maximum receiver and transmitter torques decrease when the Synchrotie speed approaches synchronous speed and rotation is with the field. However, as shown by the relative magnitudes of the rotor-current components, the maximum receiver torque is still greater than the maximum transmitter torque.

3—*Synchrotie running at low speed against direction of rotating field, Fig. 4.* This is analogous to operating at a slip greater than one. In this case, a component of the rotor current is in phase with the transmitter rotor voltage, which means the transmitter is taking power from the line. Since receiver current is 180 degrees from receiver rotor voltage, the receiver is returning power to the line. The product of transmitter voltage and current exceeds that of receiver voltage and current. Thus, when operating against the field. maximum transmitter torque exceeds that of the receiver.

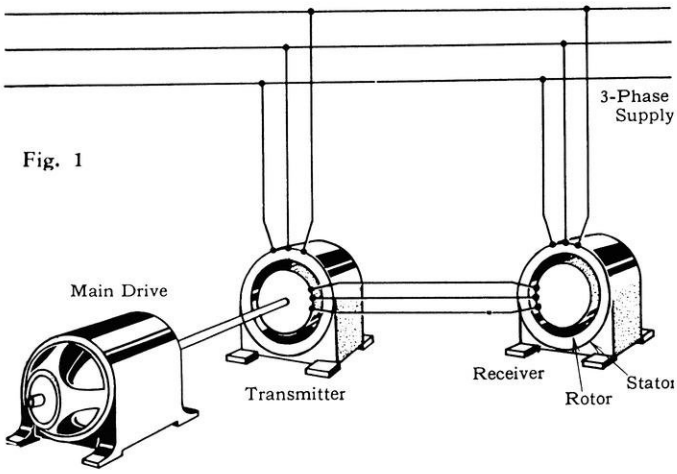


Fig. 1

Fig. 1—Two or more wound rotor motors, excited from a common source and with rotors tied together electrically, make the basic Synchrotie system.

Theory of Operation

For simplicity, consider a Synchrotie consisting of just two wound-rotor motors, Fig 1. When properly connected, and with no external torque applied, the rotors of both Synchrotie units remain stationary when line voltage is applied to their stators. When no electrical angle (phase displacement) exists between the Synchrotie rotors, the rotor-induced voltages are equal and opposed. Consequently, the rotor current is zero and no turning moment is developed by either unit. When one Synchrotie unit, called the transmitter, is rotated by an external means through a small angle, the rotor-induced voltages are no longer equal and opposite. A resultant rotor current flows to develop a torque or turning moment in an effort to balance the rotor voltages and bring the rotor current back to zero. If the transmitter is rotated continuously by an external means, the receiver rotor follows at the same speed. If load is applied gradually to the reciever, the phase displacement or angle between the two rotors increases with increase in load until the maximum synchronziing torque is reached. Any further increase of receiver load pulls the rotors out of step. When this happens the Synchrotie units begin to operate independently as ordinary induction motors, each having its rotor short-circuited through the other.

With both transmitter and receiver units energized from the same polyphase source, and if the transmitter is driven by external means in the direction it would normally run as an induction motor, the Synchrotie system is said to operate with the field. If the transmitter is driven in the opposite direction, the Synchrotie is said to operate against the field. For each of those conditions the receivers rotate in the same relation to the electrical rotation of their stator fields as the transmitters, the relationship being referred to their normal direction of rotation as induction motors.

When the Synchrotie is operated in the same direction as the rotating magnetic field, the rotor of the receiver unit is retarded with respect to its electrically neutral or in-phase position. When the Synchrotie is operated in a direction against the rotating magnetic field, the receiver rotor is displaced ahead of its in-phase position.

When operating in synchronism, one of the Synchrotie units acts like a motor taking power from the line, while the other acts like an induction generator returning the power to the line. Depending on whether the rotation is with or against the field, either unit can act as a motor or as a generator.

If the Synchrotie is running in the same direction as the rotating field, the receiver acts like a motor because it takes power from the line, Fig. 2. Meanwhile, the transmitter acts like a generator because it takes mechanical power from its shaft and electrical power from its rotor and returns power to the line. Under these conditions, the maximum receiver torque for any given displacement angle is greater than the maximum transmitter torque, Fig. 5. This is essentially the same when the Synchrotie is running close to synchronous speed in the same direction as the rotating field, Fig. 3. In contrast, when the Synchrotie is running in a direction opposite to the rotating field, Fig. 4, the maximum transmitter torque is greater than the maximum receiver torque.

The concepts of motor and generator torques can be visualized by remembering that motor torque refers to power flow from stator to rotor while generator torque refers to power flow from rotor to stator.

The term maximum torques refers to the maximum momentary torques that can be utilized to hold the Synchrotie in step at the indicated speed. The lower curve in Fig. 5 shows the maximum continuous torque obtainable at the receiver output shaft with safe receiver temperature rise. For example, when operating with the field at 50-percent speed, the Synchrotie will stay in step if 300-percent rated torque is required by the receiver load. However, for this particular design, the maximum continuous receiver torque at 50-percent speed is approximately 85 percent of rated torque.

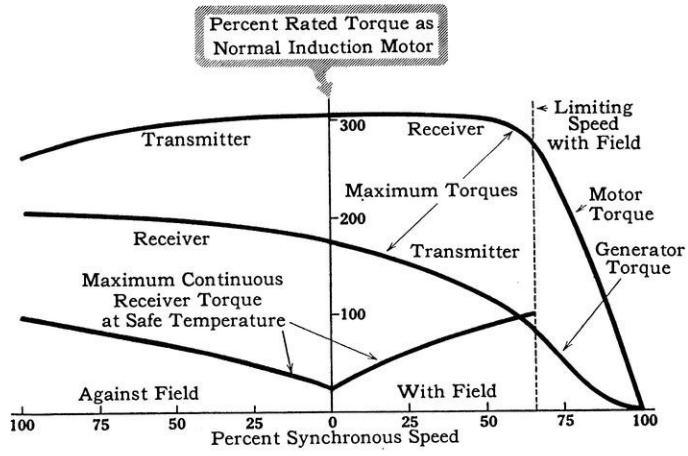


Fig. 5—Torque-speed characteristics of all two-unit Synchroties are similar, except that percent values of maximum torques over the speed range vary according to the rating. Concepts of motor and generator torques refer to power flow from stator to rotor in first case, from rotor to stator in second case.

Another important consideration in applying Synchroties is the limiting speed when operating with the field. Beyond approximately two-thirds of synchronous speed the maximum receiver and transmitter torques drop off rapidly to zero. For that reason, Synchroties should not be operated at more than 66 percent of synchronous speed in the direction of the field. Operation up to and beyond synchronous speed should be against the field.

Types of Primary Circuits

In addition to Synchroties that have their stators connected to a three-phase supply, there are a number of single-phase stator connections that can be used, each having its own advantages and disadvantages. The circuit connections that give curve A in Fig. 7 might be used where high peak torques are encountered and where the receiver displacement angle is not critical for normal continuous running torques Circuit connections that give curve B might be used where reversing service is required. In this case, the torque-displacement characteristic is the same for operation with or against the field, so it can be used in an indicating system.

Starting Methods

Synchrotie units must be synchronized or connected to the line while both units are at standstill. And even with the Synchrotie units at standstill, the application of three-phase power sometimes causes loss of synchronism and results in acceleration of one or both units to full speed as ordinary induction motors. The torque tending to turn the receiver in the direction of normal rotation as an induction motor is much greater than the torque tending to make it operate in the reverse direction (curve C, Fig. 7). The area under curve C is proportional to the energy given to the load. If the ratio of inertia to friction load is high, and if the angular displacement is large in the positive direction when power is applied, the receiver may accelerate toward synchronous speed and fail to pull into step.

Selection of Operating Speeds and Direction of Rotation

When the mechanical rotation is in the direction of the field rotation, the torque that can be exerted by the receiver is greatest. However, this receiver torque is available only under steady load and speed conditions. A sudden drop in speed of the prime mover and transmitter may cause the receiver to become the transmitter momentarily until the stored energy of the load has been equalized, but the equalizing torque that can be transmitted back to the prime mover is quite limited.

When mechanical rotation of transmitter and receiver is opposite to the field rotation, the receiver torque is reduced but does not fall off with increased speed. Also, there is no loss of synchronizing power when the torque is suddenly reversed without reversal of rotation. For this reason, where the three-phase Synchrotie is operated in one direction and where either the prime mover or receiver loads are fluctuating, the direction of Synchrotie rotation should be against the field.

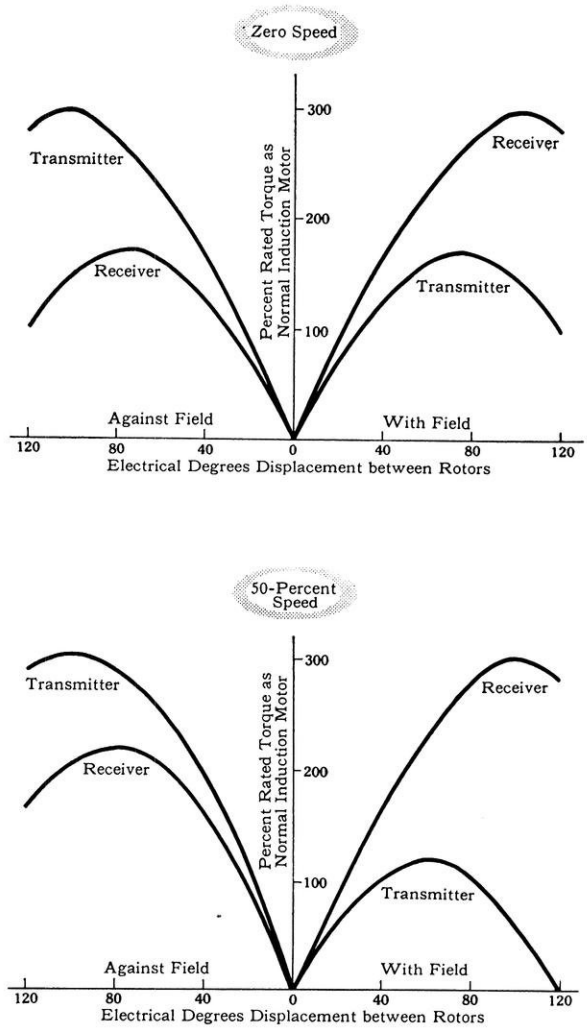


Fig. 6(a) and (b)—The percentages of torque for a typical two-unit Synchrotie do not apply to all Synchroties. However, the general shape of torque-displacement curves is the same regardless of rating.

When the system operates in either direction (with or against field) and is subject to overhauling loads, which cause a transfer of position of the receiver and transmitter, the Synchrotie units must be utilized within the torque capacity specified for the worst conditions. Thus, where reversing operation is required, the inertia of the receiver and load and the rate af acceleration and decelration must be studied carefully to determine the torque requirements. In some cases the primary leads can be reversed when mechanical rotation is reversed. This reverses the direction of field rotation, makes tne maximum synchronizing torque available in either direction, and permits the use of smaller frame sizes for the Synchroties. An example of this type of application is in synchronized hoisting when the hoisting power is applied at more than one point.

When a Synchrotie that is operating against the field pulls out of step, the receiver comes to a stop and, if load conditions permit, goes to full speed in the opposite direction as an ordinary induction motor. In some cases a control scheme can be used to shut down the drive when the Synchrotie pulls out of step and the receiver attempts to run in the opposite direction.

Effects of Number of Poles

When Synchroties are phased out, both receiver and transmitter induced rotor poles are in the same relative position with respect to their stator poles. However, in terms of relative physical position, the receiver rotor can be phased out in as many mechnical positions as there are pairs of poles on the receiver stator. Thus, a four-pole receiver can be phased out in either of two mechanical positions. Similarly, a six-pole receiver can be phased out in any of three mechanical positions. This characteristic must be considered if the receiver rotor must remain in the same mechanical position with respect to the transmitter rotor, for example, in an indicating system. This requirement can be met by keeping the Synchrotie stators excited when the drive is at standstill.

However, if there is an appreciable displacement angle at standstill, the Synchroties may overheat when the stators are kept on the line for long periods of time, unless forced ventilation is used. When overheating is a possibility, Thermo-guards or timing devices should be used to disconnect the units from the line.

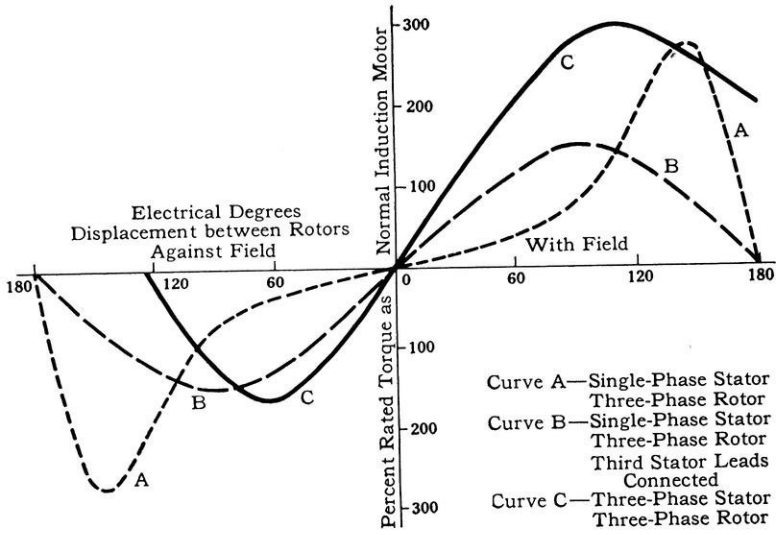


Fig. 7—Single-phase connections of stators offer advantages over three-phase for certain fixed applications, such as indicating systems.

The transmitter and receiver need not have the same number of poles for proper operation. For example, a four-pole receiver can be operated from a six-pole transmitter, or a six-pole receiver from a four-pole transmitter. In these cases, the operating speed of the receiver is the same percent of its synchronous speed as the percent synphronous speed of the transmitter. Thus a four-pole receiver operates at 1200 rpm when connected to a six-pole transmitter that is operated at 800 rpm. This type of Synchrotie usually requires special design because of the necessity of matching electrical characteristics on two different frame sizes. In most cases, it is more economical to use units with the same number of poles and apply suitable gearing to either the transmitter or receiver to obtain the desired speed on the receiver load. An added advantage is the fact that duplicate electrical and mechanical designs can be used for the Synchrotie units.

Stability of the Synchrotie

When the prime mover is subject to sudden changes in speed, or when the receiver load is fluctuating, the Synchrotie may hunt and occasionally lose synchronism. A convenient means of reducing this hunting is to add resistance in series with the Synchrotie rotors, but this reduces the amount of synchronizing torque available between the two units. Another means involves use of V-belts between the receiver and its load to provide a damping effect between the load fluctuations and the receiver shaft.

In cases where the receiver runs at times with light loads and little inertia, a flywheel on the receiver will keep the system in synchronism.

Adjustable Speed Between Receiver and Transmitter

In a simple Synchrotie, the only way to change receiver speed is to change transmitter speed. However, use of a frequency changer (sometimes called a phase advancer or electrical differential) will give adjustable speed of the receiver itself, in effect, a gear change that is infinitely adjustable. In this case the frequency changer is inserted in the rotor circuits of the Synchrotie, Fig 8. To illustrate, assume for simplicity, that the three units— transmitter, receiver, and frequency changer—are of four-pole design. If the transmitter is driven at 1200 rpm with 60-cycle voltage on the stator, the frequency of the transmitter-rotor induced voltage is 20 cycles. If the frequency changer is at standstill, this 20-cycle voltage is induced in the frequency-changer rotor and appears on the rotor of the Synchrotie receiver. Thus, the receiver has a 60-cycle stator frequency and a 20-cycle rotor frequency, which cause it to operate at 33-percent slip or 1200 rpm. So when the frequency changer is at standstill, the receiver operates at the same speed as the transmitter.

In contrast, if the rotor of the frequency changer is driven at a speed of 50 rpm, and the 20-cycle voltage from the transmitter rotor is impressed on the frequency-changer stator, the frenquency-changer slip is 92 percent because its synchronous speed at 20 cycles is 600 rpm. The frequency of the induced voltage in the frequency-changer rotor is 20 times 0.92 or approximately 18.3 cycles. The Synchrotie receiver now has a 60-cycle stator frequency and an 18.3-cycle rotor frequency. This corresponds to a slip of 30.5 percent for the receiver. The receiver now operates at a speed of 1800 times 0.695 or 1250 rpm. When the Synchrotie units and the frequency changer all have the same number of poles, the speed of the receiver is the sum of the speeds of the rotors of the transmitter and frequency changer. This is true when the rotors of the receiver and frequency changer are rotating in the same direction as their stator fields. If either rotor were to rotate against its stator field, the Synchrotie receiver speed would be the difference between the transmitter speed and the frequency-changer speed.

A typical application of a frequency changer is found on a paper-coating machine. Here the Synchrotie is used to match the speed of the coater section to the drying roll. Use of the frequency changer makes possible draw-speed

difference adjustment as well as a speed adjustment to match roll-diamter variations due to repeated grinding.

Several methods of obtaining speed adjustment with a frequency changer are possible. Typical is the use of a small d-c motor, Fig. 8(b). Changing of its speed from 300 to 1800 rpm with a field rheostat changes the receiver speed from 1250 rpm to 1500 rpm. Using a speed reducer between the frequency changer and the d-c motor gives what might be termed a "mechanical amplification" between the d-c motor and the frequency changer. For example, with a 6 to 1 gear ratio, a speed change of three rpm in the d-c motor due to a load swing will give a one-half rpm change in the Synchrotie receiver speed.

Another method involves the use of a mechanical speed adjuster, Fig. 8(c). In this case the frequency-changer speed reducer is driven by a constant-speed Synchrotie receiver through the mechanical speed adjuster. This scheme is used when very accurate speed matching must b maintained in the drive from standstill to top speed, regardless of the setting of the receiver speed-adjusting dial.

Semi-Synchroties

Two wound-rotor motors that have their secondaries connected to a common secondary resistance will, within limits, maintain a synchronized speed relationship. This type of circuit arrangement is called a semi-Synchrotie, Fig. 9, and is used when the receiver and transmitter units must also serve as the drive motors. Typical examples are the drives for large cranes and vertical lift bridges.

The semi-Synchrotie provides adjustable as well as synchronized speeds from standstill up to the desired operating speed by adjusting the common secondary resistance. The effect of the secondary resistance with regard to speed control is similar to that obtained with external resistance in the external rotor circuit of a single wound-rotor motor. However, since operation is with the field, the available synchronizing torque reduces sharply as the operating speed approaches approximately two-thirds of synchronous speed. Also, for fluctuating loads on either unit, the available synchronizing torque is limited in the same manner as discussed previously for Synchroties that operate with the field.

When a drive requires adjustable as well as synchronized operation over the wide speed range, it is usually more economical to apply a d-c motor to one of the machane sections and use the d-c motor as a prime mover for a straight Synchrotie drive for the other machine sections.

A-C Requirements of Synchroties

The question of what is required of the a-c supply for Synchroties often must be considered. This problem arises when it is necessary to have an auxiliary power supply for the Synchroties only.

At first glace, it appears that the a-c supply need only have capacity for the stator excitation losses. This is true **only** during steady-state conditions and for relatively small displacement angles. As the displacement angle increases,

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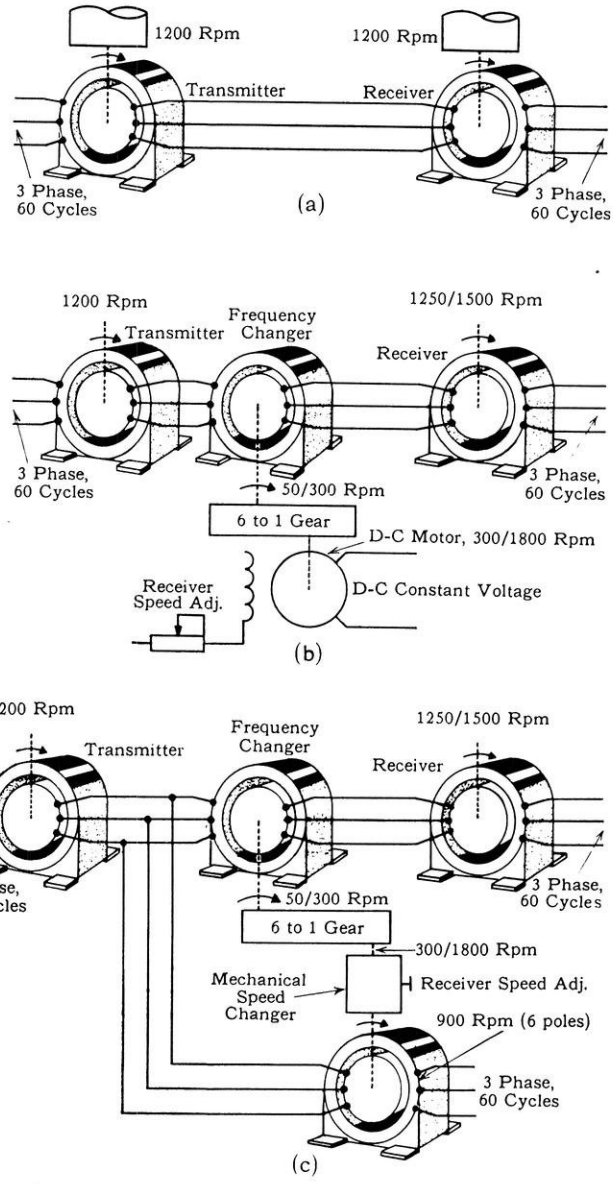
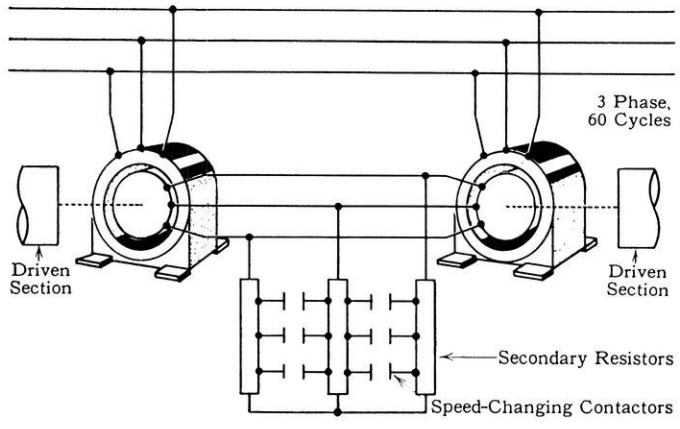
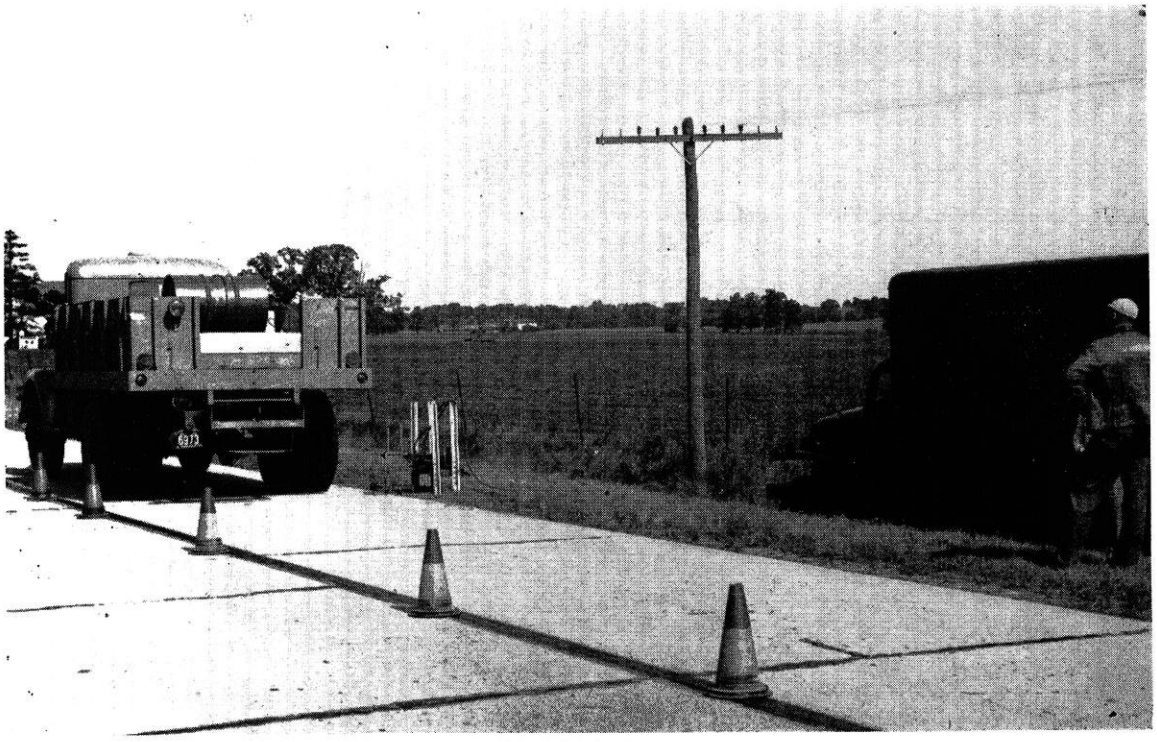


Fig. 8—A frequency changer connected electrically to tne rotor circuit provides the most suitable method of obtaining adjustable-speed operation of the receiver unit.

Fig. 9—Adjustable synchronized speeds from standstill to operating speed are possible with a common adjustable secondary resistance. This is called a semi-Synchrotie.





The University of Wisconsin

TRUCK RESEARCH PROJECT

By John S. Hickman, me'54

The truck research laboratory is located on the University of Wisconsin engineering campus in the Mining and Metallurgy building. Its location in Wisconsin is excellent when consideration is given to extremities in weather and in road beds and surfaces in this vicinity. These extremes provide a broad base for many types of experimentation.

The project became a reality in 1946 as a result of a donation of $50,000 from the Four Wheel Drive Auto Company of Clintonville, Wisconsin during the year 1945. The funds were given the university with the understanding that they be applied to experimental research upon truck and highway design. Since its inception the project has accumulated fundamental data upon fuel economy, tire wear, engineering performance, brake timing, pavement deflection, and four wheel truck handling techiques.

The financial burden of the laboratory is absorbed jointly by the university and several state industrial firms. (Namely the Warner Electric Brake Company of Beloit, the Falk Corporation of Milwaukee, the Highway Trailer Company of Edgerton and the Four Wheel Drive Company of Clintonville). The expenses incurred are subdivided as follows. Salaries are paid by the industrial firms through grants. Recently the university has been forced to subsidize these grants to meet the payroll. The building along with heat, light, and water are furnished by the university. The necessary direct and indirect material such as testing devices and miscellaneous tools are removed from the budget provided by the industries.

The laboratory owns five vehicles, four of which are strictly experimental machines, the fifth being a truck which hauls the road test devices. This truck carries an air cooled dynamometer, an electric generator to power electronic equipment, heavy duty auxiliary heaters and a small generator for intercommunication. Telephones are used for inter-truck contact. The small generator occasionally has supplied some test equipment. The laboratory possesses two 5.5 ton capacity straight trucks, one a 4 by 2 the other a 4 x 4. (After this a reference to a 4 by 2 truck indicates a 4-wheel truck powered by 2 wheels). The experimentation includes many phases of work.

The safety program has included studies of handling factors on ice at Pine Lake near Clintonville as well as on the road testing. The staff has investigated the behavior of their vehicles during skidding and jackknifing. In conjunction with these tests they have measured the effectiveness of tire chains and specific brands of tires. They concluded the effective differences in brand of tires to be nil. The development of driver technique has been an area of concern. It was noted that some drivers have difficulty in adjusting to Four Wheel drive trucks.

Tire wear has been analyzed relative to truck suspension (individual versus dual tires on either side of the axle) and the advertising claims of various tire manufacturers. All brands exhibited practically the same wear characteristics.

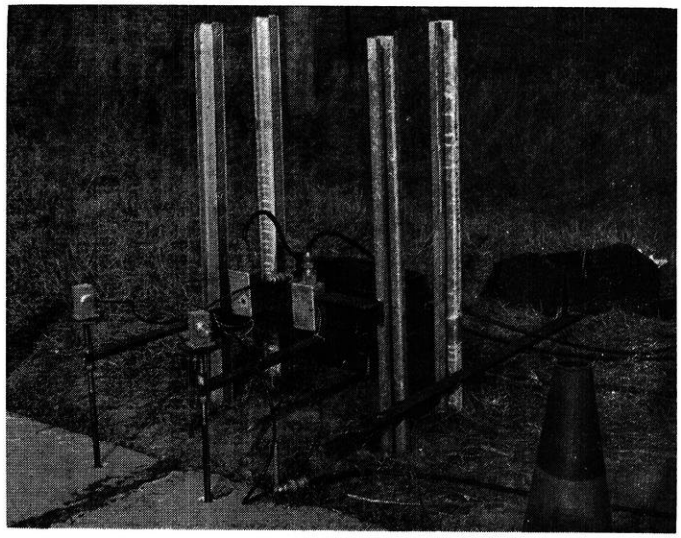
Engineering performance tests on the prime movers were restricted to six. The first being drawbar pull. Draw bar pull is a measure of output, or simply, the ability to pull the tow load. It is a basis for rigorously comparing vehicles. The second, tractive resistance, is a determination of how much of the available power is required to drive the vehicle. The third, braking, has concerned itself

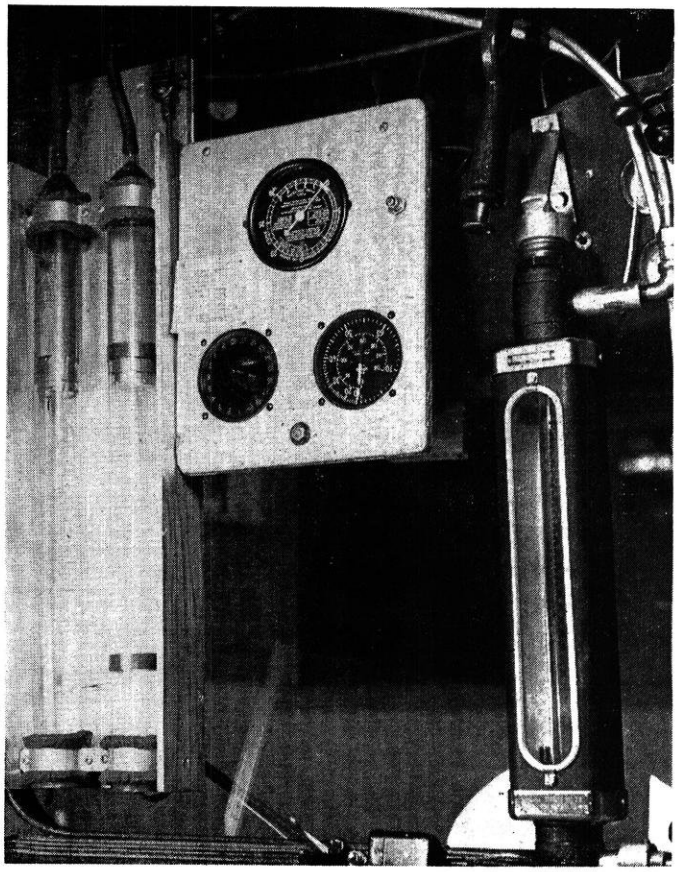
(*please turn to page* 44)

Page 20 — Truck going over test course for highway deflection. Gross weight 20,900 pounds.

Top—Highway deflection measuring equipment. Acceleratometer mounted on top of pins embedded in the concrete. The Strain gages on the cantilever beams measure deflection.

Bottom—Fuel economy equipment. The flow meter is on the left and the burrettes are on the right. The thermocouple switch, air speed and engine vacuum indicators are on the board.





Light From Mercury

By J. L. Crittenden, ch'55

(Information courtesy Westinghouse)

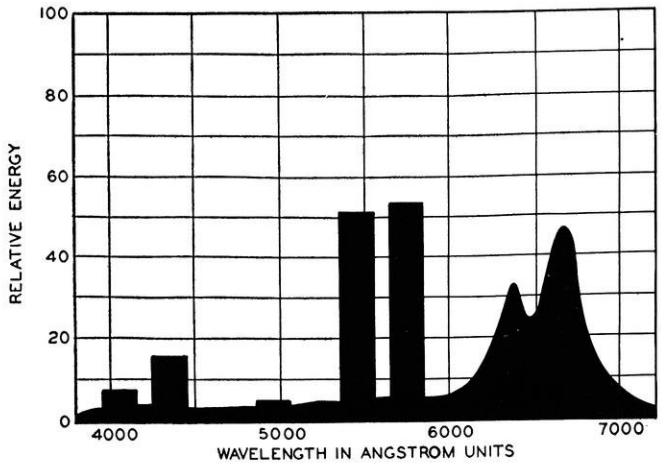
Mercury-vapor lamps belong to the general classification of electric discharge lamps, in which light is produced by an electric current through a vapor or gas, rather than through the usual tungsten filament, as in the incandescent lamps.

The development of the mercury-vapor lamp has been the direct result of American industry's demand for a more efficient lamp. Early researchers at Westinghouse, along with Cooper-Hewitt, chose mercury-vapor because of its high luminous efficiency. Even at that early stage, low pressure lamps had an efficiency of around 18 lumens per watt compared with the 3 to 4 lumens per watt of the carbon-filament lamp. Today's 1000 watt medium pressure mercury-vapor lamp with its 55 lumens per watt efficiency, better than doubles the efficiency of its counter part in the incandescent category.

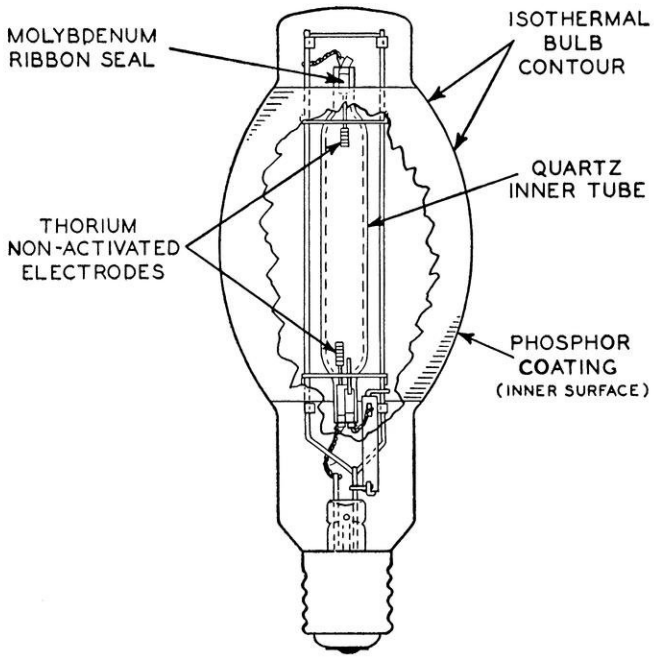
But for all its efficiency, until the recent development of the fluorescent-mercury-vapor lamp, mercury-vapor lighting was considered only for such things as street lighting where its characteristic bluish white light would not be disturbing. This radiation of the earlier lamps was caused by the lack of red in the mercury spectrum. The early lamp also lost about fifty percent of its radiation as invisible ultra-violet rays. These low pressure lamps produced a sharp line spectrum which seemed to close or blend into bands in tne visible spectrum as the vapor pressure was increased. Taking all of the structural design features into consideration made too high a pressure impractical, so that the present figure of three atmospheres is actually a compromise.

Since over half the radiated energy was being lost for illumination purposes and the emitted light lacked the red portion of the spectrum, it was desirable to find a method to change the invisible ultraviolet radiation to that of the missing red. A phosphor seemed to be the answer, but such a phosphor would have to be white so as to not subtract materially from the visible mercury emission. It should respond efficiently to all wavelengths of the ultra-violet available from the arc, and at temperatures from 300 to 500 degrees centigrade. A further desire was to have a phosphor which would fill in the lacking red portion of the spectrum, and one that was thermally and photochemically stable. Luke Thorington, at the Westinghouse Lamp Research Laboratories, fulfilled all these points when he developed magnesium fluorogermanate, and thus made a true white mercury light possible. Just how much was gained by the development of this new phosphor can be seen in the accompanying graph, where the rectangular bands are contributed by the mercury itself, while the portion from 6000 to 7000 angstroms is largely contributed by the phosphor.

There are other very interesting design features of the new mercury-vapor lamps. The latest fluorescent type lamp (see cut) consist of a quartz bulb or arc tube in which the electrodes are sealed, and in which the mercury is under pressure. Surrounding this tube is an outer bulb for protection and better performance. The arc tube also contains argon gas which is more readily ionized and wnich facilitates starting since the mercury is a liquid at room temperature. As soon as the arc strikes, the heat vaporizes the mercury, which then becomes the conductor. The arc bulb was formerly made of glass, whose melting point was a strong limitation on the mercury-vapor pressure and consequently the effectiveness of the lamp as a light source. The glass also absorbed tne ultra-violet



This shows the relative output of the fluorescent-mercury lamp. The rectangular bands are contributions from the mercury itself while the portion from 6000 to 7000 Angstroms is largely contributed by the phosphor.



Drawing of the new mercury vapor lamp showing its magnesium-phosphor coating which puts some red light into the blue mercury light and which converts ultra-violet into visible light, thus making the lamp more efficient.

rays. New problems arose however when quartz was substituted, for although it had a more suitable melting point and did not absorb ultra-violet rays, it was soon found that the sputter of the so-called activated electrodes of barium, strontium, or calcium oxide coated tungsten, which were used with the glass, attacked the quartz. Researchers solved this problem by developing a thorium electrode, but an equally important and probably more difficult problem also had to be solved. That problem was concerned with the method of introducing the lead wires into the quartz arc tube, since the difference in the co-efficient of expansion of quartz and metals is so great (approximately 1 to 8 for tungsten, which is commonly used) and the extremely high fusing temperature of the quartz (around 1750°C.) have prohibited direct sealing with these materials. The earlier lamps used a graded seal, consisting of a series of glasses of graduated expansion and temperature characteristics which filled in the gap between the quartz and the metal lead wire. But even with carefully controlled methods of manufacture these seals often developed cracks, Finally, a method where-by a thin ribbon of molybdenum pressed between two walls of quartz was found. The ribbon was so thin that the forces exerted by the expansion and contraction were negligible and a vacuum tight seal was affected.

The outer bulb's temperature and composition of the lamp (on whose inner surface is coated the phosphor in the fluorescent variety) has been found to be a determining factor in the life and performance of the arc tube. This is chiefly caused by the fact that water vapor is evolved slowly from the outer glass, which in turn breaks down under the condition of high heat and strong utra-violet light into oxygen and hydrogen. The metal parts absorb the oxygen while the hydrogen diffuses through the quartz until the lamp becomes inoperable. Since the temperature effects the rate of water vapor evolution, it was found that a larger diameter outer bulb would allow a cooler surface and better performance. A special bulb shape was also adapted to keep the surface temperature uniform, and a lime glass was substituted which not only lowered the evolution of water vapor, but caused a reduction in the temperature of the base when the lamp was operated in the inverted vertical position.

The latest lamps also use a silicone cement for basing rather than the former indented neck molding method of locking the base to the bulb, for these indentations were a potential source of glass strain which led to lamp failure.

Another aspect of the mercury-vapor lamp which must be considered is the fact that to start and operate any of the mercury-vapor lamps on a standard electric circuit (whether series or multiple), a ballast is required; a ballast being an auxiliary device to provide proper operating characteristics. A ballast may transform current or voltage, or limit current. Ambient temperature affects the stricking voltage of all discharge lamps, regardless of their starting or controlling circuits. As the temperature is lowered, a higher open circuit voltage is required to start the lamp. At present most lamps have the proper ballasts available to enable starting down to minus 30° F.

A discussion of this kind wouldn't be complete without mentioning some of the uses to which mercury-vapor lighting has been put, especially the new fluorescent mercury-vapor lamp. This new lamp is finding its greatest application where color discrimination is envolved and where high lumen output is required. At present, they're being installed in large industrial areas, transportation terminals, auditoriums and sports arenas. They are also being used outdoors to light store fronts, service stations, assembly and construction areas, freight yards, and streets. It is interesting to note that in street lighting, the new mercury-vapor installations, while actually costing more is 85% as expensive as an incandescent system which would give equal results. Because of its lower brightness, the fluorescent lamp be can be mounted lower to the ground than former mercury-vapor lamps.

The developments which made the new fluorescent mercury-vapor lamp possible also were instrumental in the development of other lamps. Most important are those used in blueprinting and photochemistry, for black light industrial inspection, for sun lamp home application, reflector lamps for industry, and an entirely new type—the short arc lamp, which opens new fields of mercury-vapor application. The reflector lamp is particularly important for, with the reflector sealed inside the outer glass bulb, it stays clean even under the most adverse conditions. These are but a few of the present applications of mercury-vapor lamps, and with its ever increasing efficiency the mercury-vapor fields seems to be limitless.

THE END

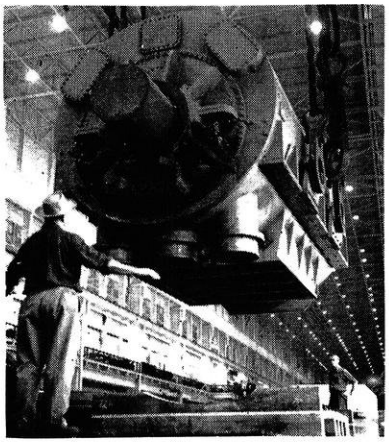
SCIENCE

INNER-COOLED GENERATOR

The world's first completely inner-cooled generator—described by engineers as one that will literally open a new era in tne history of power generation — is readied for shipment from the Westinghouse Electric Corporation. (See photo).

This new unit is rated at 100,000 kilowatts and is powerful enough to light a city the size of Nashville, Tenn. However, it is only slightly larger in physical size than the average 40,000 kilowatt machine. The new generator weighs about 350,000 pounds which is about 150,000 pounds less than the average 100,000 kilowatt unit.

The key to the increase in power rating, while the physical size is reduced, lies in a new cooling system for large turbine generators designed in such a way that the cooling agent, hydrogen gas, comes in intimate contact with not only the bare copper of the coils in the rotating part of the generator, but also with the copper coils of the stationary part of the machine. After carrying the heat away for disposal, the hydrogen is then recirculated through the machine.



Cut courtesy Westinghouse

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SEEING THE INVISIBLE

Photography is making possible the exploration of a vast invisible world.

Science is using special precision photographic devices to study such unseen things as ultra-violet rays, gamma rays, the behavior of atomic particles, and the effect of a plane passing through the sound barrier.

A photographic device known as the X-ray microscope magnifies and at the same time "sees into" the depths of objects being studied.

To illustrate the result, a picture of a common housefly taken with the X-ray microscope shows brain, organs, and even wing muscles standing out clearly on the screen.

GAS TURBINE GETS NEW JOB

A gas turbine, first cousin to the jet engine which is powering American military airplanes, soon will be used for the first time in the petrochemical industry.

The G-E turbine will be employed in a process which compresses hydro-carbon gas at one of the major refineries of the Standard Oil Company. It is the same type now being used on many railroad locomotives.

A relatively new kind of drive, the gas turbine will make it possible to mount three large compressors on a single shaft, thus providing a driving force equal to more than 40 standard automobile engines.

Natural gas will be used as fuel. The turbine will exhaust into a boiler to produce low-cost steam for other processes at the refinery.

●

NEW PREALIGNED IF AMPLIFIER FOR TELEVISION

RCA is now mass producing the television industry's first ready-to-use prealigned IF amplifier—complete with electron tubes and printed circuit with components.

Tne unique assembly is designed to help TV set manufacturers pare production time, eliminate complex

HIGHLIGHTS

assembly and alignment operations, and provide high level efficiency for amplifier operation.

Intermediate-frequency (IF) amplifiers are essential to every home TV set and now are constructed and aligned by individual set manufacturers; such operations are exacting and time-consuming because amplifier tubes, circuits, and wires must be assembled on the TV chassis, precisely positioned to assure efficient operation, and then connected and soldered manually. This new amplifier is being offered to manufacturers as a finished package, ready for attachment to the chassis.

Named the "Tandem" Amplifier, it became commercially practical with the successful application of the company's special photo-etch "printing" process for the production of wiring patterns as well as component coils. Accordingly, all hand-wiring operations are eliminated. The "Tandem Amplifier," in effect, is mass-produced from a series of film negatives covering the wiring panel and the individual printed components.

It employs printed-circuit IF transformers, coils and traps arranged in tandem; three 6BC6 amplifier tubes; and a crystal diode—all mounted compactly on a plastic panel measuring less than nine inches long and less than two inches wide. Resistors and capacitors are mounted on top of the panel, with their leads inserted through the panel and dip-soldered to the printed wiring underneath. Attachment to the TV chassis is made by six small mounting screws.

Production of the "Tandem Amplifier" begins with a photograph of the panel's specified wiring pattern. A contact print of this negative is made on a copper-clad plastic sheet coated with light-sensitive material. Tne sheet is then photographically treated to develop the wiring pattern. An etching process that "eats" away the unexposed copper veneer, leaving on the plastic sheet an embossed, sharply defined copper reproduction of the wiring pattern. After additional processing, the various components, resistors, and capacitors are placed in position, and all leads are accurately and simultaneously joined underneath the panel by means of a special dip-solder process. This process assures bonded electrical contact between the printed wiring and the components and tubes.

"NEW USE FOR SOUND"

High-pitched sound waves were advanced to a point where they are now considered to be one of the most effective methods yet devised for industrial cleaning of small parts. The sound waves, known as ultrasonics, are directed through a liquid solvent to remove dirt, grease, and metal particles from small corners and crevices where the solvent alone would be ineffective.

•

NEW PRECISION DYNAMOMETER

The George Scherr Company announces a new precision dynamometer for measuring spring tension, starting torque and the force required to actuate delicate mechanisms.

The new instrument is a highly valuable aid to the engineer in determining and checking the pressure required to overcome spring tension and other kinds of resistance in fine precision mechanisms such as electric contacts, relays,

(please turn to page 58)

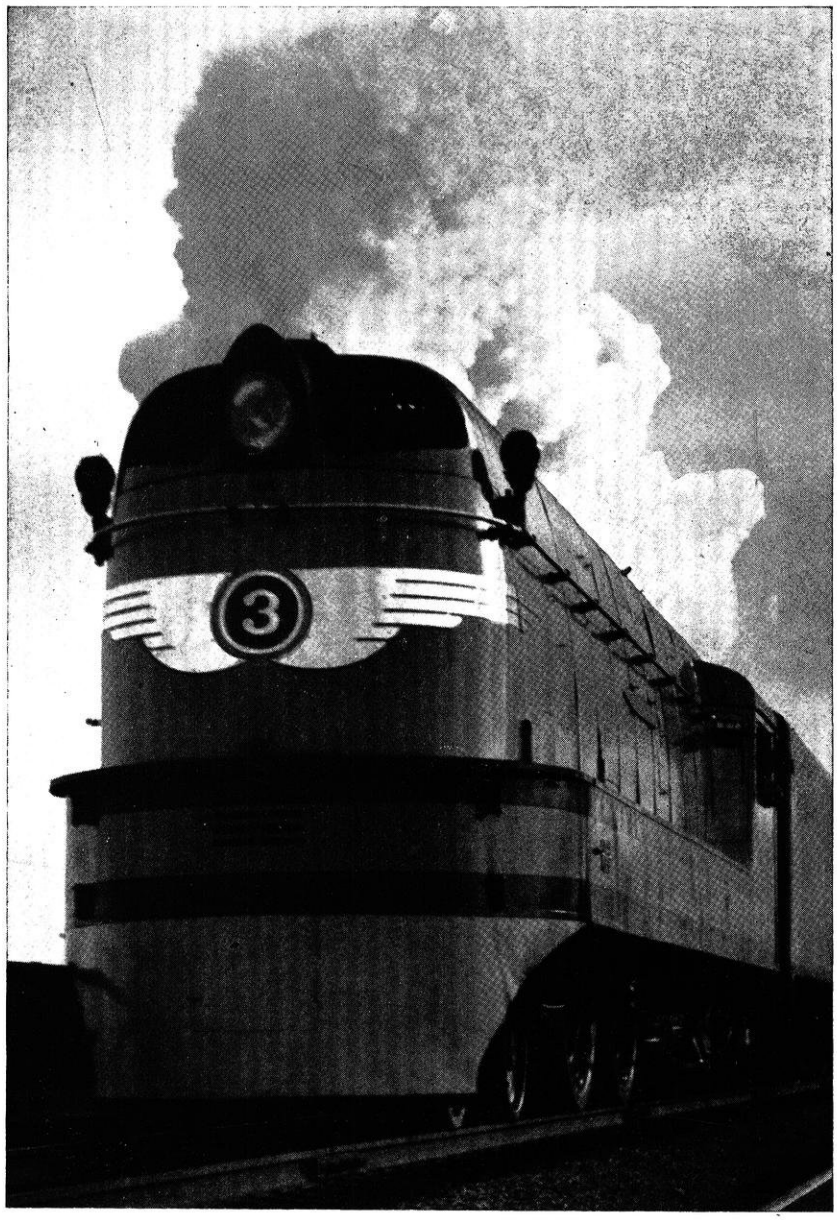
Petroleum

-And-

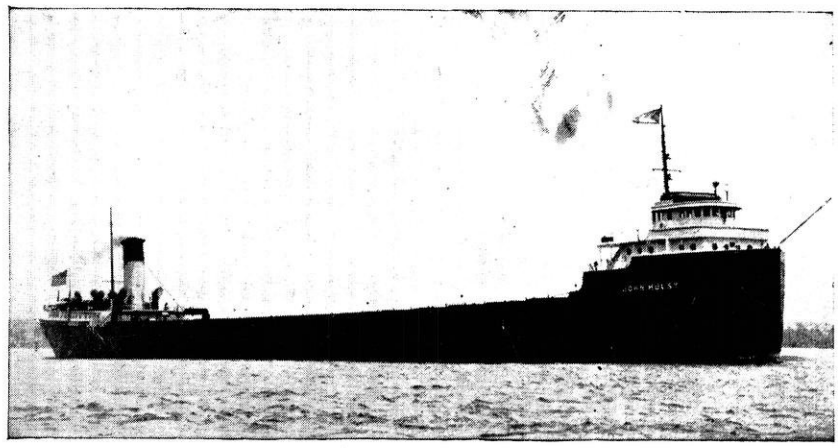
The Future

Story courtesy The National Petroleum Council

Edited by P. M. Palmer, ch.e'55



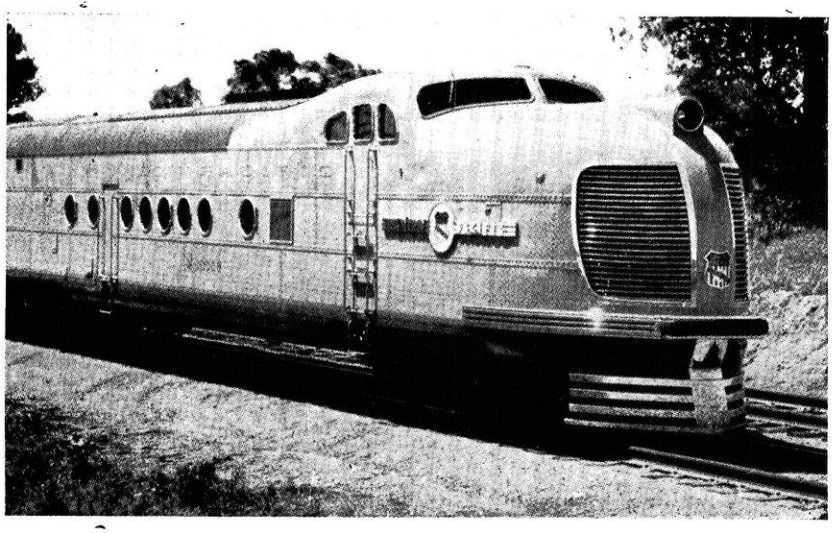
OIL---



In 1926 the federal oil conservation committee stated that the United States had oil reserves equalling only six times the annual production rate. In other words the United States should have exhausted its oil reserve by 1932. The truth is, however, the U. S. production since 1926 has been more than thirteen times the proved reserves of 1926. Reports to the effect that we will exhaust our petroleum resources within five years to several decades are frequently to be found in our daily newspapers. These reports are all based upon a study of proved reserves and annual production. This is where their fallacy lies. These estimates do not take exploration and improved production methods into account.

The American Association of Petroleum Geologists reported in 1951 that there is a prospective petroleum producing area in North America totaling about 100 times as much as the area which has been productive to date. Furthermore, much of the present productive area has not been thoroughly explored. For example, in 1950 a major field was discovered at Castiac Junction, California only 4 miles from Pico Canyon where oil was first produced in California back in 1876. Also few of the present oil provinces have wells extending below 12,000 feet and the major portion of existing wells extend only to about 5,000 feet. It is known however that many of the sediments are probably below 15,000 feet and these will be tapped as steel supplies and modern production methods allow.

Thus far the production of petroleum in the U.S. has depended exclusively upon an ever increasing demand since availability has not as yet been a problem and does not promise to be any problem in the forseeable future. The only thing which the oil industry seems to fear at the present time is the possibility of government interference in their exploration and production methods. They point to the fact that there are frequent instances in which oil has been discovered in areas after several companies had previously failed. Government control over exploration they point out might prevent such discoveries. A point in case is Russia where the petroleum industry is completely government controlled. In 1951 her production was less than a million barrels daily compared to about 6½ million barrels for the U.S. However, the industry is quick to acknowledge that government conservation restrictions probably have added immeasurably to reserves and have extended the production in many fields by years. The federal government has for the most part encouraged efficient field operation and has provided additional incentive to the industry by devising equitable tax laws which allow for depletion and depreciation of fields and equipment.



Many modern developments on both the exploration and production scene have made such large volumes of oil available in the United States. The U. S. occupies some 3,000,000 square miles of land and of this, about eighty percent is considered favorable for petroleum deposits by the American Geological Society. Only approximately one percent of this land has been developed into oil

(*continued on page* 56)

---AT WORK

LITERARY

The engineer, too, has his lighter side. He occasionally likes to get away from the formality of technical reports and ramble on—just for fun. He likes to laugh at himself and poke fun of his chosen profession just a little.

WHAT A LIFE!

By Rexford K. Roe

We have all played that old verbal game that goes something like this: "Have you ever seen a horse fly?" "No, but I've seen a nose run." Or, "Did you ever lose your 'sole'?" "No, but I've received a 'heel' of a boot," etc. But in all seriousness I have seen a motor run away. And I didn't blame it for doing so.

The motor I am referring to is in the E.E. Laboratory—poor thing. About twenty-five years ago it came into this world, as do all things, with equal opportunity to do big and great deeds. Our hero, the motor, inherited its capacities and abilities from his conceivers and these abilities were advertised for sale by able persons who promised the world that the performance of our hero could not be excelled by anything of equal or similar stature.

What happened? Through no choice of his own, our friend was sent to school, to the University of Wisconsin.

"Ah", said our hero, "I'll certainly do great things at the University!" (Poor misguided freshman)

For twenty-five years, now, our motor has been bolted to a floor. Imagine! Just think for a minute—how would you feel being bolted to a floor for twenty-five years? No sex life, no short beers at the HT, same four walls around you all the time! Sounds boring, doesn't it?

But all this can be endured if one is doing something constructive. And our hero kept hoping week after week for twenty-five years that that opportunity would arise, that he would be allowed to do the work he is capable of doing. But no such opportunity presented itself.

So the hero of this little story about life is seen to have had no social activities or was not allowed the experience of doing a job that was worthwhile for a period of twenty-five years. And, in addition to all this, he was mistreated by the thousand and one prospective engineers who used him as a guinea pig for practicing their newly learned or supposedly learned testing techniques. Can't you see how frustrating all this could become?

One day one of the mentioned prospective engineers caused a climax in the life of our friend who was just at the brink of an emotional crack-up. The engineers were going to run the experiment "parallel operation of generators". For this experiment, our hero furnished the mechanical power to the generator which converted this energy to electrical and pumped that energy back into the source which furnished the energy our hero used. Need it be said—our hero was exceedingly dismayed with the futility of the whole test. And so, when one of the engineers erred in making a connection to our motor, our friend took quick advatage of it and "blew his top".

He lost all control of himself. One minute he had been a docile creature; the next minute he was a screaming maniac, running around in circles with ever increasing speed, trying to break the shackles which kept him tied to the boring, to the frustrating life he had been living.

But just before our hero reached the possibility of going absolutely to "pieces", an unsympathetic engineer shut off the source of energy of our friend, causing him once more to submit to the will of his oppressors.

So today our friend is still shackled, still bolted to the floor in the E.E. Lab. Tomorrow, or the next day, or the following day, sometime in the future, we all expect him to do the same thing again if he is given the chance.

But, I still do not blame him for trying to run away. Do you?

ENGINEERING

These stories were originally written as pledge assignments for Eta Kappa Nu back in 1947. They represent a less serious style which has not been seen in this magazine recently. We are interested in the reader's reaction to this sort of thing. If you would like to see more humorous technical reporting won't you please let us know by post card. Send your cards to: Wisconsin Engineer, ME Building, Madison 5, Wisconsin.

LOGIC VERSUS THE ENGINEER

By Gerald H. Cohen

The Electrical Engineer is perhaps one of the most prolific users of symbolic or mathematical logic. One can pick up any one of the many trade organs published in the field and find a quantity of lurid mathematical egotism. In fact, any Engineer who can't find the curl of a vector might just as well give up entertaining the idea of becoming recognized in the field.

Even in everyday life the EE applies some form of logic. For example consider the following syllogism:

If it rains, I will take my umbrella.

If I take my umbrella I am sure to lose it.

$\therefore$ If it rains, I am sure to lose my umbrella.

This is a direct result of the celebrated theorem of The Common Man of the Street which I snall quote:

"One plus One equals Two" (sometimes).

No one can deny the validity of this argument. When does one ever see an EE carry an umbrella on a rainy day?

Again, consider this question which has received much attention lately.

All EE professors instruct and work full time.

All instructors are married who work full time.

All married men are well fed.

$\therefore$ All professors who teach EE are well fed.

One must be cognizant of demonstration in applied science. This is its distinctive characteristic. The conclusion that all EE professors are well fed could well be demonstrated with a tape measure. Need I demonstrate any more?

Suppose you, Mr. A, were going to use your training here at the U of W to get a position (very hypothetical case of course) as a city Electrical Engineer. These facts are known,

1. You are the son of a politician. (Remember this is a city job).
2. You are a jovial person, that is you laugh at jokes.
3. You are a veteran and thus have high moral values.
4. You belong to Eta Kappa Nu.
5. You can use a circular slide rule.

We now entertain the question . . . Will you get hired?

The fact that you are the son of a politician means you are susceptible to the politician's disease . . . bribery itch. We will call the probability that you will take a bribe as NDG (No damn good) and the probability that you are of high moral character as GDG (very good). Then, taking the limit in the mean of NDG/GDG we could get the exact ratio of the relative frequency you would take a bribe. Perhaps the best way to solve this indeterminate ratio is to use the method commonly used by EE's to determine whetner or not to use the ratio of $1\sqrt{3}$. This is the famous experimental method of throwing a coin in the air and assigning values to either side. If the coin lands on an edge the solution is beyond the means of the EE and consequently of no use. If you find a mathematics book and look in it for the solution you will invariably find the common phrase which will begin "It can easily be shown that . . ." You then proceed to forget all about the problem and take a job as a radio serviceman.

Perhaps one of the most striking examples of symbolic logic is the use of the practical system of units. For example consider the unit of mass in the practical system . . . the slug. Now what can be more practical? Do we not use this unit to measure out a specific mass of alcoholic intoxicant? Again consider the unit called the **foot** for want of a better name. But, there are two belonging to each EE and considering the physicist's centimeter in comparison to the foot one readily concludes that the centimeter is much smaller than a foot and therefore can be neglected . . . it usually is.

And now considering this paper in comparison to the integrated works of all the well known men in Electrical Engineering one finds it is negligible and should be neglected.

ALUMNI

By
Richard White, c'55

William T. Ennor, ChE '23, assistant director of research, Aluminum Research Laboratories, Aluminum Co. of America, is the 1953 winner of the Albert Sauveur Achievement Award, presented by the American Society for Metals.

The award was established in 1934 in honor of Dr. Albert Sauveur, late Harvard University professor, widely known as the "Dean of American Metallurgists."

The 1953 Sauveur medalist is one of the country's outstanding authorities on nonferrous metals, having developed for large scale production use the D.C. (directly chilled) ingot. Mr. Ennor has also made practical contributions in the fields of rolled forging stock and structural shapes, as well as improvements in conductor wire, Alclad wire, and aluminum screen cloth.

The Sauveur medalist for 1953 holds many patents on the processing of aluminum and its alloys. He is a graduate of the University of Wisconsin where he taught as an instructor immediately after graduation. He joined the Aluminum Co. of America in 1924.

Homewood, Robert T., c'27, ms'29, is now in charge of the Ground Safety Program for the Air Materiel Command in Dayton, O.

Guth, Leonard A., c'50, resigned from the staff of the State Highway Commission at La Crosse to join the staff of Richardson and Gordon, consulting engineers of Philadelphia. The firm specializes in highway design.

Rusch, Hugh L., e'23, is now vice president of the Opinion Research Corporation. This company serves over 80 leading corporations with its public opinion index for industry. Mr. Rusch is frequently in Chicago for meetings with his clients, but his main office is in Princeton, New Jersey.

Steinmetz, George P., c'23, was recently sworn in as chairman of the Wisconsin Public Service Commission. He had been chief engineer of the Commission since 1935.

Farley, John L., e'17, community relations director for Crown Zellerback Corporation, has been appointed director of the Fish and Wildlife Service.

Hopkins, Robert B., e'39, is working with a metal stamping concern, the Aurora Electric Company of Brooklyn, New York.

NOTES

Kessler, Lewis H., c'22, at one time professor of civil engineering at the University of Wisconsin and later professor of sanitary engineering at Northwestern Institute of Technology at Evanston, Illinois, is now with Fairbanks, Morse and Co. in Kansas City.

Luebke, Jerome J., m'48, is engaged in research for the Northern Paper Mills in Green Bay, Wis.

Smith, Wayland P., m'47, is now teaching industrial engineering in the department of mechanical engineering at the Case Institute of Technology in Cleveland.

Huth, Alton M., c'30, has returned to the staff of the Wisconsin Highway Commission after three years in the Navy. He is assigned to the Madison district office.

Noth, Melvin J., c'40, became city engineer of Menasha, Wis., last September. He had been on the staff of the Davy Engineering Company of La Crosse, Wis.

Small, Alvan L., c'40, who had been with the division of architecture of the Wisconsin State Bureau of Engineering since 1948, recently moved to Milwaukee where he will be district engineer for the American Institute of Steel Construction.

William N. Oberly has been named manager of the engineering projects section in the Knolls Atomic Power Laboratory.

The Knolls Atomic power laboratory, which is operated by the General Electric Company for the Atomic Energy Commission, is presently engaged in constructing an atomic power plant for U. S. Navy submarines.

Mr. Oberly was born in Milwaukee, Wis., and was graduated from the University of Wisconsin in 1938 with a degree in electrical engineering. In that year he joined the General Electric Company as a test engineer and since then has had assignments in various departments. He was assistant to the manager of manufacturing in the fractional horsepower motor department at Fort Wayne, Ind., before he came to the Knolls Atomic Power Laboratory in 1951.

It is a pleasure to announce the award of a 1953 Henry Marion Howe medal to **Prof. Philip C. Rosenthal,** met'35, MS'39, and **Mr. Lew Porter,** ch'40, by the American Society of Metals for the paper of highest merit published in Vol. 44 of the transactions of the society. The paper was entitled "Gas Evolution from Gray Cast Iron During Enameling." The award was formally presented October 22, 1953.

W.S.P.E.

SECRETARY'S OFFICE
2318 Rowley Avenue
Madison 5, Wisconsin
E. C. Wagner, Secretary

LEGISLATIVE ANNOUNCEMENT TO ALL MEMBERS

If there is any item of legislation that you would like taken care of, particularly if it affects the registration law, please get it to your chapter chairman, your state officers, or state legislative chairman before December 30, 1953. Be specific with any suggestions you may have so the committee can consider your definite thoughts and ideas. We need your support.

Meeting of Board of Directors of WSPE—Oct. 17, Milwaukee Athletic Club

President Ellis submitted a report from the "Dues Committee" which in essence stated that reports from chapters indicated members were willing to accept an increase in dues on the state level if there was good justification for an increase. The committee did not recommend an increase in dues.

It was moved by Director Ayers that the board accept the recommendation of the dues committee and that dues at the state level not be increased at this time and that the board await the results of the current membership drive to see if the added income from increased membership is sufficient to carry out additional activities desired by the society. The motion was seconded by Director Baumgartner.

Passed

Treasurer Schindler moved that the board approve the printing of 5,000 membership application blanks with the following new schedule of dues.

Time of Election	Member	Affiliate Member
Jan. 1 to Feb. 15	$18.00	$8.00
Feb. 16 to May 15	13.50	6.00
May 16 to Aug. 15	9.00	4.00
Aug. 16 to Nov. 15	4.50	2.00

Motion seconded by Director Lord. **Passed**

Vice-President Steinmetz, chairman of the by-laws committee, made a progress report stating that the committee was considering the following changes:

(1) change from five to seven directors to provide for one director from each chapter.
(2) change of either the fiscal year or administrative year so they would coincide.
(3) recommendation for a standard procedure for board authorization of payment of bills.

Mr. Steinmetz stated that, at present, matters are at a standstill due to a lack of replies to inquiries sent to the chapters by the committee. On July 13 a letter was mailed to all chapters requesting that they appoint a representative to work with the committee. To date replies have been received from only the Milwaukee, Southwest and Western chapters. Letters regarding the changes in by-laws that are being considered have been received from only two chapters—the Fox River Valley and the Northwest.

The board instructed the by-laws committee to consider the advisability of an amendment which would permit the office of secretary and treasurer to be held by the same person. The committee was further instructed to make a final report at the next meeting of the board.

President Ellis reported that the inter-professional committee has arranged a meeting with the architects' committee. The date of this meeting has been tentatively set as Saturday, November 7, 1953.

President Ellis asked the board's wishes regarding the location of future board meetings and also the policy regarding payment of expenses incurred by board members in connection with their attendance at board meetings. After discussion it was decided that Milwaukee was the most suitable location for future meetings and that officers and directors should submit bills for ac-

tual expenses incurred in connection with attendance at board meetings in accordance with Article 5, Section 5.08 of the society's by-laws.

The time and date for the next board meeting was set at 12 noon, December 5, 1953, at the Milwaukee Athletic Club, Milwaukee, Wisconsin.

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SHALL THE WSPE INCREASE DUES?

Briefly, the story is this: NSPE has been considering an increase in their dues for some time, and last spring opinion on WSPE board was that if we had to increase our dues because of an increase in those of NSPE, it would be appropriate to consider a simultaneous increase for WSPE in order to carry out many projects or activities that have been thought of from time to time but have been deferred because of the lack of funds.

Our by-laws provide for an automatic increase in state dues to take care of any increase in NSPE dues, but an increase in our own state dues can be made only by amendment of the by-laws upon a proper vote of the membership.

Last April the board requested Mr. Pierce Ellis to appoint a special committee to look over the state situation. Upon advice, in the middle of June, that NSPE had taken action to increase its dues effective January, 1954, he appointed the special committee outlined in the correspondence.

This special dues committee then conferred with each of the chapters and prepared a report which was submitted to our board October 17. In summary, that report stated that under no circumstances should WSPE increase its own dues for EIT members. As to an increase in dues for members in the PE class, if the state board had good reasons for so doing (which evidently did not appear obvious to the committee), it was the opinion of the committee that the membership should

OFFICIAL NOTICE

In accordance with Article VI, Section 6.01 of the by-laws, the following report of the nominating committee is submitted to the membership:

The following members are nominated for the offices indicated for the administrative term beginning July 1, 1954.

President, George Steinmetz (S.W. Chapter).

First Vice President, A. O. Ayres, (N.W. Chapter).

Second Vice President, Arthur G. Behling, (M Chapter).

Director, James E. Bambery (FRV Chapter).

Director, Ray Beherns (M Chapter).

Secretary, Eldon C. Wagner (S.W. Chapter).

Treasurer, William S. Cottingham (S.W. Chapter).

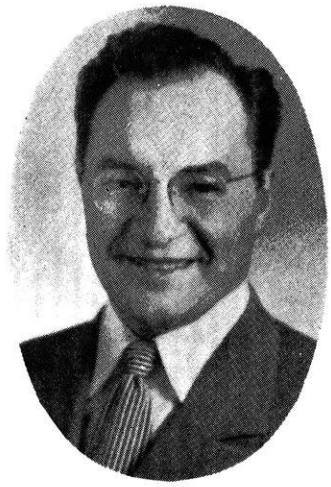
National Representative, Ed Kellavang (S.W. Chapter).

National Representative, Harold C. Trester (FRV Chapter).

Other nominations may be made by petition of twenty-five members, filed with the secretary at least forty-five days prior to the annual meeting. Said annual meeting being January 28, 29, and 30, 1954.

Members of the nominating committee are L. K. Stark (chr)., P. S. Davey, D. W. Nelson, F. E. Thorsen, W. A. Peirce, J. E. Hoeft, and H. F. Weckworth.

Meet the Presidents



GORDON R. MERCER

Fox River Valley Chapter President

Newly elected president of the WSPE Fox River Valley Chapter is Gordon R. Mercer, plant manager of the Algoma Plywood and Veneer Company in Algoma, Wisconsin. Mr. Mercer has been president of both the Algoma Junior and Senior Chambers of Commerce, president of the Algoma Men's Club, and master of his Masonic Lodge. He is now first vice-president and president-elect of the Lions Club and serves as president of the Kewaunee County Wisconsin Alumni Club.

Gordon Mercer was born in Milwaukee on April 30, 1908, but later moved to Marshfield. He worked his way through the University of Wisconsin receiving his B.S. degree in Mechanical Engineering in 1932. He then made his way out into the business world holding various engineering positions, but finally settling down to the position of assistant sales manager of the Roddis Lumber and Veneer Company in Marshfield. In 1940 he left that concern and was made assistant superintendent of the Algoma Plywood and Veneer Company in Algoma. In 1952, he was promoted to plant manager of the company.

Mr. Mercer married Claire Kane in 1927. He is the father of two children—Robert, 20; and Vicki Lynne, 14. Gordon takes an active interest in golf, bowling, hunting, and in his home workshop.

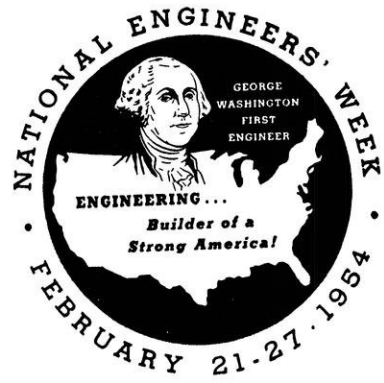
accept an increase in good grace; but if good reason is not shown, the committee recommended that the dues not be raised.

After considerable discussion of the question the board voted to keep the level of state dues where it is and await the results of our current membership campaign which Mr. Frank Carlson of La Crosse now has under way. If the results of this membership campaign materialize, it is hoped by the board that the same beneficial results can be obtained as through an increase in dues.

The secretary has been instructed to prepare new membership application forms which reflect the increase in total dues from $15.00 to $18.00 for PE classification and $7.00 to $8.00 of EIT classification.

The increase in national dues was to some extent necessitated by the need to maintain normal operations and expand the program to include the increased membership. One of the major projects to be continued and expanded is in the field of public relations activities. On the broad front of information to the public, the principal effort will be concentrated, as in the past, on National Engineers Week. A major emphasis will be placed on a continuation of the executive research survey series for the use of industries employing engineering services.

With the general expansion of the society's programs, it is expected that closer work with congressional committees and personnel will be possible. Other committees are working toward more extensive cooperation with the nation's educators, and toward greater coordination between the professional society and college graduate engineers who have not yet achieved full professional status. The fight for freedom of association for engineers is discussed elsewhere in this column.



NATIONAL ENGINEERS' WEEK COMING IN FEBRUARY

Washington, D.C. — "Engineering, Builder of a Strong America," has been selected as the theme of National Engineers' Week, scheduled for February 21-27, 1954, according to T. Carr Forrest, Jr., president of the National Society of Professional Engineers.

In making the announcement, Mr. Forrest, a prominent Dallas, Texas, engineer, invited all engineers throughout the country to join the sponsoring society in the week-long observance which will highlight the invaluable contribution their profession has made to the strength, security, and well-being of the United States.

Progress to date will be reviewed in detail during the regular fall meeting of NSPE, which will be held in Indianapolis, Ind., November 6 and 7, at the Hotel Severin; and further information on specific features of the observance will soon be forthcoming, the society president promised.

He also called attention to the significance of the time chosen for Engineers' Week, since the annual observance is always scheduled to coincide with the celebration of the birthday of George Washington, the nation's first great engineer.

NATIONAL SOCIETY OF PROFESSIONAL ENGINEERS SCHEDULES FALL MEETING

T. Carr Forrest, Jr., president of the National Society of Professional Engineers has announced that the society's 1953 fall meeting will be held November 6-7 at the Hotel Severin, Indianapolis, Indiana.

Members of the Indiana Society of Professional Engineers are acting as hosts for the event which will be held in conjunction with the Indiana organization's annual convention. J. B. Wilson of Indianapolis is president of the host society.

CHAPTER NEWS

SOUTHWEST CHAPTER

C. H. GAUSEWITZ
Reporter

Engineer Education in India

Kurt Wendt, dean of the University of Wisconsin College of Engineering, and Harold Peterson, head of the Department of Electrical Engineering in the College of Engineering, described the aims and accomplishments of their 19 day trip to India in the spring of this year. The talk entitled "How Can American Engineers Assist the Engineering Profession in India" was given to the monthly meeting of the Southwest Chapter of the Wisconsin Society of Professional Engineers at their meeting Tuesday evening, Oct. 27, at the Nakoma Country Club.

Their trip which was sponsored by the Office of Education now under the Foreign Office Administra-

(*please turn to page* 52)

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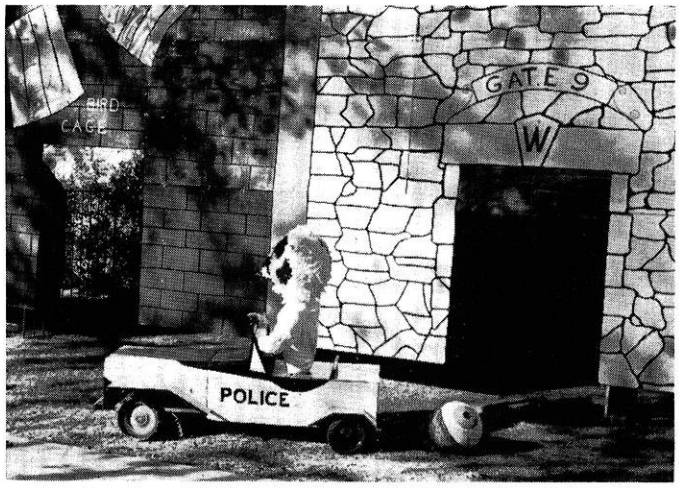


TURNER

HOMECOM

DORMS

CHAMBERLAIN

FALLOWS

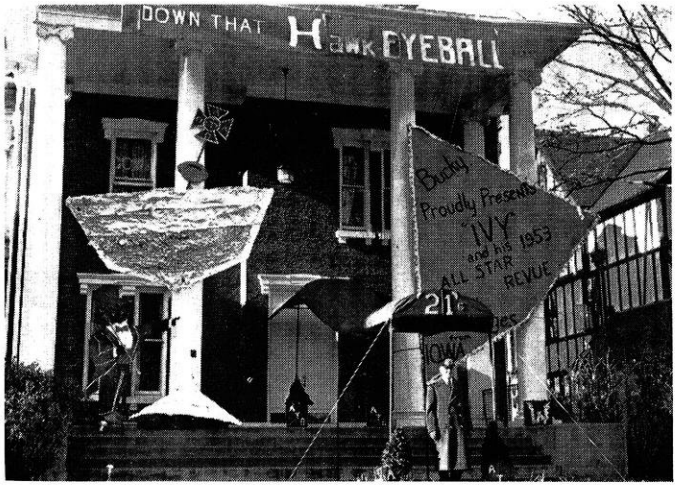
TAU KAPPA EPSILON

CHI LAMBDA ALPHA

ING 1953

Photos by Dave Dauterman

GREEKS



ALPHA TAU OMEGA

ALPHA CHI OMEGA SORORITY

Engine-Ears

By Larry McCormick, met'53

TAU BETA PI

Fritz Culver attended Tau Beta Pi's 48th national convention at Clemson College, South Carolina, on October 8, 9, and 10. The convention granted charters to four new undergraduate chapters and took the first official step toward the admission of women to membership in the association. The convention was attended by student delegates from 90 undergraduate chapters and the national officers of Tau Beta Pi headed by President E. R. Moore, chief engineer, the Detroit Edison Company. The business meetings and social functions of the convention were held on the campus of Clemson College, and Tau Beta Pi's South Carolina Alpha chapter there was host to the gathering.

The Clemson convention elected a new executive council, or board of directors, of Tau Beta Pi which will hold office for four years starting in December, 1954. The new executive council will consist of Mr. Harold M. King, retired General Electric Company engineer and consultant; Professor Walter C. Voss, retired chairman of the department of building engineering and construction at M.I.T.; Dr. Herbert K. Brown, director of the engineering graduate division at Northeastern University; Dr. Lawrence W. Bass, of the executive staff of Arthur D. Little, Inc.; and Dr. Carl F. Muckenhaupt, chief scientist of the Office of Naval Research, Boston Branch.

The convention voted to hold the 1954 national meeting of the association at Iowa State College with the Iowa Alpha chapter as official host. That meeting will be held in October next year.

Valuable features of Tau Beta Pi national meetings are the chapter-work discussions and the exhibits at which ideas for school and community service projects and chapter administration are exchanged by the delegates, most of whom are presidents of their local groups. This year's discussions in that field were led by students under the general direction of Dr. M. E. Van Valkenburg of the University of Utah, chapter coordinator of the association.

Southern hospitality was a highlight of the 1953 convention. The gracious hosts made every effort to assure a convenient and pleasant three-day conclave. Between business meetings there were excellent lunches and dinners with interesting and informative programs. A special series of social events was arranged for lady guests, and the entire convention group witnessed a review parade and fancy drill exhibition by the Clemson College cadet corps.

Tau Beta Pi is a national engineering honor society which was founded at Lehigh University, Bethlehem, Pennsylvania, in 1885. It now has 92 undergraduate chapters in U.S. engineering colleges, 26 alumnus chapters, and almost 78,000 members. Students are elected to membership by the chapters from the top 20 per cent (scholastically) of their engineering classes on the basis of character and service to their schools; alumni may be selected on the basis of their ominent achievements in the profession of engineering.

After many years of discussion, the convention finally voted to admit women to membership in Tau Beta Pi, although this action is still subject to ratification by the student members of the chapters. Up to this time, only a special award, called the women's badge, has been authorized for presentation to outstanding women students and graduates in engineering. Over the past 29 years, 156 women have been so honored; and they will be first to be offered membership in the association if the measure is ratified by the student groups.

●

TRIANGLE

(Ad #2)

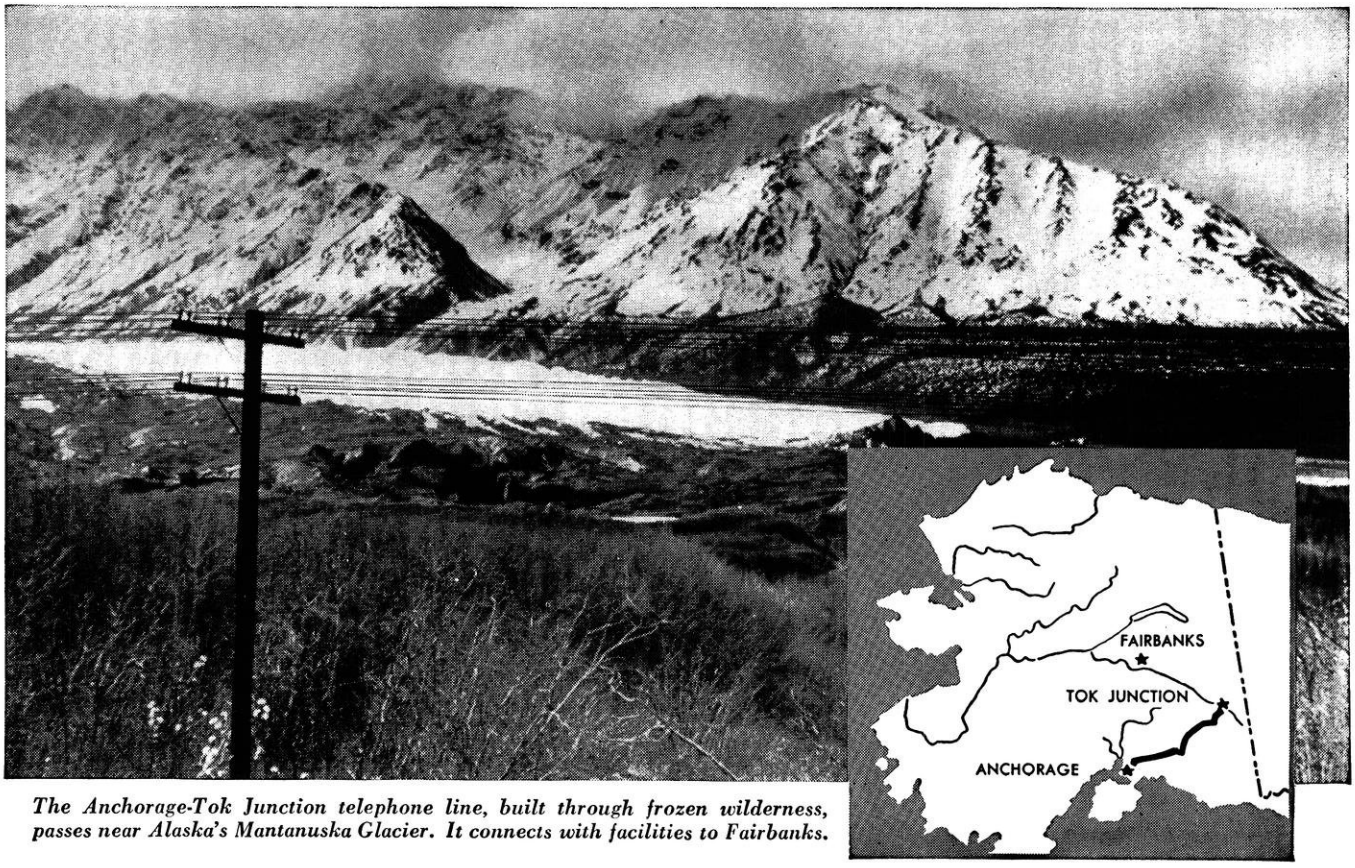
Since you last heard from us, quite a bit has happened at Triangle fraternity.

Our treasured "Blarney Stone," which proves that Saint Patrick was an engineer, is now reposing on our mantle after its eight month trip to the Marquette Chapter.

As for activities, we had a party after the Marquette game, even though the Marquette boys were rather forlorn after their defeat. The house was the scene of a party after the Ohio State game also.

The volleyball team came through the season with a record of two wins and two losses; and practice for the basketball season is in full swing.

Maybe you've noticed all the hubbub and activity around 438 Frances, so we'd like to explain. The house is being repaired on the outside, and the boys are trying to keep up to the carpenters by painting the exterior. Very soon we hope to have a new gray and white paint job adorning the structure.



The Anchorage-Tok Junction telephone line, built through frozen wilderness, passes near Alaska's Mantanuska Glacier. It connects with facilities to Fairbanks.

The line is through to Tok Junction, Alaska

Ever hear of permafrost? It's sub-surface earth, permanently frozen hard as rock. But it was only one small problem in pushing through Alaska's newest telephone line

As the nation's defense perimeter was pushed northward, it became plain that high-speed communications were needed for Alaska. The Army Signal Corps asked the Bell System to help build a modern telephone line for our strategic northern outpost. Today the line is a fact.

But the 330-mile route between Anchorage and Tok Junction on the Alcan Highway called for all the resourcefulness and skill of Bell System and Army engineers.

What type of line? Engineering studies and surveys proved that weather, expense and maintenance problems made it impractical for the new line to be aerial or buried cable or radio relay. The answer was open-wire pole line plus carrier equipment. But stringing this line through frozen wilderness was rough business.

The line had to cross two high mountain ranges. Average spacing between poles was 155 feet, but to bridge rivers, ravines and steep mountainside descents called for long-span crossings, ranging from 400 to 1800 feet.

Getting the right vehicles, tools, and materials to the right places when needed was a major feat of planning in this wilderness. The line called for 15,000 poles of varying lengths, 2500 crossarms, 1,325,000 pounds of copper-steel wire and 2400 tons of hardware.

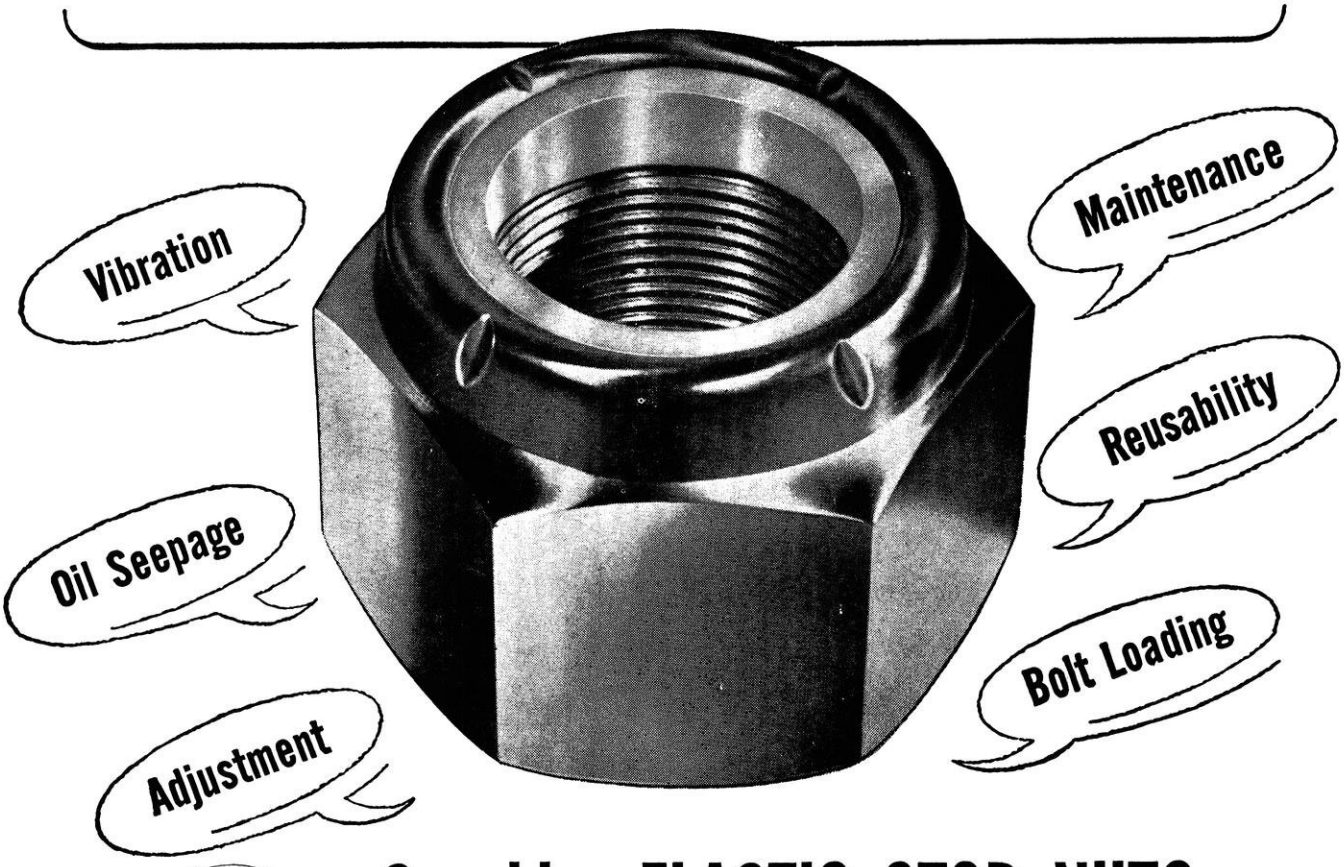
Dynamite licks permafrost. Bulldozers, pole-hole diggers and big trucks battled their way over tortuous mountain roads. The simple process of setting poles proved almost impossible in some areas because of a volcanic silt hardened by permafrost. No drill was tough enough to withstand its pumice-like action. The problem was licked by punching holes and using small dynamite charges.

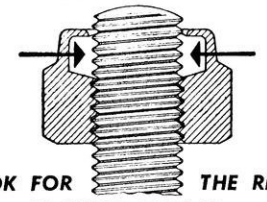
But now the work is done. Engineers have turned their talents to other parts of the vital communication system—building a long distance dial switching system between Anchorage and Fairbanks.

And so it is with the fast-growing telephone company. There always is a new frontier to conquer—in research, at the Bell Laboratories, in manufacturing at Western Electric, or in one of the operating companies serving the changing requirements of a constantly shifting population. Check now with your Placement Officer on the opportunities which await college engineers in the Bell System.

BELL TELEPHONE SYSTEM

Whenever fastening problems arise...





Consider ELASTIC STOP NUTS

LOOK FOR THE RED LOCKING COLLAR

It is threadless and resilient. Every bolt impresses (but does not cut) its full thread contact in the Red Elastic Collar to fully grip the bolt threads. In addition, this threading action properly seats the metal threads—and eliminates axial play between bolt and nut threads. All Elastic Stop Nuts—regardless of type or size—lock in position anywhere on a bolt or stud, maintain accurate adjustments and seal against liquid seepage. Vibration, impact or stress reversal does not disturb prestressed or positioned settings.

Whenever fastening presents a problem—ESNA is ready with a quick answer. More than 3000 types and sizes of self-locking vibration-proof fasteners—plus the "know-how" of ESNA engineers—are available here at ESNA.

ESNA has long been known as "design headquarters" for self-locking fasteners. Accepted by Army, Navy and Air Force, virtually every aircraft built in the past decade has been Elastic Stop Nut-equipped. On the railroads, in the oil fields, on automobiles and construction equipment, Elastic Stop Nuts manufactured to exacting quality control standards, are doing specialized jobs every day.

Be familiar with the design help ESNA offers. Write us for details on Elastic Stop Nuts. Elastic Stop Nut Corporation of America, 2330 Vauxhall Road, Union, N. J.

ELASTIC STOP NUT CORPORATION OF AMERICA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ANCHOR


HIGH TEMPERATURE


SPLINE


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GANG CHANNEL


NYLON CAP

DESIGN HEADQUARTERS FOR SELF-LOCKING FASTENERS

How your pipe dreams may become realities!

Lengths of Republic Electric Weld Casing are rapidly joined together and lowered hundreds or thousands of feet into an oil or gas well to line it with tough steel—to protect its walls against the tremendous pressures that otherwise might cause collapse of the hole.

YOU MAY NEVER DRILL for oil as a career. Nevertheless, this pipe has a message for you.

Pioneered some 23 years ago by Republic, this pipe is made by a process of electric resistance welding. Flat-rolled steel, uniformly thick, with both sides visible for inspection, is cold formed and electric welded into tubular form. The resulting pipe is uniformly round, uniform in wall thickness and uniformly strong throughout every inch of its structure. These qualities have speeded installation and improved pipe performance. Millions of feet of casing and tubing, and thousands of miles of line pipe in service have proved the dependability of the process.

You may be out of school for several years before all the economic importance of these qualities have become a part of your experience. At this point, just consider this one fact about electric welded steel pipe: it was developed by a producer of steel. Republic is now the leading manufacturer of this type of product. Republic also fabricates many other products from steel—such as tubing, conduit, culverts, radio towers, windows, office furniture, steel cabinets for kitchens. It is a leading manufacturer of these products, too.

Your pipe dreams of success in industry are more likely to flow with realities if you associate with a dynamic company. Some companies merely produce a material. Wouldn't you be better off with a company that not only produces a basic material, but also knows how to design and fabricate its own product? *That* company really knows what it is making—and selling. Such a company is Republic Steel.

REPUBLIC STEEL

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REPUBLIC STEEL

WORLD'S WIDEST RANGE OF STEELS AND STEEL PRODUCTS

MATERIALS HANDLING PRIZE AWARD

The Wunsch Foundation, Inc., has established with the University of Wisconsince a permanent trust fund to be known as the "Silent Hoist and Crane Company Materials Handling Prize Award." The income accruing from this fund is to be awarded annually to University students submitting the best papers on the subject of Materials Handling.

The Wunsch Foundation established this fund to promote the application of sound economic and scientific principles to materials handling and to stimulate the interest of University students in this subject.

Awards

The awards will be granted on June 1, 1954.

The prize awards for 1954 will be 100-50-15 and 10 dollars. Subsequent awards will depend upon the funds available.

The papers will be judged by a board of review, consisting of three faculty members interested in materials handling.

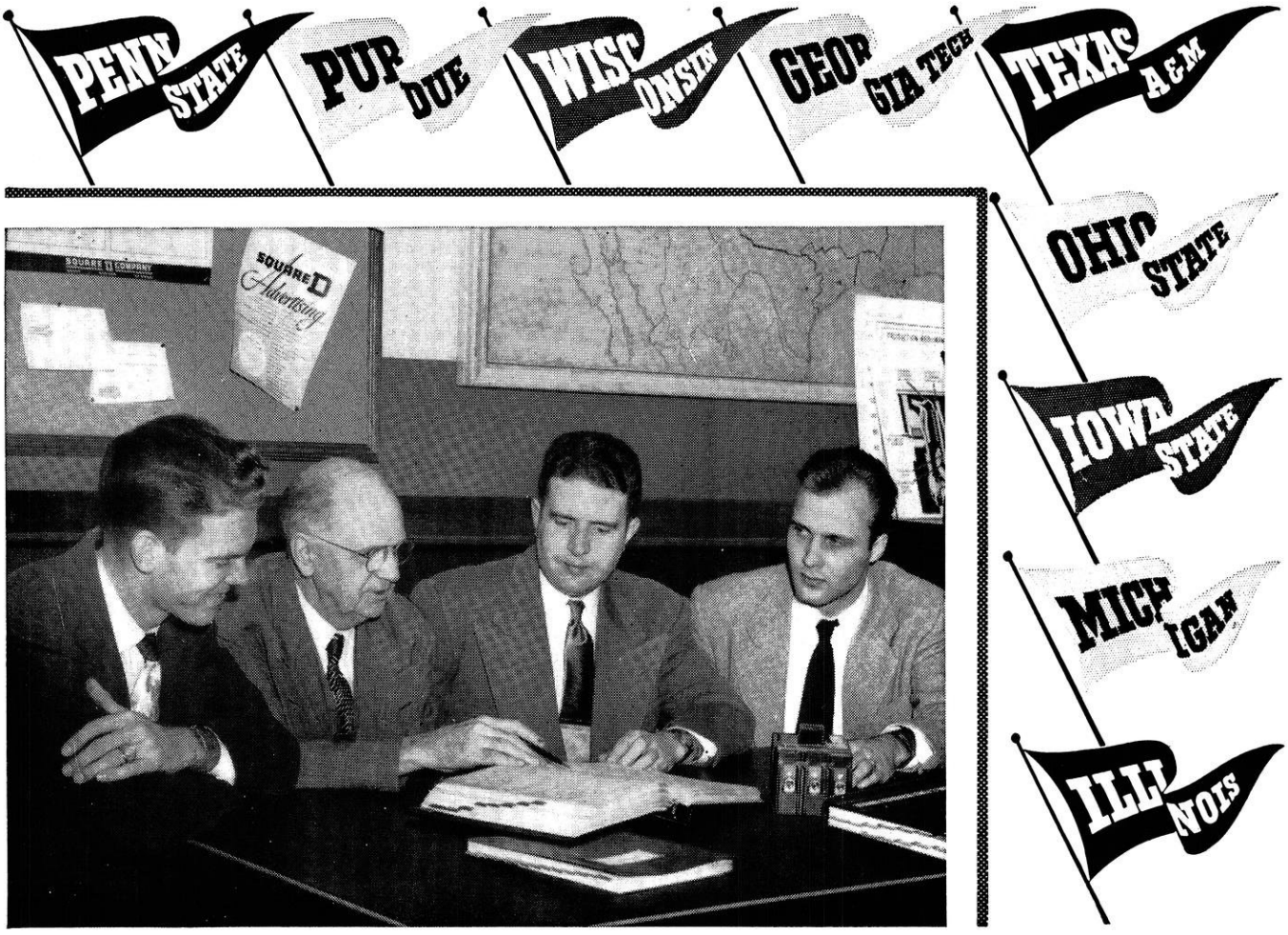
The decision of the board of review will be final.

Rules for the Awards

1. The competition is open to all members of the student body, both graduate and undergraduate, who are enrolled in a regular course of study at the University.
2. Papers, to be eligible, must be submitted in duplicate to the board of review, on or before April 1st., each year.
3. Students completing their University studies during the current year of award may enter papers while still enrolled.
4. Papers on any phase of materials handling in any field are eligible.
5. Papers will be judged on originality, organization of material, style, clarity of exposition and significance of the information presented.
6. All papers submitted shall become the property of the University of Wisconsin. The board of review will furnish the Wunsch Foundation, Inc., with a copy of each paper receiving an award; publication of such papers shall, however, be only with the consent of the Board of Review.
7. If, in the opinion of the Board of Review, papers presented in any year are not of good quality, no awards need be made. In such a case the funds available may be used to increase the number and amount of awards in succeeding years.

Board of Review Professors:

H. D. BRUHN, Agr. Engineering,
H. E. KUBLY, Commerce,
J. W. McNAUL, Mech. Engineering.



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SQUARE D COMPANY

Truck Research - -

(continued from page 21)

primarily with the ability to stop under normal conditions. The laboratory trucks are equipped with a variety of brake types including full air, air over hydraulic (hydraulic brakes with air brakes for an emergency) and pure electric. Brake timing or the period required to get full braking capacity is observed through the application of strain gauges to both foot pedal and axle. The fourth, cooling, is necessary for validity in conclusions investigated under adverse conditions. Engines, transmissions and gear boxes are all studied for their ability to avoid overheating. Fifth, acceleration tests, acceleration tests are conducted on various grades and on relatively flat surfaces. And sixth, fuel economy comparison tests have been used to compare the efficiency and effectiveness of four wheel and rear wheel drives. The comparison tests have been applied to varying terrain and during different weather conditions.

Pavement deflection tests are concerned with what deflection occurs under each type of truck and trailer as well as the harm done the highway during such deflection. Many variables effect any conclusions reached. For instance, frost action decreases a highway's capacity to withstand heavy loads. The effect of truck speed, axle spacing, and type of drive also disturbs any attempt to standardize a highway's load capacity. However, some approximations have been recorded for load limits.

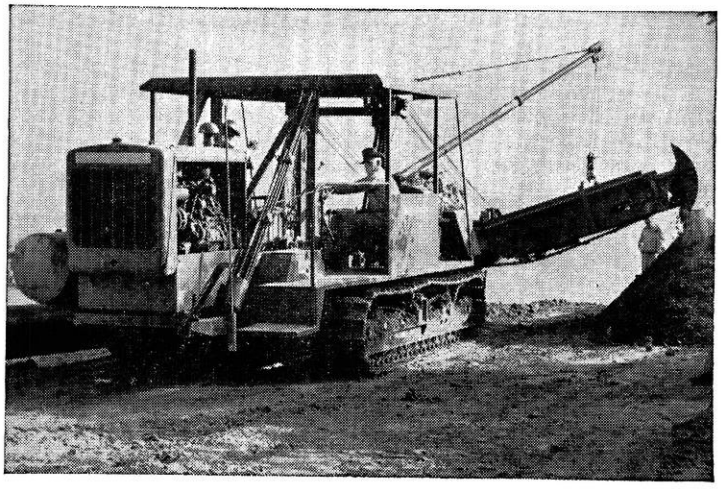
The project personnel includes three on a part time basis and two on full time. Mr. A. H. Easton, director of the project, is also an associate professor in the ME school. The responsibility of devising and organizing experimental tests and publishing the subsequent progress reports from facts collected is his. He must also procure personnel, equipment, and necessary facilities for the project. An electrical engineer, Mr. Harold Miller, is charged with the design and application of electronic testing devices and must also assist in preparing the annual progress report.

The project is subservient to the guidance of a special committee, comprised of Professors Hyland and Radar, and Professor Wendt of the Engineering Experiment Station.

It is questionable whether the Truck Research Project is an economically, justified venture, when considered from the vantage point of the sponsors. Many benefits resulting from the investigations are general, they provide truckers throughout the nation with valuable suggestions and recommendations. Either the economic burden should be carried to a greater degree by the university or those who profit directly from the project findings should be negotiated for support. This suggestion seems the more valid when present financial straits of the project with their inducing limitation are faced squarely.

THE END

Another page for **YOUR BEARING NOTEBOOK**

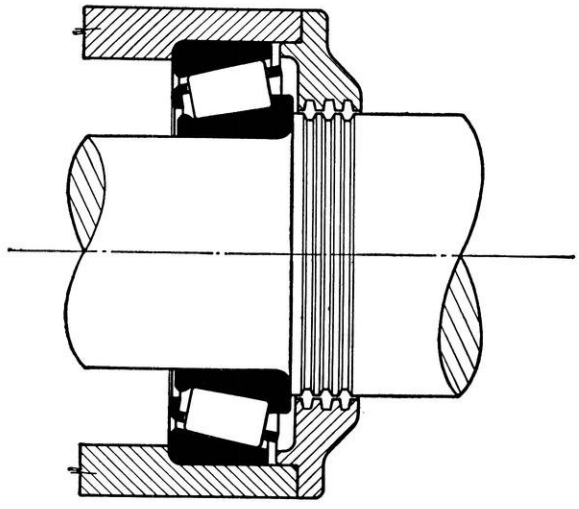


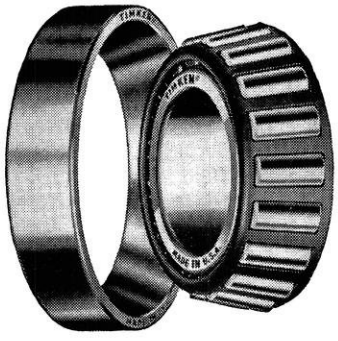
Big trencher gouges out 13 cu. yards per minute!

This big digger crawls along at 10 to 12 feet per minute digging a ditch 7½ feet wide and four feet deep. To keep it operating with minimum maintenance in this tough service, the engineers specified a total of 69 Timken® tapered roller bearings in the differential, transmissions, and track rollers. Line contact between rollers and races gives Timken bearings extra load-carrying capacity. Tapered construction enables Timken bearings to take radial and thrust loads in any combination.

Maintenance reduced with TIMKEN® bearings

Timken bearings make closures more effective, holding housings and shafts concentric. Lubricant stays in, dirt stays out. Maintenance is minimized; long, trouble-free operation is assured.





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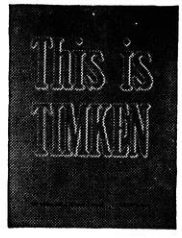
TAPERED ROLLER BEARINGS

Want to learn more about bearings or job opportunities?

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



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

Synchrotie Systems - -

(*continued from page* 19)

the excitation and I^2R losses increase, Fig. 11. Since the purpose of a Synchrotie is to maintain a speed match by providing synchronizing torques, the a-c supply must have sufficient capacity to provide the large stator currents that are required during synchronizing action.

Selection of Ratings and Frame Sizes

Although varying with individual designs and ratings, most Synchrotie units transmit continuously the normal rated motor torque at speeds as low as 50 to 75 percent of synchronous without reaching unsafe temperatures. When the Synchrotie operates continuously at reduced speeds, rotor iron losses increase because of the high induced frequencies. Similarly, operation against the field induces high frequencies, which result in greater heating.

Peak-load and accelerating torques also must be considered. For example, the rating of a receiver that is to drive a high-inertia load may depend almost entirely on the required accelerating torque and the peak torques encountered during momentary speed changes imposed by the main drive.

If dynamic braking and quick stopping are used on the transmitter prime mover, this should also be considered, because during rapid decelerations, the receiver may act as a transmitter, and the torque then available (rotation with field) for synchronizing is much less than for acceleration.

THE END

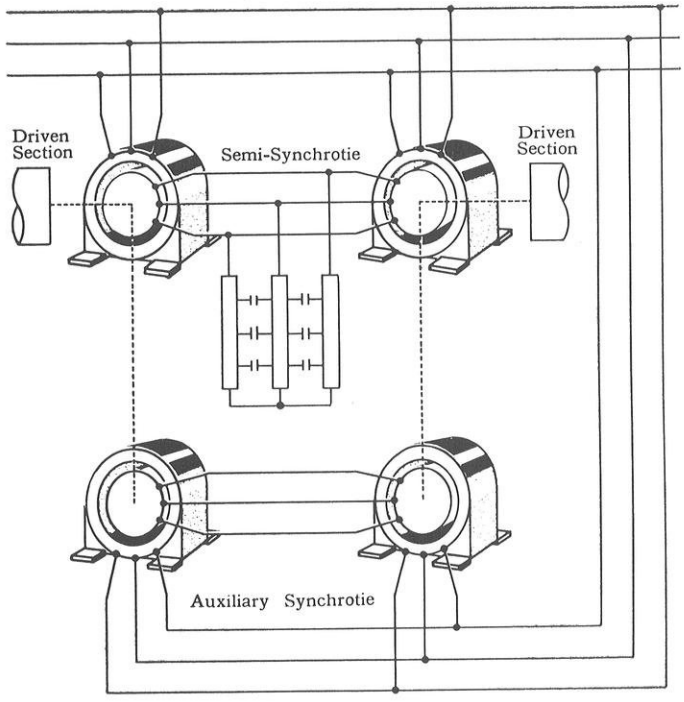


Fig. 10—An auxiliary Synchrotie must be added to a semi-Synchrotie if synchronizing torques at high speeds are desired.

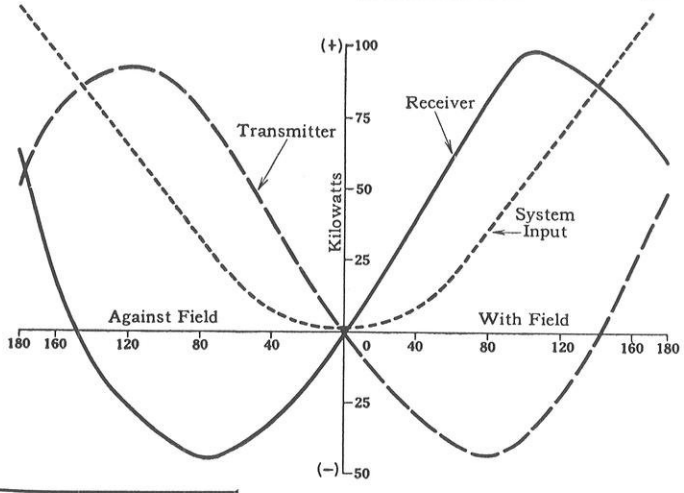


Fig. 11—Although net power required from the a-c source is low during steady-state conditions and for small displacement angles, the source must have enough capacity to supply the large stator currents during synchronizing.

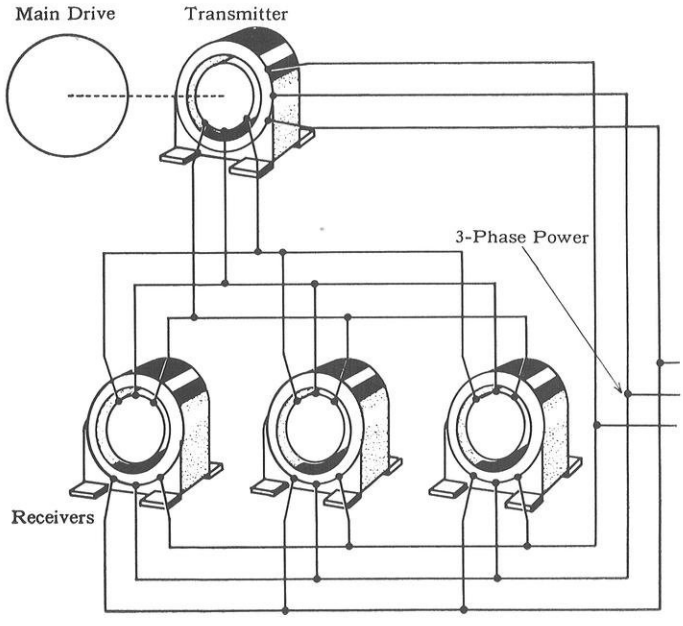


Fig. 12—To hold sections of a paper coater machine together, several receivers are operated from one Synchrotie transmitter.

THE DU PONT DIGEST

Design

AND DEVELOPMENT

Call for Knowledge, Ingenuity, Teamwork

Making new products in large amounts, devising new processes, and improving old ones—such problems are the job of Design and Development. An example was the development of a large-scale process for making "Orlon" acrylic fiber starting from small laboratory samples of polyacrylonitrile.

Quantity production of polymer was only a beginning. A whole set of new and unusual problems arose in spinning the fiber, because polyacrylonitrile decomposes before it melts, and it dissolves only in high-boiling solvents.

A team of Du Pont technical men—chemical and mechanical engineers, instrumentation specialists, metallurgists, and materials handling experts undertook to find a solution. Here are a few of the problems they met:

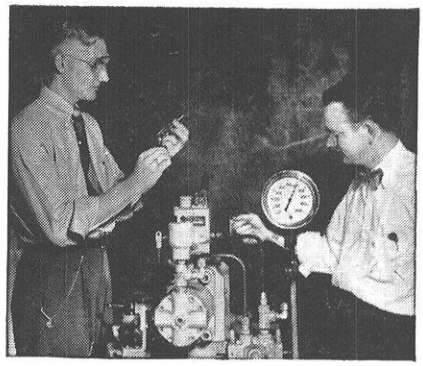
1. Solve problems in heat transfer and fluid flow arising from the fact that the spinning solution must be blanketed with inert gas to prevent fire hazards.

2. Design a system for controlling the temperature of the viscous spinning solution within ±0.5°F. at hundreds of points in the plant.

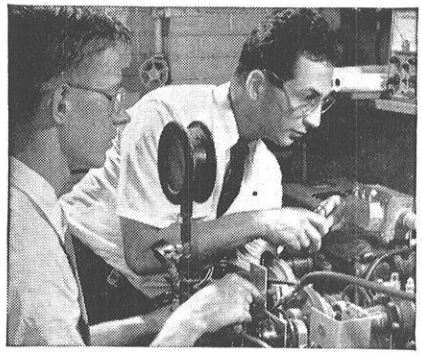
3. Design new mechanisms for winding yarn at high speed without any deviation in yarn tension.

4. Design air conditioning and ventilating systems to remove fumes from specific spots, but still allow easy access to all areas.

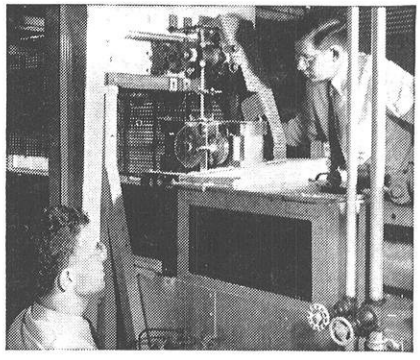
Among Du Pont's many research and engineering activities, Design and Development jobs provide great opportunity for the knowledge, ingenuity, and teamwork capacities of men in a great variety of technical fields.



The characteristics *of a super-pressure pump, designed by Du Pont engineers and made in Du Pont shops, are studied by Ralph C. Grubb, B.S.M.E., Tennessee '51, and Paul D. Kohl, B.S.M.E., Purdue '46.*



Albert Rand, *B.S.M.E., M.I.T. '50 (right) develops controls for chemical equipment.*



Carl Hellman, *B.S.Ch.E., Syracuse '50, and J. M. McKelvey, Ph.D.Ch.E., Washington '50, search for new ways to coat plastic on wire.*

ASK FOR "Chemical Engineers at Du Pont." New illustrated booklet describes initial assignments, training and paths of promotion. Just send post card to E. I. du Pont de Nemours & Co. (Inc.), 2521 Nemours Building, Wilmington, Delaware. Also available: "Du Pont Company and the College Graduate" & "Mechanical Engineers at Du Pont."

DU PONT
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. . . THROUGH CHEMISTRY

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FOR

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At Madison, Wis. and Milwaukee, Wis.

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all or part of which may have been
obtained by formal education.

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TO BE ELIGIBLE FOR THESE EXAMINATIONS APPLICATION *MUST BE ON FILE* IN THE OFFICE OF THE BOARD ON OR BEFORE DEC. 1, 1953.
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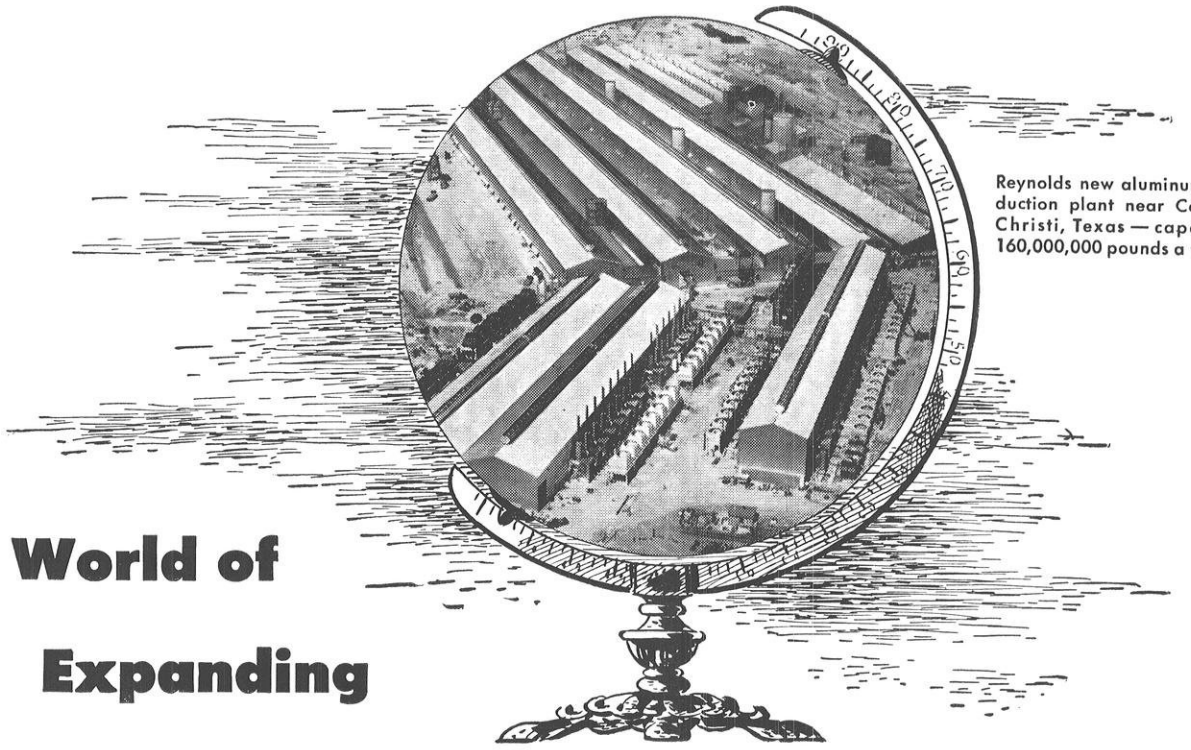
W. A. PIPER, *Secretary*
Wisconsin Registration Board of Architects & Professional Engineers
1100 State Office Building
Madison 2, Wisconsin



Reynolds new aluminum reduction plant near Corpus Christi, Texas — capacity 160,000,000 pounds a year.

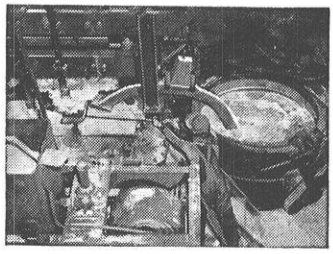
A World of Expanding Opportunity!

In a land noted for rapid expansion of free industrial enterprise, few companies have matched the swift and continuing growth of the Reynolds Metals Company. Now operating 27 plants in 13 states, and still expanding, Reynolds offers the ambitious engineering graduate a world of opportunity.

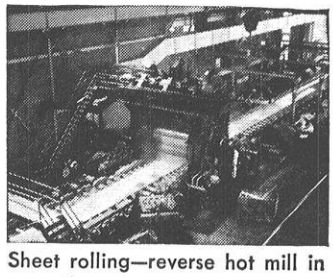
Reynolds operations include bauxite mining in domestic and foreign locations...chemical and electrolytic processing to produce aluminum pig ...sheet rolling...drawing and extrusion of mill and structural shapes ...foil rolling and printing...powder and paste production...finished parts and products fabrication. In these and in the allied sales and marketing operations promising careers exist for graduates in virtually any phase of engineering.

On-the-job training is the Reynolds policy—after preliminary orientation which may include basic experience in production plants for sales personnel, and sales office work for technical trainees. Liberal insurance, hospitalization and retirement programs are maintained.

For important background information on "your future in Aluminum," *mail the coupon.* If you are definitely interested now, write direct to General Employment Manager, Reynolds Metals Company, 3rd and Grace Streets, Richmond 19, Va.

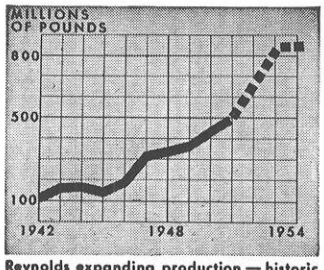


Tapping one of huge battery of electrolytic cells



Sheet rolling—reverse hot mill in operation

REYNOLDS ALUMINUM



Reynolds expanding production — historic chapter in 33 years of continuing growth.

Reynolds Metals Company, Employment Dept.
Richmond 19, Virginia

Please send me, **FREE,** your 96-page booklet, "The ABC's of Aluminum"; also the 44-page book, "Reynolds Aluminum . . . and the Company that makes it."

Name _____

Address _____

(*continued from page 35*)

tion of the federal government, was one to investigate the feasibility of the University of Wisconsin College of Engineering participating in the International Education Association in a program of assistance to India engineering schools with federal funds. Specifically the purpose would be to establish reciprocal relations with 2 universities and cooperation with 5 other technical schools in India.

The request for this relationship was instigated in India over a period of 2 years, as a result of a feeling of inadequacy in their present education system. Although theoretical training and facilities of their colleges are excellent, their training lacks the practical aspects necessary to yield good functioning engineers after graduation. It is in this respect, they need assistance.

The people of India represent extremes. They are either very wealthy or very poor; they either wear jeweled gowns or rags; live in palaces or sleep in the streets; eat 9 meals a day or a handful of rice; have autos or walk barefoot. The standard of living is low; a headwaiter makes the equivalent of $7.00 per month; a starting university professor $32.00 per month. Only a university president has enough prestige to warrant a car. The object of India's entire 5 year rehabilitation program is to raise the standard of living of all, primarily, by increased productivity, utilization of natural resources, and by reducing inequalities. It is in the utilization of natural resources and increased productivity that engineers are so sorely needed.

The country is largely a very dry desert, and the population is densely located around water sources. Rainfall is limited to one period of the year—the monsoons —when the quantity of water is very great. This suggests a large program of dams at water basins, utilization for power, reservoirs, and irrigation. This endeavor will solve two of their greatest needs—water and food for their 450,000,000 people.

In the 19 days, Dean Wendt and Professor Peterson covered 28,000 miles and conferred with 400 officials of India, Indian universities, and industry. They were busy from 7 a.m. to 9 p.m. nearly every day in India's 100° degree temperature, and each of them lost from 7 to 8 pounds in the ordeal. Their trip included visits to Banglor, Calcutta, Dunbarr, New Delhi, the India Institute of Science, Bengal Engineering College, Mysore State University, and Jodapar College. They found the people very hospitable, enjoyed American, British and Indian menus; living accommodations were reasonable, good, and modern.

The trip was successful; they found that India had a need which the College of Engineering could fill and so they negotiated a contract with the federal government for $680,000 to supply 16 professors to 7 institutes for a period of one to two years. The program will include teaching over there, as well as bringing Indian nationals here to train them in our ways and industry.

Slides were shown of the various places visited on the trip.

FOX RIVER VALLEY CHAPTER

●

R. E. LEE
Reporter

Mr. H. I. Miller was elected chairman of the education committee instead of Mr. B. E. Brevik, as previously announced.

Further information concerning this chapter is dependent upon the diligence of the chapter publicity chairman.

NORTHWEST CHAPTER

●

R. N. MORRIS
Reporter

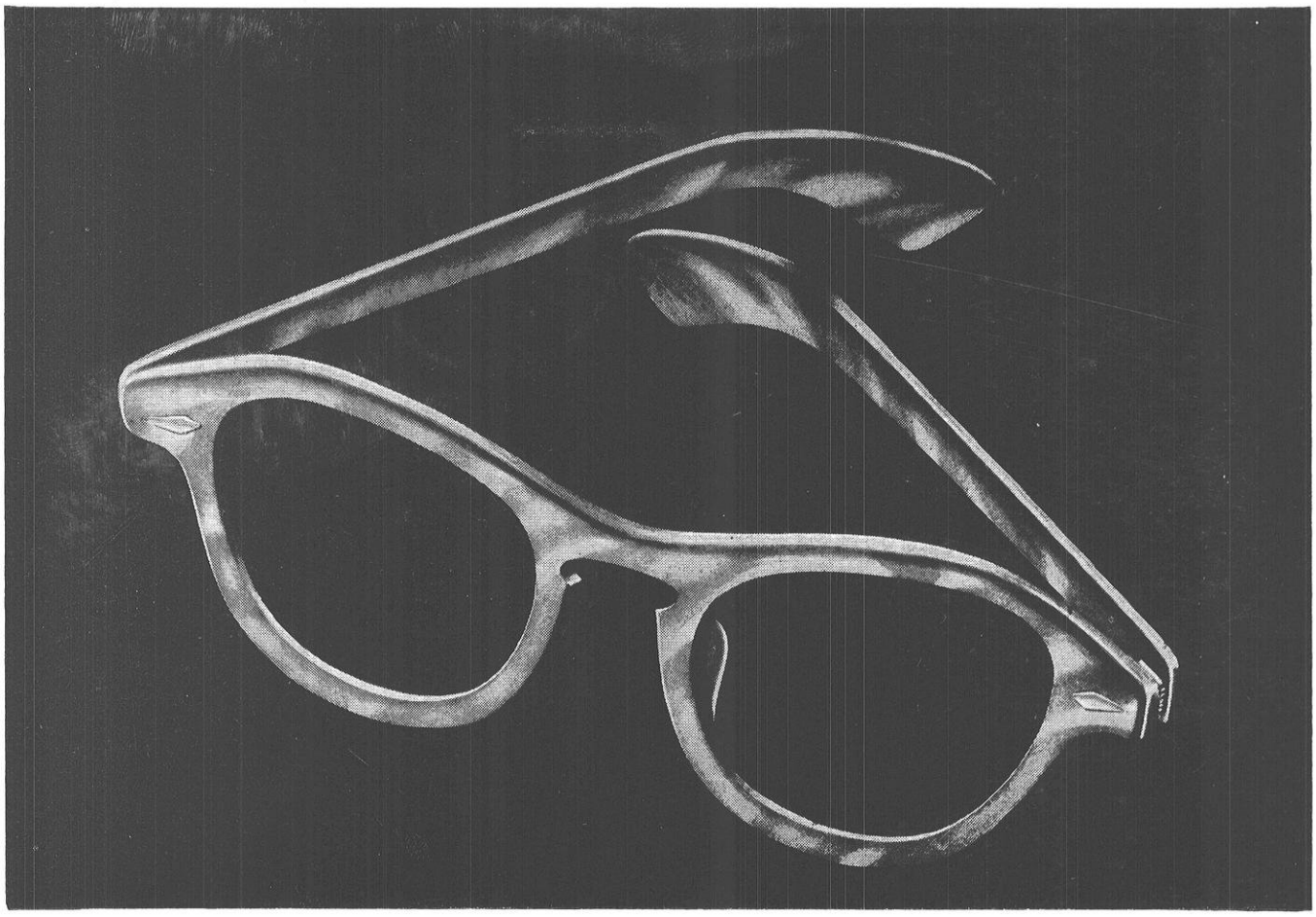
The Northwest Chapter was favored by a visit from WSPE President Pierce Ellis at our meeting of October 1. Coming from points as widely separated as Ashland and River Falls, ten wives and twenty-two men assembled at the Elks Club in Rice Lake. After the usual social period, the next order of business, a good chicken dinner was disposed of. At this point the ladies beat a retreat to the home of our lone Rice Lake member.

After considerable discussion and parliamentary bickering as to the attitude of the membership toward a suggested increase in state society dues, the decision was to instruct our representatives at the state board meeting to use their own best judgment. Some believe increased dues will increase effectiveness, others that it might slow down the increase in membership, while still others thought an increase in dues should be accompanied by a larger kick back to the chapters.

President Pierce gave an interesting discussion on society problems both in his formal talk and before and after the meeting. The attendance of a state officer is an inspiration and very helpful to the local group, also the officer learns of the different attitudes and thinking throughout the state.

Mr. R. G. Cooper is now serving as chairman of the fees and classification committee.

(*please turn to page* 52)



VISION OF VERSATILITY . . .

Look through this . . . or any of the uncounted millions of plastic eyeglass frames produced annually . . . and you'll see a bright future for plastics . . . one of the world's most versatile materials.

You'll see plastic toys and telephones, buttons and bottles, dishes and draperies, casings and coatings. For this miracle material may be of animal, vegetable or mineral origin . . . flexible or rigid . . . transparent, translucent or opaque . . . clear or colorful. Rust, rot, age or chemical action hold little or no threat to its usefulness.

SCOPE UNLIMITED . . .

How can one estimate the tremendous growth of plastics? In pounds produced the annual rate is twenty times as great as in '34 . . . but in terms of application, figures fail. Nor can one count the contributions of science and industry to its development. Chemists, mathematicians and physicists have contributed research . . . designers dreamed uses . . . engineers and production men gave the ideas physical form.

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McGRAW-HILL FOR BUSINESS

WESTERN CHAPTER

D. W. GRUNDITZ
Reporter

(*continued from page* 50)

Mr. Paul Kuhlen and Mr. Stanley Reaves spoke on the operations and organization of the Allis-Chalmers Manufacturing Company at the opening fall dinner meeting of the Western Chapter, Wisconsin Society of Professional Engineers held Tuesday evening, Oct. 20, at the Stoddard Hotel. Mr. Kuhlen is superintendent of plant maintenance and Mr. Reaves is assistant chief engineer of the La Crosse Works of Allis-Chalmers.

Mr. Reaves presented the overall view of Allis-Chalmers, describing the type of products of the two divisions, general machinery and tractor, of the firm. The general machinery division produces power plant and process industry equipment such as turbines, pumps and generators. The tractor division manufactures tractors and earth moving, cultivating, and harvesting equipment. The La Crosse Works is concerned with the engineering and manufacturing of approximately 800 items of machinery and attachments of the farm implement class including such items as plows, harrows, and planters. Mr. Reaves elaborated on the problems and trends in the design, development and field testing of farm implements.

Mr. Kuhlen outlined the La Crosse Works departmental organization which consists of the engineering, accounting, purchasing, and manufacturing departments operating under the coordination of the La Crosse Works manager with responsibility to management in Milwaukee. The facilities of the several shops in the manufacturing department were enumerated and many noteworthy advances in machinery and fabrication development were pointed out. The important part played by special services of the manufacturing department such as metallurgical analysis, preventive maintenance, health and safety, and suggestions and awards was clearly brought out.

The LaCrosse Works of Allis-Chalmers now employs about 1000 people in a plant area of about 37 acres with an annual average payroll of $4,000,000.

The next meeting of Western Chapter, WSPE, will be held November 17 at the Cerise Club and will feature Mr. J. W. Magee, Jr., of the Westinghouse Corporation in an illustrated talk on aircraft jet engines.

"The Atomic Bomb" was the topic of Mr. E. T. Neubauer at the Monday evening, Oct. 19 presentation of the 17th annual forum series at Wisconsin Rapids. The talk was one of a series sponsored by the School of Vocational and Adult Education and the Central Labor Body of Wisconsin Rapids.

Mr. Neubauer, chief development engineer at the Trane Company, was formerly employed on the Manhattan Project at Columbia University and the Hawley Plant, and was assistant chief project mechanical engineer at Oak Ridge, Tenn. He holds both the bachelor of sciense and master of science degrees in mechanical engineering from the University of Michigan and the Massachusetts Institute of Technology, respectively. His local professional and technical activities include offices or chairmanships in the Wisconsin Society of Professional Engineers, the American Society of Mechanical Engineers, and the American Society of Tool Engineers. He participates in several other technical and civic organizations.

WISCONSIN VALLEY CHAPTER

J. M. ABERNATHY
Reporter

We have received no information from this chapter.

SOUTHEAST CHAPTER

H. J. CARLIN
Reporter

On October 6, Walter A. Pierce, manager of the Racine water department, was honored by the Racine city council with a resolution citing his 25 years service to the city.

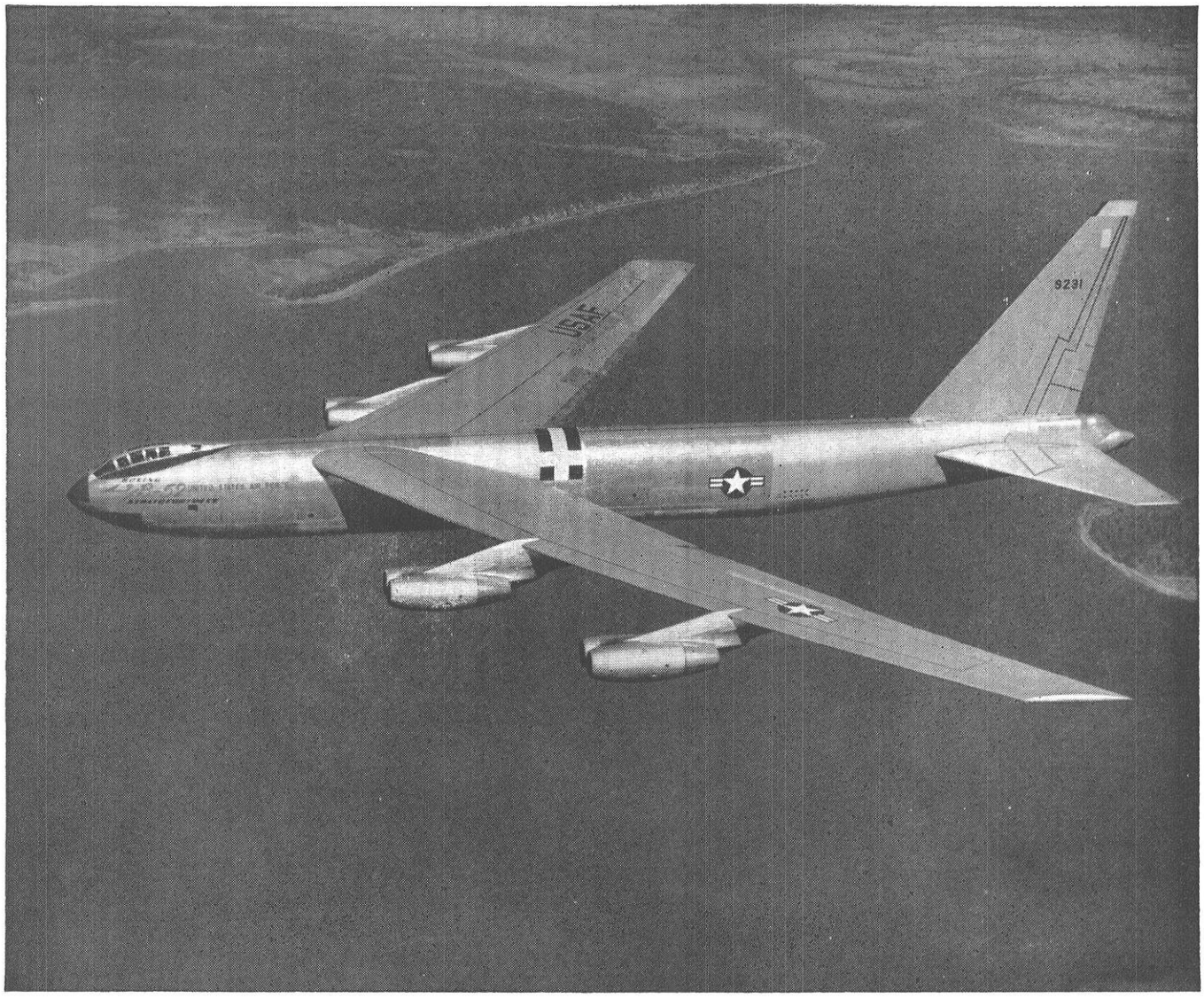
The council also lauded Mr. Peirce for his assistance in the development of programs for the training of young engineers and for the numerous awards he has received from engineering societies and institutions of higher learning, and for distinctive service in the field of engineering.

A copy of the resolution suitably inscribed will be presented to Walter Peirce by the city clerk.

Harry E. Mereness, 65, for 40 years employed as civil engineer at the Wisconsin Natural Gas Company and Electric Power Company in Racine, Wisconsin, died October 3, 1953. He was a member of St. Edward's Church, B.P.O.E., E.M.-B.A. of the Wisconsin Natural Gas and Electric Power Company, the W Club of the University of Wisconsin and the N.S.P.E.

The Southeast Chapter of WSPE held its regular dinner meeting at The Cedars in Cedarburg, Wisconsin, on October 21, 1953, Jim Trebilcock presiding.

(*please turn to page* 54)



You'll be at the head of the jet parade at Boeing

For long-range opportunities, it's hard to beat the jet aircraft field. If *you* want to get into this exciting branch of engineering after you graduate, get in at the head of the parade—at Boeing.

Through the fighter-fast B-47 six-jet bomber, and the giant new eight-jet B-52, Boeing has acquired more experience designing, flying and building multi-jet aircraft than any other company, either here or abroad. In addition, Boeing is the first American company to announce its entry into the jet transport field.

Engineering graduates will find in the aviation industry an unusually wide range of experience, and great breadth of application — from pure research to production design, all going on at once. Boeing is constantly alert to new techniques and materials, and approaches them without limitations. Extensive subcontracting and major procurement programs, all directed and controlled by engineers, afford varied experience and broad contacts and relationships.

Aircraft development is such an integral part of our national life that young graduates can enter it with full expectation of a rewarding, long-term career. Boeing, now in its 37th year of operation, employs more engineers today than even at the peak of World War II. Its projects include guided missiles, research on supersonic flight and nuclear power for aircraft.

Boeing engineering activity is concentrated at Seattle in the Pacific Northwest, and Wichita in the Midwest. These communities offer a wide variety of recreational opportunities. Both are fresh, modern cities with fine residential sections and shopping districts, and schools of higher learning where engineers can study for advanced degrees.

There are openings in ALL branches of engineering (mechanical, civil, electrical, aeronautical, and related fields), for **DESIGN, DEVELOPMENT, PRODUCTION, RESEARCH and TOOLING.** Also for servomechanism and electronics designers and analysts, and physicists and mathematicians with advanced degrees.

• • •

For further information consult your Placement Office, or write:

JOHN C. SANDERS, Staff Engineer—Personnel
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BOEING

(continued from page 52)

Mr. George Sievers of the Industrial Engineering Institute, noted engineer, psychologist and educator, gave an illuminating talk on "The economic situation in Europe, as seen through the eyes of a professional engineer." Mr. Sievers returned to his native Germany in the summer of 1952 to teach during the summer session at two of Germany's leading universities.

Following the speech, an informal panel discussion was held to give members the latest information on "Unity Amongst Engineers," "Unionism Amongst Engineers," "What Registration Means to You and Yours," "Why Join NSPE and WSPE," and "Report on the Recent Wage Survey by NSPE."

At the informal panel discussion Mr. Edwin W. Seeger, vice-president, NSPE, spoke on the importance of public relations to the general public and specified groups. Mr. Arthur G. Behling, national representative, NSPE, discussed special functions such as salary classification. Incompatibility of professionalism and unionism, unity organization and professional objectives. Mr. Pierce G. Ellis, president, WSPE, talked on the highlights of accomplishments and activities for the past 10 years, and on changes to strengthen the registration laws. Mr. Donald C. Bengs, acting secretary for this meeting, reviewed Engineers' Week activities for the Southeast Chapter. The panel was thrown into open discussion by members and guests.

Open discussion followed to determine the best way to serve engineers residing in Ozaukee, Washington, Dodge, and Jefferson counties. Representatives of Milwaukee and SE Chapters were present to answer questions.

The next meeting will be held in Waukesha on Wednesday, December 2.

MILWAUKEE CHAPTER

CLYDE R. ETHIER
Reporter

The Milwaukee Chapter of WSPE, as an affiliate of the Engineers' Society of Milwaukee, has joined with the other ten affiliated engineering groups to form an affiliate council. Each of the societies has selected a representative to serve on the coordinating program group of the affiliate council. This program group, meeting every two weeks, has been working diligently to present two outstanding programs during the coming year.

At the first program General Sam D. Sturgis, Jr., chief of engineers, U.S. Army, will address the combined engineering groups on "The Corps of Engineers, the St. St. Lawrence Seaway, and the Great Lakes System." This meeting will be held at 8:00 p.m., November 18 at the Public Service Auditorium, 231 W. Michigan Street, Milwaukee. In view of the excellence of this program, the Milwaukee Chapter of WSPE is not scheduling any other meeting of the general membership during the month of November.

A record number attended the October dinner and meeting at the ESM building in Milwaukee, and heard Dr. Karl B. McEachron speak on "Professional Development of Engineers Employed in Industry." Dr. McEachron is in charge of professional employee relations for the General Electric Co. His is a full-time job of trying to provide a "favorable climate" for the professional employees of the company.

One of the more impressive points Dr. McEachron raised, was whether an engineer can join a union and participate in recognized union practices and still maintain the ethics expected of an engineer. Dr. McEachron felt that one could not. And yet the engineering profession as a whole and those who employ engineers are not doing enough to bring this fact to the attention of young engineers, who are most susceptible to the invitations of the unions.

The engineer's position is more closely comparable to management than to labor. We have the professional engineers on one hand trying to increase the prestige of the engineer, and the unions on the other hand trying to get all engineering employees grouped with draftsmen, technicians, and the like, as labor.

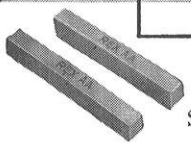
Dr. McEachron did not suggest any cure-all for the present situation, but agrees that something should be done toward unity in the engineering profession; that a unity group speaking for all engineers would be in a better position to state the engineers' case in such a manner that management could not force the employed engineers to look toward labor unions as their sole method of obtaining financial recognition from the company they serve.

Editor's Note—The copy for both the Milwaukee chapter and the Southeast chapter came to this office after our regular deadline. Late material means extra handling; but more than that, it means tnat we must estimate space for the copy and insert the article without the usual galley proofs. If, under unusual circumstances, some last minute information of importance does pop up, the ENGINEER staff will be happy to go to the extra work of seeing that it is included even though the deadline is past. However, please don't turn in your copy late just because you "just didn't get around to sending it in". A day's delay by you can double the work for us, and God only knows, we've got enough work now.

THE END

What's Happening at CRUCIBLE

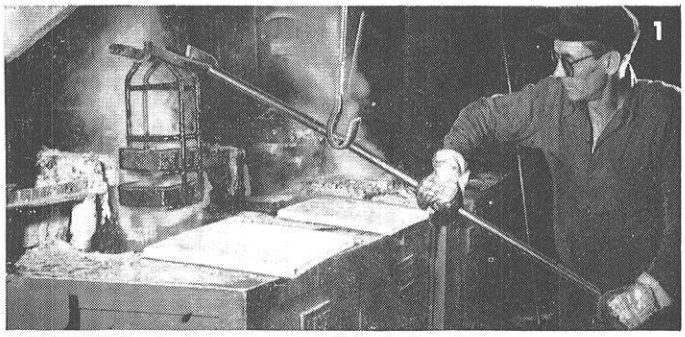
about REX HIGH SPEED tool bits



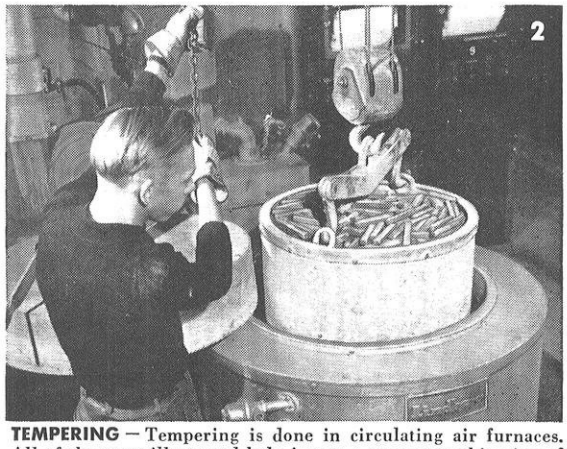
Many millions of REX High Speed Tool Bits have been produced, in recent years, at Crucible's Sanderson-Halcomb Works, Syracuse, New York.

Our Tool Bit Department is actually a manufacturing plant in itself, where production is counted in pieces—in sharp contrast to the larger production units of most other phases of steelmaking.

REX High Speed Tool Bits are made from high quality high-speed steel bar stock, produced at Crucible's Sanderson-Halcomb Mill. Bars are cut to tool bit lengths, heat-treated, grit-blasted or ground, and inspected.

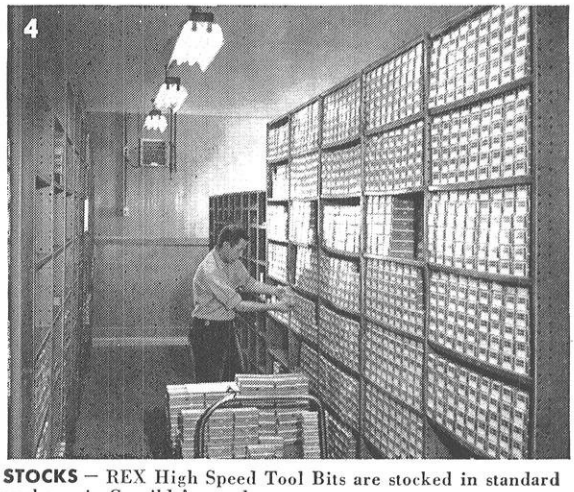


HARDENING — Small batches of REX High Speed Tool Bits are hardened in modern salt bath furnaces. The bits are then quenched in either salt or oil.



TEMPERING — Tempering is done in circulating air furnaces. All of the steps illustrated help insure a correct combination of maximum red hardness, toughness and abrasion-resistance necessary for continuous high cutting efficiency.

TUMBLING — Prior to inspection and packaging, REX High Speed Tool Bits are cleaned by tumbling.



STOCKS — REX High Speed Tool Bits are stocked in standard packages in Crucible's warehouses.

Uniformity Each individual REX High Speed Tool Bit possesses the same uniform high quality. Each bit is inspected by the magnetic particle method . . . and representative bits are tested for microstructure and hardness. These tests control quality of the finished product . . . insure that REX bits will give higher production from each grind, and a minimum of "down-time" on your machine.

Crucible Engineering Service Available Crucible engineers are available to work with you in the selection of the proper REX grade for highest cutting efficiency on your particular job.

CRUCIBLE first name in special purpose steels

53 years of Fine steelmaking

CRUCIBLE STEEL COMPANY OF AMERICA, GENERAL SALES OFFICES, OLIVER BUILDING, PITTSBURGH, PA.

Midland Works, Midland, Pa. • Spaulding Works, Harrison, N. J. • Park Works, Pittsburgh, Pa. • Spring Works, Pittsburgh, Pa.
National Drawn Works, East Liverpool, Ohio • Sanderson-Halcomb Works, Syracuse, N. Y. • Trent Tube Company, East Troy, Wisconsin

Petroleum and the Future - -

(continued from page 27)

lands to date. From this it can be seen that exploration is no easy job. To expedite tnis process, the science of geophysics has advanced from taking soundings by dynamite to date. From this it can be seen that exploration is no easy job. To expedite this process, the science of geophysics has advanced from taking soundings by dynamite to electronic and radioactive logging, obtaining inclinations by dipmeter, aerial mapping, and radio surveying. Of particular value of 3-D aerial photographs which allow rapid surveying of large land areas. This topic leads directly to drilling and well production since drilling is one of the primary exploration methods. Drilling is now achieved by a rotary bit in contrast to the old cable tool method which consisted simply of driving a heavy bit up and down. The cable tool method was slow and produced wells only about 3,000 feet deep. The rotary method as its name implies consists of twisting the bit into the earth. A fluid is pumped down the interior of the shaft and flows out around the bit and carries the dirt back up through the well with it. The newest method of drilling is a modification of the rotary bit method called the jet bit. The drilling fluid is pumped at high velocity and pressure and aids in the penetration. It is in the drilling process that electronic, redioactive, and neutron logging devices are used. They are lowered with the bit and used to examine the formations through which the bit is passing. The mud removed in drilling is also examined and devices are dropped to remove cores of the strata. In this way even dry wells lend some information which is of value in future drilling. The results of these new and modern methods of exploration and drilling are that in the period 1926-1951 we have drilled the same number of wells as in the preceeding sixty-seven years but have removed four times as much oil.

We are now in a position to see how one may arrive at availability estimates of ten to twenty years. Proved reserves for the past few years have been equal to more than ten times the annual production during these years. Thus when annual production is compared to proved reserves false estimates of future availability are the result. The rate of new discoveries has not been taken into account.

In conclusion it has been shown that estimates of our petroleum resources based on proved reserves are false and that because of excellent engineering advances in this country, production has been a function only of demand. So far that demand has been ever increasing. Until the time when atomic energy or some other form of energy limits the demand on petroleum products, there seems to be no limit to the supply of petroleum.

THE END

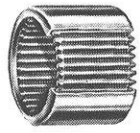
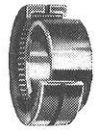
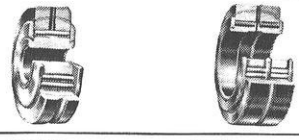
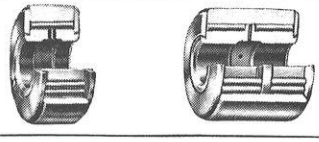
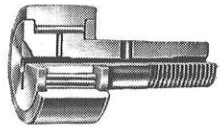
The Torrington Needle Bearing... many types for many needs

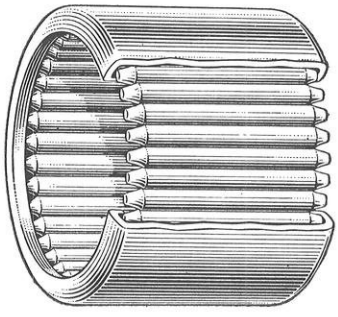
In previous advertisements in this series, the many advantages of the Torrington Needle Bearing and the proper procedure for its installation and maintenance have been discussed. The DC unit type bearing was used in these discussions because it is the Needle Bearing with by far the greatest variety of applications throughout industry.

From the basic Needle Bearing design, however, many modifications have been made. The result is a complete line of Needle Bearings suitable for specific applications. Although these bearings are all different, each offers the advantages which have made the DC unit type so popular. They give the highest possible radial load capacity in a minimum of space; they are light in weight, easy to install and simple to lubricate.

The following chart shows many types of Torrington Needle Bearings, gives their design features and general applications for which they are designed.

The new Torrington Needle Bearing catalog will be sent on request.

TYPE	SERIES	BEARINGS	DESIGN FEATURES	APPLICATIONS
DC	B		Thin, drawn shell, retaining full complement of small diameter rollers. Inner races are furnished when shafts are not hardened.	Wherever high load capacity is needed and space is at a premium.
HEAVY DUTY			The outer race is made in one channel-shaped piece, hardened and ground to precision limits. Heavy inner race.	For heavy-duty applications where split housings occur or where press fit of bearing into housing is not possible.
AIR-CRAFT	NBC		Heavy inner and outer races, with end washers securely fastened to inner race.	Aircraft applications involving oscillating motion only.
	NBE *(left)* NBK *(right)*		Similar to NBC except have self-aligning outer races.	Aircraft applications where alignment is difficult or deflection is severe.
	NBF *(left)* NBL *(right)*		Similar to NBC except have heavy outer races to carry rolling loads.	For use as rollers under heavy loads at low speeds.
CR	CR		Heavy solid-sectioned outer race and rollers made from high-quality bearing steel. Portion of stud which serves as inner race is hardened. Threaded end left soft to avoid brittleness.	Cam follower applications where maximum load capacity and shock resistance are required.



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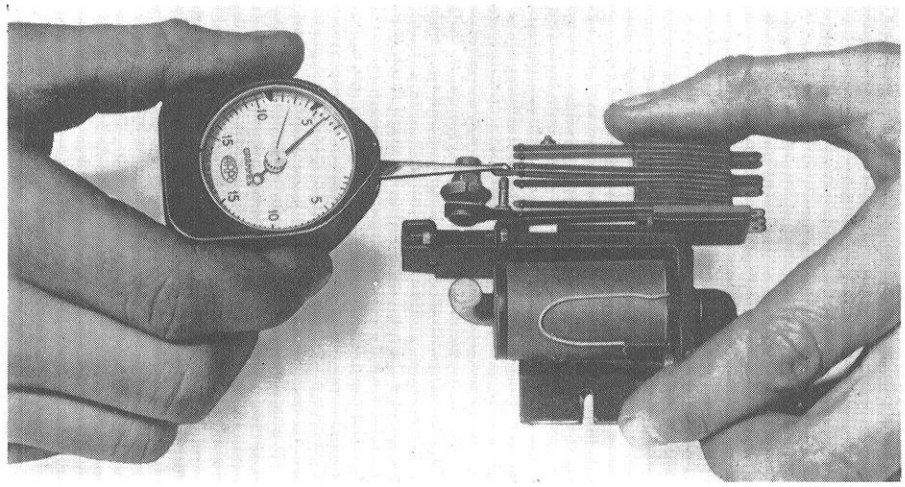
Science Highlights - -

(continued from page 25)

telephones, clocks, business machines, micro-motors for electric razors, windshield wipers, time switches and infinitely more. Applications can be found in almost every field of industry where uniformity of pressure, starting torque or spring tension are necessary to insure proper functioning.

To eliminate the necessity of observing and watching the graduation, a special friction leader hand, moved by the indicator hand, will stop and remain set at the highest point of pressure exerted by the test.



New spring tension dynamometer.

•

GLYCERINE FOR ALUMINUM-COATING STEEL

A cheap hot-dip method of coating steel with aluminum by the addition of glycerine was recently announced by the British Iron & Steel Research Association in London. The new method involves preparing the steel surface with a protective skin of glycerine before dipping. This is said to prevent two major difficulties found in previous "open dipping" techniques; first hard and brittle layers of alloyed aluminum and iron were apt to form on the strip instead of the soft ductile coating desired. Second, an adhesive skin spread across the surface of the aluminum like the scum on top of hot milk.

The glycerine coating prevents both these difficulties. As the wire or strip enters the bath through a protective carbon box, the glycerine burns quietly, preventing the ingoing strip from oxidizing. In addition, the process is such that the steel can be annealed at the same time it is coated.

•

INSTALL WORLD'S LARGEST WIND TUNNEL EQUIPMENT

Installation of the most powerful

(please turn to page 62)

MODERN FARMERS like J. A. Parks of Maloy, Iowa, using the gang plow above, can produce much more in much less time than the farmer of just a few years ago. In the horse-powered days of farming it took as many as 35 man-hours to produce and harvest an acre of corn. Now, on many mechanized farms, it is done in fewer than 11 man-hours. In addition, the shift from animal power to machine power released about 72,000,000 acres of cropland from producing feed for horses and mules to producing food for the nation's tables.

WHAT EVER HAPPENED TO THE MAN BEHIND THE PLOW?

THE "man behind the plow" is still very much in the picture, but he's *up front now*. And because he is, you and your family—even the world—are better fed today.

Not many years ago the American farmer walked behind the old horse-drawn plow, worked longer hours and produced much less than he does today. But that was before the development of the "hired hands" that never tire—the tractors, trucks and implements which do the work of many men, and the petroleum fuels and lubricants which keep them running.

In the last 50 years or so, while America's population was growing from 75,000,000 to more than 150,000,000 a remarkable change was taking place in agriculture. Today 8,000,000 *fewer* persons on America's farms are producing food for 75,000,000 *more* Americans.

Yet America has never been better fed. It has never been better equipped to export needed foods to other countries for normal requirements, or to combat famine—an ally of communism—wherever it appears.

Never have so few fed so many so well.

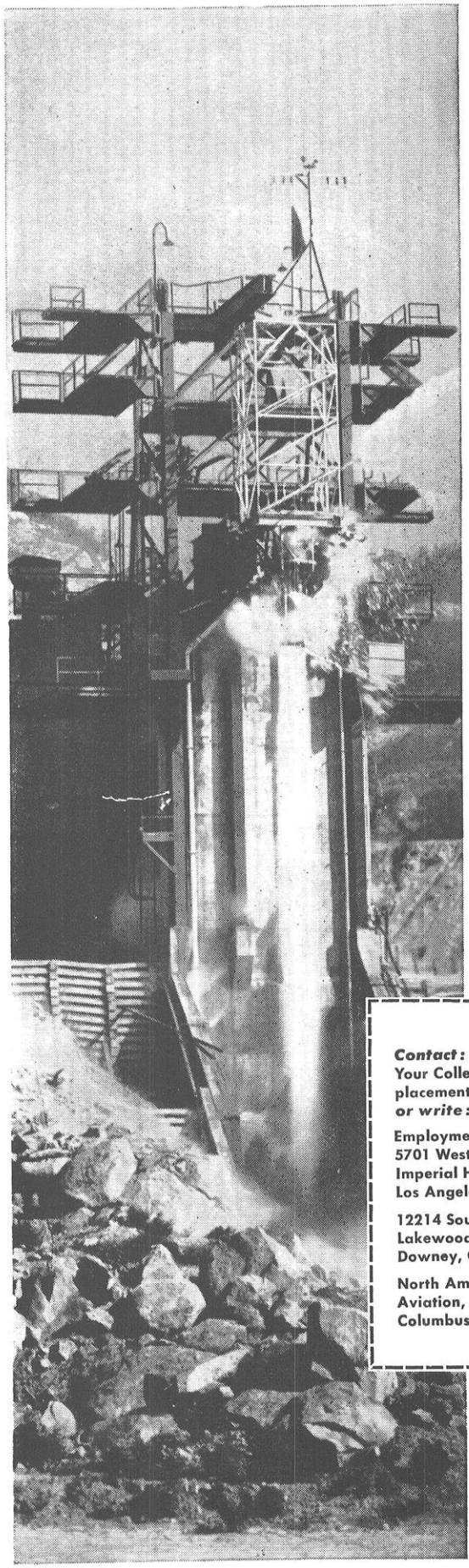
To help make ours a more abundant land, Standard Oil pioneered in delivering petroleum products right to the farmers' doors in the quantities needed and at reasonable prices. This on-the-spot delivery, started way back in 1910, was vital to the rapid growth of mechanized farming in the Middlewest—one of the most productive agricultural regions in the world.

So many rural customers have learned to depend on Standard Oil products and services that we now serve far more Midwestern farmers than any other oil company.

Standard Oil Company

910 South Michigan Avenue
Chicago 80, Illinois

STANDARD



WILL YOU BE READY TO HELP CONQUER THE "X" BARRIER?

America's security in the air may one day depend upon the kind of fresh ideas you supply . . . to solve problems that are still unknown or dimly seen. Already we have conquered the sonic barrier . . . now we're working on the heat barrier.

North American needs engineers who can work on the team that built the great planes of WW II . . . the F-51 Mustang, B-25 Mitchell . . . the record-smashing F-86 *Sabre* Jets. Other careers are in the making in North American's pioneering programs in guided missiles, jets, rockets. electronics, atomic energy . . . each years ahead to keep America strong in the air.

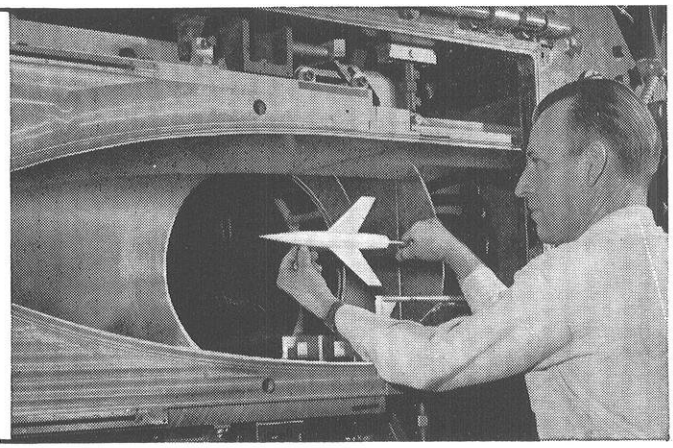
When you are prepared to enter the engineering profession, consider the well-paid career opportunities at North American. Meanwhile, feel free to write for any information concerning your future in the aircraft industry.

Contact:
Your College placement office
or write:

Employment Director,
5701 West Imperial Highway,
Los Angeles

12214 South Lakewood Blvd.
Downey, Calif.

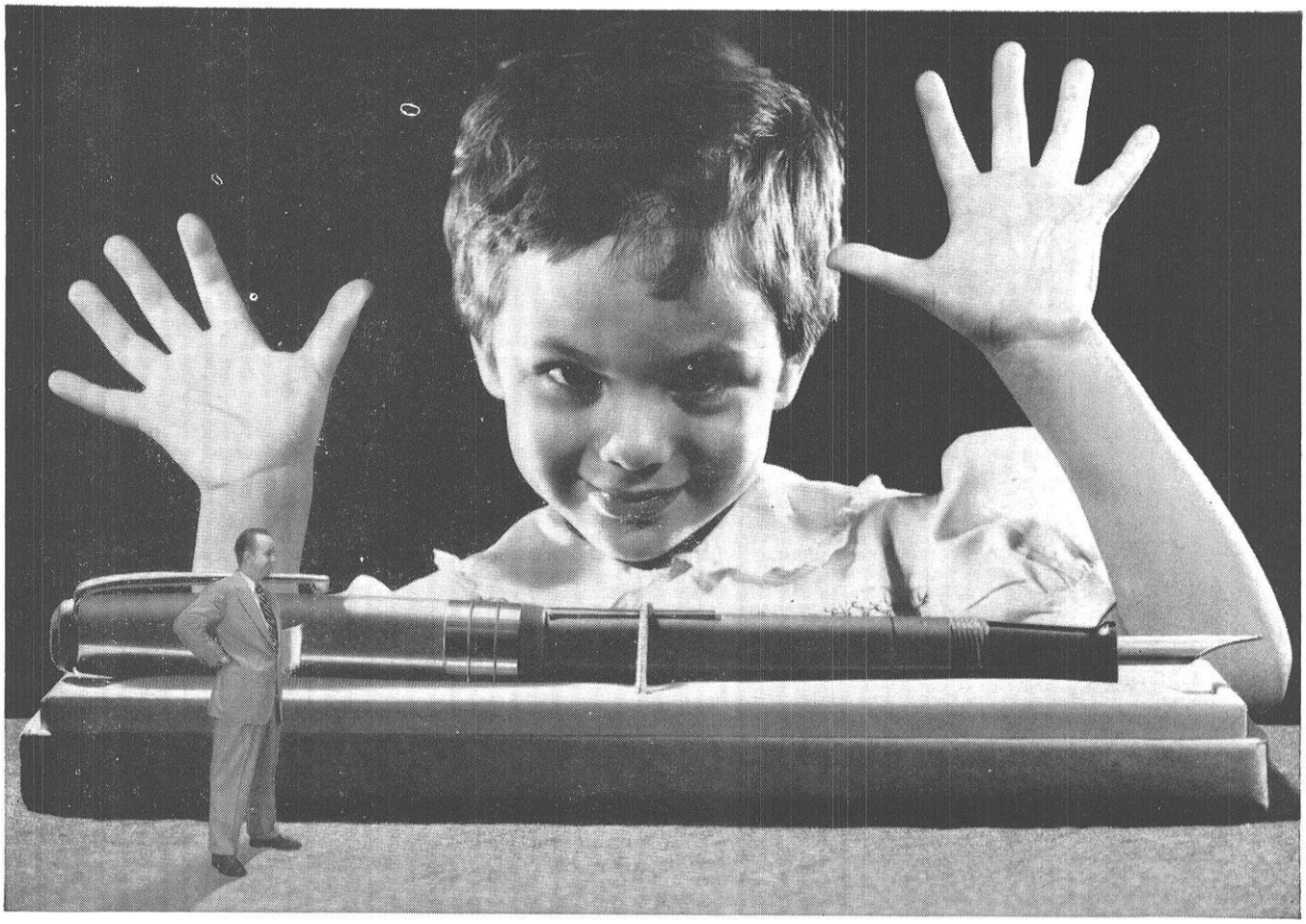
North American Aviation, Inc.
Columbus 6, Ohio



NORTH AMERICAN AVIATION, INC.

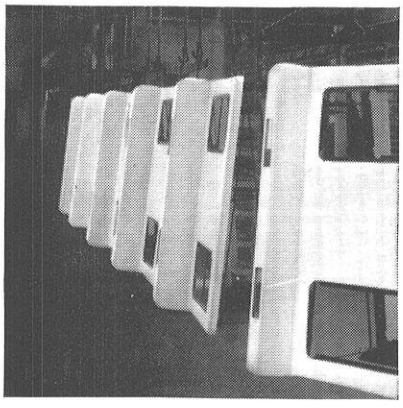
LOS ANGELES, CALIFORNIA • COLUMBUS, OHIO

North American has built more airplanes than any other company in the world



ADMIRE THE FOUNTAIN PEN. and ponder—how is it that it's priced low enough for universal ownership, yet of superior quality to the expensive product of just a few years back? Answer: precision production, ably abetted by the "man-made minerals," silicon carbide and aluminum oxide by CARBORUNDUM.® Today, barrels are finished and polished by abrasive belts or grinding wheels. Points are slitted by paper-thin abrasive wheels. Clips are finished by barrel tumbling with abrasive grain. CARBORUNDUM alone supplies all types of abrasives; quite naturally, many leading manufacturers, in all lines, have established CARBORUNDUM as their one, dependable, controlled-quality source of supply.

Where's the limit to what you can do with CARBORUNDUM's *"man-made minerals"* ?



EXTRA FURNACE LIFE you can measure not in weeks or months, but in years... that's what CARBORUNDUM Super Refractories give you. Enameling furnaces, continuous or batch type, are typical: CARBORUNDUM provides a specific material for each furnace area, with specific properties to meet a specific need. Knowing how to select and apply "man-made minerals" profitably has made CARBORUNDUM the world's largest producer of Super Refractories.

Products of the Refractories Division

TWO-WAY RADIO generally has to depend, at one end, on a fluctuating power supply—the storage battery of an automobile. Leading makers of these communication systems incorporate GLOBAR® silicon carbide resistors in the circuits. Their voltage-compensating characteristics and their extreme permanence (they have no moving parts) make them ideally suited to this service.

Made by the GLOBAR Division

SEND FOR OUR NEW 28-PAGE BOOK, "Man-Made Minerals by CARBORUNDUM." It describes how imaginative thinking—yours and ours—can put "man-made minerals" to work for you. Write for it on your business letterhead. No obligation, of course.

Write to CARBORUNDUM for help on your problems that *"man-made minerals"* may solve

REGISTERED TRADE MARK

THE CARBORUNDUM COMPANY, NIAGARA FALLS, N. Y.

Manufacturers of Refractories • Heating Elements • Resistors • Metal Additives • Grinding Wheels • Coated Abrasives • Sharpening Stones • Abrasive Grains

86-310

Science Highlights - -

(*continued from page 58*)

electric motor ever built—83,000-horsepower—completes the first major step in the assembly of the 216,-000-hp electric drive for the U. S. Air Force's new transonic and supersonic wind tunnels.

Completion of the two wind tunnels will permit the testing of full-size jet engines, guided missiles, and wing sections and fuselages of aircraft at speeds up to 2500 miles per hour.

The motor was installed at the Arnold Engineering Development Center, Tullahoma, Tenn. The Center houses important aeronautical research facilities, available not only to the Air Force, Army and Navy, but also to all parties—in government, industry, and science—interested in aircraft development.

The giant synchronous motor is one of two such units built by the Westinghouse Electric Corporation in East Pittsburgh, Pa. The second unit will be installed in the near future, along with two 25,000-hp wound-rotor induction motors. Each 83,000-hp motor stands 21½ feet high, and weighs 225 tons. Their 122-ton rotors will turn at 600 revolutions per minute.

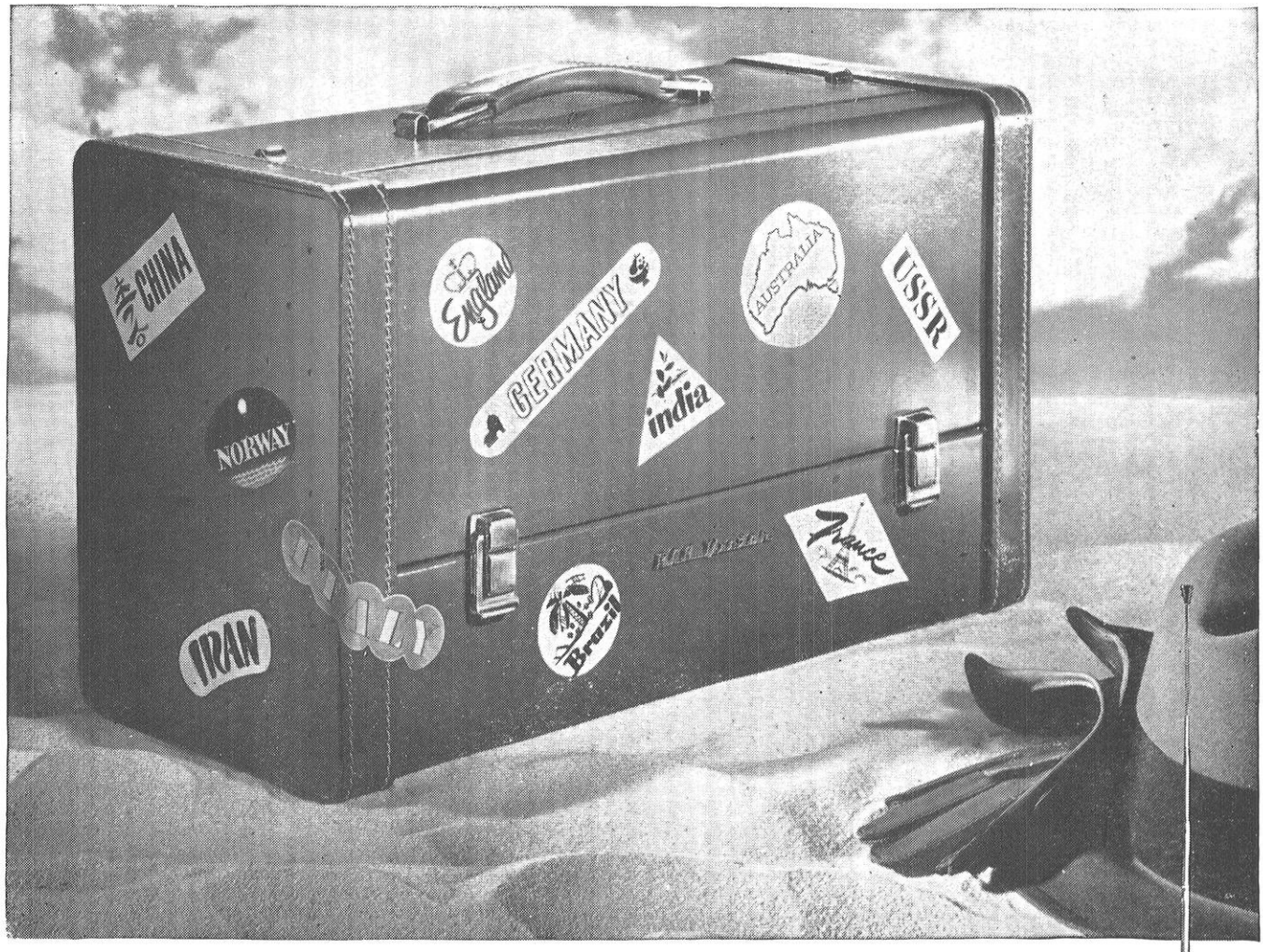
In addition to the 216,000-hp four-motor drive, the rotating machine will have five compressors.

Work on these transonic and supersonic compressors is not expected to be completed for at least another year. The transonic compressor will be a single unit, but the supersonic compressor will be made up of four compressors coupled as one.

Blades for the compressors measure two feet across the face, are six feet long, and will be mounted on a spindle 18 ft. in diameter. Weighing almost two thirds of a ton each, the blades will be solid forgings.

Although the machine will have the highest stored energy of any rotating mass ever built, it can be brought to a halt in about three minutes by using its wound-rotor motors as brakes, the energy being dissipated in liquid rheostats.

THE END



Owner goes 'round the world in 40 seconds!

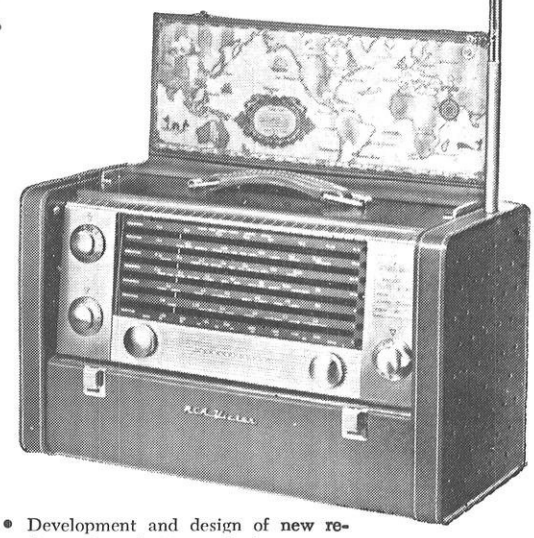
With this new multi-wave portable you can circle the globe in the time it takes to twist a dial.

That's because the RCA Victor Strato-World radio has Electronic Band Spread Tuning.

Instead of being squeezed together on one band segment, short-wave stations are in spread formation across the dial of your 7-band Strato-World. You tune London, Rome, Moscow, Tokyo just like local stations.

There's real *one-handed* portability, too. The Strato-World is a trim 23 pounds, with batteries . . . or it can be plugged into an electrical outlet. Smartly styled, with genuine cowhide case!

Here is the performance, the engineering and design you've come to expect from RCA Victor, a division of the Radio Corporation of America. See this globe-trotting, pace-setting portable at your RCA Victor dealer's.



CONTINUE YOUR EDUCATION WITH PAY—AT RCA

Graduate Electrical Engineers: RCA Victor—one of the world's foremost manufacturers of radio and electronic products—offers you opportunity to gain valuable, well-rounded training and experience at a good salary with opportunities for advancement. Here are only five of the many projects which offer unusual promise:

- Development and design of radio receivers (including broadcast, short-wave and FM circuits, television, and phonograph combinations).
- Advanced development and design of AM and FM broadcast transmitters, R-F induction heating, mobile communications equipment, relay systems.
- Design of component parts such as coils, loudspeakers, capacitors.
- Development and design of **new** recording and producing methods.
- Design of receiving, power, cathode ray, gas and photo tubes.

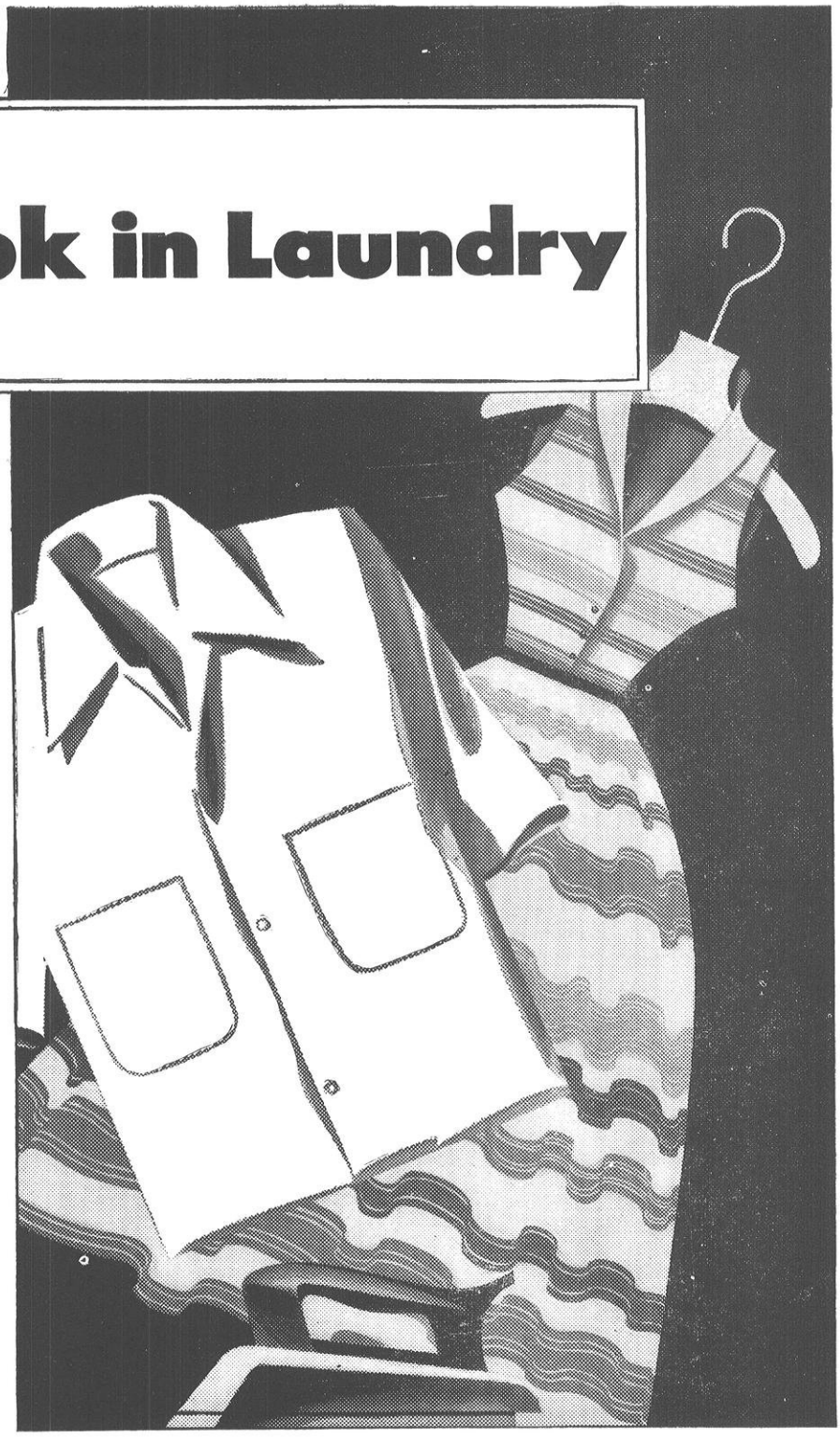
Write today to College Relations Division, RCA Victor, Camden, New Jersey.

Also many opportunities for Mechanical and Chemical Engineers and Physicists.

® *RADIO CORPORATION OF AMERICA*

World leader in radio—first in television

New Look in Laundry



CHEMICAL PROBLEM...

. . . to restore newness in feel and appearance to washable wearing apparel and linens.

SOLUTION...

. . . Hercules® CMC, a superior new-type laundry finish in dry or liquid form, which has many advantages over conventional starch. It gives sharper colors, whiter whites. Fabrics iron easier; have a new look and softer finish. CMC improves the appearance of items not ordinarily starched. Laundry washes cleaner, easier, because CMC checks dirt penetration.

COLLEGE MEN...

This is but one example of the far-reaching chemical developments in which you could participate at Hercules—in research, production, sales, or staff operations. It suggests the ways Hercules' products serve an ever-broadening range of industries and end-uses.

Hercules' business is solving problems by chemistry for industry...

. . . adhesives, soaps, detergents, rubber, plastics, paint, varnish, lacquer, textiles, paper, insecticides, to name a few, use Hercules® synthetic resins, cellulose products, chemical cotton, terpene chemicals, rosin and rosin derivatives, chlorinated products and other chemical processing materials. Hercules® explosives serve mining, quarrying, construction, seismograph projects everywhere.

HERCULES

HERCULES POWDER COMPANY Wilmington 99, Delaware
INCORPORATED
Sales Offices in Principal Cities

EC53-7

● Claud M. Kellett, Jr. received his Bachelor of Electrical Engineering degree from Georgia Tech in 1950.

Claud's first year at Allison was spent in the company of other recent engineering graduates in a college graduate training program. This program helped him gain practical experience in the activities of selected departments throughout the Allison plants. On the completion of his training, a call to active duty with the Army delayed Claud's permanent assignment to an Allison department. However, the twenty-one months he was away did not diminish his opportunities in the least. When he returned early this year he was able to resume his career in engineering with the result that today he is an experimental engineer concerned with electronic instrumentation in the Research Group of the Transmission Test Department.

The torqmatic converter turbine that Claud is working with is a vital element in the operation of Allison heavy duty transmissions. Allison is the world's largest manufacturer of torqmatic drives for heavy duty Ordnance and commercial vehicles and equipment. The commercial converters and transmissions are used in scrapers, tractors, trucks, cranes, shovels and drilling rigs.

The problem presented to him in connection with the turbine was to find the level of residual stresses created in the turbine by repair welding performed on the hub. The feasibility of such welds might then be determined. Claud applied variable resistance type strain gages to the turbine vanes at their exits and read their strain levels with the strain indicator. Then he cut the vanes around each of the strain gages to relieve residual stress and re-read the strain levels. From the difference in strain between the stressed and relieved conditions he was able to calculate the residual stress induced by the welds.

Yesterday Claud was interested in torsional vibration and the electronic "know-how" required to present it for oscillographic recording. He knows that tomorrow the many tests of transmissions and component parts will each present unique problems. Pressure transducers, vibration pick-ups electronic flow meters and tachometers must be installed with a myriad of complicating factors ever present. Equipment not available must be designed and built, or existing equipment modified. A future at Allison holds a constant challenge of doing that which has not been done before.

Allison is looking for young men with degrees in **MECHANICAL ENGINEERING, ELECTRICAL ENGINEERING, AERONAUTICAL ENGINEERING** ***and*** **INDUSTRIAL ENGINEERING.** ***There are also a number of openings for majors in Metallurgy, Electronics, Mathematics and Physics.*** Write now for further information: R. G. Greenwood, Engineering College Contact, Allison Division, General Motors Corporation, Indianapolis 6, Indiana.

Allison

DIVISION GENERAL MOTORS CORPORATION • Indianapolis, Ind.

Design, development and production—high power TURBINE ENGINES for modern aircraft . . . heavy duty TRANSMISSIONS for Ordnance and Commercial vehicles . . . DIESEL LOCOMOTIVE PARTS . . . PRECISION BEARINGS for aircraft, Diesel locomotives and special application.

UNIVERSITY OF WISCONSIN STUDENTS WIN AWARDS

William J. Chancellor wins third place and $500 in the James F. Lincoln Arc Welding Foundation Award and Scholarship Program. Five other U.W. students also receive cash awards.

William J. Chancellor walked off with the third place grand award and $500 for his paper entitled "Design and Construction of A Chain Mower." Bill is an Agricultural Engineer here at Wisconsin. Under the stipulation of the contest one Annual Scholarship of $250 will also be awarded in the department of Agricultural Engineering; this scholarship will be known as the **William J. Chancellor - Lincoln Foundation Scholarship.**

Under the Award Plan, engineering undergraduates compete for cash awards by submitting papers describing the arc welded design of either a machine, machine component, structure or structural part. A paper may be submitted for competition in one of two separate Divisions, **Mechanical or Structural.** Duplicate awards are offered in each division, making 46 awards totaling $3500.

In addition to the 46 awards offered in the two separate competitions, 3 Grand Awards are made to the 3 best-of-the-program papers chosen from either of the two divisions. All papers are eligible to receive both a divisional award as well as a grand award. The top award of the program is First Divisional Award of $500, plus First Grand Award of $750, or a total of $1250.

The other five University of Wisconsin winners in the contest were:

MECHANICAL DIVISION

Fourth place and $75 went to Wolfgang Rockenhauser, Mechanical Engineering, for "Design and Production of Welded Steel Frames for Small Arbor Presses."

William C. Dries, Mechanical Engineering, has the unusual distinction of having won an award in this contest in three consecutive years. He won fifth place and $50 with a paper etitled, "A Welded Portable Crane—One Thousand Pound Capacity."

Sixth place and $25 went to Harold K. Feltz, Mechanical Engineering, for "Design of a Portable Saw."

Another sixth place award for "A Convertible Rack Top Designed for Agricultural Purposes" was given to the Hartung twins, Darrel and Duane. The twins co-authored the paper.

STRUCTURAL DIVISION

Don Lang was the only University of Wisconsin man to place in the Structural Division. Don, a civil engineer, is a two-time winner. His paper was entitled, "Connections Designed for Welded Pipe Columns in a Multi-Story Building" and took sixth place and $25.

YOU CAN ENTER CONTEST

The Foundation is sponsoring a similar contest again this year. Students in all branches of engineering are encouraged to participate. Every engineering undergraduate has the opportunity to demonstrate his ability and originality in an engineering design project using arc welding in its design. The student will be in competition only with other engineering undergraduates. Seniors writing theses are allowed to present their thesis topic on welding design to the Foundation.

EVERY ACCEPTABLE ENTRY WILL BE AWARDED A HANDBOOK

Each student who enters a paper acceptable to the Jury of Award will be given a copy of "Design for Welding" regardless of whether or not the paper received a cash award. "Design for Welding" is the book published by the Foundation as a result of its industrial "Design-for-Progress" Award Program.

For furtner information see Professor H. E. Adkins or contact the **Wisconsin Engineer,** 331 ME. (Phone U-3743).

So You're Smart

By GENE CANFIELD

Reprinted from the May '53 Texas A & M Engineer

A Few Brain-Crackers For Your Spare Time . . . Try Some

ANSWERS NEXT MONTH

THOSE BLACK AND WHITE HATS

Three convicts, all possessing superior intelligence, but one of whom was blind, were serving life terms. The warden, who was a sporting man, offered them a chance for freedom. This was his offer:

"In the other room I have five hats, three black and two white. I shall blindfold you two who can see, select three hats at random and place them on your heads. If you can tell the color of the hat you wear, you go free; if you guess and are wrong, you will be killed; but you may admit you do not know and return to life imprisonment.

The three convicts agreed, and the warden blindfolded them and placed the hats on their heads. Then he removed the blindfold from one man. After looking at the other two, he said that he could not tell the color of his hat. So the second man's blindfold was removed. After looking at the other two, he admitted that he could not tell, either. Whereupon the blind man told the warden what color his hat was, and consequently was freed.

Now, presupposing that none of them would gamble his life away on a guess, what color hat was the blind man wearing, and how did he know?

WINE AND WATER

One tumbler is half full of wine and another tumbler is half full of water. A teaspoonful of wine is taken from the first tumbler and put into the other one. Then a teaspoonful of the mixture is taken from the second tumbler and put into the first one. Is the quantity of wine removed from the first tumbler greater or less than the quantity of water removed from the second tumbler?

THE COWS IN THE MEADOW

Three cows eat in two weeks all the grass on two acres of land, together with all the grass which grows there in the two weeks. Two cows eat in four weeks all the grass on two acres of land, together with all the grass which grows there in the four weeks. How many cows, then, will eat in six weeks all the grass on six acres of land together with all the grass which grows there in the six weeks?

WAGES

Two clerks are engaged, one at a salary commencing at the rate of $500 a year with a rise of $100 every year, the other at a salary commencing at the same rate of $500 a year with a rise of $25 every half-year, in each case payments being made half-yearly. Which has the larger income, and how much more does he make?

PLUS AND MINUS

A man had a stick forty inches long. By cutting it into four lengths he was able to measure any length from one to forty inches—no fractions of course. What lengths did he make the four pieces?

THE BARGAINING ENGINEER

An engineer walked into the store of a local merchant and made this proposition, "If you will give me as much money as I have in my pocket, I will spend $10.00. His terms were immediately accepted and he received the equal of the money in his pocket, spent ten dollars and departed. He entered two more stores, stated his proposition, was accepted each time, received the equal of the money in his pocket each time, spent $10 each time and departed. He left the last store broke without a cent of cash in his pocket. Now, how much money did he have in his pocket when he entered the first store?

X, Y, AND ZEEIN'

Three cyclists, X, Y, and Z start around a circular track of length 1. Z can travel at a rate of a foot per second. X can travel as fast as Z plus ½ as fast as Y. Y can travel as fast as X and Z combined. When and how far from the starting point will they first meet, if the length of the track is ¼ mile and Z's rate is 20 feet per second?

A QUART OF WATER

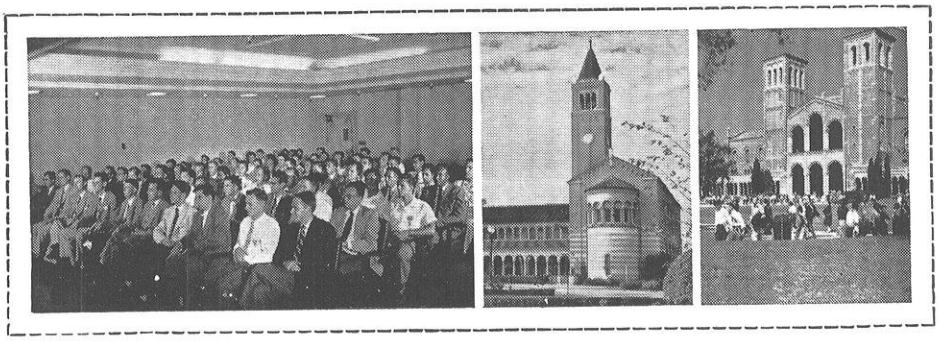
A man goes to a tube of water with two jars, one of which holds exactly 3 pints and the other 5 pints. How can he bring back exactly 4 pints of water?

ENGINEERS
and PHYSICISTS

To those interested in advanced academic study while associated with research and development in industry, the following practical programs are offered:

1
HUGHES COOPERATIVE FELLOWSHIP PROGRAM

for Master of Science Degrees



A group of participants in the Hughes Cooperative Fellowship Program (above left). Fellows study for Master of Science degrees at either University of Southern California (center) or University of California at Los Angeles (right).

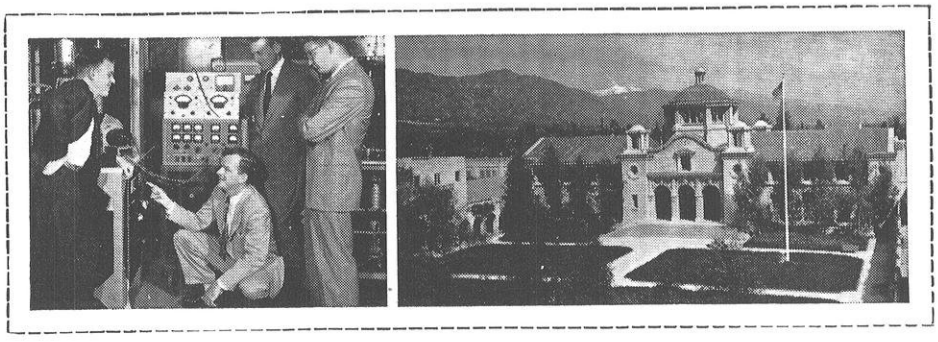
This program is to assist outstanding individuals in studying for the Master of Science Degree while employed in industry and making contributions to important military work. It is open to students who will receive the B.S. degree in Electrical Engineering, Physics or Mechanical Engineering during the coming year and to members of the Armed Services being honorably separated and holding such B.S. degrees.

Candidates must meet entrance requirements for advanced study at the University of California at Los Angeles or the University of Southern California. Participants will work full time at the Laboratories during the summer, and 25 hours per week while pursuing a half-time schedule of graduate study at the university.

The salary will be commensurate with the individual's ability and experience. Tuition, admission fees and books for university attendance will be provided. Provision is made for an allowance to assist in paying traveling and moving expenses from outside the Southern California area.

2
THE HOWARD HUGHES FELLOWSHIPS

in Science and Engineering



(From left to right) Hughes 1952 Fellows Truman O. Woodruff and Allen I. Ormsbee discuss tube processing station in Electron Tube Laboratory with 1953 Fellows Roy Gould and Baxter H. Armstrong. Their advanced study is at California Institute of Technology (above).

Eligible for these fellowships are those who have completed one year of graduate study in physics or engineering. Successful candidates must qualify for graduate standing at the California Institute of Technology for study toward the degree of Doctor of Philosophy in physics or engineering. In summers they will work full time in the Hughes Laboratories in association with scientists and engineers in their fields.

Fellows may pursue graduate research in the fields of physics, electronics engineering, electronic computing, aerodynamics, propulsion engineering, mechanical engineering, or information theory.

Each appointment is for twelve months and provides a cash award, a salary, and tuition and research expenses. A suitable adjustment is made when financial responsibilities of the Fellow might otherwise preclude participation in the program.

HOW TO APPLY: *For complete information concerning either of these Hughes Fellowship programs, consult your Placement Officer or write directly to us. Please indicate the particular program in which you are interested. A detailed explanatory brochure and application forms will be mailed promptly.*

Address all correspondence to

HUGHES

RESEARCH AND DEVELOPMENT LABORATORIES
COMMITTEE FOR GRADUATE STUDY
Culver City, Los Angeles County, California

THE HYDROSTATIC TEST

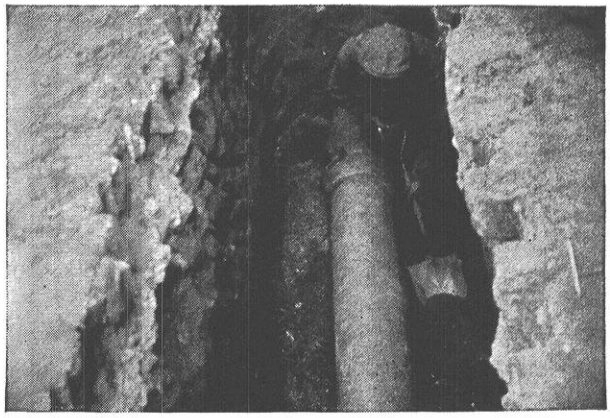
Nobody can buy a length of cast iron pipe unless it has passed the Hydrostatic Test at the foundry. Every full length of cast iron pipe is subjected to this test under water pressures considerably higher than rated working pressures. It must pass the test or go to the scrap pile.

The Hydrostatic Test is the final one of a series of routine tests made by pipe manufacturers to assure that the quality of the pipe meets or exceeds the requirements of standard specifications for cast iron pressure pipe.

Few engineers realize the extent of the inspections, analyses and tests involved in the quality-control of cast iron pipe. Production controls start almost literally from the ground up with the inspection, analysis and checking of raw materials—continue with constant control of cupola operation and analysis of the melt—and end with inspections and a series of acceptance and routine tests of the finished product.

Members of the Cast Iron Pipe Research Association have established and attained scientific standards resulting in a superior product. These standards, as well as the physical and metallurgical controls by which they are maintained, provide assurance that cast iron pipe installed today will live up to or exceed service records such as that of the 130-year-old pipe shown.

Cast iron pipe is the standard material for water and gas mains and is widely used in sewage works construction. Send for booklet, "Facts About Cast Iron Pipe." Address Dept. C., Cast Iron Pipe Research Association, T. F. Wolfe, Engineer, 122 So. Michigan Ave., Chicago 3, Illinois.



Section of 130-year-old cast iron water main still in service in Philadelphia, Pa.

CAST IRON PIPE SERVES FOR CENTURIES

STATIC

BY I. R. DROPS

Professor Rose gives the following definition of a student:

A student is a man that spends a lot of money for an education and then kicks like hell when he gets it.

* * *

Pledge: "Gee, Fred drinks something awful."

Brother: "Yeah, I've tasted it."

* * *

Answer to question on physics test: A meter is the distance between two bars in Paris.

* * *

Sweet Young Thing: "You don't love me any longer. I'm going home to mother."

Ch.E.: "Don't trouble yourself. I'll go home to my wife."

* * *

"Yes, this is a nice little apartment, but where is the bath?"

"Oh, pardon me! I thought you were one of those engineering students who wants the place just for the winter."

* * *

Speaking of Girls —

When one is mentioned here are some of the things the boys want to know:

Fine Arts Student: "What plays has she seen?"

Business Student: "Is she the business type?"

Journalism Student: "What did she ever write?"

The Engineer: "Where is she?"

Boy: "Teacher, I haven't any eraser."

Teacher: "Use the little girl's behind."

* * *

A speech is like a girl's skirt. It has to be long enougn to cover the subject, and short enough to hold your interest.

* * *

Applicant: "I'm Gladys Zell."

Personnel Manager: "I'm happy myself. Have a seat."

* * *

Attention, Lawyers

Then there was the lawyer who was retained by the farmer to prosecute the railway company for killing 24 hogs. He wanted to impress the jury with the magnitude of the injury.

"Twenty-four hogs, gentlemen! Twice the number that are in this jury box."

* * *

"I suppose you carry a memento of some sort in the locket?", said one woman to another.

"Yes, a lock of my husband's hair."

"But your husband is alive."

"Sure, but his hair is gone."

Adding youth to steel...for you

Just a "pinch" of vanadium helps steel to serve you better

STEEL IS LIKE PEOPLE. It, too, can become tired with too much shock and strain, or too much exertion. Fortunately for all of us, scientists have learned the secret of imparting the stamina of youth to steel.

SECRET OF YOUTH—It's done by adding small amounts of vanadium—often with other alloying metals—to the molten steel, usually as it comes from the steelmaker's furnace.

Thus, the springs of your car and other hard-working parts of automobiles, locomotives, ships, and aircraft withstand constant shock and strain.

WHAT IS VANADIUM? This special tonic for steel is one of the earth's rarer metals. Most of America's vanadium ore comes from the Colorado Plateau. After being concentrated and smelted, the refined metal is shipped to the steelmakers.

Vanadium is but one of many alloying metals that are used to improve today's steel. Just as vanadium makes steel shock-resistant and enduring, chromium makes it rust-resistant, tungsten makes it strong at high temperatures, manganese makes it tough at low temperatures, and silicon gives it important electrical properties.

UCC AND ALLOYS—The people of Union Carbide produce more than fifty different kinds of alloying metals, in hundreds of varying compositions and sizes. They also work closely with steelmakers in developing and improving the alloy steels that go into nearly everything that serves us today.

STUDENTS and STUDENT ADVISERS: *Learn more about the many fields in which Union Carbide offers career opportunities. Write for the free illustrated booklet "Products and Processes" which describes the various activities of UCC in the fields of* ALLOYS, CARBONS, CHEMICALS, GASES, *and* PLASTICS. *Ask for booklet F-2.*

UNION CARBIDE
AND CARBON CORPORATION

30 EAST 42ND STREET UCC NEW YORK 17, N. Y.

UCC's Trade-marked Products of Alloys, Carbons, Chemicals, Gases, and Plastics include

ELECTROMET Alloys and Metals • HAYNES STELLITE Alloys • EVEREADY Flashlights and Batteries • NATIONAL Carbons • ACHESON Electrodes
PRESTONE and TREK Anti-Freezes • PYROFAX Gas • PREST-O-LITE Acetylene
DYNEL Textile Fibers • BAKELITE, KRENE and VINYLITE Plastics • LINDE Oxygen • SYNTHETIC ORGANIC CHEMICALS

A MESSAGE TO
COLLEGE ENGINEERING
STUDENTS

from R. S. Kersh, Vice-President,
Northeastern Region,
Westinghouse Electric Corporation

To the young engineer eager for a sales career

Show me an engineer with a friendly attitude, and an eagerness to help people solve their problems and I'll show you a good sales engineer.

There's nothing mysterious about this job of being a sales engineer. To apply the products of his company to his customers' needs, he must be a good engineer.

To gain the confidence of his customers he must be a good salesman. This means simply that he should have an inquisitive nature, the desire to help others, and the quality of enthusiasm.

The Westinghouse sales engineer works with our design engineers, production engineers and engineering departments of our customers. He is a highly important and valued professional man.

What are the opportunities at Westinghouse for a young man eager for a career in sales? They are just about what you want to make them! This company's 30 divisions make over 3,000 products, totaling over $1½ billion in sales annually. Westinghouse is looking to the future with a vast expansion program. We are a fast-growing company in the dynamic field of electrical energy.

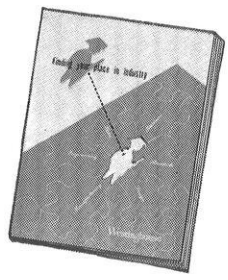
If your sights are set on a sales career, I am sure you will find the training and opportunity you seek with Westinghouse.

G-10272

YOU CAN BE SURE...IF IT'S
Westinghouse

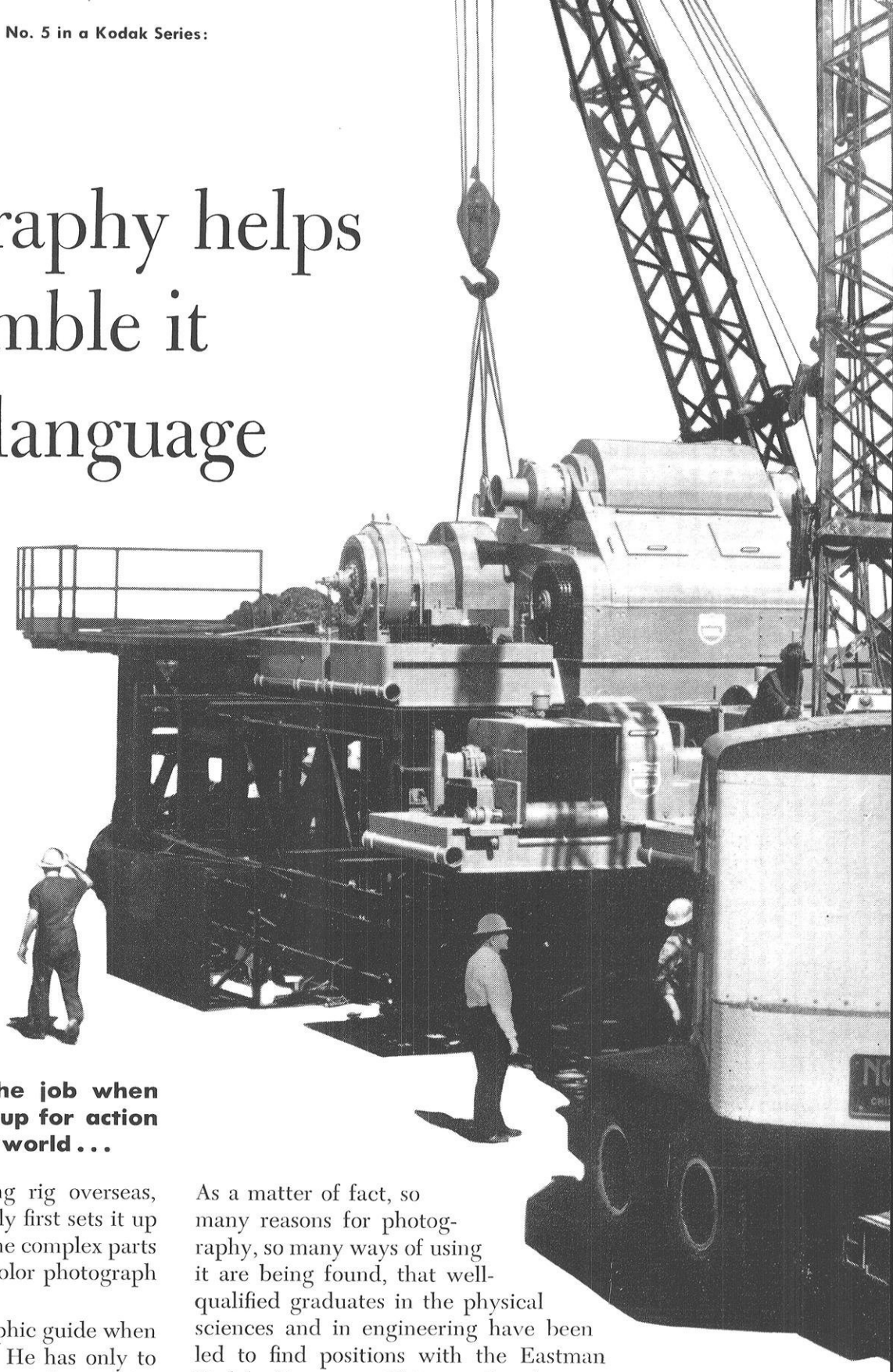
For information on career opportunities with Westinghouse, consult Placement Officer of your University, or send for our 34-page book, *Finding Your Place in Industry.*

Write: Mr. C. W. Mills, Regional Educational Co-ordinator, Westinghouse Electric Corporation, Merchandise Mart Plaza, Chicago 54, Illinois.



PHOTOGRAPHY AT WORK No. 5 in a Kodak Series:

Photography helps assemble it in any language



Pictures help boss the job when this drilling rig is set up for action half way around the world . . .

Before shipping a drilling rig overseas, National Supply frequently first sets it up here for tests and paints the complex parts in *coded colors*. Then a color photograph is made.

Why? To serve as a graphic guide when the rig reaches its buyer. He has only to follow the photograph—matching color to color—and the rig virtually assembles itself. As a technique, this use of photography makes unskilled labor more efficient, slices through the problem of language barriers.

National Supply's experience is an example of how photography saves time, cuts cost, reduces error, improves output.

As a matter of fact, so many reasons for photography, so many ways of using it are being found, that well-qualified graduates in the physical sciences and in engineering have been led to find positions with the Eastman Kodak Company. This number has included many returning servicemen.

If you are interested, write to Business and Technical Personnel Dept., Eastman Kodak Company, Rochester 4, N. Y.

Eastman Kodak Company
Rochester 4, N. Y.

Kodak
TRADE-MARK

JOHN B. NOLTE, Purdue University, asks:

"What is G.E.'s Manufacturing Training Program?"

The Manufacturing Training Program at General Electric is a program of basic training for manufacturing leadership, including planned rotational work assignments and related classroom study for outstanding young men who are interested in a career in manufacturing. It was organized to meet the increased demand for effective manufacturing leadership and technical "know how," in line with the expansion and development of the Company's operations by developing trained men to fill future key positions in the organization.

Who is eligible for this program?

In general, the Program is open to college graduates with degrees in engineering and science, and a limited number of business administration and liberal arts graduates. We are looking for outstanding young men with sound educational backgrounds, well-balanced personalities, demonstrated thinking abilities, and having the potential to develop toward top level responsibility in key assignments.

How long is the program?

The normal length of the Program is three years. However, some individuals may be able to complete their training in a shorter period because of previous knowledge or experience in manufacturing work.

What type of work assignments are made?

Work assignments are provided in all phases of manufacturing and related functions so that each man will acquire knowledge of manufacturing engineering, including manufacturing methods and techniques, shop operation, production control, personnel administration, labor relations, engineering activities, sales and manufacturing co-ordination, and general business administration.

In addition to job assignments, classroom courses cover such subjects as Company organization, manufacturing operations, labor and personnel relations, business administration, law and relationships between manufacturing and other functions of the business. Progress on the job and in classroom work is carefully observed and reviewed periodically with each man to assist him in his career.

What happens after training is completed?

After completing the training program, graduates are placed in operating departments and divisions throughout the Company in positions where leadership and initiative are needed. All placements are made in relation to the aptitudes, abilities, and interests of the graduates.

At General Electric, manufacturing operations involve the administration and supervision of activities of more than 100,000 men and women in more than 100 plants, who are involved in the making of some 200,000 different products.

The wide scope of these activities, the great variety of products, and the diversity of manufacturing activities offer limitless opportunities and exciting challenges to college graduates today.

Manufacturing training is a foundation for leadership—and an opportunity to build a satisfying, rewarding career in one of America's most important industries.

If you are a graduate engineer, or a graduate with definite technical inclinations that include an interest in the career possibilities in manufacturing, see your college placement director for the date of the next visit of the General Electric representative on your campus. Meanwhile, for further information on opportunities with General Electric write to College Editor, Dept. 2-123, General Electric Company, Schenectady 5, New York.

You can put your confidence in—

GENERAL ELECTRIC